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VII.—NORTH AMERICAN OPHIUROIDEA. I.—REVISION OF CERTAIN FAMILIES AND GENERA OF WEST INDIAN OPHIURANS. II.—A FAUNAL CATALOGUE OF THE KNOWN SPECIES OF WEST INDIAN OPHIURANS. BY A. E. VERRILL.

Part I. Revision of certain Families and Genera of West Indian Ophiurans.

THE numerous shallow water Ophiurans of the West Indian faunal region have been pretty fully studied by several authors,* so that most of the species are fairly well known, and many of them are to be found in most of the larger museums. Nevertheless there is no recent or fairly complete faunal list of the species.

The deep-sea species are also very numerous. These have been collected in large numbers by scientific explorations carried on by the U. S. Coast Survey Steamer "Blake," under the supervision of Mr. Alexander Agassiz, and by earlier explorations, under the supervision of Mr. L. F. de Pourtales. A number of deep-sea species were also dredged, in the same region, by the "Challenger." All the U. S. Coast Survey collections and those made by the "Challenger" were worked up and reported upon by Mr. Theodore Lyman in a number of important reports.†

The large collections from this region made by the U. S. Fish Commission steamer "Albatross" were also studied by Mr. Lyman, but no report upon them has yet been published.

During the present year the writer has published a report‡ on a small but interesting collection obtained by a scientific expedition to

*Lütken, *Addit. ad Hist. Ophiur., Part II; Synop. gen. Ophiur. ver., 1869.*

Lyman, *North Amer. Ophiuridæ, Ill. Catal. Mus. Comp. Zool., I. 1865.*

Ljungman, *Ophiuroidea viv. hucusque cognita enumerat, Ofvers. Kgl. Vetenskaps-Akad. Forhandlingar. for 1866, 1867.*

†Bulletin of the Mus. Comp. Zoology, Vol. I, No. 10, p. 309, 1869; Vol. V, No. 9, p. 217, 1878; Vol. X, No. 6, 1883; also Vol. V, No. 7, p. 67, 1878, and Vol. VI, No. 2, 1879 (Challenger Coll.).

Illustr. Catal. Mus. Comp. Zool., Vol. VI, 1871; Vol. VIII, No. II, 1875.

‡Report on the Ophiuroidea collected by the Bahama Exped., 1893, *Nat. Hist. Bulletin, Univ. of Iowa, Vol. V, pp. 1-86, Plates i-viii, 1899.*

the Bahamas and Cuba from the University of Iowa, under the direction of Prof. C. C. Nutting. This collection included only such species as were obtained in less than 260 fathoms.

The present revision and list is based on several collections that I have studied, but mainly on the following :

I.—The general collections of the Peabody Museum of Yale University, in which is included a series of authentically named West Indian species, sent by Dr. Chr. Lütken, from the Museum of Copenhagen, many years ago.

II.—A pretty full series of deep-sea species dredged by the "Blake" and named by Mr. Lyman, sent by the Museum of Comp. Zoology.

III.—The collection made by the Bahama Expedition from the University of Iowa, referred to above.

IV.—The extensive collection made by the U. S. Fish Commission steamers "Albatross," "Fishhawk," and others, under my own supervision, in every year from 1871 to 1887, along the American coast north of Cape Hatteras, and including many deep sea species.

Only a small proportion of those in this last named collection appear to reach the West Indian faunal area, and therefore only a few of the species will be mentioned in this article. A special article on the Ophiurans of the north-eastern coast is, however, well advanced towards completion and will be well illustrated.

In the first part of this paper, I have endeavored to revise some of the larger and more difficult genera and families, and to supply analytical tables, so as to enable students of this group to identify the species without expending such a great amount of time as has been necessary hitherto. The Amphiuridæ and Ophiacanthidæ have, therefore, received here more attention than other groups, for they are always the most difficult to deal with.

In this article I have generally used the same names for the organs and parts that were used by Mr. Lyman in his various works on this group, but have made a few changes. I have preferred to use *oral shield* instead of "mouth-shield," *adoral shield* instead of "side-mouth-shield," and *oral papillæ*, in place of "mouth-papillæ." In the genera allied to *Amphiura*, I have usually called the "outer mouth-papillæ" or papillæ of the second oral tentacle, the *distal oral tentacle-scales* to indicate their homology with the ordinary tentacle-scales. The same idea has been carried out in *Ophiacanthidæ*. In the latter group I have designated the apical "mouth-papillæ" as *tooth-papillæ*.

Class OPHIUROIDEA.

ORDER I. OPHIURÆ Müller & Troschel, 1842.

Ophiuræ Ljungman, Oph. Viv., p. 303, 1867. Verrill, 1899a, p. 4.

Ophiuridæ Lyman, and many other authors.

Zygophiuræ and *Streptophiuræ* Bell, 1892.

Family, PECTINURIDÆ Verrill, 1899.

Ophiodermatidæ Ljung., Oph. Viv., p. 87, 1867. Lutk., Addit. Hist. Oph., iii, p. 87, 1869.

Pectinuridæ Verrill, Nat. Hist. Bull. Univ. of Iowa, v, p. 4, 1899a.

The generic name, *Ophioderma*, is now recognized only as a synonym of *Ophiura*. Therefore I have changed the name of this family, as is customary in such cases. The name *Ophiuridæ* cannot properly be used for the family group here included, because Mr. Lyman and many others have always used it to designate the order *Ophiuræ*, or all the *Ophiuroidea* exclusive of the *Euryalæ*.

Family, OPHIOLEPIDÆ Ljung., 1866.

Ophiozona nivea Lyman.

Ophiozona nivea Lyman, Illust. Catal. Mus. Comp. Zool., vol. viii, p. 8, figs. 85-86, 1875; Bull. Mus. Comp. Zool., vol. v, p. 128, 221; Three Cruises of the Blake, ii, p. 110, fig. 390, 1888.

Ophiozona nivea, var. *compta* Verrill, Nat. Hist. Bull., v, p. 9, pl. iii, fig. 2, 1899.

Variety, **compta** Verrill.

PLATE XLIII. FIGURES 1, 1a.

The varietal name was given to the variety with distinctly separated radial shields, regardless of the variations in the oral shields, which happen to be, in both the specimens figured (pl. XLIII, figs. 1 and 1a) of the shorter and more ovate form.

A study of a series of specimens sent to me by Mr. Lyman (from sta. 291, 200 fath., Blake Exp.) shows considerable variation in the form of the oral shields. These are sometimes oblong, twice as long as broad, with the outer and inner portions of the same width; in other cases the outer part, beyond the lateral indentations caused by the end of the genital slit, is broader than the inner part; in other specimens the outer part is narrower than the inner. The

number and arrangement of the large angular plates outside the oral shields are variable even on the same specimen. Usually there are three or four of the larger plates, of which two stand side by side, near the margin of the disk.

The radial shields are often separated distally by a row of two or three small angular plates and a large proximal plate as in our figure (pl. XLIII, fig. 1), but in other specimens the radial shields are in contact distally, but separated proximally by a single large triangular plate, as in Mr. Lyman's type-specimen of *O. nivea*. The central disk-plate is usually closely surrounded by five large angular plates, but in many cases there are small plates intervening more or less irregularly. The variations in the scaling of the disk and in the radial shields are not coincident with the variations of the oral shields.

This species is allied to *O. tessellata*. It is easily distinguished by the large, irregular disk-plates, wide, oblong, oral shields; three subequal arm-spines, low down on the sides. There are no marginal spinules outside the radial shields. The upper arm-plates also differ in form.

Off Havana, 110 to 263 fathoms (Bahama Exped.). Taken by the Blake Exped. in 56 to 424 fathoms; off Barbadoes, 200 fath. (Blake Exped.).

Family, **OPHIOTHRICHIDÆ** Ljung.

Ophiothricidæ Ljung., Oph. Viv., 1866.

Ophiothrichidæ Lütken, Addit., iii, 1869. Verrill, Bahama Exped., p. 18, 1899.

Ophiothrichinæ Ljung., Joseph. Exp., 1871.

The family is characterized by the well defined group of true tooth-papillæ; by the absence of oral papillæ; by the usually numerous, long, slender, generally rough and glassy arm-spines; and internally by the complex, interlocking articulations of the arm-bones, and the strong mouth-frames and large radial shields. The peristomial plates, in the typical genera, are in three parts; of these the middle one is large, like an oral shield. The dental plate or apical jaw-plate is a separate piece.

This family, as now limited, includes the following genera: *Ophiothrix*, *Ophiothela*, *Ophiocnemis*, *Ophiopsammium*, *Ophiomaza*, *Ophiogymna*, *Ophiocampsis* Duncan, *Ophiotrichoides* Ludw., *Ophiop-teron* Ludw., *Lutkenia* Brock, *Gymnolophus* Brock, *Ophiocæthiops* Brock, *Ophiosphærea* Brock, and *Ophiolophus* M. Tanner.

The more typical of these genera have the disk-scales covered with slender rough spinules, but the number and length of the spinules may vary considerably, even in the same species of *Ophiothrix*. Some of the genera have only granules on the disk-scales, and others have naked scales, and some even smooth skin.

Nearly all the genera and species of this family live clinging closely to various sponges, gorgonian corals, crinoids, hydroids, or even to other ophiuroids. Many of them are more active in their movements than is usual among *Ophiuroidea*, and many are bright colored when living.

The genus *Ophiopteron* Ludw. is very remarkable for having a broad membranous web between the arm-spines, and is supposed to be a free-swimming form. It is from Amboina.

The species of this family are mostly found in the warmer seas and in shallow water, and they are most abundant and most diversified in the East Indies. Brock enumerated fifty-six species of this family from the Indo-Pacific region and considerable additions have been made to the list by later writers. Several of the genera are known only from the East Indies or Australia. *Ophiothrix* is the only West Indian genus.

Family, **AMPHIURIDÆ** Ljung., 1867 (emended).

Amphiuridæ Verrill, Oph. Bahama Exp., Nat. Hist. Bull. Univ. of Iowa, v, p. 23, 1899.

In the report on the *Ophiuroidea* of the voyage of the Challenger, Mr. Lyman, 1882, recognized about ninety species of *Amphiura*. In subsequent papers by him and others, about thirty additional species have been described. This very extensive assemblage of species is evidently capable of being divided into several natural groups, in addition to the several minor groups already separated by Mr. Lyman and others. Mr. Ljungman, as long ago as 1867, set off a large number of species as a natural generic group, under the name of *Amphipholis*. At a still earlier date, Lütken had indicated this and other natural sections of the genus, without naming them.

Mr. Lyman, however, did not recognize *Amphipholis* and some other good divisions in any of his works, except as sections of the genus.

The contrast between the structure of the mouth in typical *Amphipholis* and typical *Amphiura* is very striking. The oral papillæ in the former can close up the mouth-slits tightly, acting like oper-

cula; while in the latter the few slender and widely separated mouth-papillæ cannot close the slits, but always leave them widely open. This difference is doubtless directly correlated with important differences in their mode of feeding and nature of their food.

SUBDIVISIONS OF AMPHIURA.

The species of *Amphiura*, as adopted by Lyman, mostly fall into four large groups, which seem to be natural divisions of generic value. They are best characterized by the structure, number and arrangement of the mouth parts, as in most other ophiuran families. A few aberrant species, not found in American waters, must be referred to additional groups (V, VI, etc.).

I. *Amphiura* (restricted). Type, *A. Chiajei* Forbes.

One apical or subapical oral papilla. One (rarely two) small, distal papilla (oral tentacle-scale); middle of jaw-edge without papillæ; mouth-slits gaping. Four to seven or more (rarely three) arm-spines. Radial shields divergent.

II. *Amphipholis* (restricted). Type, *A. squamata* (or *A. elegans*.)

Two small lateral oral papillæ and one broad, operculiform, distal one, forming a continuous series along the entire jaw, and capable of nearly or quite closing the mouth-slits. Radial shields in close contact.

III. *Amphiodia* Verrill, 1899a. Type, *A. pulchella* (Lym.).

Three (rarely four) small subequal oral papillæ, none of them operculiform; they form a regular series, attached mostly to the side jaw-plate. No distal oral tentacle-scales. Three (rarely four) arm-spines. Radial shields often more or less joined.

IV. *Amphioplus* Verrill, 1899a. Type, *A. tumida* (Lym.).

Four or five small unequal oral papillæ, none operculiform, usually arranged in a discontinuous series, of which the outermost, at least, arises from the adoral shield and is really a distal oral tentacle-scale. Arm-spines three (rarely four). Radial shields generally quite separated. Disk scales naked.

V. *Paramphiura* Kæhl. Kæhler has recently established a new genus, *Paramphiura*, for *A. punctata* Forbes and *A. bellis*, var. *tritonis* Hoyle.

It is distinguished by having a pair of large supplementary scales or plates, proximal to the adoral plates. There are two small oral papillæ.

VI. *Ctenamphiura* Ver., gen. nov. Another special group is represented by *A. maxima* Lym.

It has three oral papillæ in a series, of which the middle one is very large and flat, and the outer one small and spiniform; the apical one is large. The mouth-shield is so large that it touches the first side-arm plate on each side, while the adoral shields are very small, not meeting within and not embracing the sides of the mouth-shield, as they do in all the other divisions of *Amphiura*. Two large tentacle-scales. Arm-spines very numerous, ten in the type. Upper and under arm-plates in contact. Disk scales coarse in the type. Radial shields separated.

The type, *C. maxima* (Lym.), is from the E. Indies in 28 fath.

Amphiura Forbes (restricted sense).

Amphiura Forbes, Trans. Linn. Soc., Vol. xix, pp. 149, 150, 1842 (type *A.*

Chiajei). Ljungman, Ophiur. Viv., p. 318, 1867.

Amphiura (section B.) Lutken, Addit. Hist. Oph., ii, p. 114, 1859.

Amphiura (*pars*) Lyman, Bull. Mus. Comp. Zool., i, pp. 335, 338; Voy. Challenger, v, pp. 122, 124, 1882.

Amphiura (restr.) Verrill, Ophiur. Bahama Exped., v, p. 24, 1897.

Only one pair of true oral papillæ to each mouth-slit; they are placed on each side of the apex of the jaw. A single, usually spiniform, papilla, sometimes with a smaller one by its outer side, is situated on each side of the distal end of the mouth-slit, usually attached to the edge of the adoral shield. This is really the outer oral tentacle-scale.

Owing to the small number of oral papillæ and their peculiar arrangement, the mouth slits cannot be closed, but appear always gaping, more or less.

The edge of the jaw-plate, along its middle portion, is naked. Higher up in the mouth-slit there is a small spiniform papilla, usually visible from below; this is the tentacle-scale of the first oral tentacle. It is often shown in published figures as if it were a true oral papilla. Tentacle-scales usually one or two, sometimes lacking (section *Ophiopelte*).

Arm-spines short, usually four to seven or more, rarely three. Radial shields naked, small, generally divergent, with the distal ends either in contact or somewhat separated by small scales. The disk is usually covered with small naked scales.

In one group the under side is without scales (*Hemilepis*).

In a group referred by Lyman to *Ophiocnida*, the disk is covered with small spinules, but as the mouth-parts and other organs agree with typical *Amphiura*, it might better be regarded as a distinct genus, or else as a subgenus of *Amphiura*. To this I have given the name *Amphiocnida*. (See p. 316.)

The genus *Amphiura*, as here adopted, agrees nearly with the typical genus, as restricted by Ljungman in 1867. Mr. Lyman also stated that this should be the typical group, in case the genus were to be divided. This restricted genus still includes over sixty species, with a considerable diversity of structure, as the following table will show. The species are found in all seas and at all depths.

The arms are generally long and slender, tapering very gradually, and very flexible.

Many of the species, perhaps nearly all, live buried in the mud and sand of the bottom, or concealed in crevices or under stones, etc. When buried in the mud they usually project the tip of one or more of the arms above the surface of the mud.

This habit of living concealed is doubtless correlated with the absence of disk-spines for protection, and with the lack of special imitative colors.

Many of the species have plain, dull colors, resembling the color of the sea-bottom where they live. *A. Otteri*, from deep water, is plain salmon or light orange. Such colors are protective in deep water.

*Amphiura (restricted): Table of the species inhabiting the West Indies and adjacent waters, and the Atlantic Coast of North America.**

The characters given in this table are those of the *adult* specimens, or at least of the largest described and figured. The young specimens often have fewer arm-spines and differ in other particulars. The number of arm spines given is that of the fully developed joints, towards the base of the arms. The number of spines is also liable to vary in adult specimens. Characters not named in the table, such as the shape of the oral shields, radial shields, arm-plates, etc. are often of more value in determining the species than some of the characters mentioned, and should always be considered. They are not all easily utilized in a condensed table like this.

I.—Disk covered with naked scales.

A.—Tentacle-scales present. Radial shields divergent, their distal ends separated, or scarcely touching.

B.—Tentacle-scales two to a pore.

* In the table, the species that are entirely northern in their distribution are designated by an asterisk.

a.—Disk covered with scales above and below.

b.—Disk-scales thin and nearly even.

c.—Outer oral papilla flat or squamiform, usually with a small supplementary papilla by its side. Arm-spines 3 to 5, short and stout.

A. incisa Lym., '83. Arm-spines 3; radial shields wide. Disk-scales large.

A. Eugenie Ljung., '66. Arm-spines 4 or 5. Brazil.

cc.—Outer oral papilla spiniform, prominent.

d.—Arm-spines slender, tapered. Radial shield wedge-shaped, divergent.

e.—Arm-spines 4 or 5; lowest one longest, bent. Disk-scales minute.

A. complanata Ljung., '66. Brazil.

ee.—Arm-spines 6 to 8, nearly equal, two or three lower ones usually bent. Disk scales not minute, regular.

A. Otteri Ljung., '66. Maine to W. Indies, Portugal.

dd.—Arm-spines 5, short and stout, beaked. Disk-scales minute, obscure beneath. Radial shields narrow, touching distally.

A. Palmeri Lym., '82. West Indies.

bb.—Disk-scales irregular and swollen. Arm-spines 8. Outer mouth-papilla spiniform.

A. crassipes Ljung., '66. Brazil.

aa.—Disk naked beneath, or with rudimentary scales only. Radial shields narrow, elongated. *Hemilepis* Ljung., '71.

f.—Arm-spines 4 or 5, stout, subequal.

A. semiermis Lym., '69. W. Indies.

ff.—Arm-spines 6, tapered, lowest longest.

A. flexuosa Ljung., '66. Brazil.

BB.—Tentacle-scale only one to each pore. Arm-spines 3 to 6. Radial shields divergent, the distal ends sometimes touching, usually subovate or "pear-seed shape." A small supplementary papilla or "oral scale" often stands by the side of the outer oral papilla or oral scale.

g.—Oral shield transversely elliptical, rhombic, or quadrant-shaped, broader than long.

h.—Arm-spines 5 or 6, unequal, the lowest longest. Disk-scales minute, not in a rosette. Tentacle scale large, ovate. Oral shield elliptical. A supplementary oral scale is often present.

A. grandisquama Lym., '69.

W. Indies.

hh.—Arm-spines 3, equal or subequal, tapered. Disk-scales not minute, forming a rosette. Tentacle scale small, flat. Oral shield quadrant-shaped. A supplementary oral scale is often present. Radial shields broad, in contact distally.

A. lunaris Lym., '78.

W. Indies.

gg.—Oral shields longer than broad, oblong or ovate. Tentacle-scale minute. Arm-spines 3 to 5, short, subequal. Radial shields small, divergent.

i.—Disk-scales not minute, unequal, with edges rounded and serrulate, forming a rosette, oral shield small, subovate. Under arm-plates wide shield-shaped, little longer than broad.

* *A. Sundevalli* M. and Tr.

Gulf of St. Lawrence.

ii.—Disk-scales minute, oral shields rather large, ovate. Under arm-plates oblong, much longer than broad.

A. Stimpsoni Ltk., '59.

W. Indies.

AA.—Tentacle-scales absent or rudimentary.

j.—Disk destitute of scales below, or only partly covered. Radial shields divergent, pear-seed-shaped or wedge-shaped. = *Ophiopelte* Sars, Ljung.

k.—Arm-spines six or seven, short, straight. Disk-scales minute, not in a rosette.

l.—Arm-spines seven, lowest short and stout, others flattened, subequal. A supplementary outer oral scale. Oral shield obtusely angulated or convex distally and proximally. Dorsal arm-plates triangular, with the distal end very convex; five middle spines flattened and denticulated.

* *A. denticulata* Kœhl., '96.

Off Newfoundland.

ll.—Arm-spines six, short. Oral shield acute-angled at both ends.
Dorsal arm-plates broad, ovate.

A. Atlantica Ljung., '66.

Off St. Helena.

kk.—Arm-spines three to five, slender, straight. Radial shields divergent.

m.—Arm-spines four or five, short. A rudimentary tentacle-scale sometimes present, usually wanting.

**A. fragilis* Verrill, '85. Arm-spines four or five, subequal, tips rough.
U. S. East Coast.

mm.—Arm-spines three or four, equal, slender, straight. Radial shields small, touching distally, little divergent. Disk scales small, in rosette. Disk partly naked below.

* *A. exigua* Verrill, sp. nov.

Gulf of St. Lawrence.

jj.—Disk entirely covered with scales below. Radial shields stout, largely joined, not divergent. Arm-spines three or four, equal, straight. Disk-scales rather coarse.

* *A. Canadensis* Verrill, sp. nov.

Gulf of St. Lawrence.

II.—*Amphiocnida*, gen or sub-gen. nov. (see page 316).

Disk-scales bear small acute spinules. Arm-spines five to ten. Tentacle-scale usually absent. (No American species known.)

AMPHIPHOLIS Ljung. (restr.)

Type, *A. Januarii* Ljung.

Amphipholis Ljung., Ofvers. Kongl. Vet. Akad. Förhandl., p. 165, 1866; op. cit., p. 311; op. cit., p. 644, 1871.

Amphiura (pars) Lyman, Illust. Cat. Mus. Comp. Zool., i, p. 115, 1865; Bull. Mus. Comp. Zool., i, pp. 335, 339, 1869; Voy. Chall., v., pp. 122, 125, 1882.

Amphipholis (restr.) Ver., Oph. Bahama Exped., v, p. 24, 1899.

Three or four oral papillæ form a continuous series along the whole edge of the jaw; of these the distal one is attached more or less to the adoral shield and is operculiform or flat, and often much broader than the others. The two inner are usually small and conical. Disk generally covered with naked scales, but in one species bearing a few spines (Sec. AA). Radial shields naked and usually in close contact along the whole or most of their length. Arm-spines generally three (rarely four), small, slender, tapered. Tentacle-scales one or two, sometimes none.

In the more typical species the arms, though slender, are rather short and not very flexible, but in some others they are long, slender and very flexible.*

Table of the species of Amphipholis and Amphiodia from the West Indian region, including Brazil, and from the eastern coast of North America.

I.—*Amphipholis* Ljung.

Three (rarely four) oral papillæ; outer one operculiform or broad and flat, arising partly from the adoral shield. Radial shields joined.

A.—Disk covered with naked scales.

a.—Three arm-spines, rarely four, on basal joints.

b.—Arms of moderate length.

**A. elegans* (Leach) Ljung.

Europe, America.

A. tenera (Ltk.) Ljung.

W. Indies.

A. tenuispina Ljung.

N. Atlantic.

A. limbata (Grube) Ljung. Dorsal plates wide, short.

Brazil.

A. subtilis Ljung. Radial shields long and narrow.

Brazil.

bb.—Arms long and slender.

A. Goësi Ljung.

W. Indies.

aa.—Four or five arm-spines. Arms very long and slender. Radial shields long and narrow. Oral shields large, obovate. Adorals narrow. Outer oral papillæ very broad.

A. gracillima (Stimp.) Ljung.

S. Carolina.

AA.—Disk-scales with small, scattered spinules. Two small tentacle-scales. Radial shields in contact for half their length. Three arm-spines.

A. abnormis (Lym. '78, as *Ophiocnida*).

W. Indies.

* Among foreign species of this genus are the following: *A. squamata*, Europe; *A. Torelli*, Iceland; *A. Pugetana*, *A. violacea*, *A. microdiscus*, *A. Puntarenæ*, *A. geminata*, the last five from the west coast of America; *A. Patagonica*, Magellan Str.; *A. Kochii* (Lym.) and *A. Coreæ* (Duncan), East Asia. The following have four oral papillæ; *A. impressa* Lj., E. Indies; *A. depressa* Lj. and *A. hastata* Lj., from S. Africa.

II.—*Amphiodia* Verrill, 1899a. (See p. 316.)*

Oral papillæ three, rarely four, subequal, or the outer one is smallest, forming a regular series on the side of the jaw. Arm-spines three, rarely four. No distal oral tentacle-scale.

B.—Disk-scales naked.

c.—Two tentacle-scales.

d.—Radial shields rather wide, in contact at least distally.

A. Riisei (Ltk.) Ver. Oral shield elongate; adorals small, trigonal.

A. atra (Stimp.) Ver. Oral shield pelecoidal; adorals lunate, narrow. (Sometimes has four oral papillæ and four arm-spines.)

A. planispina (V. Mart.) Ver. Oral shield ovate, broadest proximally; adorals narrow, lunate. Brazil.

cc.—One tentacle-scale. Radial shields long and narrow, largely in contact.

e.—Disk with scales on the under side; on the upper side larger scales form a rosette. Arm-plates separated above and below. Oral shield obovate, smallest proximally. Adoral shield large, trigonal.

A. pulchella (Lym. '69) Ver. Florida.

ee.—Disk without scales below; no rosette above. Oral shield "spade-shape," with a distal lobe. Adoral shield broad triangular.

A. repens (Lym. '75) Ver. Florida.

BB.—Some of the disk-scales, near the margin or beneath, bear small spinules, or granules, or both.†

A. Lutkeni (Ljng.) Ver. West Indies.

* *Amphiodia* is represented among extralimital species by a large series. Some are as follows. From west coast of America, five: *A. Barbara* (Lym.), *A. grisea* (Lj.), *A. urtica* (Lym.), *A. occidentalis* (Lym.), *A. Chilensis* (M. & Tr.), *A. Orstedii* (Ltk.), *A. antarctica* (Ljng.), Magellan Str.; *A. fissa* (Ltk.), Amoor: from the Indo-Pacific *A. ochroleuca* (Brock), *A. olivacea* (Brock), *A. impressa* (Ljng.), *A. Andreæ* (Ltk.), *A. lævis* (Lym.); from South Africa, *A. gibbosa* (Ljng.), *A. integra* (Ljng.)

† *Amphipholis Lutkeni* Ljng. and *Ophiocnida Loveni* (Ljng., Lym.) would, perhaps, go here, but they are so closely related to the type of *Ophiocnida* that I have referred to them under that genus (see p. 316).

Amphioplus, gen. nov. (See p. 306.)

Table of the species of Amphioplus from the West Indian region.

C.—Tentacle-scales present.

h.—Two tentacle-scales.

i.—Oral papillæ four to six, in a series; one or two are distal oral tentacle-scales. Arm-spines usually three, sometimes four.

j.—Dorsal and ventral arm-plates, at base of arms, in contact. Radial shields narrow, separated, or barely touching. Arm-spines three.

A. tumida (Lym. '78) Ver. Disk swollen; radial shields linear.
W. I., 321 fath.

**A. abdita* Verrill, '72. Radial shields lunate, parallel, middle arm-spine stouter, flattened, obtuse. Four oral papillæ. Long I. Sound.

**A. macilenta* Ver. Five oral papillæ. Spines all slender.
East Coast U. S.

A. nereis (Lym. '83) Ver. Oral papillæ five, thick, unequal; genital scale with a row of papillæ. W. I., 148 fath.

A. Agassizii Ver., p. 315. Oral papillæ six, slender, the two distal ones larger. W. I., 424 fath.

jj.—Dorsal arm-plates scarcely joined. Radial shields narrow and in contact distally. Five small, bead-like oral papillæ.

A. cuneata (Lym. '78) Ver. Three slender arm-spines. W. Indies.

ii.—Four (varying sometimes to three) oral papillæ. Arm-spines, three or four. Radial shields a little separated distally, divergent. Oral shield pelecoidal, acute proximally. Disk-scales do not form a rosette.

A. duplicata (Lym. '75) Ver. First under arm-plate often double; adoral shield narrow. W. Indies.

hh.—One tentacle-scale. Radial shields widely separated. Five unequal oral papillæ.

A. Stearnsi (Ives) Ver. W. Indies.

CC.—No tentacle-scale. Four oral papillæ. Four arm-spines. Radial shields touch distally.

A. Verrillii (Lym. '79) Ver. Radial shields rather large, divergent. Disk-scales form a rosette. W. Atlantic, 2650 fath.

Many extralimital species of *Amphioplus* have been described. Among them are the following :

A. canescens (Lym.) V., Pacific, 600 fath.; *A. glauca* (Lym.) V., Pacific, 345–420 fath.; *A. cernua* (Lym.) V., Pacific, 2300 fath.; *A. patula* (Lym.) V., Antarctic, 1975 fath.; *A. dalea* (Lym.) V., S. Atlantic, 2650 fath.; *A. levis* (Lym.) V., Philippines.

Amphioplus Agassizii Ver., sp. nov.

Amphiura, sp., Lyman, Bull. Mus. Comp. Zool., vol. x, p. 253, pl. v, figs. 64–66, 1883.

Disk covered with minute scales, of nearly uniform size, not forming a central rosette. Radial shields narrow, separated by several rows of small scales. Oral shield obovate or pear-shape, evenly rounded distally, longer than broad, sides a little incurved. Adoral plate long, narrow, three-lobed, not meeting proximally. Oral papillæ six; of these the four inner ones are small, conical; the two outer are larger and broader and attached to the adoral plate.

Arm-spines three, slender, tapered. Tentacle-scales two, rounded. Under arm-plates are wider than long, broadly in contact and truncate at both ends. Upper arm-plates are broadly triangular, short, barely in contact.

This species, which was well figured by Mr. Lyman, but not named, is allied to *A. nereis*, but the latter has only five oral papillæ, of which four are stouter and blunter, while the outer one is minute; its oral shield is rounder; its under arm-plates are barely in contact, and have an inner angle; its arm-spines are larger and its disk-scales are also rather larger.

West Indies, 116 fath., Blake Exp.

Ophiocnida Lyman.

Subdivisions.

That this genus, as recognized by Mr. Lyman in his later works, is a heterogeneous group has been noticed by more than one writer. Mr. Lyman, himself, intimated as much in the Voyage of the Challenger. According to his view no difference exists between this genus and *Amphiura* except that *Ophiocnida* has spines or grains on the disk. But some of the species have only a few granules, while at least one species that he referred to *Amphiura* (*A. Lutkeni*) also has some small spinules on the disk, so that this distinction seems to be of little real value, taken by itself.* But as Mr. Lyman

* The same holds good in other cases. Thus *Ophiacantha* in some species has only granules, and *O. levipellis* often has naked scales. (See p. 343.) In *Ophiothrix* similar variations are found.

included in *Amphiura* four groups that differ in their mouth-parts so widely that I have been led to separate them as genera, he naturally admitted the same variations in the mouth-parts of *Ophiocnida*. In fact we find in this group, as he finally left it, four divisions corresponding to the four divisions of *Amphiura* in structure of the mouth. They should be separated, therefore, if those of *Amphiura* are to be separated.

When originally constituted the genus included only two species. These are much alike and agree in mouth-parts. They have three subequal, true oral papillæ, arranged as in the division of *Amphiura* that I have called *Amphiodia*, to which they are in every way closely allied. It is, in fact, rather doubtful whether these two groups might not be united into a natural genus. In that case the variations in the covering of the disk might be considered as of merely sectional value.

But if we restrict *Ophiocnida* to the species having the characters of the types, they form a natural and easily recognizable group, which it is well, so far as known at present, to keep distinct. Mr. Ljungman gave the name *Ophiocnidella* to this typical group.

The second group, of which *O. Putnami* may be taken as the type, agrees with typical *Amphiura* in its mouth-parts, having but a single true oral-papilla, placed at the tip'of the jaw, on each side, and one or two pairs of oral tentacle-scales at the distal corner. I have been inclined to consider this as a subgenus of *Amphiura*, for which I have proposed above (p. 307) the name *Amphiocnida*. It is, at any rate, very closely related to *Amphiura*. A study of its internal skeletal plates may hereafter show distinctions of more evident generic value.

The third group includes, so far as I know, only *O. abnormis* Lym. This agrees so completely in its mouth-parts, spines, etc. with typical *Amphipholis*, that I do not hesitate to unite it with that genus, considering the sparingly spinulose disk as merely of sectional value. (See p. 313.)

Another group, *Amphitimna*, having *O. olivacea* as its type, has more numerous oral papillæ and arm-spines, and a generally robust structure quite unlike the typical forms. Although corresponding with *Amphioplus* in the number of oral papillæ, this group seems to have special characters worthy of generic rank.

The following synopsis will give the principal characters of the three more important divisions discussed above, and of most of the described species :

Ophiocnida Lym., 1865 (restr.). Type *O. hispida* Lym., 1865.

Ophiocnida Lym., Ill. Catal. Mus. Comp. Zool., i, p. 133, 1865; *pars*, Voy. Challenger, p. 152, 1882.

Ophiocnidella Ljung., Ofv. Kongl. Vet. Akad. Förhandl., vi, 1871, p. 649 (Type *O. scabriusecula*).

Oral papillæ three, subequal, arranged in a series along the jaw-margin. Disk-scales distinct, bearing spinules or granules. Arm-spines three to five. Radial shields divergent. Two tentacle-scales; rarely one.

A.—Disk with numerous acute spinules.

a.—Arm-spines three, rarely four.

O. hispida (LeC.) Lym. '65. Spines three. Disk with many slender sharp spinules. Panama.

O. scabriusecula (Ltk.) Lym. '65. Spines three. Disk spinose. Disk-scales thick. Oral papillæ blunt, nearly equal. W. Indies.

O. echinata Lym. '74. Spines four. Disk very spinose. Adoral shields trigonal. Radial shields narrow. E. Indies.

O. searadia Duncan. Six rays; four arm-spines; one tentacle-scale. E. Indies.

aa.—Arm-spines five or six.

O. scabra Lym. '79. Lowest spine thick and rough. Proximal oral papilla apical and bead-like. Adoral shield lunate. Off Bahia, 1275 fath.

AA.—Disk-scales partly bare; partly with granules or very short spinules, or both.

b.—Disk-scales large, in a rosette, mostly naked; some marginal and submarginal bear granules. Three arm-spines.

O. filigranea Lym. '75. Radial shields wide, divergent. Adorals lunate. Two tentacle-scales. Florida.

bb.—Disk-scales smaller, many naked; some marginal and submarginal bear grains or small conical spinules.

O. Loveni (Ljung.). Disk-scales in a rosette; some at margin, bear spinules; others below, bear granules. Outer oral papilla flat. Radial shields touch distally. Rarely four arm-spines. Brazil.

O. Lutkeni (Ljung. '71). A few submarginal and marginal scales bear small spinules. Three arm-spines. Dorsal arm-plates wide, usually broken into two or more parts. W. Indies.

Amphiocnida, gen. nov. = *Ophiocnida* (pars) Lym.

Disk-scales bear small acute spinules. Apical oral papilla small. Distal oral papilla (oral tentacle-scale) acute, spiniform. Middle of jaw-margin naked. Arm-spines five to ten. Typical species have no tentacle-scale.

A. Putnami (Lym.). Arm-spines nine to ten, stout, upper one clavate. Radial shields separate. No tentacle-scale. Hong Kong.

A. pilosa (Lym.). Arm-spines five to six, slender, tapered. Adoral shields trilobed. Radial shields, little separate. No tentacle-scale. Bass Straits.

A. alboviridis (Brock). Arm-spines five to six. No tentacle-scales. E. Indies.

A. brachiata (Mont.). Arm-spines seven to ten, flattened, one with an apical cross-piece. Europe.

Amphilimna Verrill. Type, *A. olivacea*.

Amphilimna Verrill, Ophiur. Bahama Exp., v, p. 30, 1899.

Oral papillæ four or five in a series. Tooth papillæ two to four. Arm-spines six to ten, of moderate length. Tentacle-scales usually two, spiniform, one each side of the tentacle-pore. Disk swollen dorsally, with a notch over the base of each arm, and covered with spinules. Radial shields parallel, largely in contact. This genus includes, besides the type, only *A. Caribeæ* Ljung.

Amphilimna olivacea Ver.

Ophiocnida olivacea Lyman, Bull. Mus. Comp. Zool., i, 10, p. 340, 1869; Ill.

Cat. Mus. Comp. Zool., vi, pl. i, figs. 7, 8; Bull. Mus. Comp. Zool., v, 9, p. 227; op. cit., x, p. 253. Verrill, Amer. Jour. Sci., vol. xxiii, p. 219; Ann. Rep. U. S. Fish Com., vol. x, p. 661; op. cit., vol. xi, p. 549. Lyman, Report Voy. Challenger, Zool., *Ophiuroidea*, v, p. 156, 1882.

Amphilimna olivacea Ver., Ophiur. Bahama Exped., v, p. 30, 1899.

PLATE XLII, FIGURES 1, 1a.

Arm-spines nine or ten; oral papillæ four or five.

Taken by the U. S. Fish Commission at numerous stations off the east coast of the United States, from off Martha's Vineyard to Cape Hatteras, in 63 to 192 fathoms, and by the "Blake" from off Rhode Island to the West Indies, in 40 to 126 fathoms. Off Key West, Florida, 75 to 80 fath. (Bahama Exp.).

A. Caribea (Ljung.) Ver.

Arm-spines six, rough. Oral papillæ four, the two distal ones squamiform.

It is possible that this species, from the West Indies, 300 to 400 fath., is the young of *A. olivacea*. In that case the latter name would become a synonym.

Family, **OPHIACANTHIDÆ** Ver.

Ophiacanthine (sub-family of *Amphiuridae*) Ljungman, 1866; Lütken, 1869.

Ophiacanthide Verrill, Ophiur. Bahama Exped., Nat. Hist. Bulletin, v, p. 34, 1899.

The family is characterized by the prominent and highly developed side arm-plates, usually meeting above and below, and by the numerous, usually long, and more or less rough spines, which stand out nearly at right angles to the arm. The spines may be solid or hollow, glassy or opaque, terete or flat.

The oral papillæ are usually rather numerous and form a continuous row along the sides of the jaws, but the outer ones may be of larger size or different in form from the others, or clustered, and in such cases they are really the distal oral tentacle-scales. There may be only a single apical tooth-papilla, or there may be two or three, and sometimes there is a large cluster. The first under arm-plate is usually concave or somewhat bilobed within the mouth-slit, and usually bears two vertical flat processes, which sometimes become movable, like oral papillæ.

In some cases the outer oral tentacle-pore is exposed to view on the outer margin of the jaw, and then it has one, or sometimes several, special oral scales or papillæ by its outer side, or partly surrounding it. Some of its scales may be attached to the adoral plate, or even to the first under arm-plate. This plate is usually concave or somewhat bilobed, and usually bears two inner, lateral, scale-like processes, which are sometimes movable and papilliform like oral papillæ.

There is generally a single median acute tooth-papilla at the tip of the jaw, but there may be two or three, and in some cases (*Ophiocamax*, *Ophiomitra*, *Ophiotrema*) there may be a cluster of several spiniform tooth-papillæ. These were counted as oral papillæ by Mr. Lyman, but when they stand on the dental plate they should be considered as true tooth-papillæ.

The teeth are stout, flattened, obtuse; they vary from three to eight in number.

The internal structure of the mouth-parts and arms is much like that of some of the *Amphiuridae*. The "jaw-plate" or dental plate is generally separate from the jaws, and the three parts of the peristomial plates are generally distinct, but they are united in *Ophiocamax*.

The genera *Ophioplax* and *Ophiolebes* are, in several characters, more or less intermediate between the two groups, both externally and internally.

This family, as here understood, includes the following genera: *Ophiacantha*, *Ophiomitra*, *Ophiotrema*, *Ophiocamax*, *Ophiolebes*, *Ophiothammus*, *Ophiocopa*, *Ophiochiton*, *Ophiotoma*, and probably *Ophioblenna*. To these I have recently added several others, enumerated below, separated from *Ophiacantha*, *Ophiomitra*, and *Ophiopsila*.

The first six of those named above have the disk covered with scales bearing spinules or thorny processes, or sometimes granules. *Ophiochiton* and *Ophiocopa* have naked or nearly naked scales. *Ophioblenna* and *Ophiotoma* are covered with naked skin. The radial shields may be large or small, concealed or exposed.

Ophiacantha Müll. and Troschel, 1842. (*sens. ext.*)

The species of this genus, taken in the extended sense, are very numerous in all seas and are difficult to determine. They are abundant in deep water in northern latitudes, as well as in tropical seas. Ten or eleven species are known off the coasts of New England and Newfoundland. Several of them occur only at great depths. About twenty species, including two described as new in this article, are known from the West Indian fauna.

This genus is very remarkable for the great variations in the armature of the disk. Some species have only rounded granules; others well-formed tapered spines; others short, thorny stumps; others small bifid or trifid spinules or crotchets; while many species have mixtures of two or more of these sorts.

It is probable that these structures have been developed as protective organs, in accordance with the ordinary laws of Natural Selection, and that they are, therefore, directly correlated with the habits of the various species. But the habits of many species are not yet known. I have found several species clinging to gorgonian

corals, or lodged among their branches; others have occurred on hydroids; certain species, like *O. fraterna* and *O. bidentata*, often occur in vast numbers in the dredge where the bottom is composed of broken shells, covered with hydroids, sponges, crinoids, etc., among which they evidently find shelter; some species, as *O. gracilis* and *O. pentacrinus*, cling closely to crinoids.

It seems, therefore, that most of the species live more or less exposed to the attacks of fishes and other active enemies, against which a covering of sharp spines would afford some protection. But as fishes avoid coral-animals and hydroids, on account of their stinging powers, it might be expected that those species living among the branches of such organisms would require less protection by spines than those that merely conceal themselves, more or less, among the debris of the sea-bottom. A more careful study of the habits of the shallow-water species may determine, hereafter, whether such differences in habits have determined the evolution of the spines of the disk.

As for the long arm-spines, characteristic of most of the species of this and allied genera, they appear to have been developed in nearly all genera that habitually live exposed,* while those genera that live buried in the mud or sand, like *Ophioglypha*, *Ophiomusium*, *Amphiura*, *Amphipholis*, etc., or securely hidden in crevices or under stones, generally have short arm-spines.

Some of the species of *Ophiacantha* are brilliantly phosphorescent when first caught. I have myself observed this to be the case with *O. bidentata*, *O. fraterna*, and others. It may, very likely, be a peculiarity of the deep-water species, if not of all the others.

Owing to the difficulties in the way of the ready identification of the species, I have prepared the following analytical tables, which ought to aid materially in locating any of them, if the specimens be fully grown, or nearly so. The young often differ considerably from the adults in the number and roughness of the arm-spines, armature of the disk, etc. The number of arm-spines counted is that of the largest groups, near the base of the arms; farther out the number rapidly decreases. The number of oral papillæ often varies with age, and also individually, in many species, especially in those in which they are numerous and clustered. The number of tentacle-scales,

* The genus *Ophiothrix* is notable for the high development of its spines. The species usually live more or less exposed, clinging to sponges, gorgonians, etc., which they often closely imitate in color, but some species live in the internal cavities of sponges.

or the number of joints that have two pairs varies in some species according to age, the number of these parts and of the spines increasing in the older specimens. In very large specimens of small species there is often a tendency to develop extra oral-papillæ and tooth-papillæ, either above or below the regular series. The precise number of species cannot be considered as constant in any species, and must always be understood to vary within more or less definite limits. This character has been used in some of the analytical tables only because of its easy observation. The degree to which the larger basal rows of spines approximate dorsally is of more importance, though not invariable, and the character of the serrulations or thorns on the spines is of considerable value, though slightly variable, even in adult specimens. The spines are always rougher in the young specimens.

Moreover, in using the analytical tables, it must be remembered that some of the species have been described only from a single specimen* and that the amount of variation is still unknown, in certain deep-sea species, which have not yet been studied from the later and larger collections.

It is also to be noted that in the case of deep-sea species, especially those obtained by the "tangles," many of the delicate parts are liable to be broken or torn off, and in the case of tentacle-scales and oral papillæ they may leave no traces. When such parts are reproduced they may not appear in the same number or form as at first.

Such accidents may account for many cases where the different arms or different jaws of a single specimen present variations in their appendages,† as well as for specimens in which all the arms

* Mr. Lyman's custom was to describe all his new species from a single type specimen. Had his health remained unimpaired he would, doubtless, have revised more fully the large collections from the later Blake Expeditions.

† In a large lot of typical *Ophiacantha bidentata* one abnormal specimen shows curious variations in the mouth-parts, which may be due to the repair of damages. The number of regular oral papillæ on the different jaws varies from three to five. On some jaws there is a rudimentary, wart-like, distal one; in others it is as large as the next; on one jaw there is an extra, slender, clavate papilla, back of the first, on the lower face of the jaw; the distal papilla is thick, blunt, clavate, and usually somewhat triquetral; one jaw has two papillæ grown together for half their length; one has an extra papilla above the inner one, and of the same form. The tooth-papillæ vary in form and size, and from one to three in number; one jaw has a terminal pair; and on one jaw some of the teeth are split into two. The first arm-plate has a vertical process on

vary. These ophiurans are able not only to reproduce a whole set of arms, but the entire upper part of the disk itself may be lost and reproduced.

As for the species included in the following tables, I have personally studied nearly all of them, and the few that I have not seen are well figured by Mr. Lyman.

Dichotomous analytical table of the East Coast and West Indian species that have been referred to Ophiacantha (sens. ext.)

In this table I have arranged the species as nearly as possible in accordance with what seems to be their natural relations.

Those prefixed by an asterisk (*) are from the American coast north of Cape Hatteras. All others are from the West Indian fauna.

A.—Oral shields join the first side arm-plates. Adoral shields are entirely proximal to the oral shields.

B.—True *Ophiacantha*. Disk wholly, and radial shields mostly, covered with small crotchets, thorny stumps, or short spinules or granules, or with a mixture of these forms.

C.—Disk covered with small crotchets, or short thorny stumps, or short spinules, with no elongated spines nor granules.

d.—Arm-spines finely serrulated, or nearly smooth under a simple lens, usually long and tapered, hollow, not glassy.

e.—Opposite basal rows of arm-spines, in the adults, are closely approximate dorsally or nearly so.

f.—Oral papillæ form a simple row, the distal one being generally the largest.

**O. bidentata* (Retz.). Disk with short, thick, rough, obtuse stumps and crotchets. Distal oral papillæ wider, truncate. Tentacle-scale single, obtuse.

**O. aculeata* Ver. Disk with slender, thorny, stumps. Distal oral papilla wide, flat, mucronate at the corner. Spines eight or nine, nearly smooth. Tentacle-scale lanceolate, acute. Arm-spines not always approximate dorsally.

each side, not movable. The large outer tentacle-pore is visible from below, when the distal papilla is removed. The first oral tentacle is far up in the distal part of the slit and has no papillæ. The uppermost tooth is longer and more pointed than the rest. There may be two clavate tentacle-scales on the first joint.

* *O. fraterna* Ver. When full grown the arm-spines usually closely approximate dorsally (see p. 321).

* *O. abyssicola* Sars. Spines six, short, nearly smooth. Disk covered with fine crotchets.

* *O. anomala* Sars. Six arms. Oral shields narrow, or acute. Disk-spinules short, thick, conical or obtuse, roughly serrulate or thorny.

ff.—The distal oral papillæ, or oral tentacle-scales, are clustered or form a double row; all spiniform. Tentacle-scale spiniform.

* *O. enopla* Ver. Arm-spines seven or eight, roughly serrulate. Disk covered with small, short, obtuse stumps, having several terminal thorns.

ee.—Basal rows of spines not very closely approximate dorsally. Oral papillæ in a simple row.

* *O. fraterna* Ver. Disk covered with very small thorny spinules and crotchets and some rough granules. Oral papillæ three, acute, spiniform. Arm-spines eight, serrulate. Tentacle-scale small, flat, subacute. Arm-spines, in large specimens, are approximate dorsally.

O. cosmica Lym. Disk with coarse thorny stumps having several points at the end. Oral papillæ three, stout, conical. Tentacle pores large, with one large scale. Upper arm-plates slightly joined at base of arms.

dd.—Arm-spines decidedly thorny or prickly, and usually glassy, mostly long and slender.

g.—Basal rows of spines approximate dorsally. Side arm-plates very prominent. Disk with small, slender crotchets or branched spinules.

O. aspera Lym. Arm-spines nine or ten, slender, very thorny. Disk covered with fine thorny crotchets and stumps, terminated by two to six points. Tentacle scale single, flat, larger at the end, and thorny or lobed.

* *O. millespina* Ver. Arm-spines ten, long, roughly serrulate. Disk closely covered with small, thorny or branched spinules.

O. pentacrinitus Ltk. Arm-spines six, upper ones very slender, not very thorny. Disk with fine crotchets. Tentacle-scale single, small, flat. Distal oral papilla flat.

O. scutata Lym. Arm-spines eight to ten, long, decidedly thorny. Basal tentacle-pores with two flat scales; one, and spiniform, farther out. Three tooth-papillæ. Disk-scales covered with small, thorny crotchets. A pair of papillæ on first under arm-plate.

gg.—Basal rows of spines not closely approximate dorsally. Disk with short thorny stumps.

O. stellata Lym. Arm-spines seven, very thorny. Three conical oral papillæ. One tooth-papilla.

CC.—Disk entirely covered with tapered spinules or true spines, or having more or less of them mixed with granules or other structures, or else covered with granules only.

h.—Disk covered with spinules only, or else having spinules mixed with other structures, not granulated.

i.—Disk with spinules only or mainly.

j.—Dorsal rows of spines approximate dorsally.

**O. spectabilis* Sars. Arm-spines six to eight, serrulate. Disk with tapered spines and some small conical stumps. Tooth-papillæ and distal oral papillæ clustered.

jj.—Basal rows of spines not approximate dorsally.

k.—Arm-spines finely serrulate, not glassy. Tooth-papilla single. Oral papillæ in a simple row.

O. segesta Lym. Arm-spines tapered, nearly smooth. Disk-spines small, slender, smooth, mixed with few crotchets and thorny stumps. Tentacle-scale single, small, acute. Oral papillæ three, conical, all similar.

**O. crassidens* Ver. Arm-spines short, stout. Oral papillæ and teeth large and thick, rough. Disk with small, acute, conical spinules.

kk.—Arm-spines thorny and glassy. Disk-spines slender, thorny, acute; several tooth-papillæ.

O. pectinula Ver. Outer edge of dorsal arm-plates with a row of small acute serrations. Several distal oral papillæ.

ii.—Disk bearing few tapered spines mixed with other structures. Rows of spines approximate dorsally.

l.—Disk covered with granules mixed with a few tapered spines. Arm-spines finely serrulate or nearly smooth.

O. vepraticea Lym. Arm-spines eight, long, tapered. Oral papillæ three, conical. Tentacle-scale single, large, conical or spiniform.

ll.—Disk-spines elongated, mixed with crotchets or thorny stumps. Arm-spines more or less finely serrulate.

O. varispina Ver. Arm-spines eight, serrulate, translucent. Disk with thorny stumps and few acute spines. Tentacle-scale single, flat, subspatulate. Oral papillæ wide, flat, obtuse; distally there is often an extra marginal one.

hh.—Disk covered with small close granules alone. Basal rows of spines not approximate dorsally. Arm-spines serrulate; under arm-plates short and broad, separated.

**O. granulifera* Ver. Arm-spines nine, the upper ones long and slender, finely serrulate, lower ones short, rough. Oral papillæ all spiniform. Tentacle-scale lanceolate, two on first joints.

BB.—Radial shields largely uncovered. Disk-scales either partially naked and easily visible, but bearing more or less granules or spinules, or else entirely concealed.

m.—Disk-scales largely exposed.

n.—*Ophiacæa* Ver., 1899a, pp. 38, 42. Dorsal arm-plates largely in contact. Arm-spines nearly smooth, the rows widely separated dorsally.

O. Nuttingii Ver. Arm-spines four, short, tapered. Disk-scales small, exposed, bearing small spinules. Radial shields partly exposed, narrow, separated. Tentacle-scales single, large.

nn.—*Ophiomitrella* Ver., 1899a, pp. 39, 43. Dorsal arm-plates separated by the side-plates. Arm-spines slender, thorny; the basal rows approximate dorsally.

O. lævipellis (Lym.) Disk-scales small, sometimes entirely naked, sometimes with small scattered granules. Radial shields small, separate, partly naked. Tentacle-scale single, small, acute. A pair of papillæ on the first under arm-plate.

mm.—Disk-scales mostly concealed, but radial shields naked.

o.—*Ophiacanthella* Ver., 1899a, p. 39. Basal rows of spines not approximate dorsally. Dorsal arm-plates largely in contact. Radial shields long, mostly naked, in contact by their edges. Arm-spines nearly smooth. Three tooth-papillæ. Oral papillæ four, conical, all similar.

O. Troscheli (Lym.) Arm-spines six, tapered. Disk-scales concealed, bearing granules and scattered spines. Tentacle-scale single, lanceolate.

oo.—*Ophiocalus* Ver., 1899a, pp. 39, 42. Dorsal arm-plates separated. Basal rows of spines closely approximate dorsally. Radial shields large, broad, naked, in contact for their whole length. Two or three tooth-papillæ. Arm-spines thorny and glassy.

O. echinulata Lym. Disk-scales small, nearly concealed by numerous slender, thorny spines.

AA.—The oral shield is separated from the side arm-plates by the distal lobe of the elongated adoral shields, which are therefore, not entirely proximal to the oral shields.

D.—Adoral shields narrow, trilobed, the narrow distal lobe separating the oral shield from the side arm-plate. Disk-scales usually concealed by cuticle and spinules.

E.—*Ophiopora* Ver., 1899a, p. 43. No tentacle-scales, the pores are very large; spines small, usually smooth.

O. Bartletti (Lym.) Ver. One spiniform distal oral papilla by the side of the oral tentacle-pore. Disk covered with acute spinules.

EE.—One or two tentacle-scales.

p.—*Ophiolimna* Verrill, 1899a. Arm-spines seven or eight, nearly smooth, placed obliquely on the distal part of the plates, not strongly divaricate. Jaws more or less granulated. Disk-scales and radial shields concealed, bearing granules and spines.

**O. Bairdii* (Lym.) Ver. Upper arm-plates separated. Rows of spines approximate dorsally. Tentacle-scale single.

O. mixta (Lym.) Ver. Upper arm-plates joined. Rows of spines wide apart dorsally. Two flat tentacle-scales.

pp.—*Ophiopristis* Ver., 1899a. Arm-spines serrulate, not obliquely placed. Strongly divaricate. Dorsal arm-plates separated. Tooth-papillæ usually three.

q.—Spines partly flattened, serrulate on the edges. A row or cluster of several distal oral papillæ at the large oral tentacle-pore. Two tentacle-scales on the basal joints.

O. hirsuta (Lym.) Ver. Disk-spines slender, tapered, acute. Arm-spines five or six, strongly serrate on the edges. Three tooth-papillæ. Two flat tentacle-scales.

O. ensifera Ver. Disk-scales visible, bearing small conical spinules. Spines four, blunt, mostly flat. Two flat tentacle-scales on the basal joints.

O. cervicornis (Lym.) Ver. Disk with granules and small acute spinules. Tentacle-scales two, spiniform; pores very large, open. Arm-spines six, short, flat, serrate.

qq.—*Ophiotreta* Ver., 1899a, p. 40. Only one or two, rarely three, oral tentacle papillæ, which are flat. Two to four or more tooth-papillæ. Arm-spines terete or only a little flattened, slender, serrulate or nearly smooth.

O. lineolata (Lym.) Ver. Arm-spines six or seven, slender, nearly smooth. Tooth-papillæ three to five. Two unequal tentacle-scales on several basal joints. Disk evenly granulated, and with a few scattered spines. Jaws often bear granules.

O. sertata (Lym.) Ver. Tooth-papillæ two or three. Spines seven, finely serrulate, partly flattened.

DD.—*Ophiothamnus* Lym. Adoral shields large, wedge-shaped with the broad distal end separating the narrow ovate oral shield from the side arm-plate. Disk-scales exposed. Radial shields more or less naked, close together.

**O. gracilis* Ver. Arm-spines four or five, upper ones slender, lowest rough. Disk with truncate, thorny stumps. Tentacle-scale spiniform or palmate.

O. vicarius Lym. Disk-scales bear slender, tapered, acute spinules. Tentacle-scale small, conical.

O. exigua (Lym.)

Ophiacantha should be restricted and subdivided.

In this group the armature of the disk does not seem to be correlated with other important characters; neither does the number nor the length of the arm-spines, nor their solidity, or translucency, or hollowness, nor their degrees of roughness.

One of the characters that seems to be of much importance for the separation of the typical genus, from other allied generic groups,

hitherto confounded with it, is the nature of the adoral shields. In the typical group these are small and quite in front of the oral shields. In several other divisions they extend outward in a distal lobe that separates the oral shield from the side arm-plates, as in *Ophiocopa*, etc. (See group AA, p. 327, and group XIII, p. 340.)

Other characters of importance for the separation of groups of some value, are the presence of several tooth-papillæ at the apex of the jaw (groups B, C, G, K, pp. 330-333); the presence of a large sub-marginal oral tentacle-pore, with special papillæ around it, in a row or cluster (see group J, p. 333); the partial nakedness of the disk-scales and radial shields (group F, p. 332); the size and contiguity of the radial shields (group G, p. 332); the contiguity of the dorsal arm-plates (group G, p. 332); absence of tentacle-scales and the large size of part or all of the pores (group H, p. 333, and group E, p. 332).

Some of these characters, even those of most importance, have not been referred to in many of the published descriptions, nor represented in the figures. Therefore many of the species cannot, at present, be definitely classified. Mr. Lyman's figures, in the Voyage of the Challenger, are generally very accurate, but even some of these fail to show certain details of structure needful for accurate classification of the species of this genus.

Ophiomitra Lyman (typical group) differs but little from some sections of *Ophiacantha*. It has the tooth-papillæ and distal oral papillæ numerous and clustered, as in section C; the distal oral tentacle-pore is large and partly exposed, as in section J. The radial shields are large and nearly naked and the disk scales are visible and spinose. Several species referred to *Ophiacantha* by Lyman also have naked disk-scales and radial shields (groups F and B, aa).

Subdivisions of Ophiacantha.

From the preceding remarks and table, it will be plain that several genera and subgenera* may be separated from the old genus *Ophiacantha* with characters that appear to be of as great morphological value as those that characterize, for instance, *Ophiomitra* or *Ophiolithon*.

* Most of these subdivisions were proposed in the Report on the Ophiuroidea of the Bahama Exped., Nat. Hist. Bull., Univ. Iowa, v, 1899. (Designated as 1899a in this article.)

SERIES I.

Ophiacantha (restricted). Types, *O. setosa* and *O. bidentata*.

Group A.—Typical *Ophiacantha*.

Oral papillæ form a simple row. One median tooth-papilla at the tip of the jaw. No special oral tentacle-scales at the distal angles of the mouth-slits, though the outer papilla, which serves as a tentacle-scale, may be wider than the rest. Oral tentacle-pore not exposed outside of the jaw-margin. Disk-scales more or less obscured by integument and bearing spinules, thorny stumps, crotchets, or granules. Radial shields rather narrow, separated more or less, mostly concealed by cuticle. Arm-spines usually long and slender, unequal, more or less rough, often glassy or translucent, often hollow. Dorsal arm-plates usually all separated by the side arm-plates; sometimes, on a few basal joints, they are slightly in contact.

To this section a large majority of all the described species belong.

Group B.—*Ophientodia* Ver., 1899a, p. 41.

Two, three or four tooth-papillæ clustered at the tip of the jaws. Otherwise nearly as in section A. Distal oral papillæ not clustered.

The published figures of several species shows two paired papillæ, directed centrally, at the tip of the jaws. They may not always stand on the dental plate and in such cases should be counted as oral papillæ, but in some cases they have been determined as true tooth-papillæ. Probably in this section there may be a central tooth-papilla that has been overlooked in some species, by reason of its position, high up on the jaw, or its smaller size. In some cases it may have been accidentally lost. But in some specimens either two or three papillæ occur on different jaws. Therefore, I consider the presence of *three* tooth-papillæ as the usual character of this division. The species need revision as to the tooth-papillæ. (See also group VII, page 338.)

a.—Radial shields rather small, narrow, mostly concealed.

O. scutata Lym. Three tooth-papillæ; eight to ten thorny arm-spines. Radial shields long and narrow, sometimes naked.

O. cuspidata Lym. Three tooth-papillæ.

O. pectinula Ver. Three or four tooth-papillæ. Dorsal arm-plates pectinate on the outer edge.

aa.—*Ophioscalus* Ver., 1899a, p. 42. Radial shields large, wide, closely joined, naked. Disk-scales covered with rough spinules. Arm-spines approximate dorsally.

O. echinulatus Lym. Arm-spines ten, very thorny and glassy. Tentacle-scales spiniform, two on the first joint. Two or three tooth-papillæ.

Group C.—*Ophiectodia* Ver., 1899a, p. 42.

Outer oral papillæ (oral tentacle-scales) several, forming a cluster or a double row, some often standing on the lower face of the jaw or adoral shield. Tooth-papillæ one to three, or more. The oral papillæ are clustered nearly as in typical *Ophiomitra*.

O. enopla Ver. Tooth-papillæ, one or two.

O. rosea Lym. Tooth-papillæ clustered, three or more.

O. spectabilis Sars. Tooth-papillæ three or four, in a cluster.

SERIES II.

Group D.—*Ophialcæa* Ver., 1899a, pp. 38, 42. Types, *O. Nuttingii* (Ver.) and *O. tuberculosa* (Lym.). (See p. 326.)

The dorsal arm-plates are broadly in contact, at least on many of the proximal joints. Disk-scales bear spinules or granules. Radial shields separate, sometimes more or less exposed distally, sometimes covered. Arm-spines rather short, few, nearly smooth, the rows not approximate dorsally. Oral papillæ nearly as in typical *Ophiacantha* (group A).

O. Nuttingii Ver., 1899a, p. 46. Arm-spines four, short. Oral-shield very large, ovate. Disk-scales more or less exposed, bearing conical spinules.

O. rufescens Kæhl. Off the Azores, 845 meters. Ventral plates contiguous. Arm-spines six, finely serrulate. Two large elongated tentacle-scales. Oral papillæ six or seven, outer one largest. Disk-scales covered with fine roundish granules. Distal end of radial shields naked.

O. tuberculosa Lym., '98. E. Indies. Disk and radial shields covered with cuticle and granules. Arm-spines four. One tooth-papilla. Three oral papillæ, the distal one broad and notched. Oral shield not large, transverse. Tentacle-scale single, small.

Group E.—*Ophientrema*, sub-gen. nov. Type, *O. scolopendrica* (Lym.).

Tentacle-pores and scales on one, or a few, basal joints and larger than usual,* farther out decreasing rapidly to a small or rudimentary size. Disk-scales concealed by granules. Radial shields sometimes partly exposed. Spines numerous, nearly smooth. Mouth-parts as in typical *Ophiacantha*.

O. granulosa (Lym.). Radial shields largely exposed, broad, in contact distally. Arm-spines ten, slender, the rows nearly approximate dorsally. Tentacle-pores of the first joint large, with one flat scale; of others small, with a narrow scale. Dorsal arm-plates all separate. Pacific.

O. scolopendrica (Lym. '83). Radial shields nearly concealed, close together. Arm-spines seven, unequal, the rows not approximate dorsally. Tentacle-pores large on four joints, with a small scale, rudimentary or lacking distally. Dorsal arm-plates joined on a few basal joints. European.

Group F.—*Ophiomitrella* Ver., 1899a, p. 39. Type, *O. lævipellis* (Lym.).

Disk-scales visible, bearing granules or spinules. Radial shields partly naked, not large, wide apart. Arm-spines slender, thorny or serrulate; the rows approximate dorsally in the type. One tooth-papilla. In the type-species a pair of special, distal, oral tentacle-papillæ, on the first under arm-plate,† directed into the mouth-slit. Adoral shields wide. Otherwise the mouth parts are nearly as in typical *Ophiacantha*.

O. lævipellis (Lym., '83). Arm-spines eight, slender, thorny. Disk-scales naked or partly granulated. Upper arm-plates separated.

Group G.—*Ophiacanthella* Ver., 1899a, p. 39. Type, *O. Troscheli* (Lym.).

Radial shields naked, long, parallel, in contact by their edges. Dorsal arm-plates largely joined. Three tooth-papillæ. Arm-spines nearly smooth.

* Several species that have been referred to *Ophiomitra* also have this character. (See *Ophiomitra*, section AA, p. 351.)

† The two papilliform appendages of the first under arm-plate are here supposed to be movable, but with the published figures and descriptions it is not always possible to distinguish them from the solid, immovable, crest-like lobes which are present on these plates in the same position in many species, including *O. bidentata*. Among extralimital species, these papillæ are found in some species, such as *O. serrata* Lym., that have the disk-scales and radial shields concealed.

SERIES III.

In the following groups the oral shield is separated from the side arm-plates by the adoral shields.

Group H.—*Ophiopora* Ver., 1899a. Type, *O. Bartletti* (Lym.).

Tentacle-pores all large and open. No tentacle-scales.

Group I.—*Ophiotimna* Ver., 1899a. Type, *O. Bairdii* (Lym.).

Spine-crest of the side arm-plates distally situated and oblique. Spines nearly smooth.

Disk granulose and spinulose. Jaws more or less granulose.

Group J.—*Ophiopristis* Ver., 1899a. Type, *O. hirsuta* (Lym.).

A row of distal oral papillæ alongside of the large outer oral tentacle-pore. Arm-spines partly flattened with serrulate edges. (See p. 347.)

Group K.—*Ophiotreta* Ver., 1899a, p. 40. Type, *O. lineolata* (Lym.).

One or two flat, distal oral papillæ by the side of the large oral tentacle-pore. Two or three tooth-papilla. Spines mostly terete, but sometimes flattened and with serrulate edges. (See p. 328.)

Group L.—*Amphipsila* Ver., 1899a, p. 55. Type, *A. maculata* Ver.

Oral papillæ form a simple row. Two or three tooth-papillæ in the marginal series. Disk-scales and radial shields naked, small. Tentacle-scale slender, spiniform or palmate. Arm-spines serrulate, flattened, hollow. (See p. 348.)

Ophiocopa Lym. also belongs in this series.

Ophiacantha, sens. ext.

Artificial groups of species from the West Indian region and from the East Coast of North America, arranged according to various special characters.

All the species appear in groups I and II. In these two groups all the northern species are indicated by an asterisk prefixed. These groups are not intended as natural sections of the genus, though they

may be so in some cases, but merely as aides for the comparison of the species. They may be considered as morphological tables. The genus in these XIII groups is taken as in Mr. Lyman's works.

For the natural subdivisions, see pages 329-333.

I.

Arm-spines long, thorny or prickly, more or less glassy.

a.—Rows of spines approximate dorsally on first or second joint beyond disk.

b.—Radial shields covered; disk spinulose.

O. aspera Lym., '78. Arm-spines ten, slender, very thorny.

O. pentacrinus Lütke. Spines nine or ten, long, very slender, slightly thorny.

O. pectinula Ver., sp. nov. Spines ten or eleven, very slender and glassy. Tooth-papillæ two to four. A cluster of oral tentacle-papillæ.

**O. millespina* Ver., '79. Spines ten. Disk spinules slender, with three or four long sharp branches.

**O. gracilis* Ver., † '85. Spines four to six, short, except the upper basals; lower ones thorny. Disk-scales naked, with hour-glass shaped, thorny stumps.

**O. varispina* Ver., '85. Spines eight, little rough, glassy.

bb.—Radial shields largely exposed.

O. lævipellis Lym., '83. Spines seven or eight, little flat; naked disk-scales.

O. echinulata Lym., '78. Spines nine or ten, long; disk spinose. See under *Ophiomitra*.

aa.—Basal rows of spines not closely approximated dorsally.

O. stellata Lym., '75. Arm-spines seven, very thorny.

O. scutata Lym., '78. Spines nine or ten, slightly thorny.

**O. granulifera* Ver., '85. Spines eight or nine, part of them slightly thorny.

II.

Arm-spines, in the adult, not distinctly thorny, but often finely serrulate on the edges, especially the lower ones; mostly rather opaque, but often translucent in alcohol; usually hollow.

† This singular species, on reexamination, proves to belong to *Ophiothamnus*. Its long, wedge-shaped oral shields are widely separated from the arm-plates by the broad adoral shields.

a.—Spines slender, tapered, terete, or but little flattened; often nearly smooth, or only microscopically serrulate; rougher when young.

b.—Basal rows of spines approximate dorsally on the first or second joint.

c.—One odd tooth-papilla.

O. vepratrica Lym. Arm-spines eight, long and tapered.

O. segesta Lym., '78. Disk-spines slender, mixed with thorny stumps.

* *O. Bairdii* Lym., '83. Disk with granules and some tapered spines. Jaws granulated more or less.

* *O. bidentata* (Retz.). Spines somewhat rough or serrulate, especially when young. Disk-spinules are small, thick, rough, obtuse stumps.

* *O. abyssicola* Sars. Disk-spinules minute.

* *O. aculeata* Ver., '85. Spines eight or nine, tapered, upper ones nearly smooth. Disk-spinules with three to five sharp points.

* *O. anomala* Sars.† Spines eight or nine, all terete, tapered, finely serrulate; six arms.

* *O. enopla* Ver., '85. Spines four or five, serrulate; outer oral papillæ clustered.

cc.—Two or three tooth-papillæ. Distal oral papillæ or oral tentacle-scales clustered.

* *O. spectabilis* Sars. Disk-spinules large, tapered, acute.

bb.—Basal rows of spines not very closely approximate dorsally.

d.—Dorsal arm-plates, at base of arms, separated by side plates, or only slightly in contact.

* *O. fraterna* Ver., '85. Disk covered with minute spinules having three to five sharp points.

* *O. crassidens* Ver., '85. Disk with small tapered spines. Oral papillæ very stout.

O. Bartletti Lym., '83. (*Ophiopora* Ver., p. 345.) No tentacle-scales.

dd.—Dorsal arm-plates, at base of arms, distinctly joined.

e.—Disk and radial shields covered with spinules, or mixed spines and granules.

† This species is viviparous. One specimen from off Nova Scotia has several six-armed young clinging about the mouth and genital slits.

- O. cosmica* Lym., '78. Arm-plates only a little joined.
- O. lineolata* Lym., '83. Arm-plates broadly joined. Disk with grains and some spines.
- ee.*—Jaws also more or less granulated.
- O. mixta* (Lym., '78). Disk with grains and spines. (*Ophiolimna* V., p. 345.)
- eee.*—Disk granulated; radial shields partly naked.
- f.*—Radial shields joined. (*Ophiacanthella* V., p. 344.)
- O. Troscheli* Lym., '78.
- ff.*—Radial shields separated. (*Ophialcæa* V., p. 331.)
- O. Nuttingii* Ver., 1899a, p. 46.
- aa.*—Spines partly distinctly flattened and serrulate on the edges; the rows not approximate dorsally on the basal joints. Two or three tooth-papillæ. (*Ophiopristis* V., p. 347.)
- O. hirsuta* Lym., '75. Spines four or five, slender, part flat. Disk with long, very slender spines.
- O. ensifera* Ver., 1899a, p. 47. Spines four, stout, mostly flat. Disk with small, conical spinules.
- O. cervicornis* Lym., '83. Spines five, mostly slender, acute.
- O. sertata* Lym. Spines seven, translucent. Tentacle-scales two.

III.

Radial shields more or less exposed.

A.—Radial shields partly or wholly in contact.

a.—Radial shields rather wide, angular.

O. echinulata. Inner edges of radial shields wholly in contact. (See *Ophioscalus*, p. 331, also p. 342.)

aa.—Radial shields narrow and long.

O. Troscheli. Shields naked and largely in contact. (See *Ophiacanthella*, pp. 332, 344.)

AA.—Radial shields separated, not large.

b.—Never entirely concealed.

O. lævipellis. Small, wide apart. (See *Ophiomitrella*, pp. 343, 352.)

bb.—Sometimes nearly or quite concealed.

O. sertata. Small, pear-seed-shaped.

O. scutata. Long and narrow.

O. ensifera. Small, narrow, usually largely covered. (See *Ophiopristis*, p. 347.)

O. Nuttingii. Crescent-shaped, narrow. (See *Ophialcea*, p. 331.)

Several other species are apt to have the distal end of the radial shields more or less exposed. In many cases the covering is probably accidentally rubbed off.

IV.

Dorsal arm-plates, on basal part of arms, in contact, not separated by the side-plates.

a.—Dorsal arm-plates rather narrow.

O. lineolata. Ventral plates slightly separated. (See *Ophiotreta*, pp. 333, 347.)

aa.—Dorsal arm-plates broad.

b.—Dorsal plates extensively joined. (See *Ophiacanthella*, p. 344.)

O. Nuttingii. Ventral plates in contact.

O. Troscheli. Ventral plates separated.

bb.—Dorsal plates little joined.

O. cosmica. Ventral plates separated.

O. mixta. (See p. 346.)

V.

Tentacle-pores all unusually large.

O. Bartletti. No tentacle-scales. (See *Ophiopora*, p. 345.)

O. cervicornis. Two spiniform tentacle-scales. (See *Ophiopristis*, pp. 333, 347.)

VI.

A cluster of three or more tooth-papillæ at the tip of the jaw.*

O. lineolata (three or four tooth-papillæ).

O. scutata (three or four, often only two visible below).

* Several extralimital species belong to this group, such as *O. Valenciennesi* Lym., with three tooth-papillæ and one oral tentacle-scale; *O. cuspidata* Lym.; *O. marsupialis* Lym.; *O. rosea* Lym.; the last has a cluster of tooth-papillæ and also several oral scales. (See p. 338, note, and p. 348.)

O. sertata (three, only two visible below).

O. Troscheli (three tooth-papillæ).

O. spectabilis (three to five tooth-papillæ; a cluster of distal oral papillæ).

O. pectinula Ver. (two or three tooth papillæ; three or more distal oral tentacle-papillæ).

VII.

A pair of tooth-papillæ (or apparent tooth-papillæ) close together, at the tip of the jaw; no odd median one visible from below. (In some species the odd papilla may be concealed by the pair below it, when it is actually present, but published figures and descriptions are not definite enough to determine this in many cases; in some cases it may have been accidentally broken from the type-specimen. It certainly seems to be the normal condition, in group *a*, to have only two.)

a.—A distal cluster or row of special oral tentacle-scales. See *Ophiopristis*, p. 347.

O. cervicornis.

O. ensifera.

O. hirsuta.

aa.—Only one or two distal oral tentacle-scales.

O. Bartletti. No tentacle-scale on arms.

O. echinulata. Two spiniform tentacle-scales on arms.

VIII.

A cluster of oral papillæ or oral scales near the outer corner of the mouth-slits, at the outer oral tentacle-pore, or else one or two special oral scales by the side of the tentacle-pore, which is on, or nearly outside of, the margin of the mouth-slit. (Published figures are often inaccurate as to this character.)†

a.—Several distal oral tentacle-scales or papillæ to each pore.

O. cervicornis. About four spiniform distal papillæ in a row.

O. pectinula Ver. Three to four distal papillæ.

**O. enopla*. Four to six distal papillæ in a cluster.

† Several extralimital species belong to this group; among them are: *O. rosea* Lym. (in subsection *a*); *O. marsupialis* Lym.; and *O. Valenciennesi* Lym. (in *aa*.)

O. hirsuta. Two to four papillæ in a row.

O. ensifera. Four to five papillæ in a curved irregular row.

* *O. spectabilis*. Three or four in an irregular group.

aa.—One or two special distal oral scales or papillæ, usually attached to the adoral plate; oral tentacle-pore large.

O. Bartletti. One, spiniform, distal oral papilla.

O. lineolata. Two flat papillæ.

O. sertata. Two flat papillæ.

O. levipellis. One flat papilla, attached to first arm-plate.

IX.

A pair of small, apparently movable, oral papillæ attached to the proximal end of the first under arm-plate, which is emarginate.† In most species of the genus there are, in this place, two flat, usually fixed, processes or crests. It is generally impossible to tell, from published figures, the character of these parts. They are generally badly represented.

* *O. anomala*.

O. levipellis. (See group VIII, aa.)

X.

Oral papillæ unusually large and stout.

* *O. crassidens*. Three or four thick and rough papillæ, the distal ones smaller.

* *O. varispina*. Three or four broad, flat, obtuse papillæ.

XI.

Tentacle-scales of peculiar or unusual forms, or spiniform.

a.—Tentacle-scales elongated; flat, spatulate, or lobate distally.

O. aspera. End of tentacle-scale branched or thorny.

* *O. varispina*. End spatulate.

aa.—Tentacle-scales elongated, slender or spiniform.

O. echinulata. Scales dagger-shaped; two pairs on first joint.

O. cervicornis. Two, spiniform, slender.

O. Troscheli. One, long, acute.

† Of extralimital species, *O. serrata* Lym., *O. cornuta* Lym., and *O. Valenciennesi* Lym. belong to this group.

O. vepratrica. One, large, conical.

O. segesta. One, small, acute.

* *O. gracilis.* One, slender, palmate, distal ones acute.

O. pectinula V. Spiniform, two or three on first joint.

XII.

Tentacle-scales wanting. Adoral shield as in XIII. (*Ophiopora* V.)

O. Bartletti (see p. 345). Outer oral tentacle-pore large, with a conical papilla.

XIII.

Adoral shields long, usually trilobed; the distal lobe separates the oral shield from the side arm-plate. In all typical species of the genus the oral shield and adoral shield both join the side arm-plate.

A.—One or two tentacle-scales.

B.—Disk-scales mostly concealed.

a.—Jaws not granulated, or only slightly so. (*Ophiopristis* V.)

b.—A row or series of special distal oral papillæ.

O. hirsuta. (See p. 336.)

O. ensifera. (See p. 336.)

O. cervicornis. (See p. 347.)

bb.—One or two distal oral papillæ or scales. (*Ophiotreta* V.)†

O. sertata. (See p. 348.)

O. lineolata. (See p. 348.)

AA.—Jaws granulated. (*Ophiolimna* V.)

* *O. Bairdii.* (See p. 346.)

O. mixta (Lym., as *Ophiochaeta*). See p. 346.

BB.—Disk-scales entirely exposed. Radial shields more or less naked. Adoral shields broad distally. (*Ophiothamnus*.)

* *O. gracilis* Ver. Disk-scales bear hour-glass-shaped spinules with a terminal group of points.

AA.—No tentacle-scales. Tentacle-pores all very large and open. (*Ophiopora* V.)

O. Bartletti. (See p. 345.)

† Among extralimital species that belong to this group, are *O. placentigera* (Lym.) and *O. Valenciennesi* (Lym.).

Ophiacantha scutata Lyman.

Ophiacantha scutata Lym., Bull. Mus. Comp. Zool., vol. v, p. 229, pl. i, figs. 1-3, 1878; op. cit., vol. x, p. 261, 1883 (variations).

Specimens sent to me by Mr. Lyman differ somewhat from his figures and descriptions.

The oral papillæ may be either three or four on different jaws of the same specimen; they are rather stout, spiniform, the inner largest, and all appear to be on the buccal plate, but the jaw-plates and adoral shields are so closely united together that the sutures are mostly invisible. There is often an extra outer papilla of small size, which is situated at the union of the buccal and adoral plates, outside the oral tentacle-pore, which is large, but situated inside the mouth-slit. Tooth-papillæ may be from two to four on different jaws of a large specimen. Usually there is a stout median one with a pair of smaller ones just above it, invisible from below, and another small median one outside. The last is often lacking, and the upper pair may be replaced by a single one, which is, perhaps, absent in small specimens. The oral shield is more nearly transverse-elliptical than figured, with a more obtuse inner angle. The madreporic shield is longer than the others and more rhombic, thickened, with a median concavity. The adoral shields of a large specimen are smaller than figured, narrow and tapered proximally, and the ends do not meet medially, but in small specimens they are nearly as figured and meet medially. The first under arm-plate is small, rounded, emarginate on the inside, with a small vertical crest at each side, directed inward.

The under arm-plates of the larger specimen are unlike the figure; they are narrower and longer, with the distal end projecting and strongly convex; the proximal end is very obtusely angulated or subtruncate; a little farther out on the arm they become more oblong, with the outer end more projecting and the inner end truncate and scarcely narrowed. They are slightly separated.

Tentacle-scales, on two or three of the basal joints, are flat, erect, lanceolate, and cuspidate; occasionally, in the larger examples, there are two on the first joint. Beyond the fifth or sixth joint they become slender, acute, spiniform. The first two or three pairs of tentacles are decidedly larger than those beyond.

Arm-spines, in the largest rows, are ten, shaped about as figured, with numerous small, sharp prickles on all sides. The basal rows

approximate dorsally, but not so closely as in some other species. Upper arm-plates nearly as figured, transverse lozenge-shape, with the distal edge convexly curved at first, but becoming prominent and angulated farther out.

The whole upper surface of the disk, including the radial shields, is thickly covered with small, short, thorny spinules or stumps, terminated by three to five or more short, sharp points. Diameter of disk of largest specimen, 14^{mm}; of smallest, 7^{mm}.

Off Barbadoes, 200 fathoms, Blake Exped.

Ophiacantha (Ophiectodia) pectinula, sp. nov.

Disk-scales small, entirely hidden by cuticle and bearing crowded, very slender, elongated spinules, thorny on the sides and at the tip. Radial shields small, near together, entirely hidden by cuticle and spinules.

Two to four clustered tooth-papillæ. Oral papillæ numerous, nearly equal, compressed, spiniform, smaller than the tooth-papillæ; four or five form a regular lateral row; five or six more distal ones form a cluster or two rows, and serve as oral tentacle-scales. Oral shield broadly pelecoidal, wider than long, with a slightly convex distal lobe. Adoral shields about as large as the oral, oblong-lunate, meeting within.

Tentacle-scales long, acute, spiniform, thorny, two at the basal pores. Arm-spines long, very slender, thorny, very acute; some of the rows nearly approximate dorsally at base of arms, where there are nine or ten in a row. Dorsal arm-plates small, quadrant-shape, the sides nearly straight, the outer end convex with a marginal row of minute, sharp denticles. Under arm-plates small, widely separated; the inner end forms an obtuse angle; the outer end is convex, prominent, side arm-plates prominent, meeting above and below.

Diameter of disk, 8^{mm}; length of arms, broken at tips, about 40^{mm}.

West Indies, Blake Exped., 1883.

This was sent to me by Mr. Lyman as *O. echinulata*, with which it does not agree. The type of the latter has broad naked radial shields, in close contact, and the oral papillæ are much fewer and are figured as forming a simple row. The spines and tentacle-scales are similar, though the basal rows of spines approximate more closely dorsally.

Ophiomitrella Ver., 1899a, p. 39. (See p. 336, and p. 352.)

Ophiomitrella lævipellis (Lym.) Ver.

Ophiacantha lævipellis Lym., Bull. Mus. Comp. Zool., vol. x, p. 259, pl. vi, figs. 82-84, 1883.

Ophiomitrella lævipellis Verrill, Ophiur. Bahama Exped., v, p. 39, 1899.

About twenty specimens of this species were sent to me by Mr. Lyman. They show considerable variation among themselves, and all differ more or less from his figures and description.

The disk is strongly five-lobed, owing to a deep incurvature of the interradial areas. The upper side is closely covered with small thin scales, which are usually smooth and nearly destitute of granules, but in some examples there are a few scattered, low, verruciform grains, especially near the margins; in others the grains are thinly scattered over nearly all the surface; in some cases part of the grains are conical. The scales themselves vary somewhat in size and distinctness.

The radial shields appear to be long and narrow and nearly parallel; a narrow ridge, in dry specimens, often runs inward nearly to the center from each shield; only the ends of the shields are commonly exposed; this naked part varies in form and extent, but is usually long, narrow, wedge-shaped, widest distally, and the ends often project somewhat beyond the edge of the disk over the base of the arm and may bear a few marginal granules. The ends of the shields are sometimes near together, being separated by a space less than half their breadth; in other specimens they are separated more than their breadth.

Oral papillæ vary in number, even on the different jaws of the same specimen, from three to five; most frequently there are three in the regular series, with a smaller and much shorter distal one, just at the distal end of the adoral shield and above the large pore of the outer oral tentacle. In many cases this outer papilla develops to full size, like the next one, which is stout, erect, obtuse, larger than those that follow it; the latter are usually compressed vertically, subacute; the inner one is a little longer and more conical. Attached to each inner corner of the first arm-plate there is a small vertically flattened scale or papilla that appears to be movable; it guards the oral tentacle on the inside and is sometimes wanting. It corresponds to a similar process which in several other species seems immovable.

Tooth-papilla one, or perhaps none, for the odd papilla at the tip of the jaw agrees nearly in size and form with the true teeth. It

varies in form, however, even on the different jaws of the same specimen. It is usually ovoid, or obtusely lanceolate, or even obovate; sometimes it is acute or mucronate at tip, and then it differs a little more decidedly from the teeth. It stands on the tip of the dental plate.

The oral and adoral shields are thickened and prominent, shaped nearly as in the figure by Mr. Lyman. The oral shield is small and somewhat fan-shaped, or rather pelecoidal, for the inner lateral edges are strongly incurved. In one specimen the oral shields were unusually narrow and acutely angled proximally. The adoral shields are relatively large, lunate, confined to the proximal side of the oral shield.

First under arm-plate is small, irregularly six-sided, strongly emarginate within. The second is much broader than long, curved distally, and obtusely angled proximally. Those following are still shorter, transversely narrow-elliptical, with a very obtuse proximal angle, or nearly truncate and broadly curved distally, often showing a slight median incurvature of the edge, which becomes more distinct on those farther out. They are thick and widely separated by the side arm-plates, which lie in grooves. More distally they become more nearly square, with the inner end more angulated.

Tentacle-scale small, spiniform, subacute, rather rough, becoming more slender farther out. All the tentacle-pores are small.

Arm-spines about as figured, except that many of them are more thorny, especially those near the base of the arms and in the upper series, most of which have irregular sharp divergent thorns; farther out they are mostly minutely serrulate. They are not usually distinctly flattened, as stated, but slender, terete, tapered, acute. The rows are closely approximate dorsally on the second and third joints, becoming separated farther out.

Upper arm-plates thick, swollen, widely separated, rather triangular or quadrant-shaped, with an obtuse proximal angle and a broadly convex distal edge. On the middle of the proximal part there is a small, wart-like elevation.

Diameter of disk of those described above, 3 to 6^{mm}.

Off St. Vincent, 88 and 124 fathoms. Blake Exped.

Ophiacanthella Verrill, 1899a, p. 39. Type, *O. Troscheli* (Lym.) Ver.

Three terminal tooth-papillæ in a group. Radial shields long, narrow, largely in contact, more or less naked. Disk-scales obscured by cuticle, granulose or spinulose. No special oral tentacle-scales.

Oral papillæ all similar. Dorsal arm-plates largely in contact. Tentacle-scales one or two, all similar. Spines slender, finely serrulate or nearly smooth.

This genus is, in most respects, closely related to *Ophiomitra*. It differs in having the disk-scales mostly concealed by cuticle; in having three apical tooth-papillæ, instead of one; in having the dorsal arm-plates joined; and in the smoothness of the spines.

It is separated from *Ophiacantha* especially by the naked and contiguous radial shields, and from the typical section of that genus by having three tooth-papillæ and contiguous dorsal arm-plates.

Ophiopora Ver., 1899a, pp. 39, 43. Type, *O. Bartletti* (Lym.) Ver.

Adoral plates with two distal lobes, one of which embraces the lateral edge of the oral shield and separates it from the side arm-plates, as in *Ophiopristis*. No tentacle-scales; tentacle-pores all very large and widely open. Two or three tooth-papillæ. Outer oral tentacle-pore is submarginal and furnished with one special, acute, papilla or oral tentacle-scale on the adoral shield. Disk-scales, above, and the radial shields are concealed by cuticle and spinules; on the under side the scales are visible. Arm-spines few, nearly smooth. Dorsal arm-plates are separated by side plates.

This genus is closely allied to *Ophiolimna*, but differs in the large open tentacle-pores, without scales.

Ophiopora Bartletti (Lym.) Ver.

Ophiacantha Bartletti Lym., Bulletin Mus. Comp. Zool., vol. x, p. 256, pl. v, figs. 73-75, 1888.

Ophiopora Bartletti Ver., Ophiur. Bahama Exp., Bull., v, p. 39, 1899.

This is the only known species of this group. The disk is covered by slender acute spinules. The four arm-spines are small, tapered, rather short, nearly smooth. The side arm-plates are not prominent.

West Indies, 291 fathoms, Blake Exped.

Ophiolimna Ver., 1899a, pp. 40, 44. Type *O. Bairdii* (Lym.) Ver.

Adoral shields trilobed; one distal lobe extends back between the oral shield and first side arm-plate, so that the oral shield is detached from the arm. The jaws may bear more or less granules. Disk-scales and radial shields covered with granules, or spinules, or both.

Side arm-plates prominent, with the oblique, spine-bearing crest near the distal margin, so that the spines are directed more or less distally, especially on the distal half of the arm. One or two tooth-papillæ. Several simple oral papillæ in a regular row, the outer ones broader. One or two tentacle-scales. Arm-spines tapered, nearly smooth, rather short.

This genus agrees with *Ophiacantha* and *Ophiomitra* in its mouth-parts, but differs from both in the more oblique position of the rows of arm-spines and in the separation of the oral shields from the side arm-plates. In the last character it agrees with *Ophiopristis*, *Ophiopora*, etc.

The type, *O. Bairdii* (Lym., 1883)* was taken by the Blake, off the east coast of the United States, in 1242 and 1394 fathoms, and by the United States Fish Commission Steamer Albatross in 1390 fathoms, in the same region.

This species has seven or eight smooth, acute spines, of moderate length; the rows closely approximate dorsally; the disk bears small acute granules and a few short spines; jaws partly naked, but with some granules; outer oral papilla (oral tentacle-scale) broad and flat; one tooth-papilla; one small tentacle-scale; oral shield broadly obovate; dorsal arm-plates scarcely joined on basal joints. The spine-crests are distally placed on the side arm-plates, and the spines are mostly directed distally, or often lie nearly parallel to the arms.

Ophiolimna mixta (Lym.) Verrill.

Ophiochaeta ? *mixta* Lyman, Bulletin Mus. Comp. Zool., vol. v, p. 222, pl. ii, figs. 40-42, 1878; Voyage Challenger, Oph., vol. v, p. 110, pl. xxxix, figs. 15-17, anatomy, 1882.

Ophiolimna mixta Ver., Ophiur. Bahama Exped., Bull., v, p. 40, 1899.

This species has two large flat tentacle-scales; seven smooth arm-spines; two tooth-papillæ; six oral papillæ; jaws granulated; dorsal and ventral arm-plates not separated by the side arm-plates on the basal joints; disk crowdedly covered with granules mixed with some slender spines.

The internal structure, as figured by Lyman, is much like that of *Ophiacantha*. The radial shields, seen from within, are broad, three-cornered, separated. It does not appear to be closely allied to *Ophiochaeta*.

West Indies, in 160 to 576 fathoms, Blake Exped.

* Bulletin Mus. Comp. Zool., vol. x, p. 256, pl. v, figs. 70-72 (as *Ophiacantha*).

Ophiopristis Ver., 1899a, pp. 39, 44, 47. Type, *O. hirsuta* (Lym.) Ver.

Adoral plates elongated, three-lobed; the distal end is two-lobed; one distal lobe joins the first under arm-plate; the other joins the first side arm-plate and separates it from the oral shields, so that the oral shield is quite detached from the side arm-plates, as in *Ophiocopa*. Disk-scales bear spinules or granules. Radial shields are separated, mostly concealed by cuticle. Arm-spines rather long; in the typical group, mostly flattened and with regularly serrulate edges. The rows are not approximate dorsally. Tentacle-scales one or two.

Tooth-papillæ two to four. Oral papillæ numerous; two or more of these are special oral tentacle-papillæ or scales, guarding the large outer oral tentacle-pore, which is on or near the margin of the jaw and is conspicuous. First under arm-plate is concave and has a flat process on each inner corner.

Synoptical table of Ophiopristis and Ophiotreta.

A.—Typical *Ophiopristis*. A row of several small conical or slender, distal, oral tentacle-papillæ outside the large pore. Arm-spines partly flat with serrulate edges. Two or three tooth-papillæ. Dorsal arm-plates separated, but rows of spines not approximate.

O. hirsuta Lym. (See p. 336.)

O. ensifera Ver. (See p. 336, Pl. XLIII, fig. 4.)

O. cervicornis Lym. A regular row of four or five slender oral tentacle-papillæ. Two tooth-papillæ. Two spiniform tentacle-scales; the pores very large and open. Disk and radial shields covered with fine granules and small acute spinules; some spinules on upper arm-plates. Six short flat spines serrate on the edges.

AA.—*Ophiotreta* Verrill, 1899a, p. 40. (See p. 333.) Spines terete or only little flattened. One or two, rarely three, distal oral papillæ or scales at the large oral tentacle-pore. Two to five or more tooth-papillæ.

a.—Dorsal arm-plates joined. Rows of spines not approximate dorsally. Spines nearly smooth. Tooth-papillæ three to five. Distal oral tentacle-scales flat, blunt, two or three. Two tentacle scales on several basal joints; one is flat, the other spiniform.

O. lineolata (Lym.). Disk and radial shields closely covered with granules and spines. Jaws bear granules. Arm-spines seven.

aa.—Dorsal arm-plates separate. Rows of spines not closely approximate. Two or three tooth-papillæ. Spines nearly smooth or finely serrulate or thorny; some a little flattened.

O. sertata (Lym.). Arm-spines seven. Tentacle-scale large, flat. Two flat, distal, oral scales. Disk covered with granules and tapered spines. Radial shields sometimes naked, ovate, separate, but usually concealed.

O. Valenciennesi (Lym.). Tooth-papillæ three; oral tentacle-pore large, marginal, with a large round distal scale; a pair of small papillæ on first under arm-plate; two large tentacle-scales. Spines four, with blunt thorny tips. Disk granulated.

To this group may also be referred *O. placentigera* (Lym.), off Fiji Is., 1350 fath. It has three tooth-papillæ; a large, broad, oral tentacle-scale; granulated disk; six smooth spines; one tentacle-scale.

Amphipsila Verrill, 1899a, p. 55. Type, *A. maculata* Ver.

PLATE XLIII. FIGURES 5, 5a.

Disk rounded, covered with thin, naked scales, above and below. Radial shields narrow, separated, naked. Arm-plates distinct, above and below. Arm-spines of moderate length, numerous (five to twelve), serrulate. Oral shields clearly visible, at least when dry. A simple row of oral papillæ. Only two or three conical apical papillæ, in a row; these may be considered as tooth-papillæ, but there is no distinct cluster of inner tooth-papillæ, below the teeth, as in *Ophiopsila*. Tentacle-scale spiniform.

I have separated this genus from *Ophiopsila*, as understood by Lyman, for he included in the latter *A. fulva* (Lym.), which is closely allied to our type-species.

In true *Ophiopsila* (type, *O. aranea*), to which *O. Riisei* of the West Indies also belongs, there is a cluster of many special tooth-papillæ, within the mouth, below the teeth, as in *Ophiocoma*, and the disk is covered with thick cuticle, nearly or quite concealing the scales. It appears to belong to the family *Ophiocomidae*, while our genus seems to be closely related to *Ophiacantha*, with which it agrees in its mouth-parts and spines. It differs from typical *Ophiacantha* in its naked disk-scales and radial shields, in having the upper arm-plates joined, and in the distal prolongation of the adoral plates, much as in *Ophiopristis* and *Ophiolimna*, though less distinct, owing to its narrowness.

Ophiomitra Lyman.

Bulletin Mus. Comp. Zool., vol. i, p. 325, 1869; Voyage Challenger, v, pp. 202-209, 1882, pl. xlv, figs. 4-6, (anatomy).

Verrill (restricted), Oph. Bahama Exped., Bull., v, p. 57, 1899.

This genus is very closely allied to *Ophiacantha*. The only special distinctions given by Lyman are the larger size and nakedness of the radial shields and the naked or nearly naked scales of the disk.

Mr. Lyman also described the disk of the type-species as rounded and cap-like,—a character due, perhaps, to immaturity, for in large specimens of that species the interradial margins are incurved or emarginate.

When adult the type-species (*O. valida* Lym.)* has numerous spiniform, clustered oral papillæ and tooth-papillæ. The distal oral tentacle-pore is large and sub-marginal, partly sheathed by proximal processes from the concave first under arm-plate and inner side of the jaw. The adoral shields are very broad, but wholly proximal to the small oral shields. The basal tentacle-pores are larger and furnished with two prominent tentacle-scales. The large, broad radial shields are largely in contact. The disk-scales are not large, of nearly uniform size, without specialized marginal ones, and bear coarse, short, clavate, thorny stumps. The arm-spines are numerous, somewhat thorny and glassy. The dorsal arm-plates are slightly separated by the side-plates.

Most of the species subsequently described by Mr. Lyman and others differ much from the type, in several characters.

They nearly all have a single odd tooth-papilla and a simple row of oral papillæ, as in typical *Ophiacantha*. The interradial marginal scales are usually large and specialized. The radial shields are often entirely separate and in some cases not particularly large.

In fact, they have little in common with the type, except the partial nakedness of the radial shields and disk-scales,—characters also found in species of *Ophiacantha*.† Therefore it seems necessary to subdivide the genus.

* The specimens originally described and figured by Lyman were all immature, and had not developed the true character of the mouth-parts.

† One species (*O. Normani*) referred to this genus by Mr. Lyman does not agree with it even in these characters, for the separated radial shields are no larger and no more exposed than in several species of *Ophiacantha*, and its disk-scales are granulated. In its arm-spines, which are smooth and only four in

Ophiotrema of Kähler seems to be very closely related to typical *Ophiomitra*.

Like the latter, it has clustered tooth-papillæ and oral papillæ, with a large, conspicuous distal oral tentacle-pore and special papillæ around it. The tentacle-pores are large and surrounded by several small acute spinules. Disk-scales are small, visible, bearing acute rough spinules. Radial shields are small, naked, separate, divergent. Arm-spines five, serrulate.

O. Alberti Kæhl., '96, the type, is from off the Azores.

Certain species referred to *Ophiomitra* by Kähler appear to belong to *Ophiomitrella*. (See p. 352.)

Synoptical table of the species that have been referred to Ophiomitra (sens. ext.) and Ophiomitrella.

Group A.—Typical *Ophiomitra*.

Tooth-papillæ several, clustered. Oral papillæ numerous, clustered distally. Distal oral tentacle-pore large. Radial shields large, naked, usually joined. Disk-scales visible, all of moderate size, bearing stumps or spinules. Arm-spines thorny and usually glassy. Two or three tentacle-scales on the basal joints, in the type. Adoral shields broad, proximal to the oral shields. Interradial margins of disk somewhat incurved, sometimes convex, not deeply notched.

a.—Radial shields largely in contact.

b.—Disk-scales bear short clavate or capitate stumps. Rows of arm-spines not approximate dorsally.

O. valida Lym., '69. Arm-spines nine or ten, solid, not very long, roughly serrulate or thorny.

bb.—Disk-scales bear longer and shorter, tapered, thorny spines. Rows of spines approximate dorsally.

O. ornata Ver., 1899a. This Vol., pl. XLIII, fig. 3. Arm-spines long, slender, thorny.

aa.—Radial shields divergent, in contact only distally. Arm-plates separate above and below.

number, it differs from all the species of *Ophiomitra*. Therefore I have referred it to *Ophiacantha*, with which it agrees in its mouth parts. (See p. 329.)

Another species (*O. exigua* Lym.) I refer to *Ophiothamnus*. (See p. 328.) This, also, has smooth spines, and the small oral shield is separated from the side arm-plates by the large adorals.

**O. spinea* Ver. Oral papillæ not very numerous distally. Disk-scales small, with small conical spinules. Arm-spines eight or nine, rough, hollow, the rows not approximate dorsally. One or two tentacle-scales.

AA.—*Ophioplithaca*, gen. nov. Type, *O. dipsacos* Lym. One odd tooth-papilla, oral papillæ in a nearly simple series, not clustered distally. Interradial margins of disk notched or deeply emarginate. Marginal and submarginal disk-scales large and specialized. Arm-spines thorny and glassy, usually hollow. Radial shields large and broad, naked or nearly so. First tentacle-pore decidedly larger, with two or more scales. Oral shield joins the first side arm-plates.

B.—Radial shields in contact along most of their length. Rows of spines not approximate dorsally.

c.—Upper arm-plates distinctly separated by the side plates.

O. dipsacos (Lym.). Arm-spines six, hollow, very thorny, the two upper ones very long. First tentacle-pore with two scales.

cc.—Upper arm-plates on basal joints slightly joined, or barely separate. Two or more distal oral tentacle-scales, similar to other oral papillæ.

O. incisa (Lym.). Arm-spines five or six, flattened, thorny on edges. Three to six tentacle-scales at first pore, one or two farther out. Disk-scales with few, nearly smooth, conical spinules.

BB.—Radial shields not in contact, or only slightly so distally. Spines glassy and thorny, the rows not approximate dorsally.

d.—Radial shields in contact at the distal ends, very large and wide.

e.—Upper arm-plates separated.

O. carduus (Lym.). Spines six, very thorny. Disk-scales with thorny stumps, marginal scales very large. Tentacle-scale one, lobate.

ee.—Upper arm-plates, on basal joints, not separated by side plates. First tentacle-pore larger, with two or three scales. A flat oral tentacle-scale.

O. plicata (Lym.). Radial shields joined distally in young; separate in adult. Disk-scales with small, conical spinules. Arm-spines

five or six, short, very thorny. Distal edge of under arm-plates bent downward.

dd.—Radial shields well apart, with intervening rows of scales.

f.—Upper arm-plates not separated by the side plates. Two tentacle-scales on first joint.

O. Sarsii (Lym.). Radial shields rather small, far apart. Disk-scales with small conical spinules. Arm-spines seven or eight, very thorny. Tentacle-scale lobate. A stout oral tentacle-scale.

ff.—Upper arm-plates separated by the side plates. Disk-scales coarse; marginal ones larger.

O. chelys (Lym.) Radial shields narrow, sunken. Disk with small conical spinules. Arm-spines six, hollow, very thorny. One tentacle-scale.

AAA.—*Ophiomitrella* Ver., 1899a, p. 39. (See p. 343.) Radial shields small, wide apart, naked. Disk-scales all nearly alike, not very large, outlines easily visible. One tooth-papilla. Oral shields join the side arm-plates. Interradial margins of the disk not deeply emarginate and without large scales. Disk bearing scattered granules or stumps.

g.—Arm-spines serrulate, the rows not approximate dorsally.

O. globulifera (Kæhler, '95). Arm-spines five. Disk-granules glassy, spherical. Europe, 1700 meters.

O. cordifera (Kæhler, '96). Arm-spines six or seven. Disk with small capitate granules. Azores, 1143 meters.

gg.—Arm-spines thorny and glassy, the rows approximate dorsally.

A special outer oral tentacle-scale on the first under arm-plate.

O. levipellis (Lym., as *Ophiacantha*). Seven or eight spines. Disk-scales naked or sparsely granulated; all small. Disk pentagonal. (See also page 343.)

O. cornuta (Lym., as *Ophiacantha*). Spines eight. Disk rounded, bearing small thorny stumps; a larger scale between the radial shields. (See p. 339, note.)

AAAA.—Radial shields very large and in contact, covering most of the disk. Oral shields small, triquetral, not joining the side arm-plates; adorals large and broad. Arm-spines smooth or nearly so, the rows not approximate dorsally.

O. exigua (Lym.). Disk-scales few, coarse, with few thorny stumps. Arm-spines six, rather short, tapered; oral papillæ three, the outer one on the adoral shield. Tentacle-scale one.

The last named species should, I think, be referred to *Ophiathanmus*, with which it agrees well in all external characters. (See p. 350.)

O. Normani Lym., omitted from the table, is to be referred to *Ophiacantha* (typical group) as already stated (p. 349, note). It has small and rather widely separated radial shields and four smooth arm-spines.

Ophiomitra valida Lyman.

Ophiomitra valida Lyman, Bull. Mus. Comp. Zool., i, 10, p. 325, 1869; op. cit., x, p. 264, 1883; Lyman, Ill. Cat. Mus. Comp. Zool., vi, pl. ii, figs. 4-6; Lyman, Report Voy. Challenger, Zool. Ophiuroidea, v, p. 209, pl. xli, figs. 4-6, 1882.

Ophiomitra cervicornis (young) Lyman, Ill. Cat. Mus. Comp. Zool., viii, pt. ii, p. 14, pl. ii, figs. 19, 20, 1875; Bull. Mus. Comp. Zool., vol. v, part 9, p. 231.

Ophiomitra valida Verrill, Ophiur. Bahama Exped., Bull., v, p. 58, 1899.

Several large specimens of this species, sent by Mr. Lyman, differ considerably from his figures and description, which were made from immature specimens.

The most important differences are found in the mouth-parts. The largest of our specimens have very numerous oral papillæ and tooth-papillæ, crowded together in clusters, very much as in *Ophiocamæx*. The tooth-papillæ often consist of a row of three, on or below the margin, and of two or three pairs above these, next the teeth, but frequently they are so crowded that no such regular arrangement can be made out. There may be as many as nine or ten on one jaw-apex. The distal oral papillæ form crowded groups of four to seven, or more, or they may stand in two rows, so as to cover or conceal most of the width of the jaw. They are all rather stout, spiniform, subacute. The distal oral tentacle-pore is large, marginal, exposed, nearly surrounded by sheath-like processes of the jaw and first under arm-plate, which is small and deeply concave. The oral tentacle is large, with a thickened basal part into which the distal part can be retracted.

Tentacle-scales two or three on the basal joints; farther out the pores and scales decrease in size rapidly. On the basal joints the inner scale is large, flat, lanceolate, erect, hollowed out on the side next the tentacle; the other is narrow, subacute. The under arm-

plates are smaller on the basal joints than farther out. They are broader than long, with a concave emargination on the distal edge.

The dorsal arm-plates are rather quadrant-shaped, with a broad lobe on the distal edge, and with prominent lateral angles. Some of the basal arm-plates are slightly in contact. Arm-spines ten, rather stout, roughly serrulate, blunt, the rows not approximate dorsally. The radial shields are larger, irregularly triangular, more or less encroached upon by the disk-scales and granules. The disk-scales are not large, all nearly equal, sparsely covered with short, coarse, rough, capitate stumps. The interradial margins have a small notch in dried specimens, but not larger scales.

Oral shields small, pelecoidal, with an acute inner angle, and a prominent convex outer end. Adorals about as large as the orals, wide, lunate, the surface finely granulous in appearance. In younger specimens the distal oral papillæ form one irregular row of about three or four around the pore.

Common throughout the West Indies in 10 to 1105 fathoms (Blake Expedition).

OPHIOCAMAX Lym. Type, *O. vitrea* Lym.

Ophiocamax Lym., Bull. Mus. Comp. Zool., vol. v, p. 156, 1878; Voy. Challenger, v, p. 209, 1882.

This genus is closely allied to typical *Ophiomitra*. Like the latter it has numerous tooth-papillæ in an apical cluster, and a cluster of distal oral papillæ, even more numerous than in *Ophiomitra*.

In the type-species there is also a special small distal plate (process of under arm-plate?) which bears two or three small papillæ directed proximally and serving as part of the papillæ for the large oral tentacle-pore.

The basal tentacle-pores have three or four elongated, erect tentacle-scales forming a sheath for the tentacles. Radial shields are wide and in contact. Disk-scales, which are usually visible, bear thorny spinules, but in the type species they are scarcely visible and closely spinulose in the adult.

The adoral shields are large and broad, situated in front of the oral shields.

Synoptical table of the species of Ophiocamax.

A.—Typical. Dorsal arm-plates, at base of arm, not separated by the side-plates. Rows of spines not approximate dorsally.

O. vitrea Lym. Disk closely covered with small, acute spinules; the scales nearly concealed. Tooth- and oral papillæ very numerous, slender, acute. Nine thorny arm-spines. Tentacle-scales large, obtuse.

O. hystrix Lym. Disk-scales visible, irregular, bearing few, short, conical, rough spinules. Radial shields in contact distally. Arm-spines eight, slender, the upper ones very long.

AA.—Dorsal arm-plates all separated. Rows of spines not approximate dorsally.

O. fasciculata Lym., '83. Arm-spines six, rather short, flattened, serrulate on the edges. Disk-scales plainly visible, bearing few small, tapered, acute spinules. Radial shields not very large, broad, wholly in contact. Dorsal arm-plates widely separated.

O. austera Ver., Ophiur. Bahama Exped., p. 60, pl. vi, figs. 1, 1a, pl. vii, fig. 2. Arm-spines seven, slender, the upper ones very long and very thorny, scarcely flattened. Disk-scales visible, bearing longer and shorter, rough, acute spinules. Radial shields large, triangular, extensively joined. Dorsal arm-plates nearly in contact on the basal joints. Four lanceolate tentacle-scales. A cluster of about six acute, distal, oral papillæ, pointing inward on each side, part of them arising from the lateral lobes of the deeply bilobed first under arm-plate. (See this vol., Plate XLIII, figure 2.)

OPHIOCHONDRINÆ, subfam. nov.

This group differs from typical Ophiacanthidæ chiefly in having the internal arm-plates so modified that the arms can be coiled in a vertical plane, like the *Astrophytons*, etc. The arm-spines are short, subequal, not very rough. The disk-scales may be thickly covered with cuticle and granules, or they may be naked. The oral papillæ are few, in a simple row. The thick cuticle sometimes covers the mouth shields and lower side of the arms.

The modifications of the ambulacral ossicles fits these species more perfectly for clinging closely to gorgonians, etc., by coiling the arms closely around the branches. But this power is also common to various species of *Ophiacantha*, in a lesser degree.

Ophiochondrella Ver., gen. nov. Type, *O. squamosus* (Lym.).

This differs from true *Ophiochondrus* in having the disk covered with naked scales, above and below; in having the under arm-plates

covered and concealed by thick cuticle; in having the under arm-plates in contact; and in having two tentacle-scales.

The arm-spines are short, nearly equal. Radial shields naked, ovate, and separate.

Ophiochondrella squamosus (Lym.).

Ophiochondrus squamosus Lym., Bull. Mus. Comp. Zool., x, p. 275, pl. vii, figs. 108-110, 1883.

The disk-scales are thick, swollen, irregular. Arm-spines eight, tapered. Oral papillæ three, small, spaced. Tentacle-scales minute, rounded. West Indies, 250 fathoms, Blake Exped.

Ophiochondrus Lyman.

Bulletin Mus. Comp. Zool., i, p. 328, 1869; Voy. Challenger, p. 247, 1882. Type, *O. convolutus* Lyman.

The characters given to this genus by Mr. Lyman should be modified by adding that there are two or three nearly vertical plates at the base of the arm, supporting the ends of the radial shields, so that the edge of the disk is considerably raised above the arm, making a sharp angle with it. The radial shields are still more strongly supported by an elongated genital plate, running up each side of the genital slits and joining the radial shields.

Ophiochondrus crassispinus Lyman.

Ophiochondrus crassispinus Lyman, Bulletin Mus. Comp. Zool., vol. x, p. 275, 1883.

Several specimens from the Blake Exp., Station 232, 88 fath., off St. Vincent, were sent to the Yale Museum by Mr. Lyman under the name of *O. convolutus*, under which they are also evidently recorded in Mr. Lyman's lists of 1883.

These, on careful study, appear to belong to *O. crassispinus*, as defined and figured by Mr. Lyman. The latter was described from a single specimen, from 229 fath., Blake Exp.

They have three acute, conical, oral papillæ, exclusive of the odd terminal one. The oral shield is small, thick, pear-shaped, with an acute proximal angle; arm-spines six or seven, short, nearly equal. A very small acute tentacle-scale is usually present in the larger specimens. Upper arm-plates on proximal part of arm, except two basals, are nearly quadrant-shaped with the outer edge convex and the lateral angles acute; distally they become more nearly triangular, with the sides a little convex.

The radial shields are large, elongated, separated by a band of small flat scales. Central part of disk and interradial spaces covered by very small, flat, naked scales. The arms are relatively stout, of moderate length, tapering rapidly.

O. convolutus L. is described as having the disk granulated; oral papillæ four and squarish; oral shield broader; radial shields shorter and broader; besides other differences. Possibly the two forms may be only variations of one species, but none of my specimens are intermediate.

One of the specimens from Station 232 was clinging closely to a group of Zoanthoid corals (*Epizoanthus*). The genus is evidently adapted to living clinging to *gorgonians* and similar organisms, for protection.

Family, **OPHIOSCOLICID** Ltk., 1869.

Ophiomyxidæ (*pars*) Ljung., 1866.

Ophioscolicincæ (sub-family) Ljung., 1871.

The upper side of the arms is covered with naked skin, beneath which the arm-bones can usually be seen. Under arm-plates and side arm-plates are present, though sometimes much degenerated. Arm-spines are moderately long, often rough or thorny, two to six in number. Tentacle-scale often wanting, but three or four are present in *Ophiambix*. Oral papillæ are usually numerous and form a continuous row, but sometimes they are few, and rarely lacking (in *Ophiobyrsa*). Tooth-papillæ usually lacking, rarely present as irregular spiniform papillæ. Teeth simple, spiniform.

Disk covered with a soft skin, which may contain minute scales and may bear granules or spinules. Radial shields small or rudimentary, sometimes lacking. Oral and adoral shields normal.

Internally the arm-bones of *Ophioscolex* are deeply grooved ventrally and dorsally and cut away laterally at the ends; the mouth-frames are reduced and simple, but the peristomial plates are large and in three pieces.

In some of the other genera the arm-bones are more rudimentary. In *Ophiogeron* and *Ophiosciasma* they are entirely separated, along the median plane, in two elongated parts, curved towards each other. This is an embryonic character, illustrating the relatively low development of the skeleton in this family.

This family, as now known, seems to be more nearly allied to *Ophiacanthidæ* than to *Ophiomyxidæ*, with which it was formerly united.

Externally there are no tangible characters to distinguish this family from certain of the *Ophiacanthidae*, except the lack of upper arm-plates, which are always present in the latter. But the internal structure, so far as studied, is peculiar.

The family, as here understood, includes the following described genera: *Ophioscolex*, *Ophioscisma*, *Ophiogeron*, *Ophiobyrsa*, and *Ophiambia*.

Certain species that have been referred to some of these genera do not agree in structure with the typical species, and therefore I have established two new genera for their reception:

Ophiobyrsella, gen. nov. Type, *Ophiobyrsa serpens* Lyman.

Astrogeron, gen. nov. Type, *Ophiogeron supinus* Lyman.

***Ophioscolex fragilis* Ver., sp. nov.**

Five slender arms. Oral shield small, narrow, pear-shaped, with an acute proximal angle. Adoral shields narrow, oblong, the inner end acute and touching. Oral papillæ six or seven, forming a row which is not regular in the middle; the two outer ones are larger than the others, tapered, acute; the four inner ones, which do not lie in just the same line, are small, slender, acute. Lower arm-plates hour-glass-shaped, narrow, longer than wide, truncated at the ends and closely joined, and apparently soldered with the side plates. Arm-spines three, slender, tapered, acute, nearly equal, about as long as a joint. Tentacle-pores large. No tentacle-scale. The disk is destroyed in my specimens.

Diameter of the disk-scar, 10^{mm}; length of arms, 22^{mm}.

Off Barbadoes, Station 293. Blake Exp., 82 fathoms.

***Ophiobyrsella* Ver., gen. nov. Type, *O. serpens* (Lym.).**

Disk pentagonal, covered entirely by naked skin, which hides the oral and adoral shields and extends out over the upper and under sides of the arms and spines. Small spinules are situated over the region of the radial shields and along the margins of the disk, or over the whole disk. No tentacle-scales; tentacles large. Arm-spines three to five,—three in the type; rough, glassy. About five spiniform teeth. Oral papillæ form a regular lateral row, besides two or three tooth-papillæ at the tip of the jaw.

This genus is very near *Ophioscolex* in external characters.

True *Ophiobyrsa* (type, *O. rudis*) differs in having only one oral papilla, no teeth, and only a few spiniform tooth-papillæ; these parts being very much reduced.

Ophiobyrrella serpens (Lyman) is from the West Indies, in 69 fathoms.

Another species, *O. hystericis* (Lyman), with five slender and rather long spines, was dredged off the Shetland Islands, in 345 fathoms. (Bulletin Mus. Comp. Zool., vol. x, p. 272, Pl. viii, figs. 120–122, 1883.)

Astrogeron Ver., gen. nov. Type, *Ophiogeron supinus* Lym.

Disk and arms covered by a naked skin containing minute scales; beneath the skin are small rounded radial shields and very short genital plates and scales. Teeth small, spiniform; a cluster of spiniform tooth-papillæ at the end of the jaw, and a row of oral papillæ on the edge. Oral and adoral shields normal. No tentacle-scale. About two slender, glassy arm-spines covered by skin. Arm-bones divided longitudinally. The typical species of *Ophiogeron* has no oral papillæ, the jaw-plates being naked except for a few small spiniform teeth at the tip, but, otherwise, it agrees pretty closely with this.

Astrogeron supinus (Lym.) is from the West Indies, in 200 to 464 fathoms.*

Mr. Lyman has described several very remarkable genera, allied in some respects to *Ophioscolecidae*, but presenting such peculiar structures that it does not seem reasonable to refer them to any of the described families. They should be considered as types of two distinct families, if the differences that separate families in other cases are taken as our criteria. In fact, they present greater diversities than can be found elsewhere in the entire group of regular Ophiuroids. Therefore I propose to classify them as follows:

Ophiomycetidae, fam. nov.

Sub-family, *Ophiomycetinae*, nov. Type, *Ophiomyces* Lyman.

Sub-family, *Ophiotholinae*, nov. Type, *Ophiotholia* Lyman.

Ophiichelidae, fam. nov. Type, *Ophiichelus* Lyman.

These groups will be described on subsequent pages.

Family, **OPHIOMYCETIDÆ**, nov.

Disk swollen, covered with scales, which may be either naked or spinulose. No radial shields. Teeth few. Two, three, or more apical tooth-papillæ. Oral papillæ numerous, the outer ones large,

* Bulletin Mus. Comp. Zool., vol. x, p. 270, Pl. vii, figs. 103 to 106, 1883.

flat, foliate or spatulate, recurved, in two or more divergent rows or clusters, partly on the adoral plates. The arms can be turned up vertically above the disk.

Sub-family, **Ophiomycetinae**, nov.

Disk with small but distinct scales, usually spinulose. No grapel-shaped spinules on the arms. Arm-spines of the basal joints, and sometimes the lower ones on some of the joints beyond the disk, are flattened or spatulate; others are long and slender. Tentacle-scales of basal joints flat, often multiple. Upper arm-plates small, separated. Side plates large, meeting above and below. Oral shield small. Adoral shield long, carrying many of the spatulate oral scales.

Internal mouth-frames slender; genital scales and plates broad, flat, and curved up over the base of the arm. Arm-bones well developed, but peculiar in form, and without a distal condyle. The arm can be turned up vertically above the disk.

Only four or five species are known. Two, *O. mirabilis* Lym. and *O. frutescens* Lym., are West Indian. *O. spathifer* Lym. is from off Japan, in 565 fathoms, and *O. grandis* Lym. is from the South Atlantic, in 1000 fathoms.

Sub-family, **Ophiolithinae**, nov.

No visible radial shields. Disk-scales delicate, spinulose. Arm-spines present on all joints, slender, about three; associated with the spines, beyond several basal joints, are clusters of grapel-shaped spinules,* like those of *Ophiohelus*. A simple row of flat oral papillae and tooth-papillae surrounds the proximal ends of the jaws. Distally the oral papillae and oral scales are very numerous, in several divergent rows, recurved, broad, flat, foliate or spatulate, much as in *Ophiomycetes*.

Several spiniform teeth. Tentacle-scales, on the basal joints, two or more, flat; on other joints, spiniform. The side arm-plates meet broadly below. Under arm-plates covered by cuticle.

This group is closely allied to *Ophiomycetinae*, from which it differs mainly in having grapel-shaped spinules on the distal joints and in the more simple arm-spines.

* Mr. Lyman describes these as "pedicellariae," but they are totally different from all forms of true pedicellariae. They seem to me strictly homologous with the curved hooks and hooklets of *Astronyx* and allied genera, though much more complex in structure.

Only a single species is known: *Ophiotholia supplicans* Lym., taken off Juan Fernandez, in 1825 fathoms, Challenger Expedition.

Family, **OPHIOHELIDÆ**, nov.

No radial shields. Disk-scales very thin or rudimentary. Arm-bones divided into right and left plates. Oral papillæ spiniform, few, in a simple row. Teeth spiniform. Distal joints of arms bear rows of peculiar grapel-like or "parasol-shaped" spicules, in place of true spines. Only one genus is known.

Ophiohelus umbella Lym.

Mem. Boston Soc. Nat. Hist., 1880, pl. i, figs. 5-10 and 16.

This, the type-species, was taken off Barbadoes, in 82 fathoms.

O. pellucidus Lym.

Op. cit., pl. i, figs. 11-15, 1880.

This species was taken off the Fiji Islands, in 1350 fathoms, Challenger Expedition.

Family, **OPHIOMYXIDÆ** Ljung. (restr.), 1866.

Ophiocolecidæ (pars) Lutk., 1869.

Ophiomyxinæ (sub-family) Ljung., 1871.

Ophiomyxidæ Carus, Faunæ Medit., p. 96, 1884. Verrill, Oph. Bahama Exped., p. 65, 1899.

Disk and arms covered with thick cuticle, and usually with only a row of marginal disk-scales, and a few scattered ones imbedded in the cuticle, but visible only when dried. Radial shields small, usually with a proximal series of small supplementary scales.

Teeth and oral papillæ stout, flat, with the end serrated. No tooth-papillæ. True tentacle-scales generally absent. Under arm-plates small. Side arm-plates sub-ventral, bearing several rough divergent spines. Upper arm-plates rudimentary or lacking; when present, composed of small pieces. Two large, triangular, peristomial plates on each mouth-angle.

Arm-bones peculiar, belonging to the modified "hour-glass-shaped" type, with well-formed condyles on both ends.

Ophiomyxa and *Ophiodera* are the only genera described. The second genus has the following characters:

Ophiodera Verrill, Oph. Bahama Exped., p. 67, 1899. Type, *O. serpentaria* (Lym.).

Marginal disk-scales are rudimentary and concealed by thick cuticle; the disk-scales proximal to the radial shields are lacking. No upper arm-plates. Side arm-plates may be soldered to the under arm-plates. They are not continued upward by a row of small plates. Three or four arm-spines enclosed in cuticle; the inner one is smaller and may serve as a tentacle-scale; it is sometimes forked distally. Teeth and tooth-papillæ serrate, nearly as in *Ophiomyxa*, but with finer denticles.

Ophiodera Stimpsoni Verrill.

? *Ophioscolex Stimpsoni* Lyman, Illust. Cat. Mus. Comp. Zool., viii, p. 23, pl. i, figs. 11-15, 1875.

Ophiodera stimpsoni Ver., Oph. Bahama Exped., p. 67, pl. ii, figs. 4, 4a, 1899.

PLATE XLII. FIGURES 2, 2a, 2b, 2c.

Arms very long and slender. Disk five-lobed, the lobes extending out a little on the base of the arms. Teeth three or four; upper one stout, spiniform, the others thicker, subtruncate.

Whole upper surface of disk and arms and lower surface of disk are covered with thin naked cuticle, wrinkled when dry, containing imbedded, scattered, microscopic scales on the disk, and a row of irregular small, marginal scales. Sometimes there are a few small, irregular granules along the margin and on the under side of the disk, and also on the bases of the arms. Radial shields very small or rudimentary, concealed by cuticle.

Diameter of disk 7^{mm}; length of arms about 45^{mm}.

West Indies, 60 to 240 fathoms.

Oral papillæ about five, partly slender, subspiniform, rough at tip, irregularly crowded in a row, nearly equal in length, but some are flattened and obtuse at tip. Sometimes there is also a somewhat stouter tooth-papilla. Within mouth-slits, on each side, there are two (sometimes only one) slender papillæ between the two oral tentacle-pores.

Genital slits wide and open near the oral shields, but narrow distally and not extending to the edge of the disk, bordered by narrow, naked scales.

Tentacle-pores are small and round. In some specimens there is a small, slender, spiniform tentacle-scale, which is often deeply forked, or even double, and in alcohol is covered with a sheath of cuticle; it stands nearly in line with the other spines, beside the

tentacle-pore. It is often reduced to a minute spinule, and is frequently absent.

Arm-spines three or four, divaricate, small, nearly equal, sharp, roughly serrulate and glassy, more or less covered by cuticle when in alcohol.

The internal arm-plates show as transversely rhombic plates separated by wider intervals.

Family, **HEMIEURYALIDÆ** Ver., Oph. Bahama Exped., p. 70, 1899.

In this family are included several genera of true Ophiuræ, which very much resemble, in form and habits, the simple-armed Euryalæ or Astrophytions. Like the latter, they coil their arms closely around the branches of gorgonian corals on which they dwell.

The disk is pentagonal and covered with thick plates or tubercles, which may be conical. The radial shields are large and prominent.

Upper arm-plates may be entire and accompanied by supplementary plates, or they may be replaced by a mosaic of small plates. They are thick or tubercular.

Under arm-plates well formed. Side-plates separated by extra plates. Oral and adoral shields normal. Spines few, short and stumpy. A row of oral papillæ. Teeth, but no definite cluster of tooth-papillæ.

Genital pores small, situated near together at the outer end of the oral shield. Arm-bones have special forms approaching those of the *Astrophytons*. Mouth-frames strongly ossified.

The genera belonging to this family are *Hemieuryale*, *Ophioplus*, and *Sigsbeia*.

Hemieuryale pustulata Von Martens.

Hemieuryale pustulata Von Mart., Monatsb. Konig. Akad. Berl., p. 484, 1867; Ljung., Dr. Goes., Oph., Ofv. Kong. Akad., p. 617; Lyman, Ann. Sci. Nat., xvi, Art. 4, p. 5; Bull. Mus. Comp. Zool., iii, 10, p. 268, pl. v, figs. 8-11; op. cit., x, p. 277; Report Voy. Challenger, Zool. Ophiuroidea, v, p. 249, pl. xliii, fig. 7-10 (anatomy), 1882.

Ophiura cuspidifera (?) Lamk., Hist. Anim. s. Vert., iii, p. 226, 2d ed., 1840; Encyclop. Meth., pl. cxxii, figs. 5-8.

Disk small, thick, swollen, pentagonal, with a swelling opposite the base of each arm when dried; whole surface, except radial shields, covered with larger and smaller thick scales and verrucæ. The central primary scale is round and rough like the radial shields, but not swollen. Five primary rounded radial scales, which are

larger than the rest, are strongly convex or pustular, and often white. Five somewhat smaller convex interradians may usually be distinguished by their size; the other plates and scales are of various sizes, the larger ones convex or somewhat verruciform, while the small ones are nearly flat. A radial band of small scales extends continuously between the radial shields and out over the upper side of the arms, becoming flat, angular, and closely crowded on the arms, so as to form a fine mosaic.

Radial shields long-ovate, widely separated; the surface is evenly covered with fine hemispherical elevations; the side arm-plates are ornamented in a similar manner. Along each side of the arms, above, there is a row of elevated, verruciform or almost hemispherical plates, alternating with the side arm-plates; part of these are usually pure white, alternating with others that are deep brown. Under arm-plates well developed, trapezoidal, with acute outer angles, and with a rather deep median emargination or notch in the distal edge, except on six or seven basal ones; close to the base they are larger than broad, but farther out they become broader than long. Arm-spines generally two, small, short, nearly equal, obtuse, becoming longer and more slender distally. Tentacle-scale rather large, ovate, obtuse. Oral shield large, often white, somewhat "spade-shaped" with the outer end and sides, evenly rounded, the inner edges concave, the median and inner lateral angles acute; they vary considerably in different specimens. Adoral shields swollen, somewhat crescent-shaped or pear-seed-shaped, with the acute inner ends touching. Oral papillæ about five, angular, crowded in a close series, the outer ones larger. Genital openings small, like an angular pore, between two angular plates, at the outer edge of the oral shields.

Color reddish or yellowish brown, spotted and blotched with clear white in various ways, so as to closely imitate the color and appearance of certain species of *Gorgonella* to which it habitually clings. Usually there are rows of white verruciform plates along the arms on the upper side, resembling in size and color the verrucæ of the coral, which has a brown ground-color, like that of the *Hemiewryale*. Part of the tubercular plates of the disk, part of the oral shields, part of the spines, and part of the side arm-plates are also usually white.

Common in water of moderate depth throughout the West Indies wherever the *Gorgonella* lives. Specimens from off Barbadoes have been in the Yale Museum many years. Taken by the Blake Expedition in 74 to 180 fathoms.

Ophioplus Verrill, Ophiur. Bahama Exped., p. 70, 1899.

Type, *Hemieuryale tuberculosa* Lyman.

Disk small, pentagonal, thick, covered with small, thickened or tubercular scales. Radial shields large, naked, separated. Oral shields and adoral shields well developed and naked. Oral papillæ in regular series. No tooth-papillæ. Under arm-plates rather large. Upper arm-plates entire, swollen and well formed, separated by a transverse row of small, tubercle-like plates. Side arm-plates prominent, separated above by a supplementary lateral plate. Arm-spines short, two or three in a row. Tentacle-scale single. A pair of small, round genital pores under the outer end of the oral shields.

This genus differs decidedly from *Hemieuryale*, to which it is allied, in having distinct and well formed dorsal arm-plates. It is also closely allied to *Sigsbeia*. In fact, it stands between these two genera in several characters.

Ophioplus tuberculatus (Lym.) Ver.

Hemieuryale tuberculosa Lyman, Bull. Mus. Comp. Zool., vol. x, p. 276, pl. viii, figs. 120-127, 1883.

Ophiomusium (?) Nutting, Narrative, p. 78.

Ophioplus tuberculatus Ver., Ophiur. Bahama Exped., p. 71, pl. i, figures 1-16, 1899 (description).

PLATE XLIII. FIGURES 6-6d.

Color deep brown, variously spotted with whitish, imitating the colors of *Gorgonella* to which it clings.

Usually many of the more prominent verruciform plates of the upper side of the arms and disk are white; under arm-plates dark brown.

Taken by the Blake Expedition in 96 and 115 fathoms; Bahama Expedition, Station 15 and 16, off Havana, 200 fathoms.

Sigsbeia murrhina Lyman.

Sigsbeia murrhina Lyman, Bull. Mus. Comp. Zool., v, 9, p. 234, 1878, pl. iii, figs. 55, 58; op. cit., x, p. 277; Lyman, Report Voy. Challenger, Zool., Ophiuroidea, v, p. 250, pl. xliii, figs. 4-6, 1882, anatomy; Three Cruises of the Blake, ii, p. 114, fig. 399, 1888. Nutting, Narrative, p. 79. Verrill, Oph. Bahama Exp., pp. 72, 73, pl. ii, figs. 1, 1a, 1899 (Young, description.)

PLATE XLII. FIGURE 7.

This species clings to gorgonians, which it imitates by the form of its arms and the tuberculated surface of the disk, and probably also in color, when living. Our figure represents a young specimen, which differs considerably from the adult.

Family, **OPHIORACHIONTIDÆ** Verrill, nov.

Disk entirely covered with acute spinules and cuticle, without radial shields or ribs. Arms long, slender, serpentine, so covered with cuticle that the plates are hidden. Under arm-plates are present. Side arm-plates not prominent, bearing rows of small double hooks on all the joints, but no spines. Upper arm-plates rudimentary or lacking. Tooth-papillæ spiniform, in an apical cluster; a few similar mouth-papillæ.

The only species, *Ophiobrachion uncinatus* Lym., is from off Cuba, in 250 fathoms.

Order II, **EURYALÆ** Müll. and Trosch., 1842.

Euryalidæ Gray, Synop. Brit. Mus., p. 63, 1840.

Astrophytonidæ Norman, Ann. and Mag. Nat. Hist., xv, p. 104, 1865.

Phytastra Hæckel, Gen. Morph., ii, p. 67, 1866.

Astrophytidæ Lyman, Ljungman, and others.

Euryalæ Müll. and Troschel, Syst. Aster., p. 85, 1842. Ljung., Oph. Viv., p. 334, 1867. Carus, Fauna Medit., p. 97, 1884. Verrill, Ophiur. Bahama Exped., p. 73, 1899.

Cladophiuræ Bell, Proc. Zool. Soc. London, p. 180, 1892; Catal. Brit. Echinod., p. 26, 1892.

Euryalida of several authors.

Family, **EURYALIDÆ** (*pars*) Gray, 1840, restricted.

Astrophytidæ (*pars*) Lyman, and many other authors.

Arms more or less dichotomous. Disk covered with cuticle and granules, and having ten strong radial ridges.

Teeth strong and large, in a single vertical row, as in Ophiuræ. Tooth-papillæ, few or none. Oral papillæ minute, papilliform, or lacking. Adoral shields and jaw-plates large, well formed. Oral shields rudimentary.

Under arm-plates simple; they extend the whole length of the arm. Side arm-plates small, appressed proximally, but prominent or erect distally, where they bear double claw-like hooks and thorny spinules; toward the base of the arms they bear few, small, rough, simple spines or tentacle-scales. Two rows of small plates, extending up from the side-plates, form transverse ridges, around the arms. Large spines, along the upper side of the arm, are borne by some of these plates. Dorsal arm-plates are represented only by small detached pieces.

In having a regular row of teeth and simple normal under arm-plates this group resembles ordinary *Ophiuræ* and differs widely from the *Gorgonocephalidæ*.

Subfamily, **Euryalinæ**, nov.

Arms wide at base, many times dichotomous, with short internodes, bearing two dorsal rows of spines. Disk large, with ten granulated radial ridges. Radial shields long, narrow, composed of only one piece, covered, like the rest of the disk, with cuticle. Inter-brachial areas, below, covered with strong united plates.

The type, *Euryale aspera* Lam., is from the East Indies and China Sea.

Subfamily, **Trichastrinæ** Ljung., 1872.

Disk relatively small, but thick, with ten stout radial ribs. Arms angular, stout and high at base, divided only distally into a small number of forks. Tentacle-scales short and stout, about three in a row.

Oral shield well developed.

The type, *Trichaster palmiferus* (Lam.), is from the East Indies.

The arms have two dorsal rows of short, stout, obtuse, conical spines; they generally occur on alternate ridges.

The teeth are very large and thick, with truncate ends. Usually there is a single, large, conical tooth-papilla at the apex of the jaw. Oral papillæ small, papilliform, in two or more rows. The disk and arms, above and below, are rather coarsely granulated.

Family, **GORGONOCEPHALIDÆ** Verrill.

Gorgonocephalinæ (*pars*) Ljung., 1867. Bell, Catal. Brit. Echinod., p. 27, 1892.

Gorgonocephalidæ Verrill (restr.), Ophiur. Bahama Exped., Bull. Univ. of Iowa, v, p. 83, 1899.

Arms divided dichotomously into numerous branches. Disk swollen, with ten prominent radial ribs, covered with cuticle, which may bear granules or scattered spinules, or it may be more or less naked. Radial shields, each composed of several united plates.

The entire surface of the arms and disk above and below is covered with cuticle which is usually granulated, so that the plates are hidden.

Under arm-plates mostly rudimentary, consisting of two or more small pieces, sometimes absent. Side arm-plates are united below

and cover most of the under side of the arms. They bear a row of few, small, rough spines or spiniform tentacle-scales, which are usually hook-like distally. Two or more rows of small plates run up from each of the side plates and form transverse ridges around the arms, covered with granules; these usually bear rows of small glassy hooks. The dorsal arm-plates are rudimentary or wanting.

Teeth and tooth-papillæ numerous, spiniform. Oral papillæ, when present, small, conical or papilliform. Adoral shields well-developed, but usually concealed by cuticle, sometimes broken into several plates. Oral shields rudimentary or wanting. Sometimes there are five small madreporic plates, but usually only one.

The three generic names: *Gorgonocephalus* Leach, 1815; *Euryale* Lamarek, 1816; and *Astrophyton* Agassiz, 1835, were, as originally used and intended, exact synonyms. As now employed, they only date back to Lyman's paper on the Challenger Ophiuroidea, 1878.

That he rightly divided these forms into three distinct genera cannot be doubted, and he doubtless had the right to apply the three names, as he did, to the respective groups, though it might, perhaps, have saved some confusion of nomenclature if he had given new names to two of the genera.

It is certainly useless to go back to Linck, 1733, as the prior authority for *Astrophyton*, for he was not a binomial writer.

For the same reason it is useless to try to restore the ancient pseudospecific names given by Linck and even by Seba (e. g. *costosum*), when later and determinable specific names have been given by binomial writers.

Gorgonocephalus Leach (Zool. Miscell., 1815) is the oldest of the three names under the binomial system. Leach gave a short diagnosis of the genus, and stated that he separated it from *Ophiura* on account of its branched arms. He mentions no special type, but refers to the fact that most writers, following Linné, had referred all the species to "*Asterias caput-medusæ*."

As the latter was primarily based on a species of northern Europe, Lyman's selection of the northern genus to bear this generic name was fully justified.

As for the other two names, since they were synonyms he could have applied each of them to either of the remaining groups with equal propriety, for each name had been used for all the known species.

There certainly is no good reason why Mr. Lyman's usage should not be followed, so far as these genera are concerned.

This family, as here defined, includes only two described genera : *Gorgonocephalus* and *Astrophyton*. To these should be added a third, to include *Euryale verrucosum* Lam., which differs much from both the others. For this I propose the name *Astrocladus*.

Astrocladus Verrill, gen. nov.

Resembles *Gorgonocephalus* in form, but differs in having no pavement of plates on the margins and interradial areas ; in the absence of under arm-plates ; in having no minute hooks on the arm-ridges ; in having no spines or tentacle-scales on the basal points ; in having the side arm-plates more degenerate, and not covering all of the under side of the arms, leaving spaces of naked cuticle between them. The arms have very numerous forks.

The type, *A. verrucosus* (Lam.), has rather large, rounded or verruciform tubercles, arranged in two irregular rows along the upper side of the arms and on the radial ridges of the disk.

There are usually three short, stout, obtuse tentacle-scales, thorny at the tips.

The tooth-papillæ and teeth are very numerous, elongated, spiniform. The oral papillæ form two or more rows ; the larger ones are cylindrical or spiniform, the smaller ones conical.

The whole surface of the arms and disk, above and below, is covered with fine and close granules. The annulations of the arms are not very prominent.

The forkings of the arms are very numerous, with short internodes. The arms are stout at the base.

The adoral and oral shields are represented by a group of irregular plates. The interradial areas below are covered with thin granulated cuticle, without plates.

It has been recorded from the Cape of Good Hope, etc. A specimen in the Yale Museum is labeled as from Japan, but this locality may possibly be erroneous.

Family, **ASTROCHELIDÆ** Verrill.

Astrochelidæ Verrill, Ophiur. Bahama Exped., p. 79, 1899.

Arms simple or with a few distal forks, granulated, and also annulated with raised ridges. Disk with five or ten radial ridges, its surface granulated or spinulose.

The genital openings are short, situated toward the margin of the disk, or not close to the inner angles.

Under arm-plates rudimentary or lacking. Side arm-plates cover most of the under surface, but are hidden by cuticle and granules.

They bear a short row of small rough spines or tentacle-scales; above them are double vertical rows of small plates, forming raised ridges and bearing granules and also rows of minute glassy hooks, on the sides and top of the arms. These sometimes extend on the radial ridges of the disk.

Teeth and tooth-papillæ numerous, spiniform; the latter form an apical cluster. Oral papillæ similar in form, sometimes lacking. The teeth may form double vertical rows.

This family includes *Astrochele*, *Astrogomphus*, *Astroporpa*, and *Astrotoma* all with simple arms, and *Astrocnida* with the arms forked near the ends.

Family, **ASTROSCHEMIDÆ** Verrill.

Astroschemidæ Verrill, Ophiur. Bahama Exped., v, p. 76, 1899.

Arms simple, long, slender, coiled. Disk five-lobed, with ten radial ribs; naked or granulated. Radial shields narrow, usually elongated. Under arm-plates small. Upper arm-plates poorly developed, often wanting, sometimes represented by two or more pieces, covered by naked skin or granulated. Side arm-plates relatively large, covering a large part of the lower side of the arm, and usually bearing two elongated spines or tentacle-scales.

Teeth are large, stout, several in a vertical row. Oral papillæ are small or wanting.

Oral and adoral plates, regularly formed, but covered by cuticle. Genital slits short, situated near the outer margin of the disk.

Internal mouth-frames strong, well developed, but without wing-like processes.

This family includes *Astroschema*, *Astrocreas*, and *Ophiocreas*.

Family, **ASTRONYCIDÆ** Verrill.

Astronycina (pars) Ljung., Oph. Viv., 1867. Bell, Cat. Brit. Echin., p. 27, 1892.

Astronycidæ Verrill, Ophiur. Bahama Exped., Bull. Univ. Iowa, v, p. 74, 1899.

Arms undivided, long, slender, coiled, not annulated nor granulated. Disk with ten narrow radial ridges formed by long narrow radial shields, covered with thin, smooth scales or naked skin.

Upper and under arm-plates rudimentary or absent. Side arm-plates cover most of the lower side of the arm and project laterally, bearing two, three, or more spines or tentacle-scales, which may be either simple or hook-like. The genital slits are short, near together in a depression near the oral shields.

Teeth stout, well formed, in a single row. Tooth-papillæ one or two, conical, sometimes absent. Oral papillæ small, like conical granules, placed above the margins of the jaw. Oral and adoral plates regularly formed.

Astronyx was the only described genus of this family, till recently, when I added to it a new genus, *Astrodia* (type, *A. tenuispina* Ver.), from deep water off the U. S. coast.

Astronyx Lymani Verrill.

Astronyx Loveni Lym., Bull. Mus. Comp. Zool., vol. x, p. 282, pl. viii, figs. 136-138, young (non Müll. and Troschel).

Astronyx Lymani Verrill, Ophiur. Bahama Exped., v, p. 74, pl. viii, figs. 4-4e, 1899.

PLATE XLII. FIGURES 6-6c.

Arms five, long, slender, coiled. Disk pentagonal with incurved margins, and ten high, long radial shields, which are widely separated, curved outward in the middle and somewhat sinuous distally, the outer end a little clavate or knobbed; the edge is serrulate with small scales. The radial shields and disk are covered with a thin, smooth skin which extends out on the arms, above and below. Inter-brachial region below, in the dry specimen, concave or sunken, with the two short but wide genital openings close together, near the inner angles.

Astrodia Verrill. Type, *Astronyx* (?) *tenuispina* Ver.

Astrodia Verrill, Ophiur. Bahama Exped., p. 74, 1899.

Disk small; arms very long, slender, much coiled. Upper and under surfaces of the disk and arms covered with thin, delicate, closely imbricated scales, without granules.

Under arm-plates not distinct, except on one or two basal joints.

Arm-spines three, except on a few basal joints, rather long, tapered, simple, thorny at the tip, but not becoming hooked, even on the distal part of the arms.

Teeth stout, obtuse, the lowest not differing much from the rest. No tooth-papillæ. A row of small granule-like oral papillæ. Oral and adoral shields well developed.

The type-species lives clinging, by its coiled arms, to a species of slender, pennatulid coral (*Scleroptilum gracile* V.), in 1362 to 2033 fathoms, off the United States East Coast. (See Amer. Journ. Sci., vol. xxviii, p. 219, 1885; and Annual Rep. U. S. Fish. Com. for 1883, p. 550 (as *Hemieuryale tenuispina*).

PART II.—A FAUNAL CATALOGUE OF THE KNOWN SPECIES OF
OPHIUROIDEA FROM THE WEST INDIAN REGION.

In the following article the West Indian Zoögeographical region is taken, in its broadest sense, as extending from South Florida and the Bermudas to Yucatan, and to Pernambuco, Brazil.

The extreme geographical range is here given only for those that are known, to extend beyond the West Indian region. When no special localities are given the Carribean Sea and West Indies are to be understood. Those species marked with an asterisk extend northward on our coast.

The synonymy of most of the species is given by Mr. Lyman in the Voyage of the Challenger, vol. v, Ophiuroidea. But dates have been given to indicate the works where the species were first published. Most of these are given on pages 301 and 383. A fuller bibliography will be given with Part III.

I have added references to the excellent woodcuts in the "Three Cruises of the Blake," vol. ii, by Mr. Alexander Agassiz (Bull. Mus. Comp. Zool., vol. xv, 1888); and also to Part I of this series; and to the report on the Ophiuroidea of the Bahama Expedition (1899*a*), when the species or genera are there described or figured.

Order I. **OPHIURÆ** Müll. and Trosch., 1842.

(See this volume, p. 303).

Family, **PECTINURIDÆ** Ver., 1899*a*, p. 4.

(See this volume, p. 303.)

OPHIURA Lam., 1801.

<i>brevicauda</i> Lym., '65.	0-35 fath.
<i>guttata</i> Lym., '65.	1-10 fath.
<i>brevispina</i> Say, '25.	1-122 fath.
	Bermudas and Florida to Brazil.
*var. <i>olivacea</i> .	Florida to Cape Cod. Shallow water.
* <i>Holmesii</i> Lym., '60.	S. Carolina.
<i>cinerea</i> Lym., '65.	0-115 fath.
	Florida to Abrolhos Reefs, Brazil.
<i>pallida</i> Verrill, 1899 <i>a</i> , p. 7, pl. II, fig. 3.	110-200 fath.
<i>rubicunda</i> Lym., '65.	Littoral. Shallow water.
<i>squamosissima</i> Lym., '65.	Littoral?. Shallow water.

- appressa* Say, '25. 0-20 fath.
Bermudas and Florida to Bahia, Brazil.
- elaps* Lym., '65. Nar. Blake Exped., p. 111, fig. 394.
120-300 fath.
- OPHIOPEZA Peters, 1851.
Yoldii Ltk., '56. Shallow water.
Petersi Lym., '78. 8-177 fath.
- PECTINURA Forbes, 1842.
angulata Lym., '83. 88-248 fath.
tessellata Lym., '83. 451 fath.
lacertosa Lym., '83. 159 fath.
- OPHIOLEPALE Ljung., 1871.
Goësiana Ljn., '71. Lym., in A. Ag., Nar. Blake Exped.,
p. 111, fig. 393. 38-250 fath.
- Family, OPHIOLEPIDIDÆ Ljung., 1867.
- OPHIOLEPIS M. and Tr., 1840.
paucispina Müll. and Tr., '42. 3-4 fath.
Florida and West Indies to Rio de Janeiro.
- **elegans* Ltk., '59. Charleston, S. C.; West Indies. 8½-30 fath.
- OPHIOZONA Lym., 1865.
impressa Lym., '65. 69-300 fath.
nivea Lym., '75; Nar. Blake Exped., p. 110, fig. 390.
50-424 fath.
- var. *compta* Verrill, 1899a, p. 9, pl. III, fig. 2.
This Vol., p. 303, pl. XLIII, figs. 1, 1a. 110-200 fath.
- insularia* Lym., '78. 310-315 fath.
marmorea Lym., '83. 114-250 fath.
clypeata Lym., '83. 88-157 fath.
tessellata Lym., '78. 60-300 fath.
Antillarum Lym., '78. 94-508 fath.
dubia Lym., '78. 539 fath.
- OPHIOCERAMIS Lym., 1865.
Januarii Lym., '65. 35-100 fath.
West Indies to Rio de Janeiro, Brazil, and Patagonia.
- albida* Lym., '75. 19-100 fath.
West Indies to Rio La Plata.
- OPHIOTHYREUS Ljung., 1871.
Goësi Ljn., '71. 80-300 fath.
- OPHIERNUS Lym., 1878.
adpersus Lym., '83. 159-1030 fath.
Gulf of Bengal and off the Malabar Coast,
490-1997 fath. (Køehler).

OPHIOGLYPHA Lym., 1860.

<i>fasciculata</i> Lym., '83.	288 fath.
<i>abyssorum</i> Lym., '83.	1097 fath.
<i>scutata</i> Lym., '83.	95 fath.
<i>tenera</i> Lym., '83.	124 fath.
<i>acervata</i> Lym., '69.	60-350 fath.
<i>falcifera</i> Lym., '69.	200-576 fath.
* <i>lepida</i> Lym.,	West Ind., 425-1242 fath.
East Atlantic, 425-900 fath.	Off East Coast U. S.,
813-2574 fath.	

<i>Ljungmani</i> Lym.	Off Bahia, 350 fath.
<i>variabilis</i> (?) Lym. (Var. ?)	175-955 fath.
? <i>irrorata</i> Lym., '78; '83.	1058-1097 fath.
Type, Cape Good Hope, 1900 fath.; Australia, 410 fath.	
? <i>convexa</i> Lym., '78; '83.	114-270 fath.
Type, Pacific, 2050-2300 fath.; W. Africa, 2350 fath.	

OPHIOCTEN Lutk., '54.

<i>depressum</i> Lym., '79.	315 fath.
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OPHIOMUSIUM Lym., '69.

<i>eburneum</i> Lym., '69.	92-500 fath.
var. <i>elegans</i> Verrill, 1899a, p. 12, pl. III, figs. 1, 1a.	110-260 fath.

**Lymani* Wy. Thom., '73. North Atlantic, 238-2369 fath.
Off coast of Europe; off East Coast U. States, south to
S. Carolina, common; off Tristan d' Acunha, 1100
fath.; Pacific, 565-1825 fath.

<i>serratum</i> Lym., '78.	124-1097 fath.
<i>cancellatum</i> Lym., '78 (? var.).	Bermuda, 435 fath.

Perhaps the same as the next. Mr. Lyman's type was from off Japan.

<i>stellatum</i> Verrill, 1899a, p. 14, pl. I, figs. 3, 3a.	110-260 fath.
<i>planum</i> Lym., '78; Nar. Blake Exped., p. 112, fig. 396.	
Mediterranean, 4020 meters; Gulf of Bengal, 1520- 1987 fath. (K�hler).	W. Indies, 300-955 fath.
<i>acuferum</i> Lym., '75.	27-1030 fath.
<i>archaster</i> Wy. Thom., '73.	Off Brazil, 1900 fath.
<i>sculptum</i> Verrill, 1899a, p. 106, pl. II, fig. 2, pl. VIII, fig. 2.	110-260 fath.
<i>pulchellum</i> Wy. Thom.	150-1675 fath.
North of Cape Verde Is.; off Brazil; S. Atlantic.	
<i>validum</i> Ljung., '71.	60-1568 fath.
North of Laquedives, 931 fath. (K�hler).	
<i>testudo</i> Lym., '78.	69-508 fath.

OPHIOLIPUS Lym.

Agassizii Lym., '78; Nar. Blake Exped., p. 115, fig. 401.
100-118 fath.

OPHIOMASTUS Lym.

secundus Lym., '78; Nar. Blake Exped., p. 113, fig. 398.
60-1131 fath.

OPHIOPHYLLUM Lym.

? *petilum* Lym., '79; Nar. Blake Exped., p. 110, fig. 391.
Type, off Fiji Is., 600 fath. W. Indies, 542 fath.

OPHIOPREYN Lym.

longispinus Lym., '78. 60-625 fath.

OPHIOCONIS Lutk., 1869.

militaria Lym., '78; Nar. Blake Exped., p. 112, fig. 395.
Ver. 1899a, p. 17. 163-450 fath.

Family, **OPHIOTHRICHIDÆ** Ljung. Ver., This Vol., p. 304.

OPHIOTHRIX Müll. and Trosch.

**angulata* Ayres, '52. Ver., 1899a, p. 18 (descr.). 0-200 fath.
Chesapeake Bay and Bermudas to Rio de Janeiro.
Erstedii Ltk., '56. Ver., 1899a, p. 20, colors. 0-13 fath.
lineata Lym., '60. 0-20 fath.
pallida Ljung., '71. 180 fath.
Suensonii Ltk., '56. Ver., 1899a, p. 21, colors. 0-262 fath.
Bermudas and Florida to Brazil, Lat. 22° S.

Family, **OPHIOCOMIDÆ** Ljung., 1867.

OPHIOCOMA L. Agassiz, '35.

echinata L. Agassiz, '35. 0-13 fath.
Bermudas and Florida to Brazil.
Riisei Lütken, '56, 0-210 fath.
Bermudas and Florida to Brazil.
pumila Ltk., '56. 0-100 fath.
Bermudas and Florida to Northern Brazil.

OPHIOPSILA Lutk.

Riisei Ltk., '59. 0-200 fath.
Bermudas and Florida to Northern Brazil.

Family, **AMPHIURIDÆ** Ljung., '67. Ver., This Vol., pp. 305-319.

OPHIACTIS Lutk.

Mulleri Ltk., '56. 1-337 fath.

- Bermudas and Florida to Abrolhos Islands.
 var. *quinqueradia* Lym. 27-338 fath.
dispar Verrill, 1899a, p. 31, pl. VIII, figs. 3-3e. 3-13 fath.
 **Krebsii* Ltk., '56. 1-20 fath.
- Bermudas and S. Carolina to Rio de Janeiro.
loricata Lym., '69. 10-110 fath.
Lymani Ljng., '71. 40 fath.
plana Lym., '69. 10-140 fath.
- AMPHIURA Forbes. Ver., This Vol., pp. 306, 307 (rest.).
 **Otteri* Ljung., '71. 175-1467 fath.
- Off Portugal and off New England to West Indies.
Palmeri Lym., '82. 100 fath.
incisa Lym., '83. 583 fath.
semiernis Lym., '69. 377-539 fath.
flexuosa Ljung. Var. ?, Lym., '83. 262 fath.
- Florida to Southern Brazil.
grandisquama Lym., '69. 10-262 fath.
lumaris Lym., '78. 424-955 fath.
Stimpsoni Ltk., '59. 10-69 fath.
- West Indies to Cape Frio, Brazil.
- The two following supposed "varieties" of antarctic species are recorded by Lyman, but have not been described nor figured, from the West Indian fauna. They were, therefore, omitted from the analytical table (pp. 308-311).
- angularis* Lym., '78. Var. ? 476 fath., Antarctic Ocean.
tomentosa Lym., '78. Var. ? 464 fath., Antarctic Ocean.
- AMPHIPHOLIS Ljung., '66. Ver., This Vol., pp. 306, 311.
 **tenuispina* Ljung., '64; '67. 60-487 fath.
- Off U. S. East Coast, C. Hatteras to Cape Cod ; North
 Europe to Iceland.
 **tenera* (Ltk.) Ljung. 4-200 fath.
- S. Carolina to Cape Frio, Brazil.
 **gracillima* (Stimp.) Ljung., '67, '71. S. Carolina. West
 Ind. Brazil ? (as *A. Januarii* Ljung.). Littoral.
 **Goësi* Ljung., '71. 14-280 fath.
- Bermuda and Cape Hatteras to Antilles.
abnormis (Lym., '78.) Ver. 101 fath.
- AMPHIODIA Ver., 1899a, p. 25. This Vol., pp. 306, 312.
repens (Lym., '75) Ver. Florida, 14 fath.
pulchella (Lym., '69) Ver. Florida, 18-39 fath.
 **atra* (Ltk., '59) Ver. S. Carolina. Littoral.
Riisei (Ltk., '60) Ver. Shallow water.
- West Indies to Southern Brazil.
Lütkeni (Ljung., '71) Ver. 10 fath.

- AMPHIOPLUS** Ver., 1899a, p. 25, 1899. This Vol., pp. 306, 314.
tumida (Lym., '78) Ver. 94-321 fath.
nereis (Lym., '83) Ver. 148 fath.
Agassizii Ver. This Vol., p. 315. 116 fath.
cuneata (Lym., '78) Ver. 159-370 fath.
**duplicata* (Lym., '75) Ver. 73-1568 fath.
 Mediterranean, 1385-2178 meters; off the Azores,
 1300-1850 meters (Kœhler).
Stearnsii (Ives) Ver. Shallow.
Verrillii (Lym., '79) Ver. 424-2650 fath.
- AMPHILIMNA** Ver., 1899a, p. 30, 1899. This Vol., p. 318.
Caribea (Ljung., '71) West Indies, 300-400 fath.
- Perhaps identical with the next.
- *olivacea* (Lym.) Ver., This Vol., p. 318, pl. XLII, figs. 1, 1a.
 West Indies, 40-126 fath.
 West Indies, northward to N. England, in 63-266 fath.,
 beneath the Gulf Stream.
- OPHIOCNIDA** Lym. Ver., This Vol., p. 315 (restr.).
scabriuscula Lym., '65. Florida to Bahia, Brazil. Littoral.
filogranea Lym., '75. Shallow.
- HEMPHOLIS** Lym.
**cordifera* Lym., '65. Littoral. Shallow water.
 N. Carolina to Brazil.
- OPHIOPHRAGMUS** Lym.
**Wurdemani* Lym., '65. Beaufort, N. C. to West Indies. Littoral. Shallow water.
septus (Lutk., '59) Lym., '65. 47 fath.
- AMPHILEPIS** Ljung., '67.
patens Lym., '79. 2160 fath.
- OPHIONEMA** Lutk., '69.
intricata Ltk., '69. 180 fath.
- OPHIONEPHTHYS** Lutk., '69.
limicola Ltk., '69. Littoral? Shallow water.
- OPHIONEREIS** Lutk., '59.
reticulata Lutken, '59. 0-94 fath.
 Bermudas and Florida to Rio de Janeiro, Brazil.
- OPHIOPLAX** Lym.
Ljungmani Lym., '75. 80-250 fath.
- OPHIOSTIGMA** Lutk., '56.
isacanthum (Say) Lym., '65. 0-122 fath.

OPHIOCHYTRA Lym.

tenuis Lym., '83.

291-383 fath.

Family, **OPHIACANTHIDÆ** Verrill, 1899*a*, p. 34. This Vol., p. 319.OPHIACANTHA Müll. and Trosch., '42. Ver., This Vol., pp. 320-340
(restr.)*vepratrica* Lym., '78.

291-600 fath.

aspera Lym., '78.

73-400 fath.

stellata Lym., '75.

56-262 fath.

pentacrinus Ltk., '69.

74-625 fath.

segesta Lym., '78.

1075 fath.

cosmica Lym., '78.

350-2225 fath.

(Ophientodia) scutata Lym., '78. Ver., This Vol., p. 341,
(descr.) 124-338 fath.*(Ophientodia) pectinula* Ver., This Vol., p. 342 (descr.)

Station 227, Blake Exped., 573 fath.

(Ophioscalus) echinulatus Lym., '78.

205-955 fath.

OPHIALCÆA Ver., 1899*a*, p. 42. This Vol., pp. 326, 331.*Nuttingii* Verrill, 1899*a*, p. 46, pl. I, fig. 2; pl. VIII, figs.
1, 1*a*. 200 fath.OPHIACANTHELLA Ver., 1899*a*, p. 39. This Vol., pp. 326, 344.*Troscheli* (Lym., '78) Ver.

73-300 fath.

OPHIOMITRELLA Ver., 1899*a*, p. 43. This Vol., pp. 336, 352.*lavipellis* (Lym., '83) Ver. This Vol., p. 343 (descr.).

88-124 fath.

OPHIOLIMNA Ver., 1899*a*, p. 44. This Vol., p. 345.*mixta* (Lym., '78) Ver. This Vol., p. 346.

160-576 fath.

OPHIOPORA Ver., 1899*a*, p. 43. This Vol., p. 345.*Bartletti* (Lym., '83) Ver. This Vol., p. 345.OPHIOPRISTIS Ver., 1899*a*, p. 47. This Vol., p. 347.*hirsuta* (Lym., '75) Ver.

82-955 fath.

ensifera Ver., 1899*a*, p. 47, pl. IV, figs. 1-1*d*.

This Vol., pl.

XLIII, fig. 4.

110-160 fath.

cervicornis (Lym., '83) Ver.

208-573 fath.

OPHIOTRETA Ver., 1899*a*, p. 40. This Vol., pp. 333, 347.*lineolata* (Lym., '83) Ver., 1899*a*, p. 51.

110-208 fath.

sertata (Lym., '69) Ver., 1899*a*, p. 54. This Vol., p. 348.

123-411 fath.

AMPHIPSILA Ver., 1899*a*, p. 55. This Vol., pp. 333, 348.*maculata* Ver., 1899*a*, p. 55, pl. III, figs. 4, 4*a*. This Vol.,
p. 348; pl. XLIII, figs. 5, 5*a*. 200 fath.*fulva* (Lym., '78).

13-175 fath.

- OPHIOMITRA** Lym., Ver. This Vol., pp. 349, 350; restr.
valida Lym., '69. Ver., This Vol., p. 353 descr. 10-1105 fath.
ornata Ver., 1899*a*, p. 58, pl. v, figs. 1, 1*a*. This Vol., p. 100-260 fath.
 350, pl. XLIII, fig. 3.
- OPHIOPLINTHACA** Ver. This Vol., p. 351.
dipsacos (Lym., '78) Ver. This Vol., p. 351. 390 fath.
incisa (Lym., '83) Ver. This Vol., p. 351. 334-508 fath.
chelys (Lym., '78) Ver., This Vol., p. 352. 1124-1530 fath.
- OPHIOCAMAX** Lym., Ver. This Vol., p. 354.
hystrix Lym., '78; Nar. Blake Exped., p. 110, fig. 392. 114-300 fath.
 Ver., This Vol., p. 395.
austera Verrill, 1899*a*, p. 60, pl. VI, figs. 1, 1*a*; pl. VII, fig. 2. 110-200 fath.
 This Vol., p. 355, pl. XLII, fig. 2.
fasciculata Lym., '83. Ver. This Vol., p. 355. 180-250 fath.
 Off Andaman Islands, 130-250 fath. (Kœhler).
- OPHIOTHAMNUS** Lym., '69.
vicarius Lym., '69. 15-611 fath.
exiguus (Lym., '78) Ver. This Vol., p. 353. 84-400 fath.
- OPHIOLEBES** Lym., '78.
humilis Lym., '69. 125-324 fath.
claviger (Ljng.) Lym. (Var. ?), '83. 524 fath.
- OPHIOBLENNA** Lutk.
Antillensis Ltk., '59. W. Indies. Shallow water.
- OPHIOTOMA** Lym.
coriacea Lym., '83. 1242 fath.
- Subfamily, **OPHIOCHONDRINÆ** Ver., This Vol., p. 355.
- OPHIOCHONDRUS** Lym., '69. Ver., This Vol., p. 356 (restr.).
convolutus Lym., '69. 80-400 fath.
crassispinus Lym., '83. This Vol., p. 356. 229 fath.
gracilis Ver., 1899*a*, p. 64. 100-260 fath.
- OPHIOCHONDRELLA** Ver., This Vol., p. 355.
squamosus (Lym) Ver. This Vol., p. 355. 88-250 fath.
- Family, **OPHIOSCOLICIDÆ** Ver.
- (See This Vol., p. 357.)
- OPHIOSCOLEX** Müll. and Trosch., 1842.
 **purpureus* Dub. and Koren., '44 (var. ?) West Indies, 110 fath.
 Northern Europe to Norway, 64-767 fath.
fragilis Ver., '99. This Vol., p. 358. 82 fath.
tropicus Lym., '78. 390 fath.

- OPHIOSCIASMA Lym., '78.
granulata Lym., '83. 96-100 fath.
- ASTROGERON Ver., This Vol., p. 359.
supinus (Lym.) Ver. 200-464 fath.
- OPHIOBYRSELLA Ver., This Vol., p. 358.
serpens (Lym.) Ver. This Vol., p. 358. 69 fath.
- OPHIOBYRSA Lym.
Perrieri Lym., '83. 288 fath.

Family, **OPHIOMYCETIDÆ** Verrill, This Vol., p. 359.

Subfamily, **OPHIOMYCETINÆ** Ver., This Vol., p. 360 (descr.).

- OPHIOMYCES Lym., '80.
mirabilis Lym., '88. 237-422 fath.
frutectosus Lym., '69; Nar. Blake Exped., p. 111, fig. 397.
 77-288 fath.

Family, **OPHIOHELIDÆ** Ver., This Vol., p. 361.

- OPHIOHELUS Lym., '80.
umbella Lym., '80; Nar. Blake Exped., p. 116, figs. 202, 203.
 Barbadoes, 82 fath.

Family, **OPHIOMYXIDÆ** Ljng.; Ver., 1899*a*, p. 65; This Vol., p. 361.

- OPHIOMYXA Müll. and Trosch., '42.
flaccida Ltk., '59. Ver., 1899*a*, p. 65, colors. 0-175 fath.
 Bermudas and Florida to Bahia and the Arolhos
 Reefs, Brazil.
- tumida* Lym., '83, Ver., 1899*a*, p. 67, pl. III, fig. 5; This
 Vol., pl. XLII, figs. 3, 3*a*, 3*b*. 13-300 fath.
- brevicauda* Ver., 1899*a*, p. 66, pl. III, fig. 3; This Vol.,
 pl. XLII, figs. 4-4*d*. 110-200 fath.
- OPHIODERA Ver., 1899*a*, pp. 65, 67. This Vol., p. 362.
Simpsoni (Lym., '75) Ver., 1899*a*, p. 67, pl. II, figs. 4, 4*a*;
 This Vol., p. 362, pl. XLII, figs. 2-2*c*. 60-240 fath.

Family, **HEMIEURYALIDÆ** Ver., 1899*a*, p. 70; This Vol., p. 363.

- HEMIEURYALE Von Mart., '67.
pustulata Von Mart., '67. Ver., This Vol., p. 363.
 74-180 fath.

- OPHIOPUS Ver., 1899*a*, p. 70; This Vol., p. 365.
tuberculosis (Lym.) Ver., 1899*a*, p. 71, pl. I, figs. 1-1*b*;
 This Vol., p. 365, pl. XLIII, figs. 6-6*d*. 96-200 fath.
- SIGSBEIA Lym., '78.
murrhina Lym., '78; Nar. Blake Exped., p. 114, fig. 399.
 Ver., 1899*a*, p. 72, pl. II, figs. 1, 1*a*, (young, descr.);
 This Vol., p. 365, pl. XLII, fig. 7. 88-422 fath.
 Young, 3-200 fath.

Family, **OPHIOBRACIONTIDÆ** Ver., This Vol., p. 366.

- OPHIOBRACHION Lym., '83.
uncinatus Lym., '83. Off Cuba, 250 fath.

Order II.—**EURYALÆ** Müll. and Trosch., 1842.

(See This Vol., p. 366.)

Family, **GORGONOCEPHALIDÆ** Ver., 1899*a*, p. 83 (restr.); This Vol.,
 p. 367.

- ASTROPHYTON L. Agassiz, '35.
**muricatum* Ag. (*costosum* Lym.) Ver., 1899*a*, p. 84 (descr.)
 Charleston, S. C., Ives, 1889, p. 178. 1-13 fath.
Krebsii (Erst. and Ltk.), '56. 50-125 fath.
Cecilia Ltk., '56; Blake Exped. Narrative, i, p. 310, fig. 388.
 3-124 fath.

- GORGONOCEPHALUS Leach, 1815.
**aborescens* Agassiz, '39. W. Indies? Mediterranean.
cacaoticus Lym., '74. 20 fath.
mucronatus Lym., '69. Ver., 1899*a*, p. 85 (descr.)
 80-288 fath.

Family, **ASTROCHELIDÆ** Ver., 1899*a*, p. 79; This Vol., p. 369.

- ASTROCNIDA Lym., '72.
isidis Lym., '72; Nar. Blake Exped., p. 115, fig. 400.
 Ver., 1899*a*, p. 83. 56-120 fath.
- ASTROGOMPHUS Lym., '69.
vallatus Lym., '69. Ver., 1899*a*, p. 80 (descr.)
 80-337 fath.
rudis Ver., 1899*a*, p. 82, pl. VII, figs. 1, 1*a* (descr.)
 116-200 fath.

ASTROPORPA Ersted and Ltk., '56.

**annulata* Erst. and Ltk., '56. 20-163 fath.

Off Cape Hatteras and Chesapeake Bay, 48-167 fath.

affinis Ltk., '59. 50 fath.

Family, **ASTROSCHEMIDÆ** Ver., 1899a, p. 76; This Vol., p. 370.

ASTROSCHEMA Ersted and Ltk., '56.

oligactes Ltk., '56. 69-288 fath.

arenosum Lym., '78. 124-805 fath.

tenuis Lym., '75. 88-124 fath.

brachiatum Lym., '79. 270-435 fath.

laeve Lym., '75. 56-262 fath.

sulcatum Ljn., '71. 200-320 fath.

intectum Lym., '78. 175-200 fath.

Nuttingii Ver., 1899a, p. 77, pl. VII, figs. 3, 3a.

105-125 fath.

OPHIOCREAS Lym., '69.

lumbricus Lym., '69. 60-580 fath.

spinulosus Lym., '83; Nar. Blake Exped., p. 110, fig. 389.

116-288 fath.

cedipus Lym., '79 (Var.?). 580 fath.

Family, **ASTRONYCIDÆ** Ver., 1899a, p. 74; This Vol., p. 370.

ASTRONYX Müll. and Trosch., '42.

Lymani Verrill, 1899a, p. 74 (descr.), pl. VIII, figs. 4-4e;

This Vol., p. 371 (descr.), pl. XLII, figs. 6-6c.

200-980 fath.

BIBLIOGRAPHY.

Principal Works relating to the West Indian Ophiuroidea.

Many general works, which contain West Indian species, have been omitted from this list, as well as several minor articles, not of special importance here, or else not quoted in the preceding articles. Additional Bibliography will be given with Part III.

- 1725.—Sloane, Hans. Voyage to Jamaica, ii, 272.
 1801.—Lamarck, J. B. Système des Anim. sans vertèbres.
 1815.—Leach, W. E. Zoological Miscellany, II.
 1816.—Lamarck, J. B. Histoire des Anim. sans vertèbres, 1st ed.
 1825.—Say, Thomas. Journal of the Academy of Natural Science at Philadelphia, v, p. 145.
 1830.—Bosc, S. A. G. Histoire Nat. des Vers, ii, Suites a Buffon.
 1840.—Müller, J., & Troschel, F. H. Gattungen der Ophiuren. Wiegmann's Archiv., vi, p. 326.
 1842.—Müller, J., & Troschel, F. H. System der Asteriden.
 1850.—Duchassaing, P. Animaux Radiaires des Antilles, p. 4. (For a review of this paper, see Lyman, 1872.)
 { 1851.—Ayres, W. O. Proceedings Boston Soc. Nat. Hist., iv, p. 133; iv,
 { 1852. p. 249.
 1852.—Stimpson, Wm. Two new species of *Ophiolepis* [*Amphiura*] from the southern coasts of the United States. Proc. Boston Soc. Nat. Hist., iv, p. 224.
 1856.—Lütken, Chr. Fr. Oversigt over de Vestindiske Ophiurer. Naturhist. Foren. Vidensk. Meddelelser.
 1859.—Lütken, Chr. Fr. Additamenta ad Historiam Ophiuridarum. Pt. II. 92 pp., 5 plates. Kgl. Danske Videnskab. Selskabs Skifter, 5^{te} Række, Naturvidensk. og mathem. Afdeling, V.
 1860.—Lyman, T. Descriptions of New Ophiurans. Proceed. Boston Soc. Nat. Hist., vii, Feb. and June, pp. 193, 252.
 1862.—Dujardin et Hupé. Histoire Naturelle des Zoöphytes. Echinoderms, Suites a Buffon.
 1864.—Ljungman, Axel V. Tillägg till kannedomen af Skandinavians Ophiurider. Öfvers. af K. Vet.-Akad. Förh. for 1863, No. 7, with one plate.
 1865.—Lyman, Theod. Ophiuridæ and Astrophytidæ. Illustrated Catalogue Museum Comparative Zoölogy, I, 200 pages, 2 colored plates.
 1866.—Ljungman, Axel V. Om några nya arter af Ophiurider. Öfversigt af Kongl. Vetenskaps-Akademiens Förhandlingar. No. 6, pp. 163-166.
 1867.—Verrill, A. E. On the Geographical Distribution of the Echinoderms of the West Coast of America, and Comparison of the tropical Echinoderm Faunæ of the East and West Coasts of America. Trans. Conn. Acad. Sciences, i, pp. 323-339.
 1867.—Ljungman, Axel V. Ophiuroidea Viventia huc usque cognita ennumerat. Öfversigt af Kongl. Vetenskaps-Akademiens Förhandlingar for 1866, No. 9.

- 1867.—Martens, E. Von. Monatsbericht der Königl. Akad., Berlin, p. 345 and 481.
- 1868.—Verrill, A. E. Notice of the Corals and Echinoderms collected by Prof. C. F. Hartt at the Abrolhos Reefs, Province of Bahia, Brazil, 1867. Trans. Conn. Acad. Sciences, i, pp. 351-371, 1 pl.
- 1869a.—Lütken, Chr. Fr. Additamenta ad Historiam Ophiuridarum. Part III. Kgl. Danske Videnskab. Selskabs Skrifter, 8, Bd. ii, pp. 24-101.
- 1869b.—Lütken, Chr. Fr. Synopsis generum Ophiuridarum verarum. (Forms part of the preceding work, pp. 87-100.)
- 1869.—Lyman, Theodore. Preliminary Report on Ophiuridæ and Astrophytidæ dredged in deep water between Cuba and the Florida Reefs, by L. F. de Pourtales. Bulletin Mus. Comp. Zoöl., Vol. i., No. 13.
- 1871.—Ljungman, Axel V. Förteck. öfver uti Vestindien af Dr. A. Goës samt under korvetten Josefinas Exped. i Atlantiska Oceanen samlade Ophiurider. Ofvers. Kong. Vetenskaps-Akad. Förhandlingar. No. 6, pp. 615-658.
- 1871.—Lyman, Theodore. Illustrated Catalogue of the Museum of Comparative Zoölogy. No. VI. Supplement to the Ophiuridæ and Astrophytidæ. 17 pp., two plates. Memoirs Mus. Comp. Zoölogy, II.
- 1872.—Lyman, Theod. Note sur les Ophiurides et Euryales qui se trouvent dans les collections du Mus. d'Hist. Naturelle de Paris. Ann. Sci. Nat., xvi, 8 pp. (Contains a synonymical list of the species described by Duchassaing, 1850.)
- 1872.—Verrill, A. E. Radiata from the Coast of North Carolina. Brief. Cont. to Zoöl., No. 22. Amer. Journ. Sci., vol. iii, p. 435.
- 1872.—Lütken, Chr. Fr. Ophiuridarum novarum vel minus cognitarum descriptiones nonnullæ. Oversigt Kongl. Danske Vid. Selskabs Forhand., 84 pp., 2 pl., with Résumé in French.
- 1875.—Thomson, C. Wyville. The Depths of the Sea.
- 1874.—Lyman, Theod. Ophiuridæ and Astrophytidæ, Old and New, Bull. Mus. Comp. Zoöl., iii, p. 221, 51 pp., 7 pl., part anatomical.
- 1875.—Lyman, Theod. Zoölogical Results of the Hassler Expedition, II. Ophiuridæ and Astrophytidæ, Illustrated Catalogue Museum Comparative Zoölogy, viii, 34 pp., 5 plates. Mem. Mus. Comp. Zoöl., iv.
- 1877.—Lyman, Theod. Mode of Forking among Astrophytons, Proc. Boston Soc. Nat. Hist., xix.
- 1877.—Thomson, C. Wyville. Voyage of the Challenger. The Atlantic.
- 1878a.—Lyman, Theod. Reports on the Operations of the U. S. Coast Survey Steamer "Blake," Ophiurans and Astrophytons. Bull. Mus. Comp. Zoöl., v, p. 217, 21 pp., 3 pl.
- 1878b.—Lyman, Theod. Ophiuridæ and Astrophytidæ of the Exploring Voyage of H. M. S. Challenger, under Prof. Sir Wyville Thomson. Part I. Bull. Mus. Comp. Zoöl., v, pp. 65-168, x plates.
- 1879.—The same. Part II. Bull. Mus. Comp. Zoöl., vi, pp. 17-83, pl. x-xix.
- 1879.—Rathbun, Richard. A List of the Brazilian Echinoderms, with Notes on their Distribution, etc. Trans. Conn. Acad. Sci., v, p. 139.

- 1880*a*.—Lyman, Theod. Anniversary Memoirs of the Boston Soc. of Natural History.
- 1880*b*.—Lyman, Theod. Preliminary List of the known genera and species of living Ophiuridæ and Astrophytidæ. Cambridge, Mass., 45 pp., 4to.
- 1882.—Lyman, Theod. The Voyage of H. M. S. Challenger. Zoölogy, v, Report on the Ophiuridæ dredged during the years 1873-6. pp. 368, 48 plates, 4to.
- 1883.—Lyman, Theod. Reports on the Results of Dredging, under the supervision of Alexander Agassiz, in the Caribbean Sea in 1878-79, and along the Atlantic Coast of the United States during the Summer of 1880, by the U. S. Coast Survey Steamer "Blake." Report on the Ophiuridæ. Bull. Mus. Comp. Zoöl., x, p. 227, pp. 60, 8 pl.
- 1888.—Lyman, Theod., in Agassiz, Alexander. Three Cruises of the Blake, vol. ii, pp. 109-116, with cuts. Bull. Mus. Comp. Zoöl., vol. xv.
- 1889.—Ives, J. E. Catalogue of the Asteroidea and Ophiuroidea in the Collection of the Acad. Nat. Sciences of Philadelphia. Proc. Acad. Nat. Sci., Philad., p. 169.
- 1890.—Ives, J. E. Echinoderms from the Northern Coast of Yucatan, and the Harbor of Vera Cruz. Proc. Acad. Nat. Sci. Philad., pp. 317-340, 1 plate.
- 1891.—Ives, J. E. Echinoderms from the Bahama Islands. Proc. Acad. Nat. Sci. Philadelphia, p. 337.
- 1895.—Nutting, C. C. Narrative and Preliminary Report of Bahama Expedition. Bulletin from the Laboratories of Nat. Hist. of the State Univ. of Iowa, vol. iii.
- 1896.—Kœhler, René. Note Prélim. sur les Ophiures rec. pend. les Camp. de l'Hirondelle. Mem. Soc. Zool. de France, ix, pp. 203-213.
- 1897.—Kœhler, René. Echinodermes recueillis par "l'Investigator" dans l'Océan Indien. Ann. Sci. Nat., Zool. et Paléont., pp. 277-370, pl. v-ix.
- 1898.—Clark, H. L. Notes on the Echinoderms of Bermuda. Annals New York Acad. of Science, xi, pp. 407-413.
- 1899*a*.—Verrill, A. E. Report on the Ophiuroidea collected by the Bahama Expedition in 1893. Bull. Labor. Nat. Hist. of the State Univ. of Iowa, v, No. 7, pp. 1-86, 8 plates.
- 1899*b*.—Verrill, A. E. North American Ophiuroidea. Part I. Revision of certain Families and Genera of West Indian Ophiurans. Trans. Conn. Acad. Sciences, x, part 2, pp. 301-371.
- 1899*c*.—Verrill, A. E. The same. Part II. A Faunal Catalogue of the known Species of West Indian Ophiurans. Trans. Conn. Acad. Sciences, x, part 2, pp. 372-386, pl. xlii, xliii.

EXPLANATION OF THE PLATES.

PLATE XLII.

- Figure 1—*Amphilimna olivacea* (Lym.) Ver., p. 318. Under side of a part of the disk and the proximal part of an arm. $\times 7$.
- Figure 1a—The same. A row of spines from the middle of an arm. $\times 18$.
- Figure 2—*Ophiodera Stimpsoni* (Lym.) Ver., p. 362. Under side of a part of the disk and of a ray. $\times 7$.
- Figure 2a—The same. A row of spines. $\times 28$.
- Figure 2b—The same. Under side of the distal part of an arm. $\times 7$.
- Figure 2c—The same. One of the teeth. $\times 18$.
- Figure 3—*Ophiomyxa tumida* Lym., p. 380. Under side of a part of the disk and of an arm. $\times 7$.
- Figure 3a—The same. A row of spines from the middle of an arm. $\times 12$.
- Figure 4—*Ophiomyxa brevicauda* Ver., p. 380. Under side of a part of the disk and of an arm. $\times 5$.
- Figure 4a—The same. One of the teeth. $\times 28$.
- Figure 5—Undetermined Ophiuran (Young?). Nearly vertical view of two joints from the middle of an arm. $\times 28$.
- Figure 5a—The same specimen. Side view of two joints from the distal parts of an arm. $\times 28$.
- Figure 6—*Astronyx Lymani* Ver., p. 377. Type. Under side of a part of the disk and of an arm. $\times 7$.
- Figure 6a—The same specimen. Side view of three joints from the middle part of an arm. $\times 9$.
- Figure 6b—The same. Hook-shaped spines, more enlarged.
- Figure 6c—The same. Hooks from the distal part of an arm.
- Figure 7—*Sigsbeia murrhina* Lym. Young, p. 365. Under side of a part of the disk and of two arms. $\times 6$.

PLATE XLIII.

- Figure 1—*Ophiozona nivea* Lym., var. *compta* Ver., p. 303. Type. Upper side of the disk and bases of the arms. $\times 4$.
- Figure 1a—The same specimen (297, Blake Exped.). Under side of the disk. $\times 3\frac{1}{2}$.
- Figure 2—*Ophiocamax austera* Ver., p. 355. Type. Under side of a part of the disk and of an arm; *m*, madreporic plate. $\times 5$.
- Figure 3—*Ophiomitra ornata* Ver., p. 350. Type. Under side of a part of the disk and of an arm; *m*, madreporic plate. $\times 5$.
- Figure 4—*Ophiopristis ensifera* Ver., p. 347. Type. Under side of a part of the disk and of an arm. $\times 6$.
- Figure 5—*Amphipsila maculata* Ver., p. 348. Under side of a part of the disk and base of an arm. $\times 7$.
- Figure 5a—The same. A row of spines from the middle of an arm. $\times 14$.
- Figure 6—*Ophioptus tuberculatus* Ver., p. 365. Dorsal side. $\times 5$.
- Figure 6a—The same. Under side. $\times 7$.
- Figure 6b—The same. Profile view of a part of the disk and coiled arms. $\times 7$.
- Figure 6c—The same. Side view of a part of the middle of an arm. $\times 5$.
- Figure 6d—The same. Dorsal view of a more distal part of an arm. $\times 5$.

VIII.—THE HAWAIIAN HEPATICÆ OF THE TRIBE JUBULOIDEÆ.—
BY ALEXANDER W. EVANS.

A FEW Hepaticæ from the Hawaiian Islands were collected by Menzies in 1793. They consist of small specimens and of fragments picked from other plants and are for the most part in the herbarium of Sir William J. Hooker, now preserved in the collections of the Royal Gardens at Kew. In the early decades of the present century additional small collections were made by Beechey, by Gaudichaud, and by Meyen, during their voyages of exploration, and these, together with the Menzies plants, are the Hawaiian Hepaticæ referred to in the Synopsis Hepaticarum of 1844-47. Scarcely thirty species, most of them from the island of Hawaii, are mentioned in this volume, which gives us, therefore, little idea of the richness of the hepatic flora of the Islands.

About thirty years ago another small collection was made by the late Dr. William Hillebrand. His attention, of course, being chiefly devoted to the phanerogams and pteridophytes, to the knowledge of which he made important and well known contributions, the Hepaticæ which he gathered were somewhat fragmentary in character and consisted mainly of large and conspicuous species, to which occasionally smaller forms remained attached. The collection, nevertheless, included a number of undescribed plants. Some of the specimens were sent for determination to Mr. C. F. Austin and others to Mr. William Mitten, and, as these two writers worked independently of each other, certain of the new species received two names apiece. The published accounts of Hillebrand's plants appeared between 1869 and 1876. In 1872, the Swedish botanist, Dr. Johan Ångström, published a list of the Hawaiian Hepaticæ collected twenty years previously by Professor N. J. Andersson, during the voyage around the world of the frigate *Eugenie*; and, in 1874, Austin published a list of the species collected by Messrs. Mann and Brigham in 1872. In both of these lists new species are described and the synonymy is complicated by giving new names to certain previously described species. Most of the plants in these three collections came from the island of Oahu.

The first thorough and systematic collection, however, was the one made in 1875 and 1876 by Mr. D. D. Baldwin, nearly all of whose specimens came from the island of Maui. Mr. Baldwin sent

his plants to Professor D. C. Eaton, who forwarded sample-specimens of them to Mr. Austin for determination. Austin described several of the new species from this collection in 1879 and left several others in manuscript. In 1892, the present writer compiled a provisional list of the species from the Islands, based upon Baldwin's collection and depending largely on the determinations made by Austin.

In 1896 Herr Stephani described two of Gottsche's manuscript species from specimens collected by Didrichsen, and in the following year, published a revised list of the Hawaiian Hepaticæ, adding several new species from the collections made by Mr. A. A. Heller in 1895, and several others from specimens in the herbaria of Drs. Askenasy and Spruce. He also ascribed the various Lejeuneæ to their respective genera, as these are at present understood.

During the summers of 1897, '98 and '99, large and important collections were made by Mr. C. M. Cooke, Jr., mainly on the islands of Oahu and Kauai. These collections have brought to light several new and interesting species and have added much to our knowledge regarding the distribution of forms previously known. Mr. Cooke's specimens have furnished the material for most of the descriptions and illustrations in the present paper.

Even now, however, our knowledge of the Hawaiian hepatics is doubtless far from complete: the collections of recent years have been made almost entirely on the islands of Oahu, Maui and Kauai, and we know little more about the species growing on the large island of Hawaii than was known fifty years ago. From the island of Molokai also, which seems favorable for these plants, only three species have been reported. It is quite possible that a systematic collection on Hawaii and a careful search on the other islands, particularly for the minuter forms, would more than double the number of species which we now know.

The present paper includes a part only of the leafy Hepaticæ, the Jubuloideæ of Schiffner. In its preparation, I have been able, through the kindness of correspondents and the curators of herbaria, to examine the original specimens of nearly all of the Hawaiian species. Those who have given me the most assistance and to whom I would express my grateful acknowledgments, are the following: Mr. W. H. Pearson, Professor A. G. Nathorst, Mr. William Mitten, Herr F. Stephani, Professor Victor Schiffner, Mr. W. B. Hemsley, Dr. P. Hennings, Professor L. M. Underwood and Mr. A. Gepp.

The tribe Jubuloideæ, as defined by Schiffner,* is the equivalent of the subtribe Jubuleæ of the Synopsis Hepaticarum† and of the tribe Jubuleæ of Spruce.‡ It is without doubt the most natural assemblage of forms among the leafy Hepaticæ; it is in fact so natural that Spruce did not hesitate to place it in contrast to his tribe Jungermannieæ, which included all the remaining acrogynous Jungermanniaceæ and the anacrogynous Jungermanniaceæ or Metzgeriaceæ§ as well. Schiffner, on the other hand, looks upon the group as one of the minor divisions under the acrogynous Jungermanniaceæ, equal in systematic value to the Ptilidioideæ, the Scapanioideæ, or any of the other five tribes which he recognizes. The morphological papers of Leitgeb|| would, of course, prevent a wide acceptance of Spruce's view, and the disposition made by Schiffner is more in accordance with the views of most recent hepaticologists and apparently with the facts. A reason for the unusual division advocated by Spruce is perhaps to be found in the extraordinary development of the Jubuloideæ in the tropics. Among the Hepaticæ of equatorial South America, to whose collection and study Spruce devoted many years of his life, more than half of the species which he found belonged to this group; in the Hawaiian Islands, only about a quarter of the known species are Jubuloideæ, but it is probable that the higher proportion will be reached both here and in other tropical countries, when their hepatic floras shall have been more thoroughly investigated.

Although so natural for a hepatic group, the characters of the Jubuloideæ, particularly those drawn from the gametophyte, are somewhat difficult to define. This is partly because the sexual plant exhibits considerable variation within the group, and partly because several of its most striking and constant peculiarities recur in other genera, sometimes widely removed from the Jubuloideæ. In the first place the gametophyte is very variable in size; from the smaller species of *Cololejeunea*, which are often only a few millimeters long, we may pass by all gradations to the larger *Frullaniæ*, some of which form drooping tufts a half meter in length. The more essential characters drawn from the vegetative organs are likewise just as variable, although they show certain peculiarities which are fairly

* Engler & Prantl, *Natürl. Pflanzenfam.* i², 116. 1893.

† L. c. 283. 1845.

‡ Hep. Amaz. et And. in *Trans. & Proc. Bot. Soc. Edin.* xv. 1. 1885.

§ Underwood, *Bot. Gazette*, xix, 356. 1894.

|| *Untersuch. über die Lebermoose*, 1874-1881.

constant throughout the group. The leaves are complicate-bilobed,* the antical lobes being the larger and incubous in their arrangement, while the smaller postical lobes or "lobules" are usually wholly or partially inflated and serve as water-sacs. Except in the two genera *Cololejeunea* and *Metzgeriopsis*, underleaves are always present; usually there is only one underleaf developed for each pair of side-leaves, but in the genera *Diplasiolejeunea* and *Colurolejeunea* there is an underleaf for every side-leaf, a peculiarity found nowhere else among the Hepaticæ. The branches, sexual as well as vegetative, are invariably lateral. The female inflorescence, which is of course always terminal, is sometimes borne on the main stem or on a principal branch, sometimes on a short, special branch. The number of archegonia is always small, almost never exceeding four. The perichæatial bracts, like the leaves, are complicate-bilobed, but they are usually larger and their lobules† are never inflated; the bracteoles‡ likewise are larger than ordinary underleaves. A perianth is always present and is entirely free from the bracts; it is of the hypogonanthous type, but its keels are not always distinct; in the upper part, it is abruptly contracted into a more or less distinct beak with a small opening, and it becomes lacerated when the capsule is extruded. The calyptra is free. The antheridia are borne, usually in pairs, in the axils of inflated, complicate-bilobed, perigonial bracts, whose lobes are subequal in size; these bracts are imbricated, often very densely so, and occur in clusters of from two to many pairs, sometimes in the course of an ordinary branch, sometimes on a short specialized branch. The corresponding bracteoles are usually smaller than ordinary underleaves and are often absent from the upper part or even from the whole extent of the antheridial spike. The rhizoids of the Jubuloideæ are sometimes abundant and sometimes very scanty. They are borne in clusters, each cluster arising from the lower surface of an underleaf, close to the base. In the genus *Cololejeunea*, the clusters of rhizoids are found on the postical surface of the axis, in the position where underleaves would naturally be expected.

The sporophyte, although so much simpler than the gametophyte, affords important and constant characters. The stalk, instead of

* A single exception is found in the monotypic genus *Myriocolea* Spruce, of South America, in which no lobule is developed.

† In certain genera the lobules are small and indistinct and are sometimes entirely obsolete.

‡ The bracteoles are absent in the genera without underleaves; they seem to be absent also in most species of *Colurolejeunea*.

being of the same diameter throughout, as in most hepatics, broadens out above into a disc of the same color as the capsule-wall and several cells thick in the middle part.* On the circumference of this disc the four valves of the capsule are inserted, and it appears, therefore, as if the capsule were not split to the base. The valves themselves are usually two cells thick and each bears on its inner surface close to the apex a cluster of truncate unispiral elaters. The cells of the valves do not show the peculiar band-like thickenings usually found in the cells of the inner layer of the capsule-wall, but are merely irregularly thickened.

The Jubuloideæ fall naturally into two well-marked subtribes: the Frullaniæ and the Lejeuneæ.

The Frullaniæ are almost never of a bright green color but are tinged with brown or red, sometimes so deeply so as to be nearly black. The leaf-lobes are ovate to orbicular in shape, more or less convex, and usually with entire margins. The lobules are in the form of inflated hood-shaped or club-shaped sacs, attached to the postical margin of the lobe close to the base. The opening of the sac is usually near the point of attachment and is directed backwards; in a few species, however, the lobule is reflexed and the opening is consequently directed forwards. Sometimes only a part of the lobule is inflated, and sometimes, particularly in moist localities, the lobule appears as a narrow lanceolate lamina and is not inflated at all. A third part of the leaf, the stylus, is usually distinct in this subtribe; it is situated on the inner side of the lobule and is inserted, partly at least, on the stem. The stylus is usually in the form of a minute, subulate process, and may be looked upon as a part of the postical lobe, or as an appendage to it. Underleaves are always present and are almost invariably bifid.

A branch in the Frullaniæ develops from the whole of the postical half of a segment† and replaces the lobule of the leaf beneath whose lobe it is situated.‡ Corresponding with this method of branching, the first leaf of a branch is an underleaf; the second, a side-leaf turned toward the apex of the main axis; the third, a side-

* Cf. Spruce, Hep. Amaz. et And. 5. 1885.

† This type of branching is found in many genera of Hepaticæ; it is particularly clear in *Porella*, *Lepidozia*, and others with incubous leaves, but is to be made out also in various genera with succubous leaves.

‡ An exception to this rule is found in the innovations and sometimes in the antheridial branches of *Jubula*, which conform to the type of branching described for the next subtribe.

leaf turned away from the apex; the fourth, a second underleaf, and so on.

The *Lejeuneæ* are pale or bright green in color and are sometimes tinged with brown or black, but never with red. The leaflobes vary from orbicular to lanceolate in shape, and their margins show all gradations from entire to lacinate-dentate. With rare exceptions, the lobule is attached to the lobe by a broad fold and to the axis by a long, almost longitudinal line of insertion. The lobule is strongly convex when seen from the postical surface, and its free margin is either involute or appressed to the stem, so as to form with the lobe a fairly tight water-sac. In moist situations this becomes unnecessary, and the lobule is usually more or less reduced, sometimes so much so as to be hardly distinguishable. Underleaves, when present, are sometimes undivided and sometimes bifid.

A branch in the *Lejeuneæ* springs from the basiscopic part of the postical half of a segment,* and the lobule of the corresponding leaf is normally developed. The branch remains close to this leaf and is apparently borne just behind it.† Corresponding with this method of branching, the first leaf of a branch is an underleaf; the second, a side-leaf turned away from the apex of the main axis; the third, a side-leaf turned toward the apex, and so on. According to Leitgeb, the first three leaves of a branch do not appear as such, but remain united as a sheath, enclosing the apical region of the branch, which may or may not develop farther.

A peculiar type of branch is the "innovation," which is found in nearly every genus of the *Lejeuneæ*. These innovations are borne just behind one or both of the perichætal bracts, which are here reduced to a single pair. Sometimes an innovation is small and simple, but it is more frequently as large as the axis bearing it, whose own growth has been stopped by the formation of the arche-gonium. In such a case, the innovation itself, while still short, often gives rise to a second flower and a new innovation. This mode of growth is sometimes repeated several times, the result being a complicated and characteristic flower-cluster. In case an innovation is developed behind only one of the bracts, it is not unusual to have the bracts and perianth pushed to one side, where they seem to assume a lateral position, the innovation apparently

* An exception is found in the genus *Stictolejeunea*, where the branches are borne as in the *Frullaniæ*. Cf. Spruce, *Hep. Amaz. et And.* 307.

† This type of branching is found also in the genera *Radula* and *Scapania*. Cf. Leitgeb, *Unters. über die Leberm.* ii, 29.

being a continuation of the main axis. This condition may be readily distinguished from that in which a flower is really borne on a short lateral branch by the order of the leaves on the apparent axis beyond the flower: in case this is the true axis, the first leaf will be on the side next the flower; in case it is an innovation, the first leaf will be on the side away from the flower. Very striking examples of each condition may be found in the genus *Cololejeunea*.

Subtribe I. FRULLANIEÆ.

The Frullaniæ include only two genera, *Frullania* and *Jubula*, of which only the most important characters will be enumerated here.

In *Frullania*, both antical and postical lobes are attached to the axis by very short, almost transverse lines of insertion, the attachment in the case of the postical lobe being limited to the base of the stylus. The leaf-lobe, beneath which a branch is situated, is similar to the others in position and is attached to the main axis rather than to the branch. The first underleaf of the branch seems to function as the lobule of this lobe, and their lines of insertion come very close together. This underleaf is similar to other underleaves,* but is often distorted in position; and sometimes one of its divisions, the one next the lobe, is inflated like an ordinary lobule. Between this underleaf and the lobe, we occasionally find a small leafy structure, now appearing as a minute, subulate process, now as a small, more or less rudimentary sac. According to Leitgeb† this interposed body is derived from the first postical segment of the branch, which normally gives rise to the underleaf alone; it may be looked upon, therefore, as a supplementary part of this underleaf. Properly speaking, innovations are never present in *Frullania*; that is, no branches are ever developed just behind the perichaetial bracts. It is not unusual, however, to find branching a little farther back from the perianth, and such a branch, which arises in the usual way, may apparently continue the axis, as in the *Lejeuneæ*. The stalk of the capsule is more complicated than in *Jubula* or the following subtribe, and is usually built up of four concentric layers of cells.

* According to Spruce (Hep. Amaz. et And. 5), this underleaf is truly the modified lobule, a view which is also expressed by the writer in his own work on the North American *Frullaniæ* (Trans. Conn. Acad. x, 3). The explanation just given is that of Leitgeb (Untersuch. über die Lebermoose, ii, 22), and, being based on embryological studies, is probably more nearly correct. It must be acknowledged, however, that the interposed body (described in the text) somewhat obscures Leitgeb's explanation.

† Unters. über die Lebermoose, ii, 25. 1875.

In the genus *Jubula*, which is intermediate in some respects between *Frullania* and the Lejeuneæ, the plants are distinctly green and are never tinged with red. The leaf-lobe is attached to the axis by a long oblique line of insertion, the lobule is distant from the axis and is therefore not attached to it at all, and the stylus, which is reduced to a single cell, becomes obsolete very early: it appears, therefore, as if no part of the leaf, except the lobe itself, were attached to the axis. The lobes are often dentate or ciliate. The lobe beneath which a branch is situated is more oblique than the others and is attached partly to the axis and partly to the branch. The first underleaf of a branch is usually a simple lanceolate lamina: it is much pushed out of position, being attached partly to the axis and partly to the branch, and its line of insertion does not meet that of the lobe, which is here obviously without a lobule. Innovations, like those of the Lejeuneæ, are present; in typical cases, there are two innovations for each inflorescence, though it is not unusual to find only one of them developed. In *Jubula Hutchinsia*,* the male branches apparently arise in the same way as those of the following subtribe, being borne behind small but otherwise normal and lobulate leaves: this peculiarity, however, is not constant for the genus and is not found in the Hawaiian species. The stalk of the capsule is formed of only two concentric layers of cells, as in the Lejeuneæ.

1. **FRULLANIA** Raddi.

In the last published list of Hawaiian Hepaticæ,† ten species of *Frullania* are enumerated. An eleventh species, *F. Oahuensis*, first collected by Meyen, is not included here. Although published in 1843, this species was omitted from the Synopsis Hepaticarum, perhaps through an oversight, and has not since appeared in hepaticological literature. Several of these eleven species cannot be maintained. Three of them, *F. arietina*, *F. Kunzei*, and *F. squarrosa*, are listed on incorrect determinations, and three of the others, *F. explicata*, *F. oceanica*, and *F. Helleri*, are synonyms. Ångström's *F. Sandvicensis*, on the other hand, is a mixed species and was based on two perfectly distinct plants. The six species which I have been able to distinguish fall naturally into three of Spruce's subgenera and may be identified as follows:

* Cf. Leitgeb, Unters. über die Leberm. ii, 37. 1875.

† Stephani, Hepaticæ sandvicenses. Bull. de l'Herb. Boissier, v, 842. 1897.

Key to the Species.

Lobule inflated in upper part only, the lower forming a more or less distinct, plane expansion; perianth with two distinct postical keels; inflorescence autoicous.

F. (Chonanthelia) Aongstroemii.

Lobule inflated throughout, attached to the lobe by a very short, almost transverse keel.

Lobule galeate (about as broad as long); perianth with one or two postical keels; inflorescence dioicous.

Perianth slightly roughened on the keels, otherwise smooth; leaves not squarrose. *F. (Trachycolea) Oahuensis.*

Perianth distinctly tuberculate; leaves more or less squarrose. *F. (Trachycolea) Sandvicensis.*

Lobule clavate (longer than broad); perianth with a single postical keel; inflorescence autoicous.

Lobule distant from axis and parallel; lobes sharp-pointed; underleaves contiguous or imbricated; branches not microphyllous. *F. (Diastoloba) apiculata.*

Lobule close to axis and parallel; lobes rounded at apex; underleaves distant or contiguous but not imbricated (except near the end of a stem or branch); branches not microphyllous. *F. (Diastoloba) Meyeniana.*

Lobule distant from axis and widely spreading; lobes blunt or apiculate at apex; underleaves imbricated; some of the branches microphyllous and of short, limited growth. *F. (Diastoloba) hypoleuca.*

I. Subgenus CHONANTHELIA Spruce.

1. *Frullania Aongstroemii* sp. nov.

Frullania Sandvicensis Ångstr. Öfversigt af Kongl. Vetensk. Akad. Förhand. xxix, Häft 4, 28. 1872 (in part).

Plate XLIV., figs. 1-11.

Autoicous: plants growing in wide depressed tufts, greenish, tinged with yellow or brown: stems irregularly pinnately branched: leaves imbricated, not squarrose, the lobe ovate, arching over the stem, but scarcely or not at all cordate at base, decurved at the rounded apex, entire, connected with the lobule by a long fold parallel with the stem; lobule galeate above, and forming a plane triangular expansion below; hood extending to the middle of the

lobule or beyond, compressed at the mouth and inflated in upper and outer parts; stylus minute, subulate: underleaves contiguous or subimbricated, small for the subgenus, orbicular, plane or somewhat revolute on sides, scarcely or not at all auriculate at base, bifid about one third with subacute lobes and sinus, margins entire or sinuate-unidentate on the sides: leaf-cells rather thin-walled, but with conspicuous trigones and occasional intermediate thickenings: ♀ inflorescence borne on a principal branch; bracts in about three pairs, unequally bifid, the lobe ovate (or narrowly ovate on the innermost bracts), obtuse to subacute, entire or sinuate on the margins, lobule ovate or ovate-lanceolate, acute or acuminate, subentire but bearing a distinct lobe-like tooth or stylus on the inner edge near the base; bracteole shortly connate with bracts on one or both sides, ovate, bifid about one third with narrow, acute or acuminate lobes and narrow sinus, subentire or unidentate on sides; perianth about half exerted, obovate, gradually narrowed into a short, broad beak, strongly two-keeled postically and with a broad shallow furrow antically: ♂ bracts in two or three pairs, occupying a short subglobose spike below the perianth.

Stems 0.17^{mm} in diameter, lobes of leaves $1 \times 0.8^{\text{mm}}$, lobules $0.5 \times 0.3^{\text{mm}}$, underleaves $0.4 \times 0.35^{\text{mm}}$, leaf-cells at edge of lobe 14μ , in the middle, 15μ , and at the base, 20μ in diameter, bract I, lobe $1.85 \times 0.85^{\text{mm}}$, lobule $1.85 \times 0.75^{\text{mm}}$, bracteole $1.35 \times 0.7^{\text{mm}}$, bract II, lobe $1.45 \times 0.75^{\text{mm}}$, lobule $1.25 \times 0.6^{\text{mm}}$, bracteole II, $1.35 \times 0.6^{\text{mm}}$, perianth $2.5 \times 1.2^{\text{mm}}$.

On rocks and trees. Oahu: Nuuanu (Heller); Luakaha (Cooke).

Frullania Aongstroemii, in most of the specimens at my disposal, grows in company with what I have called *F. Sandvicensis*; and it is quite evident that Ångström's original *Frullania Sandvicensis*, as described by its author, is a mixture of these two species. His sterile type-material, kindly sent me by Professor Nathorst, agrees closely with his description (so far as leaves and underleaves are concerned), and it agrees also with the numerous specimens of the emended *F. Sandvicensis*, which I have been able to examine. In his description of the perianth, however, he states:—"perianthium obovatum dorso subconcauum canaliculatum sæpe læviter bicarinatum, ventre bicarinatum," showing clearly that he did not have the perianth of a *Trachycolea* before him, but that of a *Chonanthelia*. The lower bracteoles, moreover, are described as bipartite, which certainly does not apply to the bracteoles of *F. Sandvicensis*, although it is not quite accurate for those of *F. Aongstroemii*. The

two species, although belonging to different subgenera, bear a certain superficial resemblance to each other. In certain cases the resemblance is still more marked from the fact that the lobule of *F. Aongstroemii* is sometimes inflated throughout nearly its whole extent, losing thereby its characteristic *Chonanthelia*-form, and closely approaching the lobule of *F. Sandvicensis*. These facts, together with the great rarity of the perianths in *F. Sandvicensis*, might easily account for the two having been confused. Even without their very characteristic perianths, however, there are good points of distinction between the species. The strongly cordate base of the lobe in *F. Sandvicensis*, the broad, emarginate and cordate underleaves, and the very conspicuous thickenings of the leaf-cells are quite unlike what we find in *F. Aongstroemii*.

In *Frullania arietina* Tayl., of tropical and subtropical America, *F. Aongstroemii* finds a close ally. It differs from this species in its autoicous, not paroicous inflorescence, in the entire margins of its bracts, which are less highly connate with the bracteoles, and in the different shape of its lobules. It will be remembered that Austin* has already reported *F. arietina* from the Hawaiian Islands as growing with his *Dendroceros Clintoni*. Mixed with the specimens of this last species from Mr. Pearson's collection, I find a few sterile stems of *F. Sandvicensis* but no other *Frullania*, so that it is probable that Austin's determination was incorrect. Another species of tropical America, *F. gibbosa* Nees, resembles *F. Aongstroemii* in its autoicous inflorescence and entire bracts, but it differs in its squarrose, densely imbricated leaves, with much larger lobule and large disc-like stylus, in its broader underleaves, cordate at the base and less deeply bifid at the apex, and in its more pointed perianths.

II. Subgenus TRACHYCOLEA Spruce.

2. *Frullania Oahuensis* Hampe.

Frullania Oahuensis Hampe; G. L. & N. Nova Acta Acad. Leop.-Car. xix, suppl. 1, 471. 1843.

Plate XLIV., figs. 12-19.

Dioicous: plants closely appressed to substratum, scattered or forming loose thin mats, reddish- or brownish-green, sometimes almost black: stems irregularly pinnately branched: leaves imbricated, the lobe ovate, somewhat convex, arching over the stem and slightly cordate at base, rounded at the apex, entire; lobule galeate,

* Bull. Torr. Bot. Club, v, 15. 1874.

more or less distinctly truncate at base, inflated throughout; stylus minute and slender, three or four cells long: underleaves distant, rhombic-obovate, narrowed and not at all cordate at base, bifid about one half, with acute lobes and sinus, margins angular-unidentate on sides: leaf-cells with somewhat thickened reddish-walls, trigones and intermediate thickenings distinct: ♀ inflorescence borne on a principal branch; bracts in two or three pairs, increasing in size toward the perianth, unequally bifid, the lobe broadly ovate, rounded at the apex, entire or slightly sinuate; lobule lanceolate or ovate-lanceolate, acute, or obtuse and apiculate, bearing a lobe-like tooth or stylus at the middle of the inner edge on the innermost bracts, close to the base on the others, otherwise entire; bracteole slightly connate on one side or free, ovate, bifid about one half with acute lobes and sinus, entire or sparingly lacinate-toothed on the sides; perianth more than half exerted, obovate, truncate above and abruptly narrowed into a short beak, with a broad, usually two-angled keel postically and commonly with one to three low supplementary keels on both surfaces, roughened or very sparingly tuberculate, at least on the keels: ♂ bracts in two to ten pairs, occupying a short branch and forming a globose or oblong spike.

Stems 0.09^{mm} in diameter, lobes of leaves $0.4 \times 0.3^{\text{mm}}$, lobules $0.14 \times 0.12^{\text{mm}}$, underleaves $0.14 \times 0.15^{\text{mm}}$, leaf-cells at edge of lobe 12μ , in the middle 15μ , and at the base 18μ in diameter, bract I, lobe $0.7 \times 0.5^{\text{mm}}$, lobule $0.6 \times 0.17^{\text{mm}}$, bracteole I, $0.5 \times 0.25^{\text{mm}}$, bract II, lobe $0.5 \times 0.4^{\text{mm}}$, lobule $0.4 \times 0.15^{\text{mm}}$, bracteole II, $0.35 \times 0.17^{\text{mm}}$, perianth $1.1 \times 0.75^{\text{mm}}$.

On trees. Oahu: Nuuanu (Cooke); first collected on the island by Meyen. Kauai: Kipu, Lihue, Half Way Bridge (Cooke).

Frullania Oahuensis is the smallest known Hawaiian *Frullania*, being even smaller than *F. Meyeniana*, with which it often grows and which it somewhat resembles. The regularly pinnate habit of this latter species and its clavate instead of galeate lobule will at once serve to distinguish it. The North American *F. Virginica* Gottsche is a much closer ally of *F. Oahuensis*, but is a somewhat larger plant in all its parts, and its leaves are more strongly cordate at the base.

The type-specimens of *F. Oahuensis* are apparently not to be found in the Gottsche Herbarium at Berlin. There is, however, a drawing so labeled among the beautiful "Icones Hepaticarum Ineditæ," and this agrees so closely with the specimens collected by Mr. Cooke that I have no hesitancy in pronouncing them the same.

3. *Frullania Sandvicensis* Ångstr. emend.

Frullania Sandvicensis Ångstr. Öfversigt af Kongl. Vetensk. Akad. Förhand. xxix, Häft 4, 28. 1872 (in part).

Frullania squarrosa Auct. (not *F. squarrosa* (R. Bl. & N.) Dum.).

Frullania arietina Aust. Bull. Torr. Bot. Club, 5:15. 1874 (not Tayl.).

Plate XLV., figs. 1-7.

Dioicous: growing in wide depressed tufts, often mixed with mosses or other hepatics, brownish-green, sometimes tinged with reddish: stems irregularly pinnately branched: leaves densely imbricated, more or less squarrose when moist, the lobe broadly ovate, arching over the stem and cordate, both at the antical base and at the keel, rounded at the apex, entire, slightly revolute on postical margin; lobule galeate throughout the whole or the greater part of its extent, hood inflated in upper and outer parts, compressed below; stylus small, subulate: underleaves imbricated, broadly orbicular or reniform, bifid about one fifth with broad obtuse or apiculate lobes and lunulate sinus, more or less cordate and channeled at base, margins entire or nearly so: leaf-cells rather thick-walled with very conspicuous trigones and intermediate thickenings: ♀ inflorescence borne on a short simple branch; bracts in two or three pairs, unequally bifid, the lobe ovate or obovate, obtuse or rounded at the apex, entire; lobule ovate, acute or acuminate, sparingly and irregularly toothed on the inner edge, one of the teeth (the stylus) being more distinct and larger than the others; bracteole connate on one side, ovate, bifid one fourth to one third with acute or acuminate teeth and narrow sinus, sparingly and coarsely toothed on the margins; perianth oblong-obovate, truncate above and abruptly narrowed into a short beak, strongly one-keeled postically and bearing on the surface numerous papilla-like or lobe-like projections, especially on the two lateral keels: ♂ bracts in about six pairs, occupying a short branch and forming a short, oval spike.

Stems 0.2mm in diameter, lobes of leaves $1 \times 0.9\text{mm}$, lobules $0.32 \times 0.28\text{mm}$, underleaves $0.65 \times 0.85\text{mm}$, leaf-cells at edge of leaf 16μ in diameter, in the middle $28 \times 19\mu$, at the base 30μ in diameter, bract I, lobe $1.5 \times 0.9\text{mm}$, lobule $1.3 \times 0.6\text{mm}$, bracteole I, $0.95 \times 0.7\text{mm}$, bract II, lobe $1.5 \times 1\text{mm}$, lobule $1 \times 0.6\text{mm}$, bracteole II, $0.9 \times 0.75\text{mm}$, perianth $2.3 \times 1.35\text{mm}$.

On rocks and trees. Oahu: Lulihi (Wawra); Nuuanu (Heller, Cooke); foot of Konahuanui (Cooke); Luakaha (Cooke); first collected on the island by Andersson. Kauai: Hanalei, Kilohana,

Lihue, Half Way Bridge (Cooke). Hawaiian Islands (Hillebrand, Mann and Brigham).

The determination of this species is based on the sterile type-material, preserved in the Royal Academy of Science at Stockholm. It is apparently the plant which has been referred by Austin and other authors to the widely distributed and variable *F. squarrosa*, and it is somewhat questionable as to whether the two are really distinct. When well developed, *F. Sandvicensis* is a little more robust than *F. squarrosa*, its leaves are less strongly squarrose, and its leaf-cells have somewhat better developed trigones. The underleaves, however, offer the best point of distinction: these are much broader than in *F. squarrosa*, often completely concealing the lobules, they are less deeply bifid, with broad lobes and sinus, and their margins are usually entire. These differences, although slight, are apparently constant. The distinctive characters between this species and *F. Aongstroemii* have already been pointed out and there is little likelihood of confusing it with any other Hawaiian species.

III. Subgenus DIASOLOBA Spruce.

4. *Frullania apiculata* (R. Bl. & N.) Dum.

Jungermannia apiculata R. Bl. & N. Nova Acta Acad. Caes.-Leop. xii, 222. 1825.

Frullania apiculata Dum. Recueil d'Obs. sur les Jung. 13. 1835.

Frullania explicata Mont. Ann. des Sc. Nat. II. xix, 256. 1843.

Frullania oceanica Mitt.; Seemann, Flora Vitiensis, 417. 1871.

Plate XLVI.

Autoicous: plants growing in wide depressed tufts, dark red varying to blackish or greenish: stems more or less regularly pinnate: leaves imbricated, the lobe ovate, arching over the stem but scarcely if at all cordate at base, decurved and abruptly apiculate at the apex, entire; lobule clavate, sometimes short enough to be called galeate, distant from the axis, truncate at base, inflated throughout; stylus minute, close to the lobule, borne on a broad reflexed base; underleaves subimbricated, broadly orbicular, somewhat cordate at base, bifid about one-third with acute lobes and sinus, margins entire, plane or slightly reflexed, sometimes revolute close to the base: leaf-cells with thick reddish walls, trigones and intermediate thickenings conspicuous, often becoming confluent: ♀ inflorescence borne on the main stem or a principal branch; bracts in three or four pairs, unequally bifid, the lobe ovate-lanceolate, acuminate.

nate, entire; lobule slightly narrower than the lobe, long-acuminate, bearing a small slender tooth or stylus near the middle of the inner edge, otherwise entire or slightly angular-sinuate near the base; bracteole ovate, bifid about two fifths with acuminate lobes and narrow sinus, margins entire or nearly so; perianth about two fifths exerted, oblong, rounded at the apex and abruptly narrowed into a short beak, finely ciliolate at the mouth, sharply and narrowly keeled postically, smooth: ♂ spike terminal on a short, simple branch, bracts in about two pairs: capsule borne on a stalk about as long as the perianth; spores greenish with numerous minute reddish verruculæ arranged in small circular patches.

Stems 0.17^{mm} in diameter, lobes of leaves $0.7 \times 0.5^{\text{mm}}$, lobules $0.17 \times 0.8^{\text{mm}}$ (in other cases, $0.15 \times 0.12^{\text{mm}}$), underleaves $0.35 \times 0.4^{\text{mm}}$, leaf-cells at edge of leaf 10μ in diameter, in the middle 14μ and at the base $30 \times 20\mu$, bract I, lobe $2 \times 0.75^{\text{mm}}$, lobule $1.8 \times 0.6^{\text{mm}}$, bracteole I $1.8 \times 1^{\text{mm}}$, bract II, lobe $1.5 \times 0.7^{\text{mm}}$, lobule $1.3 \times 0.4^{\text{mm}}$, bracteole II $1.3 \times 0.85^{\text{mm}}$, perianth $2.5 \times 1^{\text{mm}}$, capsule 0.75^{mm} in diameter, spores $45\text{--}55\mu$ in diameter, patches of verruculæ about 4μ wide.

On rocks and trees. Hawaii (Beechey, Macræ). Oahu: Lulumahu and Nuuanu (Cooke); also collected by Mann and Brigham. West Maui (Baldwin). Hawaiian Islands (Gaudichaud, Hillebrand). The species is widely distributed in the Malayan Archipelago, in southern Africa, and among the islands of the Pacific.

As Schiffner* has lately pointed out, the original description of *Frullania apiculata* states that the perichaetial bracts and bracteoles are incised-serrate. The authors of the Synopsis Hepaticarum, however, applied the name to a plant with entire bracts and bracteoles and all subsequent authors have done the same thing. If the type-specimens in the Nees Herbarium should turn out to be pure *Frullania serrata* Gottsche, as Schiffner thinks probable, then the name of this species should be changed to *F. apiculata*, and the plant which is at present known by this name should be called something else. Herr Stephani writes me that the *Frullania explicata* of Montagne, of which he has seen the original specimens, is the same as the *F. apiculata* of the Synopsis; and, therefore, if any change of names becomes necessary, the plant with entire bracts and bracteoles should be called *F. explicata* Mont. It is quite possible, however, that the two species are mixed in the type-material, in which case of course no change would be required.

* Conspect. Hep. Arch. Ind. 321. 1898.

The cell-structure of *F. apiculata* has already been figured by Schiffner,* who gives numerous interesting details about it. The inflorescence seems to be variable. All the fertile specimens from the Hawaiian Islands which I have seen are autoicous, while a Javan specimen kindly sent me by Herr Stephani, bears antheridia only. According to Gottsche,† the var. *a* of the Synopsis is monoicous, while the var. *β* is dioicous.

Frullania apiculata is a species which is intermediate between the subgenera *Thyopsiella* and *Diastoloba* of Spruce, and might be placed in the former perhaps better than in the latter. One of its closest allies, however, is *Frullania exilis* Tayl., of South America, and, as Spruce himself refers this species to *Diastoloba* (probably on account of its autoicous inflorescence), I have referred *F. apiculata* to the same subgenus. The South American species is much smaller in all its parts than *F. apiculata*, its leaf-lobes are very abruptly and minutely apiculate, its lobules are more slender, and the divisions of its bracts are more abruptly acuminate.

Of *F. oceanica* Mitt., the author has kindly sent me an authentic specimen from the island of Tahiti, which agrees very closely with the Hawaiian specimens above described. A second species of the Pacific islands, *F. Pacifica* Tayl., seems to be very close to *F. apiculata*, but is described as having subdentate bracts.

5. *Frullania Meyeniana* Lindenb.

Frullania Meyeniana Lindenb.; G. L. & N. Syn. Hep. 455. 1845.

Frullania Kunzei Aust. Bull. Torr. Bot. Club, v, 15. 1874 (not Lehm. & Lindenb.).

Frullania Helleri Steph. Bull. de l'Herb. Boissier, v, 845. 1897.

Plate XLV., figs. 8-14.

Autoicous: plants closely appressed to substratum, scattered or forming thin patches of considerable extent, dark red or purple, often almost black: stems, at least when young, regularly pinnate or bipinnate: leaves somewhat imbricated, the lobe ovate, arching over the stem but not cordate at base, slightly decurved at the rounded apex, convex, entire; lobule clavate, close to axis and parallel with it, rounded at base, inflated throughout; stylus minute, filiform, consisting of three or four cells in a single row: underleaves distant, obovate, cuneate and not at all cordate at base, bifid about

* Nova Acta Acad. Cæs.-Leop. ix, 224. pl. 6. f. 28-30. 1893.

† Abhandl. d. Bremen Natur. Vereine, vii, 363. 1882.

two fifths with obtuse or rounded lobes and narrow sinus, entire or angular-unidentate on sides: leaf-cells thick-walled, with distinct trigones and occasional intermediate thickenings, often becoming confluent: ♀ inflorescence borne on a principal branch; bracts in two or three pairs, the lobe ovate, acute or obtuse (away from perianth), entire or sparingly and irregularly angular-dentate, lobule ovate-lanceolate, acute or short-acuminate, angular-dentate (on innermost bract, two to four teeth on each side) or subentire, bearing a slender cilium-like stylus near the base on the inner edge; bracteoles free from bracts, ovate, bifid almost to middle, with divisions similar to the lobules of the bracts; perianth about half exerted, oblong-obovate, rounded at the apex and narrowed into a rather long beak, ciliate at the mouth, with a narrow postical keel and smooth surface: ♂ spike globose, usually borne just below the involucre; bracts in about three pairs: capsule borne on a very short stalk; spores yellowish-brown, verruculose, the verruculæ in small circular patches.

Stems 0.14^{mm} in diameter, lobes of leaves from $0.5\text{--}0.85^{\text{mm}}$ long, $0.4\text{--}0.75^{\text{mm}}$ wide, lobules $0.17 \times 0.08^{\text{mm}}$, underleaves $0.25 \times 0.15^{\text{mm}}$, leaf-cells at edge of lobe 16μ in diameter, in the middle 20μ , at the base $25 \times 23\mu$, bract I, lobe $0.95 \times 0.45^{\text{mm}}$, lobule $0.85 \times 0.25^{\text{mm}}$, bracteole I $0.75 \times 0.5^{\text{mm}}$, bract II, lobe $0.7 \times 0.35^{\text{mm}}$, lobule $0.85 \times 0.17^{\text{mm}}$, bracteole II $0.5 \times 0.25^{\text{mm}}$, perianth 1.35×0.7 , capsule 0.5^{mm} in diameter, spores $40\text{--}50\mu$ in diameter, patches of verruculæ about 5μ wide.

On trees. Oahu: Nuuanu (Heller, Cooke); Luakaha, Mt. Tantalus, foot of Konahuanui (Cooke); first collected on the island by Meyen; also collected by Mann and Brigham. Kauai: Kilohana (Cooke). West Maui (Baldwin).

My determination of this species is based on the original description and on a drawing of a sterile fragment kindly sent me by Herr Stephani, who had examined the original material. The most important difference which this author points out between *F. Meyeniana* and his recently published *F. Helleri* is in regard to the bracts. In the diagnosis of *F. Meyeniana* in the Synopsis, the involucre is briefly and inadequately described as "integerrimum," whereas in Herr Stephani's description of *F. Helleri* the bracts are said to be "acuta vel apiculata, angulatum paucidentata, lobulis duplo angustioribus acuminatis paucidentatis." As my description shows, the characters drawn from the involucre are very variable, and this is true even of the specimens of *F. Helleri* sent me by Mr. Heller himself. I have, therefore, been unable to keep the two species distinct.

In its essential characters, *Frullania Meyeniana* is almost intermediate between *F. Donnellii* of Florida, and *F. Kunzei* of the southern United States, the West Indies and Brazil, two species which are themselves very closely allied. The best points of distinction are found in the perichæatial bracts and bracteoles: in *F. Donnellii*, the lobes and lobules of the bracts and the divisions of the bracteoles (at least of the innermost row) are strongly incised-dentate; in *F. Meyeniana*, the lobes are subentire, but the lobules and the divisions of the bracteoles are coarsely dentate; while in *F. Kunzei*, the divisions of both bracts and bracteoles are entire or nearly so. In a sterile condition *F. Meyeniana* differs from both the American species in its more closely imbricated leaves and narrower lobules, which are closer to the stem and to each other.

6. *Frullania hypoleuca* Nees.

Frullania hypoleuca Nees; G. L. & N. Nova Acta Acad. Leop.-Car. xix, suppl. 1, 470. 1843.

Plate XLVII., figs. 1-11.

Autoicous: plants at first closely appressed to substratum, afterwards forming wide and intricate, depressed mats, yellowish-green varying to reddish: stems at first rather regularly bipinnate, some of the branches (especially the ultimate ones) microphyllous and of short limited growth: leaves densely imbricated, the lobe orbicular-ovate, arching over the stem but not cordate at base, slightly decurved at the rounded or obtuse, sometimes minutely apiculate apex; lobule clavate, distant from the axis, widely spreading or subparallel, rounded at the base, inflated throughout; stylus about a third as long as the lobule, obliquely triangular from a broad base, with its apex close to the lobule: underleaves imbricated, orbicular, bifid about one third, with broad, spreading or connivent, obtuse, acute, or apiculate lobes and wide sinus; cuneate and not at all cordate at base, entire or sinuately toothed on the sides: leaf-cells with conspicuous, often confluent trigones and occasional intermediate thickenings: ♀ inflorescence borne on a principal branch; bracts in about three pairs, the lobe ovate to obovate (on innermost bract), apiculate at the apex, entire or sparingly and coarsely toothed in the upper part, lobule narrowly ovate or lanceolate, acute and apiculate, bearing a distinct lobe-like tooth or stylus near or below the middle of the inner edge and sometimes a few minute and irregular teeth nearer the base, otherwise entire; bracteoles free

or the innermost slightly connate on one side, ovate, bifid about two fifths with broad, acute lobes and acute or obtuse sinus, entire or unidentate on the sides; perianth about one fourth exserted, obovate-oblong, cuneate toward base, truncate above and narrowed into a short beak, ciliate at the mouth, with a narrow postical keel and smooth surface: ♂ spikes borne single or in pairs close to the perianth; bracts in two or three pairs: capsule exserted on a very short stalk; spores yellowish-brown with minute, darker verruculæ collected in circular patches.

Stems 0.17^{mm} in diameter, lobes of leaves $1 \times 0.85^{\text{mm}}$, lobules $0.25 \times 0.1^{\text{mm}}$, underleaves $0.6 \times 0.6^{\text{mm}}$, leaf-cells at edge of lobe 17μ in diameter, in the middle 22μ , and at the base 25μ ; bract I, lobe $2 \times 1^{\text{mm}}$, lobule $1.7 \times 0.6^{\text{mm}}$, bracteole I $1.6 \times 0.95^{\text{mm}}$, bract II, lobe $1.35 \times 0.8^{\text{mm}}$, lobule $1 \times 0.45^{\text{mm}}$, bracteole II, $0.85 \times 0.5^{\text{mm}}$, perianth $2.2 \times 1.2^{\text{mm}}$, capsule 0.75^{mm} in diameter, spores $40\text{--}50\mu$ in diameter, the patches of verruculæ about 6μ wide.

On trees. Oahu: Panoa (Heller); Nuuanu, Mt. Tantalus (Cooke); first collected on the island by Meyen. West Maui (Baldwin). Sandwich Islands (Gaudichaud).

The marked resemblance between the *Frullaniæ* of the Hawaiian Islands and those of the southern United States is a matter of some interest. With the exception of *F. apiculata*, each of the six species described above has one or more close allies from the latter region, and in some cases the resemblance is very striking indeed. As has been pointed out, *F. Aongstromi* is close to *F. arietina*, *F. Sandvicensis* to *F. squarrosa*, *F. Oahuensis* to *F. Virginica* and *F. Meyeniana* to *F. Donnellii* and *F. Kunzei*. *F. hypoleuca* finally finds a close ally in *F. Caroliniana*. The American plant, however, is considerably smaller and less densely pinnate; its leaves are less imbricated and their lobes more uniformly spreading, the divisions of its bracts and bracteoles are less pointed and always entire, and its perianth is proportionately broader at the apex.

2. JUBULA Dum.

The genus *Jubula* as first proposed by Dumortier in 1822,* included the two modern genera *Jubula* and *Frullania*. In 1831,† he divided his genus into two sections, *Jubulotypus*, for his *J. Hutchinsie*, and *Ascolobium*, for his *J. dilatata* and *J. tamarisci* (now *Frullania dilatata* and *F. tamarisci* respectively). In 1835‡ he raised his two

* Comm. bot. 112.

† Sylloge Jungermann. 36.

‡ Recueil d'obs sur les Jung. 12.

sections to generic rank, retaining the name *Jubula* for his section *Jubulotypus*, and applying to his section *Ascolobium* the older name *Frullania* of Raddi, of whose work he had until then apparently been ignorant. This arrangement is adhered to in his latest work on the Hepaticæ, published in 1874.*

For many years other writers on the subject, both in Europe and in America, did not agree with these final views of Dumortier, but included both genera under the name *Frullania*. In 1884,† however, Spruce pointed out more clearly than Dumortier had done the differences between the two, and since this time, they have been almost universally recognized.

The type of the genus is *Jubula Hutchinsiae* (Hook.) Dum., a very local plant of Great Britain. Forms similar to this type have been found in eastern North America, in tropical America, in Asia, and in several islands of the Pacific, and these various forms have, with very few exceptions, been referred to *J. Hutchinsiae* as varieties. There is no doubt that these so-called varieties are very closely related to each other, and it is probable that some of them are merely temporary conditions of others. Still, as the differences between certain of them are very well marked and seem to be constant, it is doubtful if anything is to be gained by trying to keep them together. All the Hawaiian material which I have seen can be referred to the single species:

1. *Jubula piligera* (Aust.) Evans.

Frullania Hutchinsiae Auct. (not (Hook.) Dum.).

Frullania (Jubula) piligera Aust. Bull. Torr. Bot. Club, vi, 301. 1879.

Jubula piligera Evans, Trans. Conn. Acad. viii, 253. 1891.

Plate XLVII., figs. 12-20.

Autoicous: growing in flat tufts, dark green: stems irregularly pinnate: leaves imbricated, the lobe broadly ovate, reflexed or plane at the acuminate apex, entire or sometimes sparingly ciliate-dentate (with one to three teeth) near the apex, arching to about the middle of axis and neither rounded nor cordate at base; lobule galeate, distant from axis and spreading or subparallel, flattened, appearing clavate when seen from edge, narrowed at the obliquely truncate base, inflated throughout; stylus very early obsolete: underleaves ovate-orbicular, rounded toward the base and slightly decurrent, bifid

* Hep. Europ. 25, 26.

† Hep. Amaz. et And. 59.

one third to one half with acuminate lobes and acute sinus, entire or sparingly ciliate-dentate (with one or two teeth) on the sides; leaf-cells rather thick-walled with small but distinct trigones and occasional, vague, intermediate thickenings: ♀ inflorescence borne on a principal branch with innovations on one or both sides, the innovations themselves usually floriferous and innovating on one side; bracts in a single pair, the lobe ovate-oblong, narrowed into a long, acuminate point, entire or sparingly ciliate-dentate (with one or two teeth), lobule ovate-lanceolate, long-acuminate, entire (the stylus apparently obsolete); bracteole ovate, free from bracts, bifid about two fifths with acuminate lobes and acute sinus, markedly narrowed toward base, entire or with one or two cilia near apex; perianth obovate, gradually narrowed toward base, rounded or truncate at apex and narrowed into a short beak, with a high, narrow, postical keel, smooth: ♂ spikes long and slender, arising singly or in pairs near the involucre and in the position normal for vegetative branches; bracts in six or more pairs, smaller than the stem-leaves, complicate-bilobed and concave, imbricated but not densely so, the lobes ovate and acuminate, lobules smaller, ovate, acute; bracteoles similar to the other underleaves but smaller.

Stems 0.2^{mm} in diameter, lobes of leaves 1.1 x 0.8^{mm}, lobules 0.3 x 0.2^{mm}, underleaves 0.6 x 0.65^{mm}, leaf-cells at edge of lobe 13 μ in diameter, in the middle 25 x 14 μ , and at the base 32 x 19 μ , lobe of bract 1.7 x 0.7^{mm}, lobule 1.1 x 0.5^{mm}, bracteole 1.7 x 1^{mm}, perianth 2.4–2.9^{mm} long, 0.95^{mm} wide.

On the ground and on trunks of trees in damp places. West Maui (Baldwin). Kauai (Baldwin). Hawaiian Islands (Tolmie). Oahu: Konahuanui (Cooke).

Although the present species was considered distinct by Austin, Schiffner* accords it specific rank very doubtfully, and Stephanif reduces it to a simple synonym of *Jubula Hutchinsie*. The following characters, however, would seem sufficient to distinguish it: its leaf-lobes are usually entire except for the apical tooth, which is longer and slenderer than in *J. Hutchinsie*; when other teeth are present, they too are slender; the lobule does not end in a slender point, but is constricted and truncate at the mouth; the bracts and bracteoles are larger and less toothed (frequently not toothed at all) and are tipped with slender points; the ♂ branches are long, extending far beyond the stem-leaves, and they arise in the same way as ordi-

* Engler & Prantl, Natürl. Pflanzenfam. i³, 132. 1893.

† Bull. de l'Herb. Boissier, v, 842. 1897.

nary branches; the bracts are less closely imbricated, sometimes scarcely touching, and the branch sometimes bears small unmodified leaves beyond the bracts; the bracts have the same texture as ordinary leaves and are not delicate as in *J. Hutchinsie*; the ordinary leaf-cells have slightly thicker walls and are more elongated in the middle and toward the base of the lobe.

Subtribe II. LEJEUNEEÆ.

The generic limits of the forms included in the Lejeuneeæ have been subject to considerable discussion, and the opinions of hepatologists are still somewhat diverse concerning them. The old genus *Lejeunia*, as first proposed by Mlle. Libert* nearly eighty years ago, was made up of the two European species, *L. serpyllifolia* and *L.* (now *Cololejeunea*) *calcareæ*. In 1831, Dumortier† added to the genus the European species, *calyptrifolia*, *hamatifolia* and *minutissima*, and in 1835,‡ made a few more additions, mainly of tropical species, at the same time separating *L. calyptrifolia* as the type of a distinct genus, *Colura*. A few years afterwards, Nees von Esenbeck§ also recognized the genus *Lejeunea*, placing in it the same European species as Dumortier.

The publication of the Synopsis Hepaticarum in the next decade brought into the genus an immense number of exotic species, many of which had been previously described under the convenient old generic name, *Jungermannia*. In this way the number of known species of *Lejeunea* was increased to nearly three hundred. At the same time the authors of the Synopsis recognized or proposed the closely related genera *Bryopteris*, *Thysananthus*, *Ptychanthus* and *Phragmicoma*,|| which were made up almost entirely of extra-European forms. The characters assigned to these genera were in some cases both vague and false, but they were made use of by authors in a rather blind way, until the publication of Spruce's important work in 1884. This author pointed out the untrustworthy and artificial characters of certain of the Synopsis genera and proceeded to combine, in the single, much-embracing genus *Lejeunea*, all those Jubuloideæ which are constantly monogynous. He then divided his genus into thirty-seven divisions, most of which are natural and well-defined. These

* Ann. Gen. des Sci. Phys. (Brux.) vi, 372. 1820.

† Sylloge Jungermann. 32.

‡ Recueil d'obs. sur les Jung. 11.

§ Naturgeschichte der europ. Lebermoose, iii, 255. 1838.

|| First proposed by Dumortier for the European *P. Mackaili* (Hook.) Dum.

divisions he called "subgenera" and gave to each of them a name in which the word "Lejeunea" was compounded with an appropriate, descriptive prefix (e. g. *Sticto-Lejeunea*, *Neuro-Lejeunea*, etc.). This work of Spruce is his most important contribution to hepaticology, and by its means he brought a certain degree of order into a group which had heretofore been almost hopeless, both on account of its inherent complexity and on account of the brief and inadequate descriptions of many of the older authors. Spruce pointed out clearly in his writings that his so-called subgenera or, at any rate, some of them were really the equivalents of acknowledged genera in other groups of the Hepaticæ, but he continued to write of them as subgenera, and even in his last paper,* published after his death, they are so designated. Since 1885, most of the writers on Hepaticæ, who have busied themselves with exotic species, have made use of Spruce's divisions and have used his names, now as generic, now as subgeneric, in a somewhat inconsistent way. The tendency to consider these divisions as true genera, however, became more and more manifest, until, in 1893, Schiffner divided his Lejeuneæ into forty distinct genera, most of which have the limits and the names of the subgenera of Spruce. In a few cases, the names of the Synopsis or other older names are substituted; as, for example, *Bryopteris* for *Bryo-Lejeunea* and *Marchesinia* for *Homalo-Lejeunea*. Many of these genera are undoubtedly distinct; others are probably too close to one another, and a more intimate knowledge of the group will doubtless show that some should be united. For the present, however, it seems wisest to recognize most of Schiffner's genera as such, and to use his names. It hardly seems just, nevertheless, to give up Mlle. Libert's old name *Lejeunea* altogether; as Schiffner himself suggests in a foot-note, this name might readily be retained for the genus which he calls *Eulejeunea*, more especially as the type of the old genus, *L. serpyllifolia*, is the type of the restricted genus as well. It is probable also that Spruce's subgenus *Micro-Lejeunea*, as restricted by Stephani,† is as well entitled to generic rank as certain of Schiffner's genera, although it is referred by him as a subgenus to *Eulejeunea*.

As Schiffner is the writer who first defined these groups as genera, he and not Spruce should be looked upon as authority for them, and the year 1893 should be considered the date of their establishment.‡

* Hepaticæ Elliottianæ. Linn. Soc. Journ. Bot. xxx, 331-372. pt. 20-30. 1894.

† Hedwigia, xxix, 84. 1890.

‡ This should of course not apply to the old generic names given in the Synopsis and elsewhere.

An objection to this procedure may be found in the fact that other writers, notably Stephani, have used these names as generic, previous to 1893; but as these writers did not define their genera, it would complicate matters and be inconsistent with customary usage to quote them as authority for their new combinations, excepting of course those published since 1893.

Of the forty genera recognized by Schiffner, Stephani* accredits seventeen to the Hawaiian Islands, and the addition of *Microlejeunea* as a distinct genus makes eighteen. Two species, *L. unguolata* and *L. calyptrata* of Ångström, he leaves doubtful; the first of these is the same as Mitten's *L. uncinata* and is therefore a *Drepanolejeunea*, but the second belongs in the distinct genus *Coturolejeunea*. The writer is able to add the genus *Trachylejeunea* to the list, making twenty genera in all. It is evident, however, that this number is not quite correct: several of the genera are apparently listed on incorrect determinations and certain species appear to the writer to fit somewhat more naturally into other genera than those to which they have been assigned. By making these exclusions and transferences, fourteen genera are left. As many of these are represented by a single species each, it has seemed most practicable in the following key to lead directly to the species represented on the Islands, rather than to have short special keys under the respective genera.

Key to the species of Hawaiian Lejeuneæ.

Underleaves present, normal in number (i. e. one for each pair of side-leaves).

Underleaves undivided.

Leaves entire.

♀ inflorescence borne on a principal branch, without innovations. *Lopholejeunea subnuda.*

♀ inflorescence borne on a very short branch, with a short, sterile innovation. (*Platylejeunea.*)

Underleaves broadly reniform.

Platylejeunea baccifera.

Underleaves orbicular.

Platylejeunea cryptocarpa.

♀ inflorescence borne on a principal branch, innovating on one or (very rarely) on both sides.

Brachiolejeunea Sandvicensis.

Leaves usually more or less toothed at apex.

‡ Cf. Bull. de l'Herb. Boissier, v, 842. 1897. *Dicranolejeunea* is omitted from this list.

Underleaves decurrent, reflexed at apex.

Marchesinia Mittenii.

Underleaves not decurrent, plane at apex.

Thysananthus elongatus.

Underleaves bifid.

Leaves sharp-pointed.

Underleaves with broad lobes (consisting of ten to many cells), the sinus not extending beyond middle.

(Harpalejeunea.)

Leaves acute to acuminate, lobule large (about half as long as lobe).

Harpalejeunea pseudoneura.

Leaves apiculate, lobule small (about one sixth as long as lobe).

Harpalejeunea Owaihiensis.

Underleaves with slender lobes (consisting of five to seven cells), the sinus extending beyond the middle.

(Drepanolejeunea.)

Leaves entire or denticulate, acute.

Drepanolejeunea Anderssonii.

Leaves incised-dentate, acuminate.

Drepanolejeunea uncinata.

Leaves rounded at apex or very blunt-pointed.

Leaves with two or three ocelli at base of lobe.

Ceratolejeunea oculata.

Leaves not ocellate.

Leaves obliquely spreading.

Leaf-cells thick-walled or papillose or both.

♀ inflorescence borne on a very short branch (the vegetative leaves represented by a single underleaf), not innovating or with a single, short innovation on one side; perianth with a distinct antical keel.

Trachylejeunea Oahuensis.

♀ inflorescence borne on a principal branch or on a short lateral branch (always with a few vegetative leaves), innovating on one or on both sides; perianth plane or nearly so on antical face.

(Cheilolejeunea.)

Underleaves contiguous or subimbri-cated.

Leaf-lobes about 1^{mm} long and 0.5^{mm} wide; cells with thin walls and scarcely evident trigones.

Cheilolejeunea stenoschiza.

Leaf-lobes 0.5–0.6^{mm} long, 0.4–0.5^{mm} wide; cells with somewhat thicker walls and more distinct trigones.

Cheilolejeunea intertexta.

Underleaves distant.

Leaf-cells with large, conspicuous trigones.

Cheilolejeunea Hawaica.

Leaf-cells thin-walled, without trigones.

Cheilolejeunea Sandvicensis.

Leaf-cells thin-walled, not papillose, sometimes with small trigones. (*Lejeunea.*)

Underleaves bifid to beyond the middle; leaf-cells without trigones; perianth retuse at apex. *Lejeunea Pacifica.*

Underleaves bifid to about the middle; leaf-cells with small trigones; perianth not retuse at apex.

Lejeunea anisophylla.

Leaves erect-spreading. *Microlejeunea albicans.*

Underleaves absent. (*Cololejeunea.*)

Lobule more than half as long as lobe. *Cololejeunea Cookei.*

Lobule less than half as long as lobe.

Lobe not hyaline-margined, stylus reduced to a single cell, often obsolete.

Lobe less than twice as long as broad.

Perianth strongly compressed, with a low, broad, postical keel, deeply emarginate at apex; inflorescence autoicous.

♀ inflorescence borne on a very short branch, with a short sterile innovation; leaf-cells with conspicuous trigones. *Cololejeunea obcordata.*

♀ inflorescence borne on a principal branch, innovating on one side, the innovation often floriferous; leaf-cells without trigones.

Cololejeunea ceatocarpa.

Perianth slightly compressed with a high, two-angled postical keel, not retuse at apex; inflorescence dioicous.

Cololejeunea ovalifolia.

Lobe more than twice as long as broad.

Cololejeunea Hillebrandii.

Lobe hyaline-margined, at least near apex.

Stylus reduced to a single cell, often obsolete; lobule plane.

Cololejeunea lanciloba.

Stylus composed of several cells, lobule inflated.

Cololejeunea longistylis.

Underleaves present, doubled (i. e. two for each pair of side-leaves); leaves ending in a long, inflated sac. *Colurolejeunea tenuicornis*.

3. LOPHOLEJEUNEA (Spruce) Schiffn.

Lejeunea subgenus *Lopho-Lejeunea* Spruce, Hep. Amaz. et And. 119. 1884.

Lopholejeunea Schiffn.; Engler & Prantl, Nat. Pflanzenfam. i³, 129. 1898.*

Plants medium-sized to large, brown or brownish-green, sometimes deeply tinged with purple or almost black, closely appressed to substratum or growing in depressed and intricate tufts: stems irregularly pinnate: leaves imbricated, falcate-ovate, entire; the lobule small, acutely or obtusely pointed at the apex, otherwise entire: underleaves imbricated, orbicular to reniform, entire, slightly or not at all decurrent at base: leaf-cells with more or less thickened walls: ♀ terminal on a principal branch, without innovations; bracts larger than the leaves, the lobe usually denticulate to lacinate, at least at the apex, lobule small, sometimes indistinct; bracteole subrotund with a broad apex, usually entire; perianth somewhat compressed with two distinct postical keels, both these and the lateral keels tuberculate or alate with dentate to lacinate wings: ♂ spike elongated, terminal on a simple branch or occupying its whole length.

In Herr Stephani's list,† the genus *Lopholejeunea* is credited with four Hawaiian species, viz:—*L. subnuda*, *L. gibbosa*, *L. Mannii* and *L. Oahuensis*. I have been able to examine type-specimens of all of these and find that they should be referred to a single species, to

* A fuller synonymy of this and of the following genera of the Lejeuneæ is given by Schiffner. The characters of the various genera are given in full both by this author and by Spruce, and the generic descriptions in the present paper are largely compiled from the works of these writers.

† Bull. de l'Herb. Boissier, v, 842. 1897.

which, accordingly, the oldest of these four specific names should be applied.

1. *Lopholejeunea subnuda* (Mitt.) Steph.

Phragmicoma subnuda Mitt.; Seemann, Flora Vitiensis, 412. 1871.

Lejeunea gibbosa Ångstr. Öfversigt af Kongl. Vetensk. Akad. Förhand. xxix, Häft 4, 23. 1872.

Lejeunea (*Phragmicoma*) *Mannii* Aust. Bull. Torr. Bot. Club, v, 15. 1874.

Lopholejeunea Owahuensis Steph. Hedwigia, xxxv, 11. 1896.

Lopholejeunea gibbosa Steph. Bull. de l'Herb. Boissier, v, 842. 1897.

Lopholejeunea Mannii Steph. l. c.

Lopholejeunea subnuda Steph. l. c.

Plate XLVIII., figs. 1-6.

Autoicous: plants closely appressed to substratum, but usually growing in wide, depressed mats, dark olive-green or purplish, sometimes almost black: stems irregularly pinnately branched: leaves imbricated, the lobe convex, more or less decurved at the rounded or very obtuse apex, broadly ovate, arching over the stem but scarcely beyond, not cordate at base, entire; lobule broadly triangular-ovate from a broad base (when explanate), keel slightly arched, not decurrent, free margin entire, strongly involute near base, plane and very bluntly pointed at the apex, then gradually passing into lobe: underleaves contiguous or slightly imbricated, reniform, entire, attached by a curved line of insertion, but scarcely decurrent: leaf-cells papillose with indistinct and often confluent trigones and intermediate thickenings: ♀ inflorescence borne on a long principal branch, sometimes giving off branches near the bracts, but very rarely true innovations; bracts scarcely bifid, the lobule appearing as a narrow entire, rectangular expansion attached to lobe by its whole length, lobe ovate, more or less dentate at the rounded apex and along antical margin, the teeth short, sharp or blunt, and rarely more than six in number; bracteole free, ovate to obovate-quadrate, attached by a narrow base, truncate or slightly emarginate at apex, entire; perianth about half exerted, obovate or cuneiform, gradually narrowed toward base, rounded or truncate at apex and abruptly narrowed into a short beak, somewhat compressed on sides, with two distinct postical keels and often with a low antical keel, keels more or less winged, the wings undulate, dentate or lacinate: ♂ spike borne on a simple branch near the involucre, occupying the

whole branch or terminal, bracts in many pairs (sometimes twelve or more), imbricated, concave, smaller than ordinary leaves, subequally bifid with entire divisions rounded at the apex; bracteoles smaller than the other underleaves but otherwise similar to them.

Stems 0.14^{mm} in diameter, lobes of leaves $1 \times 0.7^{\text{mm}}$, lobules when explanate $0.3 \times 0.2^{\text{mm}}$, underleaves $0.5 \times 0.65^{\text{mm}}$, leaf-cells at edge of lobe 16μ in diameter, in the middle 25μ , and at the base $32 \times 25\mu$, lobe of bract $1.4 \times 0.75^{\text{mm}}$, lobule $0.5 \times 0.08^{\text{mm}}$, bracteole $0.95 \times 0.8^{\text{mm}}$, perianth $1.55 \times 0.9^{\text{mm}}$.

On trees and banks. Oahu: Luakaha, Nuuanu, foot of Kona-huanui (Cooke); also collected by Andersson, by Didrichsen, and by Mann and Brigham. Kauai: Kilohana (Cooke). Hawaiian Islands (Hillebrand).

Although in this species there are usually no branches in the vicinity of the involucre, specimens will occasionally offer an exception to this rule. In such cases branches may arise very close to the perianth, in very rare instances in fact appearing as true innovations. Such specimens, however, are so entirely like typical plants in other respects, that it would be artificial to separate them, much more so to place them in distinct genera. The crests on the perianth of *L. subnuda* are very variable: sometimes they are narrow and very slightly sinuate or sinuate-dentate on the margins; sometimes they are broader and sharply laciniate-dentate: it is, however, possible to find many intermediate conditions.

A close ally of the Hawaiian species is the widely distributed *Lopholejeunea Sagraeana* (Mont.) Schiffn., which is likewise autoicous. This species is, however, smaller, its leaves increase rapidly in size toward the perianth, and this latter organ is almost immersed in the involucre and very strongly laciniate on the keels. *L. entlopha* (Tayl.) Schiffn., found in various Pacific islands, has spinose bracts and bracteoles and is dioicous.

On the strength of specimens collected by Mr. Heller, Herr Stephani has listed as a Hawaiian plant a species found on the Marianne Islands, namely, *Archilejeunea Mariana* (Gottsche) Steph.* Through the kindness of Professor Underwood, who is now in possession of Mr. Heller's hepatics, I have been enabled to examine a large number of specimens so named, but find among them no *Lejeunea* with undivided underleaves excepting *Lopholejeunea subnuda*. It is of course possible that the *Archilejeunea* occurred in

* Bull. de l'Herb. Boissier, v, 842. 1897.

small amount in the specimens forwarded to Herr Stephani for determination, but was wanting in the rest of the collection. On account of the uncertainty concerning it, however, the species is omitted from the present account.

4. **PLATYLEJEUNEA** (Spruce) Schiffn.

Lejeunea subgenus *Platy-Lejeunea* Spruce, Hep. Amaz. et And. 124. 1884.

Platylejeunea Schiffn. ; Engler & Prantl, Nat. Pflanzenfam. i³, 130. 1893.

Plants large to very large, brown or blackish-brown, creeping or pendulous: stems irregularly pinnate: leaves somewhat imbricated, the lobe horizontally spreading, ovate, usually more or less incurved at apex and recurved along postical margin, entire, usually rounded or obtuse at apex; lobule small, strongly inflated and cucullate near axis: underleaves large, more or less imbricated, orbicular to reniform, broadly truncate or retuse, entire, often decurrent: leaf-cells with large and distinct trigones: ♀ inflorescence borne on a very short branch, with a single, short, sterile innovation on one side; bracts much smaller than the leaves, subequally bifid, entire; bracteole narrow, obtuse or more or less indented at apex; perianth small, oblong or obovate, rounded to emarginate at apex, strongly compressed, margins more or less incised-fimbriate, surface smooth or with a few scattered papillæ, antical surface plane, postical surface with two to four low, usually spinose keels: ♂ terminal on a principal branch or on a short special branch, bracts in many pairs.

Two species of *Platylejeunea* have been accredited to the Hawaiian Islands. The first of these, *P. baccifera*, as Herr Stephani has already pointed out,* was at first incorrectly referred to *Lejeunea transversalis*, a plant of tropical America. I have examined the Hawaiian material labeled *Jungermannia transversalis*, var., in the herbarium at Kew and find that it agrees closely with the Australian type-specimen of *Phragmicoma baccifera* in the same collection. Of the second species, *P. cryptocarpa*, the type-specimens have been kindly sent me by Mr. Mitten. Apparently neither of these species has been collected on the Islands since 1793.

* Hedwigia, xxix, 13. 1890.

1. *Platylejeunea baccifera* (Tayl.) Steph.

Lejeunea transversalis, β , *Hookeriana* G. L. & N. Syn. Hep. 311. 1845.

Phragmicoma baccifera Tayl. Lond. Jour. Bot. v, 387. 1846.

Marchesinia baccifera Trevis. Mem. reale Ist. Lomb. di Sci. e Lett. III. iv, 405. 1877.

Platylejeunea baccifera Steph. Hedwigia, xxix, 6. 1890. Also in herb.

Plate LXVIII., figs. 7-11.

Dioicous : plants brown : stems sparingly and irregularly pinnately branched : leaves imbricated, the lobe ovate, slightly convex, somewhat decurved at the rounded or very obtuse apex, arching over the axis but scarcely beyond, slightly or not at all cordate at base, entire or rarely obscurely crenulate at apex ; lobule triangular-ovate (when explanate), much inflated near axis, keel strongly arched, often somewhat decurrent, free margin entire, very strongly involute near base, plane and almost straight in outer half : underleaves imbricated, broadly reniform, plane or nearly so, attached by a sharply curved line of insertion and abruptly short-decurrent or indistinctly cordate at base, apex broadly truncate or retuse, margin entire or sparingly and obscurely crenulate : leaf-cells with large trigones and occasional intermediate thickenings, often becoming confluent : ♀ bracts subequally one fourth to one third bilobed, lobes and lobules ovate to oblong, rounded to subacute, entire or very obscurely crenulate at the apex from projecting cells ; bracteole obovate from a narrow cuneate base, shortly bifid (about one twelfth) with obtuse lobes and sinus, entire ; perianth (very young) compressed, dentate on lateral keels : ♂ inflorescence not seen.

Stems 0.25^{mm} in diameter, lobes of leaves 1.7 x 1.1^{mm}, lobules when inflated 0.35 x 0.25^{mm}, underleaves 0.9 x 1.5^{mm}, leaf-cells at edge 22 μ in diameter, in the middle 29 μ , and at the base 35 μ , lobe of outer bract 0.95 x 0.5^{mm}, lobule 1 x 0.4^{mm}, bracteole 0.9 x 0.6^{mm}.

Hawaii (Menzies).

The above description is drawn from a specimen kindly given me by Herr Stephani, which fully agrees with the material at Kew. *Platylejeunea baccifera* is very close to *P. transversalis* (Swartz) Schiffn., but is apparently still closer to *P. granulata* (Nees) (*Lejeunea tenuopsis* Spruce), also of tropical America. It is distinguished from the first of these by its smaller lobules and by the narrower bases of its underleaves. It differs from the second in its broader underleaves, and there are apparently slight differences also in involucre and

perianth, the bracteole of *P. granulata*, for example, being truncate or obtuse, while that of *P. baccifera* is shortly bifid. My material of the latter species is, however, too young to make full comparisons and the published descriptions of the floral organs are very incomplete.

2. *Platylejeunea cryptocarpa* (Mitt.) Steph.

Lejeunea cryptocarpa Mitt.; Seemann, Flora Vitiensis, 413. 1871.

Platylejeunea cryptocarpa Steph. Bull. de l'Herb. Boissier, v, 842. 1897.

Dioicous: plants greenish-brown: stems sparingly and irregularly branched: leaves imbricated, the lobes ovate, slightly convex, plane or somewhat decurved at the rounded apex, arching across the axis and usually a little beyond, slightly or not at all cordate at base, entire; lobule triangular-ovate, much inflated near axis, keel slightly arched, indistinctly decurrent, free margin entire, strongly revolute near axis, plane in outer half: underleaves somewhat imbricated, orbicular, broadly rounded at the apex, plane or nearly so, short-decurrent or vaguely cordate at base, attached by a sharply curved line of insertion, entire: leaf-cells with distinct trigones and occasional intermediate thickenings, often becoming confluent: ♀ bracts subequally one third bifid, the divisions ovate to oblong, the lobe usually subacute and the lobule obtuse to truncate, margin slightly crenulate from projecting cells; bracteole obovate-oblong, bifid about one third with rounded lobes and narrow sinus, slightly crenulate; perianth (young) compressed, obovate, antical surface plane, postical surface with a broad two-angled keel, lateral keels and two angles of postical keel with distinct and sharply incised-dentate wings: ♂ spike oblong, occupying a short special branch; bracts in about six pairs, bracteoles wanting, except at base of spike.

Stems 0.2^{mm} in diameter, lobes of leaves 1.2 x 0.75^{mm}, lobules when inflated 0.2 x 0.15^{mm}, underleaves 0.7 x 0.7^{mm}, leaf-cells at edge of leaf 16 μ in diameter, in the middle 26 μ , and at the base 28 μ , lobe of bract 0.6 x 0.25^{mm}, lobule 0.5 x 0.25^{mm}, bracteole 0.7 x 0.35^{mm}, ♂ spike 1 x 0.5^{mm}.

“On *Leptogium azureum*.” Hawaii (Menzies).

It will be seen from the foregoing description that this species is very close to *P. baccifera*. It is, nevertheless, smaller in all its parts and its underleaves are strikingly different in shape, so that the two should probably be kept separate. It is to be regretted that the Hawaiian material of this interesting genus is so meager and incom-

plete. As Herr Stephani has remarked, the vegetative characters of the species are exceedingly variable, and it is rarely possible to describe one of them in a satisfactory way without an extensive series of specimens.

5. **BRACHIOLEJEUNEA** (Spruce) Schiffn.

Lejeunea subgenus *Brachio-Lejeunea* Spruce, Hep. Amaz. et And. 129. 1884.

Brachiolejeunea Schiffn.; Engler & Prantl, Nat. Pflanzenfam. i³, 128. 1893.

Plants medium-sized to large, green or brownish-green, closely appressed to substratum or growing in depressed intricate tufts: stems irregularly pinnate or dichotomous: leaves imbricated, the lobe falcate, entire; lobule much smaller than lobe, denticulate on margin: underleaves imbricated, orbicular to reniform, slightly cordate or decurrent at base: leaf-cells with distinct trigones: ♀ inflorescence terminal on a principal branch, innovating on both or, more rarely, on only one side; bracts often smaller than the leaves; perianth slightly or not at all compressed, three- to ten-keeled: ♂ spike elongated, variously situated.

1. **Brachiolejeunea Sandvicensis** (Gottsche).

Phragmicoma bicolor Mont. Voyage de la Bonite, Botanique, i, 223. 1846 (not *Lejeunea bicolor* (Nees) Mont.).

Phragmicoma Sandvicensis Gottsche, Ann. des Sciences nat. IV, viii, 344. pl. 15. f. 10-24. 1857.

Phragmicoma subsquarrosa Aust. Proc. Acad. Nat. Sci. Phil. for 1869: 225.

Lejeunea subsquarrosa Aust. Bull. Torr. Bot. Club, v, 15. 1874.

Mastigolejeunea Sandvicensis Steph. Hedwigia, xxviii, 29. 1889. Bull. de l'Herb. Boissier, v, 842. 1897.

Lejeunea Sandvicensis Evans, Trans. Conn. Acad. viii, 253. 1892.

Brachiolejeunea Gottschei Schiffn. Hedwigia, xxxiii, 186. pl. 8, 9. f. 20-31. 1894.

Phragmicoma Japonica Gottsche Ms.; Schiffn. l. c. (as synonym).

Brachiolejeunea Japonica Steph. Bull. de l'Herb. Boissier, v, 842. 1897.

Dioicous: plants brownish- or glaucous-green, closely appressed to substratum or more commonly forming wide depressed mats, often growing in company with other bryophytes: leaves densely imbricated, wrapped about the stem when dry, explanate and more or less

squarrose when moist, the lobe ovate, arching across but not beyond stem, scarcely rounded at the base, rounded at the apex, entire; lobule (when explanate) ovate, strongly inflated its whole length, keel slightly arched, not decurrent, appearing crenulate from its strongly papillose cells, free margin appressed to lobe, denticulate with three or four short blunt teeth: underleaves imbricated, reniform, slightly cordate at base, entire or very slightly crenulate from projecting cells: leaf-cells papillose with small and distinct trigones and intermediate thickenings, rarely becoming confluent, marginal cells of lobe short and squarish, forming a more or less distinct edge: ♀ inflorescence borne on a principal branch, almost invariably with a single innovation; outer bract (away from innovation) shortly bifid, lobe broadly ovate or orbicular-ovate, rounded at apex, entire, lobule ovate, rounded or very obtuse at the apex, entire; inner bract (next innovation) elobulate, broadly orbicular-ovate, rounded at apex, entire; bracteole orbicular, free, truncate at apex, entire or faintly crenulate from projecting cells; perianth not compressed, truncate and slightly retuse at apex, with a short beak, deeply eight- to ten-plicate, keels slightly crenulate from papillose cells: ♂ spike not seen: spores oblong, greenish, with a thick yellowish wall, densely and minutely tuberculate and with scattered circular patches of radiating plate-like thickenings.

Stems 0.2^{mm} in diameter, lobes of leaves $1 \times 0.8^{\text{mm}}$, lobules $0.4 \times 0.25^{\text{mm}}$, underleaves $0.4 \times 0.6^{\text{mm}}$, cells at edge of lobe 18μ in diameter, in the middle 30μ , at the base $41 \times 30\mu$, lobe of outer bract $1.5 \times 1.1^{\text{mm}}$, lobule $0.7 \times 0.5^{\text{mm}}$, inner bract $1.35 \times 1.45^{\text{mm}}$, bracteole $1.2 \times 1.1^{\text{mm}}$, perianth $1.3-1.5^{\text{mm}}$ long, $0.8-0.9^{\text{mm}}$ wide, spores 40μ in shortest diameter.

On rocks and trees. Oahu: near Diamond Point (Didrichsen); Nuuanu, Luakaha (Cooke); also collected by Andersson. Kauai: Kilohana, Kipu, Lihue, Half Way Bridge (Cooke). West Maui (Baldwin). Hawaiian Islands (Hillebrand, Mann and Brigham). First collected on the Islands by Gaudichaud.

As the long synonymy indicates, the generic position of this abundant species has been a matter of considerable controversy. The fact that the perianth innovates almost invariably on only one side would seem to throw it out of the genus *Brachioléjeunea*. Schiffner, however, in his description of *B. Gottschei*, states that a double innovation, although extremely rare, is occasionally found. The pluriplicate perianth and the lobules of the leaves (with respect to their shape and free margins) are quite characteristic of *Brachio-*

lejeunea and indicate a certain affinity with *B. bicolor* (Mont.) Schiffn., to which Montagne originally referred the Hawaiian plant. It differs from this species of tropical America in its more squarrose leaves, in the less recurved postical margins of their lobes, and in their larger cells, in its single innovation, in its wingless outer bract, and in its undivided inner bract. This last character indeed is a most unusual one for the genus, and, so far as I know, does not occur in any other species. In a sterile condition, *B. corticalis* (Lehm. & Lindenb.), likewise of tropical America, resembles the present species very closely, but differs in its larger lobule and less papillose leaf-cells.

The original material of *Brachiolejeunea Gottschei* from Japan (or Java) is in the Gottsche Herbarium at Berlin and agrees closely with the Hawaiian plant. The species has also been reported from China by Professor Massalongo, who describes the inflorescence as polyoicous.*

6. **MARCHESINIA** S. F. Gray.

Marchesinia S. F. Gray, Nat. Arr. Brit. Pl. i, 689. 1821 (as "*Marchesinus*").

Phragmicoma Dumort. Com. bot. 112. 1822.

Lejeunea subgenus *Homalo-Lejeunea* Spruce, Hep. Amaz. et And. 132. 1884.

Plants large, brown or greenish-brown, usually growing in depressed tufts: stems irregularly pinnate or more commonly dichotomously branched: leaves more or less imbricated, the lobe ovate to orbicular-ovate, widely spreading, entire throughout, or apiculate and more or less toothed near apex; lobule small, plane or slightly inflated, usually with one to four teeth on free margin; underleaves large, often imbricated, orbicular to reniform, more or less cordate and decurrent at base, margin entire to dentate-spinulose: leaf-cells with more or less thickened walls: ♀ inflorescence borne on a principal branch, innovating on both sides; bracts narrower than the leaves, the lobe usually spinulose, lobule small, entire; bracteole obovate, truncate or emarginate, usually more or less toothed on margin; perianth obovate, strongly compressed, plane on both surfaces, or with a low postical keel, truncate or retuse at apex, entire or indistinctly winged on lateral keels: ♂ inflorescence variously situated, often hypogynous or within a fork, with few to many bracts.

* Mem. dell' Accad. di Art. e Comm. di Verona, lxxiii. 35. 1897.

1. *Marchesinia Mittenii* sp. nov.

Plate XLVIII., figs. 12-14.

Dioicous: plants brownish-green: stems irregularly pinnately branched: leaves slightly imbricated, the lobe ovate, horizontally spreading, plane or slightly convex, arching over the stem and rounded but scarcely cordate at base, rounded and usually apiculate at the apex, entire or sparingly dentate near apex (with one to three blunt teeth on each side of apical tooth); lobule slightly inflated, sub-quadrate from a short base, keel strongly arched, not decurrent, forming almost a right angle with postical margin of lobe, free margin of lobule at first parallel with stem, then turning at a right angle and passing into the postical margin of lobe, the two forming a straight, continuous line, margin of lobule bearing about three blunt teeth, the one farthest from the stem being the largest: underleaves slightly imbricated, broadly obovate, reflexed at the broad, rounded apex, gradually narrowed toward the decurrent and slightly cordate base and attached by a long, sharply curved line of insertion, entire or very sparingly denticulate on reflexed margin: leaf-cells with thick trigones and intermediate thickenings, occupying nearly the whole of the wall: ♀ bracts deeply and unequally bifid, the lobe obovate, rounded at the apex and sparingly dentate above the middle, lobule ovate to lanceolate, acute, entire; bracteole broadly orbicular-obovate from a narrow base, rounded or truncate at apex, sharply dentate, the teeth about twenty in number, mostly three to six cells long and two to four cells wide at base; underleaf next bracteole sparingly dentate, but with shorter teeth: perianth and ♂ spike not seen.

Stems 0.25^{mm} in diameter, lobes of leaves $1.5 \times 1^{\text{mm}}$, lobules $0.25 \times 0.3^{\text{mm}}$, underleaves $1.2 \times 1.2^{\text{mm}}$, cells at edge of lobe 21μ in diameter, in the middle 27μ , and at the base $43 \times 35\mu$, lobe of bract $2 \times 1.2^{\text{mm}}$, lobule $0.5 \times 0.25^{\text{mm}}$, bracteole $1.5 \times 1.4^{\text{mm}}$.

Hawaiian Islands (Hillebrand), mixed with the type-specimens of *Lopholejeunea subnuda* (Mitt.) Steph.

The plant described above is known only from the fragmentary type-specimens without perianths in Mr. Mitten's herbarium, but it undoubtedly belongs in this genus. It resembles very closely *Marchesinia robusta* (Mitt.) Schiffn. of tropical America, but this species is amply distinct in having more densely imbricated leaves and spinulose-denticulate underleaves.

7. **THYSANANTHUS** Lindenb.

Thysananthus Lindenb.; G. L. & N. Syn. Hep. 286. 1845.

Lejeunea subgenus *Thysano-Lejeunea* Spruce, Hep. Amaz. et And. 105. 1884.

Lejeunea subgenus *Dendro-Lejeunea* Spruce, l. c. 110.

Lejeunea subgenus *Phragmo-Lejeunea* Schiffn. & Gottsche, Lebermoose der Forschungsreise S. M. S. "Gazelle," 24. 1890.

Plants large, green or brownish-green, usually in depressed tufts: stems growing from a more or less distinct creeping caudex, pinnately or dichotomously branched, sometimes with slender flagelliform branchlets: leaves imbricated, the lobe ovate to ligulate, usually more or less recurved on postical margin, entire or usually somewhat dentate near apex, lobule small, more or less inflated, with one or two minute teeth on free margin near apex: underleaves ovate to orbicular, narrowed toward base, truncate to broadly emarginate at the entire or denticulate apex: leaf-cells with distinct trigones, more or less elongated in the middle and toward the base of lobe: ♀ inflorescence borne on a stem or principal branch, innovating on one or on both sides, the innovations usually floriferous; bracts unequally bifid, the lobe narrower than in the leaves, entire or toothed, lobule small; bracteole truncate or shortly bifid, mostly dentate; perianth linear to obovate, trigonous but sometimes with supplementary keels, the keels usually dentate- or laciniate-winged: ♂ inflorescence terminal or intercalary on a principal branch.

1. *Thysananthus elongatus* (Aust.).

Phragmicoma elongata Aust. Proc. Acad. Nat. Sci. Phil. for 1869: 225.

Lejeunea aliena Ångstr. Öfversigt af Kongl. Vetensk. Akad. Förhandl. xxix, Häft 4, 23. 1872 (misprinted "*L. alcina*").

Lejeunea elongata Aust. Bull. Torr. Bot. Club, v, 17. 1874.

Dicranolejeunea Didericiana Steph. Hedwigia, xxxv, 77. 1896.

Brachiolejeunea aliena Steph. Bull. de l'Herb. Boissier, v, 842. 1897.

Ptycholejeunea elongata Steph. l. c.

Plate XLIX.

Autoicous or dioicous: plants brownish-green, sometimes bright or yellowish-green, very variable, in some cases closely appressed to substratum but usually growing in wide depressed mats: stems irregularly pinnate, or, on fruiting plants, usually dichotomous: leaves imbricated, sometimes densely so, not squarrose, the lobe

falcate-ovate, arching to about the middle of axis, rounded but not cordate at base, entire or, usually, with a few (one to five) short blunt teeth near the apex, the apical tooth being the largest, margin often somewhat revolute; lobule (when well developed) ovate from a narrow base, narrowing at first abruptly, then more gradually, keel arched, distinctly decurrent at base, free margin strongly involute at base, plane in outer part, entire or with a single more or less distinct blunt apical tooth; lobule often very poorly developed: underleaves distant or contiguous, broadly obovate-orbicular, gradually narrowed toward base, slightly decurrent, truncate and often reflexed at apex, entire or minutely crenulate or denticulate in upper part, rarely slightly retuse: leaf-cells with conspicuous trigones and intermediate thickenings, often becoming confluent near apex and margin of lobe: ♀ inflorescence on a principal branch, with one or usually two innovations; bracts deeply and unequally bifid, the lobe oblong or ovate, apiculate at the rounded apex, subentire or usually sparingly dentate in upper part (two or three irregular teeth on each side of apex), entire below, lobule lanceolate, acuminate, entire or nearly so; bracteole free, orbicular-ovate, truncate or rarely shortly bifid at the apex, entire or commonly coarsely and irregularly dentate above the middle; perianth obovate, rounded above and abruptly narrowed into a short beak, more or less compressed on sides, grooved and with one large and usually two small supplementary keels on antical surface, on postical surface with a broad, three- or four-plicate keel, the keels indistinctly and interruptedly winged, entire or slightly sinuate-denticulate: ♂ spike terminal or intercalary on a large branch, bracts in about five pairs, imbricated, subequally and shortly complicate-bilobed, with blunt, broad, subentire divisions, margin of lobule often revolute; bracteoles similar to the other underleaves, usually entire: spores oblong, green, with a thick whitish wall, minutely tuberculate.

Stems 0.17^{mm} in diameter, lobes of leaves $1.35 \times 0.85^{\text{mm}}$, lobules $0.35 \times 0.2^{\text{mm}}$, underleaves $0.45 \times 0.55^{\text{mm}}$, cells at edge of lobe 13μ in diameter, in the middle $21 \times 17\mu$, at the base $32 \times 17\mu$, lobe of bract $1.1 \times 0.55^{\text{mm}}$, lobule $0.5 \times 0.2^{\text{mm}}$, bracteole $0.8 \times 0.65^{\text{mm}}$, perianth $1.9 \times 0.85^{\text{mm}}$, capsule 0.5^{mm} in diameter, spores 30μ in shortest diameter.

On rocks and trees. The type-specimens collected by Hillebrand. Oahu: Konahuanui (Heller, Cooke); Nuuanu, Luakaha, Palolo (Cooke); also collected by Andersson and by Didrichsen. Kauai: Half Way Bridge (Cooke); also collected by Baldwin.

The determination of this extremely variable species is based on a part of Austin's original material, which I owe to the kindness of Mr. Pearson. These plants are much elongated and sparingly branched and very few of them show any signs of inflorescence; in fact, I have been able to find only two perianths upon them, each of which is subtended by a single innovation. Similar elongated forms are found among Mr. Cooke's specimens, and these, like the type, are almost invariably sterile. A few of them, however, show unfertilized female flowers which are innovant, sometimes on only one side, but usually on both. The more common form of the species appears somewhat different from these elongated conditions: the stems are shorter and are almost always fruiting, and the female flowers are innovant on both sides, giving the plants thereby a forked appearance. Even here, however, a one-sided innovation is very frequent. Although these two extreme forms appear so unlike, they are connected with each other by numerous intermediate conditions. They also agree so perfectly in their leaves with their apical teeth and decurrent keels, in their leaf-cells, in their underleaves, and in their floral leaves and perianths, that it is impossible to draw a line between them.

The type-specimen of Ångström's *Lejeunea aliena*, kindly sent me by Professor Nathorst, is very similar to that of *Phragmicoma elongata*, while the type of *Dicranolejeunea Didericiana* is more like the usual form of the species. Herr Stephani has recently published, as *Brachiolejeunea apiculata* n. sp.,* a plant collected by Mr. Heller on Oahu. The type of this species appears to be inaccessible: there are no specimens so named among Mr. Heller's plants in New York, and Herr Stephani's own specimens seem to have been mislaid. The author, however, has had the kindness to send me a drawing made from the original material, which shows a leaf, an underleaf, and a perianth with its involucre. Judging from this drawing and from the published description, the plant is very close to *Thysananthus elongatus* and may be a form of it, as the differences brought forward could easily be accounted for by the very great variability of the species. The matter, however, must be left in doubt for the present.

The widely distributed *Thysananthus fruticosus* Lindenb. & Gottsche differs from *T. elongatus* in its vittate leaves and in the much sharper and more numerous teeth on its leaves, underleaves, bracts and perianth, as well as in the different shape of the last named

* Bull. de l'Herb. Boissier, v, 846. 1897.

organ. Judging from the figure given by Sande-Lacoste,* a much closer ally of the Hawaiian plant is the Javan *Thysananthus polymorphus* (S.-L.) Schiffner,† particularly the variety *planifolia*. Through the kindness of Professor Schiffner, I have been able to examine an authentic specimen of this species from the Berlin Herbarium and find that it is considerably larger than *T. elongatus*, that its leaves are commonly entire and more pointed and that their lobules are different in shape.

8. **HARPALEJEUNEA** (Spruce) Schiffn.

Lejeunea subgenus *Harpa-Lejeunea* Spruce, Hep. Amaz. et And. 164. 1884 (in great part).

Harpalejeunea Schiffn.; Engler & Prantl, Nat. Pflanzenfam. i³, 126. 1893.

Strepsilejeunea Schiffn. l. c. 127.

Plants medium-sized to minute, pale green, varying to brownish- or grayish-green, closely appressed to substratum, sometimes subcæspitose: stems sparingly and irregularly pinnate: leaves contiguous or slightly imbricated, widely spreading, somewhat decurved and acute or acuminate at apex, entire, crenulate or subdentate on margins, rarely incised-dentate; lobule variable in size, inflated: underleaves distant, small to large, rotund to cuneate in outline, bifid with blunt or subacute segments, rarely undivided: leaf-cells small, sometimes a few of them ocellate: ♀ inflorescence borne on a short branch, sometimes simple, sometimes innovating on one, or more rarely, on both sides; bracts and bracteoles larger than the leaves; perianth pyriform to obovate, five-keeled, keels crenulate, roughened or spinose: ♂ spike occupying a short branch or terminal on a longer branch, bracts few, antheridia one or two in each axil.

The genus *Strepsilejeunea*, first proposed by Spruce as a section of his subgenus *Harpa-Lejeunea*, is recognized by Schiffner in a somewhat tentative way, and also by Stephani. It is certainly very close indeed to *Harpalejeunea*. The most important differences enumerated by Schiffner are the following: the larger size of the plants, their darker color, the leaves toothed and reflexed at the apex, the distinctly thickened walls of their cells, the larger underleaves. These differences do not appear to be very constant. I have therefore not tried to separate the genera, but have referred to *Harpalejeunea* the

* Syn. Hep. Jav. 58. pl. 11. 1856.

† Conspect. Hepat. Arch. Ind. 305. 1898.

Lejeunea Owaihiensis of Gottsche, a plant which Stephani has placed in *Strepsilejeunea*.

1. *Harpalejeunea pseudoneura* sp. nov.

Plate L., figs. 1-9.

Dioicous: plants pale green, closely appressed to substratum or creeping among other hepatics: stems sparingly branched: leaves subimbricated, the lobe widely spreading, falcate-ovate, acute and usually somewhat decurved at apex, margins minutely crenulate or subdentate; lobule ovate, lunately truncate at apex, the apical tooth curved so strongly as almost to touch end of keel, keel arched, crenulate from papillose cells, free margin almost straight, strongly involute as far as apical tooth: underleaves obovate from a narrow base, bifid about one half with erect or slightly spreading, obtuse or subacute lobes and obtuse or lunulate sinus, entire or angular-unidentate on sides: leaf-cells with slightly thickened walls, trigones scarcely apparent, ocelli in a continuous line, running from the base of lobe almost to apex: ♀ inflorescence borne on a short branch, innovating on one side with a simple innovation; bracts unequally bifid, the lobe ovate, somewhat falcate (less so than leaves), acute, crenulate and angular-dentate on margins, lobule ovate-lanceolate, acute or apiculate, crenulate and usually angular-dentate; bracteole free, oval or ovate, bifid about one fourth with obtuse or subacute lobes and narrow sinus, crenulate and often angular-dentate; perianth obovate, truncate and slightly retuse at apex, sharply five-keeled in upper part, the keels rounded above and crenulate on margins from papillose cells: ♂ spike terminal on a somewhat elongated branch; bracts in two to five pairs, subequally bifid with obtuse or subacute lobes, crenulate on margins and keel; bracteoles absent from upper part of spike; antheridia borne singly.

Stems 0.05^{mm} in diameter, lobes of leaves $0.35 \times 0.15^{\text{mm}}$, lobules $0.17 \times 0.1^{\text{mm}}$, underleaves $0.12 \times 0.12^{\text{mm}}$, cells at edge of lobe 14μ in diameter, in the middle and at the base 16μ , ocelli $25 \times 16\mu$, lobe of bract $0.45 \times 0.2^{\text{mm}}$, lobule $0.25 \times 0.13^{\text{mm}}$, bracteole $0.35 \times 0.25^{\text{mm}}$, perianth $0.85 \times 0.4^{\text{mm}}$.

On trees or creeping among other hepatics. Oahu: Nuuanu and Konahuanui (Cooke).

The ocelli, which are found in several species of this genus, usually occur in small numbers at the base of the lobe. Their arrangement in a continuous line is an interesting character of the

Hawaiian plant, and this, together with the peculiar underleaves, will serve to distinguish it from certain South American species, which it otherwise somewhat resembles.

2. *Harpalejeunea Owaihiensis* (Gottsche).

Lejeunea Owaihiensis Gottsche; G. L. & N. Syn. Hep. 351. 1845.

Lejeunea (Strepsi-Lejeunea) Owaihiensis Steph. Hedwigia, xxix, 74. 1890.

Strepsilejeunea Owaihiensis Steph. Bull. de l'Herb. Boissier, v, 842. 1897.

Plate L., figs. 10-14.

Plants yellowish: stems sparingly and irregularly pinnately branched: leaves somewhat imbricated, the lobe widely spreading, broadly ovate, abruptly apiculate or acute, very rarely obtuse at the apex, margin minutely crenulate from projecting cells and sometimes sparingly and indistinctly denticulate; lobules more or less covered by the underleaves, inflated, triangular-ovate, the keel very slightly arched, free margin involute and almost straight in inner half, lunate at apex with a sharp apical tooth: underleaves broadly orbicular, not overlapping, slightly cordate at base and attached by a somewhat curved line of insertion, bifid one fourth to one third with acute lobes and broad, lunulate sinus, margin minutely crenulate from projecting cells: leaf-cells rather thin-walled, without trigones.

Stems 0.1^{mm} in diameter, lobes of leaves $0.45 \times 0.35^{\text{mm}}$, lobules $0.08 \times 0.07^{\text{mm}}$, underleaves $0.25 \times 0.28^{\text{mm}}$, cells at edge of lobe 13μ in diameter, in the middle 16μ , at the base $19 \times 16\mu$.

Hawaii (Menzies).

The above description is drawn from a portion of the original material kindly sent me by Dr. Hennings of the Royal Botanical Museum at Berlin. The specimens examined are all of them sterile, and it is probable that Gottsche himself did not see the perianths. The ♀ inflorescence, however, is described in the Synopsis as follows: "fructu ad basin ramorum sessili, foliis involueralibus amphigastriocque dentato-serratis, illorum lobulo magno truncato." Spruce compares this species with his *Lejeunea (Harpa-Lejeunea) pilifera** of South America, but this latter plant is amply distinct in its cuspidate leaves and much smaller underleaves.

* Hep. Amaz. et And. 170. 1884.

9. **DREPANOLEJEUNEA** (Spruce) Schiffn.

Lejeunea subgenus *Drepano-Lejeunea* Spruce, Hep. Amaz. et And. 185. 1884.

Drepanolejeunea Schiffn.; Engler & Prantl, Nat. Pflanzenfam. i³, 126. 1893.

Plants small or minute, green to yellowish-green, creeping over other bryophytes: stems sparingly branched: leaves distant or contiguous, obliquely spreading or almost erect, the lobe acuminate or acute and more or less decurved at apex, crenulate, spinulose or lacinate on the margins; lobule ovate, inflated: underleaves distant, small, deeply bifid with subulate lobes: leaf-cells with thin or slightly thickened walls, a few of them sometimes ocellate: ♀ inflorescence terminal on a short branch, with a single innovation on one side; bracts and bracteoles slightly modified; perianth five-keeled, the keels dilated into horizontally spreading toothed horns: ♂ inflorescence occupying a sharp branch or terminal on a longer branch.

Drepanolejeunea and *Harpalejeunea* are very closely related genera, but the leaves of the first are oblique or erect-spreading and usually so strongly decurved at the apex that they give the plants a peculiar appearance, enabling us at once to recognize them. The most essential difference between the genera is to be found in the underleaves: in *Drepanolejeunea* these are small and bifid to or beyond the middle and their divisions are subulate and sharp-pointed and usually widely divaricate; in *Harpalejeunea* the underleaves are larger and less deeply bifid, never beyond the middle, and their divisions are broad and blunt-pointed or, more commonly, rounded at the apex. There are also differences in the floral organs, particularly in the perianths.

1. *Drepanolejeunea Anderssonii* (Ångstr.).

Lejeunea Anderssonii Ångstr. Öfversigt af Kongl. Vetensk. Akad. Förband. xxix, Häft. 4, 24. 1872.

Harpalejeunea Anderssonii Steph. Bull. de l'Herb. Boissier, v, 142. 1897.

Plate LI., figs. 1-9.

Autoicous: plants closely appressed to matrix, yellowish-green: stems irregularly branched: leaves distant or contiguous, the lobe erect-spreading, ovate from a narrow base, acute, entire or with one or two small blunt teeth on antical margin; lobule ovate, inflated along keel and near base, keel strongly arched, forming an almost

continuous curve with postical margin of lobe, free margin of lobule plane and appressed to lobe except close to the base, lunate at apex with a curved apical tooth: underleaves distant, deeply bifid, the divisions widely spreading or, on poorly developed stems and branches, erect or only slightly divergent, subulate, three or four cells long, two cells wide at base, separated by a broad, obtuse or lunulate sinus: leaf-cells with somewhat thickened walls, the trigones and intermediate thickenings indistinct and more or less confluent; ocelli scarcely larger than the other cells, two or three in number, scattered, sometimes wanting: ♀ inflorescence borne on a very short branch, innovating on one side; bracts unequally bifid, the lobe ovate, acute, entire or subdentate, lobule ovate, acute, usually unindentate on inner side near apex; bracteole free, ovate to obovate, bifid about one third with narrow acuminate lobes and sinus, entire or nearly so; perianth cuneiform in outline, broadly truncate at apex and with a broad beak, sharply five-keeled in upper part, the keels prolonged as horizontally spreading acute horns, entire or denticulate at apex: ♂ spike occupying a short branch, globose or oval; bracts in one to three pairs, with entire lobes, bracteoles small, usually at base of spike only, bifid about one third, with narrow suberect divisions, similar to the underleaves on small branches: spores oblong, green, slightly verruculose.

Stems 0.04^{mm} in diameter, lobes of leaves $0.3 \times 0.15^{\text{mm}}$, lobules $0.2 \times 0.1^{\text{mm}}$, underleaves $0.1 \times 0.2^{\text{mm}}$, or on smaller branches $0.08 \times 0.06^{\text{mm}}$, cells at edge of lobe $18 \times 16\mu$, in the middle and at base $25 \times 16\mu$, lobe of bract $0.35 \times 0.15^{\text{mm}}$, lobule $0.3 \times 0.07^{\text{mm}}$, bracteole $0.3 \times 0.12^{\text{mm}}$, perianth $0.6 \times 0.4^{\text{mm}}$, capsule 0.2^{mm} in diameter, spores 16 to 21μ in diameter.

On trees or on living leaves. Oahu: Konahuanui (Cooke); first collected on the island by Andersson.

Through the kindness of Professor Nathorst, I have been able to examine the type-material of this distinct little species. It consists of a few fragmentary stems and upon one of these is an old and battered perianth, whose involucre has been largely worn away. The description which I had drawn from these specimens has been supplemented by the more complete material collected during the past summer by Mr. Cooke. His specimens show that the underleaves are somewhat variable in shape: on robust stems and branches, their lobes are widely divaricate, while on smaller stems and branches they may be erect or nearly so. It is in fact quite usual to find both these conditions upon an individual plant. The larger size of *D.*

Anderssonii and the subentire lobes of its leaves, acute but not acuminate at the apex, will at once distinguish it from the following species.

2. *Drepanolejeunea uncinata* (Mitt.) Steph.

Lejeunea uncinata Mitt.; Seemann, *Flora Vitiensis*, 416. 1871.

Lejeunea unguolata Ångstr. Öfversigt af Kongl. Vetensk. Akad. Förhand. xxix, Häft 4, 25. 1872.

Drepanolejeunea uncinata Steph. Bull. de l'Herb. Boissier, v, 842. 1897.

Plate LI., figs. 10-18.

Autoicous: plants creeping over other bryophytes, pale green: stems slender, sparingly and irregularly branched; leaves distant or contiguous, the lobe ovate to lanceolate, obliquely spreading, long-acuminate and deflexed forward at apex, antical margin on robust leaves with two or three sharp teeth, postical margin with a single blunter tooth next the keel, margins on poorly developed leaves often entire; lobule ovate, lunately truncate at apex, with distinct apical tooth, strongly inflated, keel arched, free margin strongly involute to beyond apical tooth: underleaves bifid to within one or two cells of base, the lobes slightly spreading, subulate, two cells wide at base and three or four cells long, sinus lunulate: leaf-cells with slightly thickened walls, the very indistinct trigones and intermediate thickenings more or less confluent; ocelli two or three, scattered: ♀ inflorescence borne on a very short branch, innovating on one side with a long sterile innovation; bracts unequally bifid, the lobe rhombic or obovate, acuminate, coarsely dentate on margins (two to four teeth on each side), lobule tooth-like, acute, entire or with a single tooth near apex; bracteole free, ovate to obovate, bifid about one third with acute or acuminate lobes and narrow sinus, with about three coarse teeth on each side; perianth obovate, truncate above and with a short beak, almost terete below, sharply five-keeled above, the keels running out into acute or acuminate almost horizontal horns or processes, slightly denticulate near the ends: ♂ spike occupying a very short branch, subglobose; bracts in one or two pairs, the divisions slightly dentate; bracteole usually single, very small: spores irregular in shape, more or less oblong, angular, green, with a thickened, whitish, minutely verruculose wall.

Stems 0.04^{mm} in diameter, lobes of leaves $0.3 \times 0.17^{\text{mm}}$, lobules $0.17 \times 0.1^{\text{mm}}$, underleaves $0.08 \times 0.07^{\text{mm}}$, cells at edge of lobe 18μ in diameter, in the middle and at the base $18 \times 12\mu$, lobe of bract $0.35 \times 0.17^{\text{mm}}$, lobule $0.2 \times 0.05^{\text{mm}}$, bracteole $0.3 \times 0.17^{\text{mm}}$, perianth

0.5 x 0.3^{mm} long, 0.3^{mm} wide, capsule 0.2^{mm} in diameter, spores 20–25 μ in shortest diameter.

On *Bazzania* and *Cryptopodium*. The type-specimens collected by Gaudichaud. Oahu: Nuuanu and Konahuanui (Cooke); also collected by Andersson.

Drepanolejeunea tridactyla (Gottsche) of Java, is very close to the Hawaiian plant, but has mamillate leaf-cells. The South American *D. palmifolia* (Nees) Schiffn. is a somewhat larger plant, the teeth on its lobes are more numerous (varying from five to ten on robust leaves), and the bracts are more lacinate. My description of *D. uncinata* is drawn from Mr. Cooke's specimens, which closely agree with the original material of the species, kindly sent me by Mr. Mitten, and also with the type-specimen of *Lejeunea unguolata*, received from Professor Nathorst.

10. **CERATOLEJEUNEA** (Spruce) Schiffn.

Lejeunea subgenus *Cerato-Lejeunea* Spruce, Hep. Amaz. et And. 198. 1884.

Ceratolejeunea Schiffn.; Engler & Prantl, Nat. Pflanzenfam. i³, 125. 1893.

Plants medium-sized, yellowish to blackish-green, growing in flat mats: stems irregularly branched: leaves contiguous to imbricated, the lobe widely spreading, falcate-ovate, rounded to subacute and often decurved at the apex, entire or crenulate, sometimes toothed near the apex, lobule small, inflated; leaves at base of a branch often modified into large inflated sacs: underleaves bifid: leaf-cells not papillose, with somewhat thickened walls, a few of the basal cells often ocellate: ♀ inflorescence borne sometimes on a short branch, sometimes on a larger branch, innovating on one or, more rarely, on both sides; bracts similar to the leaves, but the lobe often more sharply pointed and more toothed, and the lobule plane; bracteole larger than the underleaves; perianth with four or five keels, often prolonged above as horns, surface smooth or papillose: ♂ inflorescence occupying a special branch.

1. **Ceratolejeunea oculata** (Gottsche) Steph.

Lejeunea oculata Gottsche; G. L. & N. Syn. Hep. 357. 1845.

Ceratolejeunea oculata Steph. Bull. de l'Herb. Boissier, v, 842. 1897.

Plate LII., figs. 1-2.

Autoicous: plants brownish-green, creeping: stems irregularly branched: leaves contiguous or subimbricated, the lobe widely

spreading, arching to about the middle of axis, falcate-ovate, rounded or very obtuse at the apex, entire or minutely crenulate: lobule ovate, strongly inflated, obliquely truncate or lunulate at apex, apical tooth a slender apiculum, curved toward end of keel, keel arched, free margin more or less involute as far as apex: underleaves distant, orbicular, bifid about one half with acute or subacute lobes and narrow sinus: leaf-cells with slightly and uniformly thickened walls; ocelli two or three near base of lobe, thin-walled: ♀ inflorescence borne on a short, small-leaved, lateral branch, innovating on one side with a short simple innovation; bracts smaller than the leaves, the lobe oblong to obovate, obtuse to subacute, entire, lobule obovate, rounded or emarginate at apex, entire keel, narrowly winged (on outer bract); bracteole obovate, bifid about one fourth with obtuse or subacute lobes and sinus, entire; perianth not seen: ♂ spike occupying a short lateral branch; bracts in two or three pairs, subequally bifid; bracteole at base of spike small, the others wanting.

Stems 0.09^{mm} in diameter, lobes of leaves 0.4 x 0.35^{mm}, lobules 0.1 x 0.1^{mm}, underleaves 0.15 x 0.15^{mm}, cells at edge of lobe 9 μ in diameter, in the middle 17 μ , at the base 25 x 14 μ , ocelli 40 x 21 μ , lobe of bract 0.35 x 0.17^{mm}, lobule 0.2 x 0.1^{mm}, bracteole 0.3 x 0.17^{mm}.

On *Radula Javanica*. Hawaii (Menzies).

The description given above is drawn from a part of the type-material kindly furnished me by Herr Stephani. Gottsche describes the species as monoicous, but the fragmentary plants which I have studied seem to be unisexual, so that possibly the inflorescence is variable. According to Stephani* the perianth is four-keeled in the upper half, the keels being blunt and projecting upwards beyond the short beak. The same author also points out that *C. oculata* lacks the curious inflated leaves or utriculi, usually found at the base of a branch in species of this genus. It is not, however, unique in this respect, as several species of tropical America, where the genus is particularly well represented, show the same peculiarity. The species is placed by Spruce in his subgenus *Trachy-Lejeunea*.†

11. **TRACHYLEJEUNEA** (Spruce) Schiffn.

Lejeunea subgenus *Trachy-Lejeunea* Spruce, Hep. Amaz. et And. 180. 1884.

Trachylejeunea Schiffn.; Engler & Prantl, Nat. Pflanzenfam. i³, 126. 1893.

Plants medium-sized, growing in depressed tufts or creeping among other bryophytes, pale, becoming brownish or purplish with

* Hedwigia, xxix, 76. 1890.

† Hep. Amaz. et And. 181. 1884.

age: stems irregularly pinnately branched: leaves more or less imbricated, the lobe ovate, widely spreading, mostly obtuse or subacute at apex, margin usually crenulate or serrulate from projecting cells, rarely dentate, lobule medium sized, inflated, rarely obsolete: underleaves suborbicular, usually small, bifid to about the middle with acute or obtuse lobes, entire on margin: leaf-cells with thickened walls, more or less papillose, ocelli present in a few species near base of lobe: ♀ inflorescence borne on a very short branch, without innovations or with a single sterile innovation; bracts longer than the leaves, bifid, subentire or usually crenulate; bracteole free, cuneate to oval, shortly bifid, entire or crenulate; perianth clavate or obovate, sharply five-keeled, the keels and sometimes the whole surface roughened from projecting cells: ♂ spike usually occupying a short branch.

1. *Trachylejeunea Oahuensis* sp. nov.

Plate LII., figs. 3-12.

Autoicous: creeping among other bryophytes, yellowish- or brownish-green: stems irregularly branched: leaves contiguous or subimbricated, the lobe widely spreading, falcate-ovate, convex, arching to about middle of axis, rounded at apex, entire or slightly crenulate from projecting cells; lobule ovate, strongly inflated, obliquely lunate at apex with a short apiculate tooth, keel strongly arched, forming approximately a right angle with the postical margin of lobe, free margin of lobule almost straight, strongly involute to beyond apical tooth, entire: underleaves distant, broadly ovate, bifid about two fifths with obtuse lobes and narrow sinus, entire, not cordate at base: leaf-cells with conspicuous trigones, papillose: ♀ inflorescence borne on a short branch, sometimes innovating on one side, sometimes without innovation; bracts unequally bifid, the lobe obovate, sometimes broadly so, truncate or rounded at apex, entire, lobule ovate to lanceolate, obtuse, entire; bracteole ovate, bifid about one sixth with obtuse lobes and narrow sinus; perianth obovate, truncate above and with a short beak, almost terete to above middle, then sharply five-keeled, the keels crenulate: ♂ spike occupying a short branch, bracts in two to five pairs, strongly concave, subequally bilobed with blunt divisions; bracteoles at base of spike small, shortly bifid with obtuse lobes, upper bracteoles wanting.

Stems 0.07^{mm} in diameter, lobes of leaves $0.4 \times 0.3^{\text{mm}}$, lobules $0.2 \times 0.1^{\text{mm}}$, underleaves $0.17 \times 0.15^{\text{mm}}$, cells at edge of lobe 13μ in

diameter, in the middle $23 \times 18\mu$, and at the base, $26 \times 18\mu$, lobe of bract $0.45 \times 0.35^{\text{mm}}$, lobule $0.35 \times 0.1^{\text{mm}}$, bracteole $0.35 \times 0.25^{\text{mm}}$, perianth $0.85 \times 0.45^{\text{mm}}$.

On leaves or creeping among other hepatics. Oahu : Nuuanu and Lanihuli (Cooke).

Sande-Lacoste's figures and description* of *Lejeunea decursiva* would seem to indicate that this Javan species bore a marked resemblance to the plant just described. From a specimen of the original material kindly sent me by Professor Schiffner, I find that *L. decursiva* is a *Eulejeunea*, as he has already noted,† and that it is much more branched than *Trachylejeunea Oahuensis*; the lobes of the leaves, moreover, are more rounded, their lobules are smaller and the divisions of the underleaves are more pointed. The Hawaiian species is not nearly so rough as many members of the genus, but shows, nevertheless, distinctly papillose cells in many places, and particularly on the keels of the perianths.

12. **CHEILOLEJEUNEA** (Spruce) Schiffn.

Lejeunea subgenus *Cheilo-Lejeunea* Spruce, Hep. Amaz. et And. 251. 1884.

Cheilotlejeunea Schiffn.; Engler & Prantl, Nat. Pflanzenfam. i³, 124. 1893.

Plants small or medium-sized, whitish or pale green, sometimes tinged with brown or yellow, closely appressed to substratum, creeping among other bryophytes or growing in wide, thin mats: stems irregularly pinnately branched: leaves more or less imbricated, the lobe widely spreading, rounded at apex, entire or crenulate from projecting cells; lobule ovate to cylindrical, obliquely truncate, strongly inflated: underleaves contiguous or subimbricated, medium-sized, orbicular, bifid: leaf-cells rather thin-walled but usually with distinct trigones: ♀ inflorescence borne sometimes on a short simple branch without innovations, sometimes on a longer branch with innovations on one or both sides; bracts and bracteoles similar to the leaves and underleaves; perianth more or less compressed, plane or with a very low keel antically, and with a low, sometimes bluntly two-angled keel postically: ♂ spike terminal or intercalary, sometimes occupying the whole of a short branch.

* Syn. Hep. Jav. 72. pl. 14. 1856.

† Conspect. Hepat. Arch. Ind. 248. 1898.

The four genera *Hygrolejeunea*, *Euosmolejeunea*, *Cheilolejeunea* and *Pycnolejeunea* are so closely allied that they might consistently be placed in a single genus. It is not only difficult to define them in a satisfactory way, but there are several species which fit in one about as well as in another. In fact, writers are apparently most uncertain as to the limits of these groups, and we find that certain species are placed in different genera by different authors or even by the same author at different times. A few illustrations of this statement may be quoted :

Lejeunea duriuscula Nees is placed by Spruce in *Cheilo-Lejeunea*,* a few years afterwards Stephani, in his valuable revision of the genus *Lejeunea*,† places it in *Euosmo-Lejeunea*, and, on the very next page of the same article, puts it back into *Cheilo-Lejeunea*; in Spruce's last paper‡ he too places it in *Euosmo-Lejeunea*.

Lejeunea adnata Kunze is placed by Spruce in *Cheilo-Lejeunea* (as *L. confluens* Lindenb., a synonym)§, while Stephani places it in *Pycno-Lejeunea*.||

Lejeunea phyllobola Mont. is placed by Spruce in *Cheilo-Lejeunea*,¶ and by Stephani in *Hygro-Lejeunea***.

Of the four species here referred to *Cheilolejeunea*, all have been found with perianths except *C. Sanāvicensis*. They are very uniform in appearance, and, with the exception of *C. stenoschiza*, are all of about the same size. This species is considerably larger than the others, and apparently on account of its robustness, is placed by Herr Stephani in *Pycnolejeunea*, with which it certainly has much in common.

1. *Cheilolejeunea stenoschiza* (Ångstr.).

Lejeunea stenoschiza Ångstr. Öfversigt af Kongl. Vetensk. Akad. Förhand. xxix, Häft 4, 26. 1872.

Pycnolejeunea stenoschiza Steph. Bull. de l'Herb. Boissier, v, 842. 1897.

Plate LIII., figs. 1-7.

Autoicous: plants brownish-green, closely appressed to substratum and sometimes forming patches of considerable extent: stems irreg-

* Hep. Amaz. et And. 259. 1884.

|| Hedwigia, xxix, 81. 1890.

† Hedwigia, xxix, 80, 81. 1890.

¶ L. c. 259.

‡ Jour. Linn. Soc. Bot. xxx, 346. 1894.

** L. c. 81.

§ Hep. Amaz. et And. 252. 1884.

ularly branched : leaves imbricated, the lobe convex, widely spreading, falcate-ovate, arching across axis but scarcely beyond, rounded and decurved at the apex, entire ; lobule ovate-rectangular, obliquely truncate with obtuse or acute apex, keel slightly arched, free margin almost straight as far as the apex, slightly involute toward the base, entire; underleaves contiguous or subimbricated, orbicular, not cordate but sometimes very slightly decurrent at base, attached by a short curved line of insertion, bifid one sixth to one fifth with obtuse or subacute connivent lobes and narrow sinus: leaf-cells thin-walled with small, scarcely evident trigones: ♀ inflorescence borne on a principal branch, innovating on one side, the innovation repeatedly floriferous; bracts unequally bifid, the lobe falcate-ovate, rounded at the apex, entire, lobule narrowly ovate, rounded or obtuse at the apex, entire; bracteole free, oblong, very shortly bifid (about one tenth) with subacute lobes and narrow sinus, entire; perianth about a third exserted, obovate, gradually narrowed toward the base, truncate at the apex and with a short beak, slightly compressed on sides, plane or nearly so antically and with a broad, low, two-angled keel postically: ♂ inflorescence borne on very short or slightly elongated branches, bracts in two to five pairs, imbricated, inflated, subequally bifid; bracteoles smaller than the ordinary underleaves, wanting except at base of spike.

Stem 0.1^{mm} in diameter, lobes of leaves $0.95 \times 0.5^{\text{mm}}$, lobules $0.35 \times 0.2^{\text{mm}}$, underleaves $0.5 \times 0.5^{\text{mm}}$, cells at edge of lobe 12μ in diameter, in the middle 18μ , at the base $23 \times 18\mu$, lobe of bract $0.85 \times 0.5^{\text{mm}}$, lobule $0.5 \times 0.17^{\text{mm}}$, bracteole $0.6 \times 0.4^{\text{mm}}$, perianth $1.1 \times 0.65^{\text{mm}}$.

On trees. Oahu: Nuuanu (Cooke); first collected on the island by Andersson.

An interesting feature of *Cheilolejeunea stenoschiza* is the narrow sinus of the underleaves. This is in fact so pronounced and the lobes are so strongly connivent or even overlapping, that, at first sight, the underleaves appear quite undivided. *C. Sandvicensis* resembles *C. stenoschiza* in its thin-walled leaf-cells but is amply distinct in its small and differently shaped lobules. The very common *C. intertexta*, besides being much smaller, has more deeply bifid underleaves and smaller lobules with their free margins strongly revolute. Mr. Cooke's specimens of *C. stenoschiza* agree closely with the type-material of Ångström.

2. *Cheilolejeunea intertexta* (Lindenb.) Steph.*Lejeunea intertexta* Lindenb.; G. L. & N. Syn. Hep. 379. 1845.*Cheilolejeunea intertexta* Steph. Bull. de l'Herb. Boissier, v, 842. 1897.

Plate LIV.

Autoicous: plants pale or yellowish-green, sometimes brownish, closely appressed to substratum or scattered among other bryophytes: stems irregularly pinnate: leaves imbricated, the lobe widely spreading, convex, broadly ovate, slightly falcate, arching across axis but scarcely beyond, rounded or very obtuse at the more or less decurved apex, entire; lobule strongly inflated, ovate, obliquely truncate or lunulate beyond the acute apex, keel slightly arched, free margin more or less involute as far as the apex: underleaves contiguous or subimbricated, orbicular, not cordate at the base, attached by a slightly curved line of insertion, bifid one fifth to one third with subacute spreading or connivent lobes and narrow sinus: leaf-cells papillose, with thin walls and small but distinct trigones: ♀ inflorescence borne on a principal branch or on a short lateral branch, innovating on one or on both sides, the innovations often again floriferous; bracts unequally bifid, the lobe falcate-oblong or obovate, rounded at the apex, entire, lobule ovate or oblong, rounded or obtuse at the apex, entire; bracteole oblong, bifid about one fourth with obtuse or subacute lobes and narrow sinus; perianth obovate, gradually narrowed toward the base, rounded at the apex and with a short beak, plane or nearly so on antical surface, and with a broad two-angled postical keel, slightly compressed on sides: ♂ spike terminal on a simple, usually short branch; bracts in two to ten pairs; bracteoles wanting except near base of spike: spores green, irregular in shape, but more or less oblong, with a thickened, whitish, minutely tuberculate wall.

Stem 0.09^{mm} in diameter, lobes of leaves $0.55 \times 0.4^{\text{mm}}$, lobule $0.17 \times 0.03^{\text{mm}}$, underleaves $0.3 \times 0.3^{\text{mm}}$, cells at edge of lobe 12μ in diameter, in the middle 17μ , at the base $20 \times 17\mu$, lobe of bract $0.7 \times 0.4^{\text{mm}}$, lobule $0.35 \times 0.17^{\text{mm}}$, bracteole $0.5 \times 0.35^{\text{mm}}$, perianth $0.7 \times 0.5^{\text{mm}}$, spores 25μ in shortest diameter.

On trees or creeping among other bryophytes. Oahu: Pauoa (Heller); Nuuanu (Heller, Cooke). Kauai: Kipu (Cooke).

The determination of the present species is based on a plant in Mr. Heller's collection, named by Herr Stephani. In a sterile condition, *Cheilolejeunea intertexta* closely resembles several South American species, named and distributed by Spruce, and among these, more

particularly, *C. roseoalba* and *C. heteroclada*. Both of these species differ in the ♀ inflorescence, which is not subtended by an innovation; *C. heteroclada* is moreover dioicous. Judging from Mr. Cooke's collections, *C. intertexta* is one of the commonest Lejeuneæ on the Islands.

3. *Cheilolejeunea* *Hawaïca* Steph.

Cheilolejeunea *Hawaïca* Steph. Bull. de l'Herb. Boissier, v, 847. 1897.

Plate LIII., figs. 8-14.

Autoicous: plants yellowish-brown, creeping among mosses: stems irregularly pinnately branched: leaves contiguous or subimbricated, the lobe widely spreading, falcate-obovate from a narrow base, arching to about the middle of axis, rounded at the apex, entire; lobule inflated, ovate or triangular-ovate, obliquely truncate with acute apex, keel straight or slightly curved, free margin appressed to lobe except toward base, where it is involute, entire: underleaves distant, orbicular, not cordate, attached by a slightly curved line of insertion, bifid one third to one half with acute or obtuse lobes and narrow sinus: leaf-cells with large trigones and occasional intermediate thickenings, often confluent: ♀ inflorescence borne on a principal branch, innovating on one side with a short simple innovation; bracts unequally bifid, the lobe falcate-ovate, rounded at the apex, entire, lobule linear to oblong, rounded or obtuse, entire; bracteole free, oblong, bifid about one fourth with subacute or obtuse lobes and narrow sinus; perianth obovate or cuneiform, gradually narrowed toward the base, truncate at the apex and with a short beak, somewhat compressed on sides, antical surface plane, postical surface with a broad two-angled keel: ♂ inflorescence intercalary or terminal, often on a large branch: bracts in five or six pairs.

Stems 0.08^{mm} in diameter, lobes of leaves $0.55 \times 0.35^{\text{mm}}$, lobules $0.15 \times 0.1^{\text{mm}}$, underleaves $0.2 \times 0.2^{\text{mm}}$, cells at edge of lobe 8μ in diameter, in the middle 16μ and at the base $27 \times 18\mu$, lobe of bract $0.6 \times 0.4^{\text{mm}}$, lobule $0.35 \times 0.17^{\text{mm}}$, bracteole $0.6 \times 0.35^{\text{mm}}$, perianth $0.85 \times 0.6^{\text{mm}}$.

Creeping among mosses. Hawaii? (Baldwin). Oahu: Konahuanui (Cooke).

The description given above is drawn partly from the original specimens, kindly sent me by Herr Stephani, partly from the published description of that author and partly from specimens collected

last summer by Mr. Cooke. The type-locality, Hawaii, is probably incorrect, as Mr. Baldwin did nearly all of his collecting on Maui.

C. Hawaica may be at once distinguished from the other Hawaiian species by its distant underleaves and thick-walled leaf-cells. In these respects it somewhat resembles *Trachylejeunea Oahuensis*, a smaller plant with a larger lobule, the keel of which is almost at right angles with the postical margin of the lobe, instead of forming a very obtuse angle with it as in the present species. *C. Hawaica* finds a rather close ally in the South American *C. aneogyna* (Spruce), but differs from this species in having subfloral innovations.

4. *Cheilolejeunea Sandvicensis* Steph.

Lejeunea cancellata Mont. Ann. des Se. Nat. II, xix, 262. 1843 (in part).

Lejeunea (Cheilo-Lejeunea) Sandvicensis Steph. Hedwigia, xxix, 88. 1890.

Lejeunea subligulata Evans, Trans. Conn. Acad. viii, 254. 1891.

Cheilolejeunea Sandvicensis Steph. Bull. de l'Herb. Boissier, v, 842. 1897.

Sterile: medium-sized, dull green: stems robust, pinnately branched, the branches spreading at almost a right angle: leaves slightly imbricated, the lobe widely spreading, ovate-ligulate, rotund at apex, entire; lobule small, subtriangular, strongly narrowed from a broad base, obliquely truncate beyond the acute apex, keel somewhat arched, free margin strongly involute at base, entire: underleaves distant, or bicular, bifid about two fifths with subacute, distant lobes and obtuse or lunulate sinus: leaf-cells thin-walled and without trigones.

Stems 0.12^{mm} in diameter, lobes of leaves $0.9 \times 0.6^{\text{mm}}$, lobule $0.15 \times 0.12^{\text{mm}}$, underleaves $0.25 \times 0.25^{\text{mm}}$, leaf-cells at edge of lobe 8μ in diameter, in the middle 17μ , at the base $35 \times 17\mu$.

Hawaiian Islands (Gaudichaud).

I have seen no specimens of this species and my description is largely translated from the original one, a few details being added from a drawing kindly sent me by Herr Stephani. Descriptions of the male and female inflorescences of *L. cancellata* are given by Montagne, but, as it may be questioned whether these really apply to Stephani's plant, I have omitted them from my diagnosis. *C. Sandvicensis* is apparently almost as robust as *C. stenoschiza*, which it resembles also in its thin-walled leaf-cells; it is, however, amply

distinct in its small, distant, and more deeply bifid underleaves, and in its much smaller and differently shaped lobules.

13. **LEJEUNEA** Libert.

Lejeunea Libert, Ann. Gen. des Sci. Phys. (Bruxelles) vi, 372. 1820 (in part).

Lejeunea subgenus *Eu-Lejeunea* Spruce, Hep. Amaz. et And. 260. 1884.

Eulejeunea subgenus *Eulejeunea* sensu str. Schiffn.; Engler & Prantl, Nat. Pflanzenfam. i³, 122. 1893.

Plants small or medium-sized, pale or bright green, sometimes yellowish, adhering to substratum or forming thin mats: stems irregularly pinnate: leaves contiguous or slightly imbricated, the lobe widely spreading, ovate to obovate, rounded or obtuse at apex, entire or slightly crenulate from projecting cells; lobule small, sometimes obsolete, inflated or plane: underleaves distant, small or medium-sized, bifid: leaf-cells transparent, thin-walled, though sometimes with small trigones: ♀ inflorescence borne on a principal branch, innovating on one or on both sides; bracts and bracteoles similar to the leaves and underleaves; perianth with five sharp keels, one antical, two lateral and two postical, not compressed: ♂ spike usually occupying a short lateral branch.

Of the genus *Lejeunea* in its restricted sense, only two species, *L. anisophylla* and *L. Pacifica*, are definitely known from the Hawaiian Islands. My determination of *L. Pacifica* is based on the original description of Montagne, supplemented by a drawing of the type-specimen, which I owe to the kindness of Herr Stephani. The specimens referred to *L. anisophylla* agree with a portion of the type-material preserved in the Gottsche Herbarium at Berlin.

1. *Lejeunea anisophylla* Mont.

Lejeunea anisophylla Mont. Ann. des Sc. Nat. II, xix, 263. 1843.

Plate LV., figs. 8-15.

Autoicous: plants bright or pale green, closely appressed to substratum or growing in small thin mats: stems irregularly pinnate: leaves imbricated, the lobe arching to or beyond the middle of the axis, ovate, rounded or very obtuse at the apex, entire; lobule ovate from a broad base, obliquely truncate at the subacute apex, keel slightly arched, free margin strongly involute almost to the apex:

underleaves orbicular, bifid about one half with subacute lobes and lunulate sinus, entire or slightly crenulate from projecting cells: leaf-cells with small, indistinct, and often confluent trigones and intermediate thickenings: ♀ inflorescence borne on a principal branch, innovating on one side, the innovation sometimes floriferous but usually short and sterile; bracts deeply bifid, the lobe ovate or oblong, rounded or obtuse at the apex, entire or slightly crenulate, lobule lanceolate to narrowly oblong, acute to rounded at the apex, crenulate; bracteole obovate from a narrow base, slightly connate on one side, bifid about one half with acute lobes and narrow sinus, slightly crenulate or angular-unidentate on sides; perianth obovate, cuneate toward base, truncate above and with a short beak, antical keel low, the others sharp, keels entire or slightly crenulate on the edges: ♂ inflorescence occupying a short branch or terminal on a longer one, bracts in three to five pairs, subequally bifid, with broad, rounded lobes; bracteoles confined to base of spike, small, bifid one half with acute spreading lobes and narrow sinus: spores green, oblong with a rather thin whitish wall, minutely tuberculate.

Stems 0.1^{mm} in diameter, lobes of leaves $0.6 \times 0.45^{\text{mm}}$, lobules $0.16 \times 0.13^{\text{mm}}$, underleaves $0.25 \times 0.25^{\text{mm}}$, cells at edge of lobe 16μ in diameter, in the middle 20μ , at the base $31 \times 23\mu$, lobe of bract $0.5 \times 0.25^{\text{mm}}$, lobule $0.45 \times 0.08^{\text{mm}}$, bracteole $0.45 \times 0.25^{\text{mm}}$, perianth $0.7 \times 0.5^{\text{mm}}$, spores 15μ in shortest diameter.

On bark and leaves. Oahu: Nuuanu (Cooke). Kauai: Kipu, Lihue, Molokoa (Cooke). Hawaiian Islands (Gaudichaud).

2. *Lejeunea Pacifica* Mont.

Lejeunea Pacifica Mont. Ann. des Sc. Nat. II, xix, 262. 1843.

Eulejeunea Pacifica Steph. Bull. de l'Herb. Boissier, v, 842. 1897.

Plate LV., figs. 1-7.

Autoicous or dioicous: plants pale green, closely appressed to substratum: stems irregularly pinnate: leaves distant to subimbricated, the lobe ovate to obovate, not arching across stem but forming almost a straight line above the base, rounded at the apex, entire or very slightly crenulate; lobule triangular-ovate, obliquely truncate beyond the apiculate apex, keel almost straight, continuous with postical margin of lobe, free margin strongly involute near the base, entire; lobule often poorly developed: underleaves small, distant, bifid beyond the middle with narrow subulate lobes and broad lunulate sinus, entire or nearly so: leaf-cells thin-walled, without trigones: ♀ inflorescence borne on a principal branch or on a short lateral branch,

innovating on one side or not at all, the innovation sterile or once floriferous; bracts unequally bifid, the lobe narrow at the base, ovate or obovate, rounded to subacute at the apex, entire or slightly crenulate, lobule lanceolate to ovate, acute or obtuse; bracteole free, obovate from a narrow base, bifid one half with acute lobes and sinus, entire or slightly crenulate; perianth cuneiform, gradually narrowed toward the base, broad and emarginate at the apex and with a short beak, antical keel low, lateral and postical keels sharp, slightly crenulate: ♂ inflorescence borne on a short lateral branch, bracts in three to five pairs, imbricated, subequally bifid with rounded, crenulate lobes; bracteole at base of branch bifid about one half with acute lobes and sinus, other bracteoles wanting: spores green, oblong, with a rather thin, whitish, minutely tuberculate wall.

Stems 0.07^{mm} in diameter, lobes of leaves $0.5 \times 0.35^{\text{mm}}$, lobules $0.14 \times 0.12^{\text{mm}}$, underleaves $0.15 \times 0.1^{\text{mm}}$, cells at edge of lobe 17μ in diameter, in the middle $26 \times 20\mu$, at the base $31 \times 23\mu$, lobe of bract $0.55 \times 0.3^{\text{mm}}$, lobule $0.45 \times 0.1^{\text{mm}}$, bracteole $0.35 \times 0.2^{\text{mm}}$, perianth $0.7 \times 0.4^{\text{mm}}$, spores 12μ in shortest diameter.

On leaves and bark. Oahu: Nuuanu (Cooke); also collected by Andersson. Hawaiian Islands (Gaudichaud).

The peculiar shape of the perianth places this delicate little plant in Dr. Spruce's section "*Cardianthe*," which includes half a dozen South American species. Among these, *L. drymophila* comes very close to *L. Pacifica*: it differs in its leaf-cells, which, although equally thin-walled, have minute but distinct trigones; and in the shape of its perianth, which narrows more abruptly towards the base.

In a sterile condition, *L. Pacifica* is much like *L. anisophylla*, resembling it in size, in color, and in the shape of its leaves. In *L. anisophylla*, however, the keel of the lobule forms an obtuse angle with the postical margin of the lobe instead of an almost straight line, and the leaf-cells have small trigones and intermediate thickenings. In fertile plants, the very different perianths will at once serve to separate the two species.

14. **MICROLEJEUNEA** (Spruce) Jack & Steph.

Lejeunea subgenus *Micro-Lejeunea* Spruce, Hep. Amaz. et And. 286. 1884 (in part).

Eulejeunea subgenus *Microlejeunea* Schiffn.; Engler & Prantl, Nat. Pflanzenfam. i³, 124. 1893.

Microlejeunea Jack & Steph. Bot. Centralbl. ix, 11. 1894 (reprint).

Plants very small, green or whitish-green, creeping over other bryophytes or closely appressed to substratum and sometimes forming

small flat mats: stems sparingly branched: leaves distant to subimbricated, the lobe slightly spreading or subparallel with stem, rounded to subacute at apex, entire or slightly crenulate; lobule more than half the size of lobe, inflated: underleaves distant and small, bifid: leaf-cells small, thick-walled: ♀ inflorescence borne on a principal branch or on a short lateral branch, innovating on one or, rarely, on both sides; bracts and bracteoles larger than the leaves and underleaves, but similar; perianth with five sharp, smooth keels: ♂ inflorescence occupying a short branch or terminal on a longer one.

The genus *Microlejeunea*, as thus restricted by Jack & Stephani, is represented on the Hawaiian Islands by a very common species, which has been repeatedly referred to *Lejeunea cucullata* Nees. Herr Stephani has pointed out, however, that this old species, as represented in the Lindenberg Herbarium, is composite and is made up of no less than six perfectly distinct plants.* He at first advised that the name "*cucullata*" be given up altogether, but has since restricted it to a plant from Java, the original locality of the species,† and the name is also used by Schiffner in a somewhat similar sense.‡ Stephani refers the Hawaiian plant to *Lejeunea albicans* Nees, a species first collected on the Philippine Islands. In the Gottsche Herbarium at Berlin there is a specimen of this species from Manila, which closely agrees with the Hawaiian plant, and the same is true of a specimen from Luzon in the herbarium at Kew. There is also at Kew a plant from Java, determined as *L. cucullata* by Stephani, which is evidently something quite distinct. The Hawaiian specimens in the Gottsche Herbarium, finally, which are labeled *L. cucullata* are the same as the common species and therefore agree with *L. albicans* and not with the true *L. cucullata*, as represented by this specimen at Kew. In view of these facts, I feel justified in excluding *L. cucullata* from the list of Hawaiian plants and in applying to their common *Microlejeunea* the name *M. albicans*. Herr Stephani§ has recently ascribed a second species, *M. erectifolia* (Spruce) Steph. to the Islands, but I have been unable to distinguish it.

* Hedwigia, xxix, 89. 1890.

† Jack & Steph. Bot. Centralbl. ix, 10. 1894 (reprint).

‡ Conspect. Hepat. Arch. Ind. 253. 1898.

§ Bull. de l'Herb. Boissier, v, 842. 1897.

1. *Microlejeunea albicans* (Nees) Steph.

Lejeunea cucullata Auct. (not *Jungermannia cucullata* R. Bl. & Nees).

Lejeunea cucullata γ *parasita* G. L. & N. Nova Acta Acad. Leop.-Car. xix, suppl. 1, 473. 1843.

Lejeunea albicans Nees ; G. L. & N. Syn. Hep. 387. 1845.

Micro-Lejeunea albicans Steph. Hedwigia, xxix, 88. 1890; Jack & Steph. Bot. Centralbl. lx, 10. 1894 (reprint).

Plate LVI., figs. 1-5.

Autoicous: plants pale or bright green, closely appressed to substratum, sometimes occurring in wide, thin mats: stems irregularly pinnate: leaves distant to subimbricated, the lobe slightly spreading or almost erect, ovate, reaching to about the middle of axis, rounded at the apex, entire; lobule strongly inflated, ovate, obliquely truncate or excavate beyond the apiculate apex, the apical tooth composed of one or two cells, keel strongly arched, crenulate, free margin strongly involute as far as apical tooth: underleaves distant, orbicular, bifid about one half with obtuse or subacute lobes and narrow sinus: leaf-cells papillose, pretty uniformly thickened and without distinct trigones: ♀ inflorescence borne on a short lateral branch or on a principal branch, innovating on one or, rarely, on both sides, the innovation usually floriferous; bracts unequally bifid, the lobe obovate, rounded at the apex, the lobule lanceolate and subacute, both entire; bracteole slightly connate on one side, obovate from a narrow, cuneate base, shortly bifid (about one tenth) with obtuse or subacute lobes and acute sinus, entire or obscurely angular-unidentate on sides; perianth obovate, gradually narrowed toward base, truncate above and with a short beak, antical keel low, the others sharp: ♂ inflorescence occupying a short lateral branch, bracts in two to five pairs, imbricated, subequally bifid with rounded lobes; bracteole at base of spike small, orbicular, bifid, the others wanting: spores green, oblong, with a thick, white, minutely tuberculate wall.

Stems 0.04^{mm} in diameter, lobes of leaves 0.25 x 0.15^{mm}, lobules 0.17 x 0.1^{mm}, underleaves 0.08 x 0.08^{mm}, cells at edge of lobe 9 μ in diameter, in the middle 12 μ , at the base 23 x 12 μ , lobe of bract 0.35 x 0.2^{mm}, lobule 0.3 x 0.08^{mm}, bracteole 0.4 x 0.25^{mm}, perianth 0.6 x 0.35^{mm}, spores 25 μ in shortest diameter.

On trees. Oahu: Nuuanu, Mt. Tantalus (Cooke); also collected by Didrichsen and by Meyen. Kauai: Kilohana (Cooke). Hawaii Kilauea (Didrichsen); also collected by Remy.

A very close ally, apparently, of *M. albicans* is *M. crassitexta*, described by Jack and Stephani from sterile specimens collected on the Fiji Islands. This species differs, however, in its more deeply cleft underleaves. The true *M. cucullata* has ovate, long-decurrent underleaves and differently shaped leaves.

15. **COLOLEJEUNEA** (Spruce) Schiffn.

Lejeunea subgenus *Colo-Lejeunea* Spruce, Hep. Amaz. et And. 291. 1884.

Cololejeunea Schiffn.; Engler & Prantl, Nat. Pflanzenfam. i³, 121: 1893.

Plants variable in habit, very small to medium-sized, pale green varying to brownish-green: leaves attached by a very narrow base, the lobe widely spreading, rounded to subacute at the apex, entire, crenulate, or denticulate, lobule inflated or plane, very variable in shape; stylus present, sometimes reduced to a single cell: underleaves absent, in their place clusters of rhizoids, one for each leaf: leaf-cells mostly thin-walled, often papillose: ♀ inflorescence terminal on a principal branch or on a short branch, innovating on one side, the innovation often floriferous; bracts similar to the leaves; perianth very variable: ♂ inflorescence occupying a short branch or terminal, sometimes on the main axis.

According to our present knowledge, *Cololejeunea* is represented by more Hawaiian species than any other genus of the Lejeuneæ, and it is probable that many interesting forms still remain undiscovered. The majority of the species are small and some of them are very small, and this fact, together with the epiphyllous habit of most of the tropical species, sometimes makes the plants difficult of detection. Of the seven Hawaiian species, six belong in Dr. Spruce's section *Leptocolea*, which is exclusively tropical, while the seventh species, *C. Cookei*, represents his section *Physocolea*, which is found in both tropical and temperate regions. These two sections are almost of generic importance. Most of the Hawaiian species show the disc-shaped gemmæ, whose structure and development has been fully described by Goebel.*

* Ann. du Jard. Bot. de Buitenzorg, vii, 49ff. 1888.

I. Subgenus *PHYSOCOLEA* (Spruce) Schiffn.

1. *Cololejeunea Cookei* sp. nov.

Plate LVI., figs. 6-14.

Autoicous: plants green or brownish-green, growing in loose thin mats: stems irregularly branched: leaves distant, the lobe broadly ovate, squarrose, attached to the axis by a very narrow base, rounded or very obtuse at the apex, crenulate from projecting cells; lobule ovate, plane or somewhat inflated, keels strongly arched, crenulate, free margin plane throughout or slightly involute at base, ending in a blunt tooth and bearing between this and the end of the keel a second tooth composed of two cells, crenulation less marked than on the lobe; stylus a single cell, often obsolete: leaf-cells papillose, thin-walled and without trigones: ♀ inflorescence borne on a principal branch, innovating on one side, the innovation inserted at or above the level of the opposite bract, long, not immediately floriferous; bracts at different levels, slightly bifid, the lobe and lobule rounded or very obtuse at the apex, crenulate; perianth obovate from a narrow, often stalk-like base, rounded above and narrowed into a short beak, sharply five-keeled (one antical, two lateral and two postical), the keels slightly crenulate: ♂ inflorescence terminal on a principal branch, large for the size of the plant; bracts in ten or more pairs, closely imbricated, subequally bifid; antheridia two in each axil: spores more or less oblong in shape, greenish, with a rather thick, yellowish, minutely tuberculate wall.

Stem 0.05^{mm} in diameter, leaf-lobes $0.25 \times 0.2^{\text{mm}}$, leaf-lobules, $0.18 \times 0.1^{\text{mm}}$, cells at edge and in the middle of lobe 16μ in diameter, at the base 18μ , lobe of bract $0.4 \times 0.15^{\text{mm}}$, lobule $0.35 \times 0.1^{\text{mm}}$, perianth $0.6 \times 0.35^{\text{mm}}$, spores 25μ in shortest diameter.

On bark of trees. Kauai: Molokoa, Kipu (Cooke).

Cololejeunea Cookei may be at once distinguished from all the other Hawaiian species by its minute size, its more or less squarrose leaves, its proportionately large lobule, which is often three fourths as long as the lobe, its crenulate leaf-margins and its sharply five-keeled perianth. A much nearer relative is the well-known *C. minutissima* (Sm.) Schiffn. of Europe and the southern United States. This species is, however, a little larger and has larger leaf-cells; its perichæatial bracts are subopposite and the innovation is usually below the opposite bract; the male spike is smaller and is situated on a small lateral branch. According to Spruce*, the ♂ bracts of *C.*

* Hep. Amaz. et And. 293. 1884.

minutissima are monandrous, but this character, which might seem an excellent differential one, is not constant, as, in an Italian specimen collected by the author, the bracts are distinctly diandrous.

II. Subgenus LEPTOCOLEA (Spruce) Schiffn.

2. *Cololejeunea obcordata* (Aust.).

Lejeunea obcordata Aust. Bot. Gazette, i, 36. 1876.

Plate LVII., figs. 1-6.

Autoicous: plants yellowish-green, creeping about in tufts of other bryophytes: stems irregularly pinnately branched: leaves contiguous or subimbricated, the lobe widely spreading, ovate from a very narrow base, rounded at the apex, subentire or indistinctly crenulate and angular-dentate, antical margin curved, postical margin almost straight; lobule inflated, ovate, keel slightly arched, free margin involute and entire near the base, rounded above and bearing two or three small teeth; stylus a single cell, often obsolete: leaf-cells with thickened walls, trigones and intermediate thickenings conspicuous and often confluent: ♀ inflorescence borne on a very short branch, innovating on one side with a short sterile innovation; bracts bifid, the lobule a little smaller than the lobe, both divisions ovate to oblong, rounded at the apex, subentire; perianth cuneiform, deeply emarginate and with a short and very indistinct beak at bottom of depression, strongly compressed, the two lateral keels extending upwards as widely spreading, rounded and more or less denticulate projections, antical surface plane, postical surface with a broad, low keel, both surfaces smooth: ♂ spike occupying a short branch, globose to oval, bracts in one to three pairs, imbricated, strongly inflated, unequally bifid with entire lobes.

Stems 0.05^{mm} in diameter, lobes of leaves $0.55 \times 0.35^{\text{mm}}$, lobules $0.2 \times 0.15^{\text{mm}}$, cells at edge of leaf 20μ in diameter, in the middle and at the base 25μ , lobe of bract (a) $0.5 \times 0.3^{\text{mm}}$, (b) $0.35 \times 0.25^{\text{mm}}$, lobule (a) $0.45 \times 0.3^{\text{mm}}$, (b) $0.3 \times 0.2^{\text{mm}}$, perianth 0.8^{mm} long, 0.7^{mm} wide in broadest part.

Creeping among other bryophytes. Oahu: Konahuanui (Cooke). Austin simply refers the plant to the "Sandwich Islands" and does not give the collector's name.

Cololejeunea obcordata, although closely allied to the following species, may be at once distinguished from it by its firmer texture, the leaf-cells having thick walls and very conspicuous trigones, by the position of the ♀ inflorescence and by the widely divaricate lobes.

of the perianth, which are usually dentate and not crenulate on the margin.

3. *Cololejeunea ceatocarpa* (Ångstr.) Steph.

Lejeunea ceatocarpa Ångstr. Öfversigt af Kongl. Vetensk. Akad. Förhand. xxix, Häft 4, 27. 1872.

Cololejeunea ceatocarpa Steph. Bull. de l'Herb. Boissier, v, 842. 1897.

Plate LVII., figs. 7-13.

Autoicous: plants pale green, creeping, sometimes forming thin patches of considerable size: stems irregularly pinnate: leaves distant or contiguous, the lobe widely spreading, oblong from a very narrow base, antical margin more curved than postical, rounded at the apex, entire or minutely denticulate at apex; lobule ovate, more or less inflated at least toward base, keel slightly arched, free margin slightly involute near the base, elsewhere appressed to the lobe, bearing a rounded tooth a little beyond the middle, then obliquely truncate and with a small apiculum between the tooth and the end of keel; stylus a single cell, often obsolete: leaf-cells thin-walled with small and very indistinct trigones, marginal cells near apex sometimes with angular outer walls forming minute, blunt teeth: ♀ inflorescence borne on a principal branch, innovating on one side, usually once floriferous; bracts unequally bifid, the lobe and lobule obovate, rounded at the apex, entire or the lobe usually slightly denticulate at the apex from projecting cells, the lobule with an apiculate tooth on the edge; perianth obovate, compressed, gradually narrowed toward base, obovate at apex and bearing a short beak at bottom of depression, antical surface plane, postical keel low, cells in upper part, especially on keels, papillose, making the perianth appear denticulate on the edge: ♂ spike terminal on a principal branch or occupying a short branch, bracts in five to ten pairs, smaller than the leaves, imbricated, lobe and lobule subequal in size at least toward apex of spike, entire or slightly denticulate; antheridia two in each axil.

Stem 0.05^{mm} in diameter, lobes of leaves $0.6 \times 0.35^{\text{mm}}$, lobules $0.25 \times 0.15^{\text{mm}}$, cells at edge of leaf 19μ in diameter, in the middle 21μ , at the base $40 \times 18\mu$, lobe of bract $0.65 \times 0.2^{\text{mm}}$, lobule $0.35 \times 0.12^{\text{mm}}$, perianth $0.7 \times 0.4^{\text{mm}}$.

On leaves or, more rarely, on bark. Oahu: Nuuanu (Cooke); first collected on the island by Andersson. Kauai: Hanapepe Falls (Heller).

C. ceatocarpa is apparently the commonest *Cololejeunea* on the Islands. It sometimes grows in company with *C. lanciloba* (as in Heller's specimens), but can be separated from this species even when dry from the fact that its leaves do not adhere closely to the substratum. More closely allied to it than any of the other Hawaiian species are *C. erigens* Spruce* of South America and *C. Goebelii* (Gottsche) Schiffn.† of the East Indies. In the first, the leaves are narrower and more obliquely spreading and show curious bluntly conical papillæ on the cells, particularly those at and near the apex. The papillæ project at right angles to the surface of the leaf and not beyond the margin, as do the differently shaped marginal papillæ sometimes formed on the leaves of the Hawaiian plant. The East Indian species is still closer to *C. ceatocarpa* and may prove to be identical with it: the marginal denticulations or crenulations in this species are, however, always present (although in Schiffner's var. *Acrotrema* they are very scanty) and are scattered along the whole margin, instead of being confined to the apical region. The ♂ bracts also are described as semiglobose, whereas in *C. ceatocarpa*, they are more like the ordinary leaves. The specimens collected by Cooke and by Heller agree closely with Ångström's type.

4. *Cololejeunea ovalifolia* sp. nov.

Plate LVIII., figs. 1-6.

Dioicous: brownish-green (at least when dry), closely adherent to substratum: stems irregularly pinnate: leaves distant, the lobe oval or ovate, rounded at the very narrow base and at the apex, entire; lobule oval, inflated at the base, keel arched, free margin more or less involute in lower part, ending in a blunt apex, then obliquely truncate and bearing a small tooth tipped with a papilla between apex and end of keel, lobule often much reduced; stylus a single cell, often obsolete: leaf-cells thin-walled, without trigones: ♀ inflorescence borne on a principal branch, innovating on one side, the innovation often floriferous; bracts unequally bifid, the lobe obovate, rounded at the apex, entire, lobule very narrow at the base, broader and apiculate at the apex, entire or bearing two or three blunt teeth formed from projecting cells; perianth obovate or cuneiform, not

* *Lejeunea obliqua* Spruce, Hep. Amaz. et And. 298. 1884 (not Mont.).

Lejeunea erigens Spruce, l. c. (as synonym).

Cololejeunea erigens Spruce, Hep. Spruceanae. 1892 (exsic).

† Nova Acta Acad. Caes.-Leop. 1x, 240. pl. 10. f. 1-10. 1893.

compressed, with a short beak, antical surface plane, postical surface with two sharp keels in upper part, the keels (lateral and postical) ending in subacute points or horns, cells in upper part of perianth with more or less projecting walls especially on the keels, making the latter appear slightly crenulate: ♂ inflorescence terminal on a principal branch or occupying a short lateral branch; bracts in three to eight pairs, slightly imbricated, subequally bilobed (at least near the end of the spike); antheridia two in each axil.

Stem 0.05^{mm} in diameter, leaf-lobes $0.5 \times 0.35^{\text{mm}}$, lobules $0.15 \times 0.1^{\text{mm}}$, cells at edge of lobe 17μ in diameter, in the middle 21μ , at the base 23μ , lobe of bract $0.45 \times 0.15^{\text{mm}}$, lobule $0.15 \times 0.05^{\text{mm}}$, perianth $0.5 \times 0.35^{\text{mm}}$.

On leaves. Oahu: Nuuanu (Cooke).

The specimens of this plant have so far been found only in company with *C. ceatocarpa*. It is smaller than this species and darker in color, its leaves are shorter, and their lobules are much smaller and more inconspicuous. The most striking differences, however, are to be found in the perianths: in *C. ovalifolia* this organ is not flattened and its four keels run out into four sharp horns; in *C. ceatocarpa*, the perianth is much flattened and obcordate at the apex. There is little danger of confusing the present plant with any of the other Hawaiian species.

5. *Cololejeunea Hillebrandii* (Aust.) Steph.

Lejeunea longifolia Aust. Bull. Torr. Bot. Club, v, 17. 1874 (not Mitt.).

Lejeunea Hillebrandii Aust. Bot. Gazette, i, 35. 1876.

Cololejeunea Hillebrandii Steph. Bull. de l'Herb. Boissier, v, 842. 1897.

Plate LVIII., figs. 7-11.

Dioicous: pale or whitish-green, closely creeping: stems irregularly branched: leaves distant, the lobe widely spreading, ovate to lanceolate, gradually narrowed into an acute, obtuse or rounded apex, entire; lobule ovate, inflated at least toward base, keel arched, free margin appressed to lobe, curved toward base, bearing an obtuse tooth at about the middle, obliquely lunulate beyond, and with a small tooth in the middle of the lunation; stylus a single cell, often obsolete: leaf-cells more or less elongated, at least toward middle and base of lobe, thin-walled and without trigones: ♀ inflorescence borne on a principal branch, innovating on one side (or rarely on both), the innovation once floriferous; lobe of bracts similar to that

of normal leaves, lobule attached by an almost straight keel, oblong in shape, with a papilla near the free upper angle and a second one on the inner edge near the apex; perianth obovate, truncate or rounded above, and narrowed into a very short beak, subterete (without distinct keels), smooth: ♂ inflorescence terminal on a principal branch or occupying a short branch, bracts in three to six pairs, contiguous or subimbricated, sometimes scarcely different from the leaves in shape, sometimes subequally bifid; antheridia two in each axil.

Stem 0.08^{mm} in diameter, lobes of leaves 0.85 x 0.25^{mm}, lobules 0.35 x 0.15^{mm}, cells at edge of lobe 35 x 18 μ , in the middle 30 x 16 μ , at the base 37 x 14 μ , lobe of bract 0.7 x 0.2^{mm}, lobule 0.25 x 0.05^{mm}, perianth 0.6 x 0.25^{mm}.

On *Dumortiera* and also on leaves. Hawaiian Islands (Hillebrand). Oahu: Konahuanui (Cooke).

The present species is known only from the type-material in the Austin Herbarium and from a few fragmentary specimens collected last summer by Mr. Cooke. A part of the type was kindly sent me by Mr. Pearson, and has served for the above description. The leaf-cells of *C. Hillebrandii* are variable in shape; sometimes they are elongated as in the ones whose measurements are given, sometimes they are more nearly isodiametric. In comparing this plant with other Hawaiian species, its closest ally seems to be *C. ceatocarpa*. Even in a sterile condition, however, the difference in the shape of the leaves at once suffices to distinguish them: in *C. Hillebrandii*, the lobes narrow very much toward the apex, and the broadest part is just above the base; in *C. ceatocarpa*, the lobes are broad at the apex, and the broadest part is nearer the middle. The perianths of *C. Hillebrandii* are very scanty in the plants examined and are apparently not perfectly developed. It can be made out, however, that they are scarcely if at all flattened, and that they show no signs of anything like projections or cordations at the apex. They would, therefore, afford important differential characters for the two species.

6. *Cololejeunea lanciloba* Steph.

Cololejeunea lanciloba Steph. Hedwigia, xxxiv, 250, 1895.

Plate LIX., figs. 1-7.

Autoicous: plants green, closely appressed to substratum, sometimes forming patches of considerable size: leaves slightly imbricated, the lobe plane, obliquely spreading, arching beyond axis and rounded at the very narrow, almost transverse base, oval, rounded at

the apex, hyaline-margined except near the base, margin entire, almost straight at postical base; lobule plane, subulate from a narrow base, acute or obtuse, bearing a short tooth below the middle of the inner edge, otherwise entire or nearly so, keel short, straight, almost at right angles with axis; stylus a single cell, often obsolete: leaf-cells with small trigones and occasional intermediate thickenings; hyaline marginal cells in one or two rows at the apex, in one row elsewhere, thin-walled: ♀ inflorescence borne on a short branch with smaller leaves than the main axis, innovating on one side, the innovation usually once or twice floriferous; bracts very deeply and unequally bifid, the lobe elliptical, rounded at the apex, entire, hyaline-margined at and near the apex, lobule elliptical, rounded, truncate or emarginate at the apex, entire or with a blunt tooth near the middle of the inner edge; perianth obovate, gradually narrowed toward base, truncate and emarginate at the apex, and with a short broad beak, plane on antical surface, and with a low postical keel, smooth: ♂ inflorescence terminating a branch; bracts in five to ten or more pairs, closely imbricated, lobe attached to lobule by an arched keel about half as long as bract; lobule inflated, with its free margin strongly involute; antheridia two in the axil of each bract.

Stem 0.07^{mm} in diameter, lobes of leaves (on robust axis) $0.95 \times 0.65^{\text{mm}}$, lobules $0.3 \times 0.1^{\text{mm}}$, leaf-cells just within hyaline margin of lobe 12μ in diameter, in the middle 15μ , at the base $32 \times 17\mu$, lobe of bract $0.7 \times 0.3^{\text{mm}}$, lobule $0.35 \times 0.15^{\text{mm}}$, perianth $0.75 \times 0.5^{\text{mm}}$.

On leaves of *Eugenia Malaccensis*. Kauai: Hanapepe River (Heller). Oahu: Nuuanu (Cooke).

Cololejeunea lanciloba is the largest Hawaiian representative of the genus. In common with *C. longistylis*, the lobes of its leaves are hyaline-margined, but it is readily distinguished from that species and from all the others known from the Islands, by its remarkable, plane and narrow lobules. The species was first described from specimens collected on the Nicobar Islands.

7. *Cololejeunea longistylis* sp. nov.

Plate LIX., figs. 8-16.

Sterile: pale green, closely appressed to substratum: stems irregularly branched: leaves imbricated, the lobe obliquely spreading, ovate-oblong, rounded and hyaline-margined at the apex, entire, antical margin slightly curved, postical margin almost straight; lobule inflated, ovate, keel cordate at the base, then almost straight and con-

tinuous with postical margin of lobe, free margin of lobule slightly involute near base, bearing an obtuse tooth ending in a single cell at about the middle, and between this and the end of the keel, bearing a larger, broad, obtuse or subacute tooth; stylus three to six cells long, often two cells broad at and near the middle: leaf-cells thin-walled, hyaline cells at apex in one to three rows.

Stem 0.08 in diameter; lobes of leaves $0.6 \times 0.35^{\text{mm}}$, lobules $0.25 \times 0.2^{\text{mm}}$, cells at edge of lobe 14μ , in the middle 17μ , at the base $26 \times 14\mu$.

On bark of *Aleurites Mollucana*. Oahu: Nuuanu (Cooke).

Cololejeunea longistylis is at present known from sterile material only, but it is so different from the other Hawaiian species that it can be easily and surely distinguished. It resembles *C. lanciloba* in having hyaline marginal cells, but these are limited to the apical region of the lobe; in general appearance too it approaches *C. cœtocarpa*, but in this species the leaves are widely spreading and the lobule is different in shape; the most important character, however, which distinguishes it not only from these two species, but from all the others, is the multicellular stylus. A very close ally of *C. longistylis* is *C. stylosa* (Steph.)*, from the island of Luzon. This plant has likewise hyaline cells at the apex of the lobe and a multicellular stylus, but its leaf-lobes spread more widely and are more pointed and the lobules are very different in shape. *C. stylosa* is also known in sterile condition only.

16. **COLUROLEJEUNEA** (Spruce) Schiffn.

Colura Dumort. Recueil d'obs. sur les Jung. 12. 1835. (not *Coluria* R. Br.).

Lejeunea subgenus *Coluro-Lejeunea* Spruce, Hep. Amaz. et And. 303. 1884.

Colurolejeunea Schiffn.; Engler & Prantl, Nat. Pflanzenfam. i³, 121. 1893.

Plants small, pale or yellowish-green, scattered or forming small tufts: stems irregularly pinnate, closely appressed to substratum: leaves ascending, squarrose, attached by a very narrow base and ending in a variously shaped hollow sac, derived from the lobes and in many cases closed by a valvular arrangement; lobule small, margin strongly involute and enclosing a canal leading to the apical sac: underleaves doubled, deeply bifid with subulate lobes: ♀ inflo-

* Hedwigia, xxvii, 289. pl. 11. f. 9, 19-17. 1888.

† Cf. Goebel, Organographie der Pflanzen, 286. 1898.

rescence borne on a principal branch, innovating on one side, the innovation often floriferous; bracts smaller than the leaves, plane, entire, without clear indication of lobule; bracteole usually absent;* perianth variable in shape: ♂ spike small, occupying a short lateral branch; bracts inflated, subequally bifid.

1. *Colurolejeunea tenuicornis* sp. nov.

Lejeunea calyptrifolia, var. Ångstr. Öfversigt af Kongl. Vetensk. Akad. Förhand. xxix, Häft 4, 28. 1872 (misprinted "*L. calyptrata*").

Plate LIX., figs. 17-21.

Autoicous: plants pale green, scattered or in small tufts: stems sparingly branched: leaves distant, ascending in a curved line from the axis and not at all adherent to substratum, oblong in general outline and gradually narrowed above into a long, hollow slender horn, about half the length of the entire leaf and finely denticulate at the apex (with two or three teeth), free portion of lobe orbicular from a broad base, truncate, entire; lobule tubular, the free margin strongly involute; sac inflated in lower part, then narrowing into horn; leaf-cells thin-walled, papillose in narrowing portion of sac: underleaves distant, bifid to near the base with slender subulate divisions and obtuse sinus, entire: ♀ inflorescence borne on a principal branch, innovating on one side; bracts oblong or obovate, rounded or obliquely truncate at the apex, entire; bracteole apparently wanting; perianth oblong or obovate from a narrow base, truncate at the apex and with a very short beak, terete below, five-keeled in upper part, the keels running out into long, horizontally spreading horns, denticulate at the end: ♂ spike small, occupying a short branch; bracts in two or three pairs; antheridia two in each axil.

Stem 0.08^{mm} in diameter, leaf $1.6 \times 0.25^{\text{mm}}$, underleaf $0.15 \times 0.15^{\text{mm}}$, cells at free margin of lobe 20μ in diameter, on surface of sac $23 \times 17\mu$, bracts $0.4 \times 0.1^{\text{mm}}$ perianth $0.6 \times 0.2^{\text{mm}}$.

On leaves of a fern. Oahu: Nuuanu (Cooke); also collected by Andersson.

The rare European *C. calyptrifolia* (Hook.) Schiffn., as represented in the Kew Herbarium, is very close to this curious Hawaiian plant but differs in the much shorter horns of its leaves and perianths.

* A bracteole is described for *C. obtusa* Steph. (Hedwigia, xxx, 208. pl. 29. f. 31-34. 1891), and for *C. Ari* Steph. (l. c. xxxv, 73. 1896).

In addition to the *Lejeuneæ* described and noted in this paper, the two following species, both of which are rather widely distributed in tropical America, are accredited to the Hawaiian Islands: *Prionolejeunea microdonta* (Gottsche) Steph. and *Stictolejeunea squamata* (Willd.) Schiffn. I have looked in vain for Hawaiian specimens of these plants in the herbaria at Kew and Berlin, and Herr Stephani makes no mention of such specimens in his paper on the *Lejeuneæ* in the Lindenberg Herbarium at Vienna. I have therefore omitted them, as it is probable that they were listed on incorrect determinations.

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EXPLANATION OF PLATES.

PLATE XLIV.

Frullania Aongstroemii Evans.—Fig. 1. Part of stem with perianth and andrœcium, postical view, $\times 14$.—Fig. 2. Part of stem, postical view, $\times 14$.—Fig. 3. Leaf, antical view, $\times 14$.—Figs. 4, 5. Bases of branches, postical view, $\times 14$.—Fig. 6. Cells from middle of lobe, $\times 255$.—Fig. 7. Innermost bracts and bracteole, $\times 14$.—Fig. 8. Bracts and bracteole of second row, $\times 14$.—Figs. 9, 10. Bract and bracteole of third row, $\times 14$.—Fig. 11. Transverse section of perianth, $\times 14$. All figures drawn from specimens collected by Mr. Cooke at Luakaha, on the island of Oahu.

Frullania Oahuensis Hampe.—Fig. 12. Part of stem with perianth, postical view, $\times 28$.—Fig. 13. Leaf, antical view, $\times 28$.—Fig. 14. Base of branch, postical view, $\times 28$.—Fig. 15. Cells from middle of lobe, $\times 255$.—Figs. 16, 17. Bracts and bracteole of innermost row, $\times 28$.—Fig. 18. Bract and bracteole of second row, $\times 28$.—Fig. 19. Bract and bracteole of innermost row from another involucre, $\times 28$. All figures drawn from specimens collected by Mr. Cooke on the island of Kauai.

PLATE XLV.

Frullania Sandvicensis Ångstr.—Fig. 1. Part of stem, postical view, $\times 14$.—Fig. 2. Leaf, antical view, $\times 14$.—Fig. 3. Base of branch, postical view, $\times 14$.—Fig. 4. Cells from middle of lobe, $\times 255$.—Figs. 5, 6. Bracts and bracteole of innermost row, $\times 14$.—Fig. 7. Perianth, $\times 14$.—Figs. 1–4 from specimens collected by Mr. Heller at Nuuanu, on the island of Oahu; Figs. 5–7 from specimens collected by Mr. Cooke on the same island.

Frullania Meyeniana Lindenb.—Fig. 8. Part of stem with perianth and andrœcium, postical view, $\times 28$.—Fig. 9. Leaf, antical view, $\times 28$.—Fig. 10. Base of branch, postical view, $\times 28$.—Fig. 11. Cells from middle of lobe, $\times 255$.—Fig. 12. Bracts and bracteole of innermost row, $\times 28$.—Figs. 13, 14. Bracts and bracteole of second row, $\times 28$. All figures drawn from specimens collected by Mr. Cooke at Kilohana, on the island of Kauai.

PLATE XLVI.

Frullania apiculata (R. Bl. & Nees) Dumort.—Fig. 1. Part of stem with perianth and andrœcium, postical view, $\times 20$.—Fig. 2. Part of stem, antical view, $\times 20$.—Figs. 3, 4. Bases of branches, postical view, $\times 20$.—Figs. 5, 6. Bases of branches, antical view, $\times 20$. Fig. 7. Cells from middle of lobe, $\times 360$.—Figs. 8-10. Bracts and bracteole of innermost row, $\times 20$.—Figs. 11-13. Bracts and bracteole of second row, $\times 20$. All figures drawn from specimens collected by Mr. Cooke at Lulumahu, on the island of Oahu.

PLATE XLVII.

Frullania hypoleuca Nees.—Fig. 1. Part of stem with perianth and andrœcia, postical view, $\times 14$.—Fig. 2. Leaf, antical view, $\times 14$.—Fig. 3. Base of branch, postical view, $\times 14$.—Fig. 4. Cells from middle of lobe, $\times 255$.—Figs. 5-6. Bracts and bracteole of innermost row, $\times 14$.—Figs. 7-9. Bracts and bracteole of second row, $\times 14$.—Figs. 10, 11. Bracts and bracteole of third row, $\times 14$. All figures drawn from specimens collected by Mr. Cooke on Mt. Tantalus, on the island of Oahu.

Jubula piligera (Aust.) Evans.—Fig. 12. Part of stem with perianth and andrœcium, postical view, $\times 14$.—Fig. 13. Part of stem, antical view, $\times 14$.—Fig. 14. Base of branch, postical view, $\times 14$.—Fig. 15. Base of same branch, antical view, $\times 14$.—Fig. 16. Cells from middle of lobe, $\times 255$.—Figs. 17-19. Bracts and bracteole, $\times 14$.—Fig. 20. Underleaf next bracteole, $\times 14$. All drawings from specimens collected by Mr. Baldwin on the island of Kauai.

PLATE XLVIII.

Lopholejeunea subnuda (Mitt.) Steph.—Fig. 1. Part of stem with perianth and andrœcium, postical view, $\times 14$.—Fig. 2. Part of stem, antical view, $\times 14$.—Fig. 3. Cells from middle of lobe, $\times 255$.—Figs. 4-6. Bracts and bracteole. All figures drawn from specimens collected by Mr. Cooke on the island of Oahu.

Platylejeunea baccifera (Tayl.) Steph.—Fig. 7. Part of stem with ♀ inflorescence, postical view, $\times 15$.—Fig. 8. Cells from middle of lobe, $\times 255$.—Figs. 9-11. Bracts and bracteole, $\times 14$. All drawings from specimens collected by Menzies on the island of Hawaii.

Marchesinia Mittenii Evans.—Fig. 12. Part of stem, postical view, $\times 14$.—Fig. 13. Cells from middle of lobe, $\times 255$.—Fig. 14. Free margin of lobule, $\times 200$. All figures drawn from the type-specimens.

PLATE XLIX.

Thysananthus elongatus (Aust.) Evans.—Fig. 1. Part of stem with perianth, postical view, $\times 16$.—Fig. 2. Part of sterile stem, postical view, $\times 16$.—Fig. 3. Part of stem with perianth, postical view, $\times 16$.—Fig. 4. Part of stem, antical view, $\times 16$.—Fig. 5. Perianth and bracts, antical view, $\times 16$.—Fig. 6. Cells from middle of lobe, $\times 290$.—Figs. 7-9. Bracts and bracteole, $\times 16$.—Figs. 10, 11. Bracts and bracteole from another involucre, $\times 16$.—Figs. 12, 13. Transverse sections of perianths, $\times 32$. Fig. 1 is drawn

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**IX.—NOTES ON SOME TYPE-SPECIMENS OF MYXOMYCETES IN THE
NEW YORK STATE MUSEUM.—BY W. C. STURGIS, PH.D.**

AMONG the earlier students of the Myxomycetes in this country, Professor C. H. Peck of the New York State University stands pre-eminent for the number of species recorded and described. A careful examination of Professor Peck's Annual Reports from 1869 to 1893 reveals the fact that during that period no less than 107 species were recorded by him, largely from the State of New York. Of these, 33 are described as new.

Until 1875, the date of Rostafinski's Monograph, the facilities for the systematic study of the Myxomycetes were very meagre. It is not surprising, therefore, to find that much of the work done by Professor Peck, previous to that date, had to undergo considerable revision later. In his Thirty-first Report, for the year 1877, he gives a list of the species recorded by him up to that time, and the same revised in accordance with Rostafinski's Monograph. It is a notable fact that of the 77 species included in this list, 44 remain unchanged in the revision. But, in common with all American students of the Myxomycetes, Professor Peck labored under the disadvantage of having access to very few, if any, of the European type-specimens which formed the basis of Rostafinski's Monograph. His revision, therefore, was based on descriptions and figures merely, and, as was to be expected under the circumstances, did not prove to be final. As time progressed and the critical study of the group began to feel the stimulus of Rostafinski's work, further revision became necessary. Many of Professor Peck's species were either eliminated or transferred by the author himself, but a number still remained awaiting careful examination and final disposition. When Mr. Arthur Lister undertook the task of preparing a monograph of the Myxomycetes, and later when Professor Macbride did the same for the North American species, it became necessary, of course, for both authors to take cognizance of Professor Peck's species and to assign them to definite positions. This, however, was a matter of considerable difficulty. That author's original descriptions and figures, judged by modern standards, are in most cases inadequate, and, so far as I can learn, the specimens themselves were never generally distributed, indeed some of them appear now to be lost. A few were

apparently sent to Dr. Rex, or at least examined by him, but as a rule Mr. Lister was obliged to rely chiefly upon the original descriptions or upon specimens sent to him by Dr. Rex as authentic. How far Professor Macbride was enabled to examine the type-specimens I do not know, but my impression is that his knowledge of them rests upon the same basis as that of Mr. Lister. It is interesting, therefore, to note the history of these thirty-three species.

The following list includes, I believe, every species described by Professor Peck; in each case I have given the original name, the name as it appeared after revision by the author, and the final disposition of the species by Messrs. Lister and Macbride respectively.

From an examination of this list of species, it is apparent that there exists, among the authorities, a considerable difference of opinion with regard to many of them. This seems to be due in a measure to the fact that the type-specimens themselves have not been sufficiently examined. Acting upon this supposition, I requested from Professor Peck permission to examine the material in the herbarium of the New York State Museum at Albany. This was most courteously accorded me, and I desire here to express my thanks to Professor Peck for his kindness in the matter. In November, 1899, I visited Albany and examined the greater portion of the Myxomycetes in the herbarium, paying special attention to the species originally described by Professor Peck. Notes were made upon each one, indicating the habit, color, and other external features, while for the microscopic detail, mountings in glycerine were made upon glass slides and preserved for future study.

Of the 33 species originally described by Professor Peck, type-specimens of 17 were examined on the spot. Later I received, through the kindness of Professor Peck, 10 more type-specimens not before examined, making 27 in all. These species are marked with an asterisk in the list. Of the remaining 6 species, *Didymium angulatum* is not represented in the herbarium; the specimens of *Stemonitis Morgani*, *Comatricha subcaespitosa* and *Comatricha longa* are not at present accessible; *Didymium oxalinum*, though not included in the collection, has been otherwise, and doubtless correctly, referred by Professor Peck himself; *Aethalium geophilum* has been decided by Professor Peck to belong, not to the Myxomycetes but to the doubtful genus *Hyphelia*, Fr., a near relative of *Botrytis*, and is therefore not included in the list.

For the reasons above stated it has seemed to me highly advisable that the type-specimens still existing should be accurately described

PECK.

- **Didymium magnum*, Pk.
- **Craterium obovatum*, Pk.
- **Physarum albicans*, Pk.
- **Didymium subroseum*, Pk.
- **Physarum atrorubrum*, Pk.
- * " *inaequalis*, Pk.
- * " *pulcherripes*, Pk.
- * " *ornatum*, Pk.
- * " *intecolum*, Pk.
- * " *citrimellum*, Pk.
- **Didymium flavidum*, Pk.
- **Licea ochracea*, Pk.
- **Physarum mirabile*, Pk.
- **Diderma flavidum*, Pk.
- * " *crustaceum*, Pk.
- * " *farinaceum*, Pk.
- **Diachæa splendens*, Pk.
- * " *subsessilis*, Pk.
- Didymium oxalinum*, Pk.
- * " *connatum*, Pk.
- * " *eximium*, Pk.
- * " *angulatum*, Pk.
- Stemonitis Morgani*, Pk.
- * " *herbatica*, Pk.
- Comatricha subcespitosa*, Pk.
- * " *longa*, Pk.
- * " *aequalis*, Pk.
- **Physarum caespitosum*, Pk.
- **Trichia reniformis*, Pk.
- **Perichæna flavida*, Pk.
- **Oligonema brevifila*, Pk.
- **Arcyria macrospora*, Pk.

LISTER.

- Badhamia magna*, Pk.
- " *rubiginosa*, Rost.
- Physarum globuliferum*, Pers.
- (Not mentioned.)
- Physarum pulcherrimum*, B. & R.
- " *inequale*, Pk.
- " *pulchripes*, Pk.
- " *viride*, Pers.?
- " *virescens*, Ditm.?
- Craterium citrimellum*, List.
- (Not mentioned.)
- Fuligo ochracea*, Pk.
- Physarella mirabilis*, Pk.
- (Original name not mentioned.)
- Chondrioderma globosum*, Rost.
- (Original name not mentioned.)
- Diachæa splendens*, Pk.
- " *subsessilis*, Pk.
- (Not mentioned.)
- { *Physarum globuliferum*, Pers.? }
- { " *compressum*, A. & S. }
- Didymium nigripes*, Fr. var. *eximium*.
- " *effusum*, Lk.?
- Stemonitis splendens*, Rost.
- " *herbatica*, Pk.
- Comatricha obtusata*, Pr.
- " *longa*, Pk.
- " *obtusata*, Pr.
- Lindbladia Tubulipa*, Fr.
- Trichia contorta*, Rost.
- Oligonema nitens*, Rost.
- " "
- Arcyria ferruginea*, Saut.?

MACBRIDE.

- Badhamia capsulifera* (Bull.), Berk.?
- " *rubiginosa*, Rost.
- Physarum globuliferum*, Pers.
- (Not mentioned.)
- Physarum pulcherrimum*, B. & R.
- " *lateritium* (B. & R.), Rost.
- " *rufipes* (A. & S.), Morg.
- " *aurescens*, Cke.
- (Not mentioned.)
- Physarum caespitosum*, Schw.
- (Not mentioned.)
- Fuligo muscorum*, A. & S.
- Physarella oblonga* (B. & C.), Morg.
- (Original name not mentioned.)
- Diderma crustaceum*, Pk.
- (Original name not mentioned.)
- Diachæa splendens*, Pk.
- (Not mentioned.)
- (Not mentioned.)
- Physarum nephroideum*, Rost.
- Didymium eximium*, Pk.
- (Not mentioned.)
- Stemonitis Morgani*, Pk.
- " *axifera* (Bull.), Macbr.
- Comatricha Persoonii*, Rost.
- " *longa*, Pk.
- " *aequalis*, Pk.
- Lindbladia effusa* (Fhr.), Rost.
- Trichia contorta*, Rost.
- Oligonema flavidum* (Pk.), Mass.
- " *brevifila*, Pk.
- Arcyria ferruginea*, Saut.

and their relationships determined as nearly as possible. In the following notes I have endeavored to do this, paying special attention to those species regarding which there is a considerable divergence of opinion on the part of expert authorities.

BADHAMIA MAGNA, Pk. (*Dictydium magnum*, Pk.), Rep. XXIV, p. 84, 1871, and Rep. XXXI, p. 57, 1878.* Sporangia spherical to obovoid, occasionally confluent, 0.8–1^{mm} in diameter; gray, iridescent and marked with white wrinkles; clustered on long, yellowish, membranous and filiform stalks 5–7^{mm} in length. Sporangium-wall hyaline, almost devoid of lime and very delicate. Columella absent. Capillitium, a loose, brittle network of delicate, branching tubes, expanded at the angles; partly filled with small, white lime-granules, and partly empty and shrunken. Spores not clustered, dark purplish-brown, 10.5–11.5 μ in diameter, minutely and equally spinulose all over. (Pl. LX, figs. 1 & 2.) *Hab.* On old *Polyporus*. *Loc.* Center, N. Y. *Leg.* C. H. Peck.

The type-specimen is a very fine and abundant one, exactly resembling in outward appearance the long-stalked forms of *B. utricularis*, Berk. It differs from that species, however, in the more delicate and less calcareous capillitium and in the character of the spores, which are not even loosely clustered and are much less distinctly spinulose. Although the spores are sometimes slightly darker on one side than on the other, when highly magnified the whole surface is seen to be evenly covered with the minute spines. From *B. hyalina* it differs in the character of the stalk, the more delicate capillitium, the segregation and finer markings of the spores, and the habitat. (Cf. Pl. LX, figs. 1–7.) For the present, at least, we must consider *Badhamia magna*, Pk., as a distinct species, though allied to *B. utricularis*, Berk., a fact also noted by Peck (Rep. XXXI, p. 57). This close relationship is emphasized by the fact noted by Lister (Mon., p. 31), that sporangia of *B. utricularis* from the same plasmodium exhibit marked differences in the quantity of lime contained in the capillitium and in the degree of agglutination of the spores. The peculiar habitat of the two species is the same.

Maebride doubtfully refers Peck's species to *B. capsuliferi* (Bull.), Berk. [*B. hyalina* (Pers.), Berk.], on the mistaken supposition that the spores are coherent. In his Key to the species of *Badhamia* (N. Amer. Slime-Moulds, p. 63), it falls readily under *B. utricularis*, Berk.

* Throughout this paper these references are to the Annual Reports of the State Botanist of New York, published in the reports of the New York State Museum of Natural History.

CRATERIUM OBOVATUM, Pk., Rep. XXVI, p. 75, 1873. This species requires but little comment. It is a perfectly typical specimen of *Badhamia rubiginosa*, Rost., and is so referred by both Lister and Macbride. The spores are of the normal type characteristic of Lister's var. *genuina*.

PHYSARUM ALBICANS, Pk., Rep. XXX, p. 50, Pl. II, figs. 5-8, 1877. The very scanty type-specimen shows a few scattered sporangia, globose, pure white, and borne upon delicate, white stalks charged throughout with lime. The capillitium is very delicate but persistent, retaining the form of the sporangium after the wall of the latter has disappeared; it arises from a small, hemispherical or slightly conical, white columella. The lime-knots are small, whitish and fusiform or round. The spores are bright violet-brown, almost smooth, and measure 7.5-8.4 μ in diameter. (Pl. LX, fig. 9.) These are so evidently the characteristics of *Physarum globuliferum*, Pers., that there can be no hesitation in referring the specimen to that species, as is done by Lister and Macbride. The only peculiarity about the specimen is seen in the slightly swollen bases of the stalks, filled with large, globular masses of lime and refuse matter which readily separate from the enclosing wall of the stalk. (Pl. LX, fig. 8.)

PHYSARUM ALBICANS, var. SUBROSEUM, Pk. (*Didymium subroseum*, Pk.), Rep. XXVIII, p. 54, 1875; Rep. XXX, p. 50, 1877; Rep. XXXI, p. 55, 1878. A single small specimen of this form accompanies the type-specimen of *P. albicans*, Pk. Professor Peck considered it as a variety of that species on account of "the pinkish tinge of the peridium." This feature is not now apparent and the so-called variety should be merged with the species.

PHYSARUM ATROBRUBRUM, Pk., Rep. XXXI, p. 40, 1878. The type-specimen of this most beautiful species is rather scanty, but is quite sufficient for accurate determination. Lister and Macbride agree in referring it to *P. pulcherrimum*, B. & R., and notwithstanding the meagre character of the original description of that species and the apparent absence of any specimen of it, the words "*stipite brevi purpureo; peridio globoso floccisque lilacinis*," apply so perfectly to the species described by Peck and to no other with which we are acquainted, that we can but conclude that the two species are identical. The color of Peck's type-specimen is almost exactly that of *Dictydium umbilicatum*, Schrad. The original description of the species, repeated by Macbride (N. A. Slime-Moulds, p. 49), is thoroughly adequate and covers the main features observed in the type-specimen.

PHYSARUM INÆQUALE, Pk., Rep. XXXI, p. 40, 1878. The difference of opinion expressed by Lister and Macbride regarding this species rests merely on a question of nomenclature. That *Physarum inæquale*, Pk., and *Didymium lateritium*, Berk. & Rav., are the same thing, there is no room for doubt, since the fact of their identity is proved by type-specimens. If one adopts the principle that a specific, sub-specific, or varietal name originally given remains unaffected by any subsequent change in the generic name of the same species, then the name *Physarum lateritium* (B. & R.), Rost., stands, and *P. inæquale*, Pk., becomes a synonym. If, on the other hand, one prefers the principle that the first authentic specific name published under the genus in which the species now stands, shall take precedence, then the name *Physarum inæquale*, Pk., must be accepted, since, although Rostafinski transferred the present species to the genus *Physarum*, he made *lateritium* a varietal, not a specific name, and the specific name *inæquale* was the first authentic one which the species received after its transfer from the genus *Didymium*.

The type-specimen is very scanty, but it shows the rather peculiar characteristics of the species; the membranous sporangium-wall with innate, pale yellow granules of lime and beset with reddish-orange masses which give it a rugose appearance; and the large, rounded lime-knots of the capillitium, yellow, with reddish-orange centres, and connected by extremely delicate threads. The reddish masses seen on the surface of the sporangia and occupying the center of the lime-knots are amorphous accretions consisting apparently of plasmodic matter. Their appearance and structure are quite different from those of the lime-granules proper. In the type-specimen the latter are always spherical, pale yellow, and exceptionally large. The peculiar structure and double coloration of the lime-knots is very apparent in the type-specimen (although here and there one is seen which does not show the red center), and in all of the specimens of this species which I have seen. The great variation in the size of the spores which led Peck to suppose that the larger ones were "an investing membrane which encloses the true spores," is evidently due to the immature condition of parts of the specimen.

PHYSARUM PULCHERRIPES, Pk., Rep. XXVI, p. 75, 1873. The type-specimen is an exceptionally fine one. The following description is made from a portion of the specimen sent me by Professor Peck.

Sporangia stipitate, globose, slightly umbilicate beneath, 0.4–0.5^{mm} in diameter. Wall membranous, grey, hyaline, rugose with clusters of reddish-orange lime-granules. Stalk slender, terete, sulcate, erect or curved, twice the height of the sporangium, reddish-orange, charged throughout with lime, rising from a small, concolorous hypothallus. Columella small, conical. Capillitium delicate, persistent, hyaline. Lime-knots small, triangular, rounded, or fusiform, reddish-orange. Spores pale violet-brown, 7.5–9 μ in diameter, almost smooth. *Hab.* On moss, growing on decayed wood.

The distinction between this species and *P. psittacinum*, Ditm., to which it bears a certain external resemblance, is admirably pointed out by Macbride (l. c., p. 51).

A comparison between the above description and that given by Lister of *P. pulchripes*, Pk. (l. c., p. 41), makes it evident that the latter must have been made from an authentic specimen at least, and when Lister states that he has examined a type-specimen of *Didymium Ravenelii*, B. & C., and that it is identical with Peck's species, it seems impossible to follow Macbride in regarding them as distinct. If they are the same, then assuredly Macbride is mistaken in making *Physarum murinum*, List. synonymous with *Didymium Ravenelii*, B. & C., if color counts for anything. As to the proper name for Peck's species, Lister, in retaining Peck's name (with a slight change in the orthography), seems to have overlooked the fact that Albertini and Schweinitz (*Consp. Fung.*, p. 94), described as var. *rufipes* of *Physarum aurantium*, (Bull.) Pers., a form, the description of which might possibly apply to the species under consideration. The description, however, though long, is not sufficiently exact in detail to enable us to determine what species the authors had under consideration. They suggest that it may be worthy of specific rank and Fries accords it this position under the name *Diderma rufipes*, Fr. (*Syst. Myc.* III, p. 101). All we can say is that these authors described a form very similar to *Physarum aurantium* (Bull.) Pers. (*Tilmadoche mutabilis*, Rost.), but differing in the color of the stalk, which is described as "*ex aurantio rufi*." Upon this basis Macbride rehabilitates the variety, accords it specific rank, and gives *Physarum pulchripes*, Pk., as a synonym. A safer course, and one less liable to lead to confusion, seems to be that adopted by Lister, by which the name *P. pulchripes* is retained as representing a distinct species concerning which there can be no doubt. It would, however, seem permissible, and possibly desirable, to retain the specific name *Ravenelii*, as being both the original name applied to the species

and also the first which it received after its transfer to the genus *Physarum*, and to call the species *Physarum Ravenelii* (B. & C.), Mass. This name is free from ambiguity, transgresses no accepted rule of nomenclature, and is based upon the identity of type-specimens.

PHYSARUM ORNATUM, Pk., Rep. XXXI, p. 40, 1878. Of the type-specimen of this species only the scantiest vestiges remain. They consist of two or three sporangia in so immature a condition that they show no characters of diagnostic value, and a number of short, robust stalks, very dark brown in color and containing no lime. It is impossible even to guess what species they represent. The poorly-developed remains of the capillitium do not appear to be that of *Physarum auriscalpium*, Cke., to which Macbride refers the species, and its general robust habit is unlike that of *Physarum viride*, Pers., to which it is doubtfully referred by Lister. The original description quoted by Lister (Mon. p. 63) throws little light on the question. The species should be discarded.

PHYSARUM LUTEOLUM, Pk., Rep. XXX, p. 50, Pl. II, figs. 15-18, 1877. The same general remarks apply to this species as to *P. ornatum*. The type-specimen was originally scanty and the leaf of *Cornus Canadensis* upon which the sporangia were borne was evidently dried by pressure, to the damage of the specimen. The persistent bases of the sporangia alone remain, together with bits of the capillitium here and there and a few spores. The sporangia were small (though apparently larger than those of *Physarum virescens*, Ditm.), gregarious but not clustered, and pale yellow in color. The remnants of the capillitium are very delicate, with lime-knots of medium size, angular or rounded, and whitish or pale yellow in color. The spores are pale violet-brown, very minutely spinulose, and measure 8.2-10.5 μ in diameter. Neither Peck's description nor his figures are of much assistance in determining the species. In habit, color and general appearance the specimen resembled *Physarum virescens*, Ditm., var. *nitens*, List., but the lime-knots are paler in color and smaller and less branching than in that form, and the spores are decidedly larger. It is useless under the circumstances to attempt to locate the species, and therefore, in my opinion, the name should be discarded.

PHYSARUM CITRINELLUM, Pk., Rep. XXXI, pp. 55 & 57, 1878. This specimen is interesting as being the type of a species widely distributed by Rex, although with no statement on the part of the latter to the effect that he had even compared his specimens with the type. Lister received it from Rex and based upon that specimen his

description of *Craterium citrinellum*, List. It was distributed by Rex in Ellis & Everhart's N. Amer. Fungi, No. 2490. Macbride (l. c., p. 38) says, "Under the last name (*P. citrinellum*, Pk.) the species has been generally recognized in the United States and distributed." It is satisfactory, then, to note that the specimens so distributed are identical with Peck's type, with the unimportant exceptions that in the latter the lime-knots of the capillitium are rather smaller and the spores are smaller and decidedly less distinctly spinulose than is the case in the specimens distributed by Rex. In the type the spores measure 9.4–11.2 μ as compared with 11.5–12 μ in the case of the Ellis and Everhart specimens.

Peck originally called his specimen *Diderma citrinum*, Fr., a species referred by Rostafinski to *Physarum Schumacheri*, Spr. (*P. citrinum*, Schum.). When Rostafinski's Monograph appeared Peck changed the name of his specimen to *Physarum citrinellum*, Pk., and published a brief but sufficiently accurate description of it. (Rep. N. Y. St. Mus., xxxi, p. 57.) The species is certainly very closely related to at least one other. In 1818 Fries described his *Physarum flavum*. This was the same thing (*teste* Rostafinski, Mon., p. 100) as a specimen which Fries had sent to Kunze during the previous year under the name *Physarum citrinella*, Fr. This earlier name Fries disregarded in later publications, and the final form in which he left it was *Craterium flavum*, Fr. Rostafinski adopted the earlier generic name, with the remark that "the transfer of this *Physarum* to the genus *Craterium*, as Fries did later, rests on no sufficient grounds." Now the description of *Physarum flavum*, Fr., distinctly recalls Peck's species. Lister's comment on the former is: "This description applies to *Craterium citrinellum*, List.," and R. E. Fries, in his latest work on the Swedish Myxomycetes,* commenting on *P. flavum*, Fr., recognizes its close relationship to *C. citrinellum*, List., though, not having seen a specimen of the latter, he is naturally unwilling to unite the two and therefore retains the Friesian name. Personally, I have little doubt that the two forms are one and the same species, but, in default of comparative material, Peck's name must be retained for the American form. Whether we should call it a *Physarum* or should refer it to the genus *Craterium* because of the cartilaginous character of the base of the sporangium wall, is a comparatively unimportant matter of opinion.

More important is Macbride's reference of the species to *Physarum caespitosum*, Schw. The original description of that species is brief,

* Öfersigt af Kongl. Vetenskaps-Akad. Förhandl., 1899, No. 3, p. 224.

it is accompanied by no figures, and, so far as I know, there is no authentic specimen in existence. Under these circumstances certainty is out of the question, and it seems to me unwise in principle to supersede a generally recognized name of many years' standing and referring to a well-known form, by a name to which no certainty can be attached. The original description of the shape, the habit, and the color of the capillitium of *P. caespitosum*, Schw., seems, as noted by Lister, to apply quite as well to *P. virescens*, Ditm., as to *P. citrinellum*, Pk., if not better.

PHYSARUM FLAVIDUM, Pk. (*Didymium flavidum*, Pk.), Rep. XXVIII, p. 54, 1875, and Rep. XXXI, p. 55, 1878. The type-specimen of this species is unfortunately immature, nevertheless the following characters can be determined from it.

Sporangia scattered, dull yellow, subglobose, sessile or shortly stipitate, 0.5–0.6^{mm} in diameter, seated upon or rising from a thin, membranous hypothallus. Stalk, when present, robust, membranous, brownish-yellow. Wall double; the outer, pale yellowish-grey, membranous above and beset with scattered aggregations of yellow lime-granules, thicker and persistent below; the inner, very delicate and colorless, widely separated from the outer wall. Capillitium composed of delicate, colorless threads with rounded lime-knots of medium size of a white or pale straw color. Spores pale violet, (black in the mass), minutely spinulose, variable in size, but averaging 9.7–11.2 μ in diameter.

The almost sessile character of the sporangia, the wide space separating the inner from the outer wall, the fact that the spores form a shrunken, indurated mass, the pale color of the spores when separated, and their variable size, are all indications of immaturity. Fortunately, however, there is little choice in deciding where the species properly belongs. It is evidently an immature specimen of *Physarum citrinellum*, Pk. (*Craterium citrinellum*, List.)

FULIGO OCHRACEA, Pk. (*Licea ochracea*, Pk.), Rep. XXVIII, p. 55, 1875, and Rep. XXXI, p. 56, 1878. The type specimen of this species is fairly abundant and in good condition. Lister's description (l. c., p. 67) fits the specimen so exactly that it is unnecessary to attempt to add to it. Macbride makes Peck's name a synonym of *Fuligo muscorum*, A. & S., a name apparently overlooked by Lister. The description and figures given of their species by Albertini and Schweinitz (Consp. Fung., p. 86, Tab. VII, fig. 1) are exceptionally good and, as stated by Macbride, they seem referable to *F. ochracea*, Pk. On the other hand, in the absence of the type-specimen, we

cannot be certain of that fact. Albertini and Schweinitz failed to realize the extreme variability of *F. septica*, Gmel., and their diagnoses of species rest largely on external characters. They were necessarily ignorant of those characters, such as the size of the spores, which serve to distinguish Peck's species from others of the genus. A degree of certainty attaches to our knowledge of *F. ochracea*, Pk., which cannot possibly attach to *F. muscorum*, A. & S., so that, although there is a strong probability that the two names refer to the same species, it does not seem wise to retain a name based on mere probability.

PHYSARELLA MIRABILIS, Pk. (*Physarum mirabile*, Pk.), Rep. XXXIII, p. 22, 1880. Bull. Torr. Bot. Cl., IX, p. 61, 1882. The type-specimen of this species requires no comment. It agrees perfectly with the published descriptions and so peculiar a species could hardly be confused with anything else. Whether we choose to call it *Physarella oblonga*, (B. & C.) Morg., or *Physarella mirabilis*, Pk., will depend upon which of the two general principles of nomenclature we follow.

DIDERMA FLAVIDUM, Pk., Rep. XXVIII, p. 54, 1875, and Rep. XXXI, p. 55, 1878. Professor Peck has very properly referred this species to *Physarum contextum*, Pers. I mention it here under the original name merely because neither Lister nor Macbride refers to that name as a synonym of *P. contextum*, Pers. The specimen requires but little comment. I have compared it with an authentic specimen received from Mr. Lister and the two are essentially identical. The sporangia of Peck's specimen are smaller and of a more greenish-yellow color than in the Lister specimen, and the spores are somewhat larger. Some of the sporangia in Peck's specimen, especially the elongated forms, show a false columella in the shape of a dense, flattened aggregation of lime-knots occupying the median line of the sporangium but entirely free from the base. It may be noted that in both specimens the lime-knots of the capillitium are white only by reflected light; by transmitted light they are of various shades of yellow.

CHONDRIODERMA CRUSTACEUM, Pk. (*Diderma crustaceum*, Pk.), Rep. XXVI, p. 74, 1873, Rep. XXXI, p. 56, 1878. This is an interesting species on account of the confusion which exists regarding it. Lister places it under *C. globosum*, Rost., on account of the smooth outer wall, the strongly developed hypothallus, and the dark purplish-brown, spinulose spores, measuring 10–14 μ in diameter. Macbride, however, describes the spores of *C. globosum*, Rost., as measuring

only 8μ in diameter, and gives this character and the less crowded habit as his reason for retaining *C. crustaceum*, Pk. as a species distinct from *C. globosum*, Rost. It will be seen, therefore, that the confusion has arisen from a misconception, not of Peck's species, but of Rostafinski's. That author gives 8.3μ as the size of the spores of *C. globosum*, and if that be correct, then it is certainly difficult to regard *C. crustaceum*, Pk. as the same species. But in the Appendix to his Monograph, Rostafinski describes a species, *C. affine*, Rost., with spores $10.8-14\mu$ in diameter. This species is certainly very closely related to *C. globosum*, and Lister (Mon., p. 78), as the result of his examination of the type-specimens of both, states that they are identical, and, moreover, that the spores of *C. globosum* actually measure $11-13\mu$ in diameter.

Turning now to Peck's type of *C. crustaceum*, it may be described as follows: Sporangia white, smooth, $0.5-0.7^{\text{mm}}$ in diameter, globose or obovate, angled by mutual pressure, densely crowded upon a strongly developed, white, calcareous, almost spongy hypothallus. Wall double, the outer composed of spherical lime-granules, brittle, widely separated from the membranous, gray, iridescent inner wall. Columella small but prominent, subglobose or clavate, white. Capillitium abundant, a network of pale violet, branching and anastomosing threads with occasional fusiform expansions filled with lime-granules. Spores dark purplish-brown, densely spinulose, $11.2-14.2\mu$ in diameter. (Pl. LX, figs. 10 & 11.) That this description applies to *Chondrioderma globosum*, Rost., as understood by Lister, there can be no possible doubt. Moreover, Peck's specimen is absolutely identical with an authentic specimen of that species, collected by Mr. A. P. Morgan and sent to me by Mr. Lister.

It may not be out of place to discuss in this connection a peculiar *Chondrioderma* which was sent to me recently by Professor Peck. It forms, on dead fern-stalks, an effused crust consisting of a thin, whitish, wrinkled hypothallus, bearing closely aggregated subglobose or flattened sporangia of a whitish color with a faint pinkish tinge. The outer wall is rugose, almost farinaceous, wrinkled, very fragile, never widely separated from the membranous inner wall, and sometimes inseparable from it. The columella is pulvinate and the capillitium scanty. Judged by external characters, the specimen might well pass for *C. spumarioides*, Rost. But the spores, instead of being of the pale color and small size characteristic of that species, are dark violet-brown, spinulose, darker and more distinctly spinulose on one side, and measure $11.2-15\mu$ in diameter. These spores are iden-

tical with those of *C. globosum*, Rost., according to Lister's measurements; moreover, the capillitium-threads in this specimen show here and there fusiform expansions filled with lime-granules, a character also seen in the capillitium of *C. globosum*. The specimen is unquestionably an immature example of that species. A specimen of *C. spumarioides*, Rost., collected by myself and authenticated by Mr. Lister, shows the pinkish tinge seen in the specimen of *C. globosum* received from Professor Peck, and has a dark capillitium, and fairly dark spores measuring 9.3–11.2 μ . Still another has the pale capillitium and spores of typical specimens, but the spores measure 8.2–11.2 μ in diameter. This is not the place to discuss these specimens in detail. I mention them merely to emphasize the fact that there can be no sharp line drawn between *C. globosum*, Rost. and *C. spumarioides*, Rost. As a rule, however, specimens showing, when mature, a smooth outer wall, strongly developed hypothallus, capillitium with occasional expansions containing lime, and dark, coarsely spinulose spores measuring 10–14 μ in diameter, may be placed under *C. globosum*, Rost.; the name *C. spumarioides*, Rost. may be applied to specimens showing, even when mature, a rugose, fragile outer wall, thin and crust-like hypothallus, pale capillitium, and pale, minutely spinulose spores measuring 8–10 μ (Cf. Pl. LX, figs. 12–13 & 14–15).

To the former species *C. crustaceum*, Pk. unquestionably belongs, if we accept Lister's conception of that species. I have given above my reasons for so doing.

DIDERMA FARINACEUM, Pk., Rep. XXVI, p. 74, 1873, and Rep. XXXI, p. 56, 1878. This is a perfectly normal specimen of *Chondrioderma spumarioides*, Rost., and was so referred by Peck in the second publication noted above.

DIACHAEA SPLENDENS, Pk., Rep. XXX, p. 50, Pl. II, figs. 1–4, 1877. This species has rightly been retained by both Lister and Macbride and the descriptions given by both authors are so admirable that it is unnecessary to add anything here. The type agrees perfectly with the published descriptions and figures. The spore-surface, beset with large, scattered, truncate tubercles which are occasionally confluent in short bands, is sufficient to distinguish this species from the globose form of *Diachaea elegans*, Fr. (Cf. Pl. LXI, figs. 21 & 22.) These tubercles, when examined with a $\frac{1}{12}$ Homog. Im. lens, are seen to be, not solid tubercles, but clusters of blunt, spinous processes, the variability in the size of the seeming tubercles being due to the greater or smaller number of spines composing the clusters. Occasionally the spines occur singly, interspersed among the tubercles.

(Pl. LXI, fig. 21a.) A somewhat similar instance of compound papillæ was noted by Rex in the case of *Diachæa Thomasii*, Rex. (Proc. Acad. Nat. Sc. Phil., 1893, p. 368.)

DIACHÆA SUBSESSELIS, Pk., Rep. XXXI, p. 41, 1878. Peculiar interest attaches to the type-specimen of this species since no accurate description of it has ever been published. Fortunately it is so well-marked a species that the original brief description has proved sufficient to enable later investigators to identify it with a fair degree of certainty. That Rex had seen the type, seems evident from the accuracy with which he described the episporic markings characteristic of the species (l. c., p. 368. Cf. Lister, Mon. p. 92). Lister has described it at some length on the basis of a specimen collected by him in September, 1896, in Bedfordshire, England, which agreed with the original description and possessed spores marked as described by Rex. A portion of this specimen was sent to me by Mr. Lister. In January, 1899, I collected it at Bonchurch, Isle of Wight, and in the following August I made a small gathering of it at Poquonock, Conn. All of these specimens are identical with one another and with the type. Inasmuch as Lister's description of the species may not be accessible to most American students, it may be well to describe briefly the salient features of the type-specimen. They are as follows: Sporangia subglobose, 0.5–0.6^{mm} in diameter, sessile or stipitate. Stalk, when present, very short, robust, tapering, filled with white lime or dark with included refuse matter. Wall membranous, hyaline, slightly iridescent, splitting irregularly from above. Columella pulvinate, short-conical, or sometimes almost obsolete. Capillitium dark violet-brown, paler below. Spores violet-brown, 9.3–11.2 μ in diameter, marked with an irregular, broken network, composed of minute warts and covering the greater part of the surface. (Pl. LXI, fig. 20.) *Hab.* on dead leaves.

The sessile or short-stalked habit of this species, and the peculiar episporic markings, are quite sufficient to distinguish it from any other *Diachæa*. It is apparently rare in this country, as Macbride makes no mention of it. I am unable to detect the greenish tint said, by Lister, to be characteristic of the spores of this species. (Journ. of Bot., Vol. XXXV, p. 213, 1897.)

DIDYMIUM OXALINUM, Pk., Rep. XXVIII, p. 54, 1875, and Rep. XXXI, p. 57, 1878. No specimen bearing this name is now to be found in the collection. In his Thirty-first Report, p. 57, Peck remarks "*Didymium oxalinum*, Pk., is probably only a form of *Phy-sarum cinereum*, and is therefore omitted." The original descrip-

tion contains nothing which militates against this statement and the latter may be accepted as correct.

DIDYMIUM CONNATUM, Pk., Rep. XXVI, p. 74, 1873, and Rep. XXXI, p. 55, 1878. This species is represented in the N. Y. St. Mus. Herb. by two specimens. One is marked, "*Physarum polymorphum*, Mont. (*Didymium polycephalum*, Rav., *Didymium connatum*, Pk.), Catskill Mts., leg. C. H. Peck." The label upon the other reads "*Didymium connatum*, Pk., Portville, leg. C. H. Peck." Both of these specimens belong to the same species, the only difference between them being that in the first the sporangia are separate and in the second they are connate in clusters of two to five. Peck's reference of them to *Physarum polymorphum*, Mont., is evidently an error since the sporangia do not exhibit the compressed or convolute form characteristic of that species. The connate form is immature, but both specimens are distinctly referable to *Physarum nephroideum*, Rost. (*P. compressum*, A. & S. var. δ , List.), one of the commonest species in northern New England. The robust habit; the absence of lime in the stalk except as an external crust; the large, rounded, white lime-knots of the capillitium; the absence of a columella; the large, dark, violet-brown, minutely spinulose spores, are all features which distinguish this species from such related forms as *P. globuliferum*, Pers., *P. leucophæum*, Rost., and *P. leucopus*, Lk. Neither specimen shows the "ovoid or reniform, laterally compressed" sporangia characteristic of typical *P. nephroideum*, Rost. (Cf. Lister, Mon. p. 54), so that whether we call them a globose form of that species or refer them to Lister's globose variety of *P. compressum*, A. & S., is a matter of little importance. Macbride discards the latter name on the ground that no degree of certainty can be derived from the original description. I am inclined to share this opinion and to accept Rostafinski's name for the species under consideration. This globose form, so typically American and so constant in shape, is possibly deserving of something more than varietal rank, but inasmuch as other writers, more competent than I to judge, have not seen fit to establish it as a separate species, it seems inadvisable for me to attempt it.

Mr. Morgan has described it in his "Myxomycetes of the Miami Valley" and considers it a distinct species (Journ. Cinn. Soc. Nat. Hist., August, 1896, p. 92), but unfortunately he has referred it to *Physarum connexum*, Lk., a species suppressed by Rostafinski as being merely a clustered form of *P. leucophæum*, Fr. (Rost. Mon., pp. 113 & 114.) In the absence of the original type and of any

authentic specimen of Link's species, the acceptance, as final, of Rostafinski's judgment concerning it, seems unavoidable.

DIDYMIUM EXIMIUM, Pk., Rep. XXXI, p. 41, 1878. A small bit of the type of this species, consisting of a portion of a leaf bearing three sporangia, was sent me by Professor Peck. It presents the following characters.

Sporangia globose, slightly umbilicate beneath, 0.4–0.6^{mm} in diameter, white, stipitate. Stalk slender, 1^{mm} long, golden-brown, longitudinally wrinkled, expanded below and almost black from included refuse matter, rising from a small hypothallus. Sporangium-wall hyaline, colorless, beset with stellate crystals. Columella irregularly subglobose, golden-brown. Capillitium scanty, consisting of delicate, colorless threads expanded at their point of origin from the columella. Spores rather dark, violet-brown, minutely spinulose, 7.5–9 μ in diameter.

I have compared this specimen most carefully with a large number of authentic specimens of *Didymium nigripes* (Lk.) Fr. and *D. xanthopus* (Ditm.) Fr. in my collection, and with specimens distributed in Ellis & Everhart's N. A. Fungi, including two named by Rex. *D. eximium*, Pk. No. 412, in that collection, is the typical *D. microcarpon* of Fries and Rostafinski, common everywhere, and usually occurring on *Sphagnum*. No. 2089 is the same, differing only in its habit (a dead herbaceous stem) and its slightly larger, darker, and more distinctly spinulose spores.* Both show the white sporangia, pale yellowish subglobose columellas and slender brownish-orange stalks characteristic of *Didymium xanthopus*, Fr. No. 1393, according to Macbride (l. c., p. 91), represents Rex's conception of *Didymium nigripes* (Lk.) Fr. The former notes the small size of the sporangia, "about 4^{mm}," and the correspondingly small spores "6–8 μ ." "Otherwise," he writes, "the species is hardly more than a variety of the next" (*D. xanthopus*, Fr.). In this I can fully agree with Professor Macbride. But Rex's specimen is hardly typical of *D. nigripes*. An authentic specimen of the latter, furnished me by Mr. Lister, has pure white sporangia measuring 0.5^{mm} in diameter

* It should be noticed that this specimen was distributed by Dr. Rex under the name *D. eximium*, Pk., that he recognized important differences between it and the specimen later distributed under the same name (No. 2493), and that his conclusion regarding these two specimens was expressed in the following words: "They apparently form the extreme limits of what must be considered an extremely variable species, the intermediate and connecting links of which exist." (Proc. Acad. Nat. Sci., Phil., 1890, p. 195.)

and the spores measure 7.8–9.3 μ . On this basis there is not even a varietal difference between *D. nigripes* and *D. xanthopus*. The difference expressed by the two specific names is merely one of degree. The color of the stalk is essentially the same in both, though it has a much darker tone in the former than in the latter.

I have dwelt at length upon these two species in order to call attention to the resemblance existing between them and the type of *Didymium eximium*, Pk., described above. I cannot but conclude that all three represent one and the same species, and that Peck's species, from the standpoint of color, occupies an intermediate position between the other two.

On referring to the second specimen distributed by Rex as *D. eximium*, Pk. (N. A. F., No. 2493), we find a most interesting form, apparently the one upon which Macbride and Morgan based their descriptions of that species. In many respects, such as the habit, the size, and the character of the spores, it agrees fairly well with Peck's type; in others, this is not true. The sporangia have a decidedly yellowish tinge, which, on closer examination, is seen to be due to aggregations of small, spherical, bright yellow granules imbedded in the hyaline wall. The columella is irregularly sub-spherical or flattened and of an orange-yellow color. The capillitium consists of delicate, hyaline threads, expanded at the base and often for a considerable distance upwards; similar expansions, of a more or less fusiform or elongated shape, are of frequent occurrence in the continuity of the threads. (Pl. LX, figs. 16 & 17.) These expansions are filled with spherical, yellow granules similar to those imbedded in the sporangium-wall. The capillitium thus presents somewhat the appearance of a *Physarum*-capillitium. That the granules are not composed of lime, however, is seen from the fact that upon treatment with dilute potassium hydrate they dissolve at once and completely, leaving the expanded portions of the thread empty and hyaline. They are evidently organic bodies. The expanded portions in connection with the surface of the columella are conical or tapering and persistent, so that upon dissecting away the looser part of the capillitium the columella appears beset with the long, somewhat spine-like bases of the capillitium threads. (Pl. LX, fig. 16. Cf. Macbride, l. c., p. 92.) The spores are rather dark, violet-brown, distinctly spinulose, and measure 9.3–11.2 μ in diameter. This specimen certainly exhibits a marked variation from normal forms of either *Didymium nigripes*, Fr., or *D. xanthopus*, Fr., in the presence of the peculiar granules of organic

matter above mentioned. It is equally, and for the same reason, distinct from the type-specimen of *D. eximium*, Pk. The question then arises whether this feature is of sufficient importance to warrant the erection of a new species. I should be inclined to answer affirmatively, were it not for one fact. The specimen of *D. nigripes*, Fr., distributed as No. 1393 in Ellis & Everhart's N. A. Fungi, though scanty and partially immature, presents very similar features in its capillitium. The bases of the threads are expanded in the same manner and the threads themselves show similar fusiform expansions in abundance. The contents of these expansions are of a violet-brown color and are more homogeneous and less soluble in alkaline solutions than in the case of the specimen distributed as *D. eximium*, Pk., but there can be no doubt that both are analogous structures. No other specimen of *D. nigripes* which I have examined shows them, and I can but conclude that, in this case at least, they are abnormal structures of no taxonomic value.

We have seen that Rex regarded Nos. 2089 and 2493 of the N. A. Fungi as the extreme limits of a single, variable species. We have further seen that Macbride is correct in referring No. 2089 to *D. xanthopus*, Fr. The type-specimen of *D. eximium*, Pk., is almost identical with No. 2089; it certainly is in the direct series of which Nos. 2089 and 2493 are the "extreme limits." But in my opinion, as above expressed, there is no essential difference between *D. xanthopus*, Fr. and *D. nigripes*, Fr., hence I must conclude that Lister is correct in regarding *D. eximium*, Pk., as a mere variety of *D. nigripes*, Fr. If Rex was correct in referring the very peculiar form distributed by Ellis & Everhart as No. 2493 to *D. eximium*, Pk., it is certainly a very well marked variety and may yet prove to be deserving of specific rank. The type of that species, however, is not distinguishable from *D. nigripes*, Fr. (*D. xanthopus*, Fr.).

DIDYMIUM ANGULATUM, Pk., Rep. XXXI, p. 41, 1878. No type-specimen of this species exists and the original description is not sufficient to enable us to locate the species with any degree of certainty. Lister refers it tentatively to *Didymium effusum*, Lk., and Macbride makes no mention of it. Under these circumstances the species should be excluded.

STEMONITIS MORGANI, Pk., Bot. Gaz., V. p. 33, 1880. The type-specimen of this species has been unfortunately stored away where it is not at present accessible; nothing definite, therefore, can be said regarding it. Lister, on the basis of presumably authentic specimens collected by Wingate and distributed in Ellis & Ever-

hart's N. A. Fungi, No. 2088, identifies it with Rostafinski's type of *S. splendens* from Cuba. Under that species he also places *S. Bauerlinii*, Mass. and its var. *fenestrata*, Rex; *S. Webberi*, Rex; and *S. confluens*, Cke. & Ell. Macbride disregards, as species, *S. splendens*, Rost. and *S. Bauerlinii*, Mass., but gives specific rank to Rex's variety of the latter, and restores *S. Morgani*, Pk., *S. Webberi*, Rex and *S. confluens*, C. & E., as autonomous species. He thus deprives *S. splendens*, Rost. of all its varieties, but fails to indicate what disposition we are to make of that species itself. In view of this extreme divergence of opinion on the part of two authors, it is interesting to note the view of this matter entertained by a third authority.

In December, 1892, I received from Dr. Rex a series of six specimens representing various intergrading forms of essentially one type, and all referred to *S. splendens*, Rost. They include the following names: *S. Bauerlinii*, Mass. ("according to the type sent by Masee"); *S. Bauerlinii*, Mass., var. *fenestrata*, Rex; *S. Morgani*, Pk.; and *S. Morgani*, Pk., var. *fenestrata*, Rex. In the letter referring to these specimens, Dr. Rex says: "They illustrate a series which must, I believe, all be taken into *Stemonitis splendens*, Rost. They represent a series (I have still other links) which include, I think, *S. Bauerlinii*, Mass. and *S. Morgani*, Pk. I shall also have to include my own species *S. Webberi*." This is precisely the position taken by Lister, and taking it for granted that the distributed specimens of *S. Morgani*, Pk., are actually that species, Lister's opinion seems to me to be in accordance with the facts.

STEMONITIS HERBATICA, Pk., Rep. XXVI, p. 75, 1873, and Rep. XXXI, p. 58, 1878. Like *S. Morgani*, Pk., this species is an illustration of the extreme difficulties attending the effort to draw sharp lines of distinction between the so-called species of this perplexing genus. We may, with almost equal propriety, select certain "centres" and group around them extensive series of intergrading forms, or select the terminal extremes of such series and regard them as more or less fixed species. The difficulty of adopting either method exclusively lies in the fact that two observers examining the same specimen may yet disagree as to its apparently essential features. Thus, in the case before us, both Mr. Lister and Professor Macbride have examined the type of *S. herbatica*, Pk., yet the former describes the spores as "purplish" (not ferruginous), as in *S. splendens*, Rost., while the latter describes the spore-mass as "ferruginous," as in *S. ferruginea*,

Ehr. The reason for so fundamental a difference of opinion is seen when we examine the actual specimens. I have before me an authentic specimen of *S. ferruginea*, Ehr., received from Mr. Lister; the type-specimen of *S. herbatica*, Pk.; and a large number of specimens of the latter, most of them collected in this country and examined by Mr. Lister, one of them collected in England by Mr. Lister himself. The type-specimen of *S. herbatica*, Pk. has the sporangia densely aggregated, forming a tuft on grass; they measure 6–7^{mm} in height. I can distinguish no difference, in the color of the spore-mass or of the individual spores, between this and the specimen of *S. ferruginea*, Ehr. The habit of the two is also identical. The English gathering of *S. herbatica*, Pk., has distinctly darker spores of a purplish tinge, whether examined in the mass or shed upon white paper. All of the other specimens are in the form of loose tufts, 10^{mm} high, growing on dead wood. The spores in the mass have the light greyish-violet color of the type, neither as purplish as those of *S. splendens*, Rost., nor as ferruginous as those of *S. Smithii*, Macbr. For my own part, and judging merely by the specimens in my possession, I cannot with any certainty distinguish between *S. herbatica*, Pk., and *S. ferruginea*, Ehr.

The same conclusion is reached by Macbride, who, however, unites both species under the name *Stemonitis axifera*, (Bull.) Macbr. Expediency and established usage would alike seem to render inadvisable the adoption of Bulliard's name, even if his description and figures referred with certainty to the species under consideration. They apply quite as well, if not better, to the form now known as *S. Smithii*, Macbr.

COMATRICHA SUBCÆSPITOSA, Pk., Rep. XLIII, p. 71, Pl. III, }
 figs. 6–9, 1890. }

COMATRICHA LONGA, Pk., Rep. XLIII, p. 70, Pl. III, }
 figs. 1–5, 1890. }

The type-specimen of neither of these species is at present accessible. *Comatricha subcæspitosa*, Pk. is placed by Lister under *C. obtusata*, Pr., on the basis of a slide-mounting of the type, furnished by Rex. (Lister, Mon. p. 118.) Macbride rejects the name *C. obtusata*, Pr., on the ground that the figure of that species given in Sturm's *Deutsch. Fl.*, Pl. LXX, is rather that of *Enerthenema*, and substitutes the name *C. nigra*, (Pers.) Schrt. I am inclined to agree with Professor Macbride in regarding both the description and the figures of Preuss' species as referable to *Enerthenema*. If this be correct, and if we proceed on the principle of the

inherent vitality of specific names, then we must accept the name given by Persoon, notwithstanding the fact that later he himself reduced it to varietal rank under his species *Stemonitis ovata*. (Syn. Meth. Fung., p. 189.) If, however, we decide to adopt the first specific name given under the genus to which the species is now referred, then *C. alta*, Pr. (according to the synonymy given by Lister), would seem to be the proper name of this species. This question will be more fully discussed later, with reference to *Comatricha æqualis*, Pk.

Under the name *Comatricha nigra*, (Pers.) Schrt., Macbride includes only the long-stalked form with subglobose sporangia. *C. subcæspitosa*, Pk. does not answer to this description, and Macbride therefore refers it to *C. Persooni*, Rost.

Comatricha longa, Pk. is regarded as a good species by both Lister and Macbride.

COMATRICHÆ ÆQUALIS, Pk., Rep. XXXI, p. 42, 1878, and Rep. XLVI, p. 57, 1893. The type-specimen of this species is in good condition and exhibits the following characters.

Sporangia gregarious or loosely clustered, total height 3.6–6.3^{mm}, cylindrical, obtuse, greyish-violet, stipitate. Wall evanescent. Stalk 2.2–2.8^{mm} long (about equalling the sporangium in length, hence the specific name), black, slender, subulate, expanded at the base, rising from a thin, brown hypothallus. Columella gradually merging, toward the apex of the sporangium, into the capillitium. Capillitium a dense network of violet-brown threads, its ultimate branches paler and anastomosing, but showing many free colorless tips. Spores rather dark, violet-brown, almost or quite smooth, 7–7.5 μ in diameter.

I do not find this species so easy to dispose of as does Professor Macbride. He regards it as a distinct and easily recognizable one. This depends, however, upon the conception which one has formed of its near ally *C. nigra*, (Pers.) Schrt. If we limit that species to purplish-brown forms with small, more or less globose sporangia, as Macbride does, then his conclusion regarding such elongated forms as *C. æqualis*, Pk., and *C. Suksdorfii*, Ell. & Ev., is logical and unavoidable; they must be regarded as distinct species. Such, however, was not Rostafinski's conception, as is evident from his figures of *C. Friesiana* (Mon. Tab. IV, fig. 51), as well as from the specimens (Rab. Fung. Eur., No. 568) to which he refers (l. c., p. 200), as illustrative of vars. *oblonga* and *obtusata* of that species. Lister's conception of *C. Friesiana*, (*C. obtu-*

sata, Pr.), agrees with Rostafinski's, and he includes under it the elongated forms mentioned above. Specimens in my own collection show, in the same group, small, almost globose sporangia and others which are cylindrical and 2-3^{mm} long. When these, and others even more elongated, exhibit the same color (which, in the case of *C. æqualis*, Peck describes as "almost exactly like *Stemonitis fusca*"), the same type of capillitium and the same almost smooth spores,* and when these characters run, without essential variation, through a large series of forms exhibiting sporangia of very varied degrees of height, it would seem but natural to regard the constant characters as diagnostic and to attach to the one character which varies, merely a varietal significance. On this basis *Comatricha æqualis*, Pk. can only be regarded as a variety of *C. nigra*, (Pers.) Schrt. [*C. Friesiana*, (D By.) Rost.†]

PERICLÉNA CÆSPITOSA, Pk. (*Physarum cæspitosum*, Pk. *Licea cæspitosa*, Pk.), Rep. XXVI, p. 75, 1878; Rep. XXVIII, p. 85, 1875; and Rep. XXXI, p. 57, 1878. As noted many years ago by Rex (Bot. Gaz., vol. xvii., p. 202, 1892), this is a fine specimen of *Lindbladia effusa*, (Ehr.) Rost., var. *simplex*, Rex. It is of peculiar interest, however, from the fact that in the upper part of the sporangia, not only are the plasmodic granules arranged in a reticulate manner, but the wall itself shows, here and there, large, rounded perforations, thus emphasizing the peculiar relationship between the two genera *Lindbladia* and *Cribraria*. (Pl. LXI, fig. 18.)

TRICHIA RENIFORMIS, Pk., Rep. XXVI, p. 76, 1873, and Rep. XLVI, p. 57, 1893. Both Lister and Macbride agree in referring this species to *Trichia contorta*, Rost. It is the form described by Lister as var. *genuina*, with few elaters, and those very irregularly cylindrical, short, either simply branched or forked, and marked usually with three indistinct spiral bands. (Pl. LXI, fig. 19.) Macbride draws a distinction between the three very similar forms, *T. inconspicua*, Rost., *T. contorta*, Rost., and *T. Iowensis*, Macbr., on the basis of differences observable in the elaters. These differences, however,

* Macbride (l. c., p. 131) describes the spores of *C. æqualis*, Pk. as "distinctly warted." This feature does not appear in my glycerine mountings from the type-specimen.

† Since writing the above, Mr. Hugo Bilgram, of Philadelphia, has called my attention to the striking similarity, in external appearance, between *Comatricha æqualis*, Pk. and *Stemonitis pallida*, Wing. This is certainly very marked; nevertheless I think they may be distinguished by the denser capillitium of the *Stemonitis*, its superficial net and its slightly smaller and redder spores.

appear to be rather developmental than specific. The character of the elaters in the *Trichiaceæ*, useful as it undoubtedly is as indicative of generic and even specific lines of demarcation, nevertheless can hardly be regarded as very stable. Species of *Hemitrichia* occasionally show the free elaters characteristic of the genus *Trichia*, and on the other hand forms normally provided with free elaters are sometimes found with the elaters combined into a network. Within the limits of a single species, or even of a single specimen, great variety in the markings of the elaters is often seen. In the small specimen of *T. reniformis*, Pk., which we are considering, some of the elaters are almost exactly like those of *Oligonema*, while others are long, well-developed, and show perfectly even and distinct spirals, approaching very closely in this respect Rostafinski's *T. inconspicua*. It does not seem advisable therefore, merely on the ground of variations in the character of the elaters, to distinguish, as separate species, forms otherwise so nearly identical as the three above mentioned, and I can but regard *Trichia reniformis*, Pk. (*T. contorta*, Rost., var. *genuina*, List.), *T. inconspicua*, Rost., and *T. Iowensis*, Macbr., as varieties of a single species characterized by sessile, subglobose or somewhat elongated sporangia, of a dark reddish or purplish-brown color, and provided with warted spores.

OLIGONEMA FLAVIDUM, Pk. (*Perichæna flavida*, Pk.), Rep. XXVI, p. 76, 1873, and Rep. XXXI, p. 57, 1878. The genus *Oligonema* presents serious difficulties to the systematist, by reason of the varied and intergrading characters exhibited not only in different gatherings, but often in different portions of the same gathering. The type-specimen of the present species presents the following characters:

Sporangia densely aggregated in small, effused clusters, occasionally superimposed, 0.4–0.6^{mm} in diameter, globose or slightly elongated, sometimes cylindrical, clear golden yellow, shiny, smooth, or wrinkled above. Wall membranous, pale yellow; inner surface minutely and densely punctate. Elaters scanty, simple or sparingly branched, 52–243 μ long, irregularly cylindrical, with occasional bulbous swellings, short blunt spines, and minute warts, the whole surface very minutely and densely spinulose or punctate, tips rounded or bluntly pointed. Spores yellow, 13–15 μ in diameter,* the surface marked with narrow, raised bands forming an almost complete network. (Pl. LXI, figs. 23 & 24.)

* The measurements of the spores, in this and the following cases, include the spore-border.

The specimen bears a strong resemblance in outward appearance to *Trichia affinis*, DBy. The punctation on the inner surface of the sporangium-wall is resolved by the $\frac{1}{12}$ Homog. Im. lens into minute bristle-like hairs which lie in groups appressed in various directions. (Pl. LXI, fig. 24.) Peck's reference to the spores as "echinulate" (Rep. N. Y. St. Mus. xxvi., p. 76) is evidently an error in observation.

The question is, is this specimen referable to *Oligonema nitens*, Rost.? Lister considers that it is; Macbride regards it as distinct, on the basis of the roughened elaters with no distinct rings or spirals. The two forms differ also in habit, *O. flavidum* having exactly the habit of a *Trichia*. The markings of the sporangium-wall in *O. flavidum* are peculiar, and at first sight seem distinctive, but the examination of a number of specimens of *O. nitens* show that they cannot be so regarded. A specimen of *O. nitens* collected at Cambridge, Mass., shows an almost smooth wall marked only with extremely delicate striæ; others are absolutely identical in this respect with *O. flavidum*. As to the markings on the elaters in the two species, they are, at least in the case of *O. nitens*, subject to considerable variation. The Cambridge specimen above referred to has perfectly smooth elaters with the exception that, in a few instances, the very tip shows a ring-like thickening; other specimens show elaters marked with very faint spirals and here and there a stout, blunt spine, but no rings. In no specimen which I have seen, however, do they show the very densely punctate surface seen in *O. flavidum*. In this connection, another specimen in Professor Peck's collection is of interest. It was collected at Granville, Ohio, and was placed provisionally with *O. flavidum*. In outward appearance it is even more like a *Trichia* than is the type-specimen of *O. flavidum*, the sporangia being columnar in shape (rarely globose), densely crowded in an effused patch, and of a clear pale yellow color. The wall shows the same markings noted in *O. flavidum*. (Pl. LXI, fig. 27.) The fairly abundant capillitium consists of long, mostly simple but sometimes branching elaters, with a few bulbous expansions and marked with faint spiral bands, occasional short, blunt spines, and minute scattered warts. (Pl. LXI, fig. 26.) The elaters of this specimen are thus seen to approach those of *O. nitens* in the faint spiral markings which they exhibit when highly magnified, while the minute scattered spines or warts which are characteristic of the specimen distinctly recall the similar, though more abundant, markings of the elaters of *O. flavidum*. In its general habit and the abundance of

its capillitium it presents even a more marked divergence toward the genus *Trichia* than does the specimen with which it is associated.

The spores of the Granville specimen are slightly smaller than those of either *O. nitens* or the type-specimen of *O. flavidum*;^{*} this, however, is a slight and unimportant distinction. A most careful examination of these specimens and a comparison of them with many specimens of *O. nitens*, leads to the conclusion that the name *Oligonema flavidum* is worthy of retention as applied to specimens showing more or less the habit of the genus *Trichia* and provided with densely and very minutely spinulose elaters, although specimens may occur which, in the abundance of the capillitium and the indications of spirals on the elaters, are hardly distinguishable from members of the genus *Trichia*, while others may show an equally marked divergence toward *Oligonema nitens*.

OLIGONEMA BREVIFILA, Pk., Rep. XXXI, p. 42, 1889. In outward appearance the type-specimen of this species is almost indistinguishable from *O. flavidum*, Pk. The color of the sporangia is of a slightly browner tinge and the wall is of a duller lustre. Macbride finds a specific distinction between them on the ground that *O. brevifila* occurs "in broad effused patches" and *O. flavidum* "in small heaped clusters." This distinction is not apparent in the type-specimens, both being equally effused, with the latter, if anything, less heaped together than the former. Both occur on moss. The sporangium-wall of *O. brevifila* shows the inner surface marked with densely clustered, very minute, bristle-like, appressed hairs, as in *O. flavidum*. The spores of *O. brevifila* are slightly smaller ($11.2-12\mu$) than those of *O. flavidum*. The only marked difference between the two is seen in the elaters. In *O. brevifila* they are extremely scanty, reduced in length and increased in thickness; in shape they are irregularly cylindrical or fusiform; they are marked with fairly distinct but crowded and irregular spiral bands, occasional short, blunt spines or warts, and minute scattered spinules. (Pl. LXI, fig. 25.) This rudimentary condition of the elaters is practically the only feature which distinguishes this form from the Granville specimen of *O. flavidum* above described. The length of the elaters surely affords very insufficient grounds for establishing specific distinctions either in this genus or in the genus *Trichia*, since, e. g., typical specimens of *Oligonema nitens* almost always show, among the normal, long elaters, a few

* The following are the spore-measurements of these three forms: *O. flavidum*, $13-15\mu$; *O. nitens*, $12-14.2\mu$; the Granville specimen, $10.5-12.7\mu$. In all other respects the spores are identical.

which are almost as much reduced in length as those characteristic of *O. brevifila*. The genus *Trichia* also, presents the same varying feature, it being not uncommon to find specimens of *T. affinis*, DBy., in which all of the elaters are thus reduced. Taking these facts into consideration, it seems quite impossible to regard *Oligonema brevifila*, Pk. other than as a variety of *O. flavidum*, Pk.

It may not be out of place here to record the fact that typical specimens of neither *Oligonema nitens* nor *O. flavidum* and its varieties, commented upon above, show characters which serve to unite them with the very beautiful form described by Mr. Morgan as *Calonema aureum*. The latter, it is true, bears a very close external resemblance to *Oligonema nitens*, nor can we overlook the fact, regarding the highly developed capillitium, that in the genus *Trichia* analogous forms occur in which the normally free elaters are combined to form a network; nevertheless the peculiar character of the sporangium-wall in *Calonema aureum*, marked with scattered, raised papillæ from which radiate countless fine veinlets, and the abundant, strongly developed capillitium marked with reticulate ridges, faint spirals and prominent rings and spines, are combined features practically wanting in the genus *Oligonema*, and serve to distinguish that species from any other at present known to us. (Pl. LXI, figs. 28 & 29.)

ARCYRIA MACROSPORA, Pk., Rep. XXXIV, p. 43, 1881. Both Lister and Macbride agree in referring this species to *A. ferruginea*, Saut., and examination of the type confirms their statements. The dark, reddish-brown, ovoid sporangia, the coarse capillitium-threads somewhat triangular in section and marked with anastomosing or transverse bands and spinous processes, the large, pale-reddish, minutely spinulose spores, and the beautifully reticulated cup, are characters applicable to no other species.

A somewhat peculiar effect is produced in this species upon treatment with dilute potassium hydrate. In reddish-brown specimens this color is rapidly dissolved out from the sporangium, capillitium, and spores, leaving them of a uniform pale yellow color; in specimens originally yellow or ochraceous in color, this is at first changed by the alkali to a reddish-brown and then dissolved out. This lack of stability in the coloring matter of this and some other species is also seen in the rapidity with which it fades when exposed to direct sunlight.

We are now in a position to sum up the results of the foregoing observations upon the species originally described by Professor Peck.

Of the thirty-two species retained among the Myxomycetes by that author, I have been obliged to recommend that three names be discarded on the ground of the insufficiency, for purposes of accurate identification, of the original descriptions, and of lack of type-material. These species are *Physarum ornatum*, *Physarum luteolum*, and *Didymium angulatum*. In the case of three species, viz., *Stemonitis Morgani*, *Comatricha subcæspitosa*, and *Comatricha longa*, the type-specimens were not accessible to me and I have, therefore, referred them doubtfully, relying upon the original descriptions and upon the fuller notes published by other observers. The remaining 26 species I have referred as follows, confirming in most cases the judgment of one or the other of the two leading authorities on the group, Mr. Lister and Professor Macbride.

Badhamia magna, Pk. =	Badhamia magna, Pk.	
Craterium obovatum, Pk. =	“ rubiginosa, (Chev.) Rost.	
Physarum albicans, Pk.	} =Physarum globuliferum, (Bull.) Pers.	
“ “ var. subroseum, Pk.		
“ atrorubrum, Pk. =		“ pulcherrimum, Berk. & Rav.
“ inæquale, Pk. =		“ lateritium, (Berk. & Rav.) Rost.
“ pulcherripes, Pk. =		“ Ravenelii, (Berk. & Curt.) Mass.
“ citrinellum, Pk. =		“ citrinellum, Pk.
“ flavidum, Pk. =	“ “ “	
Fuligo ochracea, Pk. =	Fuligo ochracea, Pk.	
Physarella mirabilis, Pk. =	Physarella oblonga, (Berk. & Curt.) Morg.	
Diderma flavidum, Pk. =	Physarum contextum, Pers.	
Chondrioderma crustaceum, Pk. =	Chondrioderma globosum, (Pers.) Rost.	
Diderma farinaceum, Pk. =	“ spumarioides, (Fr.) Rost.	
Diachæa splendens, Pk. =	Diachæa splendens, Pk.	
“ subsessilis, Pk. =	“ subsessilis, Pk.	
Didymium oxalinum, Pk. =	Physarum cinereum, (Batsch) Pers.	
“ connatum, Pk. =	“ nephroideum, Rost. var. globosum.	
“ eximium, Pk. =	Didymium nigripes, (Lk.) Fr.	
Stemonitis herbatica, Pk. =	Stemonitis ferruginea, Ehrenb.	
Comatricha æqualis, Pk. =	Comatricha nigra, (Pers.) Schroet.	
Perichæna cæspitosa, Pk. =	Lindbladia effusa, (Ehr.) Rost. var. simplex, Rex.	
Trichia reniformis, Pk. =	Trichia contorta, (Ditm.) Rost.	
Oligonema flavidum, Pk. =	Oligonema flavidum, Pk.	
“ brevifila, Pk. =	“ flavidum, Pk. var. brevifila Pk.	
Arcyria macrospora, Pk. =	Arcyria ferruginea, Saut.	

EXPLANATIONS OF PLATES.

PLATE LX.

- Fig. 1. *Badhamia magna*, Pk. Capillitium and spores. $\times 330$.
 Fig. 2. The same. Spores. $\times 680$.
 Fig. 3. *Badhamia hyalina*, Berk. Capillitium. $\times 330$.
 Fig. 4. The same. Spores. $\times 330$.
 Fig. 5. The same. Spores. $\times 680$.
 Fig. 6. *Badhamia utricularis*, Berk. Spores. $\times 330$.
 Fig. 7. The same. Spores. $\times 680$.
 Fig. 8. *Physarum albicans*, Pk. Sporangium showing columella, portion of capillitium, and rounded bodies within the stalk at the base. $\times 70$.
 Fig. 9. The same. Spores. $\times 680$.
 Fig. 10. *Chondrioderma crustaceum*, Pk. Spores and spherical lime-granules from the outer wall. $\times 680$.
 Fig. 11. The same. Portion of capillitium. $\times 680$.
 Fig. 12. *Chondrioderma globosum*, Rost. Portion of capillitium. $\times 680$.
 Fig. 13. The same. Spores and spherical lime-granules from the outer wall. $\times 680$.
 Fig. 14. *Chondrioderma spumarioides*, Rost. Spores* and spherical lime-granules from the outer wall. $\times 680$.
 Fig. 15. The same. Portion of capillitium. $\times 680$.
 Fig. 16. *Didymium eximium*, Pk. (No. 2493 of Ellis & Everhart's N. Amer. Fung.) Upper part of stalk, columella, and persistent bases of capillitium-threads in optical section. $\times 70$.
 Fig. 17. The same. Part of columella and capillitium, and five spores. $\times 330$.

PLATE LXI.

- Fig. 18. *Licea caespitosa*, Pk. Upper portion of sporangium-wall, showing perforations. $\times 330$.
 Fig. 19. *Trichia reniformis*, Pk. Elaters and spores. $\times 330$.
 Fig. 20. *Diachæa subsessilis*, Pk. Spores. $\times 680$.
 Fig. 21. *Diachæa splendens*, Pk. Spores. $\times 680$.
 Fig. 21a. The same. Single spore, showing compound tubercles. $\times 1000$.
 Fig. 22. *Diachæa elegans*, Fr. Spores. $\times 680$.
 Fig. 23. *Oligonema flavidum*, Pk. Elaters and spores. $\times 680$.
 Fig. 24. The same. Part of sporangium-wall. $\times 680$.
 Fig. 25. *Oligonema brevifila*, Pk. Elaters and spores. $\times 680$.
 Fig. 26. *Oligonema flavidum*, Pk. (Specimen from Granville, Ohio.) Elaters and spores. $\times 680$.
 Fig. 27. The same. Part of sporangium-wall. $\times 680$.
 Fig. 28. *Calonema aureum*, Morg. Capillitial thread and spores. $\times 680$.
 Fig. 29. The same. Part of sporangium-wall. $\times 680$.

X.—THE AIR-BREATHING MOLLUSKS OF THE BERMUDAS.
BY HENRY A. PILSBRY.¹

THE land-snail fauna of the Bermudas is one of considerable interest from the isolation of the islands and their typical "oceanic" character. Their small extent and low altitude have not favored the development of a rich fauna, and in 1852, the date of the first list, some exotic snails had already become established there. Colonization proceeded until now the immigrants outnumber the original Bermudians in the roll of Stylommatophores.

Origin of the Bermuda Fauna.

The fauna of air-breathing mollusks of the Bermudas is divisible, in respect to origin, into three groups of forms.

- (a) Autochthonous species, peculiar to the islands.
- (b) Drift waifs from the West Indies.
- (c) Species imported by the agency of man.

The first group includes a single *Thysanophora* (*hypolepta*) and one *Helicina* (*convexa*), both of Antillean type, and the genus *Pæcilonites* with four species and several varieties.² The relation-

¹ This paper is based upon the collection made by Professor Verrill and party in 1898, that of Professor Heilprin's class who visited Bermuda in 1888, that of Robert Swift, and specimens from the collections made by Thomas Bland and C. B. Adams. Professor Verrill has added the results of his personal observations on many species, greatly increasing the value of the study.

² The species are *P. bermudensis*, *nelsoni*, *reinianus* and *circumfirmatus*. The genus *Pæcilonites* was supposed by its founder to include the recent *Helix bermudensis* and the German lower Miocene *Helix imbricata* Braun. In a former paper on Bermudian Helices I had occasion to show that several other Bermudian species belong to *Pæcilonites*, and I would here record my belief that in bringing a European Miocene species into the Bermudian group, Dr. Boettger is only chasing an ignis fatuus. The pursuit of false lights has led most of the Germans who write on Helices into a maze of quagmires. Whether dealing with fossil or recent forms, their ideas on classification, and consequently on zoögeographic and palæontologic history also, are so hopelessly astray that the only path to redemption is for the young men to break away from the blind leaders of the blind, and seek solid footing.

ships of this genus are with *Gastrodonta*, a genus of the eastern United States, which comprises species with an internal lamella, as in *P. circumfirmatus*, and others without it, as in the other *Pecillozonites*. The very peculiar genitalia leave no doubt as to the alliance between *Gastrodonta* and *Pecillozonites*. No closely allied forms are known from the Antilles or from Europe. It appears therefore that the oldest element in the Bermudian Pulmonate fauna is distinctively North American, while all the rest of the endemic fauna is Antillean.

The single *Veronicella* of the fauna has, so far, not been found elsewhere, but it may yet prove to be exotic.

The second group of forms consists of species common to Bermuda and the Antilles. Omitting the *Auriculidae*, *Siphonariidae*, *Onchidiidae*, and *Truncatella*, which from their littoral habits and tolerance of salt water have exceptional facility in over-sea journeying, we find some eight species of truly terrestrial forms which apparently reached Bermuda by natural means of transportation, and are not modified from the parent stocks.

Thysanophora vortex, Greater Antilles, Bahamas, Southern Florida.

Polygyra microdonta, Bahamas.

Zonitoides minusculus, Greater Antilles; whole United States.

Pupa (Bifidaria) servilis, Cuba, Bahamas.

“ “ *rupicola*, Cuba, Florida.

“ “ *jamaicensis*, Jamaica.

Pupoides marginatus, Greater Antilles; U. S.

Succinea barbadensis, Barbados, and under various names, some other islands.

The small or minute size of all these is noteworthy; the *Succinea* being the largest species which has been able to journey so far over sea.

The whole series of littoral air-breathers (*Auriculacea* and *Truncatella*) likewise belongs to the Antillean group, the species being in all cases either identical with West Indian forms, or but very slightly modified.

A third element of the Bermudian fauna consists of those forms which have probably been transported thither by human agency; and as the date of introduction of the several forms is a matter of some interest to those who may hereafter study their variation in a new environment, I give below the data for each species so far as practicable.

Species.	When first collected or reported.	Original patria.	Present occurrence.
<i>Helicella ventricosa</i>	1852. T. Prime.....	Europe.....	Very abundant.
<i>Eulota similaris</i>	1889. T. H. Aldrich.....	East Indies.....	Abundant
<i>Vallonia pulchella</i> }	1876. J. M. Jones }	Europe, N. America }	Not recently taken.
	1881. Thos. Bland }		
<i>Polygyra appressa</i>	1876. J. M. Jones.....	Virginia, Tenn.....	In some abundance.
<i>Rumina decollata</i> }	1888. Heilprin, }	Southern Europe.. }	Very numerous.
	Stone, <i>et al.</i> }		
<i>Subulina octona</i>	1881. T. Bland.....	West Indies.....	Abundant.
<i>Opeas octonoides</i>	1888. Heilprin party	West Indies, etc...?	?
" <i>swiftianum</i>	" " " "	St. Thomas, etc....?	?
<i>Ennea bicolor</i>	" " " "	East Indies.....	One shell taken in '88.
<i>Cæcilioides acicula</i>	1861. T. Bland.....	Europe.....	No recent record.
<i>Limax flavus</i>	1898. A. E. Verrill.	".....	".....
<i>Agriolimax lævis</i>	1873. 'Challenger' Ex.	".....	Not again reported.
<i>Amalia gagates</i>	" " " "	".....	In some numbers.
<i>Physa acuta</i>	1880-'88.	".....	Not again reported.
	G. Brown Goode }		

From the data supplied by Prof. Verrill's expedition and that of Prof. Heilprin it seems that *Vallonia pulchella*¹, *Cæcilioides acicula*, *Agriolimax lævis*, and *Physa acuta* rest upon single records now nearly twenty years old, and they may not have permanently colonized; but as none of them are conspicuous forms, and no special collectors of land shells have sought for them, the merely negative evidence is inconclusive. Probably all the others are well established colonists.

The abundance of European forms corresponds with the preponderance of European shipping in former times. The Indian or East Indian forms were probably brought with living plants for the Botanical Garden; while the single North American form, *P. appressa*, may have had a similar advent. How the *Physa* found its way to Bermuda is problematic,² as the cistern in which it occurred is one of the roofed rain-water catchment reservoirs commonly in use in the islands.

It is somewhat peculiar that *Helix nemoralis*, *lactea*, and *aspersa* have not yet established themselves in Bermuda, as they are usually among the first emigrants from the old country, like the slugs.

¹ This species was recorded both by J. M. Jones, 1876, and by Bland, 1881, independently, but as Jones and Bland were in correspondence at that time (see p. 508), it is quite probable that it was collected only by Jones, who resided in the Bermudas during many years in the winter and spring season and made large collections there.—(A. E. V.)

² It may have been introduced with the cultivated water lilies.—(A. E. V.) See note, p. 503.

It is obvious that in dealing with certain Antillean species, such as *Opeas*, it is not possible to rigidly discriminate between those introduced by natural means and those imported by man. The earlier faunal lists are our chief dependence in such cases. The same difficulty is encountered in deciding upon the primitive flora of the islands, and of course attends all work on insular faunas or floras at the present day.¹

Oceanic characteristics.—The foregoing data expose the truly "oceanic" nature of the fauna, which is a peculiarly *disharmonic* assemblage, to use Baur's expressive term. The endemic element (*Pecilozonites*) undoubtedly long antedated the other forms, as its generic divergence and strong specific differentiation indicate. In all probability it was derived from the eastern United States by some rarely efficient means of transport. The remaining forms are all Antillean in their affinities, and probably a drift or flotsam fauna. But the Antillean element by itself is not harmonic, for the absence of *Cerion*, *Urocoptidae*, belogonous or epiphallagonous *Helices*, and cyclostome operculates, all eminently characteristic of the West Indian faunas, betrays the hand of what we call chance, or the rigorous selective action of an over-sea journey, in the Bermudian assemblage.

List of Species.

Family **HELICIDÆ.**

Helicella (Cochlicella) ventricosa (Drap.).

First reported by Temple Prime in 1852. It has been noticed by all later collectors, and it is now exceedingly abundant.

It is common under the scales of cycad trunks, and in crevices of bark and knot holes of other trees. Also under the bark of fallen trees.—(Cook.)

¹ As early as 1615-20, or immediately after the first settlement, expeditions were sent to the Bahamas to introduce various useful tropical plants in growing condition, as well as seeds. Among the plants enumerated as introduced at that time and with which snails and insects may have been introduced, were the pineapple, papaw, sugarcane, banana, plantain, cassava, orange, lemon, and many others.

At about the same time various useful plants were also introduced from Virginia and from England. "Vines and cuttings of vines" were sent from England about 1616.

Eulota similaris (Fér.).

First reported by Hon. T. H. Aldrich, in 1889 (Nautilus III, 9) and found in some abundance by Mr. T. H. Montgomery some years later. The specimens collected by Prof. Verrill's party¹ are remarkable for their great solidity, elevated spire and distant faint spiral lines. The genitalia, however, are typical for the species. The kidney is very long and band-like, as in *Polygyra*, being double the length of the pericardium, and over half that of the lung.

This species has been widely distributed by commerce from an oriental center, and has long been known from Barbadoes, Rio de Janeiro, Havana, etc.

Vallonia pulchella (Müll.).

Recorded by Jones, 1876, and in Bland's list of 1881. The specific identity of Bermudian specimens has been confirmed by Dr. V. Sterki, from examples in U. S. Nat. Mus. (Proc. A. N. S., Phila., 1893, p. 278).

Thysanophora vortex (Pfr.).

PLATE LXII, FIGURES 1a, 1b.

An abundant Bermudian species, taken by many, if not all, collectors.

Common under stones on the larger islands. A few dead shells were found on Bailey Bay Island (Cook).

¹ This party consisted of Professor A. E. Verrill, Yale University, with M. C. Cook, W. E. Porter, and C. S. Verrill, students in the Sheffield Scientific School of Yale University. They were in Bermuda during April and May, 1898. Much more attention was paid by this party to the study of marine zoölogy than to terrestrial forms. Mr. Cook, however, devoted considerable time specially to the land snails, and to his devotion to this part of the work the relative completeness of the collection is mostly due. It was not practicable, however, to visit all parts of the islands, nor to spend much time in searching for rare and minute species. Doubtless a thorough search, especially in the swampy districts, would reveal a number of additional species. Some of the rarer forms, especially of slugs, were obtained by collecting in the night, with a lantern, when large numbers of snails and slugs could be found creeping on the stone fences, which are all built of limestone and often whitewashed. The owners of the fences sometimes complain that the snails eat the mortar from between the stones and thus damage the walls. Several species occur in vast numbers, and some of them, especially *Rumina decollata*, are quite injurious to garden vegetables and to fruit.—(A. E. V.)

Thysanophora hypolepta (Shuttl. ; Pils.).

PLATE LXII, FIGURES 2a, 2b.

Helix (Microphysa) hypolepta Shuttl., Pilsbry, Proc. A. N. S. Phila., 1889, p. 82, pl. iii, f. 6, 7, 8.

This minute species has the size of *Zonitoides minusculus*, but differs radically from that species in form, especially in the outline of the aperture. It could not certainly be known from Shuttleworth's note whether he had this species or the broadly umbilicated variety of *Z. minusculus*, but the tradition preserved on labels by Bland fixes its identity. The species is apparently peculiar to Bermuda. First recorded by Jones, 1876. It was also recorded by C. B. Adams and T. Bland, but seems to have escaped later collectors.

Polygyra microdonta (Desh.).

PLATE LXII, FIGURE 3.

Found by Robert Swift in 1852, and by all later naturalists who collected land shells. It is distinguished from the Florida wheel-shaped *Polygyras* by its very much finer striation above. It occurs also in the Bahamas. One of the most abundant Bermudian species.

It is one of the few species found on Shelter Island and various small uninhabited arid islands. It occurred abundantly under stones on the main island, near the Causeway.—(Cook.)

Polygyra appressa (Say).

First recorded from Bermuda by Jones, 1876, and by Bland in 1881. It still flourishes there, as the specimens taken by Professor Verrill's party attest. These are rather small (diam. 13–14^{mm}) and strongly ribbed, belonging to the var. *sculptior* Chadw., which ranges from Virginia westward. There cannot be much doubt that the species was imported from the United States. Mr. J. M. Jones, 1876, knew it from but one locality, near St. Georges. Now common.

It was found abundantly in an old stone wall near the Post Office at Bailey Bay.—(Cook.)

Family **ACHATINIDÆ**.**Rumina decollata** (L.).

This south European species has become extremely abundant over the cultivated portion of the main island, doing damage to fruit and vegetables. It was first reported from the island in 1888. It was not recorded by Jones in 1876.

I was told that it was abundant in the vicinity of Hamilton several years before it spread to Bailey's Bay and other parts of the main island. It is not found on the smaller islands.—(A. E. V.)

Subulina octona (Chemn.).

PLATE LXII, FIGURE 4.

Reported from Bermuda by Bland in 1881, and found by Aldrich, Heilprin, and by Verrill's party. Common under stones.—(A. E. V.)

Opeas octonoides (C. B. Ad.).

Several small specimens taken by Prof. Heilprin's party in 1888.

Opeas swiftianum (Pfr.).

PLATE LXII, FIGURE 5.

Twenty specimens taken by the party of 1888. It is known from St. Thomas, St. John, Porto Rico, and Vieque. Whether this and the preceding two Antillean species were introduced by natural means or by human agency is not known with certainty, but their recent detection strongly indicates the latter alternative.

Cæcilioides acicula (Müll.).

Reported by Bland in 1861, and by Jones in 1876, but not found by later collectors, so far as I know.

Family **PUPIDÆ.**

Mr. M. C. Cook of our party notes that most of the Pupidæ in our collection were obtained from under stones in a field opposite Mr. Seon's residence at Bailey Bay, where they were abundant. Some dead ones were found on Bailey Bay Island and on Trunk Island in Harrington Sound.—(V.)

Pupa (Bifidaria) servilis Gld.

PLATE LXII, FIGURE 6.

This is *Pupa pellucida* of Bland's list, and probably in part *Pupa bermudensis* of Prime, though the latter may have been based upon the following species, or both. Originally described from Cuba, the species is known from various West Indian islands. Alt. 2.7^{mm}.

Pupa (Bifidaria) jamaicensis C. B. Ad.

PLATE LXII, FIGURE 7.

Described as Jamaican, but probably occurs throughout the Greater Antilles. It differs from *P. servilis* in having the middle tooth of the outer lip situated decidedly deeper than its fellows, not prominent as in *servilis*. There is a more or less developed ridge or crest behind the outer lip. Alt. 2.3^{mm}.

Pupa barbadensis Pfr. has been reported by Bland from Bermuda, but specimens so labelled in the collection of the Acad. Nat. Sci., Phila., prove to be *jamaicensis*.

Pupa (Bifidaria) rupicola Say.

PLATE LXII, FIGURE 8.

Shell resembling *P. servilis* in size and form, perforate, pale brownish corneous, striatulate, composed of fully 5 convex whorls, those above tapering to a very obtuse apex; the last whorl widest, expanding to form a narrow whitish crest very close behind the lip. Aperture oval-rounded, obstructed by 5 denticles: the parietal lamella with bilobed crest, but with no other indication of its composite structure; columellar lamella strong, entering; sub-columellar very small, short, low, and well immersed; two palatal plicæ immersed beyond the position of the external crest, the upper one very small, the lower deeper immersed, and slender. Outer lip expanded, enormously thickened within by a white callus or flange, which is weakly emarginate above, and a little grooved on its flattened face.

Alt. 2.4; diam. 1; longest axis of aperture .84^{mm}.

Bermuda. This species was taken by Prof. Heilprin in 1888. It differs from the allied forms chiefly in the conspicuous thickening of the peristome by a white internal callus or flange. The same form occurs in Cuba and Florida, though there it has a less thickened lip. I have considered it well to figure and redescribe Say's species because the *P. rupicola* of Binney's works is *P. procera* Gld.

Pupoides marginatus (Say).

PLATE LXII, FIGURE 16.

Recorded under various names by Bland and others. Specimens taken by Prof. Verrill's party are practically typical. It is the *Pupa fallax* of most American writers. Recorded by Jones, 1876, as rare.

Bailey Bay in field under stones.

Family **STREPTAXIDÆ.**

Ennea bicolor (Hutton).

A single specimen of this little traveller was taken by Prof. Heilprin's class, and is now first recorded. Originally East Indian, the species has now been scattered widely in the Eastern Hemisphere. It has been recorded from Trinidad, and Mr. S. N. Rhoads collected specimens near Havana in 1899.

Family **ZONITIDÆ.**

This family contains the only genus of land snails peculiar to Bermuda, *Pæcilozonites*. The relationships of this group are clearly with the genus *Gastrodonta*, which is confined to the eastern United States. The generic synonymy, which is somewhat extensive, has been given in full in Proc. Acad. Nat. Sci., Phila., 1889, p. 86. The species are as follows:—

a. No lamina within the mouth.

b. Umbilicus narrow; columella making an angle with the basal lip; shell strong and solid. *P. bermudensis*, *P. nelsoni*.

b'. Umbilicus wide; peristome evenly arcuate below; shell thin, radially flammulate. *P. reinianus*.

a'. A lamina revolving within the aperture, on the outer wall.

P. circumfirmatus.

Pæcilozonites bermudensis (Pfr.).

Pilsbry, Proc. Acad. Nat. Sci. Phila., 1888, p. 239; 1889, p. 85.

This is one of the most abundant and the largest living species. While usually banded with brown, it is sometimes plain yellowish; and the young are often prettily flammulate.

It occurred under stones and old logs, and in walls; generally distributed.—(V.)

The *Helix ochroleuca* of Pfeiffer's monograph (vol. i, p. 80) described from Bermuda, looks like a narrowly umbilicate *P. bermudensis* with the periphery rounded, not carinated. If really Bermudian, it probably is a distinct species of *Pæcilozonites*, which will require a new name when rediscovered, as it is not the *ochroleuca* of Férussac.

Helix ochroleuca Férussac (Histoire, pl. 30, f. 1) is identical with the later *Pachystyla rufozonata* H. Ad. (cf. Nevill, Journ. Asiat. Soc. Bengal, 1875, p. 104), a Mauritian species.

Pœcilozonites nelsoni (Bld.).

Hyalina nelsoni Bld., Ann. Lyc. N. H. of N. Y., xi, 1875, p. 78.

P. nelsoni Pilsbry, Proc. A. N. S., Philad., 1888, p. 290, pl. xvii, f. J, K, L.

P. nelsoni v. Mart., Sitzungsber. Ges. Nat. Freunde, Berlin, 1889, p. 201.

This species was found by Mr. T. M. Jones in the "stalagmitic conglomerates in caverns at Tucker's Town." Professor Heilprin procured specimens from the same locality, and probably Beyrich's specimens, recorded by Von Martens, were from the same place.

It occurs at numerous localities imbedded in the softer æolian limestone, often in large numbers. At Bailey's Bay Island I obtained specimens from a ledge exposed only at low tide.—(A. E. V.)

Bland's type measured alt. 19,¹ diameters 37 x 34^{mm}. Four specimens before me measure: alt. 21½, diam. 33; alt. 26, diam. 40; alt. 30, diam. 33; and alt. 30, diam. 30^{mm}. The last three are exceptionally coarse in sculpture, almost or entirely free from carination at the periphery, and have about 9 whorls.

Rarely a specimen of *P. bermudensis* is found with much the contour of the more elevated forms of *P. nelsoni*.

Pœcilozonites reinianus (Pfr.).

Helix reiniana Pfeiffer, Malak. Bl., xi, 1863, p. 1.

Pilsbry, l. c., p. 290, pl. xvii, f. I, 1888. Also 1889, p. 85, pl. iii, f. 12, 13 (var. *goodei*).

This species is more broadly umbilicated than *P. circumfirmatus*, and has no internal lamina. The variety *goodei* Pils. has a still wider umbilicus and is quite flat above.

This species was not found by our party. Our specimens were presented to us by Miss A. Peniston.—(V.)

Pœcilozonites circumfirmatus (Redf.).

Helix circumfirmata Redfield, Ann. Lyc. N. H. of N. Y., vi, p. 16.

Pilsbry, Proc. Acad. N. S., Phil., 1888, p. 291, pl. xvii, f. F, G, H.

Helix discrepans Pfr., Malak. Bl., 1864, p. 1.

? *Helix ptychoides* Prime, Bermuda Almanac, 1852 (*nomen nudum*).

PLATE LXII, FIGURES 9, 9a.

Peculiar by the lamina within, reminiscent of the allied genus *Gastrodonta*. It varies from the thick typical form to a depressed

¹ The alt. was probably measured by Pfeiffer's method, which is more correctly the length of the central axis, not of the whole shell.

form which has been called *Helix discrepans* by Pfeiffer. The abbe A. Vathelet found a clear corneous race in one locality, though where I do not know; and this is what I named var. *corneus*.

Common under stones at Bailey Bay.—(Cook.)

Zonitoides minusculus (Binn.).

PLATE LXII, FIGURE 17.

A number of specimens collected by Prof. Verrill's party show some variation in the size of the umbilicus, as in those from Florida; and in some it is quite as wide as in the form called var. *alachuanus* by Dall. Some specimens before me were taken many years ago by Prime, and it is probably to be reckoned as indigenous. It is a common and wide-spread North American and West Indian species.

Common in the yard of a house at Bailey Bay, under stones. (Cook.)

Family LIMACIDÆ.

Limax flavus L.

Typical specimens of this European species were taken by Prof. Verrill's party. It is not uncommon in Philadelphia and some other Eastern cities, but has not hitherto been reported from Bermuda.

Under stones. Also taken at night, by lantern light, on stone fences.—(A. E. V.)

Agriolimax lævis (Müll.).

Cockerell, Journ. of Malacol., vi, p. 3 (1897).

A young specimen was found by Prof. Cockerell among *Amalia gagates* collected by the naturalists of the 'Challenger' in 1873, and is now in the British Museum.

Amalia gagates (Drap.).

E. A. Smith, Proc. Zool. Soc., Lond., 1884, p. 276. Cockerell, Ann. Mag. N. H. (6), vii, p. 328 (1891).

Taken by the 'Challenger' naturalists in 1873, by Mr. T. H. Aldrich in 1889, and by Prof. Verrill in 1898. It would therefore seem to be firmly established in Bermuda. Easily known by the very dark color and keeled back.

Found at night creeping on the stone fences. Taken while hunting snails with a lantern. Occasionally found under stones.—(A. E. V.)

Family **SUCCINEIDÆ.*****Succinea barbadensis*** Guild.

Guilding, Zoological Journal, iii, p. 532, Suppl., pl. 27, f. 4-6.

S. bermudensis Pfr., P. Z. S., 1857, p. 110; Monographia, iv, p. 817.

Variable in length of the spire, but I am unable to recognize more than one species in a series of several hundred shells collected by Swift, Bland, Vathelet, Heilprin, and Verrill.

The several *Succineas* reported from Bermuda—*S. margarita* Pfr., *S. fulgens* Lea, and *S. bermudensis* Pfr.,—seem to me to be merely varying identifications of a single species, the *S. bermudensis* of Pfeiffer. On comparing with *S. barbadensis* Guilding, from Barbados, I must agree with Mr. Smith¹ that there is no difference between the shells; but the shells of this genus are peculiarly uncharacteristic, species of different regions frequently resembling each other. Probably the soft anatomy will give better specific characters, as in the slugs.

Taken in large numbers in the crevices of the bark of a large tree in Miss Peniston's grounds.—(Cook.)

Family **VERONICELLIDÆ.*****Veronicella schivelyæ*** (Pilsbry).

Vaginulus schivelyæ Pils., Proc. Acad. Nat. Sci., Phila., 1890, p. 297, p. 5, f. 6, 7, 8.

Two specimens were taken by Miss Mary Schively, a member of Professor Heilprin's class, in 1888. A few years later I was told that the species had become abundant and destructive to vegetables. Professor Verrill obtained a number of specimens. Owing to its nocturnal feeding habits, it is not likely to be conspicuous to the casual visitor.

In coloration it varies from heavily blotched in two bands along the back, to mere indications of the bands. While it would seem likely that the species is an introduced one, I have been unable to identify it with any of those described from other regions.

Nearly all of our specimens were obtained, with many other pulmonates, by examining the whitewashed surfaces of the stone fences and outhouses by the light of a lantern, late at night. The largest were 8 to 10 inches long when extended.—(A. E. V.)

¹ Proc. Malacol. Soc., Lond., i, p. 321.

Family **ONCHIDIIDÆ**.

Onchidium floridanum Dall.

O. floridanum Dall, Proc. U. S. Nat. Mus., 1885, p. 288.

O. transatlanticum Heilprin, Proc. Acad. Nat. Sci., Phila., 1888, p. 327, pl. 16, f. 4, 4a.

Originally described from Knight's Key, Florida, where Hemphill collected it. Professor Heilprin found the types of *O. transatlanticum*, which seems to me to be completely synonymous with *floridanum*, "in a rock hollow on the north shore just beyond Wistowe, near Flatts Village."

It was very abundant at Bailey's Bay, near Mr. Seon's house, on the rough eroded ledges, at and just below high-tide mark. Its dark olive green color agrees so well with the stains on the rocks that it is very inconspicuous.—(A. E. V.)

Family **PHYSIDÆ**.

Physa acuta Drap.

Specimens of this common European species were collected by Mr. G. Brown Goode, in a fresh-water tank, several years ago. All the freshwater on the island is rain water storage, so the means by which this species reached the tank is a mystery. I am indebted to Prof. Dall for the opportunity of seeing this species.

Water lilies and other aquatic plants have been cultivated in the gardens (see Lefroy's List of Plants, Bull. Nat. Mus., xxv). It may have been introduced with such plants, or with goldfish that are now naturalized in the brackish ponds.—(A. E. V.)

Family **AURICULIDÆ**.

Pedipes mirabilis (Mühlf.).

Typical specimens of all ages taken by Heilprin. It is readily distinguished from the next species by the blunt tooth within the outer lip of adults, with a ridge running parallel to the peristome below it. Length 4–5^{mm}.

Pedipes tridens Pfr.

PLATE LXII, FIGURE 10.

Originally described from Bermuda, from Redfield's collection, some of whose specimens are before me. Also collected by Profes-

sors C. B. Adams, Heilprin, and Verrill's party. It is much smaller than *P. mirabilis*, more oval than the young of that species, and never develops a tooth within the outer lip. Recorded by Jones, 1876.

Plecotrema cubense Pfr.

PLATE LXII, FIGURE 11.

Taken by Heilprin's party in 1888 and by Prof. Verrill's party in 1898 (No. 12,046). The specimens agree with those from Cuba.

Alexia myosotis bermudensis Pfr.

Scarcely distinct from the European and New England *myosotis*, but on the average differing in the absence or small size of the upper parietal fold, there being usually but two folds on the columellar side of the mouth, and none within the outer lip. Occasional specimens, however, have three folds. Those before me were collected by C. B. Adams, Heilprin's party, Prof. Verrill's party, and others, so that it is apparently an abundant species. Recorded by Jones, 1876.

Our examples were mostly collected on the edges of a small pond, near the Post Office at Bailey's Bay.—(V.)

Melampus flavus Gmel.

Taken by Heilprin's party. It is easily known by the very low position and subvertical direction of the columellar fold.

Melampus redfieldi Pfr.

Scarcely, if at all, to be distinguished from the prior *M. gundlachi* Pfr., but not attaining so large a size. It was originally described from the Bermudas, and has been taken there by Robert Swift, Thomas Bland, and the parties conducted by Professors Heilprin and Verrill.

Melampus gundlachi Pfr.

Three specimens, typical of this form, were sent me many years ago by Mr. C. T. Simpson; and Mr. E. A. Smith identifies it among the 'Challenger' shells. It seems to intergrade in Florida with *M. coffea* L. Dall, in his revision of the Auriculacea, has mistaken it for *M. flavus*, which is really quite a distinct thing.

Family SIPHONARIIDÆ.

Siphonaria brunnea Hanley.

P. Z. S., 1858, p. 24. *S. picta* Sow. and *S. alternata* Say, of Heilprin's list.

Differs from *S. alternata* in the more unequal ribs, but is perhaps only a variety of that species. Cf. also *S. picta* D'Orbigny. This form is of course exclusively marine, and introduced here merely to complete the list of air-breathing mollusks.

Abundant on rocks between tides.—(A. E. V.)

An undescribed species of *Siphonaria* was also taken. See a subsequent article by Verrill and Bush in this volume (p. 524).

Family TRUNCATELLIDÆ.

The species known from Bermuda may be determined by the following key :

- a. No noticeable crest behind the outer lip.
 - b. Ribs close and numerous, regularly developed ; alt. usually 6-7^{mm}. *T. caribæënsis*.
 - b¹. Ribs partially or wholly effaced on the convexity of each whorl ; size usually smaller. *T. caribæënsis pulchella*.
- a¹. A strong, continuous crest behind the basal and outer lips ; alt. 4-5^{mm}.
 - b. Ribs fine and close, 25-30 on the last whorl. *T. bilabiata*.
 - b¹. Ribs strong and coarse, 13-15 on the last whorl. *T. clathrus*.

Truncatella caribæënsis 'Sowb.'; Reeve.

PLATE LXII, FIGURES 14, 14a.

Typical specimens are in the collections made by Verrill and by Heilprin.

Truncatella caribæënsis pulchella Pfr.

The specimens before me were collected by Robert Swift and C. B. Adams, but they evidently found it in large numbers. Recorded by Jones, 1876.

Truncatella bilabiata Pfr.

PLATE LXII, FIGURE 12.

Taken by Prof. Heilprin's class, and by Prof. Verrill's party. It is the strong-crested Floridian variety of the species, not the typical form, which occurs in Bermuda.

Truncatella clathrus Lowe.

PLATE LXII, FIGURE 13.

This coarse-ribbed and comparatively rare species was collected by both Verrill and Heilprin. It has hitherto been reported only from Porto Rico and St. Thomas.

Family **HELICINIDÆ.****Helicina convexa** Pfr.

PLATE LXII, FIGURES 15, 15a.

Abundant and taken by nearly all collectors. Evidently the *Helicina subdepressa* Poey of Jones, and *H. fasciata* of some early lists refer to this species. There seems scant justification for Angus' assertion that *H. convexa* is identical with *H. fasciata*; I consider it a well characterized species.

Bland reports *H. convexa* from Barbuda; but I cannot help thinking that either his identification or locality was wrong. It is probably peculiar to Bermuda.

Abundant under stones and in walls.—(V.)

BIBLIOGRAPHY.

All of the lists based on original material are noticed below. The older ones contain many erroneous identifications.

1852, 1859.—The Naturalist in Bermuda, by John Matthew Jones (London). Mollusca on pp. 106, 107.

This list is said to be compiled from one by Mr. Temple Prince (*sic*) published in the Bermuda Almanac for 1852. I have not seen the original list by Prime. The following air-breathing mollusks are enumerated.

<i>Helix palludosa</i> (<i>Polygyra microdonta</i>).	<i>Bulimus bermudensis</i> n. sp.
“ <i>microdonta</i> (“ “).	“ <i>sandysii</i> “
“ <i>ptychoides</i> (<i>Pœcilozonites circumfirmatus</i>).	<i>Pupa bermudensis</i> “ (<i>Bifidaria</i> sp.).
“ <i>selenina</i> (<i>Thysanophora vortex</i>).	<i>Helicina variabilis</i> (<i>H. convexa</i>).
“ <i>bermudensis</i> (<i>P. bermudensis</i>).	<i>Succinea bermudensis</i> n. sp. (<i>S. barbarendensis</i>).
“ <i>sancta-georgiensis</i> n. sp.	<i>Truncatella aurea</i> n. sp.
“ <i>somerseti</i> “	<i>Auricula flava</i> (<i>Melampus</i> sp.).
<i>Bulimus ventrosus</i> (<i>Cochlicella ventrosa</i>).	

Many of the names of this list were evidently erroneous identifications; and the new species were never described under these names, with the exception of *Succinea bermudensis*. It is of value as showing that the fauna contained at least thirteen terrestrial species in 1852, only one of which, *Bul. ventrosus*, is known to be introduced. I have given in parenthesis the equivalents in modern nomenclature of such of the species as can be recognized. *Helix sancta-georgiensis* and *H. somersetti* may have been applied to *Pocillozonites reinianus* and *Thysanophora hypolepta* or *Z. minusculus*. *Bulimus bermudensis* and *B. sandysii* were perhaps based upon species of *Opeas* or *Pupoides marginatus*, though it is likely that an American observer would have recognized in the latter a common United States species.

1860.—Bermuda: Its history, geology, climate, products, agriculture, commerce and government. By Theodore L. Godet, M.D. London; Smith, Elder & Co. Chapter XIV, "Shells" includes Crustacea and Mollusca. Under the head *Pulmonea* (p. 224–227) are enumerated *Limax cinereus*, *Testacella haliotidea*, *Vitrina pellucida*, *Helix concava* and *hortensis*, *Pupa chrysalis*, *Clausilia papillaris*, *Bulimus lubricus*, *Achatina columaria*, *Succinea bermudensis*, *Limnæa auricularia*, *Physa fontinalis*, *Auricula midæ* and *Ancylus rivularis*. With the exception of *Succinea bermudensis*, which is proposed as a new species, there is no reason to believe that any of these identifications were based upon Bermudian specimens. The list might have been compiled in Bedlam, and is introduced here merely as a curiosity, and for the sake of bibliographic completeness.

1861.—Catalogue of a collection of mollusks from Bermuda, by H. B. Tristram. Proc. Zool. Soc., Lond., 1861, pp. 403–405.

This collection was made by Col. Freeman Murray, one time Governor of the Bermudas.

The greater number of species listed are marine forms, but the following pulmonates are given :

<i>Helix bermudensis</i> .	<i>Succinea</i> ——— ?
" <i>circumfirmata</i> .	<i>Helicina variabilis</i> Ad.
" <i>microdonta</i> Dh.	<i>Melampus coffea</i> .
" <i>paludosa</i> Say.	" <i>fasciatus</i> Chemn.
<i>Bulimus ventricosus</i> Dr.	" <i>oblongus</i> Pfr.

1861.—On the Geographical Distribution of the Genera and Species of Land Shells of the West India Islands; with a Catalogue of the species of each island, in Ann. of the Lyc. of Nat. Hist of N. Y., vii, p. 351. By Thomas Bland.

This is the first list of Bermudian shells by an experienced conchologist. It was based upon specimens collected by C. B. Adams, Robert Swift, Temple Prime, T. Bland and others.

<i>Helix bermudensis</i> Pfr.	<i>Pupa jamaicensis</i> C. B. Ad.
“ <i>circumfirmata</i> Redf.	“ <i>pellucida</i> Pfr.
“ <i>microdonta</i> Dh.	<i>Succinea bermudensis</i> Pfr.
“ <i>ochroleuca</i> Fér. ?	“ <i>fulgens</i> Lea.
“ <i>vortex</i> Pfr.	“ <i>margarita</i> Pfr.
<i>Bulimus nitidulus</i> Pfr.	<i>Truncatella subcylindrica</i> Gray.
“ <i>ventrosus</i> Fér.	<i>Helicina convexa</i> Pfr.
<i>Achatina acicula</i> Müll.	

This list was the basis of the later ones of Kobelt and Fischer.

1864.—Contributions to the Nat. Hist. of the Bermudas, Part i, Mollusca, by T. Matthew Jones, Halifax, N. S., 1864. Air-breathing forms on pp. 8, 9.

<i>Helix bermudensis</i> Pfr.	<i>Bulimus ventrosus</i> Fér.
“ <i>circumfirmata</i> Redf.	Pupa ——— ?
“ <i>microdonta</i> Desh.	<i>Melampus redfieldii</i> Pfr.
“ ——— ?	“ <i>flavus</i> Gm.
<i>Succinea texasiana</i> Pfr.	<i>Helicina subdepressa</i> Poey.
“ ——— ?	

1876.—The Visitor's Guide to Bermuda, with a Sketch of its Natural History. By J. M. Jones. Halifax, 1876. Land shells on pp. 138, 139.

The following twenty-six nominal species are enumerated. Those here marked with an asterisk are not included in the earlier lists.

The author (p. 436) acknowledges the assistance of Thomas Bland in the identification of the terrestrial and fluviatile shells.

Hyalina ochroleuca. Rare (= var. of next).

H. bermudensis. Very common.

H. “ *var. nelsoni*. Semifossil.

**H. reiniana*. Rare.

H. circumfirmata. Common.

**H. discrepans*. Rare (= var. of last).

Helix vortex. Not common (= *Thysanophora*).

H. hypolepta. Rare (= *Thysanophora*).

**H. pulchella*. Not common (= *Vallonia*).

H. microdonta. Very common (= *Polygyra*).

H. ventricosa. Not uncommon (= *Helicella*? See under *Bulimus*, where it is apparently repeated).

**H. appressa*. Only one locality known, near St. Georges (= *Polygyra*).

Cionella acicula. Very rare.

**Pupa fallax*. Rare (= *Pupoides marginatus*).

P. pellucida. Rare (= *P. servilis*).

P. jamaicensis. Rare.

Succinea fulgens. Not common (= *S. barbadosensis*).

S. bermudensis. Common (= var. of last).

S. margarita. Not common (= var. of last).

Bulimus ventrosus. Very common (= *Helicella ventricosa*?).

Helicina convexa. Common.

Truncatella subcylindrica. Not common.

**T. pulchella*. Rare.

Melampus redfieldii. Common; borders of mangrove swamps.

**Pedipes tridens*. Not uncommon.

**Alexia bermudensis*. Common under stones; borders of mangrove swamps.

1881.—Bland, in Wallace's *Island Life*, p. 256, gives a list with the following species additional to his list of 1861. Most of them were included in Jones' list of 1876.

Hyalina discrepans.

Helix pulchella.

Hyalina nelsoni.

Patula reiniana.

Pupa barbadensis.

" *hypolepta*.

Helix appressa.

Stenogyra octona.

1884.—An Account of the Land and Freshwater Mollusca collected during the Voyage of the 'Challenger,' P. Z. S., Lond., p. 276. By E. A. Smith. Eight common species were obtained by the 'Challenger,' in 1873, and *Amalia gages* is recorded for the first time.

1889.—On the Helicoid Land Mollusks of Bermuda, by H. A. Pilsbry, in Proc. Acad. Nat. Sci. Phila., 1888, pp. 285-291, pl. xvii.

Deals chiefly with *Pæcilozonites*, which is anatomically characterized. Reprinted in Heilprin's *The Bermuda Islands*, pp. 191-201, pl. 16.

1889.—The Bermuda Islands, by Angelo Heilprin. Land Mollusks on pp. 181-184.

In addition to the forms enumerated by Jones, Kobelt, Fischer and by Bland in Wallace, the following are given as occurring in Bermuda.

Bulimulus decollatus L. (= *Rumina*)

Melampus pusillus Gmel. (erroneous identification).

" (*Tralia*) *cingulatus* Pfr. (erroneous identification).

Truncatella caribæensis Sow.

Onchidium transatlanticum Heilpr. (= *O. floridanum*).

EXPLANATION OF PLATE LXII.

All the figures were drawn by Mr. Alpheus H. Verrill except figures 2a, 2b, 6, 7, 8, which were drawn by the author, and 16, 17 which are from Binney's Gould.

Figure 1a, 1b.—*Thysanophora vortex*. × 5½.

Figure 2a, 2b.—*Thysanophora hypolepta*. × 10.

Figure 3.—*Polygyra microdonta*. × 3.

Figure 4.—*Subulina octona*. × 2.

Figure 5.—*Opeas swiftianum*. × 2½.

Figure 6.—*Pupa servilis*. × 12.

Figure 7.—*Pupa jamaicensis*. × 12.

Figure 8.—*Pupa rupicola*. × 12.

Figure 9, 9a.—*Pæcilozonites circumfirmatus*. × 2½.

Figure 10.—*Pedipes tridens*. × 15.

Figure 11.—*Plecotrema cubense*. × 15.

Figure 12.—*Truncatella bilabiata*. × 10.

Figure 13.—*Truncatella clathrus*. × 10.

Figure 14.—*Truncatella caribæensis*; young. × 8.

Figure 14a.—The same; adult. × 8.

Figure 15, 15a.—*Helicina convexa*. × 2½.

Figure 16.—*Pupoides marginatus*. × 6½.

Figure 17.—*Zonitoides minusculus*. × 4.

XI.—ADDITIONS TO THE ICHTHYOLOGICAL FAUNA OF THE BERMUDAS, FROM THE COLLECTIONS OF THE YALE EXPEDITION OF 1898.
BY SAMUEL GARMAN.

THREE species are represented by the fishes sent me for identification. One of them is a Labroid that is common along the coast of Florida and among the West Indies; its occurrence in the Bermuda waters has been noted by Goode and Bean. The second is a Gobroid of which the habitat has heretofore been undetermined. The fact that the type locality is unknown gives the more importance to the specimen in the present collection. The third species is a Brotuloid which has a close ally in one from the Florida Keys, and in another from the coasts of Lower California. Though the differences are slight, they are such as to make it necessary to describe and name the Bermudan form as a new species. The following are the species as determined. They were all taken in shallow water, by the dredge.

PlatyGLOSSUS bivittatus Bloch, 1791.

D. 20; A. 15; V. 6; P. 12; Ll. 26; Ltr. 2 + 1 + 7-8.

The specimen examined has a total length of 0.064, length of head 0.0165, length from snout to dorsal 0.0165, length from snout to anal 0.0295, length from snout to caudal 0.052, length of eye 0.004, and length of snout 0.004 metres. This species was placed in *Choerajulis* by Goode and Bean and in *Iridio* by Jordan and Evermann.

Hab. Florida and the West Indies to northern South America and to the Bermudas. Bailey Bay, 4-6 fathoms.—(A. E. V.)

Gobius stigmaturus Goode and Bean, 1882.

D. 6 + 12; 13; Ll. 33; Ltr. 10.

Entire length 0.042, length of head 0.008, distance from snout to dorsal 0.012, distance from snout to anal 0.0175, length of caudal fin 0.011, and length of eye 0.003 metres.

Hab. Bermuda Islands. Off Bailey Bay, 4-6 fathoms.

This capture makes it appear very likely that the type from which the original description was secured was taken in the same locality rather than in the West Indies.

Brosmophycis Verrillii sp. nov.

Br. r. 7; D. 70; A. 50; Ll. 100; Ltr. 23.

Total length 0.045, length of head 0.011, distance from snout to dorsal 0.013, distance from snout to anal 0.02, length from snout to caudal 0.04, depth of body 0.007, length of ventral 0.01, length of eye 0.001, length of snout 0.002, length of pectoral 0.007, and length of maxillary 0.005 metres.

Body moderately robust, compressed behind the head, slender in the caudal pedicel, slightly arched from snout to caudal, greatest depth of body little more than one-sixth of the total length. Head as wide as deep, convex on the crown, arched transversely and longitudinally, depressed forward, convex on the sides, broadly rounded across the end of the snout, one-fourth of the total in length. Snout broad, blunt, twice as long as the eye. Mouth wide, anterior, jaws equal, maxillary nearly half as long as the head, expanded at the end to nearly twice the width of the eye, broadly rounded on the hind margin, upper edge concave posteriorly. Teeth in villiform bands on jaws and vomer and in narrow bands on the palatines; Vomerine band arched forward in the middle. Eye small, about one-tenth as long as the head, half as long as the snout, above the middle of the mouth, or slightly farther forward. Operculum with a straight sharp spine at its upper angle; no other spines on the head. Gill membranes hardly united below the mouth, free from the isthmus. Gill rakers short, compressed, as broad as long, rudimentary 2 + 12, similar on the different arches. Length of body cavity in its entirety nearly twice that of the head. The dorsal and the anal are of moderate depth and are free from the caudal though the base of the hindmost ray in each is very close to the bases of the caudal rays; the rays in both are shorter forward and longer in the posterior half, toward the caudal; the hinder angles extend backward of the bases of the caudal rays in an acute angle. Dorsal origin above the end of the anterior fourth of the pectoral. Anal origin below the base of the twenty-first ray of the dorsal. Caudal distinct, small, pointed. Pectorals small, pointed, in length equal to depth of body. Ventrals close together at their bases, inserted close behind the humeral symphysis, each a long slender filament. Pores distinct around the mouth, margins slightly produced, anterior pair on lower jaws larger. Lateral line indistinct. Scales of the body small, thin, cycloid, imbricated. Muscular portion of cheek covered by small scales. Anal papilla of slight prominence.

Light olivaceous puncticulate with brown, centers of scales darker; fins whitish, as also lower surface of head and belly. Each flank with three longitudinal yellow streaks, a single scale in width, separated from one another by spaces five scales in width, beginning behind the shoulders and ending forward of the caudal, lowest one longer. Each stripe bears a remote resemblance to a lateral line. At the bases of dorsal and anal there are faint indications of similar streaks. On a photograph of this specimen when fresher, there is a darker tract on the scales of the cheek, a dark blotch below the anterior portion of the dorsal, and another above the foremost rays of the anal fin.

Named in honor of its discoverer, Professor A. E. Verrill of Yale University.

Hab. Bermuda Islands. Bailey Bay, 4-6 fathoms. One specimen.

Of the four known species of *Brosmophycis*, two, *B. marginatus* and *B. ventralis*, belong to the coasts of California and Lower California, while the third was taken at Key West, Florida. As is shown below, in affinities the new species is very close to that from Florida or that from Lower California. At present the different members of the genus may be distinguished thus:

Rostral cilia present (*Brosmophycis*);

D. 92; A. 70; bright reddish brown *marginatus*.

Rostral cilia absent (*Ogilbia*);

D. 64; A. 50; Ll. 100; brownish, without markings *ventralis*.

D. 68; A. 50; Ll. 87; Ltr. 27; uniform brownish *cayorum*.

D. 70; A. 50; Ll. 100; Ltr. 23; brownish, striped and blotched *Verrillii*.

XII.—ADDITIONS TO THE MARINE MOLLUSCA OF THE BERMUDAS.
BY A. E. VERRILL AND KATHERINE J. BUSH.

THE additions to the fauna recorded in this article are mostly from the collection made at the Bermudas in April and May, 1898, by the Yale scientific party under Professor Verrill.* They are all shallow-water (less than 8 fathoms) and littoral forms, no dredging having been done outside the reefs. The new species are nearly all of small size and were mostly obtained by picking over the samples of white shell-sand dredged up from the bottom in 3 to 7 fathoms in Bailey Bay, Murray Anchorage, Harrington Sound, and Castle Harbor. A large part of the bottom of these and the other bodies of water enclosed by the outer reefs is covered with this shell-sand, which varies considerably in coarseness and in the nature of the contained organisms. In general it contains only a very small amount of fragments of corals (chiefly *Millepora* and *Oculina*), some bryozoa, more or less fragments of calcareous algæ and echinoderms, and a number of rather large foraminifera of several species.† But the bulk of the material consists of the broken shells of small mollusca, especially of bivalves of many species. Usually from 80 to 90 per cent. of the bulk of the sand is of this nature in the localities dredged. By washing such sands and sifting them into various grades of fineness it is easy to find a large number of

* The other members of the party were Messrs. M. C. Cook, W. E. Porter, and C. S. Verrill, all students in the Sheffield Scientific School of Yale University. All the species here recorded, unless otherwise stated, were collected by this party.

† The following species of Foraminifera, selected from these shell-sands, have been identified by Miss K. J. Bush by comparison with the figures in Dr. Flint's report on the "Recent Foraminifera" (Report U. S. National Museum for 1897, 1899).

Biloculina bulboides d'Orbigny, *Miliolina venusta* Karrer, *Miliolina circularis* Bornemann, *Orbitolites marginalis* Lam., with the very abundant *Orbiculina adunca* Fitchtel and Moll., which was also found by the Challenger party, and *Orbulina universa* d'Orbigny.

A single specimen was also found of an interesting form of *Peneroplis* belonging to the group having narrow, compressed forms, of which *Peneroplis arietinus* Botch is the type (Challenger Report, p. 204, pl. xiii, figs. 18, 19, 22). It differs in having a more flaring or tapered form and more numerous segments than any species hitherto described.

minute species of shells, both of gastropods and bivalves. A considerable proportion of the small gastropods were living when taken, and a smaller proportion of the bivalves. The bulk of the broken and dead shells have evidently passed through the digestive organs of the abundant large holothurians (*Stichopus*), sea-urchins (*Toxopneustes*), many fishes, etc., which swallow great quantities of the organic muds and sands for the sake of the living organisms that they contain. To this cause, in part, is also due the finely comminuted calcareous mud, which is everywhere mixed with the coarser materials.

Some interesting additions to the list of bivalves were obtained by breaking up large masses of dead corals from the reefs. These are mostly true borers, but others are nestlers that find shelter in the holes made by the boring species. No doubt there are many more species to be added to the list of the Bermuda fauna whenever careful dredging shall have been made over the large areas of bottom outside the bordering reefs, in 10 to 60 fathoms of water, where the fauna is, as yet, practically unknown. It is well-known to the local fishermen that several of the large showy shells like *Strombus gigas*, *Triton variegatus*, etc., are rarely to be found except in rather deep-water on the south side of the islands. Several of the littoral shells, also, are common on the south side, but rare or absent on the north side of the islands.

The present list does not include the pteropods, the nudibranchs, nor the tectibranchs with rudimentary shells, which will be discussed in the next article.

Several lists of the marine mollusca of the Bermudas have already been published.

J. Matthew Jones, in 1859,* published one of the earliest lists, and in 1876† added considerably to the number of species. In the latter work 87 species were included, of which 55 were gastropods, 31 bivalves, with 1 cephalopod.

A. Heilprin, in 1889,‡ enumerated 171 species, of which 110 were gastropods, 57 bivalves, and 4 cephalopods.

W. H. Dall, in 1889,§ recorded 163 species, of which 105 were

* Jones, J. Matthew. *The Naturalist in Bermuda*. London, 1859.

† ———. *The Visitor's Guide to Bermuda*, pp. 137-140. Halifax, 1876.

‡ Heilprin, Angelo. *The Bermuda Islands*, pp. 166-181, with plates 15 and 17. 8vo. Philadelphia, 1889.

§ Dall, William Healey. *Bulletin of the U. S. National Museum*, No. 37. Washington, 1889.

gastropods, 57 bivalves, with 1 cephalopod. Of these, 94 species are apparently not in Heilprin's list, though some names may be synonymous. Other species have been discovered by the naturalists of the Challenger Voyage, and by several other naturalists. In the present paper about 80 species are added to the fauna, of which about 25 appear to be new species.

Thus the list of Bermuda marine mollusca now contains about 350 determined species, mostly of West Indian origin.

A considerable number of the smaller forms from the shell-sands in our collections still remain to be determined.

Many collections brought from Bermuda contain shells bought from the local dealers in curiosities or from local fishermen who sell them to visitors. In many cases such collections contain shells and corals that do not inhabit the Bermudas, such for example as *Cypræa tigris* and *Voluta musica*, with other well-known East Indian species, which the local collectors will claim as native to the waters. So, likewise, many West Indian shells are said to occur there which, at least, need confirmation by a scientific collector.* Ever since the settlement of Bermuda there has been very free communication and much commerce with the West Indies, and many shells are often brought home from the West Indies by returning sailors, soldiers, and passengers. Therefore it is important to state whether any doubtful or rare species was personally collected or purchased.

The total number of nominal species contained in the several lists, together with those now added, amounts to about 350. To this number should be added at least 8 species of nudibranchs, 3 of *Aplysia*, and one allied to *Pleurorbranchus*. (See next article, p. 545.)

Nearly all the pteropods of the tropical Atlantic are also found in the vicinity of the Bermudas, as well as several pelagic gastropods of the Sargasso sea.

* A specimen of the common large West Indian *Melongenæ* was offered to me by a colored boy who declared that he had found it on the beach at Coney Island. This may possibly have been true, but this shell has never been found at the Bermudas by a reliable collector, and therefore cannot be properly included in the faunal list. (A. E. V.)

List of Additional Species.

BIVALVIA.

Family **OSTREIDÆ.**

Alectryonia limacella (Lam.).

Alectryonia limacella Chenu, Manuel Conch., ii, p. 197, f. 1005, 1862.

Several specimens adhering firmly to gorgonians were seen in the excellent collection of Miss A. Peniston.

Family **PECTINIDÆ.**

Chlamys exasperatus (Sowerby).

Pecten exasperatus Hanley, Recent Shells, p. 273, 1856.

Pecten fuscopurpureus Conrad, Journ. Acad. Nat. Sci., Philadelphia, new series, i, pp. 209, 280, pl. 29, f. 10, 1849.

Pecten exasperatus Dall, Bull. U. S. Nat. Mus., No. 37, p. 34, 1889.

The young of a form agreeing with the typical *P. fuscopurpureus* of Conrad are not uncommon. Dr. Dall considers it one of the variations which grade into the typical *exasperatus* of Sowerby.

Lyropecten nodosus (Linné).

Pecten nodosus Hanley, Recent Shells, p. 279, 1856. Chenu, Manuel Conch., ii, p. 183, f. 922, 1862. Dall, Bull. U. S. Nat. Mus., No. 37, p. 34, 1889.

Lyropecten nodosus Verrill, these Transactions, p. 63, 1897.

One broken specimen of this species was dredged in 1898. Several fine examples were seen in Miss Peniston's local collection.

Family **MYTILIDÆ.**

Modiola (Botulina) opifex Say.

PLATE LVIII. FIG. 3.

Modiola opifex Say, Journ. Acad. Nat. Sci., Philadelphia, iv, p. 369, pl. xix, f. 2, May, 1825. Philippi, Conchylien, iii, p. 21, tab. ii, f. 7, 1851. Dall, Bull. U. S. Nat. Mus., No. 37, p. 38, 1889.

Not uncommon. Our specimens are young.

Modiola (Botula) cinnamomea Lam.

Modiola cinnamomea Lam., in Hanley, Recent Shells, p. 238, pl. 24, f. 24, 1856 (should be *cinnamomea*). Dall, Bull. U. S. Nat. Mus., No. 37, p. 38, 1889.

One specimen, from dead coral.

Lithophaga niger (d'Orb., 1846).

Lithodomus niger d'Orbigny, L'Ile de Cuba, p. 331, Atlas, pl. xxviii, figs. 10, 11, 1853.

Modiola Antillarum Philippi, Conchylien, iii, p. 20, tab. ii, f. 4, 1847 (non d'Orbigny, 1846); *L. Antillarum* d'Orbigny, 1846, same as *corrugatum* Philippi, 1846).

Lithophaga Antillarum Dall, Bull. U. S. Nat. Mus., No. 37, p. 38, 1889.

There seems to be considerable doubt as to the correct name to be applied to this very common species, which agrees perfectly with the *L. niger* of d'Orbigny. The *Antillarum* of d'Orbigny (1846) is a much larger species, of lighter color, with the striations covering the entire surface. It differs from the *Antillarum* of Philippi (1847) but agrees with *corrugatum* of Philippi (1846).

Numerous living specimens were taken from dead coral.

Family **ARCIDÆ.**

Pectunculus undatus Linné.

Pectunculus undatus Dall, Blake Report, pt. i, p. 238, 1885; Bull. U. S. Nat. Mus., No. 37, p. 42, 1889.

Only one valve was dredged. Others were seen in local collections.

Family **CARDITIDÆ.**

Cardita Dominguenis d'Orb., 1846.

PLATE LXIII. Figs. 6, 7 and 8.

Cardita Dominguenis d'Orbigny, L'Ile de Cuba, ii, p. 291, Atlas, pl. xxvii, figs. 27-29, 1853. Dall, Bull. U. S. Nat. Mus., No. 37, p. 46, 1889.

A small species, very common in the shell-sand.

Family **CRASSATELLIDÆ**.

Crassatellites (Crassinella) lunulata (Conrad), var. **parva** (C. B. Adams).

PLATE LXIII. FIG. 11.

Thetis parva C. B. Adams, Proceedings Boston Soc. Nat. Hist., ii, p. 9, Jan., 1845.

Crassatella Gaudalupensis d'Orbigny, L'Ile de Cuba, ii, p. 289, Atlas, pl. xxvii, figs. 24-26, 1853.

Astarte lunulata Conrad, Journ. Acad. Nat. Sci., Philadelphia, vii, p. 133, 1837; Fossils of the Medial Tertiary of the United States, p. 44, pl. 21, f. 8, 1840.

Crassatella (Eriphyla) lunulata Conrad, var. *parva* Dall, Blake Report, pt. i, p. 259, 1885; Bull. U. S. Nat. Mus., No. 37, p. 48, 1889.

Crassatellites (Crassinella) Guppy and Dall, Proc. U. S. Nat. Mus., xix, p. 326, 1896. See also, Zittel, Text-book of Palæontology, i, p. 396, 1900.

This variety differs from *lunulata* Conrad in being more elongated in form with the anterior end subtruncated, with a distinct sinuation in the concentric ribs.

Very common in the shell-sands.

Family **LEPTONIDÆ**.

Lasæa Bermudensis Bush.

PLATE LXIII. FIGS. 4 and 5.

Lasæa rubra (pars) Dall, Proc. U. S. Nat. Mus., xxi, p. 895, 1899.

Lasæa Bermudensis Bush, Science, x, No. 243, p. 251, 1899.

Very common between tides, especially among bunches of mussels, clinging to the byssus.

Family **LUCINIDÆ**.

Lucina nux, sp. nov.

PLATE LVIII. FIGS. 12 and 13.

Shell small, white, higher than long, obliquely ovate in a side-view. Umbos prominent, strongly curved forward. Surface strongly costulate and subcancellate. Posterior dorsal margin descending from the umbos in a broadly rounded curve; ventral margin distinctly produced and rounded in the middle; anterior end short, broadly rounded below, subtruncated above. Lunule small, deeply excavated.

Primary radial costæ about twelve, most of them double, those near the anterior and posterior margins less distinct; in the deep grooves between them there are usually three to five delicate costulæ, finely cancellated by the smaller lines of growth. Rather strong, elevated liræ cover the entire surface, crossing both the costæ and grooves; on the former some of them rise up into scale-like prominences and on the posterior ones often become subspinulose. In the right valve there are two very unequal cardinal teeth, the central one prominent and slightly bilobed; the anterior much smaller, prominent, with a little pit between. The lateral teeth are well-developed, the anterior one much the longer. The ligament is strong, with a deep groove.

Length of the single valve, 7^{mm}; height, 8^{mm}; thickness, 3^{mm}.

Lucina reticulata Poli (*non* Lam.).

Lucina pecten Philippi, Moll. Sicily, i, p. 31, tab. iii, f. 14, 1836 (*non* Lamarck).

Lucina reticulata Philippi, Conchylien, iii, p. 104, tab. ii, f. 6, 1850.

The comparatively few specimens from Bermuda agree with Philippi's figure, but it is doubtful if they are but an elongated form of *L. pecten* Lam., being less orbicular with finer sculpture than that species, and being intermediate between *pecten*, which is rounder with coarser sculpture, and *pectinata* Ad. (*obliqua* Reeve), which has more prominent beaks and much finer sculpture.

Family **CARDIIDÆ.**

Cardium (Papyridea) Petitianum d'Orb., 1846.

Cardium Petitianum d'Orbigny, L'Ile de Cuba, ii, p. 309, Atlas, pl. xxvii, figs. 50-52, 1853. Dall, Bull. U. S. Nat. Mus., No. 37, p. 54, 1889.

Two separate immature valves were dredged.

Family **PETRICOLIDÆ.**

Petricola (Naranaio) lapicida (Gmelin).

PLATE LXIII. FIGS. 14 and 15.

Petricola lapicida Hanley, Recent Shells, p. 53, 1843. Dall, Bull. U. S. Nat. Mus., No. 37, p. 58, 1889.

Examples of this rare form, taken from borings in dead corals, forwarded to Dr. Dall, were identified as this species.

Coralliophaga coralliophaga (Gmel.).

PLATE LXIII. FIGS. 9 and 10.

Cypricardia coralliophaga Hanley, Recent Shells, p. 150, 1843.

? *Cypricardia Hornbeckiana* d'Orb., L'Ile de Cuba, ii, p. 266, Atlas, pl. xxvi, figs. 33-34, 1853.

Coralliophaga coralliophaga H. and A. Adams, Genera, ii, p. 439, pl. 109, figs. 6, 6a, 1858.

This very common species, identified by Dr. Dall, varies greatly, not only in form, but also in the strength and character of the hinge-teeth.

Family **TELLINIDÆ.**

Tellina Candearia d'Orb., 1846.

PLATE LXIII. FIGS. 1 and 2.

Tellina Candearia d'Orbigny, L'Ile de Cuba, ii, p. 251, Atlas, pl. xxv, figs. 50-52, 1853.

A single valve agrees with d'Orbigny's figures.

Tellina iris Say, variety **Caribæa** d'Orb., 1846.

Tellina Caribæa d'Orbigny, L'Ile de Cuba, ii, p. 251, Atlas, pl. xxv, figs. 47-49, 1853.

Tellina iris Say, Journ. Acad. Nat. Sci., Philadelphia, ii, p. 302, 1822. Tryon, Amer. Mar. Conch., p. 149, pl. 26, f. 354, 1873. Dall, Bull. U. S. Nat. Mus., No. 37, p. 60, 1889. (? *non* Philippi, Conchylien, ii, p. 25, tab. iii, f. 5, 1845.)

One worn valve which Dr. Dall thought might be a worn *iris* Say, when compared with specimens of that species from Cape Hatteras, was found to be much larger, of quite different shape, with more numerous, oblique lines. Although Dr. Dall considers *Caribæa* but one of the forms of *iris*, it is such an extreme one, that it seems desirable to retain the name, at least, as a variety.

Tellina simplex d'Orb., 1846.

Tellina simplex d'Orbigny, L'Ile de Cuba, ii, p. 255, Atlas, pl. xxvi, figs. 15-17, 1853.

Common in the dredged shell-sand.

Tellina mera Say.

Tellina mera Say, Amer. Conch., pt. vii, p. 228, pl. lxiv, f. 2.

Tellina mera Binney's Say's Conch. U. S., p. 228, pl. 64, f. 2, 1858.

Strigilla mera Tryon, Amer. Marine Conch., p. 151, f. 366, 1873.

Tellina mera Dall, Bull. U. S. Nat. Mus., No. 37, p. 60, 1889.

Shells from Bermuda have a shorter and more inflated form than Say's figure represents, but they are considered this species by Dr. Dall. They look like worn examples of the following species.

Found in the shell-sand.

Tellina (Angulus) (sp. nov.).

Shells found with *mera* Say were identified as this new species by Dr. Dall. It is closely related to that species, but has a more elongated form, with less crowded concentric sculpture.

The description is to be included in a report on the Tellinidæ by Dr. Dall, soon to appear in one of the government publications.

Macoma (Psammacoma) tenta (Say), variety Souleyetiana Recl.

Tellina tenta Say, Amer. Conch., pt. vii, p. 228, pl. lxxv, f. 3, 18— Binney's

Say's Conch. U. S., p. 228, pl. lxxv, f. 3, 1858.

Tellina Souleyetiana Recluz, Journ. de Conch., iii, p. 253, pl. x, figs. 5-5', 1852.

Tellina tenta Tryon, Amer. Marine Conch., p. 149, figs. 350-351, 1873.

Macoma (Psammacoma) tenta Say, var. *Souleyetiana* Dall, Bull. U. S. Nat. Mus., No. 37, p. 60, 1889.

We are indebted to Dr. Dall for the identification of this form, which is abundant in the dredged shell-sand.

Family SEMELIDÆ.

Semele orbiculata (Say), var. radiata (Say).

Amphidesma orbiculata Say, Journ. Acad. Nat. Sci., Philadelphia, ii, p. 317, 1822.

Amphidesma radiata Say, op. cit., v, p. 220, 1826.

Amphidesma radiatum Say, in Hanley, Recent Shells, p. 342, pl. 12, f. 8 (as *A. australe*) and *A. subtruncatum* Sowerby, 1856.

Semele orbiculata Tryon, Amer. Mar. Conch., p. 154, pl. 27, f. 382, 1873.

Semele radiata Tryon, op. cit., f. 383.

Semele reticula Dall, Bull. U. S. Nat. Mus., No. 37, p. 62, 1889.

This has formerly been recorded from Bermuda under the name *reticulata*.

Common in shallow-water.

Semele bellastrata (Conrad).

Amphidesma bellastrata Conrad, Journ. Acad. Nat. Sci., Philadelphia, vii, p. 239, pl. xx, f. 4, 1837.

Amphidesma cancellata d'Orbigny, L'Île de Cuba, ii, p. 241, Atlas, pl. xxv, figs. 42-44, 1853.

Semele nexilis Gould, Proc. Boston Soc. Nat. Hist., viii, p. 281, 1862.

Semele cancellata Dall, Bull. U. S. Nat. Mus., No. 37, p. 62, 1889.

Formerly recorded from Bermuda under the name *cancellata*.

Not uncommon.

Family **GASTROCHÆNIDÆ.**

Gastrochæna (Spengleria) rostrata Spengler.

*Gastrochæna mytiloides** Lamarck, in Hanley, Recent Shells, p. 10, pl. 9, fig. 37, 1842.

Gastrochæna Chemnitziana d'Orbigny, L'Ile de Cuba, ii, p. 229, pl. xxv, figs. 29-30, 1853.

Rocellaria (Spengleria) rostrata Spengler, in Tryon, Structural and Systematic Conchology, iii, p. 120, pl. 104, f. 47, 1884.

Gastrochæna (Spengleria) rostrata Dall, Bull. U. S. Nat. Mus., No. 37, p. 72, 1889.

Common in borings in both dead and living coral.

Family **TEREDINIDÆ.**

Teredo Thomsoni Tryon.

Teredo Thomsoni Tryon, Proc. Acad. Nat. Sci., Philadelphia, p. 280, pl. 3, figs. 3-5, 1863. Gould, Invert. of Mass., p. 31, f. 358, 1870. Dall, Bull. U. S. Nat. Mus., No. 37, p. 74, 1889.

This large species was found in great abundance in a large log cast ashore at Bailey Bay.

GASTROPODA.

OPISTHOBRANCHIATA ; TECTIBRANCHIATA.

Family **ACTÆONIDÆ.**

Actæon punctostriatus (C. B. Adams).

PLATE LXV. FIGS. 15 and 18.

Tonatella punctostriatus C. B. Adams, Boston Journ. Nat. Hist., ii, p. 323, pl. iii, f. 9, 1840.

Actæon punctostriatus Bush, these Trans., vi, p. 467, pl. xlv, f. 17, 1885. Dall, Blake Report, pt. ii, p. 40, 1889; Bull. U. S. Nat. Mus., No. 37, p. 84, pl. xli, f. 17, pl. lii, f. 22, 1889.

The half dozen specimens from Bermuda agree in the size of the nucleus with examples from New England, but among those from off Cape Hatteras, N. C., there is great variation in this character, as shown in the figure.

* d'Orbigny calls attention to the close resemblance of his shell to the *mytiloides* of Lamarck.

Family **TORNATINIDÆ**.

Tornatina recta (d'Orb.).

PLATE LXIV. FIG. 2.

Bulla recta d'Orbigny, L'Ile de Cuba, i, p. 131, Atlas, pl. iv bis, figs. 17-20, 1853.
Tornatina recta Dall, Bull. U. S. Nat. Mus., No. 37, p. 84, 1889. Pilsbry,
Manual Conch., xv, p. 184, pl. 22, figs. 13-15, 1893.

Rare in the dredged shell-sand.

Tornatina decurrens, sp. nov.

PLATE LXIV. FIG. 1.

Shell white, minute, oblong-elliptical, with a somewhat turreted spire, consisting of about two whorls, besides the relatively large and prominent, vertically upturned nucleus, which consists of nearly three whorls. Suture impressed and slightly canaliculate, that of the body-whorl very oblique. Aperture long, much narrowed posteriorly, somewhat expanded anteriorly, with a distinct, very oblique fold on the columellar margin. Surface smooth and polished.

Length from 2.5 to 3^{mm}; breadth, 1.12 to 1.5^{mm}.

This rare species is readily recognized by its very oblique suture. Found in the dredged shell-sand.

Family **SCAPHANDRIDÆ**.

Cylichna Auberi (d'Orb.).

PLATE LXIV. FIG. 3.

Bulla Auberi d'Orbigny, L'Ile de Cuba, i, p. 127, Atlas, pl. iv bis, figs. 5-8, 1853.

Cylichna Auberi Dall, Blake Report, pt. ii, p. 55, 1889.

Rare ; found in the dredged shell-sand.

Family **BULLIDÆ**.

Bulla Bermudæ, sp. nov.

PLATE LXIV. FIG. 4.

Shell white, minute, oblong-ovate, broadest anterior to the middle. Body-whorl flattened and sometimes slightly constricted just above the middle. Summit subtruncate, with the angle obtusely rounded and with the posterior margin of the lip rising slightly in an obtuse

curve; apical region with a shallow, but distinct depression. Surface nearly smooth, but usually showing microscopic revolving lines, especially on the posterior half; in the young covering the entire surface. Aperture longer than the body-whorl, narrowed in the middle but expanded at each end, the anterior margin considerably produced and somewhat flaring; a minute perforate umbilicus in some specimens, columellar margin thickened and nearly straight.

Length of the largest specimen, 3^{mm}; breadth, 1.6^{mm}.

Rare, in the dredged shell-sand.

Haminea Antillarum (d'Orb.), var. **Gaudalupensis** Sowerby.

PLATE LXIV. FIG. 6.

Bulla Antillarum d'Orbigny, L'Ile de Cuba, i, p. 124, Atlas, pl. iv, figs. 9-12, 1853.

Haminea Antillarum Mörch, Syn. Moll. Mar., p. 175, 1875. Dall, Bull. U. S. Nat. Mus., No. 37, p. 84, 1889. Pilsbry, Manual Conch., xv, p. 358, pl. 41, figs. 30-36, 1893, with variety *Gaudalupensis* Sowerby.

Rare in dredged shell-sand.

Family **SIPHONARIDÆ.**

Siphonaria henica, sp. nov.

PLATE LXV. FIG. 8. PLATE LXVI. FIG. 8.

Shell with a broad, elliptical aperture; a moderately elevated strongly recurved apex, situated near the posterior margin; and with the surface covered with regular, rather fine, radial costulæ and strongly marked, undulating lines of growth which interrupt the costulæ, giving an irregularly cancellated appearance; the costulæ are also crossed by fine, intermediate lines of growth. The apical portion consists of a small spiral nucleus of about 1½ whorls turned a little to the left side, and of an expanded, smooth, hood-like, nepionic stage. The costulæ commencing at the edge of the latter are at first fine and regular, becoming coarser as they approach the margin. Interior white and glossy, with the muscular scars well-marked, and with a distinct, pulmonary sinus, which forms a distinct emargination at the margin, which is sometimes entire and sometimes crenulated by the costulæ.

Color of the single live specimen, white tinged with yellow.

Length of aperture, 7.8^{mm}; breadth, 7.1^{mm}; height, 3^{mm}. Bailey Bay, shore.

PROSOBRANCHIATA.

RHIPHIDOGLOSSA.

Family STOMATIIDÆ.

Synaptocochlea Pilsbry, 1890. Type, *S. Montrouzieri* Pilsbry.

Synaptocochlea Pilsbry, Manual Conch., xii, p. 6, 1890.

Synaptocochlea picta (d'Orb.) Pilsbry.

PLATE LXIV. FIGS. 5 and 12.

Stomatia picta d'Orbigny, L'Ile de Cuba, ii, p. 184, Atlas, pl. xxiv, figs. 19-21, 1853. Heilprin, op. cit., p. 175, 1889.

Stomatella picta Dall, Bull. U. S. Nat. Mus., No. 37, p. 168, 1889. Pilsbry, Manual Conch., xii, p. 29, pl. 54, figs. 19-20, pl. 21, figs. 22-25, 1890. (Non *Stomatella picta* Montrouzier, 1862 = *S. Montrouzieri* Pilsbry, 1890.)

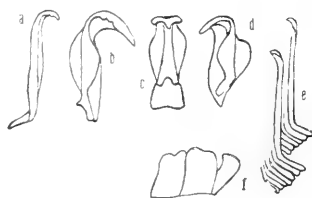


Figure 1. Radular teeth of *S. picta*. Camera-lucida drawing, greatly enlarged.

In the radula, the strongly hooked and finely serrate teeth are arranged in many rows, in each of which there are from 40 to 50; 15-20 slender marginals with much bent bases, as *a* and *e*; 5 or 6 lateral, as *d*, the outer one (*b*) larger than the others; and one broad median (*c*). In some of the posterior rows, broad marginals are found, as *f*. The operculum is circular, of few whorls, with central nucleus, very thin, of a delicate horn-color.

Common in the shell-sand. Recorded also by Heilprin.

Family SCISSURELLIDÆ.

Scissurella costata d'Orb.

Scissurella costata Pilsbry, Manual Conch., xii, p. 50, pl. 50, f. 1, 1890.

One specimen, in shell-sand.

Schisomope cingulata (O. G. Costa).

Schisomope cingulata Pilsbry, Manual Conch., xii, p. 61, pl. 57, figs. 1-7, 1890.

One young specimen with three of another, apparently undescribed species.

Family **FISSURELLIDÆ.****Emarginula**, sp.

Two young specimens of an apparently undescribed species of *Emarginula* were found.

The larger is oblong or subelliptical in outline, with an elevated, strongly incurved apex and a narrow, deep, marginal notch. The surface, near the margin, is covered with well-marked costæ crossed by fine concentric lines of growth.

It differs from the young of *E. pumila* Ad. and its variety *pileum* (Heilprin), of which a number of living specimens were taken.

GYMNOGLOSSA.Family **EULIMIDÆ.****Eulima hypsela**, sp. nov.

PLATE LXIV. FIG. 9.

Shell rather slender, very elongated, with sixteen whorls in the adult, besides the very minute apical whorl. Whorls very flat, so that the outlines of the spire are rectilinear. Suture distinct not impressed, somewhat oblique (more so than in *E. amblytera*). Body-whorl evenly rounded, somewhat produced and narrowed in front. Aperture long-ovate, acute posteriorly, obtusely rounded and somewhat flaring anteriorly and at the columellar margin, its edge strongly sinuous in a profile view.

Color bluish white, slightly tinged with brown on the lower whorls and with a strong brown tint showing through by transparency on most of the upper whorls; sometimes pure white; surface smooth and brilliantly polished.

Length of the largest example (upper whorls wanting), 8^{mm}; breadth, 2.5^{mm}.

A number of examples were found in the shell-sand.

Eulima amblytera, sp. nov.

PLATE LXIV. FIG. 8.

Shell white, elongated, subfusiform with a long, evenly tapered, nearly straight spire and an evenly rounded, produced body-whorl. Sutures distinct but scarcely impressed, not very oblique. Outlines of the spire nearly straight, owing to the flatness of the whorls. Whorls nine in the largest specimen, besides the relatively large mammiform, apical whorl. Aperture long-ovate, obtusely rounded,

slightly flaring in front, acute posteriorly; anterior part of the outer-lip and columellar margin sometimes thickened in the adult. Surface smooth and brilliantly polished.

Length, 5.5^{mm}; breadth, about 0.6^{mm}.

The apical whorl is more obtuse and larger than in most of the Bermudian species.

A few specimens were found in the shell-sand.

Eulima engonia, sp. nov.

PLATE LXIV. FIG. 7.

Shell moderately elongated, rapidly tapered to the very acute apex. Whorls twelve or more when full grown, besides the very minute, rounded, apical whorl. Whorls of the spire completely flattened, so that the outlines are rectilinear; suture distinct, but not impressed, little oblique. Body-whorl distinctly but obtusely angulated at the periphery, relatively short and broad, not produced. Aperture broad-ovate or subrhombic, due to the angulation in the middle of the outer lip and a slight angle at the junction of the columella with the inner lip; anterior margin rounded and slightly flaring. Outer lip strongly sinuous in a profile view, with a distinct incurved posterior notch. Color bluish white, sometimes tinged with brownish yellow.

Length, 4.5^{mm}; breadth, about 1.5^{mm}. There are fragments of larger examples.

Several specimens in the shell-sand.

This species is easily distinguished from the others herein included by the broader, angulated body-whorl, the wider aperture, and the minute nucleus, which is similar to that of *E. hypselæ*.

Eulima compsa, sp. nov.

PLATE LXIV. FIG. 16.

Shell minute, elongated, subfusiform, composed of about eight whorls, besides the rather small, prominent, rounded apical whorl. Outlines of the spire rectilinear. Whorls flattened; suture rather indistinct, slightly oblique. Body-whorl elongated, strongly produced anteriorly. Aperture regularly ovate, evenly rounded and flaring in front; outer lip regularly curved, acute, somewhat sinuous in profile view.

Color white; surface polished.

Length of the single specimen, about 3.5^{mm}; breadth, about 1.5^{mm}.

Found in the shell-sand.

Eulima atypha, sp. nov.

PLATE LXIV. FIG. 10.

Shell minute, elongated, subfusiform with the spire somewhat crooked. Whorls seven or eight, besides the somewhat upturned, rather prominent, mammiform apical whorl. Whorls flattened or a little convex. Sutures rather distinct, slightly oblique. Body-whorl long, regularly curved, produced anteriorly. Aperture small, regularly ovate; collumellar margin thickened and somewhat produced and reflected anteriorly. Outer lip regularly curved.

Color bluish white, the surface brilliantly polished.

Length, about 2.2^{mm}; breadth, about 0.8^{mm}.

This species is distinguished by the peculiar apical whorl, by the produced body-whorl, and by the small ovate aperture.

Two specimens from the shell-sand.

Family **PYRAMIDELLIDÆ.****Pyramidella dolabrata** Linné.

Pyramidella dolabrata Tryon, Manual Conch., viii, p. 300, pl. 72, figs. 71-74, 1886. Dall, Bull. U. S. Nat. Mus., No. 37, p. 128, 1889.

Specimens said to have been collected in Bermuda were seen in several local collections.

Turbonilla Heilprini Bush.

PLATE LXV. FIG. 12.

Turbonilla Heilprini Bush, Proc. Acad. Nat. Sci., Philadelphia, pp. 167, 172, pl. viii, f. 13, 1899.

The only specimen seen was obtained by Mr. Heilprin's party, in 1889.

Turbonilla valida, sp. nov.

PLATE LXIV. FIG. 20.

Shell white, slender, much elongated, consisting of ten convex, costulate whorls with deep sutures, besides the relatively large, upturned, apical whorl. The whorls of the spire are evenly and strongly convex, crossed by twelve to fourteen strong, prominent, obtuse, longitudinal ribs, separated by deep, concave interspaces of about the same breadth and without any spiral sculpture. The suture is decidedly oblique and deeply impressed. Body-whorl is rather large, not much produced anteriorly, with a smooth base.

The large, prominent nucleus, consisting of about two whorls, is strongly upturned so as to lie in a plane transverse to the axis of the spire. The aperture is regularly ovate with a somewhat thickened margin, flaring anteriorly.

Length of the only specimen, 5.5^{mm}; breadth, 1.35^{mm}.

This species is distinguished from other Bermudian *Turbonilla* by its deep suture, comparatively few longitudinal ribs, and the large nucleus.

Found in the dredged shell-sand.

Turbonilla leuca Bush.

PLATE LXIV. FIG. 18.

Turbonilla leuca Bush, Proc. Acad. Nat. Sci., Philadelphia, pp. 167, 172, 1899.

Rare; found in the shell-sand.

Turbonilla Penistoni Bush.

PLATE LXV. FIG. 13.

Turbonilla pulchella Heilprin, The Bermudas, p. 173, 1889 (*non* d'Orbigny).

Turbonilla Penistoni Bush, Proc. Acad. Nat. Sci., Philadelphia, pp. 165, 172, pl. viii, f. 14, 1899.

Comparatively rare in the shell-sand.

Turbonilla Swiftii Bush.

PLATE LXIV. FIGS. 21 and 21a.

Turbonilla Swiftii Bush, Proc. Acad. Nat. Sci., Philadelphia, pp. 166, 173, 1899.

Two young agree more closely with this than any other described species.

Found in the shell-sand.

Pyrgostelis Monte., 1884. Type *P. rufa* (Philippi).

Pyrgostelis Monterosato, Nom., Genera and Species, Conch., Med., p. 89, 1884.
Tryon, Manual Conch., viii, p. 318, 1886.

Longitudinal ribs not extending below the periphery of the body-whorl; interspaces and base cut by equal, or nearly equal, incised spiral lines. Color white, fulvous, or banded. Columella with a more or less prominent reentering fold. In its most extended sense this genus should include all the species, hitherto referred to *Turbonilla*,

having spiral sculpture. In a restricted sense it includes only those having spiral sculpture similar in character to that of *rufa* of Philippi.

Pyrgostelis puncta (C. B. Adams).

PLATE LXIV. FIGS. 19 and 19a.

Chemnitzia puncta C. B. Adams, Cont. to Conch., No. 5, p. 72, 1850. Mörch, Syn. Moll. Mar., p. 162, 1875.

Turbonilla puncta Tryon, Manual Conch., viii, p. 331 (not pl. 76, fig. 22), 1886. (†) Dall, Bull. U. S. Nat. Mus., No. 37, p. 128, 1889. Bush, Proc. Acad. Nat. Sci., Philadelphia, pp. 162, 174, 1899.

Common in the shell-sand.

Pyrgostelis fasciata (d'Orb.)?

Turbonilla fasciata Bush, Proc. Acad. Nat. Sci., Philadelphia, pp. 155, 175, 1899; (not *Chemnitzia fasciata* Req., 1848 = *Pyrgostelis fulvocincta* Thompson, nor *Turbonilla fasciata* Forbes, 1843 = *Eulimella*).

Found in the shell-sand.

Subgenus **Mumiola** A. Adams, 1864. Type, *M. spirata* A. Adams.

Mumiola A. Adams, Journ. Linnæan Soc., vii, p. 5, 1864. Tryon, 1886, in part (not *Mumiola* Monterosato, 1884).*

"Test thin, elongate or ovate; whorls convex, cancellated or granulose. Aperture ovate; margin of the lip regularly arched."

"An ovate, cancellate group which is named *Mumiola*."

First species—*Monoptygma spirata* A. Adams, 1851 (not *Chemnitzia spirata* Kurtz and Stimpson, 1851 = *Ondina*, nor *Parthenia spirata* A. Adams, 1860 = *Pyrgostelis*)—taken for type.

"Surface regularly and beautifully decussated with raised lines."

Shell light brown or yellowish with ribs extending over the base, with the interspaces crossed by raised spirals.

Pyrgostelis (Mumiola) asperula Bush.

PLATE LXV. FIG. 23.

Turbonilla asperula Bush, Proc. Acad. Nat. Sci., Philadelphia, pp. 151, 176, 1899.

Not uncommon in the shell-sand.

* *Mumiola* Monterosato, 1884 = *Ostomiella* Bucq., Dautz. Dollf., 1883. Type *O. doliolum* Phil. Figured in Report of Expeditions by Prince Monaco.

Subgenus **Mormula** A. Adams, 1864. Type, *M. rissolina* A. Adams.

Mormula A. Adams, Journ. Linnæan Soc., vii, p. 1, 1864. Tryon, 1886, in part.

“Test subulate-turritid, rissoid, solid, thick, longitudinally plicate. Aperture large; inner lip spirally twisted; outer lip somewhat thickened within with a sharp edge.

“A plicate form with spiral axis which is named *Mormula*.” First species—*M. rissolina* A. Adams—taken for type.

Brown-banded of seven (7) flattened whorls, with thick, undulating, longitudinal plications, with the interstices very much lirate.

“Very much resembling a *Rissolina* with the inner lip spirally twisted and with the nucleus sinistral.”

Pyrgostelis (Mormula) pupoides d'Orb., and variety **ischna** Bush.

PLATE LXV. FIGS. 21 and 22.

Chemnitzia pupoides d'Orbigny, L'Ile de Cuba, i, p. 224, Atlas, pl. xvi, figs. 32-36, 1853.

Chemnitzia (Mumiola) pupoides Mörch, Syn. Moll. Mar., p. 164, 1875.

Turbonilla pupoides Tryon, Manual Conch., viii, p. 332, pl. 76, f. 26, 1886.

? *Odostomia phrikalea* Watson, Challenger Report, xv, p. 493, pl. xxxii, f. 7, 1885.

Turbonilla pupoides Bush, Proc. Acad. Nat. Sci., Philadelphia, pp. 152, 176, pl. viii, f. 5, 1899.

Very common in the shell-sand.

Odostomia Jonesii, sp. nov.

PLATE LXIV. FIG. 13.

Shell white, smooth, polished, ovate, composed of five or six whorls, besides the nucleus. Suture little impressed and sometimes slightly canaliculate. Whorls slightly but evenly convex, the last slightly diminished in diameter in some instances, giving the shell a slightly fusiform appearance. Nucleus with a very small, upturned, apical whorl. Aperture rather broad-ovate; outer lip regularly rounded; columellar margin very oblique and sinuous, with a well-marked oblique plication. Some specimens have a slight umbilical chink, others have none.

Length, 3.5^{mm}; breadth, about 0.2^{mm}.

This species appears to be more nearly related to *O. nitens* Jeffreys than to any other described *Odostomia*.

It is larger, stouter and less fusiform with a broader and relatively shorter aperture, with the columellar fold stronger and situated more anteriorly.

Common in the dredged shell-sand.

Odostomia ovuloides C. B. Adams, 1850.

PLATE LXIV. FIG. 14.

Odostomia ovuloides C. B. Adams, Contr. to Conch., No. 7, p. 109, 1850.

Odostomia levigata d'Orbigny, L'Île de Cuba, i, p. 227, Atlas, pl. xvii, figs. 7-9, 1853. Mörch, Syn. Moll. Mar., p. 166, 1875. Tryon, Manual Conch., viii, p. 357, pl. 78, f. 44, 1886.

Three examples from the shell-sand are identified as this species.

Odostomia lubrica, sp. nov.

PLATE LXIV. FIG. 15.

Shell white, smooth, polished, rather stout-ovate, rapidly tapered, acute, composed of five whorls besides the small, abruptly upturned nucleus. Suture deeply impressed, the whorls being slightly angulated just below it. Whorls evenly convex; body-whorl relatively large, swollen, with the base wellrounded, but not produced. Aperture broadly ovate; outer lip broadly and evenly rounded, not angulated anteriorly. Columellar margin sinuous, with a distinct plication within the aperture. Umbilical chink small, but distinct.

Length of the single perfect specimen, 2.2^{mm}; breadth, about 1.2^{mm}.

Several other examples, imperfect and worn, but having a somewhat angular body-whorl, are doubtfully referred to this species.

From the shell-sand.

Subgenus **Cyclodostomia** Sacco, 1892. Type, *C. Mutinensis* Sacco.

Cyclodostomia Sacco, Mem. Reale Acc. Sci. Torino, xlii, 2d series, p. 628, 1892.

“Shell small, more or less conic. Whorls angular sometimes and near the suture above with a small but distinct cingulum. Columella uniplicate.”

First species—*C. Mutinensis* Sacco, (Tab. i, f. 102) 1892—taken for type.

The sides of each whorl concave with a cingulum just below each suture.

Odostomia (Cyclodostomia) didyma, sp. nov.

PLATE LXV. FIG. 14.

Shell minute, white, subovate, consisting of five whorls besides the minute, slightly prominent, upturned, apical whorl. The whorls of the spire are strongly flattened and somewhat concave in the middle, with a somewhat raised, thick, rounded cingulum just above, and one just below the suture, which is deeply impressed and somewhat canaliculate. On the body-whorl there is a deep groove just below the peripheral cingulum, bordered anteriorly by another similar cingulum. Base but little produced, with a small spiral rib in the umbilical region. Aperture small, broad-ovate, slightly flaring anteriorly.

Length of the only specimen, 1.3^{mm}; breadth, about 0.7^{mm}.

From the shell-sand.

Subgenus **Evalea** A. Adams, 1860. Type, *E. elegans* A. Adams.

Evalea A. Adams, Ann. Mag. Nat. Hist., vi, p. 22, 1860.

“Test having the form of an elevated cone, somewhat turritid, high spire with the whorls (5) transversely sulcate or striate. Aperture oval; outer lip produced with a transverse columellar fold.”

First species—*Odostomia elegans* A. Adams, 1860 (*non* Monterosato, 1869)—taken for type.

Transversely grooved or sulcate species of *Odostomia*.

Odostomia (Evalea) Somersi, sp. nov.

PLATE LXV. FIG. 7.

Shell small, thick, ovate with four whorls besides the small, upturned nucleus. Suture canaliculate. Whorls slightly convex, with three narrow, incised grooves, producing three broad, strong, rounded cingula. Base of the body-whorl smooth. Aperture ovate, acute posteriorly, slightly produced at the anterior angle, and with a distinct columellar plication deep within the aperture.

Color white, sometimes in fresh specimens tinged with flesh-color.

Length, 2.5^{mm}; breadth, about 1.28^{mm}.

Common in the shell-sand.

Subgenus **Cingulina** A. Adams, 1860. Type, *C. circinata* A. Adams.

Cingulina A. Adams, Ann. Mag. Nat. Hist., vi, 3d series, p. 414, 1860.

Polyspirella Carpenter, Proc. Boston Soc. Nat. Hist., vii, p. 407, 1861 (not defined). Type, and only species, *Chemnitzia trachealis* Gould, 1861.

(Not *Miralda* A. Adams, 1864, nor *Cingulina* Monterosato, 1884=*Rissoa*.)

“Test having a subulate, turritid form with the numerous whorls ornamented with elevated, spiral cingula with sculptured interstices. Aperture oblong, anteriorly entire; inner lip straight, simple; outer lip sharp and arched.”

Only species and type, *C. circinata* A. Adams.

Longitudinally striate and spirally cingulate species of *Odostomia*.

Odostomia (Cingulina) Babylonica (C. B. Adams) Bush.

PLATE LXV. FIG. 11.

Chemnitzia Babylonica C. B. Adams, Proc. Boston Soc. Nat. Hist., ii, p. 6, 1845.

Chemnitzia (Miralda) Babylonica Mörch, Syn. Moll. Mar., p. 165, 1875, (a *Cingulina* A. Adams).

Odostomia (Miralda) Babylonica Tryon, Manual Conch., viii, p. 358, 1886.

Odostomia (Cingulina) Babylonica Bush, Proc. Acad. Nat. Sci., Philadelphia, p. 176, 1899.

On the three specimens from Bermuda the deep spaces between the conspicuous spiral ribs are crossed by numerous microscopic, raised longitudinal lines, more nearly perpendicular than indicated in the figure. This ornamentation seems to have been overlooked by Profs. Adams and Mörch.

From the shell-sand.

Subgenus **Miralda** A. Adams, 1864. Type, *M. diadema* A. Ad.

Miralda A. Adams, Journ. Linnean Soc., vii, p. 3, 1864. Monterosato, 1884, in part. Tryon, 1886, in part.

Parthenia Carpenter, Mazatlan Moll., p. 415, (Section B, in part), 1855-7.

“Test solid, ovate or elongate; whorls plane, posteriorly plicate, anteriorly transversely lirate. Aperture with the lip posteriorly subangulate with crenate margin.”

“A little group, solid, half costate and half lirate, which I designate *Miralda*.”

First species—*Parthenia diadema* A. Adams, 1860—taken for the type.

Species of *Odostomia* having the whorls ornamented with more or less developed granules above and below, and on the base with distinct, sometimes conspicuous, spiral cingula.

Odostomia (Miralda) seminuda (C. B. Adams), 1839, var. **gemma** C. B. Adams, 1850.

Jamina seminuda C. B. Adams, Boston Journ. Nat. Hist., ii, p. 280, pl. iv, 13, 1839.

Odostomia seminuda Gould, Invert. Mass., ed. ii., p. 329, fig. 599. Tryon, Manual viii, p. 357, pl. 78, f. 35, 1886. Dall, Bull. U. S. Nat. Mus., No. 37, p. 130, pl. lii, f. 10, 1889.

Odostomia gemmulo C. B. Adams, Cont. to Conch., No. 7, p. 109, 1850.

Dunkeria gemmulo Mörch, Syn. Moll. Mar., p. 168, 1875.

One example of this slender, elongated variety was found in the shell-sand.

PTENOGLOSSA.

Family SCALIDÆ.

Scala uncinaticosta (d'Orb.).

PLATE LXIV. FIGS. 17 and 17a.

Scalaria uncinati-costa d'Orbigny, L'Île de Cuba, ii, p. 19, Atlas, pl. xi, figs. 25-27, 1853. Tryon, Manual Conch., ix, p. 77, pl. 16, f. 95, 1887.

Scala uncinati-costa Mörch, Syn. Moll. Mar., p. 150, 1875. Dall, Blake Report, pt. ii, p. 318, 1889.

Our specimen, although much larger than the measurements given by d'Orbigny, agrees so closely in all other characters, that there can be little doubt of its being identical. The similar species (*S. turricula* Sow.) has not the sutural spines characteristic of this species. It bears some resemblance to *S. vittata* Jeffreys and *S. Algeriana* Wienkauff, from the Mediterranean.

From dredged shell-sand.

Scala echinaticosta (d'Orb.).

Scalaria echinaticosta d'Orbigny, L'Île de Cuba, ii, p. 18, Atlas, pl. xi, figs. 4-6, 1853. Tryon, Manual Conch., ix, p. 64, pl. 13, f. 98, 1887.

Scala echinaticosta Mörch, Syn. Moll. Mar., p. 145, 1875.

Rare, found in the shell-sand.

Scala Blandii Mörch (?).

Scalaria echinaticosta d'Orbigny, var. (?) *Blandii* Mörch, Syn. Moll. Mar., p. 145, 1875. Tryon, Manual Conch., ix, 64, 1853, as a var. of *occidentalis* Nyst.

Scala Blandii Dall, Bull. U. S. Nat. Mus., No. 37, p. 124, 1889.

Of the half dozen examples, the largest, having five whorls below the nucleus, measures about 8.5^{mm} in length, but otherwise agrees

with Mörch's description. A larger fragment has the whorls entirely disunited. It closely resembles the figures of the very much larger species, *S. hyalina* Sowerby.

Scala electa, sp. nov.

PLATE LXIV. FIG. 11.

Shell white, small, stout, regularly conical, consisting of six regularly rounded whorls which are only slightly in contact, so that the suture is very deeply impressed. The body-whorl is crossed by about twelve, rather prominent, slightly thickened, nearly even ribs which are often slightly recurved, but not oblique; the interstices, which are much wider, are concave and smooth. The ribs converge to, and reach deeply within the umbilicus, which is deep and rather narrow and somewhat obscured by the reflexed inner margin of the aperture. Nucleus small, regular, nearly smooth. Aperture round with a rather strongly thickened margin.

Length of the largest specimen, 8^{mm}; breadth, 4.5^{mm}.

Several specimens were found in the dredged shell-sand.

TÆNIOGLOSSA.

Family **CERITHIOPSIDÆ**.

Cerithiopsis Bermudensis, sp. nov.

PLATE LXV. FIG. 20.

Shell slender, regularly tapered, composed of ten whorls besides the smooth, prominent, apical whorl. Whorls strongly convex in the middle, excavated above and below the suture so that the latter lies in a rather wide groove. Three prominent spiral cingula are situated on the middle or more prominent part of each whorl, the median one of which is slightly the most prominent; just below the suture there is a fourth decidedly smaller one, often obsolete on the upper whorls; on the last whorl there is a spiral carina resembling a fifth cingulum. These cingula are separated by concave grooves of about the same width, both are crossed by delicate costulae which usually give a slightly nodulose appearance to the cingula. Base obliquely subtruncate, smooth. Aperture broad and short; outer lip broadly rounded, flaring anteriorly and projecting decidedly beyond the columella and separated from it by a deep notch. Columella slightly sigmoid. Color white or pale buff.

Length, about 4.5^{mm}; breadth, about 1.3^{mm}.

This common species resembles *C. metaaxæ* Watson, but is stouter with a less attenuated spire, and differs somewhat in the character of the sculpture and in the larger size of the siphonal notch.

Found in the shell-sand.

Family CÆCIDÆ.

The following comparatively rare species were dredged in the Ship Channel and Bailey Bay, in 12 to 40 feet, with the very abundant *Cæcum termes* Heilprin and its varieties.

Section I.—*Levia*.—Shell smooth.

Cæcum tenue, sp. nov.

PLATE LXV. FIG. 5.

Shell thin, translucent, slender, slightly curved, scarcely tapered, nearly smooth, with microscopic annular lines of growth. Aperture but little oblique, with a thin margin. Plug little prominent, obliquely truncated, most prominent close to the outer margin, without a micro. Pale flesh color.

Length, about 1.6^{mm}; diameter, about .35^{mm}.

In shell-sand, rare.

Section II.—*Annulata*.—Shell annulated.

Cæcum tornatum, sp. nov.

PLATE LXV. FIG. 1.

Shell slender, rather strongly curved, tapering a little, surrounded by eighteen to twenty-two strongly elevated, sub-acute cingula which, on the convex side, are rather narrower than the interstices, but on the concave side are of about the same width. Aperture round. Plug somewhat prominent, oblique, obtusely rounded, most prominent near the outer margin.

Some fresh specimens are somewhat translucent and often very pale flesh color, but most of the examples are opaque white.

Length, 2.5^{mm}; diameter, 0.6^{mm}.

A single specimen, apparently the young of this species, is more strongly curved, very slender, and strongly tapered toward the posterior end. It is surrounded by numerous, delicate, thin, prominent cingula, separated by wider spaces.

Rare in the shell-sand.

Section III.—*Costulata*.—Shell ribbed longitudinally.

Cæcum obesum, sp. nov.

PLATE LXV. FIG. 2.

Shell thick, relatively short, stout, moderately curved, with about twelve strong, obtuse, longitudinal ribs, with wider, concave interstices; close to the anterior end these are decussated by several incised, revolving lines and close to the margin are replaced by two to six cingula, one of which is sometimes more elevated than the rest. Aperture round, unusually oblique, with a somewhat thickened margin. Plug with a small, prominent, oblique mucro, close to the outer margin. Color white, tinged with rusty brown.

Length, 2.5^{mm}; diameter, 0.75^{mm}.

Cæcum delicatulum, sp. nov.

PLATE LXV. FIG. 4.

Shell small, thin, delicate, strongly curved, but little tapered, covered with numerous, fine, raised, longitudinal riblets, about as wide as their interstices. Near the margin, crossed by a number of fine, transverse lines, which form definite cingula close to the margin. Aperture nearly round, very oblique. Plug broadly exposed, oblique, most prominent near the outer margin, without a definite mucro. Color white.

Length, 2^{mm}; diameter, 0.5^{mm}.

Two young specimens, referred to this species, are strongly curved, regularly and rapidly narrowed posteriorly, with the surface, toward the larger end, minutely costulate, but smooth and translucent posteriorly. Plug just within the aperture, with a delicate spine close to the outer margin, visible only in profile.

In shell-sand, rare.

Cæcum debile, sp. nov.

Shell differing from *C. delicatulum* in having a prominent, nearly hemispherical plug and the surface covered by less numerous, very delicate, raised, longitudinal riblets, well separated but unequally spaced, crossed, near the margin, by very delicate well separated cingula, one of which, just below the edge, is more prominent than the others. Entire surface crossed by microscopic growth lines.

In shell-sand, rare.

Cæcum crispum, sp. nov.

PLATE LXV. FIG. 3.

Shell slender, thin, delicate, strongly curved, covered with very fine, incised, longitudinal lines, which in some places are wavy, visible only with a lens. Toward the margin marked with several annular incised lines, with delicate intervening cingula. Aperture round, very oblique. Plug but slightly prominent, obtuse, with a small rounded mucro near the outer margin. Color white.

Length, 2.1^{mm}; diameter, 0.5^{mm}.

In shell-sand, rare.

Family **RISSOIDÆ**.

Alvania (*Alvinia*) *pagodula* Buq., Dautz. and Dollf.

Rissoa Philippiana Jeffreys, Ann. Mag. Nat. Hist., xvii, 2d series, p. 183, pl. ii, figs. 4, 5, 1856 (not *R. Philippiana* Nyst, 1845, nor *R. Philippii* Aradas, 1847). Name substituted but not adopted (Monterosato). Chenu, Manuel Conch., i, p. 307, f. 2169, 1859.

Rissoa (*Alvinia*) *pagodula* Buquoy, Dautzenberg and Dollf., Moll. Rouss., p. 296, pl. 56, figs. 23-26.

Alvania (*Alvinia*) *Philippiana* Monterosato, Conch., Med., p. 60, 1884.

Rissoa (*Alvinia*) *pagodula* Tryon, Manual Conch., ix, p. 366, pl. 66, f. 55, 1887.

Although specimens from Bermuda have but four whorls, they so agree in the form and character of the sculpture with descriptions of this species as to leave little doubt as to their identity.

In shell-sand.

Alvania (*Alvinia*) *platycephala* Dautz. and H. Fischer.

PLATE LXV. FIG. 24.

Alvania platycephala Dautzenberg and H. Fischer, Mem. Soc. Zool., France, p. 63, pl. xix, figs. 12, 13, 1896.

In shell-sand.

Rissoa (*Manzonina*) *Auberiana* d'Orb.

PLATE LXV. FIG. 17.

Rissoa Auberiana d'Orbigny, L'Ile de Cuba, ii, p. 22, Atlas, pl. xi, figs. 34, 36, 1853. Chenu, Manuel Conch., i, p. 307, f. 2170, 1859.

Rissoa (*Alvania*) *Auberiana* Mörch, Syn. Moll. Mar., p. 54, 1875.

Rissoa (*Manzonina*) *Auberiana* Tryon, Manual Conch., ix, p. 337, pl. 68, f. 85, 1887.

In shell-sand.

Rissoa (Manzonia) minuscula, sp. nov.

PLATE LXV. FIG. 16.

Shell very minute, pale yellowish brown, ovate, consisting of five whorls besides the small, mammillary, apical whorl. The whorls are convex in the middle; those of the spire are crossed by three revolving cingula and covered by numerous, fine, elevated, longitudinal costulæ, most distinct in the grooves between the cingula and on the subsutural area, giving the surface a finely cancellated appearance under the microscope; these costulæ do not interrupt the stronger revolving lines. The body-whorl is relatively large and has three or four smaller, additional revolving cingula below the periphery, the last of which circumscribes the narrow and shallow umbilical chink. Aperture round-ovate with a strongly thickened margin, supported by a well-developed marginal rib.

Length of the only specimen, 2.1^{mm}; breadth, 1.2^{mm}.

From the shell-sand.

Family **NATICIDÆ**.

Neverita duplicata (Say), 1822.

Natica duplicata Say; Gould, *Invert. Mass.*, Binney Ed., p. 345, fig. 615, 1870.
Neverita duplicata Verrill, *Rep. on Invert. of Vineyard Id., etc.*, pl. xxiii, fig. 130, 1873. Dall, *Bull. U. S. Nat. Mus.*, No. 37, p. 154, pl. 51, f. 12, 1889.

One dead and broken specimen was found at Bailey Bay.

Family **VANIKORIDÆ**.

Vanikoro oxychone Mörch.

PLATE LXV. FIG. 6.

Vanikoro oxychone Mörch, *Syn. Moll. Mar.*, p. 94, 1877. Tryon, *Manual Conch.*, viii, p. 69, 1886.

Rare in the shell-sand.

RACHIGLOSSA.

Family **COLUMBELLIDÆ**.

Atilia monilifera (Sowerby).

PLATE LXV. FIG. 9.

Columbella (Atilia) monilifera Tryon, *Manual Conch.*, v, p. 149, pl. 53, f. 100 (poor), 1883.

Common in the shell-sand.

Atilia Cumingii (Reeve), var. **acus** Reeve.

Columbella (Atilia) Cumingii Reeve, var. *acus* Tryon, Manual Conch., v, p. 151, pl. 53, f. 16, 1883.

Rather common in the shell-sand.

Æsopus Stearnsii (Tryon) Dall.

PLATE LXV. FIG. 19.

Seminella Stearnsii Tryon, Manual Conch., v, p. 179, pl. 58, f. 48 (poor), 1883.

Æsopus Stearnsii Dall, Blake Report, pt. ii, p. 194, pl. xxix, f. 5, 1889; Bull.

U. S. Nat. Mus., No. 37, p. 118, pl. 29, f. 5, 1889.

Very common in the shell-sand.

TOXOGLOSSA.

Family **PLEUROTOMIDÆ.**

Mangilia quadrata Reeve, var. **monocingulata** Dall ?

Mangilia quadrata Reeve, var. *monocingulata* Dall, Blake Report, pt. ii, p. 114, pl. xi, figs. 15, 16, 1889; Bull. U. S. Nat. Mus., No. 37, p. 102, pl. 11, figs. 15, 16, 1889.

One imperfect dead specimen from the Ship Channel, in 30-40 feet, agrees very closely with Dr. Dall's figure 15, quoted above. Neither the longitudinal ribs nor the spiral cingula are as prominent as in the type specimen of *Mangilia eritima* Bush, from Cape Hatteras, N. C., and the granular effect is entirely concealed by erosion.

Three other apparently undescribed species belonging to this family were also found in the shell-sand.

CEPHALOPODA.

Two species of *Octopus* were taken, in 1898, both of which have been previously recorded. The common large species is generally listed as *O. vulgaris*, but sometimes as *O. granulatus*, or *O. rugosus* Bosc, under the belief that this West Indian and Florida species is distinct from the European—a question that cannot be considered as settled at present. They are certainly very closely related.

The second, which is smaller and much less common, is *O. Bermudensis* Hoyle (Challenger Report, xvi, p. 94, pl. ii, fig. 5 = *O. chromatus* Heilprin, The Bermudas, pl. 15, fig. 1). It has very long slender arms, with a narrow basal web, and is very active. When living, its colors are bright and very changeable, but there are four or more larger round blue spots on its back which do not disappear.

Some of the native fishermen call it the "grass scuttle," and designate the common one as the "rock scuttle," by way of distinction.

Mr. G. Brown Goode obtained a very large squid, which was cast ashore at Bermuda in 1876. This was described and figured in 1880 and 1882* as *Sthenoteuthis pteropus* = *Ommastrephes pteropus* Steenstrup (?).

The Yale party, in 1898, secured one living specimen of another squid. It was captured in Bailey Bay, while swimming slowly at the surface. It appears to be *Sepioteuthis sepioidea* d'Orb., which was also taken at Bermuda by Goode and recorded in 1880 and 1882 by Verrill (op. cit.), but it has not appeared in later lists.

* Verrill, these Trans., v, p. 228, pl. 27, figs. 7, 7a, pl. 36, figs. 5-9, 1880; Report U. S. Fish Com. for 1879 (pp. 107-111 of separata), pl. vii, fig. 2, pl. xvii, figs. 3-9, 1882.

EXPLANATION OF PLATES.

The figures on the following plates are reproductions of drawings by A. H. Verrill.

PLATE LXIII.

- Figure 1. *Tellina Candearia* d'Orb., p. 520. Sculpture. $\times 20$.
 Figure 2. The same. Left valve. $\times 3$.
 Figure 3. *Modiola (Botulina) opifex* Say, p. 516. Young. $\times 6$.
 Figure 4. *Lasea Bermudensis* Bush, p. 518. Hinge of both valves. $\times 7$.
 Figure 5. The same. A left valve.
 Figure 6. *Cardita Dominguenis* d'Orb., p. 517. A right valve. $\times 10$.
 Figure 7. The same. A left valve. $\times 10$.
 Figure 8. The same. Another valve. $\times 10$.
 Figure 9. *Coralliophaga coralliophaga* Gm., p. 520. Hinge of both valves. $\times 4$.
 Figure 10. The same. A right valve. $\times 3$. The radial sculpture is more distinct than usual.
 Figure 11. *Crassitellites (Crassinella) lunulata* (Conrad) var. *parva* C. B. Adams, p. 518. A right valve. $\times 8$.
 Figure 12. *Lucina nux* Verrill and Bush, p. 518. Type specimen. $\times 3\frac{1}{2}$.
 Figure 13. The same. $\times 5$.
 Figure 14. *Petricola (Naranai) lapicida* (Gmel.), p. 519. Hinge. $\times 5$.
 Figure 15. The same. A right valve. $\times 5$.

PLATE LXIV.

- Figure 1. *Tornatina decurrens* Verrill and Bush, p. 523. $\times 12$.
 Figure 2. *Tornatina recta* d'Orb., p. 523. $\times 12$.
 Figure 3. *Cylichna Auberi* d'Orb., p. 523. $\times 10$.
 Figure 4. *Bulla Bermude* Verrill and Bush, p. 523. $\times 3$.
 Figure 5. *Synaptocochlea picta* (d'Orb.) Pilsbry, p. 525. Adult. $\times 10$.
 Figure 6. *Haminea Antillarum* d'Orb., var. *Gaudalupensis* Sow., p. 524. $\times 8$.
 Figure 7. *Eulima engonia* Verrill and Bush, p. 527. $\times 5$.
 Figure 8. *Eulima amblytera* Verrill and Bush, p. 526. $\times 8$.
 Figure 9. *Eulima hypsela* Verrill and Bush, p. 526. $\times 4$.
 Figure 10. *Eulima atypha* Verrill and Bush, p. 528. $\times 9$.
 Figure 11. *Scala electa* Verrill and Bush, p. 536. $\times 3$.
 Figure 12. *Synaptocochlea picta* (d'Orb.) Pilsbry. Young specimen. $\times 10$.
 Figure 13. *Odostomia Jonesii* Verrill and Bush, p. 531. $\times 6$.
 Figure 14. *Odostomia ovuloides* C. B. Adams, p. 532. $\times 6$.
 Figure 15. *Odostomia tubrica* Verrill and Bush, p. 532. $\times 7$.
 Figure 16. *Eulima compsa* Verrill and Bush, p. 527. $\times 5$.
 Figure 17. *Scala uncinaticosta* d'Orb., p. 535. $\times 7$.
 Figure 17a. The same. Nucleus. \times about 6.

- Figure 18. *Turbonilla leuca* Bush, p. 529. $\times 15$.
 Figure 19. *Pyrgostelis puncta* (C. B. Adams) Bush, p. 530. $\times 15$.
 Figure 19a. The same. Sculpture much enlarged.
 Figure 20. *Turbonilla valida* Verrill and Bush, p. 528. $\times 9$.
 Figure 21. *Turbonilla Swiftii* Bush, p. 529. Specimen No. 72,055 of Philadelphia Academy, from the West Indies. $\times 10$.
 Figure 21a. The same. Nucleus. $\times 37.5$.

PLATE LXV.

- Figure 1. *Cæcum tornatum* Verrill and Bush, p. 537. $\times 15$.
 Figure 2. *Cæcum obesum* Verrill and Bush, p. 538. $\times 15$.
 Figure 3. *Cæcum crispum* Verrill and Bush, p. 539. $\times 15$.
 Figure 4. *Cæcum delicatulum* Verrill and Bush, p. 538. $\times 15$.
 Figure 5. *Cæcum tenue* Verrill and Bush, p. 537. $\times 13$.
 Figure 6. *Vanikoro oxychone* Mörch, p. 540. \times about 15.
 Figure 7. *Odostomia (Evalea) Somersi* Verrill and Bush, p. 533. $\times 12$.
 Figure 8. *Siphonaria henica* Verrill and Bush, p. 524. $\times 3.5$.
 Figure 9. *Atilia monilifera* Sow., p. 540. $\times 10$.
 Figure 10. *Cæcum termes* Heilprin, p. 537. Young. $\times 15$.
 Figure 11. *Odostoma (Cingulina) Babylonia* (C. B. Adams) Bush, p. 534. $\times 12$.
 Figure 12. *Turbonilla Heilprini* Bush, p. 528. $\times 12$.
 Figure 13. *Turbonilla Penistoni* Bush, p. 529. $\times 6$; a nucleus. $\times 30$.
 Figure 14. *Odostomia (Cyclodostomia) didyma* Verrill and Bush, p. 533. $\times 18$.
 Figure 15. *Actæon punctostriatus* (C. B. Adams). \times about 13. Off Cape Hatteras.
 Young. To show variation in size of nucleus.
 Figure 16. *Rissoa (Manzonina) minuscula* Verrill and Bush, p. 540. $\times 12$.
 Figure 17. *Rissoa (Manzonina) Auberiana* d'Orb., p. 539. $\times 12$.
 Figure 18. *Actæon punctostriatus* (C. B. Adams), p. 522. Adult. \times about 13.
 Figure 19. *Æsopus Stearnsii* (Tryon) Dall, p. 541. Young. $\times 20$.
 Figure 20. *Cerithiopsis Bermudensis* Verrill and Bush, p. 536. $\times 10$.
 Figure 21. *Pyrgostelis (Mormula) pupoides* d'Orb., p. 531. $\times 12$.
 Figure 22. The same, var. *ischna* Bush, p. 531. $\times 8$.
 Figure 23. *Pyrgostelis (Mumiola) asperula* Bush, p. 530. \times about 4.
 Figure 24. *Alvania (Alvinia) platycephala* Daut. and H. Fischer, p. 539. $\times 12$.

XIII.—THE NUDIBRANCHS AND NAKED TECTIBRANCHS OF THE BERMUDAS. BY A. E. VERRILL.

Hitherto these groups of Bermuda Mollusca have been much neglected. Heilprin (1889*) described a single new nudibranch (*Chromodoris zebra*, op. cit., p. 187), and the common ocellated *Aplysia* under a new name (*A. equorea*, op. cit., p. 185) from a single small faded example. The latter is, however, clearly identical with a well known West Indian species originally described from the Cape Verde Islands, as *A. datylomela* Rang.

The Yale Expedition of 1898 obtained a large number of specimens of *A. dactylomela*, which is common both on the reefs and in the lagoons, and a few examples of two other much rarer species, one of which is very large and appears to be undescribed.

Aplysia megaptera, sp. nov.

PLATE LXVI. FIGURE 6.

Body very large and robust; side-flaps unusually large and broad, each one nearly semicircular, entirely disunited posteriorly, and extending far forward, nearly to the rhinophores and rising abruptly on the neck, with the front margin well rounded; when expanded their breadth is greater than the length; when folded they broadly overlap above the back, with frilled margins. Foot broad, extending posteriorly only a short distance beyond the side-flaps, and abruptly tapered. Head short and thick. Tentacles large, with the anterior fold wide and crenulated. Rhinophores large, long-conical when closely folded. Anal siphon very large and broad, extending beyond the side-flaps when these are folded. A small nearly simple mantle-pore, with only a slight papilla. Shell thin and delicate. Gills large, deep purple.

Color, in life, dark olive-green, irregularly spotted and blotched with paler bluish green; most of the spots on the sides are rather small and oval or oblong, but some are large, not ocellated; on the inner surface of the side-flaps, the paler spots are much larger and more irregular; no black bars; shell-mantle dark purplish brown, with irregular pale spots.

* The Bermuda Islands, Philadelphia, 1889.

Length in life, 12 inches; height, with folded side-lobes, 5.5 inches; breadth across expanded side-lobes, or fins, 10 inches; length of latter, 7 inches; breadth of neck, at origin of side-lobes, 3 inches.

Bailey Bay, on reefs. It swims readily and strongly.

This species is larger and stouter than the common *A. dactylomela*, with much broader side-flaps, or fins. The latter species, in life, is usually lighter yellowish olive or greenish yellow, with ill-defined whitish spots and reticulated with narrow brown or black lines; and on the sides it has also rather large, roundish, ocellated spots of purplish brown, 6 to 12^{mm} across, with pale yellow or white centers, the dark linear reticulations usually crossing the spots; the inner surface of the side-flaps is greenish with about 6 or 7 large, irregular, often rather rectangular, transverse blotches or interrupted bars of dark chocolate-brown or black.

According to strict rules of priority this should doubtless be called *Tethys megaptera*, for Mr. Pilsbry has shown that *Tethys* was originally applied to the genus usually called *Aplysia*.

***Aplysia* (or *Tethys*) *Willcoxi* Heilprin (?).**

Aplysia Willcoxi Heilprin, Proc. Acad. Nat. Sci., Philad., p. 364, 1886.

Tethys Willcoxi Pilsbry, Man. Conch., xvi, p. 80, pl. 35, figs. 30, 31, 32, 1896.

PLATE LXVI. FIGURE 7.

A single specimen of a much smaller and plainer colored species was obtained, which I refer with some doubt to this Florida species.

The body is relatively longer and less robust than in either of the other species, and the foot extends considerably beyond the posterior end of the side-flaps. The latter are well rounded, moderately large, and nearly disunited posteriorly. The anal siphon is large and projects far beyond the side-flaps. Mantle-pore simple, subcentral. Oral tentacles large and very wide.

Colors were not noted in life, but only after being in formalin a short time, when they had probably changed very little. Sides and upper surface of neck, head, foot, tentacles, and outer surface of side-flaps, dull grayish brown, very irregularly blotched, mottled, and streaked with brownish black; top of head mostly black. Inner surface of side-flaps paler gray, with only a few irregular blotches of brown; gill dark brown.

Length, 6 inches (150^{mm}); length of side-flaps, 3.5 inches; breadth across latter, when expanded, 4 inches.

Bailey Bay, in shallow water. One example.

Pleurobranchopsis, gen. nov.

Body ovate, dorsum separated from the neck by a groove. Shell absent. Rhinophores elongated, folded. Oral tentacles conical. Gill lateral, attached along its entire length, or nearly so; no shell.

Allied to *Pleurobranchus*, but differs in lacking the shell and in the sessile gill. From *Pleurobranchæa* it differs in the gill, and the free anterior margin of the mantle.

Pleurobranchopsis aurantiaca, sp. nov.

PLATE LXVI. FIGURE 5.

Mantle convex, smooth, with a free edge all around, forming a slight sinus at the gill. The gill arches upward and backward and is attached along its whole length. Foot wide, extends a short distance beyond the mantle posteriorly. Rhinophores slender, divergent, longer than the conical tentacles.

Color of entire upper surface bright orange, deeper orange-red on the mantle, which is finely specked with white and slightly translucent; foot, head and gill paler orange.

Length in life, in extension, 32 to 36^{mm} (about 1.75 inches); breadth, 18 to 20^{mm} (about .75 inch).

Coney Island at low-tide, among algæ. One example.

A cluster of eggs found at the same time and place, under a flat stone, is supposed to belong to this species. It is in the form of a broad gelatinous ribbon, attached by one edge and filled with numerous bright orange eggs in many rows.

Elysia crispa Mörch.

PLATE LXVI. FIGURE 4.

This is a small, delicate, light green species, covered with small white specks and larger white spots or blotches, and a squarish white spot on the back of the head and neck, with prolongations into the rhinophores. Length 7-10^{mm}.

Among dead corals and on green algæ, 2 to 8 feet below low-tide. Bailey Bay, May 5.

Coryphella (?) *pallida*, sp. nov.

Body small, slender, dorsal papillæ long, slender, in two series of lateral clusters, numerous, not crowded, usually curved. Rhinophores elongated, tapered, slightly plicated, light yellow. Foot narrow,

its anterior lobes much prolonged, slender, acute, usually curved back.

Body white; dorsal papillæ dark gray with white tips.

Bailey Bay, in corallines; one example. Length 10^{mm}.

Doris* (?) *bistellata*, sp. nov.

PLATE LXVI. FIGURE 2.

Body oblong-elliptical, rather thick and elevated, convex. Foot thick. Rhinophores clavate, plicated, retractile, without sheaths. Gills seven, retractile, pedunculated, some of them forked near the base, with few branches.

Proboscis large white, extensile.

Upper side rich dark purplish brown; back with two median large, irregularly stellate spots of flake-white, and with small scattered specks of white on body, head, gills, and sides of foot; under side of foot white with brown spots.

Length, 15 to 20^{mm}; breadth, 6 to 8^{mm}.

Castle Harbor, 2 to 4 feet, on reefs or dead corals, April 18.

***Doris* (?) *olivacea*, sp. nov.**

Body small, in life elliptical or broad ovate, when at rest capable of considerable extension; both ends broadly rounded. Foot narrow, scarcely extending beyond mantle posteriorly. Mantle border wide, thin, undulated. Head lunate. Rhinophores small, conical, without sheaths, retractile. Gills retractile, numerous, slender, pinnate. Color pale green to dark olive-green above, with specks of dark green and with a darker green median patch; gills dark green; rhinophores dark olive-green; under side of mantle lighter green.

Length, 10^{mm}; breadth, 6^{mm}.

Bailey Bay, among corallines, April.

***Lamellidoris lactea*, sp. nov.**

Body, in life, small, oblong elliptical, much depressed; edges of mantle thin, undulated. Dorsal surface little convex, covered rather uniformly with numerous small, obtuse, spiculose verrucae.

* This and some of the other species are here referred doubtfully to the old genus *Doris*, because their anatomy and dentition have not been studied, owing to lack of more than one example in most cases. None of them belong to *Doris*, as now restricted.

Color nearly pure white. Length, in life, about 12^{mm}. Probably young.

Bailey Bay Island, at low-water mark, among corallines. One example.

Lamellidoris (?) *quadrimaculata*, sp. nov.

PLATE LXVI. FIGURE 3.

Body much flattened, broadly elliptical in life, with wide, thin, undulated mantle margins. Rhinophores conical, subacute, plicate, white, without distinct sheaths. Eyes small, nearer together than the rhinophores. Gills five, small, white, much branched. Back covered with minute spiculose papillæ, light orange-yellow with a darker orange wide median patch, and specked with numerous very small flake-white dots and with four larger, very distinct, prominent, round white spots, arranged in a quadrangle on the middle region of the back; numerous branching and reticulated thin white lines run out radially toward the margins of the mantle, above and below, and seem to be due to spicules imbedded in the tissues.

Length about 12^{mm}; breadth, 6 to 8^{mm}.

Castle Harbor, on dead corals, April 18. Two examples.

Chromodoris (?) *roseopicta*, sp. nov.

PLATE LXVI. FIGURE 1.

Body broad-ovate, subtruncate in front, obtuse behind; marginal ridges elevated and undulated in life. Gills rather large and numerous (about 16), elongated, simply pinnate. Rhinophores with a stout sheath. Dorsal area, except in middle, covered with rather numerous small conical papillæ, which form a single row behind the gills and near the front of head.

Ground-color of dorsum and sides bluish gray, but thickly specked with black and flake-white dots, these specks largest on the back; marginal ridge edged with bright carmine or rose-red, with a sub-marginal line of white; dorsal papillæ, rhinophore-sheaths, and tips of gills also carmine-red; outer margin of foot carmine or orange red.

Length, 25^{mm}; breadth, 10^{mm}.

Bailey Bay, just below low-tide mark, on rocks. One example, April.

EXPLANATION OF PLATE.

PLATE LXVI.

- Figure 1.—*Chromodoris roseopicta*, sp. nov. $\times 2$.
Figure 2.—*Doris* (?) *distellata*, sp. nov. $\times 3$.
Figure 3.—*Lamellidoris* (?) *quadrinaculata*, sp. nov. $\times 3$.
Figure 4.—*Elysia crispa*. $\times 4$.
Figure 5.—*Pleurobranchopsis aurantiaca*, sp. nov. $\times 1\frac{1}{2}$.
Figure 6.—*Aplysia megaptera*, sp. nov. $\frac{1}{3}$.
Figure 7.—*Aplysia Willcoxi*. $\times \frac{1}{2}$.
Figure 8.—*Siphonaria henica* V. and B., sp. nov. $\times 4$.

XIV.—ADDITIONS TO THE ANTHOZOA AND HYDROZOA OF THE
BERMUDAS. BY A. E. VERRILL.

ANTHOZOA.

Madreporaria.

A partial list of the corals collected at Bermuda (9 species) was published by J. M. Jones* in 1869. The identifications of his species were mostly made by the present writer, but his collection was very incomplete, and errors were made in printing the list. Another list (10 species) was also prepared by the writer for Prof. J. D. Dana† and published in 1872. Mr. A. Heilprin‡ also published a list of the Bermuda corals in 1889. His list included 19 species, of which I consider eight as spurious or mere varieties. The most extended list was prepared by J. J. Quelch for the Narrative of the Voyage of the Challenger (vol. i, part i, p. 146, foot note, 1885). This list included 23 species, but several of the six species of *Isophyllia* admitted by Quelch are scarcely more than individual variations of one species, not even worthy to be called varieties. Probably not more than two actual species of *Isophyllia* exist at Bermuda, and even these may eventually be united into one very variable species. I could detect no constant differences in the soft parts after a careful study of hundreds of living specimens, including all the varieties, though the color varies extremely, ranging through bright green, olive-green, gray, lavender, etc., all these colors being often found on a single example, distributed in regular patterns, or in irregular blotches, and generally they are varied with spots or blotches of flake-white.§ In some cases the color may be clear emerald-green, in others nearly clear lavender or gray, but some large examples were found that were half uniform green and half lavender without blotchings, the two colors being defined by a median plane. Nor

* Cont. to the Nat. Hist. of the Bermudas, Trans. Nova Scotia Inst., 1869. Reprinted in Visitors' Guide to Bermuda, p. 145, 1876.

† Corals and Coral Islands, Ed. I, 1872; Ed. II, p. 114, 1874.

‡ The Bermuda Islands, Philad., 1889.

§ Some specimens were phosphorescent at night and this property seemed to be related to the white pigment.

do these colors depend to any great extent on the station, for in some cases all these variations may be found in one place. But those specimens found scattered in shallow water on bottoms of white shell-sand were usually gray, or pale lavender mottled with gray, though the hard parts do not differ from the darker colored ones. One of the commonest forms at Bermuda was named *Mussa fragilis* by Dana (Zoöph., p. 145, 1846). The type of this, from Bermuda, is still in the Museum of Yale University. This, which is the common more delicate form; should therefore bear the name *Isophyllia fragilis*. It is possible that the coarser *I. dipsacea* (D.) is only a variation of the same species, due to more vigorous growth.

Quelch also recognized seven species of *Oculina* from Bermuda, which is doubtless too many, for all the species are variable in form, the degree of elevation of the corallites, etc. Apparently all the Bermuda forms of *Oculina* can be reduced to four species. He also recorded two species of *Astræa* (*A. ananas* and *A. coarctata*). We found these two forms common in tide-pools, but consider them merely variations of one species (*A. ananas*).

So, likewise, we consider *Diploria Stokesii*, listed by Heilprin, as a mere variation of *D. cerebriformis*, with the ridges wider and more deeply grooved than usual. It is a common form.

Thus, at least eight nominal species should be eliminated from Quelch's list, leaving but 15 species. On the other hand he omitted one of the commonest species (*Porites astræoides*), recorded in other lists,* and *Siderastræa radians*, recorded by Jones. I have now to add three additional species of true reef corals, two of which (*Orbicella annularis* and *O. cavernosa*) are not uncommon and grow to large sizes. Thus the number of true anthozoan corals now known is about 20.

All these corals, except the *Plesiastrea*, herein described as new, are common West Indian and Florida species. The coral-fauna of Bermuda differs chiefly from that of the Florida reefs and the Bahamas in the absence of certain prominent and well known genera and species characteristic of the latter, especially the genera *Madrepora*, *Manicina*, *Colpophyllia*, *Eusmilia*, *Dichocænia*, *Dendrogyra*, *Cladocora*, and the two very common species, *Mæandrina clivosa* and *Agaricia agaricites*. Possibly some of these may yet be discovered at Bermuda, but if found there at all they must be very local and rare, for the Bermuda corals have been extensively collected.

* See Richard Rathbun, Proc. U. S. Nat. Mus., 1887, p. 354.

Additional species of Bermuda Corals.

Orbicella annularis Dana.

Madrepora annularis Ellis and Sol., 1786.

Astræa annularis Lam., Anim. sans Vert., ii, 1816.

Heliastrea annularis Edw. and Haime, Corall., ii, 1849.

Astræa (Orbicella) annularis Dana, Zoöph., p. 214, pl. 10, fig. 6, 1846.

Orbicella annularis Verrill, Bull. Mus. Comp. Zoöl., I, p. 48, 1864. Pourtales, in Agassiz Rep. on Florida Reefs, Mem. Mus. Comp. Zoöl., vii, part I, pl. iv, figs. 1-10, 1880.

I have examined several large and characteristic examples of this species from the outer reefs of the Bermudas and also from the reefs in Great Sound, etc. Good specimens are in the American Museum, New York, and in the museum of the University of New York. The latter were obtained by Prof. Bristol's party. We obtained but one example.

The color in life is dull yellow. It does not differ from the Florida form.

Orbicella cavernosa (Esp.) Dana.

Madrepora cavernosa Esper., 1797.

Astræa argus Lam., Anim. sans Vert., ii, 1816.

Astræa (Orbicella) argus Dana, Zoöph., p. 207, pl. x, figs. 1a, 1b, 1846.

Heliastrea cavernosa Edw. and Haime, Corall., ii, 1857.

Orbicella cavernosa Verrill, Bull. Mus. Comp. Zoöl., I, p. 47, 1864.

The only specimen studied by me is a large hemispherical mass, in excellent condition, which formed part of the Bermuda exhibit, sent by the Governor of Bermuda to the Centennial Exposition at Philadelphia, in 1876, and afterwards presented to the U. S. National Museum. It is said to be not uncommon on the outer reefs near North Rocks.

Plesiastrea Goodei, sp. nov.

PLATE LXVII. FIGURE 1.

Coral solid, massive, hemispherical, calices circular, not very deep, pretty regularly arranged, near together, with their margins a little prominent and thickened. Septa prominent, nearly entire, usually 24, of which 12 are broad, reaching the columella, and alternate with 12 much narrower ones that extend only one-third the distance. The larger septa are vertical within, distinctly thickened distally, and bear thickened paliform lobes at the inner edge, close to the columella.

Columella solid, rather prominent, convex, circular or elliptical.

Diameter of coral about 9 inches (225^{mm}); of calicles, 2.6^{mm} to 3^{mm}.

A single specimen of this fine species was collected at Bermuda by Mr. G. Brown Goode, in 1876.

Madracis decactis (Lyman, 1857), Verrill, 1864.

This species often grows in irregular masses composed of rounded nodules, easily broken apart. Although the coral has but ten equal septa, the animal has 20 regular but obtuse tentacles, in two cycles, differing a little in size and position (Pl. lxxvii, fig. 10). The color, in life, is light orange-yellow or ochre-color. It is not rare.

Siderastræa siderea (Ellis and Sol.) Blainv.

This is very common in shallow water, both on the reefs and in the sounds, and it often grows in places where no other corals grow, owing to the turbidity of the water. It sometimes forms hemispheres over a foot across.

The figures of the polyps of this genus given by Agassiz (Florida Reefs) are not correct in representing the tentacles as three-lobed. They are simple, short, clavate or subcapitate, those of the different cycles quite unequal; a pair of small ones, each side of the base of a larger one, gave rise to the error in the figures drawn for Agassiz.

Figures of the animals of this and many of the other corals have been made for the final report on our Bermuda collection.

ACTINARIA.

A valuable paper on the Bermuda actinians was published by Prof. J. P. McMurrich in 1888-1887, with studies of the internal structure of most of the species. His list included five actinians* and five Zoanthidæ. One or two additional species were recorded from the Challenger Expedition.†

* Proc. Acad. Nat. Sci., Philad., 1888, and reprinted in Heilprin's *The Bermuda Islands*, pp. 105-135, pl. 10, 11, 1889. Of the species enumerated "*Aiptasia* sp." is probably *A. tages*; *Oulactis fasciculata* is *Asteractis flosculifera* (Les.) Verrill, Amer. Journ. Sci., vii, p. 45, 1899 (non McMurr.); *Phymactis crucifer* is *Epicystis crucifera* (Les.) Ehr.; Verrill, op. cit., vi, p. 496, 1898. The latter is a very large, handsome, pink and white species, with thickened, white transverse ridges on the inner side of the tentacles. It lives deeply buried in the crevices of the reefs.

† *Ilyanthopsis longifilis* Hertw., Rep. Zool. Voy. Challenger, xxvi, p. 13, pl. ii, fig. 12, was described from the Bermuda reefs.

It is shaped like *Aiptasia*, with a smooth column and collar; no acontia; 160 long tentacles and the same number of perfect mesenteries; a pedal disk; no sphincter muscle. Evidently allied to *Anthea* or *Anemonia*.

The most abundant species is *Condylactis passiflora* D. and M., which is often a foot across. Its body is red; tentacles very long, gray, tipped with pink or purple.

Our party added several interesting species to the list, some of which have already been recorded by me in the American Journ. Science.* The Zoanthidæ of our collection have not yet been fully studied, but they probably include one or two species, not included here, new to the fauna. The following are the species not definitely included in McMurrich's list. (See foot note above.)

Additional Actinaria.

Lebrunia Danæ (D. and M.) Verrill.

Oulactis Danæ Duch. and Mich., Corall. Antil., p. 47, pl. vii, fig. 10, 1860.

Lebrunea neglecta Duerden, Actin. Jamaica, p. 456, 1898 (*non* D. and M.).

Lebrunia Danæ Verrill, Amer. Journ. Sci., vii, p. 46, fig. 15, p. 48, 1899.

PLATE LXVII. FIGURE 3. PLATE LXIX. FIGURE 1.

Several large specimens, up to 8 inches in diameter, were found imbedded to the tentacles in crevices of the reefs. The arbor-esciently branched, green, gill-like fronds (fig. 3) are very large and covered with many round, blue acrorhagi.

Actinotryx Sancti-Thomæ Duch. and Mich.

Corall. Antill., p. 45, pl. vii, fig. 2, 1860. Andres (*Actinotryx*), 1883. Duerden, Jamaican Actinaria, part ii, p. 148, pl. x, figs. 3-6, pl. xi, figs. 3, 4, pl. xii, fig. 3, 1900.

Rhodactis Sancti-Thomæ McMurrich, Actin. Bahama Is., p. 42, pl. i, fig. 9, pl. iv, figs. 2, 3, 1889.

PLATE LXVIII. FIGURE 5.

Very common on the reefs, living exposed and usually gregariously, those in each group generally of the same color, and probably produced by fission from one parent stalk. The body is usually pear-shaped or top-shaped with a wide disk, covered with radial rows of small, lobed actinobranchs, diversified in color. Marginal tentacles are very small, unequal. It secretes a large quantity of mucus when irritated. The color is variable, usually brownish or purplish exteriorly. The base is smaller than the disk, often lobate, and very firmly adherent. The disk is but little contractile and not retractile.

* Vols. vi and vii. Brief Cont. to Zoöl., Nos. lviii-lxii, 1898, 1899.

Ricordea florida (D. and M.).

? *Ricordea florida* Duch. and Mich., Corall. Antill., p. 42, pl. vi, fig. 11, 1860.
Duerden, op. cit., p. 156, pl. x, fig. 7, pl. xi, figs. 5, 6, pl. xii, figs. 1, 2, pl. xiii,
fig. 1, 1900.

Heteranthus floridus McMurrich, op. cit., p. 47, pl. i, fig. 10, pl. iv, figs. 4, 5, 1889.

Habits and colors nearly the same as of the last.

It is possible that this is not the true *florida* of D. and M., but it appears to be the species described under this name by McMurrich. Duerden's species agrees better with the type of D. and M.

Epicystis osculifera (Les.) Ver.

Actinia osculifera Leseur, Journ. Philad. Acad. Sci., i, p. 175, 1817.

This species or variety scarcely differs from *E. crucifera*, except in lacking the transverse white ridges on the tentacles, characteristic of the latter. The colors of the two forms are similar and are variable in the same way in each.

Leseur's description seems to apply better to this than to any other known West Indian form. Duerden (op. cit., 1900, p. 139), considers this only a variety of *E. crucifera*.

Bunodactis stelloides (McMur.) Verrill.

Aulactinia stelloides McMurrich, Actinaria of Bahama Is., p. 28, pl. i, figs 5, 6, pl. iii, figs. 8-10, 1889.

Aulactinia stella Duerden, Journ. Inst. Jam., ii, p. 454, 1898 (*non* Verrill sp.).

Bunodella stelloides Verrill, Amer. Journ. Sci., vii, p. 43, Jan., 1898.

Bunodactis stelloides Verrill, op. cit., vii, p. 146, foot note, 1899.

Common under stones near low-tide mark.

SAGARTIADÆ.

Aiptasia annulata (Les.) Andres.

Actinia annulata Leseur, Journ. Philad. Acad., i, p. 172, 1817.

Aiptasia annulata Andres, Actinies, 1883. McMurrich, Actinaria Bahama Is., p. 7, pl. i, fig. 1, pl. iii, fig. 1, 1889.

PLATE LXVIII. FIGURE 3.

This species is not uncommon in the crevices of the reefs at and below low-tide. The largest examples were 8 inches or more in diameter when fully expanded and had several hundreds of tentacles. The color is generally light green with subspiral, raised, white annulations on the tentacles, which persist in preserved specimens.

Aiptasia tagetes (D. and M.) Andres.

Bartholomea tagetes Duch. and Mich., Supl. Corall. Antill., p. 39, pl. vi, fig. 16, 1866.

Aiptasia tagetes Andres, Actinies, 1883. McMurrich, Actin. Bahama Is., p. 12.

PLATE LXVII. FIGURE 2.

Common at low-tide in crevices of the reefs. Usually green, or dark olive-green, with white specks.

Phellia rufa Verrill, sp. nov.

? *Phellia clavata* Duerden, Actin. Jamaica, p. 459, 1898 (*non* D. and Mich.*).

PLATE LXVIII. FIGURE 2.

Column rather slender, usually cylindrical or nearly so, but often somewhat hour-glass-shaped; in expansion often three or four times as high as broad, the capitulum forming about one-fourth the height. Scapus covered with a thick, firmly adherent, tough coat of sand, etc., its upper edge slightly free and irregularly denticulated. Tentacles 36 to 48, in the larger examples, about as long as the diameter of the column or rather longer, the inner ones somewhat longer than the others, but not abruptly so, regularly tapered, subacute.

Color of scapus, under the sandy coat, dull brown; capitulum light rosy red to brick-red and flesh-color, translucent; tentacles variable, most often light terra-cotta red, or salmon-red, sometimes bright red, broadly tipped with reddish brown, and crossed by two or three broad, V-shaped or W-shaped reddish-brown bands, and with an elongated spot of the same color on each side of the base; disk similar to the tentacles in color, variegated with brown and flake-white spots, radially arranged.

Height of largest, 20 to 32^{mm}; diameter, 8 to 12^{mm} in expansion.

Common under and in crevices of stones and dead corals, just below low-tide mark (2 to 6 feet).

This agrees pretty closely with the Jamaican species described as *Phellia clavata* by Duerden, but not with the original account of that species.

* The species described by Duch. and Mich. has the following synonymy:

Phellia Americana Verrill, Proc. Essex Inst., v, p. 327 [13].

Paractis clavata Duch. and Mich., Corall. Antilles, p. 40, pl. vi, figs. 7, 8, 1860 (*non Phellia clavata* Stimp., sp., 1855; Verrill, op. cit., iv, 1865, and vol. vi, pl. i, figs. 3-3b, 1869; *nec Phellia clavata* Duerden, Actinaria around Jamaica, Journ. Inst. Jamaica, ii, p. 459, 1898).

Capnea clavata Duch. and Mich., Supl., p. 33, 1866.

ANTHEADÆ.

Actinoides pallida (Duch. and Mich.) Duerden.

Anthopleura pallida Duch. and Mich., Corall. Antill., Supl., p. 126, 1866.

Actinoides pallida Duerden, Actin. around Jamaica, p. 453, 1898.

PLATE LXVIII. FIGURE 4.

This small species has vertical rows of verrucæ, only on the upper part of the column, decreasing downward, to which bits of shells were firmly adherent; usually there are about six in the larger rows; the upper one is more prominent and somewhat like an acrorhagus. It can usually be recognized by the chain of round or elliptical flake-white spots along the inner surface of the tentacles, bordered externally on each side by a narrow dark olive-green or brown line; some of the spots may touch each other, but they are mostly a little apart and united by a white line, while the dark lines are continuous and persist in preserved specimens after all other colors have faded.

The disk is variegated with green, brown, gray, and flake-white, the white being in the form of 12 or 24 squarish or oblong radial spots in front of the bases of the inner tentacles, and edged with brown radial lines; the lips are either green or white.

Not uncommon under stones at low-tide near Bailey Bay.

Actinia Bermudensis Verrill, Amer. Journ. Sci., vi, p. 495, 1898.

? *Diplactis Bermudensis* McMurrich, in The Bermuda Is., p. 116, pl. 10, figs. 4, 6, pl. 11, figs. 1, 2, 1889.

PLATE LXVII. FIGURE 7.

This is a common red species with a circle of large, round, blue acrorhagi close to the tentacular margin. Occasionally brownish yellow or rust-yellow specimens occur (*var. ferruginea* V.).

Prof. McMurrich has suggested (in letter) that it may prove to be the same as his *Diplactis*, the latter having been described from badly preserved specimens. If so his description certainly does not apply well to this species, which is a typical *Actinia*.

Common under stones at and above low-tide mark.

ALICIINÆ.

Bunodeopsis globulifera, sp. nov.

? *Viatrix globulifera* Duch. and Mich., Corall. Antill., p. 44, pl. vi, figs. 15, 16, 1860.

Verrill, Amer. Journ. Sci., vii, p. 146, fig. 20, 1899.

Bunodeopsis, sp. nov., Duerden, Actin. Jamaica, Journ. Inst. Jamaica, ii, p. 456.

PLATE LXVII. FIGURE 4.

Column broad below, narrowed above; in the least contracted specimens the upper part is tapered to the tentacles and nearly free of tubercles; in others the column is short and covered with tubercles throughout, the naked part being concealed. The tubercles are smooth, rounded, and variable in size and number, larger and smaller ones are mingled together, but in general the lower ones are the larger. They are often very numerous over the lower half of the column and closely crowded. They are present in considerable number in specimens only 2^{mm} in diameter of column, but in such specimens they are mostly near the base. The limbus is strongly crenulated and lobed.

Tentacles, in full expansion, very long and slender, three or four times the diameter of the body, but they can contract to a much thicker, tapered form, about twice the diameter of the disk. They vary in number from 18 to 36, in the examples studied. Usually the number increases two at a time, for examples with 18, 20, 22, 24, and 26 tentacles were found. The twelve inner ones are longer than the others, and two rudimentary ones, just appearing, may often be found. In one case a forked tentacle was noticed. The disk is often nearly flat, but in many it protrudes in a conical form. The mouth is small, with two feeble siphonoglyphs.

Color in life yellowish green, often with dark brown streaks; vesicles yellowish brown. The largest examples are about 15^{mm} high and 8^{mm} broad at base.

Only a single example of this curious species was obtained by us, but a considerable number were collected by Prof. Bristol's party in 1898, which he has kindly loaned to me for study.

It lives attached to algæ in shallow water.

Mr. Duerden informs me that this is doubtless identical with his supposed new species. At first I thought that it would prove to be the adult of the long-sought *Viatrix globulifera*, but if so the latter was badly figured, for its vesicles are represented as close to the bases of the tentacles instead of confined to the lower part of the column. Therefore it seems best to consider it a new species.

EDWARDSIADÆ.

A species resembling an *Edwardsia* is contained in our collection, but it did not expand fully in life.

A specimen dredged in Flatt's Inlet, in 6 to 8 feet, sand, was reddish brown on the scapus, but it did not expose the tentacles. It has 8 fertile and muscular mesenteries with several pairs of small imperfect ones.

It needs to be studied more carefully by serial sections.

ZOANTHIDÆ.

Several species of Zoanthidæ have been described from Bermuda, and some additional forms were obtained by our party.

McMurrich, in 1889, described the five following species, all of which are, apparently, in our collection. His descriptions and figures are largely anatomical and histological.

Zoanthus flos-marinus (non Duch. and Mich.) = *Z. proteus* Ver. = ? *Z. Danæ* Hert. (non Verrill).

Mammillifera tuberculata (Gray) = *Isaurus tuberculatus* Gray. McMur., 1896; Duerden, 1898.

Corticifera ocellata (non Ellis and Sol.) = *Palythoa grandiflora* Ver., sp. nov.

C. glareola (non Les., 1817) = *Palythoa mammillosa* (Ellis and Sol.) = *C. lutea* Hert. (non Quoy and Gaim.) = *P. mammillosa* Duerden, 1898.

Gemmaria Riisei (*Rusei* by error, non Duch. and Mich.) = *Parapalythoa Heilprini* Ver., sp. nov.

Hertwig (Rep. Voy. Chall., 1888) described *Zoanthus Danæ?* (non Verrill), and *Corticifera lutea* (non Quoy and Gaim.) The former is perhaps our *Z. proteus*; the latter is our *Palythoa mammillosa*.

*Additional Species.***Parazoanthus parasiticus** (D. and M.).

Zoanthus parasiticus Duch. and Mich., Corall. Antill., p. 50, pl. viii, figs. 3, 4, 1860.

This minute species is frequently found parasitic on the tubular sponge (*Tuba* or *Spinosella vaginalis*). Only the disk shows at the surface of the sponge. When dried they appear as small, circular, about 12-rayed, stellate, and mostly separated spots, 1.5 to 2^{mm} in diameter, more or less scattered over the surface.

A variety or distinct species, with disks up to 3^{mm} in diameter, occurs, more closely grouped, on a sponge of the genus *Hircina*.

Zoanthus sociatus Les., 1817.

Zoanthus sociatus McMurrich, Actin. Bahama Is., p. 62, pl. ii, fig. 3; pl. iv, figs. 15-18, 1889.

?*Zoanthus flos-marinus* Duerden, Jamaican Actin., part i, p. 339, pl. xviiA, fig. 2, pl. xviiiA, fig. 2, 1898 (*non* Duch. and Mich.).

Several specimens were obtained that seem to agree with this species as described by McMurrich, from the Bahamas, and with the *Z. flos-marinus* of Duerden. The latter has much smaller polyps than the original type of Duch. and Mich., and differs in form, color, and number of tentacles. (See p. 566, below.)

Zoanthus proteus, sp. nov.

?*Zoanthus Danæ* Hertwig (*non* Verrill).

Zoanthus flos-marinus McMurrich, The Bermuda Is., p. 119, pl. xi, figs. 3, 4, 1889.

PLATE LXVII. FIGURES 5, 5a, 5b.

Polyps of moderate size, extremely variable in form and height, united into more or less extensive clusters either by slender narrow stolons, or by flat expansions of cœnenchyma, or directly, the buds often springing from the basal regions of the column, or even from higher up on the sides, so as to appear furcate or branched; sometimes stolons also arise from above the base. The polyps may be crowded or loosely aggregated; column may be short or long cylindrical; bottle-shaped; jug-shaped; club-shaped; or tall, slender, trumpet-shaped; all these forms often occurring in one cluster (see figs. 5-5b). The wall is soft, but often has dirt, grains of sand, etc., adhering slightly to the surface, except on the upper third or fourth part, which is smoother and naked, so that the surface is usually divisible into two regions; but this difference is not always evident. A constriction sometimes occurs between the two areas (fig. 5).

Tentacles numerous, slender, usually 48 to 52.

Color of column usually olive-green, sometimes bluish above; disk and tentacles pale ochre-yellow, with white specks, sometimes greenish.

Height of longest polyps, in contraction, 18^{mm}; greatest diameter, 3.5 to 5^{mm}; height of short forms, 4 to 6^{mm}; diameter, 4 to 5^{mm}; height of medium polyps, about 10^{mm}; diameter, 3 to 5^{mm}.

At and just below low-tide mark, on the reefs, adhering to stones and dead corals.

Zoanthus dubius Les., op. cit., p. 1817 (?non D. and M.).

PLATE LXVII. FIGURE 9.

A few specimens were obtained on the reefs that appear to agree with this species. The polyps are often slightly clavate and distinctly smaller (about 4^{mm} diam.) than those of *Z. proteus* and *Z. sociatus* and form small open clusters, united by flat stolons. The lower part of the column is covered with sponges and other foreign substances; the upper part is soft and smooth.

Protopalythoa, nom. nov. Type *G. variabilis* Duerden.

Gemmaria Duch. and Mich., Corall. Antill., p. 55, 1860, (non McCreedy, 1859).

Gemmaria McMurrich, The Berm. Is., p. 131, 1889; Actinaria Bahama Is., p. 64, 1889. Duerden, Jamaican Actinaria, i, p. 350, 1898.

The name *Gemmaria* having been preoccupied in Hydrozoa, it is necessary to give a new one to this group, if it is to be considered as really distinct from *Palythoa*, from which it seems to differ only in the fact that the zooids are not united together laterally by cœnenchyma, but only by stolons or based expansions. Some species of *Palythoa* are not thus united for more than half their height, or even less, and perhaps future discoveries may show a complete gradation between the two conditions.

The sphincter muscle is single; the mesenteries are microtypic; the mesoglaea contains lacunæ; the walls contain grains of sand, etc., making them more or less coriaceous. The zooids are sometimes monœcious; sometimes diœcious.

In renaming this genus I have intentionally assigned a new type, selecting the species which has been most fully described anatomically. The first species named by Duch. and Mich. (*P. Riisei*) was not figured and was so imperfectly described that it cannot be determined; not even the colors, nor the number of tentacles were given.

The second species (*P. clavata*) is said (1850) to have 30 tentacles, and to have a brown body and violet disk and tentacles. It seems to be very like *P. variabilis*, but the latter has 60 to 80 tentacles, and is larger.

Other closely allied species are *P. isolata* McMur., Bahamas; *P. fusca* Duerden, Jamaica; *P. McMurrichi* Hadd. and Shaekl.; *P. Mutuki* H. and S.; *P. Canariensis* H. and Duerd.; *P. Heilprini* Ver. = *G. Riisei* McM. (non D. & M.), see p. 560. The affinities of *G. brevis* D. and M. are uncertain.

Protopalychtha grandis, sp. nov.

PLATE LXVII. FIGURE 6.

A large species with the polyps united into small divergent clusters by short stolons, furcate at the base, or sometimes isolated; walls thickly encrusted with fine sand. Column in expansion usually clavate, obconic, or long trumpet-shaped, with the basal part tapered and rather narrow; often two to three times as high as broad. Disk broad, cup-shaped or when fully expanded convex or umbrella-shaped, with the borders recurved. Tentacles numerous, about 60 to 66, in two alternating rows, all similar, short, obtuse; outside the tentacles is a circle of marginal papillæ, nearly as large as the tentacles and alternating with the outer row. Sometimes one tentacle (directive), in line with the long axis of the mouth, was larger and lighter colored than the rest.

Color of column usually pale orange, salmon, or buff, under the coat of white sand; disk usually rich orange or orange-brown, sometimes light orange, buff, or ochre-yellow, the tint often varying in the same cluster, its outer part, near the tentacles, darker than the central, and usually with darker radial lines, sometimes tinged with green; lips white or orange; tentacles like disk, but usually a shade paler, often darker at base, but the tentacles may be darker than the disk in pale specimens.

Height of largest polyps, 30 to 36^{mm}; diameter of expanded disk, 12 to 16^{mm}.

On dead *Oculina*, off Bailey Bay, 30 to 40 feet; Harrington Sound, 2 to 6 feet; also in shallow water on the reefs, not common.

Decidedly larger than either of the species hitherto described from the Atlantic.

Palythoa Lamx., Polyp. flex., 1816.

Corticifera Leseur, Journ. Acad. Sci., Philad., i, p. 178, 1817.

This genus differs from *Protopalychtha* only in having the polyps united laterally, to a greater or less extent, by cœnenchyma filled with sand and other foreign substances, so as to form continuous coriaceous crusts, often of great extent.

The mesenteries are microtypical,* as in *Zoanthus*, and usually not very numerous.

* McMurrich, evidently by error, states that they are macrotypical (Actin. Bahama Is., p. 62), but he describes them as microtypical on a later page (p. 66).

Two species of this genus are common and often found together, on the rocks at low-tide, in tide pools, or even in exposed situations, where they are often laid bare by the tide. Both are buff or pale ochre-color and thickly encrusted with whitish sand. The more common is the species described as *Corticifera lutea* by Hertwig and as *C. glareola* by McMurich. As indicated above (p. 560), neither of these names is correct. The zoöids are decidedly larger and the tentacles (36–38) more numerous than in *P. glareola*. It forms broad encrustations, often one to three feet in diameter, varying in thickness up to one-half an inch or more (10 to 15^{mm}), with the zoöids 6 to 8^{mm} in diameter when expanded, or 6 to 7^{mm} in contraction, and projecting, when fully contracted, only very slightly or not at all above the cænenchyma, but in partial expansion forming more or less prominent verrucæ, often nearly as high as broad. All these various conditions can often be seen in the same cluster. Pl. lxviii, fig. 7.

This appears to be the earliest described species, *Palythoa mammillosa* (Ellis and Sol., 1780), of which their second species (*ocellata*) was perhaps a synonym, differing only in the state of preservation.

The other Bermuda species, remarkable for the large size of the polyps and the extent to which they are free distally, appears to be undescribed. (*P. grandiflora* V.)

We did not find the real *Palythoa glareola* Les., at Bermuda. It is distinguished mainly by the smaller size of the polyps (diam. 4^{mm} contracted) and the fewer mesenteries and tentacles (24, t. Les.; 28–34 t. Duerd.). Perfect mesenteries about 16–17, often unsymmetrical (t. Duerd.); 17 (t. Les., fig.). Disk violet (t. Les.).

Its appearance and mode of growth are nearly the same as in *P. mammillosa*, but it forms thinner crusts (about 5–8^{mm}), though perhaps of equal extent. It was well described and figured, with anatomical details, by Leseur (op. cit., pp. 178, 184, 185, pl. viii, figs. 6–9, 1817), and more fully, with histology, by Duerden (*Jamaican Actinaria*, i, p. 365, pl. viii A, fig. 9, pl. xix, figs. 5–7, 1898) as *P. Caribæa* D. and M.

***Palythoa grandiflora*, sp. nov.**

PLATE LXVIII. FIGURE 6.

Zoöids large, often free distally for about half their entire length, and forming clusters (usually of 12 to 24) several inches across. In contraction the zoöids form large, rounded mammillæ, often higher than broad, strongly sulcated longitudinally, the grooves (about 26) converging to the central depression of the summit; sur-

face covered with a firm coat of fine sand. In partial expansion, the summit becomes considerably swollen or turbinate; in full expansion, broad saucer-shaped. Tentacles about 52 to 56 or more, short, subequal, with half as many marginal denticles.

Color buff or light ochre to dark ochre; disk dull orange or brownish yellow, usually marked with radial lines and specks of white; tentacles dull orange, often tipped with white; marginal denticles, flake-white.

Height of zoöids, 15 to 20^{mm}; diameter in contraction, 10 to 13^{mm}; disk, in expansion, 14 to 16^{mm}.

This species has larger zoöids and much more numerous tentacles than any hitherto described.

It is probably the species described as *Corticifera ocellata* by McMurrich (Bermuda Is., p. 127), but not the original *ocellata*.

As additional species of West Indian *Zoanthi* are likely to occur at the Bermudas, I add, for convenience, the following analytical table, based chiefly on the external characters given in the *original* figures and descriptions, but supplemented in some cases by the observations of later writers (as indicated), and by personal studies. Valuable diagnostic characters are undoubtedly to be derived from anatomical and histological studies, especially from the character of the sphincter muscles and the musculature of the mesenteries. But at present only a few species have been studied in these respects and some of those that have been thus studied have evidently been erroneously identified, so that these characters cannot be used advantageously in this table. Moreover the individual variations in their anatomy, known to be great, have not been sufficiently investigated in any species. The size and form of the sphincter muscles vary according to the degree of contraction and mode of preservation. For such characters reference should be had to the plates of McMurrich and of Duerden. The number of tentacles is equal to that of the mesenteries, but as the latter are added by pairs, bilaterally, next the directives, the number varies considerably, even in polyps that seem adult.*

I do not pretend to vouch for the specific distinctness of all the nominal species included in this table, but they are the forms usually regarded as distinct.

* This mode of increase and the bilateral arrangement of the mesenteries was first definitely described by the present writer in these Transactions, vol. i, pp. 495, 496, 1869, as characteristic of the entire family. Leseur had figured them correctly as early as 1817. Probably the number of *perfect* mesenteries will be found more constant than the total number, but this has seldom been given by writers on this group.

Analytical table of West Indian Species of Zoanthus.

- A.—Tentacles short, subequal, in two alternating series.
- B.—Cœnenchyma mostly in the form of tubular or band-like stolons.
- C.—Tentacles 50 to 60, or more.
- d.—Column usually clavate and pedunculate; stolons mostly tubular; clusters open.
- e.—Greatest diameter of column usually 4 to 5^{mm}; height 25^{mm} or less, column usually bluish green or violaceous distally; prevailing color of disk, green or blue, variegated or radially spotted with brown. *Z. sociatus* Les.
- ce.—Greatest diameter of column 11^{mm}; expanded disk 13–14^{mm}; height of column up to 50^{mm} or more. Prevailing colors of column yellowish or reddish; of disk and tentacles, yellowish, reddish, or red-brown. Test “coriaceous”; “ovaries, 20” (t. Leseur). *Z. Solandri* Les. (type).
- dd.—Column usually nearly cylindrical, not distinctly pedunculate; stolons mostly flat and band-like; clusters close, exposed. Size “one-third smaller than *sociatus*” (t. Les.). *Z. dubius* Les. (type).
- CC.—Tentacles 48–52. Column protean, may be cylindrical, jug-shaped, subclavate, and trumpet-shaped in one colony. Stolons variable, mostly narrow. Diameter of column, usually 5 to 6^{mm}; height up to 20^{mm}, mostly less. Prevailing color of disk and tentacles, green. Test with a rough cuticle proximally. *Z. proteus* Ver.
- CCC.—Tentacles about 36. Size large. Column somewhat clavate, but with a wide base. Clusters open. Diameter of column distally about 15^{mm}; its height up to 35^{mm}; diameter of expanded polyp, 20^{mm}; length of tentacles, 2.5^{mm} (t. fig. by Duch. and Mich.). Column greenish distally; a ring of green around the mouth. *Z. flos-marinus* D. and M. (type).
- BB.—Cœnenchyma mostly lamellar or membranous, polyps short, clusters usually rather close.
- f.—Column short, usually obovate, swollen, pedunculate. *Mammillifera* Les.

Tentacles about 52–60.* About 60 mesenteries, of which 27 are perfect and bear ovaries (t. Leseur, p. 184, and pl. viii, fig. 3). Diameter of column, in contraction, about 6^{mm}; in expansion about 7^{mm}; height, 7–8^{mm}. Test “soft and smooth.” Disk greenish; tentacles and column reddish (t. Les.).

Z. auricula (Les.).

* Leseur, on p. 178, Journ. Phil. Acad., i, 1817, gives the number of tentacles as 26–30, but this is evidently an error, probably due to the fact that only one cycle was shown in the drawing. In his remarkably accurate transverse section he shows 61 mesenteries, and also indicates the directives, the inequality of the pairs, and the *bilateral arrangement* of the later pairs,—features that were ignored by later writers for nearly half a century! (See these Trans., i, p. 495.) As the number of tentacles, in this family, corresponds to the mesenteries, it is safe to assume that 52 to 60 are the usual numbers. McMurrich and others have been misled by this error (see McMurrich in Ann. N. York Acad., ix, p. 189, 1876).

ff.—Column cylindrical or subclavate, with a rather stout base.

g.—Tentacles about 50 (t. Les.); 56–62 (t. McMur.). Column short, nearly cylindrical; diameter in contraction, 3–4^{mm}; height, 2–3.5^{mm} (t. McMur.). Disk yellowish, a green circle at base of tentacles; tentacles light brown; mouth rosaceous (t. Les.). Test soft and smooth, but with a cuticle (t. McMur.). Hermaphrodite. *Z. nymphæa* (Les.).

gg.—Polyps larger; column more elongated, cylindrical or only slightly clavate.

h.—Tentacles small and very numerous. Diameter of column, in contraction, 5–6^{mm}; disk, in expansion, 8–9^{mm}; height of column, 10–12^{mm} (t. fig. by D. and M.). Cœnenchyma thick, fleshy. Clusters rather open.

Z. Anduzii (D. and M.).

hh.—Tentacles about 60. Perfect mesenteries 26–28. Column wall thin, with a cuticle below, carrying foreign matter. Diameter of column, in contraction, about 6^{mm}; of fully expanded disk, 8–10^{mm}; height of column, 4–30^{mm}, average about 13^{mm}. Clusters rather close. Cœnenchyma thin, tough, lamellar. Colors variable; column, pale below, olive-blue above; tentacles usually dark brown, sometimes green or olive; disk usually bright green with paler radial lines, sometimes pale green or yellow, sometimes a dark triangular spot in line with each angle of mouth; peristome pink, bright green, or yellow. Becomes dark green in alcohol (t. Duerd.). Hermaphrodite. Sphincter muscle distinct from that of *Z. nymphæa* (t. Duerd.).

Z. pulchellus Duerden.

(*M. distans* and *M. pulchellus* (both of D. and M., Supl., 1864), St. Thomas, were originally too imperfectly described, and as intimated by their authors, may be only varieties of *Z. nymphæa*.)

AA.—Tentacles long and slender, recurved, about 60, their length 8^{mm}, as figured. Polyps large, clavate, pedunculate, 40–42^{mm} high; diameter of column distally, in contraction, 8^{mm}; of expanded disk, without tentacles, 10^{mm}. Tentacles blue. *Z. nobilis* D. and M.

(This may be an *Epizoanthus*, which it resembles in the length and slenderness of its tentacles. Its anatomy is unknown.)

ALCYONARIA.

GORGONACEA.

Lists of the Gorgonacea have been published by J. M. Jones, J. D. Dana, Heilprin, and others, but none of them are very complete. Heilprin gives nine species, but two of them are probably mere varieties. The following valid species are in Heilprin's list (Bermuda Is., p. 103).

Gorgonia flabellum Linn. Sea-fan.

Gorgonia acerosa (?) Pallas. Purple sea-plume.

Gorgonia Americana Gmel. (Recorded by Dana.) Sea-plume.

Plexaura flexuosa Lamx. Sea-rod.

This is one of the largest as well as the most common species. It becomes two feet or more broad and often three feet or more high, with a very large main stem, two or three inches in diameter. The branches are furcate with very numerous terminal branchlets, 4 to 6^{mm} in diameter. The calicles are small, round, not crowded, with the borders only very slightly raised or not all so. Color in life, dull dark purple or grayish brown; when dried usually purple-brown, often brownish yellow, or a combination between these colors.

Plexaura homomalla (Esp.) Lamx. Black sea-rod.

Plexaurella crassa (Ellis and Sol.) Lamx. = *multicauda* Heilp. Sea-rod or sea-whip.

See pl. lxix, fig. 4. Remarkable for the very large size and elegance of the polyps, which cannot be retracted; but in life they completely conceal the coral and make it look like a soft branching sponge. The pores are large, open, and close together when dry.

Plexaurella dichotoma (Esp.) Kölliker.

Easily recognized by its long, stout cylindrical or digitate branches, covered with very irregularly shaped pores, which may be narrow-oblong, elliptical, oval, or circular, with the long axis in various directions and with lips only slightly raised or not at all.

The *Gorgonia purpurea* and *G. pseudo-antipathes* of Heilprin's list are indeterminable. The former is probably the purple variety of *Plexaura flexuosa*.

Gorgonia turgida (Ehr.) Verrill, has been recorded from Bermuda by the present writer (Amer. Journ. Sci., xlvi, p. 424, 1869).

Additional Species of Gorgonacea.

Gorgonia citrina Esper., 1794.

Gorgonia citrina Esper, Die Pflanzenth., ii, p. 129, pl. xxxviii, figs. 1, 2, 1794.

Gorgonia (Pterogorgia) citrina Dana, Zoöph., 1846.

Xiphigorgia citrina Verrill, Bull. Mus. Comp. Zoöl., i. p. 33, 1864.

Several specimens of this small, flat-branched species were obtained by our party in 1898. Both varieties, yellow and purple, occur but most examples are tinged with both these colors.

Gorgonia setosa Linn. Purple sea-plume.

A single perfect specimen of this fine species is in our collection. Others, of large size, but imperfect, were seen in local collections. It may be only a variety of *G. acerosa* Pallas.

Muricea muricata (Pallas) Verrill.

Gorgonia muricata Pallas, Elench. Zoöph., p. 198, 1766. Ellis and Sol., 1780.

Muricea spicifera Lamx., Exp. Method., pl. 71, figs. 1, 2, 1821.

Muricea muricata Verrill, Amer. Journ. Sci., xlv, p. 411, 1868.

Numerous fine specimens of this species were obtained, in 1898, by the Yale party, on a small reef in Bailey Bay, a few feet below low-tide, by diving. It completely covered one small reef. It was also found on the reefs in Castle Harbor, but only sparingly. In life, its color is yellowish brown to ochre-yellow, with beautiful translucent, white or buff, elongated polyps, which become so exsert in expansion that they entirely conceal the coral, their length equal to the diameter of the branches. When dried the color is pale buff or ochre, sometimes tinged with rust-brown. The lower lip of the calicles projects strongly and the whole surface is very spiculose, some of the superficial spicules being very large and irregularly fusiform.

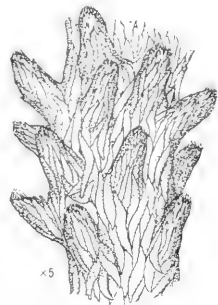


Figure 1.—*Muricea muricata*. $\times 5$

Eunicea ramulosa Ehr., 1834.

Gorgonia spicifera Dana, Zoöph., 1846.

A few specimens of this were seen in local collections, but none were taken by our party. The branches are slender and arise laterally or pinnately from the main stems.

Eunicea grandis, sp. nov.

PLATE LXIX. FIGURES 3, 3a.

A very large species, with long, round, thick, digitate or furcate, rigid branches, which taper but little distally and usually lie somewhat in one plane, thus forming corals one to two feet broad and sometimes nearly three feet high. Axis nearly cylindrical, dark brown or black, osseous at base. Cœnenchyma very thick and hard, filled with fusiform spicules of moderate size.

Calicles, in dried specimens, not much elevated, usually forming low convex verrucæ, with a small, terminal, indistinctly eight-lobed aperture; sometimes with a large round opening having the edges a little elevated.

Color when dried brownish black, dark umber-brown, or yellowish brown. In life umber-brown or sepia-brown, sometimes tinged with purplish or yellow.

The very large exsert zooids expand freely in confinement and then the calicles are more prominent, and evidently 8-lobed. The expanded zooids are swollen, somewhat translucent, dark russet-brown or yellowish brown, paler than the cœnenchyma, with a white line on the outside of tentacles, due to spicules; mouth bordered with white. The tentacles are much stiffened by spicules and contract slowly.

Diameter of main stalk often 2 to 3 inches, at base; diameter of digitate branches about .50 to .75 inch (12 to 18^{mm} or more), their length 6 to 12 inches.

Not uncommon in 6 to 20 feet, on the reefs.

This species is similar to *E. Rousseaui* Edw., in size and appearance, but that species has a prominent lower lip to the large calicles. Our species appears to be a larger, much stouter and more branched form.

Eunicea Tourneforti Edw., Corall., i, p. 150, 1857.

? *Gorgonia madrepora* Dana, Zoöph., p. 671, 1846.

PLATE LXIX. FIGURES 2, 2a, 2b.

This species grows in forms similar to the last, but it is smaller, with the branchlets about 7 to 12^{mm} in diameter. The calicles are more prominent, oblique, with the aperture on the upper side and the lower lip prolonged, as in the calicles of madrepores.

Color dark umber-brown or black when dried; dark brown or sepia-color in life.

Eunicea Rousseaui M. Edw. and Haime.

Corallieres, vol. i, p. 151, 1857. Verrill, Bull. Mus. Comp. Zoöl., i, p. 36, 1864.
Gorgonia pseudo-antipathes (*pars*) Dana, Zoöph. (*non* Esper).

This is also a large species with stout, forked, digitate branches, nearly as in the last, but larger. The calicles are large, rounded, somewhat elevated, directed obliquely upward, and with the lower lip a little prolonged.

Diameter of digitate branchlets 12 to 18^{mm}; their length, 150 to 300^{mm} (6 to 12 inches).

Color when dried, dark umber-brown or blackish.

Only a few specimens were obtained.

HYDROZOA.

This group has been studied but little at the Bermudas. Mr. J. Walter Fewkes* has published a descriptive list of 26 free Hydrozoa and 4 Ctenophora observed by him during a brief visit to Bermuda. Some of these were new species, but several are known from the New England coast and farther south.

Our party collected very few free forms and added to the list only the common *Porpita Linnæana*.

Attached hydroids are not numerous, either in species or individuals, only about 6 species of sertularians, 3 campanularians, one plumularian, and one tubularian having been collected by us.

The tubularian is *Pennaria tiarella*, found also on the American coast northward to Cape Cod. All the sertularians appear to be well known West Indian species.

The most common sertularian appears to be *Sertulariella Gayi*. It was taken with gonothecæ.

All the numerous specimens of *Millepora* seen by us could be referred to the common polymorphous species, *M. alcicornis*, though *M. ramosa* has been recorded from there by Quélch (Voy. Challenger, Narrative, i, p. 146, note.

* On a few Medusæ from the Bermudas, Bull. Mus. Comp. Zoöl., vol. xi, pp. 79-90, pl. xi, No. 3, 1883.

EXPLANATION OF PLATES.

PLATE LXVII.

- Figure 1.—*Plesiastraea Goodei*, sp. nov. Group of calicles. $\times 4$.
 Figure 2.—*Aiptasia tagetes*. $\times 1\frac{1}{2}$.
 Figure 3.—*Lebrunia Danae*. One of the actinobranchs. $\frac{1}{2}$.
 Figure 4.—*Bunodeopsis globulifera*, sp. nov. $\times 2$.
 Figure 5.—*Zoanthus proteus*, sp. nov. Two of the more elongated polyps. $\times 2$.
 Figure 5a.—The same. Group of polyps from the same specimen as 5.
 Figure 5b.—The same. Short polyps from the same colony.
 Figure 6.—*Protopalythoa grandis*, sp. nov. $\times 2$.
 Figure 7.—*Actinia Bermudensis* Ver. About natural size.
 Figure 8.—*Madracis decactis* Lym. Group of calicles. $\times 6$.
 Figure 9.—*Zoanthus dubius*. Base is overgrown with sponge. $\times 2$.
 Figure 10.—*Madracis decactis* Lym. Group of living polyps, enlarged about 10 times.

PLATE LXVIII.

- Figure 1.—*Actinactis flosculifera*. Side view. $\times 1\frac{1}{2}$. *b*. Three of the pseudo-fronds, more enlarged.
 Figure 2.—*Phellia rufa*, sp. nov. $\times 1\frac{1}{2}$.
 Figure 3.—*Aiptasia annulata*. Three tentacles of different cycles, much enlarged.
 Figure 4.—*Actinoides pallida*; *a*, fully expanded; *b*, partially expanded; *c*, one of the tentacles, inner surface, more enlarged.
 Figure 5.—*Actinotryx Sancti-Thomae*. Oblique view; enlarged about $1\frac{1}{2}$.
 Figure 6.—*Palythoa grandiflora*, sp. nov. Polyps contracted. Cluster, natural size. Photographed from a specimen in formalin.
 Figure 7.—*Palythoa mammilifera*. Part of a cluster. Some of the polyps are more or less expanded, others are entirely retracted. Natural size. Photographed from a specimen preserved in formalin.

PLATE LXIX.

- Figure 1.—*Lebrunia Danae*. Oral side. About natural size.
 Figure 2.—*Eunicea Tourneforti*. Side view of part of a branch. $\times 3$.
 Figure 2a.—The same. Section of branch. $\times 3$.
 Figure 2b.—The same. Portion of a section, more enlarged, to show spicules.
 Figure 3.—*Eunicea grandis* Ver., sp. nov. Part of branch. $\times 3$.
 Figure 3a.—The same. Section of a branch. $\times 3$.
 Figure 4.—*Plexaura crassa*. Surface of a part of a dried branch to show the large open calicles. $\times 3$.

XV.—ADDITIONS TO THE CRUSTACEA AND PYCNOGONIDA OF THE
BERMUDAS. BY A. E. VERRILL.

CRUSTACEA.

The collection of Crustacea obtained by the Yale party in 1898 contains nearly all the species recorded from there by previous writers, and many that are new to the fauna. Of marine Isopoda and Amphipoda about 50 species were collected, but they have not yet been carefully studied. Very few of them have been reported from Bermuda.

Lists of the Bermuda decapod Crustacea have been published by J. M. Jones,* A. Heilprin, and in the several Reports on the Zoölogy of the Challenger Expedition, but they are all quite incomplete. Mr. W. M. Rankin† has very recently published a more extensive catalogue of the Bermuda Decapoda. His list contains 56 species of this group.

Our 1898 collection and those collected by J. M. Jones ; G. Brown Goode ; C. Hartt Merriam ; F. V. Hamlin and others, now in the Yale Museum, include about 20 species of Decapoda not contained in Mr. Rankin's list, so that the total number now known is about 75. Nearly all of these are also West Indian species.

To these may be added *Geryon incertus* Miers, dredged in deep water off Bermuda by the Challenger Exp.

A number of the smaller and more difficult species have been sent to Miss M. J. Rathbun of the U. S. National Museum for determination, and to her I am much indebted for aid of this kind, as indicated under particular species. A few are still undetermined.

* Mr. Jones sent to the Yale Museum, about 1877, a valuable collection of Bermuda Crustacea collected by himself, during several years of residence there. It contains a large example of the great land crab, *Cardisoma Guanhumi*. I was informed that this species still occurs at Cooper's Island, but not elsewhere. We had no opportunity to collect at that locality.

† Annals New York Acad. Sci., xii, No. 12, pp. 521-548, May, 1900. This list is based on the collections made by Prof. Bristol's parties in 1897-1898, but it includes, also, those that were collected by Mr. G. Brown Goode, and most of those obtained by the Challenger Expedition; some that have been enumerated by Heilprin and others are omitted.

Additional Decapod Crustacea.

BRACHYURA.

GRAPSIDÆ.

Geograpsus lividus (Edw.) Stimp.

Grapsus lividus A. Milne Edw., Hist. Nat. des Crust., ii, p. 85, 1837; Melang. Carcinol., p. 135.

Geograpsus lividus Stimpson, Proc. Acad. Nat. Sci., Philad., 1858, p. 101; Notes on North Amer. Crust., Annals Lye. Nat. Hist., N. York, vii, p. 230, 1860. Kingsley, Proc. Acad. Nat. Sci., Philad., p. 195, 1880 (description).

This species, in life, has the carapax light brownish yellow or pale brown, marked irregularly with brownish black bands and streaks.

Two adult specimens were taken in 1898; Mr. Goode also obtained one example. West Indies.

A closely related form (*G. occidentalis* St.) considered identical by Kingsley, occurs on the west coast of America, from Cape St. Lucas to Chili.

Sesarma Miersi Rathbun.

Synopsis Amer. Sesarmæ, Proc. Biol. Soc. Wash., xi, p. 91, 1897.

Miss Rathbun refers one young specimen to this species with some doubt (coll. 1898). Bahamas,—Rathbun.

Sesarma Ricordi M. Edw.

Ann. Sci. Nat., Ser. 3, vol. xx, p. 183, 1853. Kingsley, Proc. Acad. Nat. Sci., Philad., for 1880, p. 217. Rathbun, Synopsis Sesarmæ, p. 91.

Miss M. J. Rathbun identifies the very common Bermuda *Sesarma* as this species. It is doubtless listed by Mr. Rankin and others as *S. cinerea*. Whether the true *S. cinerea* is also found there is doubtful. Our numerous examples all appear to be of one species, though they vary much in color. Common on the shores under stones and among dead algæ, nearly up to high-tide mark.

Plagusia depressa (Fabr.) Say.

Cancer depressus Fabr., Ent. Syst., Supl., p. 406, 1775.

Plagusia Sayi DeKay, N. York Fauna, p. 16. Stimpson, Notes on N. Amer. Crust., i, p. 18 [64]; ii, p. 104 [232].

Plagusia depressa Say, Journ. Acad. Nat. Sci. Philad., i, p. 100, 1817.
Rathbun, Dec. Crust. W. Africa, p. 281, 1900 (distribution). Miers, Rep. Voy. Chall., xvii, p. 272, 1886.

This species is commonly seen running with great rapidity over the rough ledges and cliffs, above high-tide mark, in the same manner as *Gapsus grapsus*, but it is even more alert and swifter in its motions, so that its capture is difficult.

It was taken by us on Castle Island and Bailey Bay Island, in 1898.

Percnon planissimum (Herbst).

Cancer planissimus Herbst, Naturh. Krebb., p. 3, pl. lix, fig. 3, 1804.

Acanthopus planissimus Stimpson, op. cit., p. 104 [242], 1860.

Acanthopus Gibbesii Milne Edw., Mel. Carcin., p. 146.

Leiolophus planissimus Miers, Catal. Crust. N. Y., p. 46, 1876.

Percnon planissimum Rathbun, Dec. Crust. W. Africa, Proc. U. S. Nat. Mus., xxii, p. 281, 1900.

Very common in some localities under stones at low-tide; a situation for which its very flat body is admirably adapted. Also received from J. M. Jones, Mr. Goode and others.

CANCRIDÆ.

Leptodius Floridanus (Gibbes) A. M. Edw.

Chlorodius Floridanus Gibbes, Proc. Am. Assoc. Adv. Sci., iii, p. 175, 1850.

Stimpson, Notes on N. Amer. Crust., Annals Lyc. Nat. Hist. N. York, vii, p. 209. S. I. Smith, Trans. Conn. Acad., ii, p. 3, 1869.

Leptodius Floridanus A. M. Edw., Miss. Sci. Mex., v, vol. i, p. 268, pl. xlix, fig. 2, 1873.

Several specimens were collected in 1898. It ranges to Aspinwall and Brazil.

Heteractæa ceratopus (Stimp.) A. M. Edw.

Pilumnus ceratopus Stimpson, Annals Lyc. Nat. Hist. New York, vii, p. 215 [87], 1862; and x, 1871.

Heteractæa ceratopus A. Milne-Edw., Sci. Miss. Mexico, part v, i, p. 300, pl. lii, figs. 3-3d.

One adult example taken in shallow water, 1898. Florida to Guadeloupe.

Xanthodius parvulus (Fabr.) t. Rathbun.

Chlorodius Americanus Saussure, Mem. de la Soc. Phys. et d'Hist. Nat. Genève, vol. xiv, p. 430, pl. i, fig. 5, 1857.

Xanthodius Americanus Stimp., Notes on N. Amer. Crust., Ann. Lyc. Nat. Hist., N. York, vii, p. 81, 1860.

Leptodius Americanus A. Milne Edw., Miss. Sci. Mex., v, i, p. 269, 1873.

A single adult specimen,—coll. F. V. Hamlin. Florida reefs to the Antilles. Hayti (Saussure).

Miss M. J. Rathbun informs me that she has identified this species by comparison with the original type of *Cancer parvulus* Fabr. in the Museum of Copenhagen, and that it belongs to the genus *Xanthodius*.

Eupanopeus occidentalis (Saussure) Rathbun.

Panopeus occidentalis Saussure, Rev. et Mag. Zoöl., ii, ix, p. 502, 1857; Mem. Soc. Phys. Genève, xiv, p. 431, pl. i, fig. 6, 1857. A. M. Edw., Miss. Sci., Mexico, v, i, p. 310, 1880. Benedict and Rathb., Proc. U. S. Nat. Mus., xiv, p. 360, 1891.

Eupanopeus occidentalis Rath., Bull. Labr. N. Hist. Univ., Iowa, iv, p. 273, 1898.

Miss Rathbun identifies one young example (No. 3021, Yale Mus.) as this species. South Carolina and Florida to Trinidad.

Eupanopeus serratus (Saussure) Rathbun.

Panopeus serratus Saussure, Rev. et Mag. Zoöl., ii, ix, p. 502, 1857; Mem. Soc. Phys. Genève, xiv, p. 432, pl. i, fig. 7, 1857. S. I. Smith, Proc. Boston Soc. Nat. Hist., xii, p. 280, 1869. A. M. Edw., Miss. Sci. Mexico, v, i, p. 311, 1880. Benedict and Rathbun, The Genus *Panopeus*, Proc. U. S. Nat. Mus., xiv, p. 371, 1891.

Panopeus Herbstii, var. *serratus* Miers, Rep. Voy. Chall. Zoöl., xvii, p. 129, 1886.

Eupanopeus serratus Rathbun, Bull. Labr. Nat. Hist., Univ. of Iowa, iv, p. 273, 1898.

A species was recorded under this name from Bermuda by Heilprin, and by Miers, but at that time the much more common species (*E. Bermudensis* Ben. and Rath., 1891), had not been distinguished, so that it is uncertain whether he really had this species. Rankin did not find it in the collections studied by him.

An example of this species from our collection (No. 3119), has been identified by Miss Rathbun by direct comparison with a photograph of Saussure's type.

Liomera dispar (Stimp.) Rathbun.

Chlorodius dispar Stimp., Prelim. Rep. on Crust. Gulf Stream, Bull. Mus. Comp. Zoöl., ii, p. 140.

Leptodius dispar A. M. Edw., Miss. Sci., Mex., v, i, p. 271, 1880.

Two males of this rare species have been identified by Miss Rathbun (No. 3176, Yale Mus.).

Pilumnus spinipes (A. M. Edw.) Rathbun.

Micropanope spinipes A. M. Edw., Miss. Sci., Mexico, v, i, p. 326, pl. liv, fig. 3, 1880.

Pilumnus spinipes Rathbun, Bull. Labr. Nat. Hist. Univ. Iowa, iv, p. 264, 1898.

Two specimens of this rare species were taken by our party, in 1898. Cuba (Edw.).

PORTUNIDÆ.

Portunus (Achelous) Ordwayi (Stimp.).

Achelous Ordwayi Stimpson, Notes on N. Amer. Crust., ii, p. 96 [224], 1860. S. I. Smith, Trans. Conn. Acad. Sci., ii, p. 9, 1869 (deser.).

Several specimens, mostly collected by J. M. Jones, are in the Yale Museum. They have been determined by Miss Rathbun. It was not taken by our party. It ranges southward to Brazil (Smith).

MAIIDÆ.

Mithrax depressus A. M. Edw.

Mithrax depressus A. Milne Edw., Mission Sci., Mexico, part v, i, p. 96, pl. xx, fig. 4, 1880.

A single young specimen (No. 3019, Yale Mus.) has been identified as this species by Miss Rathbun. Florida to Guadeloupe.

Stenorhynchus sagittarius (Fabr., 1793).

Leptopodia sagittaria Leach, Zoöl. Miscell., ii, pl. lxxvii, 1816. Latreille, Encycl. Meth., Insects, pl. 299, fig. 1, 1818. Desm., Consid. Crust., p. 155, pl. xvi, fig. 2, 1825. Latr. in R. Anim., Cuvier, ed. ii, pl. iv, 1829. Milne Edw., Ill. ed. Cuv., Crust., pl. xxxvi, fig. 1. A. M. Edw., Mission Sci., Mex., part v, vol. i, p. 172, 1873.

Mr. Goode, while in Bermuda, sent to Prof. S. I. Smith a characteristic drawing of this species made from a specimen in the local collection of the late Mr. Bartram of St. Georges. This collection

now belongs to the Bermuda government, but was mostly inaccessible at the time of our visit. The drawing, however, leaves no doubt of the identification.

Cape Hatteras to the West Indies and to Bahia, Brazil; Madeira; Cape Verde and Canary Is.; West Africa; west coast of America.

Chorinus heros (Herbst) Leach.

Cancer heros Herbst, *Krabben und Krebse*, pl. xlii, fig. 1; pl. xviii, fig. 102.

Chorinus heros M. Edw., in Cuvier, *Illust. ed.*, *Crust.*, pl. xxix, fig. 2. A.

M. Edw., *Miss. Scient., Mex.*, part v, vol. i, p. 86, 1873.

One specimen (No. 3126, Yale Mus., coll. J. M. Jones), determined by Miss Rathbun. Key West to Barbadoes. Rare.

ANOMURA.

PAGURIDÆ.

Calcinus sulcatus (M. Edw.).

Pagurus sulcatus M. Edw., *Ann. Sci. Nat.*, ser. 2, vi, p. 279, 1836; *Hist. Nat. Crust.*, ii, p. 230.

Calcinus sulcatus Stimpson, *Proc. Acad. Nat. Sci.*, Philad., 1858, p. 234. S. I. Smith, *These Trans.*, ii, p. 17, 1869.

Several specimens of this species are in the collection, determined by Miss Rathbun. It ranges southward to Brazil (Smith).

Petrocheirus insignis (Sauss.).

Pagurus insignis Saussure.

Two specimens from our collection have been determined by Miss Rathbun. One was collected many years ago by Mr. F. V. Hamlin.

Paguristes (?), sp. indet.

Six specimens of an undetermined species, which Miss Rathbun thinks may be undescribed, are in the Yale Museum, collected by Mr. Hamlin.

MACRURA.

ALPHEIDÆ.

Alpheus formosus Gibbes, Proc. Amer. Assoc., iii, 1851.

Alpheus Poeyi Guerin, Sagra's Hist. isle de Cuba, 1, p. xix, pl. ii, fig. 10, 10a, 1857.

This species is one of the most common in cavities in dead coral. Recorded also by Heilprin. Possibly *A. Websteri* Kingsley is the same.

Synalpheus lævimanus, longicarpus (Herrick).

This species has been identified by Miss M. J. Rathbun, from specimens in the U. S. Nat. Museum.

Athanas Ortmanni Rankin.

Annals New York Acad. Sci., xi, p. 251, pl. xxx, fig. 7, 1898.

Identified by Miss M. J. Rathbun from specimens in the U. S. Nat. Museum.

PALÆMONIDÆ.

Palæmon Savignyi (Bate).

Brachycarpus Savignyi Bate, Macrura, Voy. Challenger, xxiv, p. 795, pl. cxxix, 1888.

Palæmon Savignyi Rankin, Crust. Bahamas, Annals New York Acad. Sci., xi, p. 244, 1898.

Reported from Bermuda by Bate; from Nassau, N. P. by Rankin.

Latreutes ensiferus (M. Edw.) Stimp.

Latreutes ensiferus Stimpson, Proc. Acad. Nat. Sci., Philad., p. 27, 1860.
Bate, Rep. Zoöl. Voy. Chall., xxiv, p. 583, pl. 104, figs. 1-1g.

Common among gulf-weed.

PONTONIDÆ.

Several specimens of an undetermined shrimp belonging to this family are in the Yale collection (No. 3080).

Periclimenes Americanus (Kings.) t. Rathbun.

Anchistia Americana Kingsley, Proc. Acad. Nat. Sci., Philad., 1878, p. 8;
Bull. Essex Inst., x, p. 65.

Numerous Bermuda specimens of this species, from several different collections, are in the Yale Museum, determined by Prof. S. I. Smith and Miss Rathbun. It is common. Key West,—Kingsley.

PENÆIDÆ.

Penæus Braziliensis (Latr.).

Nouv. Dict. d'Hist. Nat., xxv, p. 154. M. Edw., Hist. Nat. Crust., ii, p. 414.
Gibbes, Proc. Amer. Assoc. Adv. Sci., 1850, p. 198. Stimpson, Notes on N.
Amer. Crust., iii, p. 132, 1871. Smith, These Trans., ii, p. 27.

A single specimen from Mr. Goode's collection. It ranges from New York to Bahia and Rio Grande do Sul, Brazil, and to West Africa.

Sicyonia dorsalis Kingsley.

Proc. Acad. Nat. Sci., Philad., 1878, p. 97; Bull. Essex Inst., x, p. 69.

One example determined by Miss Rathbun. It may, perhaps, be identical with "*S. carinata*?" recorded by Rankin. Florida,—Kingsley.

SCHIZOPODA.

MYSIDÆ.

Heteromysis Bermudensis G. O. Sars.

Rep. Zool. Voy. Challenger, xiii, p. 216, pl. xxxviii, figs. 1-7, 1885.
Shallow water with *Paranebatia longipes* (t. Sars).

PYCNOGONIDA.

No species of this group has hitherto been reported from Bermuda, so far as known to the writer. Our party obtained two small species in 1898.

Ammothea (?) *rugulosa*, sp. nov. *Ammothella*, subgenus nov.

PLATE LXX. FIGURE 9.

A small rudely spinulose species covered with adhering dirt. Body elliptical of moderate width, abdomen small. Proboscis large, fusiform, much swollen in the middle, large at the distal end, longer than half the length of the body. Eye-tubercle rather large, subclavate, with a rather large, brown, 4-lobed eye-spot at the rounded tip. Legs crooked, covered with rough spinules; 3 basal joints short; 4th and 5th longer, a little swollen; 6th longer and more slender; 7th very short; 8th strongly curved; dactylus strong and much curved; two accessory claws and several smaller spinules. Palpi long and slender, tapered, extending much beyond proboscis, 10-jointed; 1st and 3d joints short; 2d and 4th long; last 6 subequal, very well defined, rather short; the four last fusiform, the terminal one a little the longer and thinner. Antennæ nearly as long as the proboscis, 3-jointed, spinulose, two basal joints long, 2d stouter, clavate; dactylus very small, forming a very small chela. Accessory legs nearly concealed by several clusters of eggs, 9-jointed, 2 basals and 3 terminals very short; 3-6 longer. Length of body and proboscis 2mm; of proboscis 0.75mm.

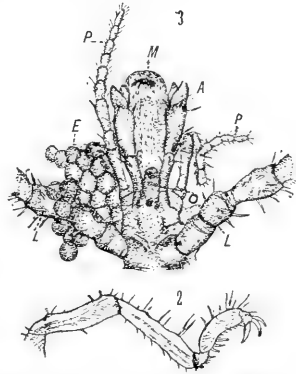


Figure 2.—*Ammothea* (*Ammothella*) *rugulosa*; part of leg much enlarged.

Figure 3.—The same. Anterior parts enlarged; A, antenna; P, palpus; M, mouth and proboscis; O, eye-tubercle; E, eggs; L, L, anterior legs.

One specimen, Bailey Bay, low-tide.

This species differs from typical *Ammothea* in having the palpi 10-jointed instead of 8-jointed. The number of joints in the accessory legs was not made out very clearly, but 9 joints were visible.

Achelìa (?) *gracilis*, sp. nov.

PLATE LXX. FIGURE 10.

A small, slender species, minutely spinulose, with very slender, moderately long legs. Body rather narrow-elliptical, proboscis rather large, fusiform, tapering to a small, rounded distal end, its aperture with curved, chitinous hooks. Antennæ short, almost rudimentary, apparently 2-jointed and minutely chelate. Eye-cone small, rather high and narrow, obtuse, oblong-conic with minute



Figure 4.—*Achelìa?* *gracilis*; part of leg, much enlarged.

terminal papillæ; eyes very small, brown. Abdomen small, slender, slightly fusiform and turned up; bilobed at end.

Legs slender, with a strong dactylus and accessory claws; 3 basal joints short; 4th much longer, decidedly swollen; 5th and 6th about as long and much more slender. Accessory legs slender, apparently 12-jointed, including a minute terminal joint with 2 claws; 11 joints distinct.

Palpi little longer than proboscis, not very slender, spinulose, apparently 8-jointed or perhaps obscurely 9-jointed; 2d and 4th joints long; 5th (6th?) and last very short; next to last a little longer, rather thick (5th and 6th perhaps not distinct).

Length of body and proboscis, 1.25^{mm}.

One specimen, Flatts Inlet, dredged in shallow water.

This does not belong to restricted *Achelìa*, on account of having only 8 definite palpal joints (instead of 9), and apparently 12 in the accessory legs (instead of 10); and in having the antennæ obscurely chelate.

XVI.—ADDITIONS TO THE ECHINODERMS OF THE BERMUDAS.
BY A. E. VERRILL.

ECHINODERMATA.

A list of the species of echinoderms known from Bermuda has recently been published by Mr. H. L. Clark.* In this list he enumerated 28 species, but admitted that four or five of the holothurians are doubtful; an opinion in which I fully concur. Of Ophiuroidea he listed seven species.† Our collection increases the number of species in this group to 18.

Most of these have already been recorded by me,‡ and some of them had previously been recorded by Mr. Theod. Lyman (Rep. Voy. Challenger, V.).

We obtained nearly all the recorded echinoids and starfishes, except *Luidia clathrata*, and apparently all the known holothurians, but we did not add any species to the lists of these groups except in the case of the holothurians. Our holothurians have not yet been fully studied, but a small green *Synapta* was taken that has not been recorded from Bermuda. This appears to be the *Synapta viridis* Pourtales, described from the Florida coast in 1851, but apparently not since rediscovered.

Synapta vivipara was found common in a great variety of situations—under stones, in dead coral, buried in sand, etc. In life it is brownish red.

The large black *Stichopus*, named *S. diaboli* by Heilprin, was found very abundantly everywhere on the white shell-sand bottoms down to at least 50 feet deep. It is exceedingly hard to preserve it by any method tried by us, either in alcohol or formalin solutions. Possibly ice-cold alcohol might have succeeded, if there had been

* Notes on the Echinoderms of Bermuda, Annals New York Acad. Sci., xi, pp. 407-413, 1898. Based on the collection made by Prof. Bristol's party.

† The species recorded by Mr. Clark are as follows: *Ophiura appressa*; *Ophiactis Mülleri*; *Ophiostigma isacanthum* (two with 6 arms and 1 with five arms were taken by us in 1898); *Ophionereis reticulata*, common; *Ophiocoma echinata* (= *crassispina* Say), common; *O. punila* (both 6-rayed and 5-rayed forms were found common by us, 1898); *Ophiomyxa flaccida*, common. All these were also collected by the Yale party, 1898. All of these, except the first, had also been recorded by Heilprin.

‡ These Trans., vol. x, Faunal Catalogue, Ophiuroidea from the West Indian Region, pp. 372-377, 1899.

facilities for keeping it cold for several days, as we had successfully done with several large, gelatinous, deep-sea species of holothurians on former occasions.

The spotted *Stichopus* (*S. xanthomela* Heilp.) is much less common, and it is also difficult to preserve, though we succeeded fairly well with some of the smaller specimens in alcohol. I am not prepared to express a decided opinion as to its specific distinctness, for I have not yet studied it with care. It is referred to *S. Möbi* Semper, by Clark. We observed only these two forms of *Stichopus*.

No crinoids have been positively recorded, though Sir W. Thomson (Narrative Voy. Challenger) mentions seeing a mutilated specimen of the rare genus *Holopus* in a local collection at Bermuda. Very likely it occurs in deep water, outside the reefs.

The total number of echinoderms now known from the Bermudas is about 40, all of which seem to be identical with West Indian species.

The small variety of true starfishes is remarkable, for only four species are known, and two of these are very rare. *Asterias tenuispina* is the only common species, though the little polygonal *Asterina folium* is not rarely found under stones at low-tide. It is usually pale blue in life, a very unusual color among echinoderms. The others, *Luidia clathrata* and *Ophidiaster Guildingii*, are very rare.

Additional Species of Echinoderms.

OPHIUROIDEA.

In the following list the sequence and nomenclature used is the same as in my Faunal Catalogue (This vol., p. 372).

PECTINURIDÆ Ver. (This vol., pp. 303, 372.)

Ophiura brevicauda (Lützk.) Lyman.

Ophioderma brevicauda Lütken, Vidensk. Meddel., Jan., 1856, p. 8; Addit. ad Hist. Ophiur., pt. ii, p. 94, pl. 1, figs. 3-3e, 1859.

Ophiura brevicauda Lyman, Illust. Catal. Mus. Comp. Zool., i, p. 16, 1865. Verrill, Notes on Radiata, Trans. Conn. Acad., i, p. 342, 1868. Lyman, Report Voy. Challenger, Zool., Ophiuroidea, v, p. 9, 1882.

Crevice in the reefs; not common, 1898. Florida and West Indies to South America.

Ophiura cinerea (Müll. and Tr.) Lyman.

Ophioderma cinereum Müll. and Troschel, Syst. Aster., p. 87, 1842.

Ophioderma Antillarum Lutk., Vid. Meddel., p. 9, 1856; Add. ad Hist.

Ophiur., pt. ii, p. 88, pl. i, figs. 1a-1e, 1859.

Ophiura cinerea Lyman, Illust. Catal. Mus. Comp. Zoöl., i, p. 27, 1865;

Lyman, Report Voy. Challenger, Zoöl., Ophiuroidea, v, p. 9, 1882; Bulletin Mus. Comp. Zoöl., x, p. 230. Verrill, Notes on Radiata, Trans. Conn. Acad., i, p. 342, 368, 1868. Nutting, Narrative Bahama Exp., p. 131.

Interstices and crevices of the reefs. Taken by the Yale party, 1898, and by G. Brown Goode.

Florida reefs to Bahia, Brazil.

OPHIOLEPIDIDÆ Ljung.**Ophiolepis paucispina** Müll. and Tr.

Ophiura paucispina Say, Journ. Acad. Nat. Sci., Philad., v, p. 149, 1825.

Ophiolepis paucispina Müll. and Trosch., Syst. Aster., p. 90, 1842. Lütken,

Addit. Hist. Ophiur., ii, p. 102, pl. ii, figs. 2a, 2b, 1859. Lyman, Illust.

Catal. Mus. Comp. Zoöl., i, p. 55, 1865.

Two specimens were dredged in Bailey Bay, 20 to 30 feet, shell-sand, 1898. Florida to Rio de Janeiro.

OPHIOTHRICHIDÆ Ljung.**Ophiothrix angulata** (Say) Ayres.

Ophiura angulata Say, Journ. Phil. Acad. Nat. Sci., v, p. 145, 1825.

Ophiothrix violacea Müll. and Trosch., Syst. Aster., p. 115, 1842. Lyman,

Ill. Cat. Mus. Comp. Zoöl., i, p. 164. Lütken, Add. ad Hist. Oph., pt. ii, p.

150, pl. iv, figs. 1-1d, 1859. Verrill, Trans. Conn. Acad., i, p. 342, 366, 1868.

Ophiura hispida Ayers, Proc. Bost. Soc. Nat. Hist., iv, p. 249, 1852.

Ophiothrix angulata Ayers, Proc. Bost. Soc. N. Hist., iv, p. 249, 1852.

Lyman, Illust. Cat. Mus. Comp. Zoöl., i, p. 162, pl. i, figs. 1-3, 1865; Report

Voy. Challenger, Zoöl., Ophiuroidea, v, pp. 216, 219, 1882; Bull. Mus.

Comp. Zoöl., x, p. 267, 1883. Verrill, Bull. Labor. Nat. Hist. Univ. Iowa, v, p. 19, 1899 (deser.).

Not common. It often lives gregariously among sponges. Cape Hatteras to Rio Janeiro, Brazil. Off Cuba, 200 fath.

Ophiothrix Suensonii Lütken.

Ophiothrix Suensonii Lütken, Vid. Meddel., p. 15, 1856; Add. ad Hist. Oph., pt. ii, p. 148, pl. iv, fig. 2. Lyman, Bull. Mus. Comp. Zoöl., v, 9, p. 232;

op. cit., x, p. 267. Verrill, Trans. Conn. Acad., i, p. 342, 1868. Lyman,

Report Voy. Challenger, Zoöl., Ophiuroidea, v, p. 222, 1882. Nutting,

Narrative Bahama Exp., p. 221 (colors). Verrill, Bull. Labor. Nat. Hist., Univ. Iowa, v, p. 21, 1899 (descr. colors, etc.).

Collected at Bermuda by Mr. G. Brown Goode.

OPHIUCOMIDÆ Ljung., 1867.

Ophiocoma Riisei Lütken.

Ophiocoma Riisei Lütken, Vid. Meddel., p. 14, Jan., 1856; Add. ad Hist. Oph., pt. ii, p. 143, pl. iv, fig. 6. Lyman, Ill. Cat. Mus. Comp. Zoöl., i, p. 76. Verrill, Trans. Conn. Acad., i, pt. 2, p. 341, 1868. Lyman, Report Voy. Challenger, Zoöl., Ophiuroidea, v, p. 171, 1882.

Common from Florida and the Bermudas, throughout the West Indies, to Colon and to Brazil.

This is a large black species. It is easily distinguished from *O. echinata*, found in the same localities, by its long, slender, upper arm-spines, which in the latter are stout, blunt, swollen in the middle.

Ophiopsila Riisei Lütken.

Ophiopsila Riisei Lütken, Add. ad Hist. Oph., pt. ii, p. 136, pl. v, fig. 2, 1859. Lyman, Illust. Catal. Mus. Comp. Zoöl., i, p. 150, figs. 16, 17, 1865; Bull. Mus. Comp. Zoöl., v, 9, 228. Verrill, Notes on Radiata, Trans. Conn. Acad., i, p. 341, 1868. Lyman, Report Voy. Challenger, Zoöl., Ophiuroidea, v, p. 160, pl. xl, figs. 1-3, 1882 (anatomy).

Florida Reefs to Brazil, shore to 57 fath. Bermuda (Lyman).

AMPHIURIDÆ Ljung., 1867.

Ophiactis Krebsii Lütken.

Ophiactis Krebsii Lütken, Vid. Meddel., p. 12, 1856; Addit. ad Hist. Oph., pt. ii, p. 126. Lyman, Ill. Cat., i, p. 111, figs. 10, 11. Verrill, Notes on Radiata, Trans. Conn. Acad., i, p. 341, 366, 1868; Bull. Labor. Nat. Hist. Univ. Iowa, v, p. 34, 1899.

Ophiactis Savignyi (pars) Lyman, Report Voy. Challenger, Zoöl., Ophiuroidea, v, p. 115, 1882.

Mr. Lyman, in his later works, considered this identical with *O. Savignyi* and *O. virescens*, from the Indian and Pacific oceans respectively. With this opinion I am not able to agree.

This, like most other species of the genus, usually has six or seven arms when young, and it increases by spontaneous fission. It is green, variegated with white or gray. It lives in the interstices of sponges and corals, often gregariously while young.

Common in sponges and interstices of dead corals. Charleston, S. C., and Florida Reefs to Rio de Janeiro, Brazil.

Amphipholis Ljung. (restricted). Type, **A. squamata** (= *A. elegans*).

Two small lateral oral-papillæ, and one broad, operculiform, distal one, forming a continuous series along each side of the jaws, and capable of nearly or quite closing the mouth-slits. Radial shields in close contact.

Amphipholis tenera (Ltk.) Ljung.

Amphiuira tenera Lütken, Addit. ad Hist. Ophiur., pt. ii, p. 124, pl. iii, figs. 5a, 5b, 1857. Lyman, Illust. Catal. Mus. Comp. Zoöl., i, p. 123.

Amphipholis tenera Ljung., Ophiur. Viv., Kong. Akad., 1866, p. 312; op. cit., 1871, pp. 634, 645. Verrill, Bull. Labor. Nat. Hist. Univ. Iowa, v, p. 29, 1899 (description).

Shallow water on shell-sand, Bailey Bay, 1898. Charleston, S. C., to West Indies. Off Cuba, 100–200 fath.

Amphipholis Goesi Ljung.

Amphipholis Goesi Ljungman, Dr. Goes Oph., Kong. Acad., 1871, pp. 635, 648.

Verrill, Expl. of Albatross in 1883, Annual Rep. U. S. Fish Com. for 1883, p. 549, 1885. Verrill, Bull. Labor. Nat. Hist. Univ. Iowa, v, p. 28, 1899 (description).

Amphiuira Goesi Lyman, Voy. Challenger, Zoöl., v, pp. 125, 146, 1882.

Dredged in shallow water (20–30 feet), Bailey Bay, shell-sand, 1898. Off Cape Hatteras, 14 fath., to West Indies.

HOLOTHURIOIDEA.

[For a revision of this group, see Clark, Annals N. York Acad., xii, p. 117, 1899.]

Synapta viridis Pourt.

Synapta viridis Pourtales, Proc. Amer. Assoc. for Adv. of Science, 5th meeting, p. 14, 1851.

This small species was not uncommon among filamentous green algæ. It is very active. Most of the specimens were pale green to olive-green with white specks. The larger ones are about 30 to 36^{mm} in length, and are not mature. It was originally described from Biscayne Bay, Florida. Mr. Clark, op. cit., records three additional *Synapta* and *Chirodota rotifera* Pourt.

ECHINOIDEA.

The more common recorded species of echinoids are *Toxopneustes variegatus*, abundant on the shell-sand bottoms; *Hipponöe esculenta*, reefs and outer islands; *Diadema setosum*; *Echinometra subangularis*; *Mellita saxiforis*.

XVII.—ADDITIONS TO THE TUNICATA AND MOLLUSCOIDEA OF THE BERMUDAS. BY A. E. VERRILL.

Most of the published information concerning the Bermudian Tunicata is by Herdman in the Reports on the Zoölogy of the Challenger Exp., vol. vi, 1882; vol. xiv, 1886; and vol. xxvii, p. 141. In these volumes several ascidians are described from Bermuda, viz:

- Symplegma viride*, vol. xiv, p. 144, pl. xviii, figs. 7-14.
Didemnum inerme, vol. xiv, p. 265, pl. xxxiv, figs. 6, 7.
Botrylloides nigrum, vol. xiv, p. 50, pl. ii, fig. 8; iii, figs. 19-21.
Ecteinascidia turbinata, vol. vi, p. 243, pl. xxxvi, figs. 1-6.
Clavellina oblonga, vol. vi, p. 246, pl. xxxv, figs. 6-10.
Ascidia nigra (Savig.) = *A. atra* (Les., 1817), vol. vi, p. 210.

All these species and many more were obtained by our party in 1898. The total number collected is about 25 species. These have, as yet, been but partially studied.

Among the additional genera are the following: *Diazona* (*D. picta*, sp. nov.); *Botryllus*; *Leptoclinum*, several species; *Distalium*, a new species forming pyriform colonies of a bluish gray or smoky brown tint when in formalin; *Distoma*; *Amorœcium*; *Styela*, and others.

The most interesting species is that which I have named *Diazona picta*. It forms large compound clusters, usually attached to gorgonians, and often 6 inches or more in breadth and height. Each zoöid has the oral aperture surrounded by a carmine-red band and a stripe of the same color runs down one side, while the ground-color is translucent bluish or pinkish white, giving to the whole cluster an elegant appearance when living.

Additional Species.

Styela partita (Stimp.) Ver.

Cynthia partita Stimp., Proc. Boston Soc. Nat. Hist., iv, p. 231, 1852. Verrill, Amer. Jour. Sci., iii, p. 213, 1872. Rep. Invert. Anim. Vineyard Sd., p. 407 [701], pl. xxxiii, fig. 246, 1874.

Halocynthia partita Verrill, Proc. U. S. Nat. Mus. for 1879, p. 197.

Distinguished externally by the alternating stripes of red and white in the apertures.

Common on the under side of stones and dead corals and in crevices of the reefs. Mass. Bay to Florida and West Indies.

Styela canopoides Heller. Traust.

Similar to *S. partita* externally. Tunic salmon-color with very fine muscle-bands; oral siphon very short, scarcely prominent; atrial siphon short conical, not far back (distance $\frac{1}{4}$ whole length of tunic). Tentacles numerous, simple, very slender. Gonads in two groups on each side, pyriform, each group attached along the sides of a slender sinuous duct.

Halocynthia rubrilabia, sp. nov. Fig. 7.

Body rather large, swollen, oblong or oblong-ovate, usually longer than high, broadly attached, with the tubes wide apart, large, and moderately elongated in extension, nearly equal, or the oral a little longer.

Test thick, firm, more or less wrinkled, when large usually covered with extraneous matters through which the reddish color often shows but faintly.

Apertures similar, rather large, both 4-angled with 6-8 small lobules in each angle; when large roughly nodulose or warty.

Tunic very muscular, the muscular bands strong, forming a very distinct network; about 30 longitudinal bands on each side.

Branchial sac has six broad plications on each side; usually 4 or 5 large stigmata to each mesh. Dorsal lamina is represented by series of small languettes. Tentacles about 20, of several diverse sizes; the 12 largest ones are thick, tapered, acute, with 16 to 20 small, simple pinnæ on each side (fig. 7; *c*). Ciliated organ U-shaped, with both ends curved one way. Siphons red; apertures four-lobed, the sinuses rounded (fig. 7; *a*).

The anus has a crenulated margin with about 12 unequal lobes, (fig. 7, *x*; *b*). Intestine forms a broad loop; liver is large, glomerate, greenish.

Gonads, in the adult, consist of 10-12 rather large glomerate lobules in two curved rows on each side, but so crowded that their serial arrangement is not very obvious; those of the left side lie mostly within the bend of the intestine. In younger examples they appear as separate, small, rounded, brown masses, arranged pretty regularly in two curved rows of 10-12 each, attached to the tunic.

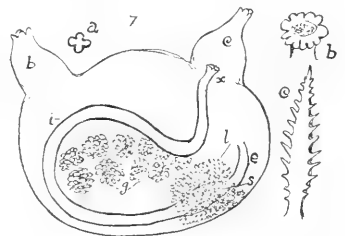


Figure 7.—*Halocynthia rubrilabia*, left side; *b*, branchial siphon; *c*, atrial siphon; *e*, oesophagus; *s*, stomach; *i*, intestine; *x*, anus; *l*, liver; *g*, gonads. *a*, Oral aperture. *b*, Anal papillæ. *c*, A tentacle, much enlarged.

Color of adult, reddish brown to pale red; the borders of the apertures bright red or rose-red, sometimes lined with a paler tint.

Greatest diameter, 35 to 50^{mm}; breadth, 20 to 25^{mm}; height, 25^{mm}; length of oral tube, 10 to 13^{mm}; diameter at end, 5 to 6^{mm}.

Common in shallow water, adhering to stones, dead shells, etc.

Halocynthia Riiseana (Traust.). Gen. *Cynthia* Savigny, 1816, non Fabr., 1808.

Cynthia Riiseana Traustedt, Vestindiske Ascidiæ simplices, Vidensk. Meddel. naturh. Foren. Kjobenhavn, 1882, p. 43, pl. v, fig. 13, pl. vi, fig. 19 (gill).

This species is allied to the last, but the tunic is flask-shaped and has longer and more divergent siphons, not so far apart, the anal one being dorsal and divaricate. The gill has 6 pairs of strong folds and 6–8 stigmata to a mesh instead of 4 or 5; tentacles 12, pinnate; anus bordered with longer papillæ; intestinal bend not so broad. Test in formalin is yellowish white; tunic pink.

One specimen, 1898. St. Thomas, W. I. (Traust.).

Microcosmus miniatus, sp. nov. Fig. 8.

Test orange-red, or bright red, rather thick and tough, leathery, ovate, somewhat flattened, attached obliquely by the base and one side, surface in the adults rudely wrinkled, often smoothish in the young; apertures far apart, on low verrucæ, which, in the adult, are covered with rude folds and irregular nodules, as contracted.

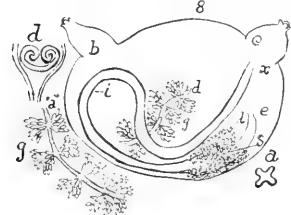


Figure 8.—*Microcosmus miniatus*, left side, partly diagrammatic; *b*, branchial siphon; *c*, atrial siphon; *e*, cesophagus; *s*, stomach; *i*, intestine; *l*, liver; *g*, gonads; *d*, duct; *x*, anus. *a*, Oral aperture. *d*, Dorsal tubercle and aperture of ciliated organ. *g*, Group of gonads from right side.

Tunic red, rather muscular, the muscle-bands slender and forming a distinct network. Siphons not very long, divergent.

Tentacles large and strongly pinnate; about eight to ten larger ones alternate with others about one-half as large; the larger ones are bipinnate, the pinnæ being large and branched; there are also others of still smaller size. Ciliated organ (fig. 8; *d*) has the two lobes strongly spiral and incurved.

Branchial sac has 9 plications on each side, that next the endostyle being smaller than the rest. The dorsal lamina is a simple and plain band. Intestine forms a rather narrow bend, the two portions nearly or quite in contact for some distance. Liver large and bilobed.

The gonads, which are found on both sides (fig. 8, *g; g*), consist of about four double clusters of follicles arranged along each side of a curved tubular organ (*d*) attached to the tunic.

Length up to 30^{mm}; breadth, 20–25^{mm}.

Shallow water, on the reefs and under stones.

Resembles *H. rubritabia* externally, but can usually be distinguished by the redness of the entire test.

Polycarpa multiphiala, sp. nov.

Test brown, thick, leathery, tough, roughly wrinkled in contraction, ovate, depressed, attached by most of one side, partly covered with adherent shell-sand; apertures near together, on large, short, thick, rudely wrinkled verrucæ. Tunic smooth, soft, rather thick, dark brown and nearly opaque, as preserved in formalin; its muscular bands are fine and numerous, the net-work rather irregular. Siphons short and stout, enlarged distally; apertures with four large lobes.

Tentacles many, simple, slender, subequal, curved inward, pigmented on inside; 40 were counted in the type. Branchial sac has 4 broad plications on each side; 6–12 stigmata to a mesh (usually 8 or 9). Gonads attached to tunic, numerous, small, flask-shaped with two small apertures at the free end. Intestinal bend small, simple; stomach enlarged.

Length, 45^{mm}; breadth, 30^{mm}.

On the reefs, not common.

Allied to *P. Mayeri* Traust., of the Gulf of Naples.

Diazona picta, sp. nov.

PLATE LXX. FIGURE 8.

Forms large gelatinous colonies, consisting of a massive main stem from which arise more or less numerous lobes, each lobe often containing 12 to 20 zooids, which, in expansion, are much exsert above the common mass, the free portion being slender and three or four times as high as broad. Apertures, when expanded, on short terminal tubes, the oral one larger and higher than the atrial.

General color usually translucent pinkish white; oral aperture surrounded by a band of bright carmine-red, edged on both sides with flake-white; a stripe of the same carmine color extends from the oral band down the ventral side of each zooid.

Height of larger colonies 125 to 160^{mm}; breadth about the same; height of free part of zoöids in life, 15 to 20^{mm}; their diameter 5 to 6^{mm}; diameter of oral tube about 2^{mm}.

Harrington Sound and Castle Harbor, just below low-tide, usually attached to gorgoniæ or bryozoa.

MOLLUSCOIDEA.

BRACHIOPODA.

No species of this group, so far as I know, has hitherto been recorded from the Bermudas.

By examining carefully the under side of unbleached specimens of the delicate, foliaceous coral, *Mycedium fragile*, I found a number of small specimens, mostly immature, of a reddish species of *Cistella*. A few were also found on the under side of *Isophyllia dipsacea*, and on the base of *Oculina*. Most of these, if not all, were taken in Harrington Sound, just below low-tide mark.

Cistella cistellula (Searles Wood).

PLATE LXX. FIGURE 7.

Professor Chas. E. Beecher, who has studied these specimens, furnishes the following note:—

“The Bermuda variety agrees in form and structure with *C. cistellula* from Great Britain. It differs principally in its more uniform outline and in color. Typical examples of *C. cistellula* are of a yellowish brown hue, while the Bermuda shells are nearly white with four not clearly defined, broad, radiating bands of red.”

BRYOZOA or POLYZOA.

This group is much less abundant in the Bermudas* than on the New England coast or in the Florida and West Indian seas. Only about 20 species, mostly well known West Indian forms, were obtained by the Yale party. Most of these are encrusting species of *Escharidæ*, found on the bases or dead parts of corals.

A curious large form (?*Schizoporella Isabelliana*, fig. 5), commencing as an encrusting species, becomes massive by one layer of

*Several Bermuda species have been recorded in various works, but more particularly by Busk in the Challenger Reports, vols. x and xvii. Our collection has not been sufficiently studied to warrant the insertion of a list of species new to the fauna, at this time.

zoecia growing over another, and finally, by surrounding the tubes of serpulæ or other objects and growing beyond them, forms large groups, often 6 inches high, of thin-edged tubular branches, having the thin expanded tips, in life, light pink or orange-red. Its aper-

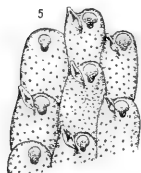


Figure 5.—*Schizoporella Isabelliana*?; group of cells; much enlarged.

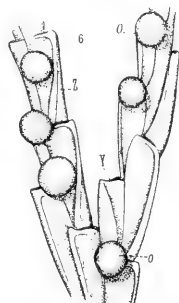


Figure 6.—*Bugula* (or *Acamarchis*) *neretina*; x, zoecia; y, aperture; o, oecia.

tures have a rounded proximal emargination. The acute pedicellariæ are at the sides of the aperture. When dried this species becomes dark purplish brown or blackish. *Hippothoa*, or *Schizoporella*, *spongites* is also common in foliaceous growths on corals. Other common forms are *Amathia lendigera*, a *Lichenopora* like *L. radians*, and *Crisia denticulata*.

One large, brown, thickly-branching species of *Bugula* (*B. neretina*, fig. 6) is common. It grows four or five inches high.

A much more delicate, white *Bugula* consists of divergent fan-shaped branches attached to the alternate sides and to the tip of slender jointed stems, sometimes having alternately a long joint and a very short joint, but more frequently the short joint is lacking and the ends of the long joints are swollen, as in *Stirparia*.

There are usually 2 or 3 annulations at the base of each main branch, and these arise just below the internodes. Many of the cells have a slender distal vibraculum, or sometimes two.

It should, doubtless, form the type of a new genus or subgenus (*Caulibugula*), intermediate between *Bugula* and *Bicellaria*, on account of its articulated spines or vibracula, and related to *Stirparia* by its jointed stem. It may be named *Bugula* (*Caulibugula*) *armata*. Its zoecia are oblong and biserial, alternate; the pedicellariæ are on short pedicels, large, lateral, not numerous.

A small intricately branched cellularian, *Scrupocellaria cervicornis* (Smitt, as *Cellularia* from Florida) with antler-shaped markings on the fornix or shield, long vibracula, and 4 to 6 distal marginal spines, is common.

Biflustra dentata Busk is common on Sargassum, found on the beaches. *Steganoporella elegans* (Edw.) Smitt is common on dead corals, both in encrusting and in free foliaceous forms.

The most interesting species was a curious species of the family *Pedicellinida* which forms large groups on the under side of stones, or on ascidians, sponges, etc., at low-tide mark. When disturbed it bends its stalks over to one side with a rather sudden jerk, which is sure to attract the attention of the collector when the clusters are large. This motion is effected by means of strong muscles lodged in a cylindrical dilation of the base of the stalk. It belongs to the genus *Barentsia* of Hincks or *Ascopodaria** Busk.

PEDICELLINIDÆ.

Barentsia timida, sp. nov.

PLATE LXX. FIGURE 4.

A large species forming extensive groups, connected by slender round stolons, that usually branch at right angles, from under the base of each zoöid.

Stem not very long, varying in length from 3 to 5 times as long as the height of the body, its basal portion, for a length equal to about the height of the body, much enlarged, cylindrical, tapering abruptly to the slender portion, and containing a large deflector muscle; above this the slender stem gradually increases in size distally; one or two annulations at the base of the body; the enlarged basal portion is covered with numerous fine annulations; the slender part appears punctate, owing to small tubular extensions of the lighter yellow inner layer, but these usually do not cause any elevations of the exterior.

Body cup-shaped or wide campanulate. Tentacles numerous, long, slender, curled in contraction.

Height of stems, 4–6^{mm}; of basal enlargement, 0.75 to 0.90^{mm}; its diameter, about 0.3^{mm}; height of body, 1^{mm}; its diameter, 0.8 to 1^{mm}.

On under side of stones, on sponges, corallines, ascidians, etc., at low-tide, common.

This species is closely allied to *B. discreta* (Busk), Voy. Challenger, xvii, p. 44, pl. x, figs. 6–12. The latter has, however, a shorter and more strongly annulated basal cylinder and also several annulations of the stem below the base of the cup; its tentacles are only 12 in number.

* Mr. Busk (op. cit., p. 41) admits that *Barentsia* has priority of publication, although he had himself previously distinguished the genus in MSS.

XVIII.—ADDITIONS TO THE TURBELLARIA, NEMERTINA, AND ANNELIDA OF THE BERMUDAS, WITH REVISIONS OF SOME NEW ENGLAND GENERA AND SPECIES. BY A. E. VERRILL.

VERY little has hitherto been published concerning the Turbellaria and Nemertina of the Bermudian fauna.* Both these groups seem to be sparingly represented there, though some of the species are of special interest.

Particular efforts were made by our party to make good collections of these groups and of the Annelida. Yet of the two former groups we found only three planarians and four or five nemerteans. The nemerteans were all of rather small size and inconspicuous coloration, contrary to what is usually the case in the warmer seas.

TURBELLARIA; DENDROCÆLA.

Leptoplana lactoalba, sp. nov.

Body, when extended in life, long-lanceolate or narrow-oblong, very flat, with thin undulated edges. Ocelli rather numerous,



Figure 9.—*Leptoplana lactoalba*. $\times 1\frac{1}{2}$.

arranged in two parallel series, each series having a rounded cluster near the posterior end and about two separated larger ocelli in line behind each cluster.

Color, translucent milk-white.

Length, in life, 30–50^{mm}; width, 10–12^{mm}.

Under stones and corals on the reefs, 1898.

Similar to *Leptoplana pallida* of the Gulf of Naples.

* A small terrestrial nemertean (*Tetrastemma agricola* W. Suhm) was discovered at Bermuda, by the naturalists of the Challenger. It occurs in brackish moist localities under stones, etc. (See Mosley, Notes by a Naturalist, p. 26.)

Pseudoceros superbus Lang.

Lang, Die Polycladen, Fauna und Flora des Golfes von Neapel, p. 540, pl. v, fig. 5; pl. xxi, figs. 2, 14; pl. xxii, figs. 1, 2, 3, 6, pl. xxx, fig. 18.

PLATE LXX. FIGURE 5.

Three specimens of this large and handsome species were obtained. We found it difficult to preserve well by any of the ordinary methods, either in alcohol or formalin. It is soft, thin, and very mutable in form.

Its color, in life, is a very rich, dark, purplish black or very dark maroon, with a velvety appearance, bordered all around with a narrow marginal band of bright orange, edged with light orange, while the extreme edge is purplish brown; under side brownish purple.

Length, in life, 50 to 60^{mm}; breadth, 25 to 30^{mm}.

Under stones at and just below low-tide, usually associated with a dark botrylloid compound ascidian or with a dark purplish sponge, with both of which it corresponds closely in color.

This is one of the few species of Bermudian marine invertebrates which appear to be certainly identical with Mediterranean species, though many are closely related. Among the nemerteans there is another case of this same kind (*Teniosoma curtum* Hubr.).

Pseudoceros pardalis, sp. nov.

PLATE LXX. FIGURES 6, 6a.

A large, broad species, covered with yellow spots.

Body, as preserved, broadly elliptical or oblong-ovate, subtruncate anteriorly, with thin undulated margins. Ocelli numerous.

Color, in alcohol, brownish black, covered with numerous round, pale yellow spots (probably bright yellow in life). Length, 60^{mm}; breadth, 40^{mm}.

The only specimen of this fine species was collected many years ago by Dr. C. Hartt Merriam and presented by him to the Museum of Yale University.

NEMERTINA.

The most interesting nemertean, as well as the most common, appears to be identical with a Mediterranean species of wide distribution. Mr. W. R. Coe, who has studied the Naples nemerteans in the Biological Station, made sections of my Bermudian specimens for comparison. He has given me the following synonymy and memoranda concerning this species:—

Tæniosoma curtum (Hubrecht) Coe.

Polia curta Hubrecht, Genera of European Nemerteans critically revised, Notes Leyden Museum, 1879.

Eupolia marmorata Bürger, Unters. ueber Anat. u. Histol. der Nemertinen, Zeitschr. wiss. Zoöl., vol. 1, 1890.

Eupolia curta Joubin, Les Némertiens, Faune Française, Paris, 1894. Bürger, Nemertinen, Fauna und Flora des Golfes von Neapel, Monogr. 22, 1895.

PLATE LXX. FIGURE 3.

"The specimens obtained in Bermuda belong to the more slender variety of the species, and show numerous sharply-marked, but interrupted, longitudinal lines. Both in their external appearance and internal organization these specimens exhibit a close resemblance to *Tæniosoma delineatum* (= *Polia delineata* Delle Chiaje,* = *Eupolia delineata* Hubrecht†), and in many respects are intermediate between the two species. The Bermudian form agrees in detail with the specimen collected at Mauritius and drawn by Möebius.‡ The species has a wide range of distribution. It is common in the Mediterranean, and has been recorded, also, from Mauritius, Chili, Samoa, Fiji Islands, and other localities in the tropical and subtropical seas of both hemispheres.

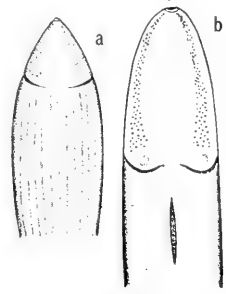


Figure 10.—*Tæniosoma curtum*; a, dorsal; b, ventral views of the head. $\times 4$.

T. delineatum has an even greater range of distribution than has *T. curtum*, and is commonly found associated with it. From my experience with Naples forms I am somewhat doubtful whether this is specifically distinct from *Tæniosoma curtum*.”§

When fully extended in life our larger specimens were 250 to 300^{mm} long; they were quite slender and flattened, about 2 to 3^{mm} broad, but changeable; the head is usually a little broader than the body, and subacute. In contraction the body is nearly round. General tint, to the naked eye, is light smoky brown, yellowish brown, or chocolate-brown, due to numerous narrow alternating

* Memorie sulla storia e notomia degli animali senza vertebre del regno di Napoli, Naples, 1823-28.

† Voyage of the Challenger, Nemertea, Zoöl., vol. xix, 1887.

‡ Bürger, Beitr. zur Anat., etc., der Nemertinen, Zeits. wiss. Zoöl., lxi, 1895.

§ The generic name *Tæniosoma* Stimpson, 1854, Proc. Philad. Acad. Sci., ix, has evident priority over all other names proposed for this genus.

stripes of dark chocolate-brown and grayish or yellowish white. About 100 minute ocelli in each lateral group.

Common in shell-sand at low-tide and also in cavities in dead corals.

***Lineus albocinctus*, sp. nov.**

PLATE LXX. FIGURES 1, 1a, 1b.

Body not very long, slender, tapered posteriorly, a little flattened; head usually a little wider than body and more depressed. Ocelli small, about 4 or 5 in a single series on each side of the head. Lateral fossæ large and long.

Color dark smoky-brown or nearly black, crossed by about 20 white rings, which become like narrow white lines in contraction; neck usually with a wider white band; head with white edges and a median white dorsal spot. Under side whitish.

Length, in extension, 35 to 50^{mm}; diameter, about 1 to 1.5^{mm}.

Low-tide, among corallines.

***Lineus albonasus*, sp. nov.**

PLATE LXX. FIGURE 2.

Body small, very slender, tapering posteriorly; head not enlarged. Ocelli usually two on each side, in the white patch.

Color red, usually brownish red anteriorly, and becomes light cherry-red posteriorly; front of head clear white above.

Length, in extension, about 35^{mm}; diameter 1^{mm} or less.

Bailey Bay, at low-tide.

Another nemertean, 100 to 150^{mm} long and about 3^{mm} in diameter, in extension, was found at low-tide in tenacious tubes coated with shell-sand. It is light orange-yellow anteriorly, becoming pale ochre-yellow posteriorly. Proboscis long and slender. It is probably a *Lineus*, but has not been carefully studied.

ANNELIDA.

The annelids are numerous at Bermuda, but our collection has not yet been fully studied. It includes over 110 species. A list of Bermudian annelids was published by Prof. H. E. Webster* in

* The Annelida from Bermuda collected by Mr. G. Brown Goode, Bulletin U. S. Nat. Mus., No. 25, p. 307, pl. vii-xii, 1884.

1884, based on the collection made by Mr. G. Brown Goode in 1872. This list included 26 species, of which 13 were described as new.

Five species, viz: *Podarke obscura* Ver.; *Arabella opalina* Ver., *Arenicola cristata* Stimp.; *Enoplobranchus sanguineus* Ver.; *Hydroides dianthus* Ver. are found, also, on the southern New England coast, but probably range southward to the West Indies. The balance are known West Indian species.

M'Intosh, in Report Voy. Challenger, Annelida, vol. xii, 1885, records 13 littoral species of Bermuda annelids, some of which are identical with those of Webster's list.

One of the larger and more conspicuous forms is *Protulides elegans* W., which projects from its tough tubes large and elegantly formed branchial plumes, as brilliant and varied in colors as carnations. It is common on the reefs, its tubes being contained in dead corals. It is also found on the coast of North Carolina.

Another large species is *Terebella magnifica* W., which lives buried in shell-sand at low-tide. In life its large flaccid body, which is pale flesh-color or nearly white, is often 12 to 16 inches long and about half an inch in diameter, while its numerous white tentacular cirri can be extended more than a foot in every direction. This belongs to *Polymnia* Malmg. or *Eupolymnia* Ver.

The *Hermodice carunculata* Kinb. is a large, stout species, densely covered with sharp, white calcareous setæ, with red gills between them. It is very common under stones at low-tide.

Cirratulus grandis Verrill, a large yellowish green or olive-green worm, with numerous long orange-red cirri, is common at low-tide in sand, especially in stony places. It agrees perfectly with New England specimens. It is not in Webster's list.

In our collection there are three species of Phyllodocidæ and more than twenty-five of Syllidæ, including ten species of *Syllis*. These families are not included in Webster's list.

Polynoë pustulata M'Int. = *Polynoë granulata* Ehlers = *Halosydna leucohyba* Web., non Schmarda, a large scaly species, was common, living as a commensal in the tubes of a large *Eunice*, in dead corals.

Miss K. J. Bush has identified the following species in our collection that are new to the fauna:

<i>Nereis articulata</i> Ehl.	<i>Marphysa Goodsiri</i> ? M'Int.
<i>Nereis Antillensis</i> M'Int.	<i>Lumbrinereis Floridana</i> Ehl.
<i>Trypanosyllis vittigera</i> Ehl.	<i>Branchiomma lobiferum</i> Ehl.
<i>Eunice violaceomaculata</i> Ehl.	<i>Eupomatus uncinatus</i> (Phil.) Ehl.

Additional unrecorded species occurred in the following genera :—

<i>Nereis.</i>	<i>Cirratulus.</i>
<i>Leodice</i> or <i>Eunice</i> , 7 sp.	<i>Aricia.</i>
<i>Marphysa</i> , 2 sp.	<i>Anthostoma</i> or <i>Scoloplos.</i>
<i>Arabella.</i>	<i>Sabella.</i>

The following genera, hitherto unrecorded from the Bermudas, are represented in our collection by undetermined or new species :—

<i>Chrysopetalum.</i>	<i>Staurocephalus</i> or <i>Staurinereis</i> , n. nov.
<i>Sthenelais.</i>	2 sp.
<i>Eudalia.</i>	<i>Cirrhinereis</i> or <i>Cirronereis.</i>
<i>Phyllodoce.</i>	<i>Heterocirrus.</i>
<i>Eteone.</i>	<i>Capitella</i>
<i>Autolytus</i> , 2 sp.	<i>Notomastus.</i>
<i>Syllis</i> , 10 sp.	<i>Clymene</i> or <i>Euclymene</i> , n. nov.
<i>Haplosyllis</i> , 2 sp.	<i>Axiolthea</i> or <i>Axiolthea</i> , n. nov.
<i>Eusyllis</i> , 2 sp.	<i>Polydora.</i>
<i>Desmosyllis</i> , g. nov.	<i>Pectinaria.</i>
<i>Trypanosyllis</i> , 3 sp.	<i>Loimia.</i>
<i>Hemisyllis</i> , g. nov.	<i>Eugrymca</i> , g. nov.
<i>Opisthosyllis.</i>	<i>Protothelepus</i> , g. nov.
<i>Odontosyllis</i> , 2 sp.	<i>Nicolea.</i>
<i>Branchiosyllis.</i>	<i>Polymniella</i> , g. nov.
<i>Grubeosyllis</i> , n. nov. 2 sp.	<i>Polycirrus</i> , 3 sp.
<i>Lysidice.</i>	<i>Frotula</i> , 2 sp.
<i>Paramarphysa.</i>	<i>Vermilia</i> , 2 sp.
<i>Heteromarphysa</i> , g. nov.	<i>Filigrana.</i>
<i>Nematonereis.</i>	<i>Spirorbis</i> , 2 sp.
<i>Lumbrinereis</i> , 2 sp.	

The following are some of the new species* obtained, especially of the Syllidæ and Eunicidæ.

Phyllodoce Bermudæ, sp. nov.

A small, slender species, with cordate-lanceolate posterior branchiæ and large caudal cirri.

Head small, rounded, both in front and behind. The front a little more produced. Antennæ about equal, lower a little shorter; upper ones as long as head, fusiform with acuminate tips; tentacular cirri similar in form, but longer. Eyes large, round, black, posteriorly placed. Inferior branchial lobes, on the anterior segments, oblong-ovate, $1\frac{1}{2}$ times as long as broad, with round blunt tips; farther back they gradually increase in size and length, those about the middle

* The illustrations of these species could not be finished in time for publication in this article. They will be published in vol. xi of these Transactions in connection with the full report on the Annelida.

being twice as long as broad. Upper branchiæ are preserved only on the posterior third of the body; the most anterior seen are cordate-lanceolate, one-third longer than broad, with blunt tips; farther back they become narrower lanceolate. Caudal cirri large, dark colored, oblong-ovate, obtuse, 4 times as long as broad. Setæ are long and very slender, the blades rather long, straight, very acute.

The color in formalin is reddish brown (in life probably green); the branchial appendages and caudal cirri are more deeply pigmented than other parts, and nearly opaque; a transverse fusiform lighter spot exists between the segments, bounded by narrow, curved, whitish lines; there is a dark spot at the dorsal base of the parapodia, surrounded by a pale zone.

Length, as preserved, about 14^{mm}; diameter 1^{mm}, in life much longer.

Eulalia megalops, sp. nov.

A long and slender, dark green species with very large eyes.

Body wider in the middle, tapering gradually to both ends. Head ovate, obtuse in front, longer than broad. Eyes very large, black; four frontal antennæ long, slender, whitish; odd tentacle similar in size; 4 pairs of long, slender, tapered tentacular cirri, the dorsal pairs longer, in life six times as long as head. Branchial lobes of parapodia falcate, long, narrow, acute, curved upward, 1½ to 2 times as long as breadth of body.

Color, in life, mostly dark olive-green; branchiæ light green; anterior segments with a whitish transverse marginal line and a pale median patch. Length, in life, 90^{mm}; breadth, 1.5^{mm}.

Bailey Bay, in dead corals.

Syllis Savigny. (Including *Typosyllis* and *Ehlersia*.*)

The genus *Syllis* is here taken to include those species having minutely bidentate tips to the terminal blades of the compound setæ, as well as those in which the tips are acute. In some species both forms occur on the same individual and in many cases the bidentation is so slight as to be visible only under a high power objective (e. g. No. 6, Zeiss or Leitz, or ¼ inch American), so that it seems useless to make this a generic character. *Eusyllis* Malmgren was separated mainly on this account from *Syllis*, but the type species, *E. Blomstrandii* M., also has the dorsal cirri nearly smooth or with-

* For a synoptical table of the genera and subgenera of Syllidæ here described see p. 632.

out evident articulation or beading, while in true *Syllis* they are very distinctly beaded or articulated. This was made the principal character of *Eusyllis* by McIntosh. Langerhans restricted it to species having the edge of the œsophagus denticulated, and in that sense it is used by me. All the Bermuda Syllidæ studied by me, except *Odontosyllis*, *Autolytus*, and *Grubeosyllis*, have distinctly and usually strongly articulated cirri.

In most of the following species the blades are decidedly longer on the upper than on the lower setæ, and they are decidedly shorter on the posterior segments than on the anterior, so that no very close descriptions nor measurements can be briefly given that would be useful. Nor are the differences so marked as to be very useful for the recognition of related species, even when figured, owing to the variations of each. The forms of the palpi, antennæ, cirri, œsophagus, and stomach afford better characters, though these are all able to vary considerably by contraction.

In our species of *Syllis* the œsophagus (or chitinous pharynx) has a solitary, conical, median tooth, and usually a smooth anterior margin, becoming revolute when extruded from the mouth, but in a few the margin is minutely crenulate, or it may be ill defined, passing gradually into the soft part.

More than one species of *Syllis* was observed, in life, in the process of producing one or more free sexual zooids by the alteration and breaking away of a certain number of posterior segments, as in *Autolytus*, and some were preserved with the fully formed zooids attached. These agree with the genus *Tetraglene*. They have large eyes, with a lens, but lack antennæ and palpi. They have fascicles of long capillary setæ, in addition to the compound setæ, and long beaded cirri. Several specimens of *Tetraglene* were also taken in the surface towing-net, in the evening, about the last of May, associated with the allied form of sexual zooids known as *Chaetosyllis*.

But in related species of *Syllis* (*S. corallicola*, *S. catenula*, *T. fertilis*) masses of ripe eggs were found along the posterior half of the body, without any alteration of the segments, setæ, or cirri. The species of *Syllis* seem, therefore, to differ widely in their life histories.

Many of the following species of Syllidæ were obtained by breaking up dead and decayed masses of corals, and placing them in dishes of water for the annelids to crawl out. Others were obtained by placing masses of living corallines and sponges in the dishes, especially at night, for the same purpose.

Syllis (Typosyllis) corallicola, sp. nov.

A large species with long, strongly beaded antennæ and cirri, and with a large, rather short, dark brown, chitinous œsophagus armed with a single tooth near the emarginate edge.

Head large, about one-third broader than long (1: 1.33 to 1: 1.50 in contraction), frontal margin broadly rounded and slightly three-lobed, the median lobe only slightly prominent, sides strongly convex, narrowing backward, posterior margin with a wide shallow emargination. Eyes conspicuous, with lens, but not very large, the anterior distinctly larger and farther apart, those of the same side pretty near together. Palpi large and broad, separate to base; when extended the free part is as long as the head or longer, ovate-lanceolate, slightly incurved on inside, obtuse at the end. Odd antenna or tentacle long and tapered, about 5 times as long as the head, its free portion $3\frac{1}{2}$ times as long as that of the palpi, strongly beaded, the annuli about 40, short and not very separate proximally, but becoming longer and very distinctly constricted distally. Antennæ about $\frac{1}{3}$ shorter than the tentacle, and more slender, beading similar, the annuli broader than long. Dorsal tentacular cirri much like the tentacle, but $\frac{1}{3}$ longer; ventral one smaller and nearly $\frac{1}{2}$ shorter. Anterior dorsal cirri are also mostly long like the tentacular cirri, but farther back part of them, alternating irregularly, become shorter; the longer ones are 2 to 3 times as long as the tentacle and equal to twice the diameter of the body, while the shorter ones are equal to about $\frac{2}{3}$ its diameter.

The setæ are slender and long, the upper ones with rather long, narrow, nearly straight, lanceolate blades, 6 or 8 times as long as wide, with minutely bidentate tips; the lower and posterior ones have wider, bidentate blades, often only 2 or 3 times as long as broad. Anteriorly 3 or 4 spiniform acicula occur in each fascicle; 1 or 2 posteriorly.

The œsophagus (or chitinous proboscis) is stout, moderately long, occupying 10–12 segments, often wrinkled or crumpled in contracted specimens, dark brown, its anterior edge not denticulated, but with a ventral emargination; the median tooth is rather large and a little back from the edge. The stomach is long, occupying 14–17 segments, in preserved specimens about $\frac{1}{3}$ longer than the œsophagus and decidedly stouter, a little wider in the middle, covered with dense rows of dark rounded granules or glands.

Color, in formalin, yellowish white; the annuli of the cirri have groups of pale greenish pigment cells.

Length up to 1.5 inches or more (or 40^{mm}); diameter, 2–3^{mm}.

Var. *lineolata*, nov.

This variety occurs with the preceding form, from which it differs chiefly in color. The cirri and antennæ are equally long, and the setæ have the same forms. In formalin each anterior segment is crossed close to the anterior edge by a narrow brown line; another similar transverse brown line runs across the middle of the segments, but does not reach the sides; behind the middle of the body these lines gradually fade out. In some specimens they are rather faint even anteriorly. The color in life was not noted. Both varieties were common in the cavities of dead corals, from the reefs; also in corallines.

Syllis grandigularis, sp. nov.

This closely agrees in size and appearance and in its setæ, with *S. corallicola*. It differs in having a larger and broader head, widest in front of the eyes, which are black and in a trapeze, and especially in the very large size of the œsophagus and stomach, and their structure. The œsophagus is nearly as long and almost as thick as the stomach, and nearly fills the anterior part of the body; its margin is nearly even and entire, but appears to be minutely crenulated when extruded, and the median tooth is very large, blunt-conical, and projects one-third of its length beyond the margin of the extruded proboscis. The stomach is elongated, tapering a little toward both ends; it occupies 8 segments; its surface is covered with numerous close, confused and irregular rows of cells,* but they do not form regular, rounded groups, as in most other species.

The antennæ and cirri are all long and slender,—more slender than in *S. corallicola* and *S. catenula*,—and composed of numerous round strongly pigmented beads, about as long as broad. The posterior setæ are longer than the anterior with strongly incurved acute blades on the lower ones. Allied to *S. annularis*, also.

Length, in formalin, 18^{mm}.

Syllis (Typosyllis) catenula, sp. nov.

A smaller and more slender species than the preceding with rather shorter cirri, long palpi, and a rather longer and more cylindrical œsophagus, armed with a small tooth close to the entire and even margin, usually with linked markings on back, often causing three rows of pale spots. Head about one-half wider than long (ratio

*According to some observers these are radial muscular cells, not glandular.

1:1.45), the front edge usually slightly and broadly three-lobed, sometimes rounded; sides evenly rounded; posterior strongly emarginate. Eyes rather small, the pairs far apart, those of each side close together, the anterior larger and more lateral, with lens. Palpi large and long, divergent, lanceolate, somewhat falcate, with a broad base, blunt end and incurved inner margin; the free part usually projects $\frac{1}{4}$ more than the length of the head. Tentacle tapered, moderately long, nearly three times as long as head, about $\frac{1}{3}$ of its length projects beyond the palpi, strongly and elegantly beaded, with 20-22 annuli, these are 2 to $2\frac{1}{2}$ times as broad as long distally, each with pigmented cells. Antennæ similar, with the same beading, $\frac{1}{4}$ to $\frac{1}{3}$ shorter and smaller, projecting only a little beyond the extended palpi. Dorsal tentacular cirri similar to tentacle but about $\frac{1}{3}$ longer, with 28-30 annuli; lower ones about $\frac{1}{2}$ as long. First dorsal cirri still longer, about $1\frac{1}{2}$ times as long as the tentacle, with 30 or more annuli. Several others on the anterior segments are nearly as long, but alternate irregularly with much shorter ones, $\frac{1}{2}$ to $\frac{2}{3}$ as long, all becoming rather shorter posteriorly; the longer ones are about twice as long as the diameter of the body. Caudal cirri long and slender, beaded like the dorsal cirri and equally long, but more slender. Setæ slender, the upper ones with nearly straight, narrow lanceolate blades, 4 or 5 times as long as wide, with slightly bidentate incurved tips, sometimes entire; the ventral and most posterior setæ have the blades much shorter. Acicula usually 2-4, spiniform.

Œsophagus rather long and slender, occupying 10-12 segments, in extension $1\frac{1}{4}$ times the length of the stomach, but it is sometimes made shorter and wrinkled in contracted specimens, so that it may be scarcely longer than the stomach. When protruded from the mouth the aperture is flaring with the margin even, entire, and often revolute; the tooth is small, acute, near the edge and sometimes projects beyond it when everted. The soft membranous proboscis when everted shows about 10 rather broad obtuse denticles or lobes, the 6 dorsal ones larger. Stomach long, cylindrical, usually occupying 6 to 8 segments, usually shorter than the œsophagus and distinctly larger, covered with close rows of rounded glandules. Color, in formalin, yellowish white, each segment anteriorly marked dorsally with two curved transverse lines of brown, which converge and blend into a spot on the middle of each segment, and also unite at the sides, so as to enclose, on each side, an elliptical pale spot, and leave a similar spot between the segments along the middle of the back; thus there are three alternating rows of pale spots along the back, but these

fade out posteriorly and are often indistinct anteriorly. Color, in life, was not noted. One ♀ was found filled with eggs.

Length of preserved specimens usually 20–25^{mm}; diameter, .75 to 1^{mm}.

Common among corallines and in dead corals.

Syllis jugularis, sp. nov.

This species is closely related to *S. catenula*, with which it agrees very nearly in its cirri and setæ. It is somewhat smaller and more slender. The most obvious difference is found in the œsophagus, which is much longer and more slender than that of the latter. It is straight and rather narrow, nearly cylindrical, with a basal swelling and an even, entire, expanded or flaring margin. Its tooth is very small, conic, close to the edge, or projecting a little beyond it. When extruded its base is at the 14th segment and its margin projects much beyond the head. The stomach is much shorter (about one-half as long), and occupies about 7 segments. It is cylindrical and has numerous regular rows of rounded groups of cells.

Length, 12^{mm}.

Syllis (Typosyllis) diplomorpha, sp. nov.

A large elongated species which produces *Tetraglene*-zooids by posterior fission. Proboscis pale colored, short, stout, shorter than stomach.

Head large, nearly as long as wide, narrowed behind middle, three-lobed anteriorly, broadly and strongly emarginate posteriorly (ratio in type 1:1.15). Eyes black, large, the anterior at least twice as large as the others and considerably farther apart, but only a little more in advance, the distance between the two about equal to the diameter of the anterior eyes; posterior eyes just behind bases of antennæ. Palpi divergent, large and broad, about as long as the head, lanceolate, obtuse, incurved on the inside. Tentacle long, $3\frac{1}{2}$ times as long as the head, regularly beaded. Antennæ similar, but shorter, about $2\frac{1}{2}$ times the length of the head; upper tentacular cirri about equal to the tentacle; lower equal to the antennæ. First and fourth dorsal cirri long, about $\frac{1}{3}$ longer than the upper tentacular cirri; 3d and 4th are somewhat shorter, about equal to the tentacle; farther back the dorsal cirri are shorter, more slender and tapered, and unequal, the longer ones in the middle of the body are about equal to $\frac{2}{3}$ the diameter of the corresponding segments; the shorter ones about half as long.

Setæ are long and abundant; the upper anterior ones have narrow lanceolate blades, 3 to 4 times as long as broad, with slightly bidentate tips; the lower ones are only about 2 times as long as broad, with incurved tips.

The œsophagus is stout and rather short, occupying 7 segments, cylindrical, about $\frac{1}{3}$ shorter than stomach and nearly as thick; it is unusually translucent, lacks the brown chitinous color seen in most species; its tooth is near the margin, which is not well defined, but seems to be entire. The stomach is long and thick, cylindrical, and occupies 9 segments; it is crossed by numerous crowded rows of rounded granules.

Color of type, in formalin, pale greenish brown, each anterior segment crossed by a pale narrow sutural line and sometimes by a darker brown middle line; posterior half of the body has a row of squarish spots along each side at the bases of the parapodia. Length, 30^{mm}; diameter, 1.5^{mm}.

The posterior end, in the type, is changed into a *Tetraglenezoïd*, back of the 110th setigerous segment. The new head has four very large and prominent black eyes with lens, but lacks all other appendages, the eyes are in contact on each side. There is no buccal segment, the first segment is very short and has setæ. All the 20 segments bear fascicles of long, slender capillary setæ, longer than the breadth of the body, and a smaller number of compound setæ. The dorsal cirri have been lost.

The parapodia are large and prominent, as long as half the breadth of the segments.

Syllis (Tetraglene), sp.

In a small collection of plankton, taken in the latter part of May, there are several specimens of a *Tetraglene* somewhat similar to the above, but evidently a distinct species.

The head is much shorter and smaller, with very much smaller, separated, light brown eyes. The body itself is larger and much stouter, with 24 crowded, broad segments and short, rounded parapodia. The dorsal cirri equal about $\frac{1}{4}$ the breadth of the segments, and are regularly beaded and tapered. The caudal cirri are not tapered, as long as the dorsal cirri, and strongly beaded with about 10 annuli, the distal beads are nearly round. Large fascicles of slender compound setæ are present on all the segments, with short terminal blades, $1\frac{1}{2}$ to 2 times as long as broad, part of them very minutely bidentate at tip. No capillary setæ are present on either specimen. A row of rather dark, round spots runs along each side, a spot being at the base of each parapodium.

Syllis (Chætosyllis), sp.

Several specimens of sexual zoöids with two antennæ, but otherwise like *Tetraglene*, were taken at the surface. They probably belong to some species of *Syllis*.

Syllis (Typosyllis) annularis, sp. nov.

A small species with long slender antennæ and dorsal cirri, banded with dark green, and with long fascicles of setæ, the posterior ones longer and stouter with short, strongly incurved, acute blades; œsophagus short, wide, brown, with a long acute tooth.

Head large, broader than long, widest at the front, opposite anterior eyes, narrowed backward; front margin broadly rounded; posterior margin broadly emarginate. Eyes not very large, pale brown, the anterior a little larger and separated from the posterior by a space equal to their diameter; a minute brown pigment speck at the base of each palpus may represent the third pair of eyes. Palpi large with broad swollen bases, rather longer than the head, abruptly narrowed on inside, at about the proximal third, blunt at tip.

Tentacle stout, a little tapered, about $\frac{1}{3}$ longer than the palpi, strongly annulated, with about 20 annuli; the distal ones longer than broad. Antennæ similar, a little shorter, the ends reaching to within two or three distal annuli of the tentacle tip. Upper tentacular cirri rather longer than tentacle, but of the same thickness; lower one somewhat shorter. First dorsal cirrus larger and about $\frac{1}{3}$ longer than tentacle, of about 38 annuli, the distal half a little stouter than the proximal; most of the cirri on the first eight segments are similar to those of the first, or even longer, or about $\frac{1}{3}$ longer than the breadth of the body; some still longer and more slender occur even back of the middle, composed of 48 to 52 annuli, with others about $\frac{2}{3}$ as long, of 38 annuli, but the shorter ones usually exceed the breadth of the body.

Setæ of anterior segments are in large fascicles of 5 to 10, all compound, but with about 3 stouter acicula that project but little or not at all; the upper setæ have narrow lanceolate, slightly curved blades, 6 to 7 times as long as wide, with minutely bidentate tips; the lower ones have wider and shorter blades, length to breadth about 3 or 4:1, with strongly incurved, acute, claw-like tips; posteriorly most of the setæ are longer with stouter stems, but the lower ones are shorter; there are about 6-8 in a fascicle, with two or three stouter spiniform acicula, projecting but little; the upper setæ

have stout curved blades, about 3 or 4 times as long as broad, with strongly incurved acute tips; the lower ones have shorter, much curved, acute, claw-like blades, 2 or 3 times as long as broad.

The œsophagus is brown, large, stout, nearly cylindrical, a little contracted at each end, about $\frac{1}{3}$ shorter than the stomach and $\frac{2}{3}$ as broad, occupying 9 segments; anterior margin is entire or feebly crenulate, a little emarginate dorsally; the median tooth is large, long, acute, with a wide ovate base. The stomach is large, longer than the œsophagus, occupying 8 segments, cylindrical, a little swollen posteriorly, covered with numerous interrupted, irregular, or poorly defined rows of minute cells, not arranged in very definite groups.

A caudal region of about 14 new and small segments is being regenerated on the type.

Length of one specimen (32 segments, caudal segments lacking), 7.5^{mm}; breadth, .75^{mm}; length of œsophagus, 1.38^{mm}; of stomach, 1.6^{mm}. Another specimen (type described) with 57 segments and partly regenerated caudal region is 14.5^{mm} long; 1^{mm} broad; length of œsophagus, 1.40^{mm}; of stomach, 1.60^{mm}.

Color, in formalin, is translucent whitish; the cirri appear distinctly banded with 8 to 10 small dark green spots, every fourth annulus having a very distinct, darkly pigmented area.

Rare—only two specimens were found.

Syllis (Typosyllis) cincinnata, sp. nov.

A strongly colored, rather large species, with numerous compact segments and a highly contractile body; when preserved in formalin usually coiled irregularly, thick and rounded anteriorly, with very short, closely contracted segments, short anterior parapodia; flattened and tapered posteriorly, with longer posterior segments and more prominent parapodia and setæ; antennæ and anterior cirri long, strongly beaded and irregularly curled about the head, so as to nearly conceal it; middle dorsal cirri mostly long, incurved over the back; œsophagus short with a very long tooth; stomach very long and large; blades of setæ mostly rather short, strongly incurved, the anterior ones mostly not bidentate at tip.

The head is small, wider than long, transversely broad-elliptical; buccal segment short. Eyes black, unequal, the anterior rather large and near the sides of the head; posterior ones about $\frac{1}{2}$ as large, separated by about their own diameter, and but little farther back, lens indistinct.

Palpi large, separate to base, longer than head, lanceolate when seen from above, with the inner edge incurved, tips blunt.

Tentacle long and large, the free part projecting twice as far as the palpi, composed of very numerous short annuli, 4 or 5 times broader than long. Antennæ similar, about $\frac{1}{3}$ shorter. Upper tentacular cirri similar, rather stouter and about as long; lower about $\frac{1}{3}$ shorter. Dorsal cirri of about 12 anterior segments are mostly even longer than the upper tentacular cirri, much curled in various directions over the head and back, equal in length to $1\frac{1}{4}$ to $1\frac{1}{2}$ or more times the breadth of the body; farther back in the gastric region they become unequal, some being about as long as the preceding, others only $\frac{1}{3}$ to $\frac{3}{4}$ the breadth of the body, usually recurved over the back; posteriorly most of them are less in length than $\frac{1}{2}$ the breadth of that part of the body. Caudal cirri long, slender, tapered. The anterior parapodia are short and crowded, posteriorly they become well separated and longer, with longer lobes and longer and stouter setæ.

Setæ of the anterior segments are 8 to 10 short and slender, accompanied by 3 or 4 acute acicula, which project but little; the blades of the upper anterior setæ are narrow-lanceolate, breadth to length about 1:4-6, with incurved acute tips, sometimes faintly bidentate; the lower ones have shorter blades, ratio 1:2 or 3, with more incurved acute tips; the posterior setæ have rather longer and stouter stems, with the blades shorter, wider, ratio 1:2 to $3\frac{1}{2}$, and with more incurved tips, a few of which are minutely bidentate; there are usually 5 or 6 in a fascicle; the stem is serrulate near the tip; they are usually accompanied by two large, straight, acute acicula.

Œsophagus brown, rather short, thick, in the contracted specimens so bent and crumpled that the length cannot be correctly determined; median tooth large, projecting beyond the margin, the free part equal to the length of two segments, long-conic, acute. Stomach long and rather large, nearly cylindrical, occupying 17 segments, covered by about 36 regular rows of well-separated, small, elliptical groups of cells, with definite lines between the rows.

Color, in formalin, is dull greenish with transverse lines of a darker green on each segment and a dark median dorsal stripe along the back.

Length of largest preserved specimen, 18^{mm}; diameter anteriorly, 1.20 to 1.40^{mm}.

Found among the zoöids of *Polythoa mammillosa* at low tide.

In life the head and anterior part of the body were noted as tinged with orange-red, the head brightest red; eyes orange; posterior

segments dark olive-green ; caudal segments and cirri pink. Some specimens were forming two sexual zooids at the same time (these were not found in the preserved collection). Two or more species were confused in this lot.

Another specimen (No. 12), supposed at the time to be the same, was described when living, as translucent whitish anteriorly, light green posteriorly ; the sexual zooid was pink and had conspicuous eyes and numerous segments, which were broader than those of the stem-form. This is probably a distinct species, for the œsophagus appears to have a crenulate margin and the median tooth is much smaller.

Syllis (Typosyllis) cincinnata. (Stem-form, with a sexual Zooid.)

One specimen, in formalin, has part of the dorsal cirri replaced by a thick, ovate pigmented body, with a small terminal papilla, perhaps due to disease. This specimen has a zooid-head forming at about the 28th segment, with two small brown eyes developed, but special antennæ and cirri are not present, nor any capillary setæ. About 50 segments follow this head. In other respects this individual agrees closely with the type-form described above.

Syllis (Ehlersia) exigua, n. sp.

In addition to the various species described above, a small and very slender or attenuated species was noted, but not fully described. The single specimen is poorly preserved. It is remarkable for the unusually elongated segments. Its generic characters are somewhat doubtful.

The body is composed of about 50 setigerous segments. Head rather broad ; palpi short ovate ; eyes 6, the four posterior, which are nearly equal, form a trapeze ; the anterior are smaller and nearer together. The antennæ, tentacular cirri, and anterior dorsal cirri are all similar, long and slender with numerous rounded beads ; the dorsal cirri of the middle segments are also long, often twice as long as the diameter of the body ; posteriorly they become shorter.

Stomach is short, elliptical, as broad as long, occupying about 2 segments.

The setæ are long and slender ; in the anterior 10 segments the upper ones have very long, thin blades, ratio, 1:8-1:10, the lower ones have the blades about half as long, all feebly bidentate at tip ; farther back the blades of the upper ones become shorter ; on the posterior segments decidedly so. In each fascicle, there is usually a

single, slender, acute, simple seta, and one spiniform aciculum, often bent at top.

Length, 10^{mm}; diameter, 3^{mm}.

Syllis (Ehlersia) nitida, sp. nov.

A small slender species with the dorsal cirri and cephalic appendages slender and beaded with rounded annuli, mostly 10–14, and in length generally $\frac{2}{3}$ to $\frac{9}{10}$ the diameter of the body, referred to the subgenus *Ehlersia* because the upper compound setæ have long linear blades, very unlike the lower ones.

Head transversely elliptical, considerably broader than long, distinctly three-lobed in front; posterior margin broadly rounded, eyes 6, black; two posterior pairs, which form a short trapeze, are small, nearly equal; a pair of minute front eyes at bases of the palpi. The palpi are large, broad-ovate, obtuse, rather longer than the head. Tentacle, with about 11 regular rounded beads, is rather longer than the palpi. Antennæ are similar, but shorter, with about 9 beads. Upper tentacular cirri are a little longer than the tentacle; lower ones much shorter.

The dorsal cirri are all similar and vary but little in length, the largest ones being those along the middle of the body, where some of them are about as long as the diameter of the body and composed of 12–14 beads; they are slender and tapered, and very regularly beaded with rounded annuli, mostly about as long as broad; the shorter ones are from $\frac{1}{2}$ to $\frac{2}{3}$ the diameter of the body, and with about 8 beads. The anterior dorsal cirri are about equal to the upper tentacular cirri, and have about 12 beads.

Setæ are all compound anteriorly, slender, rather numerous; 1 or 2 upper ones, all along the body, have long, slender, linear, nearly straight blades with incurved tips, ratios 1:10–15, becoming longer posteriorly; the lower ones have much shorter lanceolate blades, ratios 1:3–4; there is no gradation between the two sorts. Back of the middle the setæ become larger and more differentiated; the blades of the lower ones are bidentate.

Posteriorly there are usually two spiniform acute acicula, one of which projects considerably.

The œsophagus is long and slender, about twice as long as the stomach; its tooth is small, conic, close to the margin; the edge is indistinct, but appears to be finely denticulated. The stomach is narrow-cylindric, covered with many very close rows of glands. Color, in formalin, plain yellowish white. Length, 5^{mm}; diameter, about 4^{mm}. Only one specimen was taken.

Haplosyllis Langerhans.

Zeitsch. Wissenschaft. Zoöl., xxxii, p. 527, 1879.

This group was made a subgenus of *Syllis* by Langerhans, but it seems to differ sufficiently from that genus to justify its generic separation.

The special character, mentioned by Langerhans, is the presence of simple setæ alone, on all the segments. "Setæ all simple." In our species the shortness and paucity of the setæ are equally noteworthy, for there are usually only one or two short setæ, with a single hooked aciculum, in each fascicle. The simple bidentate setæ have the structure and nearly the form of the stem or shaft of the ordinary form of the compound setæ of *Syllis*, indicating that they are merely such setæ that have lost, or else have not developed, the blade. They are unlike the bifid setæ of *Eusyllis viridula*, which seem to be formed by the consolidation of a short angular blade with the shaft.

Our species of *Haplosyllis* also have the edge of the œsophagus denticulated, nearly as in *Eusyllis*. So that the group appears to be allied to the latter more than to *Syllis*.

The typical genus *Syllis*, as restricted by Langerhans, has simple setæ anteriorly or medially and compound setæ posteriorly. *Typosyllis* has them all compound, or with compound ones on all the segments.

Haplosyllis cephalata, sp. nov.

A small and rather stout species, appearing stouter anteriorly, owing to the prominent head and unusually large palpi; eyes small, black; a few longer anterior cirri; those on most of the body very short, composed of few annuli; setæ simple, bidentate, very few; œsophagus rather short, with a median anterior tooth.

Head thick and convex above, elliptical in outline, widest about the middle, with a slight median lobe anteriorly; posterior edge slightly emarginate. Eyes unusually small, round, black, arranged in a trapeze; the posterior pair are rather small and separated from the anterior by a space equal to 3 or 4 times their diameter.

Palpi very large, wider than the head, ovate, not excavate on the inner margin, obtuse at the end; the exposed part longer than the head, scarcely divergent, but often strongly curved downward in the preserved specimens, with their bases overlapping each other. Tentacle and antennæ long and slender, strongly beaded; the tentacle projects considerably beyond the ends of the palpi; the anten-

næ are shorter, only projecting a little beyond the palpi. The upper tentacular cirri are similar to the tentacle and of about the same length. The lower ones are about $\frac{1}{3}$ shorter.

The 1st dorsal cirrus is similar to the upper tentacular cirrus, but longer. The 2d is very much shorter, and the succeeding ones rapidly decrease in length, those beyond the gastric region being only $\frac{1}{5}$ to $\frac{1}{6}$ as long as the diameter of the body, or even less, and consisting of only a few annuli (often only 3 or 4) and scarcely longer than the parapodia.

Setæ very few; anteriorly there are usually 1 or 2 rather strong simple bidentate setæ and one acute aciculum, which rarely projects; posteriorly there is generally only one bidentate setæ, which is longer and larger than the anterior, and a single aciculum, which often has a bent, hook-like tip. No blades were found on any of the setæ of numerous specimens examined. The bidentate setæ, which correspond to the stems of compound setæ, have a simple, incurved or slightly hooked tip, with a strong triangular tooth below it, the intervening space being concave and oblique. Possibly a blade may be present in the very young. The anterior parapodia are short; the posterior ones become more elongated.

The œsophagus is rather short and wide, pigmented with opaque green, so that its form is not easily seen; median tooth near the edge, acute conical, its end projecting beyond the aperture; margin incurved and usually indistinct, but minutely denticulate, at least in some cases. Soft pharynx with about 10 rounded lobes. Stomach barrel-shaped, usually a little shorter and not much thicker than the œsophagus, opaque, the rows of glands poorly defined; sometimes the stomach and œsophagus are about equal in length, or the stomach may be the longer, owing to the frequently crumpled and contracted condition of the œsophagus.

Color, in formalin, is yellowish white; the tissues are more opaque than in most species. Length, 4 to 6^{mm}; diameter, .5 to .6^{mm}.

Taken in large numbers on one occasion. It inhabits sponges.

Easily distinguished from the young of other species by the large palpi, head, and anterior segments, and the extreme shortness of all the cirri, except those of the head and first segment. The small number of the setæ and their peculiar tips are also characteristic.

This is allied to *H. hamata* of Europe and Madeira, which has the tips of the simple setæ trifid, and to *H. tentaculata* (Mar. 1879, as *S. spongicola*, var.), which has much longer cirri and trifid setæ.

H. streptocephala (Erst and Grubé), from St. Croix, has longer cirri.

Haplosyllis palpata, sp. nov.

An elongated, slender, somewhat larger species, with large palpi and longer dorsal cirri and setæ than those of *P. cephalata*. The head and antennæ are nearly as in the latter; the palpi are very large and thick, subovate; the body has more numerous and more distinct segments. The dorsal cirri are unequal, but the longer ones, along most of the body, have about 9 or 10 rounded annuli, about as long as broad, and in length are equal to about $\frac{1}{2}$ the diameter of the body. The setæ consist of two or three simple, strongly bidentate setæ, similar to those of the preceding species, but larger and longer, and of one or two acicula, one of which has a small bent tip. The œsophagus is rather long, tubular; its margin is indistinct, but seems to be entire; the tooth is small. *H. Setubalensis* (McInt.) (as *Syllis*) resembles this species in the character of its setæ.

Trypanosyllis attenuata, sp. nov.

Body very long and slender, composed of a large number of rather elongated segments. Cirri all moderately long and strongly beaded with rounded annuli.

Setæ numerous, all compound with rather long narrow blades.

Head about as long as broad, well rounded and slightly three-lobed in front and nearly truncate posteriorly. Eyes 4, small, black, in trapeze, the anterior ones a little larger and situated much behind the middle of the head, at about the posterior third, separated from the posterior by a distance equal to about four diameters of the latter. Palpi large and broad, wider at base than the head, separate to the base, divergent, thick at the base and incurved on the inner margin, very obtuse at the end.

Antennæ and tentacle are gone; upper tentacular cirrus long and slender, composed of about 17 rounded annuli; first dorsal cirrus considerably longer, with about 24 annuli. Succeeding dorsal cirri are all much shorter and somewhat unequal, the longer ones being about as long as the diameter of the body, and composed of 12-14 rounded annuli, mostly about as long as broad, or a little longer distally; the shorter cirri are about $\frac{3}{4}$ as long. Similar cirri continue to the end of the body, gradually decreasing in size.

The caudal cirri are long and slender, their length being equal to the diameter of the body in its middle, composed of about 13 annuli, which are mostly longer than broad.

The setæ are numerous and slender, about 10-12 compound ones in the anterior fascicles, with three or four small slender acicula that do not project. The blades of the upper setæ are narrow and nearly

straight, ratio about 1:6-9, with the tips very minutely bidentate and slightly incurved; the lower ones are shorter, ratio about 1:4-5, but of the same form. Posteriorly they become larger and longer, with stouter stems, usually 5 or 6 in a fascicle, and the blades are somewhat broader and more distinctly bidentate at tip, but the change is very gradual.

The œsophagus is very long and slender, straight, occupying 17 or 18 segments; its edge is divided into a circle of about 10 rounded or obtuse scallops; median tooth small, close to the edge; soft pharynx, when extended, elongated, its margin with about 10 large rounded lobes, longer than broad, the seven upper ones longer than the lower. The stomach is small, oblong-elliptical, occupying 4 segments; it is covered by about 26 rows of small cell clusters.

Color, in formalin, yellowish white; œsophagus and stomach pale.

Length, about 16^{mm}; diameter, .25 to .30^{mm}.

Dredged off Bailey Bay, in 5-6 fathoms, shell-sand.

Typanosyllis fertilis, sp. nov.

A species of medium size, with a large and broad head and wide palpi; rather long, strongly beaded dorsal cirri; numerous and long setæ, the posterior ones decidedly longer and stouter than the anterior, with a short, wide, distinctly bidentate blade. The female has the posterior half of the body distended with large polygonal eggs, but has no special sexual setæ.

Head unusually large and wide, broader than long, with the sides very prominent and convex behind the eyes, concave farther back; front edge prominent, three-lobed; posterior margin narrow, emarginate. Eyes of moderate size, brown, the anterior a little larger, farther forward and farther apart, distant from the posterior by 3 or 4 diameters. Palpi large and broad, their bases rather wider than the head, their free part about equal to the length of the head, broad-ovate, blunt, the inner edge concave. Tentacle slightly tapered, strongly beaded, composed of 16 annuli, the free part about twice as long as the palpi; distal annuli about 1½ times wider than long, the middle ones about ½ as long as wide. Antennæ similar but shorter, only their two distal annuli extending beyond the palpi. Upper tentacular cirri similar to the tentacle and of the same length, consisting of 15 annuli; lower ones about ½ as long. Dorsal cirri on several (about 12) anterior segments mostly similar to the tentacle, but ¼ to ⅓ longer, and are equal to or considerably exceed the diameter of the adjacent segments. Along the rest of the body the dorsal

cirri are more unequal, but the larger ones are longer than those of the anterior segments, composed of 18 or 19 annuli, and often exceed the diameter of the body by $\frac{1}{2}$ of their length; the shorter ones are about $\frac{2}{3}$ as long with 14 or 15 annuli.

The setæ of the anterior parapodia are numerous, long and slender, with delicate narrow-lanceolate blades, slightly bidentate at tip, the upper ones longer, breadth to length about 1 : 4 or 5, in the lower ones about 1 : 3 or 4. In the anterior parapodia there are also 3 or 4 slender acute acicula, side by side, but usually not projecting. Posteriorly the compound setæ become longer and slender, 7-9 in a fascicle, with larger and shorter blades, ratio as 1 : $1\frac{1}{2}$ - $2\frac{1}{2}$, with the tips strongly incurved and distinctly bidentate. These are accompanied by 2 or 3 stouter spiniform acicula, one of which usually has the tip somewhat hook-shaped.

In the type the segments, commencing somewhat forward of the middle, from about the 33d segment, are crowded with ripe eggs, which are polygonal from pressure.

Œsophagus brown, rather long and large, occupying 7 segments, cylindrical, with a short stout tooth near the margin; edge divided into about 10 rounded lobes or scallops, recurved when extended. Soft pharynx with about 10 low, broad, rounded lobes.

The stomach is light greenish, deeply pigmented, and opaque, nearly $\frac{1}{2}$ as long as the œsophagus and more than twice as thick, occupying 5 segments, somewhat barrel-shaped, or elliptical, widest posteriorly and covered with an alveolar arrangement of polygonal glands separated by narrow dark lines so as to have a honey-comb-like appearance externally, unlike that of other species.

Color of the preserved specimens is plain yellowish-white.

Length of type, about 24^{mm} (caudal segments gone); diameter .6^{mm}.

This appears to be a species that does not produce special sexual zoöids. The large size and form of the head; the character of the setæ; and the alveolar surface of the stomach, are its most notable diagnostic characters. It appears to be rare.

Trypanosyllis tenella, sp. nov.

A small, slender species, with long beaded cirri, which is doubtfully referred to this genus on account of the strongly denticulated or scalloped margin of the œsophagus; in most other respects it closely resembles the young of *Syllis corallicola* and *S. catenula*, but it has a narrow stomach and the setæ are more bidentate, at tip.

Head small, the anterior portion nearly semicircular, deeply emarginate or cordate behind, well rounded in front, but with a slight median lobe, sides evenly rounded, most convex opposite the eyes, which are about equal, rather small, black, arranged in a short trapeze, the distance between the anterior and posterior about equal to two diameters; a pair of minute black ocelli at the anterior margin in front of the antennæ.

Palpi large and long, lanceolate, regularly tapered, longer than the head, obtuse. Tentacle shorter than the antennæ, of 8 annuli, equal to the palpi, tapered, its distal annuli longer than broad. Antennæ similar, but about $\frac{1}{4}$ longer, of 13 annuli, about 3 or 4 distal annuli projecting beyond the palpi. Tentacular cirri long and slender with rounded annuli, about as long as broad; upper ones, with 18 annuli, are longer than the antennæ, lower ones about $\frac{2}{3}$ as long. Dorsal cirri of segments 1, 3, 4, 6, and many others are longer than the tentacular cirri, composed of 22–28 annuli, and about twice as long as the diameter of the body; shorter ones irregularly alternating are $\frac{1}{2}$ to $\frac{2}{3}$ as long. Caudal cirri long and slender, tapered, similar to the longer dorsal cirri.

Setæ rather numerous, long and slender, all compound and similar; the upper anterior ones have slender lanceolate blades with bidentate tips, ratio about as 1:4 or 5; of the lower ones about 1:3 or 4. Posteriorly the blades are shorter and the tips are more incurved and more strongly bidentate, with the denticles divergent, ratio about 1:2–2 $\frac{1}{2}$; these are usually accompanied by 1 or 2 rather stouter spiniform acicula, with the tips slightly projecting, that of one usually somewhat hooked, the other only a little bent.

The œsophagus is rather long, occupying 8 segments, but not slender, wrinkled transversely in the type and somewhat contracted at each end; its margin is emarginate on each side and is divided into a number of rather small, not very regular, obtuse denticles or scallops; the tooth is close to the edge and rather small; the soft pharynx is divided into a circle of rounded lobes. The stomach is elongated, narrow, cylindric, occupying 8 segments, about equal in length to the œsophagus, and not much larger; its surface is covered with 50 to 55 close rows of opaque cell-groups?. Color, in formalin, plain yellowish white. Length, about 11^{mm}; diameter, .6^{mm}.

This species is very distinct from *T. vittigera* Ehlers, which is a large brownish species conspicuously marked by two transverse, narrow, white bands on each segment, and with the denticles of the œsophagus large and subtruncate. The setæ have short, bidentate blades. The latter was taken by us in considerable numbers.

T. gigantea McInt. (Chall. Voy.) as *Syllis*, appears to be closely allied to this last species.

Hemisyllis, gen. nov.

Similar to *Eusyllis*, but with the large palpi united together for about half their length in front of the head. Antennæ, tentacle, and anterior cirri long and beaded, as in *Syllis*; œsophagus straight, with the front edge serrulate; median tooth submarginal. Setæ few and simple, bidentate, without blades.

Hemisyllis dispar, sp. nov.

A small species with broad head and palpi, the lobes of the palpi projecting forward from the swollen common base which looks like a part of the head.

Head large and broad, the anterior half nearly semicircular; the front margin well rounded, apparently coalescent with the palpi in the middle; sides most prominent posterior to the eyes; posterior margin broadly convex. Eyes 4, small, black, in a trapeze, the anterior larger, not very close to the sides of the head; the posterior are very small, separated by about 4 diameters from the anterior ones. Palpi very large and wide, their bases thick and swollen, united together for about half their length, the front edge of the common base convex between the separated free lobes, which are narrow-ovate and obtuse.

Tentacle, antennæ, and all cirri are all similar in form, tapered and strongly beaded with rounded annuli, which on the middle and distal parts are as long as wide, or even longer than wide, and elliptical toward the end. The tentacle has about 20 beads and is about as long as the head and palpi combined; the antennæ are rather shorter, with 18 beads. The upper tentacular cirri are longer and rather stouter, with about 20 beads; the lower are about $\frac{2}{3}$ as long. The first dorsal cirrus is longer than the tentacular cirrus and has about 22 beads; its length is about $1\frac{1}{2}$ times the breadth of the segment; second cirrus is about $\frac{1}{3}$ as long, with 9 beads; third and fourth are rather longer than the second, with 14 beads; farther back they decrease rapidly, so that back of the stomach most of them are quite short, mostly with only 2-4 beads. The ventral cirrus is papilliform. Caudal end is lacking.

The setæ are few, small, and short; in the anterior region there is, in each fascicle, only 1 small bidentate seta (without blade, in the type), and 1 slender aciculum, with a small hooked tip, scarcely projecting.

The œsophagus is long and slender, occupying 7 segments; its edge is denticulated with small, unequal, acute teeth; median tooth

is small, close to the margin. The stomach is large, in length about equal to the œsophagus, long-elliptical, occupying 6 segments; it is covered with about 38 crowded rows of small, dark, round or elliptical glands. Color, yellowish white. Diameter of the type, .4^{mm}; the posterior half is lacking. Only one specimen was found.

Opisthosyllis Langerhans, op. cit., p. 541, 1879.

Palpi, body-segments, setæ, and cirri as in *Syllis* (*Typosyllis*). Œsophagus large and rather short, cylindrical, with the anterior margin entire; median tooth near the posterior end. Stomach large, its glands very distinct. Head pyriform, widest in front; palpi long and divergent. Buccal segment forms a collar.

Opisthosyllis nuchalis, sp. nov.

A large elongated species with numerous rather long, beaded cirri. Œsophagus large, showing as a conspicuous, brown, oblong patch on the back of the anterior segments.

Head pyriform, widest close to the anterior margin, which is truncate or slightly emarginate in the middle and on either side, so that it is slightly four-lobed; the sides are convex, narrowing backward, the posterior end narrow with a small emargination between two angular lobes. Eyes yellowish brown, small, nearly equal, prominent, with a convex lens; the anterior are wider apart, the four forming a trapeze. Palpi large, divergent, longer than the head, lanceolate, the distal half rapidly tapered, tips subacute, inner margins excavated.

The buccal segment is transversely narrow, and its anterior edge is extended forward as a rather broad, thin collar, conspicuous on the sides, where it extends as far forward as the anterior eyes and almost to the bases of the palpi, but receding dorsally, so as to expose the posterior eyes. The first and second setigerous segments are a little wider than the buccal and the breadth of the body suddenly increases at the third segment, where the end of the œsophagus is situated in the type specimen, but this is probably due, in part at least, to the pressure used in mounting it.

Tentacle and antennæ are slender, tapered, strongly beaded with small annuli, the distal ones are as long as broad, the proximal short and indistinct; the tentacle is considerably longer than the palpi, and contains about 24 annuli; the antennæ are but little longer than the palpi. Upper tentacular cirri are larger and about $\frac{1}{3}$ longer than

the tentacle, or about twice as long as the breadth of the buccal segment; lower ones about $\frac{1}{3}$ shorter. The first dorsal cirrus and most of the others on the anterior half of the body are longer than the upper tentacular cirrus and contain 36-40 annuli; these long cirri are regularly tapered, more or less curled, regularly beaded distally, and equal or somewhat exceed the diameter of the body. Others not more than half as long occur irregularly.

Setæ are all similar, long and numerous, 8-10 in a fascicle, larger than usual in this family, with rather short, wide blades, the ratio of width to length about as 1 : $2\frac{1}{2}$ - $3\frac{1}{2}$; their tips strongly incurved, simple and acute. The posterior setæ and acicula are rather larger and longer than the anterior, but similar in form; two acicula, larger and more yellow than the setæ, occur in most fascicles; their tips are a little blunt or enlarged, and seldom project. Posteriorly there are often one or two simple acute setæ. The stems of the compound setæ are very oblique at the enlarged end, and have a rounded lobe just below the tip, on the outside.

The œsophagus is deep brown, as wide as the stomach and $\frac{2}{3}$ to $\frac{3}{4}$ as long, nearly cylindrical, but usually a little swollen in the middle and slightly contracted posteriorly. Its aperture is wide and nearly even, with a narrowly revolute entire margin. There is no anterior armature, but a small, rounded, highly refracting spot near the posterior end indicates the existence there of a posterior tooth, which bends inward and forward, with an acute tip, the base being much wider than the tooth itself.

The stomach is large and long, occupying about 12 segments, cylindrical, pale colored, covered with very distinct and well-separated roundish or elliptical groups of greenish glandular cells, arranged in about 70 pretty regular rows; on the posterior half a whitish line ususally runs along the middle of each row, so as to divide the most of the groups of cells into two nearly equal parts; anteriorly this line, or membrane, runs between the rows. Each glandular cluster seems to rise, with a narrow stem, from the center of a whitish, square or polygonal area, bounded by fine lines. They are arranged so regularly in quincunx that when not much magnified they have a tessellated appearance. Seen in profile the glandular groups are long-pyriform, with a narrow base. Other small irregular groups are scattered between the regular rows.

The color of the type specimens, in formalin, is yellowish white, with a dark brown oblong spot anteriorly, due to the œsophagus.

Length of the larger specimens, 20 to 25^{mm}; diameter, 1.4 to 1.6^{mm}.

In dead corals from the reefs.

Var. ? *gularis*.

One specimen, differently preserved, and much contracted, is rather deeply tinged with green, and has a narrow dark line across the front part of the anterior segments, and pale sutural lines; there is also a dark median stripe posteriorly. This was one of the specimens mixed with *Syllis cincinnata* and noted, in life, as having the anterior parts orange-red and the posterior olive-green (see page 610).

This may, perhaps, be an additional species of *Opisthosyllis*.

The posterior tooth of the œsophagus is more distinct. The stomach is much like that of the type described above. The cirri and antennæ are shorter and more curled, the longer ones about $\frac{1}{2}$ the diameter of the body, but the entire body and the appendages are much contracted.

The anterior setæ are fewer, stouter, and longer than in the type of *nuchalis*, especially the upper ones, on which the blades are shorter and wider, with incurved tips, which are not bidentate.

The posterior setæ are decidedly longer and stouter than the anterior, with very oblique, shorter incurved blades, all with acute tips. Two stout acute acicula occur in the posterior fascicles; three in the anterior.

Length, as contracted, 10.5^{mm}; diameter, 1.2^{mm}; much longer in life.

Bailey Bay, at low-tide, in *Palythoa*.

Eusyllis (Synsyllis) viridula, sp. nov.

A small, very slender, pale green syllid with short, slender dorsal cirri scarcely longer than the breadth of the body; œsophagus long, slender, with the margin minutely denticulated; stomach long; palpi rather short.

The head is transversely elliptical, with the middle of the front margin slightly prominent and the posterior margin a little emarginate. Eyes small, light brown.

Palpi separate to base, nearly regularly broad-ovate, about as long as the head, obtusely rounded at the end and not concave on the inner margin.

The antennæ are scarcely tapered, rather short, about equal to the breadth of the head, projecting somewhat beyond the palpi, consisting of about 9 annuli, the distal ones well defined. The upper tentacular cirri are about $\frac{1}{3}$ longer and rather stouter; the lower ones are about equal to the antennæ in size and length.

The dorsal cirri on segments 1-4 are rather more slender than the upper tentacular cirri but of about the same length and about equal

to the breadth of the body, with well-defined annuli, those on the distal portion being rather longer than broad. Farther back the cirri gradually become shorter and more slender, but unequally so, longer and shorter ones often alternating, the longer ones scarcely equal to $\frac{3}{4}$ the breadth of the body, composed of about 12 annuli, the shorter about half as long. Back of the gastric region the cirri become shorter and more nearly alike, equal to about $\frac{1}{3}$ to $\frac{1}{4}$ the breadth of the adjacent segments, composed of 6 to 8 annuli, tapered, and subacute. The ventral cirri are ovate, nearly as long as the setigerous lobes. The parapodia are large and the segments are rounded and separated by well marked constrictions.

The setæ are few; in the anterior fascicles there are usually 4 or 5, all compound, with slender stems; the upper ones have slender lanceolate blades, 4-6 times as long as wide; the lower ones have shorter blades, 2-2 $\frac{1}{2}$ times as long as wide; the tips are incurved and most of them are very minutely bidentate. One or two slender subacute acicula are usually present, but they rarely project beyond the ends of the parapodia. Posterior to the stomach the setæ are reduced to 2 or 3 long compound ones, with very short blades; from segments 20-22 they are replaced by 1 or 2 simple bidentate setæ or crotchets, but compound setæ may have existed on the lost caudal segments; the posterior setæ are much longer than the anterior, with a much stouter stem, terminating in a bifid or two-pronged tip, evidently due to the consolidation of a short blade with the stem. There are usually two stout acicula, one with a blunt tip and the other hooked.

The œsophagus is very long and slender, occupying about 12 segments; it has a bulbous swelling a little back of the anterior end; the margin is a little emarginate, with the dorsal side longer; the edge is finely denticulated; the tooth is large and elongated, acuminate, with a sharp tip which projects beyond the edge. The stomach is nearly opaque, whitish, rather long and thick, occupying 6 segments. It is covered with about 38 rows of distinct rounded groups, separated by definite narrow lines of green cells, which unite in the median line to form a row of angular groups.

The color in formalin is pale green with a darker green line across the middle of each anterior segment, above; stomach opaque, whitish.

Length of the type, without caudal segments, 15^{mm}; diameter, .5^{mm}.

***Eusyllis (Synsyllis) longigularis*, sp. nov.**

Body long and slender with short dorsal cirri, and a long slender œsophagus, minutely denticulate at the margin. Head small, rather

wider than long, and slightly trilobed anteriorly, emarginate posteriorly. Eyes small, black, the anterior ones a little larger and farther apart. Palpi large, divergent, the free part rather longer than head, the inner margin concave, tips obtuse. Tentacle slender, tapered, rather short, extending about to ends of palpi. Antennæ tapered, somewhat shorter and smaller, distinctly beaded, with 8 to 10 annuli. Upper tentacular cirrus similar in form, about twice as long as tentacle, with about 15 annuli; lower one smaller, about $\frac{1}{2}$ as long, with 8-10 annuli. The first and some of the other dorsal cirri are as long as, or longer than, the dorsal tentacular cirri, and equal to about twice the breadth of the first segment. In the type longer cirri occur on segments 1, 2, 4, 6; shorter ones on 3, 5, 7, 8. Farther back the longer dorsal cirri are mostly less than the diameter of the body, and on the posterior half they are equal to about $\frac{1}{2}$ the diameter of the corresponding segments. They are all tapered and neatly beaded. Caudal cirri larger than the adjacent dorsal cirri and twice as long.

The anterior setæ, 5-7 in a group, have the blade narrow, nearly straight, 3 to $3\frac{1}{2}$ times as long as broad; shorter below and on the more posterior segments; the tips minutely bidentate. Setæ beyond the 20th segment are reduced to 2 or 3 in each fascicle, much longer and stouter than the anterior ones and about equal to the dorsal cirri; the longer one is a two-pronged crotchet; on the compound ones the blades are short, ratios $1:1\frac{1}{4}$ - $1\frac{3}{4}$, the tips bidentate; on the last 10 segments the setæ are all compound. They are accompanied by 1 or 2 spiniform acicula.

The œsophagus is brown, very long and slender, occupying about 13 segments; its tooth is near the front margin, which is unevenly finely serrulate with about 16 denticles. The stomach is narrow, cylindrical, rather short, occupying about $5\frac{1}{2}$ segments,* with many crowded rows of small cell-groups and a median sulcus. Color, yellowish white. Length, in formalin, about 15^{mm} ; diameter, $.5^{\text{mm}}$.

***Branchiosyllis lamellifera*, sp. nov.**

A small greenish syllid with compact segments, wide truncated head, blunt falcate palpi, beaded dorsal cirri, and large parapodia, having a leaf-like gill on their anterior side. Setæ with short blades.

Head large, broader than long, widest near the front; the anterior margin nearly straight, but has a small rounded lobe in the middle;

* The number of segments occupied by the stomach or œsophagus varies considerably in all the species, owing to the great contractility of the segments. It is a character of some value, however, if taken relatively.

sides rounded, but narrowing backward, posterior margin cordate-emarginate in the middle. Eyes 4, rather large, nearly black, placed in advance of the middle, nearly in a transverse row, the posterior ones being $\frac{1}{3}$ smaller and a little farther back, distant less than their diameter from the others. Palpi broad, obtuse, with the inner edge incurved and the ends usually bent downward, the free part about as long as the head.

The tentacle is short, tapered, scarcely longer than head, reaching but little beyond the ends of the palpi, basal part not beaded, the two or three distal beads more evident. Antennæ like the tentacle, but shorter.

Tentacular cirri are large, but not very long, scarcely tapered; the upper one is about $\frac{1}{3}$ longer than the lower, composed of 14 annuli, the distal ones being nearly as long as broad, and separated by deep constrictions. The first dorsal cirrus is similar to, and about $\frac{1}{5}$ longer than the upper tentacular cirrus, or about $1\frac{1}{2}$ times longer than the diameter of its segment; the second is less than $\frac{1}{3}$ as long; the third is longer than the first. Farther back the cirri are variable in length, part of them being rather longer than the breadth of the body and others not half as long, of about 10-12 annuli. The parapodia are large and prominent; the setigerous lobe terminates in two small papillæ; the ventral cirrus is stout and nearly as long as the setigerous lobe.

The gill is present on all the segments; beginning as a small rounded lobe anteriorly, it increases to an ovate form a little farther back; along the middle region of the body it becomes much larger, broad, foliaceous, with three or sometimes four lobes, becoming more simple and smaller posteriorly. The larger ones are as long as the thickness of the parapodia and considerably wider.

Setæ are large and long. The compound ones, of which there are usually 2 to 4, have a small and short incurved blade, wider at base, with an acute, hook-like tip; the length is about equal to the breadth. With these there are one or two somewhat stouter, acute acicula, with the tips slightly bent and projecting but little or not at all beyond the setigerous lobes.

The œsophagus is small, cylindrical, short, occupying 5 or 6 segments, light colored, cylindrical, with a stout, conical tooth near the dorsal edge; the margin is indistinct, but appears to be finely irregularly denticulated. The stomach is thick, pale in color, and slightly longer than the œsophagus, occupying 6 segments.

Color, in formalin, light green, with indication of a broad, darker greenish band across each segment; in one specimen there is a pale line between the segments and a row of darker roundish spots with pale centers along each side; the gills were apparently dark green. The color in life was not noted.

Rare, only three specimens seen, none perfect.

It is closely related to *B. oculata* Ehlers, from Florida, described from a single small, imperfect specimen, but the latter has smaller and shorter simple gills, and a differently shaped head.

***Desmosyllis longisetosa*, sp. nov.** (See p. 635.)

A small, slender, 6-eyed species with long, well-beaded antennæ and dorsal cirri; setæ of two kinds, compound and simple; the upper anterior have long, slender, acute blades.

Head broader than long, widest in front of middle, with the posterior border emarginate and the front with a medial lobe. Palpi short and broad, oblong ovate, united for about $\frac{1}{3}$ their length, wider than the head and about as long. The four larger eyes are black and conspicuous, though small, the anterior are a little larger and much farther apart, though only a little farther forward; the third pair are minute, situated at the bases of the antennæ. The tentacle is large and long, 5 or 6 times as long as the head, composed of about 28 annuli, of which 23 are beyond the ends of the palpi; the annuli are mostly about $1\frac{1}{2}$ times wider than long, but the distal ones are about as long as broad, elliptical, with deep constrictions between.

The antennæ are similar and nearly as stout as the tentacle and about $\frac{3}{4}$ as long, with about 24 beads. The upper tentacular cirri are like the tentacle and longer, projecting forward nearly as far; the lower ones are about half as long. The dorsal cirri are all long and strongly beaded, but those of the first 10 segments are particularly long, some of them being nearly twice the length of the upper tentacular cirri and 5 or more times as long as the diameter of the body, with about 38 annuli; those left near the posterior end are about 4 times the diameter of the corresponding segment, but most are lost posteriorly.

Ventral cirri slender, tapered, nearly as long as the setigerous lobes. Setæ are numerous and long; those of the anterior fascicles have the free part longer than half the diameter of the body; the posterior are equal to the breadth of the corresponding segments; the upper anterior setæ have long, narrow, straight blades, 8-10 times as long as wide, with the tip incurved and faintly bidentate; the

lower ones have the blades only 4 to 6 times as long as wide; the posterior fascicles have numerous similar compound setæ and also one slender, acute, simple straight seta, usually rather shorter than the rest; a smaller simple seta occurs in many anterior fascicles.

The œsophagus is short, with a median tooth, but its margin could not be distinctly seen. The stomach is short, occupying about 6 segments, strongly elliptical, covered with regular rows of squarish cell-clusters.

***Odontosyllis enopla*, sp. nov.**

A large species with a dark brown, wide, short œsophagus, armed with a ventral row of six stout, recurved, hook-like teeth anteriorly, besides the median dorsal tooth.

Head large, broader than long, broadly rounded in front and on the sides; posteriorly with two rounded lobes, separated by a small median emargination. Eyes black, unequal, the anterior ones much the larger, reniform; those of each side are so close together that they seem to be almost in contact.

Palpi shorter than the head, rather wide, thin, often wrinkled or folded in contraction, and commonly curved downward.

Tentacle tapered, rather slender, not annulated, its length about $1\frac{1}{2}$ times that of the head. Antennæ similar, about $\frac{1}{2}$ as long. Tentacular cirri similar to the tentacle, the upper one rather larger and longer; the lower ones shorter; first dorsal cirrus decidedly longer and larger than the upper tentacular cirrus. Succeeding ones mostly shorter, unequal, alternately shorter and longer, tapered distally; the longer ones are equal to the breadth of the body, the shorter ones about $\frac{1}{2}$ as long; those on setigerous segments 3, 4, 6, 9 are longer than the others.

The setæ are all similar, numerous, slender, short, projecting but little beyond the parapodia, with short rather wide blades, ratio as $1:2\frac{1}{2}-3$; their tips are strongly incurved and acute, with a small denticle a little distant from the end. Two spiniform yellow acicula usually occur in each fascicle.

The œsophagus is short and occupies about 4 segments; its margin is incurved and strongly emarginate dorsally. It bears a group of 6 nearly equal, parallel, recurved hooks or teeth, which are large and strong. The conical dorsal tooth is near the margin.

The stomach is large and occupies 8 segments; it is wide, elliptical, and about twice as long as the œsophagus. Its surface is cov-

ered with angular or alveolar markings, often hexagonal, so as to have a honeycomb-like appearance, but not arranged in definite rows.

Color, in formalin, is nearly white, except when containing eggs.

Length, 25^{mm}; diameter, about 1.5^{mm}.

One of the largest specimens has all the segments back of the gastric region filled with eggs.

***Odontosyllis brachydonta*, sp. nov.**

Similar to *O. enopla* in size and form, but easily distinguished by the very short tapering œsophagus and the much smaller size of its ventral teeth, and by the 4 well separated eyes.

Head large, but smaller and narrower than in *O. enopla*, deeply emarginate in front and with two prominent lobes, most prominent and somewhat angular in front of the anterior eyes; sides broadly convex; posterior margin cordate-emarginate.

The buccal segment extends forward as a collar with median and lateral lobes. Tentacle without articulations, stout at base, rapidly tapered, in length about equal to the breadth of the head. Antennæ similar, about $\frac{1}{3}$ shorter. Upper tentacular cirri and many of the dorsal cirri are larger and $\frac{1}{4}$ to $\frac{1}{3}$ longer than the tentacular cirri, but similar in form, usually curled in contraction; the longer ones exceed the diameter of the body. Setæ numerous and crowded, slender, with small and short blades, ratio about 1:2-3; the tips are distinctly bidentate, with the denticle somewhat removed from the strongly incurved tip. Œsophagus dark umber-brown, very short, about as broad as long, with the base nearly twice as broad as the anterior end; its edge is narrowly revolute; the 6 ventral teeth are small and short, with angular bases, in a regular row; the four central teeth are larger than the lateral; median tooth near the dorsal margin. Stomach large, long-elliptical, light colored, shorter than in *enopla*.

The only specimen found has lost the caudal portion. It is similar to *O. enopla* in size. Each anterior segment is crossed by a narrow dark line.

***Grubeosyllis nitidula*, sp. nov.** (See p. 634.)

A very small, slender, nearly smooth species, consisting of about 25 setigerous segments; the antennæ and all the cirri fusiform with slender acuminate tips; eyes large, black; setæ with relatively long blades.

Head rather large for the body, evenly rounded in front and on the sides, subtruncate posteriorly. Eyes are conspicuous; the anterior ones are about twice as large as the others and farther apart, the distance between being about equal to the diameter of a posterior eye.

Palpi large, broader than the head, united together nearly to the tips, which are separated by a notch or emargination; the length of the projecting portion is equal to the length of the head.

Tentacle is as long as the head and palpi combined, slender, somewhat fusiform proximally, the tip long and acuminate, without distinct annulations, but with some very minute rough points. Antennæ similar in form, but about $\frac{1}{3}$ shorter. Tentacular cirri two on each side, of about the same length, and like the antennæ in size and form. First dorsal cirrus like the tentacular cirri, but about $\frac{1}{3}$ longer. The following cirri are about equal to the tentacle in length, or nearly equal to the diameter of the body; nearly smooth, but showing a few scattered, minute, conical papillæ when highly magnified. The anterior parapodia are rather long, equal to about $\frac{1}{3}$ the breadth of the segment.

The compound setæ are long and rather numerous; the upper ones have a long, slender, nearly straight, acute blade, ratio about 1 : 8-12; the lower ones have shorter blades, ratio 1 : 5-6. In most fascicles there is also a single, slender, needle-like seta, about as long as the others.

The œsophagus is short and rather stout, occupying about 3 segments, and in length about equal to the stomach, which is thick and nearly cylindrical, occupying $2\frac{1}{2}$ segments; it is covered with close rows of dark clustered cells.

***Grubeosyllis rugulosa*, sp. nov.**

A very small species with 28 segments, with the dorsal surface of the body and cirri roughened with minute conical papillæ.

Eyes well developed, dark brown, close together. Palpi large, united nearly to the tips, longer than the head, a little broader than long. Tentacle and antennæ of about the same form and size, shorter than head, fusiform, with a small acuminate tip. Tentacular cirri short, similar to the tentacle in size and form, nearly equal. Dorsal cirri all short and much like the tentacular cirri.

The compound setæ are rather long and slender, usually 4-6 in a fascicle; in the anterior fascicles the upper ones have rather long, narrow, slightly curved blades, and the lower ones blades about half as long and more incurved; posteriorly they are all shorter and

more incurved. In each fascicle there is usually one slender, needle-like, acute seta, nearly as long as the others.

The œsophagus is rather short, but $\frac{1}{3}$ longer than the stomach, with a large tooth. The stomach is short elliptical, as broad as long, and occupies but one segment. The parapodia and setæ are prominent, especially posteriorly, where they are as long as the breadth of the body; anteriorly they are about $\frac{1}{2}$ its breadth.

Length, 3^{mm}; diameter, .2^{mm}.

Only one specimen was found.

Autolytus (Proceræa) simplex, sp. nov.

A small, slender species with long slender tentacle and antennæ, and three pairs of cirri that are still longer, other dorsal cirri short. Head small and rounded; eyes black, rather large, those of the same side in contact or nearly so, the anterior a little larger; a few black pigment cells at the front border of the head may represent a pair of ocelli. Palpi small, rounded, united.

Antennæ and tentacle similar, long, slender, smooth, scarcely tapered, with slight indications of articulations, three or four times as long as the head and palpi combined. Tentacular cirri similar to the tentacle in size and form, the upper ones nearly twice as long; lower ones about equal to the antennæ. First and second dorsal cirri are like the upper tentacular cirrus, or a little longer. All the succeeding cirri are small and very short, the length from $\frac{1}{6}$ to $\frac{1}{2}$ the diameter of the body. Caudal cirri long and tapered, distinctly annulated.

The setæ are all essentially alike; anteriorly there are 6-8 in a fascicle, with the stems slender and subclavate, the blades are small and very short, ratio about as 1:1 $\frac{1}{4}$ to 1 $\frac{1}{2}$; their tips are slightly incurved and minutely bidentate at the end.

The œsophagus is long, slender, and folded, occupying 11 segments. The stomach occupies 5 segments; it is rather short, cylindrical, narrowed at both ends, with numerous close, narrow rows of glands.

The bases of the parapodia back of the stomach are swollen, rounded, and dark colored, causing a conspicuous lateral row of spots on each side, which extend forward nearly to the head.

A constriction occurs at the 40th segment, indicating the formation there of the head of a sexual zoïd, which has two small eye-specks, but no special appendages are present. The zoïd contains 21 segments and is already full of eggs.

Length, 5^{mm}; diameter, .25^{mm}.

In addition to the numerous species of Syllidæ described above, there are, apparently, single specimens of several others, but some of them are not perfectly preserved, and others are so contracted that essential features, like the armature of the œsophagus, cannot be made out without destroying the specimens. Among these there are, apparently, another *Trypanosyllis*, an *Autolytus*, and perhaps an additional *Eusyllis*. Many additional Syllidæ will probably be discovered at the Bermudas when carefully sought for, especially at different seasons of the year.

***Autolytus (Proceræa) rubropunctatus* (Grubé).**

Sylline rubropunctata Grubé, Arch. fur Naturg., 1860, I, p. 87, pl. iii, fig. 8.

Autolytus (Proceræa) ornatus Mar. & Bobr., Ann. Sci. Nat., Ser. 6, II, p. 44, pl. v, figs. 14-14d, 1875, (non Verrill, 1874); St. Joseph, Ann. Polych. Cotes Dinard, Annales des Sci. Natur., Ser. 7, vol. 1, p. 220, pl. x, figs. 98, 99, 1886.

Proceræa rubropunctata Lang., Zeits. fur Wissen. Zoöl., xxxii, p. 579, pl. xxxii, figs. 30a, 30b, 1879.

This European species has also been recorded from Beaufort, N. C., and is, therefore, likely to be found at the Bermudas.

It is peculiarly marked with a transverse row of four orange spots on each segment, and has larger palpi than usual in this group.

The species originally named *Stephanosyllis picta* V. in 1874, was soon afterwards changed by me, (Amer. Jour. Sci., 1874) to *Stephanosyllis ornata*. Since *Proceræa* and *Stephanosyllis* are now generally considered synonymous, that specific name cannot be used for the European species. It should be designated as above indicated.

Our New England species may bear the name *A. (Proceræa) ornatus*, unless some reliable characters can be found for the separation of *Stephanosyllis*.

Analytical table of the Genera of Bermudian Syllidae, described above.

- I.—Palpi large, separate to their bases.
- A.—Œsophagus with only a single median tooth. Antennæ and cirri moniliform.
- B.—Parapodia without a branchial lobe.
- C.—Median tooth near anterior end of œsophagus.
- D.—Margin of œsophagus entire or nearly so. *Syllis*.
- α.—Setæ all compound and similar, but differing somewhat in relative length of blades. Subgen., *Typosyllis*.
- αα.—Upper anterior setæ with abruptly longer, narrow blades. Subgen., *Ehlersia*.
- ααα.—Setæ few, simple, without blades; end bidentate. *Haplosyllis*, sp.
- DD.—Margin of œsophagus dentate or serrulate.
- b.—Margin serrulate or finely dentate.
- c.—Setæ all, or in part, compound. *Eusyllis*.
- cc.—Anterior setæ compound; those of middle region mostly two-pronged crotchets. *Synsyllis*.
- ccc.—Setæ few; all simple with bidentate ends. *Haplosyllis*.
- bb.—Margin strongly dentate or scalloped.
- d.—Œsophagus straight. *Trypanosyllis*.
- dd.—Œsophagus folded, slender. *Pterosyllis*.
- CC.—Median tooth of *œsophagus* near its posterior end; margin entire; opening wide. A buccal collar. Setæ mostly compound; blades acute. *Opisthosyllis*.
- BB.—Parapodia with a branchial lamella. Setæ all compound, with acute, claw-like blades. *Branchiosyllis*.
- AA.—Œsophagus short, with a ventral row of recurved teeth. Cirri not moniliform. Setæ compound, with acute, incurved blades. *Odontosyllis*.
- II.—Palpi large, more or less united medially. Œsophagus with a median tooth.
- e.—Palpi only partially united. Antennæ and cirri long, moniliform.
- g.—Setæ all simple with bidentate ends. *Hemisyllis*.
- gg.—Setæ mostly compound; simple setæ acute. *Desmosyllis*.
- ce.—Palpi united nearly or quite to their tips. Antennæ and cirri short, fusiform, not moniliform. Buccal segment distinct, with 2 pairs of tentacular cirri. *Grubeosyllis*.
- III.—Palpi small, or rudimentary, or wanting.
- E.—Head normal; œsophagus and stomach well-developed. Stem-form of *Autolytus*.
- EE.—Head abnormal. Eyes large. Œsophagus and stomach wanting or rudimentary. Capillary setæ usually present. (Sexual zooids.)
- f.—Antennæ and tentacular cirri present. ♀ *Autolytus*.
- ff.—Antennæ and tentacular cirri absent. *Tetraglene*.
- fff.—Tentacular cirri absent. *Chaetosyllis*.

*Remarks on certain genera of Syllidae.***Amblyosyllis** Grubé non Langerhans.

The genus *Amblyosyllis* Grubé (Vidensk. Meddel. Naturhis. For., Kjøbenhavn, 1857, p. 186) seems to have been misunderstood by later writers. It seems to be widely different from the genus of that name as defined by Langerhans and adopted by others.

As originally established it included only *A. rhombeata* from St. Croix. It was said to agree with *Syllis* as to its body, parapodia, cirri, and setæ, but the cephalic lobe is coalescent with the buccal segment, and palpi are wanting. "Tentacles 3, tentacular cirri 2, eyes 2." Under the specific description these characters are reaffirmed. The tentacular cirri are again said to be 2 ("utrinque 1.") The setæ are numerous, compound, with long linear blades. The body-segments are few (14). The two eyes are large, oval. The tentacles (antennæ) and cirri are long and imperfectly articulated or "crenulated."

It is, perhaps, the sexual zoïd of some better known genus, but the single pair of tentacular cirri and eyes, and the absence of distinct palpi are characters entirely at variance with the genus *Amblyosyllis* of Langerhans, unless it be arbitrarily assumed that it was very badly described.

The latter is made nearly equivalent to *Pterosyllis* Clap. and nine species were referred to it, besides Grubé's type. As defined, it scarcely differs from *Trypanosyllis*, except in having a long, folded œsophagus. But it has *two pairs* or *three pairs* of eyes; *two pairs* of tentacular cirri; a *distinct* buccal segment; and *two free, separate* palpi, which are usually small and bent down under the head.

To this genus of Langerhans belongs the elegant New England species, *Pterosyllis cincinnata* Ver. (1874, p. 394, and 1881, p. 308). The latter has rather small, but distinct, palpi; six eyes; and very long moniliform cirri.

Until the original species of Grubé can be reexamined, it would appear to be far better to retain *Pterosyllis* for the northern genus, for it is probable that there are still numerous unknown generic types of annelids in the West Indies.

Grubeosyllis V., nom. nov. = **Grubea** Quatr.

The name *Grubea* Quatr., 1865, was preoccupied by *Grubea* Diesing, 1858, a genus of trematode worms. Therefore I propose to substitute for it *Grubeosyllis*. (See the analytical table, p. 632, for the generic characters.)

Several species occur on the U. States east coast; among them are *G. Websteri* V.; *G. maculata* V., sp. nov., which is a stouter species, but similar to the last; has a larger and wider head and larger eyes, and a large buccal segment, on which there are four dark ovate spots; the antennæ and cirri are longer and have a middle band of brown with acuminate, acute tips; and *G. fusca* V., sp. nov., which is distinguished from both by its shorter and wider palpi and head, more swollen and shorter antennæ and cirri, shorter and more elliptical stomach, and by having crowded brown spots on its dorsal surface, becoming fewer in front of the stomach, and by its large anterior eyes.

There are also several Mediterranean and Madeira species, as *G. fusifera* (Quatr.); *G. clavata* (Clap.); *G. dolichopoda* Marentz., also recorded from New Jersey by Webster; *G. pusilla* (Duj.); *G. tenuicirrata* (Clap.); *G. limbata* (Clap.). By Langerhans the first three of these European species are considered identical.

Eusyllis Malmgren.

Under this genus there are now included several diverse groups that agree in having the anterior margin of the œsophagus finely denticulated but differ in their setæ, cirri, palpi, etc.

Eusyllis, typical subgenus.

If we consider as type, the first of the two species of Malmgren (*E. Blomstrandii*), in which the antennæ and cirri are not moniliform and the non-sexual setæ are mostly compound with bidentate blades, the genus would scarcely differ from *Pionosyllis* Malmg., of the same date, except in the serrulation of the œsophagus. *Pionosyllis* was originally separated mainly on account of its capillary setæ, now known to be only a sexual character. It may be said to be a *Syllis* without articulated cirri.

As it is convenient to have a distinctive name for this particular type, I propose to consider it a subgenus, *Eusyllis*, differing from the next group in having the appendages imperfectly articulated. Besides the compound setæ there is an acute simple seta and often a bidentate one in the posterior fascicles. Saccular gular glands are lacking alongside the œsophagus.

The second species described by Malmgren was *E. monicornis*. It has been redescribed by others and is better known than the first species. Its palpi are separate nearly to their bases; the cirri are

more distinctly articulated; its setæ are partly compound with bidentate tips, as in *Syllis*, and partly simple, with bidentate or forked ends.

Synsyllis, subgen. nov. Type *S. viridula* V.

E. viridula Ver., described above, p. 622, and *E. longigularis* (p. 624), differ from the type chiefly in having posteriorly mostly simple forked setæ or crotchets, like the stem of a compound seta having a short blade consolidated with it; and by having regularly beaded cirri and large, entirely separate palpi, as in *Syllis*.

Langerhans (1879, p. 550) united *E. Blomstrandii* and *E. lamelligera* Mar. and Bobr., which differ so considerably that it seems impossible they can be identical. St. Joseph, op. cit., p. 171, clearly separated them. Malmgren's species is described and figured as having entirely separate palpi, while *E. lamelligera* is represented as having them united for nearly half their length; the latter also has flat, large, differentiated ventral cirri on the first parapodia, and a pair of large saccular gular glands. These characters would indicate a generic difference.

Desmosyllis, gen. nov.

Type *D. tenera* Ver., Brief Cont., 53, p. 368, 1882, (as *Eusyllis*). Two species from our coast—*D. tenera* Ver. and *D. fragilis* (Webs. 1879, as *Syllis*) agree in having the large palpi united for about half their length, and in having long, regularly articulated antennæ and cirri. Most of the setæ are compound with bidentate blades, as in *Syllis*. In *D. longisetosa*, (see page 626) there is also a single, long, needle-like seta in most of the fascicles.

For this group, which I think ought to rank as a distinct genus, I propose the name *Desmosyllis*. To it may belong *D. lamelligera* (Mar. and Bobr.) referred to above, though in the latter the cirri are less strongly articulated. But the partial union of the palpi is a character of much greater importance.

Hemisyllis Ver. See p. 619, above.

The Bermuda species, described above as *Hemisyllis dispar*, also has the palpi half-united, but it has only a few, simple, unequally bidentate or birostrate setæ, all alike, as in *Haplosyllis*. Like the latter, it inhabits sponges.

Marphysa regalis, sp. nov.

A highly iridescent, large, robust species, composed of about 125 to 130 segments, narrowed close to the head. The branchiæ begin at about the 20th segment; becoming trifid at about the 25th or 26th segment, and 4-branched at about the 45th, continuing as a simple cirrus, on a large number of more posterior segments. In the adult some branchiæ are 5-branched.

Head narrowed, with two deeply separated, rounded front lobes. Three median antennæ are about equal, tapered, articulated, with about 5 oblong annuli, not deeply constricted; length about one-half the breadth of the buccal segment; outer antennæ similar, about one-quarter shorter.

The buccal segment is as long dorsally as the next two, or as long as the next three at the sides.

From 18 to 22 anterior setigerous segments are without branchiæ. The first branchiæ are usually bifid in the adult, but simple in immature individuals; bifid branchiæ continue to about the 25th or 26th setigerous segments, where they become trifid, with long, slender, nearly equal branches, and these may continue for a large number of segments, but in the fully adult specimens they become 4-branched on a number of segments back of the 45th, and a few sometimes have 5 cirri. Posteriorly they gradually decrease; being simple on about 40 segments, and wanting on the last 60 segments.

The dorsal cirri on the anterior 20 segments are rather long, thick at base, rapidly tapered or acuminate distally, and faintly annulated; in the branchial region they become smaller and more conical. The first pair of ventral cirri are rather long, equal to the setigerous lobe; a little farther back they became low, broad, verruciform with a small, papilliform terminal joint.

The setæ in the branchiated segments are numerous; in the upper fascicle the longer capillary setæ have rather long and slender acuminate tips; they are accompanied by a number of brush-shaped setæ with wide ends. In the lower fascicle all the setæ are compound, and have rather stout stems, with enlarged sublanceolate ends; blades oblong-lanceolate, the ratios as 1:4-5, with the tips strongly bidentate. Each fascicle has a large, black, spiniform aciculum, that of the upper fascicle larger and less acute; their tips project somewhat, as preserved.

Color, in formalin, brownish or flesh-color, mottled with darker, with a brilliant iridescence. The surface, under a lens, appears minutely punctate, and is finely specked with whitish dorsally.

Length, in life, over a foot (+300^{mm}).

Breadth of a large but imperfect specimen, in the branchial region (40th segment) is 9^{mm}; of buccal segment, 4^{mm}.

Heteromarphysa, gen. nov.

Body slender; five antennæ (or tentacles) and a pair of separated ventral palpi. Head rounded in front. Eyes 4, well-separated. Buccal segment large, united to the head dorsally, and to the next segment without a visible suture (as preserved). Branchiæ lacking. Setae of several sorts—compound, capillary, and uncinata; ventral ones in the anterior fascicles, compound. Jaws similar to those of *Paramarphysa*.

Heteromarphysa tenuis, sp. nov.

Slender and rather long, with elongated segments, separated by constrictions, except the first four, which are nearly continuous, (perhaps due to imperfect preservation).

Head about as broad as long, obtusely rounded in front, with a minute median emargination; posterior margin more broadly rounded; widest behind the middle. Eyes 4, small, black, nearly equal, nearly in a square; the anterior ones situated close to the anterior margin; the others, rather farther apart, are behind the outer antennæ. The palpi are rounded, about as long as wide.

The jaws are mostly soft and light colored, but appear to agree closely with those of *Paramarphysa*.

Antennæ very long and slender, tapered, acute, smooth, not articulated, but attached to a large and long base. The inner paired ones are the longest, being about 5 times the breadth of the head; odd one somewhat shorter; outer ones about one-quarter the length of the longest.

The buccal segment is wider than the head and continuous with it.

Two tentacular cirri are present on one specimen; they are very long and slender. The larger specimen has 47 segments, but the posterior end is gone. Another smaller entire one has 38 segments.

The parapodia are longest and largest on the anterior segments, decreasing rapidly, but not abruptly, in length after about the 7th.

The dorsal and ventral cirri are about equal on the anterior six segments, rather long, tapered, enlarged at base and tapered distally. On following segments the dorsal cirri become gradually shorter and thicker, and are nearly obsolete after the 12th, but the ventral cirri become smaller and more slender and continue to the end of the body.

The ventral fascicles, on the anterior 3 segments, have 4 or 5 compound setæ, with strongly curved blades, 4 or 5 times as long as wide, with a strongly incurved bidentate tip. The upper fascicle contains a few small capillary setæ. On the 4th segment there are one or two shorter compound setæ with smaller blades, and a few acute capillary setæ with the shaft thickened and bent distally, and a group of longer and more slender ones in the upper fascicle. Uncinate setæ with the tips bidentate and limbate commence on the 11th segment, where there is only one, but they increase to 2 or 3 farther back, and then decrease to 1 posteriorly. All the setæ are larger and longer on segments 6 to 12; there are also 2 or 3 compound setæ with acute capillary blades on segments 8 to 10.

Color, in formalin, greenish white, with paler, fine, sutural lines and a darker dorsal stripe; an obscure darker spot at the base of each of the parapodia.

Length of the longer imperfect specimen, 11^{mm}; diameter, 6^{mm}.

Flatts Inlet beach, in shell-sand, at low tide; 2 specimens.

Leodice or Eunice.

Eunice Cuvier, 1817, *pars.* = *Leodice* Savig., 1820, emend. Malmgren.

The Bermuda species belong to the genus *Leodice*, as restricted by Malmgren, who restricted *Eunice* to the type of *E. gigantea*. The name *Eunice* was in prior use by Hubner for a genus of insects, in 1816, and its use may have to be abandoned for the annelids.

At least 21 nominal species of *Eunice* have been described from the West Indies, Florida, and Bermuda; 3 by Schmarda, 1861; 1 by Baird, 1870; 4 by Ørsted and Grubé, 1879; 2 by Pourtales; 4 by Webster, 1884; 2 by McIntosh, 1885; 5 by Ehlers, 1887. Ehlers* has also redescribed and admirably figured several of the species previously described by Ørsted and Grubé and by Pourtales.

In consequence of the three later works appearing so nearly together, several of the species have received two or three names. The difficulty of identification is, in some cases, much increased by the fact that several of the species which actually grow to large size, have been described from very small and immature specimens, only one or two inches long, and in some cases even these were mere fragments of a single individual, so that no account could be taken of individual variations or of differences due to age.

* *Memoirs Mus. Comp. Zoöl.*, vol. viii, 1887. In this work nine species are included; eight species are very fully described and figured.

Our Bermuda collection contains several common species that grow to the length of 8 to 12 inches or more, which, indeed, seems to be a common size for the species of this genus.

The commonest large reef-species are *L. longisetis* W.; *L. mutilata* W. = *E. barvicensis* McInt.; *L. violaceomaculata* Ehl.; *L. denticulata* W. = *L. filamentosa* (Ørst. and Gr.) = *E. cirrobranchiata* McInt. We did not find *L. longicirrata* (Webst.).

Webster also recorded *E. violacea* Ø. and Gr. from Bermuda, but this large species was described from the Pacific coast of Central America. It has a 4-lobed head and very large pectinate branchiæ, with 20-28 branches. No such species was found by us. Webster gives no description of his examples, therefore it is impossible to tell what he had, without a re-examination of his specimens, but it may have been *L. violaceomaculata* (Ehl.). This is a very large species that is not uncommon. It has a bilobed head; the branchiæ are all pectinate and the larger ones have about 20 branches; the first appear on segments 6 to 9; the dorsum is curiously mottled, and there is no white nuchal band.

One of the most abundant species in dead corals is *L. longisetis* (W.) This becomes more than a foot long. In life it is reddish brown or chocolate-brown, curiously marked dorsally with longitudinal, zigzag or reticulated brownish-black lines. The antennæ and long dorsal cirri are conspicuously banded with pale yellow and dark brown, about 6 pale bands on the antennæ and 3 on the dorsal cirri. There is a conspicuous white band on the 3d setigerous segment. The larger branchiæ are pectinate, with 7 to 10 slender graduated cirri; the first appear on the 4th to 6th segment, usually on the 5th. The head is bilobed in all our numerous specimens, though Webster described it as 4-lobed. His single specimen was probably badly preserved and misleading. It resembles *L. Floridana* (Ehl.) and *L. fucata* (Ehl.), of Florida.

Leodice mutilata (Webs.) = *E. barvicensis* McInt. is another large and abundant species, which lives with the last and is often over a foot long. Like the latter, it has a white nuchal band,—a feature not uncommon in the genus. These two species look much alike, but differ in their jaws and setæ. In *L. mutilata* the gills usually first appear on the 5th to 7th segment, and the largest seldom have more than 6 to 8 cirri, which are long and subequal. The dorsal cirri are much shorter than the branchial cirri, and the antennæ are rather short and not articulated.

Leodice denticulata (Webs.) = *E. cirrobranchiata* McInt. is another large species found among dead corals. Probably *E. filamentosa*

Ærs. and Gr. is the young ($14\frac{1}{2}$ lines long) of the same species. *L. conglomerans* (Ehlers) is a fully adult, large form, perhaps the same. Perhaps *L. hamata* (Schmarda) is also the same species.

It is distinguished by having the first simple branchiæ arising on the 23d to 27th segment, and bifid and trifid ones back of about the 45th to 50th segment; the largest branchiæ have usually 4 or 5 cirri, rarely 6; simple branchiæ extend to very near the end of the body. The antennæ are nearly smooth or feebly articulated, according to the state of preservation, and the enlarged distal part of the stem of the compound setæ is denticulated on one side. The segments are very short and numerous (over 300 in examples 250^{mm} long), and usually finely specked with white on the back.

Leodice binominata (Quatr.) = ***E. punctata*** Ærs. and Gr.

This is a smaller (150^{mm} long) and much rarer species, not before recorded from Bermuda. Its antennæ and cirri are long and delicately beaded, and it has branchiæ only on about 30 segments, beginning on the 4th or 5th. The larger ones are gracefully pectinate with about 10-12 cirri and they meet over the back. In life it is usually pale green, but reddish anteriorly, and finely specked with white dorsally, and with a median row of white spots, one to a segment; the cirriferous buccal ring is also white. The row of white spots persists a long time in formalin. *L. rubra* (Æ. & G.) is much like this, but has branchiæ on nearly all the segments.

Leodice elegans, sp. nov.

Head deeply bilobed, narrow. Body slender, with about 155 segments, flattened posteriorly. Notable for the anterior position of the branched gills.

Antennæ long and very slender, scarcely tapered, well articulated; about 10 distal annuli, most distinct on the longer ones, and mostly elliptical; the inner paired antennæ reach back to the 3d body segment; outer ones about equal to the long buccal segment (median is broken in the type). Eyes large, black, with a lens. Tentacular cirri slender, tapered, rather longer than the buccal segment, with about 8 short annuli. Parapodia prominent; dorsal cirrus rather long, tapered, acuminate distally, and annulated, with about three divisions.

Branchiæ are mostly gracefully pectinate; they begin with 2 slender branches on the 2d setigerous segment; they have 3 branches on the 3d, and become pectinate, with 4 or 5 branches, on the 4th; a little farther back they become 9-branched, with the branches slen-

der and graduated. On the posterior branchial segments there are three pairs of gills with 4 branches; 3 with 3; 2 with 2; and 1 with 1 cirrus. They end at about the end of the anterior third of the body, or near the 30th segment, leaving about 125 segments without any. Ventral cirrus anteriorly is long and tapered; on the 1st segment about equal to the dorsal cirrus. Upper caudal cirri long and slender, about like the tentacular cirri; lower ones short.

Capillary setæ are long and slender with fine long tips; brush-shaped setæ are few, with elongated marginal processes and about 6 intermediate fine denticles and striæ. Acicula 2, yellow, spiniform, hardly acute, unequal, about twice as thick as the compound setæ; the latter are short, their blades have ratios of breadth to length of 1:4-1:6, limbate, tip only slightly incurved, with a tooth below it, standing nearly at a right angle; another small tooth stands near the base; the edge of the limb is finely serrulate, as is the inner distal margin of the head of the shaft.

Length, about 100^{mm} (mutilated posteriorly); breadth, 2^{mm} to 2.5^{mm}.

Only one specimen was found.

***Leodice stigmatura*, sp. nov.**

A long, slender species with long, very slender, partially or distally annulated antennæ and tentacular cirri; long slender dorsal cirri; digitate branchiæ, the larger with three to five slender cirri, and bifid or simple branchial cirri present to about the 100th segment. Caudal region with two or four rows of distinct, round blackish spots.

Head with two lobes, separated but little by the frontal notch; each lobe is usually very obscurely divided by a slight transverse indentation into an upper and lower half (head quasi-4-lobed). Eyes rather large, black; median antenna very long and slender, scarcely tapered; the basal half obscurely divided by shallow grooves into rather short joints, but the distal part has more evident and longer articulations, the distal six joints forming about half its length; it extends back in some specimens to the 15th setigerous segment, but more often about to the 5th, varying according to the degree of contraction of the segments; it is about five times as long as the head; inner paired antennæ similar, but somewhat shorter, reaching in some cases the 10th segment, in others to the 3d. Outer antennæ about one-quarter as long as the median, more distinctly annulated, with about 10 annuli, the distal four forming half the

length, long-elliptical, or sausage-shaped. Tentacular cirri long, slender, tapered, acute, feebly articulated, about equal to the buccal segment and head, and decidedly longer than the outer antennæ. Parapodia rather prominent and the segments rather deeply constricted. Dorsal cirri long and slender, tapered; the anterior ones usually longer than the longest branchial cirri, and about equal to the length of four body-segments.

Branchiæ begin as simple cirri on the third segment; become trifid at about the 7th; 4-branched from about the 10th–14th to the 37th, and then decrease gradually, bifid and simple ones extending nearly to the end, usually ceasing about on segments 100 to 105, leaving about 40 bare, in specimens of average size. In the large examples some of the larger branchiæ may have five cirri; their cirri are long and slender, mostly subequal, arising from short stems, so that the gill is digitate rather than pectinate; the larger ones meet across the back.

The posterior and middle parapodia contain usually one or two spiniform acicula and a rather smaller, oblique, recurved uncinata one, which has a slightly bidentate tip, with two small scarcely hooked terminal denticles, below which the inner edge bears a much larger, rather wide, triangular tooth, standing at about right angles to the shaft; the end is broadly limbate. The compound setæ have rather long and narrow bidentate blades, the terminal hook being narrow and but little incurved, the other a little removed and divergent, so that the interspace is concave; the edge of the limb and the terminal inner edge of the shaft are finely denticulate, as in *L. elegans*. The uncinata acicula frequently appear to have the tip narrowly truncate, owing, perhaps, to the wearing away of the two distal denticles, which are always smaller and less hooked than those of *L. binominata*.

The color in life is milk-white or translucent white, often with two submedian and two lateral rows of small, round, blackish spots; the lateral spots are at the bases of the gills and occur in several other species; the other spots are often conspicuous, but are sometimes wanting in the ripe females, which have the whole posterior part of the body filled with large white eggs. The intestine usually shows as a broad, irregular brownish band, and the dorsal blood-vessel as a narrow red line.

Length of ordinary specimens, in life, 75 to 100^{mm}; breadth, 1–2^{mm}; in formalin the length is usually about 60^{mm}. A few females, filled with eggs, are considerably larger,—about 100^{mm} long in formalin.

Not uncommon in dead corals on the reefs. A few specimens were found in tubes attached to the under side of stones at low tide. The tube is thin, parchment-like and coated with small fragments of shells. It secretes a large amount of mucus when disturbed.

Leodice concinna, sp. nov.

Head slightly bilobed, with a very shallow frontal notch. Eyes moderately large, black. Antennæ all strongly beaded, of moderate length. The median one reaches about to the second setigerous segment; outer lateral ones about one-third as long; inner laterals similar to the median one and nearly as long.

Buccal segment, with the cirriferous ring, is about equal to the next two segments. Tentacular cirri are about as long as the buccal segment, small, tapered.

Body-segments are numerous, short, but little constricted. Parapodia only little prominent, especially back of the branchial region. Dorsal cirri rather small, tapered, of moderate length.

Branchiæ are palmate or digitate, rather than pinnate; the first appear as small simple cirri on the third setigerous segment; 3-branched ones on the 7th; 4-branched ones on the 8th; none with five cirri were observed. They cease on the 52d segment, the last 10 being simple and short.

The setæ are much like those of *L. stigmatura*.

Found in dead corals from the reefs.

This resembles *L. stigmatura*, but the latter has many more branchiæ, longer antennæ and cirri, and more constricted and much longer segments.

Leodice tenuicirrata, sp. nov.

A small species with remarkably long dorsal cirri. Head very obscurely 4-lobed; the frontal lobes are rounded, but have a slight horizontal indentation on the outer side. The antennæ are long, slender and articulated; the median one is about four times as long as the breadth of the buccal segment; the inner lateral are lost from the type; the outer laterals are about half as long as the median, a little stouter and more tapered, and with many short annuli, in length equal to about $1\frac{1}{4}$ times the breadth of the buccal segment.

Tentacular cirri very slender, acute, nearly as long as the median antennæ. Dorsal cirri very long and slender, nearly as long as the tentacular cirri, are nearly equal to the breadth of the body, much longer than the branchial cirri; they stand out at right angles to the body so that they are conspicuous.

Branchiæ begin as simple cirri on the 3d setigerous segment; they have 2 cirri on the 6th; 3 on the 8th; 4 on a few segments farther back. On the 46th, which is the last segment preserved, they have two cirri. From dead corals; only one example.

The setæ resemble those of *L. binominata* and *L. stigmatura*. It is allied to *L. articulata* (Ehl.) and to *L. ornata* (Andrews).

***Leodice unifrons*, sp. nov.**

A small slender species. Head undivided, rounded in front, without any frontal emargination, the outlines nearly semicircular. Eyes rather large, black. Antennæ articulated, with the annuli unequal, the distal ones elliptical, twice as long as wide, and very distinct; the median antenna is rather longer than the head and buccal segment; the inner laterals are a little shorter; the outer laterals about half as long as the median. Tentacular cirri are obscurely annulated, slender, about equal to the length of the buccal segment. The dorsal cirri are long, equal to the longest branchial cirri.

The branchiæ begin as simple cirri on the 3d setigerous segment; two branched ones appear at about the 8th segment; the largest are pectinate, with five or six long, slender, subequal cirri on the 16-23d; trifid on the 34th; simple branchiæ continue nearly or quite to the posterior end of the imperfect specimen, which has 43 segments.

In life the color is pale brown with a median dorsal row of white spots, one to a segment, and with olive-brown irregular mottlings on each side; antennæ pale, translucent, banded with flake-white.

The only specimen found had lost the posterior segments. It was about $1\frac{1}{2}$ mm in diameter, in life, and 60-70mm long.

Flatts Inlet, in shell-sand at low-tide.

***Leodice margaritacea*, sp. nov.**

A small long and very slender species, nearly white, with a pearly iridescence. Antennæ slender, distinctly annulated; gills short pectinate; anterior parapodia prominent; posterior ones small. Head slightly bilobed; eyes rather large. Antennæ very slender, rather long; the median reaching back to the 2d or 3d setigerous segment; inner laterals a little shorter; outer laterals about $\frac{1}{2}$ as long as the inner. All are unusually slender, scarcely tapered, very distinctly annulated distally, the joints being constricted and the divisions longer than broad. Tentacular cirri slender, tapered, acute, reaching about to the front edge of the buccal segment. The 1st buccal segment and cirriferous ring together are about equal to the

next two segments and longer than the head. The parapodia on the anterior half of the body are rather long and prominent, with long capillary setæ, but back of the branchial region they become small and but little elevated, with a minute papilliform dorsal cirrus.

The larger branchiæ have 4 or 5 long slender cirri; they begin on the 3d or 4th segment with two small cirri, and increase to 3 cirri on the 8th and to 4 at about the 14th; those from the 24th to 28th often have 5 cirri. They begin to rapidly decrease at about the 30th and cease at about the 45th to 50th segment.

The capillary setæ anteriorly are 3 or 4, not very long, becoming 4 to 6 and longer, farther back; compound setæ are about 6 anteriorly, and 4 posteriorly; the uncinæ setæ are strongly recurved at the neck; the end is tridentate, the tip is divided into two small slightly incurved denticles, and the hook on the inside is sharply angular, longer than the terminal part.

The color in formalin is pearly white and iridescent, sometimes with slight darker bands or rows of spots across the anterior segments and with dusky annulations on the antennæ.

Length, 35 to 50^{mm}; diameter, 1.5^{mm}.

Flatt's Inlet, low-tide to 10 feet, in shell sand, common.

***Lysidice bilobata*, sp. nov.**

The head has two evenly rounded lobes in front, separated by a deep notch. The buccal segment is twice as long as the next, and about equal to the head. The three antennæ are about equal, and about as long as the head, scarcely tapered, blunt. The eyes are small, black.

The parapodia are small with papilliform dorsal and ventral cirri. On the anterior segments, the compound setæ are about 6, with stout distal enlargements and small, short blades, minutely bidentate at the extreme tip, and with a tooth on the inside edge, near the base. The capillary setæ are much longer, usually 4 or 5, considerably bent and flattened, with a long acuminate tip. The 2 or 3 brush-shaped setæ are rather small, and the rapidly enlarged end has about 10 slender denticles, the marginal ones only slightly longer. There is one, or sometimes two, black spiniform acicula and a black uncinæ seta of about the same size, having the end slightly bifid and a little bent, but not limbate; the bidentation is at the extreme tip; the lateral tooth is slightly the larger and is directed obliquely distally.

Posteriorly the setæ are nearly the same, but the uncinata seta is more strongly bidentate.

Color in formalin, plain yellowish white and strongly iridescent. The largest specimen is a female filled with large white eggs. It has lost its posterior segments. The anterior portion, with 30 setigerous segments, is 9^{mm} long; 2^{mm} broad; young ones of 80 segments are 16^{mm} long.

Paramarphysa obtusa, sp. nov.

Long and slender, widest anteriorly, attenuated posteriorly, with rather prominent parapodia and long setæ in the anterior region, and much smaller ones posteriorly. Head $\frac{1}{3}$ broader than long, evenly obtusely rounded in front, with a faint median furrow, or slightly bilobed in front, according to the mode of preservation.

Antennæ smooth, rather short, the three median subequal, often fusiform and slightly tapered distally, or slightly clavate and obtuse; the median one is about twice the length of the head; inner laterals scarcely $\frac{1}{2}$ shorter; outer laterals $\frac{1}{4}$ shorter. Eyes large, black, reniform. Buccal segment rather longer than head, scarcely distinct from the next. Dorsal cirri rather short, tapered, the first very small.

The posterior third becomes very slender, with rather long and almost moniliform segments and small parapodia, with conspicuous black acicula. Caudal cirri small, about as long as the diameter of the anal segment; median cirrus minute papilliform.

The 1st buccal segment is nearly as long as the head, and $\frac{1}{3}$ longer than the second segment.

The 2d buccal segment is rather closely united with the first and with the succeeding 1st setigerous segment, with shallow constrictions, but farther back, the segments are convex with well-defined constrictions between them. The 1st pair of parapodia are small and only slightly prominent, with few and short setæ, and a small papilliform dorsal cirrus, smaller than the ventral, but they rapidly increase in size and prominence, in the thoracic region. Posteriorly they again become small, with papilliform cirri. The jaws are well developed but mostly pale horn-color.

Capillary setæ 4-6 anteriorly, 2-4 posteriorly, flattened distally, with long, slender pointed tips. Compound setæ 6-8 anteriorly rather large with short blades, minutely bidentate at the extreme tip, not incurved. Uncinate seta of the middle and posterior regions, large, black, strongly curved distally, at the neck, and with

a large angular hook, stouter than the acute terminal denticle; absent anteriorly. Aciculum posteriorly large, black, spiniform, subacute; paler and more slender anteriorly.

Color, in formalin, white. Length, 25–35^{mm}; diameter, 1–1.25^{mm}.

Flatt's Inlet, at low-tide, in shell-sand. Several specimens.

P. longula Ehl. differs from this in having a distinctly bilobed head; much longer antennæ, straighter and less hooked uncinuate setæ, fewer and more slender capillary setæ, longer and more strongly bidentate blades to the compound setæ, and shorter jaws.

Nematonereis hebes, sp. nov.

Body long, slender, terete, with rather long, and posteriorly with only slightly constricted segments; often coiled in a spiral. Head broadly rounded in front, nearly hemispherical, rather broader than long. Eyes small, black. Antennæ fusiform, swollen above the constricted base and gradually tapered to the acute tip, nearly as long as the head. First buccal segment about as long as the head, the second about half as long and about equal to the next. The divisions between the two buccal rings and several following segments is very slight. Dorsal cirri on the 1st segment are small, papilliform; on succeeding segments they are longer and tapered, the longest about $\frac{1}{3}$ as long as the breadth of the body. The longest anterior parapodia are quite prominent, with a short, thick ventral cirrus, with a swollen base, a large setigerous lobe, and a long dorsal cirrus. There are 2 or 3 long, slender, slightly flattened capillary setæ; a few compound setæ with narrow, feebly bidentate blades; a slender, yellow, spiniform aciculum, and farther back an uncinuate seta with a strongly recurved neck and a strongly bidentate tip; the hooked lateral tooth is larger than the acute terminal one, and angular, much as in *Paramorphysa obtusa*. Color, in formalin, pale greenish white.

Length, 25–30^{mm}, in formalin; diameter, about .3^{mm}. Three specimens.

Stauronereis, nom. nov. = *Anisoceras* and *Staurocephalus* Gr. (preoc.)

Type *Staurocephalus Rudolphi* (D. Ch.) Ehlers, Borstenw., p. 434, pl. xviii, figs. 17–26.

Anisoceras Grubé, Vid. Meddel., p. 60, 1856 (non Pictet, Cephal., 1854).

Staurocephalus Grubé, Zeitsch. fur Wiss. Zool., 1855, p. 97 (non Barr., Crust., 1846).

The name *Staurocephalus* must be dropped, because clearly pre-occupied in Crustacea, 1846. *Anisoceras*, which Grubé originally considered a distinct genus, but which Ehlers and others have

regarded as only a subgenus, with longer antennæ, cannot be used for the genus, because it and its variants had been used in at least four or five other senses before it was applied to these annelids. *Anisoceras* was used by Pietet in 1854; *Anisocera* was used in Coleoptera, both in 1833 and 1835; *Anisocerus* was used in Coleoptera, both in 1835 and in 1837. *Prionognathus*, Kef., 1862 (*non* LaF., 1851, *nec* Pand., 1856) is a closely related group, but the type *S. ciliata* (Kef.) may, perhaps, be a distinct subgenus.

Another group, perhaps of generic value, is typified by *S. rubrovittata* (D. Ch.) well described and figured by Ehlers (Borstenw., p. 424, pl. xviii, figs. 1-16), which was the type of *Staurocephalus* Gr. It has a prominent, long, pyriform head with large, flat, recurved, frontal palpi; much shorter articulated antennæ; 4 eyes; a conspicuous ciliated lobe on each side of the neck; a terminal article on the dorsal cirri; stout nearly parallel lower jaws, ending abruptly anteriorly, and with acute, mostly strongly dentate plates in two or three series forming the upper jaws. For this group, I would propose the subgeneric name *Teleonereis*.

If it be thought necessary to change the name of the family owing to the change in the principal genus, I would propose to adopt *Stauronereidae*, as it is analogous to *Lumbrinereidae*.

The following three Bermuda species belong to the group called *Anisoceras* by Ehlers, for they have long articulated antennæ. The same is true of *Stauronereis pallidus* (V. 1873), of the New England coast; *S. sociabilis* (W. 1878) of Virginia; *S. cæcus* (W. 1884), of New England; and several European species, including *Stauronereis Rudolphi* (D. Ch.) so well described by Ehlers, and *S. Chiajei* (Clap.) of the Mediterranean; *S. rubra* (Gr.) St. Croix; *S. vittata* (Gr.) and *S. bioculata* (Gr.) from the west coast of Costa Rica.

S. (Stauroceps) eruciformis (Malmgren). This Arctic species may be the type of a special subgenus, *Stauroceps*. It has a small head with very short non-articulated antennæ and smooth dorsal cirri, without a terminal article. Its jaws, as figured, also appear to be more simple than those of most of the other described species. *S. minimus* (Langerh., 1884) of Madeira has even less developed antennæ and cirri, though it must be immature. Perhaps it belongs rather to *Paraectius*.

Stauronereis melanops, sp. nov.

Head rounded in front and behind, with the sides a little prominent, about as long as broad; a pair of divergent, narrow-lanceolate ridges arises from the middle of the posterior margin.

Eyes round, black, with lens, the anterior ones much the larger, situated at the anterior bases of the antennæ and as broad as the antennæ, or a little broader; posterior eyes about half as large and nearer together, thus forming a trapeze. Antennæ longer than the palpi, tapered, distinctly annulated, with 13 articles. The articles near the base are short; distally they become much longer and more separated, the last two being 4 or 5 times broader than long, and these two joints project beyond the tips of the palpi. The palpi are stouter than the antennæ, curved, tapered, crenulated on the outer edge, and slightly annulated distally.

Dorsal cirri are biarticulate, rather long and slender, the basal article longer and about equal to the setigerous lobe on anterior part of body, while the distal article is more slender, tapered, acute. Posteriorly the basal article becomes longer and more slender, exceeding the setigerous lobes, and the distal joint also becomes longer, nearly as long as the basal, with a slender acute tip.

Setæ are long and numerous, the capillary ones are slender and straight, a little longer than the compound ones, which have a narrow blade, 5 to 8 times longer than wide, with strongly bidentate tips.

The lower jaws are strong, black, both ends strongly bent back like a short bow, the posterior end blunt; the anterior prolonged by a series of 4 small separate pieces; the upper jaws are elongated, little bent, divided into about 20 denticulated plates, with very acute, long, incurved denticles in the under series, anteriorly.

None of the specimens have the caudal segments; the longest is 10^{mm} long, 2^{mm} broad, and has 38 setigerous segments.

***Stauronereis erythrois*, sp. nov.**

Head broadly rounded in front, a little produced posteriorly, longer than broad. Eyes yellowish-brown, arranged in a trapeze, and much smaller than in the preceding species, the anterior about twice as large as the posterior, all with a lens. The antennæ and palpi are short and about equal, in length less than breadth of head; the palpi are stouter than the antennæ; the latter are annulated. The dorsal cirri are much shorter than in the preceding species; the basal article is thick, the terminal is small, ovate or elliptical; the total length about the same as the setigerous lobe, or a little more, anteriorly, but posteriorly both articles become longer and the cirri considerably exceed the setigerous lobes. The compound setæ have rather short bidentate blades; their length 3 to 5 times their breadth.

The lower jaws are rather less bent than in the preceding species, with the posterior ends more incurved and acute. The upper jaws, which have about 16 plates in each series, are stronger and more bent in the middle, the anterior plates having the denticles shorter than those farther back and less claw-like than in the last species. The two middle denticles are much the larger.

The only specimen (probably young) has 55 setigerous segments; length, 7^{mm}; breadth, 1^{mm}.

These two species appear to be quite distinct from *S. pallida* Ver., 1873 (*non* Langerhans, 1879),* and other species of the United States coast, and from *S. rubra* (Erst. and Grubé), as *Anisoceras* (1854) of St. Croix, the only related species described from the West Indian region.†

In both of our species the lower series of plates of the upper jaws terminate posteriorly in a rather short, irregularly oblong plate, without denticles, while the denticles increase in length on the other plates, anteriorly. Thus the structure is quite unlike that of the jaws in *S. rubrovittata* figured by Ehlers, but more like that of *S. Rudolphi*. The under jaws, especially, resemble those of the latter in form and in having a divergent series of small plates in line with the acute anterior ends, while those of *S. rubrovittata* are much stouter, straighter, and have obtuse anterior ends.

It is possible that these two Bermuda forms may be male and female of one species, but our specimens appear to be immature and the sex cannot be determined. Should this be the case, the name *melanops* would be preferred.

***Stauronereis polydonta*, sp. nov.**

A third species has much longer upper jaws, with about 35-40 plates in each row, gradually decreasing to the minute anterior ones.

* For the species named *S. pallidus* by Langerhans, 1879, I propose the name *Stauronereis Maderiae*. It is very different from our New England species.

† The curious free-swimming, gregarious species recently admirably described and illustrated by A. G. Mayer (Bull. Mus. Comp. Zool., xxvi, No. 1, with 3 plates, 1900) as *Staurocephalus gregaricus*, does not really belong to that genus, but is the type of a new genus for which I propose the name *Mayeria*.

This genus is characterized by the presence of a single pair of unsegmented organs (palpi) on the front of the head, and by the unsegmented dorsal cirri. The type is without antennæ and eyes. The jaws, also, differ considerably from those of typical *Staurocephalus*.

Mayeria gregarica, the type species, was found swimming at the surface off the Tortugas, Fla., in vast numbers nearly at the last quarter of the moon, from July 1 to July 10, for breeding purposes. This species will almost certainly be found to occur off the Bermudas, at about the same date.

The compound setæ have very long, straight, minutely bidentate blades. Segments, 44 + ; length, 16^{mm}.

Lumbrinereis nasuta, sp. nov.

A long, brilliantly iridescent species. Head (cephalic lobe), in life, much elongated and subacute in extension, the length about twice the breadth, considerably flattened, changeable in shape, sometimes subacute ; no eyes. Buccal segment about half as long as the head. Parapodia small, setigerous lobe swollen ; cirrus small, blunt, papilliform. Setæ of middle and anterior segments are 3 or 4 long uncinatè ones, with 2 spiniform acicula that do not project. The uncini bend back distally, at the narrowed neck, with an enlarged truncate head, terminated by two small strongly incurved apical hooks, and with a large, stout, blunt ventral hook. The neck and head have a curious miniature resemblance to those of a horse.

Color, in life, bright light red or purplish and highly iridescent ; parapodia paler or whitish. In formalin, purplish-brown. Posteriorly there is often a single, somewhat bent, acutely acuminate and limbate capillary seta.

Length, in life, 150 to 200^{mm} (about 6 to 8 inches) ; diameter 1 to 1.5^{mm}.

Flatts Inlet, in shell-sand at low-tide.

Arabella maculosa, sp. nov.

In life, very long and slender, only slightly iridescent. Head, in extension, long-conic, somewhat blunt ; ocelli 4, outer ones larger and slightly farther forward. Buccal segment elongated. Parapodia small, with a papilliform lobe.

Body, in life, pale orange-yellow. Most of the segments have 8 to 10 small, transverse, dark olive-green dorsal spots ; 2 of these are median, near the proximal and distal margins ; 2 others may occur on each side proximally ; a row of 4 smaller ones crosses the middle ; a pair of small white spots occurs near the distal edge. Parapodia pale. Posteriorly these markings disappear gradually. Length, in life, 150 to 200^{mm} ; diameter about 1^{mm}.

Flatts Inlet, low-tide, in shell-sand.

Aricia setosa, sp. nov.

Body widest and considerably flattened near the anterior end, gradually becoming smaller and narrowed posteriorly, with the under

side rounded and the back flat and nearly concealed by the prominent cirri and branchiæ. Anterior segments near the head rapidly decrease in breadth. Head small, flattened, widest near the front end, which is truncate or slightly emarginate; sides rounded. Two small blackish spots, like imperfect ocelli, are situated near its posterior border.

The branchiæ begin on the 6th setigerous segment, rapidly become of full size, when they are elongated, tapered, acute ligulæ, as long as the dorsal cirrus, but not quite so broad proximally. They continue nearly or quite to the end of the body.

The first two or three parapodia are quite small, but they rapidly increase to about the 10th. The lower division consists, on the anterior segments, of a torus filled with a crowded group of capillary setæ; and a foliaceous lobe, prolonged above into a small papilliform cirrus. The tori increase rapidly to the 10th segment and continue of about full size to about the 20th and then rapidly decrease to the 25th, when they become very small, and beyond this, at about the 30th, they are replaced by a papilliform lobe and a cluster of longer capillary setæ and 4 or 5 larger spiniform ones.

The upper parapodium, anteriorly, consists of a broad flat lobe, prolonged at the dorsal angle into a small acuminate cirrus; at about the 25th–30th segment they change rapidly to a longer and narrower falcate cirrus, with a constricted base, above which they rapidly expand, on the outside, to a broad flat portion, beyond which they taper gradually to the subacute tip; they are concave on the dorsal side and are recurved over the back, like the branchial cirri, which they equal in length. These cirri, at about the 35th segment, are more than three times as long as broad, and about twice as long as the ovate ventral lobe, though not much wider.

The numerous crowded setæ of the anterior ventral toriform lobes are much alike, in the form of short, acute capillary setæ, with rather stout shafts. The capillary setæ of the upper fascicle are much longer and far more slender.

On a parapodium from the 32d segment there are 12–16 long, very slender capillary setæ, with attenuated tips, as long as the dorsal cirrus, and about 4 moderately large, straight, acute spiniform setæ, not half as long; in the lower fascicle there are about 18 shorter capillary setæ of the same kind, rather longer than the ventral lobe, and three slightly bent spiniform setæ.

On the posterior segments the setæ are similar, but fewer, about 10 to 12 long ones in the upper fascicle, and 6 to 8 in the lower, with

3 spiniform ones, a little more bent distally. The branchiæ are more slender and longer than the dorsal cirri.

In life pale red; each segment has two narrow, transverse, parallel, orange vittæ, not extending entirely across, and a roundish spot of the same color on each side at the bases of the dorsal cirri. There is a dark irregular spot close to front edge of the head.

Length, in life, 200^{mm}; breadth, 3 to 3.5^{mm}.

Flatts Inlet beach in shell-sand at low tide.

This species is evidently related to *A. platycephala* McInt. (Chall. Voy.), also from Bermuda, but the latter species has gills only on segments 8-18, and the setæ and cirri are different in form.

Cirratulus (Audouinia) capillaris, sp. nov.

A small species with very long slender cirri. Head short, somewhat depressed, bluntly rounded in front, confluent with the buccal segment; the next two segments are hardly distinguishable, except below, and thicker than those that follow, which are subequal, but increase in length posteriorly and decrease in diameter, some being as long as broad; the posterior ones become small, short and crowded.

Setæ and cirri begin together on the 2d body segment; the first cirrus is smaller than the others; the longest are on 2 to 6 following segments, but continue long on 8 or 9 more; shorter ones occur irregularly on more or less of the other segments of the anterior half of the body, but rarely on the posterior half; the length of these is scarcely greater than the diameter of the body.

A transverse group of longer and distinctly larger cirri or tentacles occurs on the 4th setigerous segment, arising from the dorsal surface, about 3 on each side.

The setæ of the anterior 6 or 7 segments, both dorsal and ventral, are very slender, capillary, acute, in small fascicles; they are about equal to $\frac{1}{2}$ the diameter of the body. Spiniform setæ, bent in a sigmoid curve, begin to replace the capillary ones in the ventral fascicles on the 8th segment, and increase in number farther back, till they nearly or quite replace the slender setæ. In the upper fascicles longer, more slender, nearly straight spines gradually replace the capillary setæ, but one or two of the latter persist nearly or quite to the end of the body. Posteriorly there are usually, in the upper fascicles, 2 or 3 spines and 1 or 2 capillary setæ; in the lower ones, about 3 curved spines, larger than the anterior ones.

Cirratulus (Audouinia) Websteri V., nom. nov.

Cirratulus tenuis Webst., Bull. U. S. Nat. Mus., No. 25, p. 323, pl. xi, figs. 56, 57, 1884 (non Verrill, Rep. Inv. Vin. Sd., 1873).

This Bermuda species is quite distinct from *A. capillaris*, which seems to be more nearly allied to *A. punctata* (Ærst. & Gr.), from St. Croix. The latter is said to have an interrupted row of cirri on the 5th segment, and differs in other ways.

C. assimilis McInt., which we also obtained at Bermuda, has two oblique series of eyes and larger branchial cirri.

Euclymene V., nom. nov. Type, *Clymene* *Ærstedii* Clap.

Clymene Savig., 1817 (non Oken, Moll., 1815).

The name *Clymene* having been preoccupied by Oken, I propose to substitute *Euclymene* for it.

As here understood, it would include as a subgenus, *Praxillella* Ver., 1882, type *P. gracilis* (Sars) = *Praxilla, pars*, Mgn., 1865 (non Reich., 1853). But if the latter cannot well be distinguished as a subgeneric group, then *Praxillella* should include the entire genus as being the earliest tenable name. The extended genus is characterized by the limbate head; funnel-shaped anal segment, bordered by numerous papillæ; and especially by having on about three anterior setigerous segments, one or two stout, bent spines, replacing the rostrate uncini of the ventral parapodia. The setæ are mostly bilimbate, but there are generally, if not always, some smaller pennate setæ, especially in the first three fascicles. The uncini have three to five apical hooks in one row.

The typical forms seem to lack a distinct, free thoracic collar, but some aberrant deep-water forms, that have been referred here, have a collar. They seem to represent new genera.*

**Clymenopsis* V. Type *C. cingulata* (Ehl.) Florida Annel., Blake Exp., p. 185, pl. xlviii. This is characterized by the presence of a large collar on the 4th segment, most prominent beneath. The head is gibbous, with a very narrow limbus, and confluent with the buccal and following three segments. Uncini and anterior spines are as in *Euclymene*. Setæ bilimbate. Anal segment unknown.

Clymenura V. Type *C. cirrata* (Ehl.) op. cit., p. 182, pl. xlvi, figs. 10-13. Head as in *Euclymene*. Anal segment elongated, with a circular rim, bearing 4 long cirri. Uncini remarkable for having, above the large tooth, two transverse rows of numerous small hooklets, the first row containing about 9 larger ones, the 2d many more. The 2d, 3d and 4th setigerous segments are elongated, and each has a narrow anterior collar.

The number of setigerous segments is variable (18 to 70), but is usually from 18 to 22.

Subgenus *Euclymene* (typical) has 17 to 24 setigerous segments, of which the three anterior have one to three ventral spines, and one, two, or three preanal segments, without setæ.

E. zonalis V. = *Praxilla zonalis* V., 1874, is the only New England species.

Subgenus *Praxillella* has the same variation in the number of setigerous segments, but has 4 or 5 achæitous preanal segments. *E. (Praxillella) gracilis* occurs off the northern coast of New England.

Among European species of *Euclymene*, besides the type, *E. Ørstedii* (Clap.); *E. palermitana* (Gr.); *E. planiceps* (Sars), 1871; *E. digitata* (Grubé), belong to this group. But *E. (Praxillella) lumbricoides* (Grubé); *E. (Praxillella) simplex* (Clap.); *E. (Praxillella) collaris* (Clap.); *E. (P.) gracilis* (Sars); *E. (P.) quadrilobata*, have the characters of the subgenus *Praxillella*.

A very aberrant species from near Vineyard Sound, Mass. (*E. elongata* (Lewis), as *Olymene*, Proc. Boston Soc. Nat. Hist., xxviii, p. 111, pl. 1, 2, 1897), has a remarkably large number of segments, about 70 according to the excellent description and figures given by Miss Lewis, to whom I am indebted for a specimen. In other respects it does not differ much from the more typical species. But the remarkable increase in the number of segments, so unusual in this family, seems to be a matter of sufficient importance on which to base a subgeneric group, which I propose to call *Macroclymene*, with *E. (M.) producta* (Lewis) as the type.

The principal characters of this group are the presence of a single preanal non-setigerous segment and of more than 50 setigerous segments, the increase being in the postabdominal region. As in the typical group, there are both bipennate and bilimbate setæ, and the rostrate uncini are of the usual form.

***Euclymene coronata*, sp. nov.**

A large, stout species, none of the examples entire. Head short, thick, with distinct transverse and oblique lateral grooves; median ridge narrow, prominent, with a short obtuse tip; marginal lateral lobes rather wide, erect, with a slight lateral notch, above which the dorsal margin is divided into 8 or 10 small obtuse lobes or denticles.

First three setigerous segments (as contracted) are short, subequal, with a single (sometimes 2), stout, acute, slightly bent, yellow ventral

setæ, and a small fascicle (12 to 15 on the 3d segment) of long, very acute dorsal setæ; the 4th and 5th segments are rather longer, with long series of strong, bent, yellow, bearded uncini (about 30 on the 4th segment); 6th to 8th segments longer; 9th much longer, usually constricted behind the tori; 10th to 15th and following segments are very long, narrowed anteriorly, and have prominent posterior tori. Anal segment funnel-shaped, the border surrounded by 30 or more subequal slender papillæ.

The capillary setæ are of three kinds. Usually there are 6 to 8 longer and larger, rather strong, smooth, very narrowly bilimbate ones, ending in long, slender, flat, flexuous, minutely denticulate tips, and 4-6 shorter and much more slender ones, with fine capillary tips, not limbate; with these there are a few very slender, bipennate setæ, slightly flattened and widened distally, and finely spinulose to the acute tips, the spinules projecting considerably.

The uncini of the middle region are stout and bent back strongly, with a large, sharp, somewhat incurved rostral hook, and 4 small, graduated, appressed apical hooks, of which the 4th is very minute; apex and sides are strongly striated distally. The beard is long and curved strongly backward, it arises from just under the rostrate hook and contains but few fibers. The bulb of the stem is well developed.

Color, in life, bright red, more or less distinctly banded with bluish at the posterior end of most of the segments; posterior half of many segments bright red; 4th with a definite bright red ring.

Length, in life, over 150^{mm}; diameter, 4-5^{mm}.

Found at Castle Island at low-tide, in shell-sand.

Clymenella Verrill, 1873. (Sens ext.)

Axiiothea Malmgren, 1865, type *A. catenata*; (non Pasc., Coleop., 1864).

Clymenella Verrill, 1873. Rep. on Invert. of Vineyard Sound, etc., pp. 49, 314, pl. xiv, and Annual Rep. U. S. Com. Fish and Fisheries, 1874, pp. 343, 608, pl. xiv, figs. 71-73. Type, *C. torquata* (Leidy).

The genus *Clymenella* originally had for its special character, to distinguish it from *Axiiothea*, the presence of an evident collar, with a wide, free anterior edge, arising from the 4th setigerous segment. In all other characters it agrees well with *Axiiothea* Mgn., in which no such collar has been described. I have since examined authentic specimens of *Axiiothea catentata*, the type of the genus *Axiiothea*, sent from the Museum of Copenhagen, and found that it has a narrow collar or fold, both on the 4th and on the 3d setigerous seg-

ments, but much less developed than in *C. torquata*, when the latter has been equally contracted by alcohol. The collar is doubtless much narrower in life than in the latter, but it is of the same nature.

As *Axiiothea* was in prior use in Coleoptera (Pasc., 1864) it must be abandoned for this genus, and *Clymenella* now seems to be its equivalent, both types being essentially alike in all generic characters.

This genus has the following characters: Number of segments variable. A limbate cephalic plate; a funnel-shaped anal plate bordered with papillæ; a thoracic collar on the 4th setigerous segment, and sometimes on the 3d and 5th; rows of ventral, rostrate, uncinata setæ, having a series of apical hooks and a beard, on all the anterior setigerous segments; both pennate and smooth bilimbate capillary setæ in the upper fascicles (pennate ones overlooked or perhaps accidentally absent in some described species); usually 2 or 3 preanal segments without setæ.

Besides the type, at least two other East American species are known:

C. elongata (Webst.) 1879, as *Praxilla*, from New Jersey and Connecticut. It has thirty-seven to thirty-nine segments (thirty-six setigerous in the larger ones). Mr. Moore, 1893, has also described, as a new species, *Clymenella elongata* from New Jersey, which is probably identical, though the coincidence in name was accidental.

C. mucosa (Andrews) as *Axiiothea*, Proc. U. S. Nat. Mus., 1891, has twelve uncini on the 1st setigerous segment, and thirty farther back. The anal papillæ are of various lengths.

These three species all have small pennate setæ mixed with the bilimbate ones, but in *C. torquata* the pennate setæ are very small, slender and fragile, so that they are easily broken off and overlooked.

Axiiothella, sub-gen., nom. nov. Type, *A. catenata* (Mgn.).

Axiiothea Malmgren, 1865; St. Joseph and others (*non* Pasc., 1864).

The name *Axiiothea*, as above shown, is untenable, but I propose to establish a subgenus, *Axiiothella* for the typical species of *Axiiothea*, making the smaller or rudimentary condition of the collar* the

*St. Joseph, op. cit., p. 131, objects to the use of the existence of a thoracic collar as a generic character, because it has been found to exist in species of other genera (*Rhodine*, etc.). But the same objection would apply to the limbate head, and to the infundibuliform anal plate, which exist in several genera. In fact it is probable that in those cases where it exists it will be found to be associated with other truly generic characters. (See p. 654.)

principal character of the group. As in typical *Clymenella*, there are pennate setæ in the better known species, and perhaps in all, for they may have been accidentally lost in some cases, or else overlooked, owing to their delicacy and fragility.

Such setæ are known to be present in the following European species: *Clymenella (Axiothella) constricta* (Clap.); *C. (A.) cirrifera* (Lang.); and *C. (A.) lyrocephala* (Schm.) from Cape of Good Hope.

The two northern species, *C. (A.) prætermisssa* (Mg'n.) and *C. (A.) polaris* (Theel) are not known to have pennate setæ, but these may have been accidentally lost or overlooked.

***Clymenella (Axiothella) Somersi*, sp. nov.**

A slender species, with eighteen setigerous segments, perhaps more in the adults. The post-abdominal segments are unusually long.

The head is rather long, with a prominent median lobe having a produced obtuse tip, with a group of orange-brown ocelli on each side below; marginal lobes thin, rather wide, erect, nearly entire, those of the two sides confluent dorsally, with only a shallow median notch.

Head and buccal segment shorter than the following two segments; 3d to 5th setigerous segments are shorter; 6th is about equal to the 2d; 7th to 9th are elongated; 10th to 15th are very long with the tori at the posterior end. The length of these in a small specimen is 30 to 38^{mm}; diameter 3 to 4^{mm}; the 16th to 18th decrease rapidly in length. Two short preanal segments lack setæ. There is a narrow collar on the 4th setigerous segment and also on the 5th.

Uncini begin on the 1st setigerous segment, on which three or four stand in a row, in specimens about 50^{mm} long; four or five in each row on the 2d; six to eight on the 4th; longer rows farther back.

The caudal segment is cup-shaped with incurved sides and enlarged or annulated base; its margin bears about twenty-four slender cirri, alternately longer and shorter, with a distinctly longer one on the median ventral edge.

The capillary setæ of the first three setigerous segments are small, slender, acute, and nearly all are distinctly pennate to the tips, with rather long denticles; on the 4th segment they are partly, and on the 5th mostly, replaced by larger and longer, narrowly limbate, smooth setæ that taper rapidly to acute tips.

The uncini of the anterior region have a large, sharp, rostrate hook, directed somewhat upward, and three (sometimes four) small appressed apical hooks.

Color, in life, is light red in the smaller specimens, and with no definite red bands. The large ones were yellowish brown.

The tubes are made of fine shell-sand, and stand upright in the sand at low-tide.

In life the smaller specimens were about 50^{mm} long and 0.5^{mm} in diameter, the larger ones about 150^{mm} long and 4-5^{mm} in diameter.

In consequence of the modern revisions of the Maldanidæ by St. Joseph and others, it will be necessary to establish additional generic groups. The common, large New England species described by me (1873) as *Maldane elongata* cannot be placed in any of the recognized genera, and I therefore propose to establish a new genus for it.

Maldanopsis, gen. nov. Type *M. elongata* V., 1873.

Head with a well formed limbate cephalic plate, as in *Maldane*. Caudal segment with a wide, prominent foliaceous spatulate lobe on the dorsal side, and on the ventral side a deep, funnel-like, anal opening, surrounded by a distinct semi-circular rim, without denticulations, so that the anal opening is inside the margin of the anal plate, and not outside, as in *Maldane*. This plate is, therefore, more like that of *Petaloproctus*.

The anterior setigerous segment has no uncini; the 2d and 3d have short rows of rostrate uncini. All preanal segments bear setæ.

Lumbriclymene filifera Ver.

The *Maldane filifera* V., 1879, Proc. U. S. Nat. Mus., p. 179, does not belong to *Petaloproctus*, as St. Joseph supposed, but rather to *Lumbriclymene* Sars, 1871, but it differs from the type, so that the generic characters should be altered somewhat. Its anal region consists of a somewhat flattened cone, turned up dorsally and nearly acute, but without a limbus. The small anus is close to the tip on the dorsal side of the segment, while the oblique postero-ventral side may be flat or concave. The head has a central carina with a pit each side of it, but no definite plate or limbus. The anterior ventral tori contain one or two spiniform setæ. The two short preanal segments have small tori, but no setæ.

Praxillura Ver., 1879. Type, *P. ornata* V., op. cit., p. 179.

This cannot be united to *Lumbriclymene*, as St. Joseph has done with doubt. It differs very much in having spines on about seven anterior segments and a mixture of spines and uncini on others; in having very numerous segments (about 40); and in having the anal segments small and simple, or not specialized in any way, with the anus terminal.

This is, perhaps, the most generalized or primitive type of Maldanidæ hitherto discovered. This is shown in the simple structure of the head and caudal segment; in the large number of only slightly differentiated segments; in the increased number of anterior segments with simple spines, and in the mingling of spines and rostrate uncini in intermediate segments.

Eupolymnia, nom. nov.

Polymnia Malmgren, Ann. Polychæta, p. 108, 1867 (*non* Muls., Verr., Birds, 1866). Von Marenz., 1884. St. Joseph, Ann. Sci. Nat., Ser. 7, xvii, p. 219, 1894.

The above name is proposed as a substitute for *Polymnia*, which was preoccupied in 1866.

At the same time I propose to somewhat extend its limits, in order to include a remarkable Bermuda species for which it seems necessary to establish a subgenus, *Polymniella*.

As now understood, this genus is characterized mainly by having the ordinary Terebelloid form of body and cirri, with about 17–22 anterior segments bearing smooth capillary setæ, which begin on the 4th body segment. The uncini, which are rather simple, begin on the 5th segment. They have only two rows of apical denticles, usually with 2 and 3 in the rows; a rather long base, with a tubercle at each end, and a lateral tubercle for the ligament; on some of the anterior segments they form a single row, but farther back they are in two rows that face each other. The branchiæ are arborescent, the anterior usually largest. Usually there are three pairs, arising from segments 2, 3, 4, but in *Polymniella* the last is on the 6th segment.

The very large Bermuda species, *P. magnifica* (Webst.), see p. 599, above, is a typical member of this genus. It has over 120 segments, of which 17 bear setæ, and three pairs of large arborescent gills, the first pair largest.

Polymniella, subgen. nov.

This is proposed for the following new species which agrees with *Polymnia*, except in the arrangement of the branchiæ and anterior

setæ. There are three pairs of arborescent branchiæ, but they are situated on segments 2, 3, 6; segments 4 and 5 are without any trace of branchiæ in both specimens, though it is possible that they may have been accidentally lost from those segments, and in that case there would have been five pairs; the last pair is larger than the others. The capillary setæ begin on the 2d segment (or first branchial) and continue on 22 segments.

Eupolymnia (Polymniella) aurantiaca, sp. nov.

Cirri long and slender. The first segment is medially emarginate and recedes dorsally, but it advances in a broad lobe laterally; the next segment also has a similar lateral lobe. Ventral side with 10 short, transversely oblong glandular shields, with a few narrower ones farther back. The branchial stems are usually very short, as contracted; the branches are fine and numerous.

The uncini are much like those of typical *Polymnia*. The base is about twice as long as broad, wide and rounded anteriorly, but slightly convex, or even concave, on the basal edge. The rostrate hook is large, strongly incurved; the two apical hooks, as seen in profile, are unequal, small and closely appressed; in a top-view there is a central, rather small denticle, and five much smaller ones, standing nearly in one cross-row farther back. The capillary setæ are long, smooth, slender, scarcely limbate, mostly with delicate, thin, flat, flexuous tips.

Color, in life, orange red; the gills blood-red. Length of the largest specimen, which is mutilated beyond the 30th segment, in formalin, 50^{mm}. Castle Harbor, in dead corals. Only two specimens.

Streblosoma M. Sars, 1871.

Grymæa Malmgren, Ofver. Kong. Vet. Akad. Forh., 1865, p. 388 (non Fres., Protozoa, 1858).

Streblosoma M. Sars, Vidensk.-Selsk. Forh., 1871, p. 10. Type, *S. cochleatum* Sars.

The name *Grymæa* was preoccupied, and *Streblosoma* is, apparently, the only tenable name of this genus.

It is closely related to *Thelepus*, but has three pairs of clustered cirriform branchiæ, and the capillary setæ begin on the second segment (1st branchial). All, or nearly all, the segments bear setæ.

The only New England species is *S. spiralis* Ver., 1874, as *Grymæa*.

The following Bermuda species differs so much from the type that it seems to require separation as a subgenus.

Eugrymæa, sub. gen. nov.

Differs from typical *Streblosoma* in having 4 clusters of cirriform branchiæ on segments 2, 3, 4, 5, and sometimes a few cirri on the 6th segment. The capillary setæ begin on the 1st branchiferous segment, and continue on about 35 to 45 segments, or nearly to the end of the body.

Streblosoma (Eugrymæa) polybranchia, sp. nov.

Body rather slender. The two anterior segments have a lateral lobe on each side. Tentacular cirri long. Lower lip small, semicircular. The branchiæ consist of four crowded clusters of long, slender cirri on each side of the first four setigerous segments, with a few in one case on the fifth; the first ones are largest. The fascicles of setæ begin with the branchiæ; the first ones are well developed; the last observed, which are on the 45th segment, are very small. Anteriorly there are 8-10 or more long, slender ones, narrowly limbate, with very slender tips, and about the same number of shorter ones, more broadly limbate on one side, much bent distally, and with shorter tips. The fascicles become abruptly smaller beyond the 17th segment. No pennate setæ were observed.

The uncini begin on the 4th setigerous segment. They form simple curved rows of 40 or more on the anterior segments, and shorter rows of 10-14 posteriorly. They are minute, about as long as high, with an elongated base, narrowed anteriorly and ending in a small muscle-tubercle, convex on the middle of the base, but concave on the posterior margin, which inclines forward, so that the posterior end is prominent and rounded, with a small tubercle for the ligament; rostrate hook large and only a little incurved; seen in profile there are two or three small apical denticles or hooks; in a top-view there is the central rostral hook and two small hooks at its base, side by side, and one or three very minute ones in a row farther back, the middle being slightly larger and often the only one visible.

Color, in life, pale flesh-color; cirri whitish. Length, in life, about 40^{mm}. Castle Harbor, in dead corals.

Protothelepus, gen. nov.

Allied to *Euthelepus*. The first segment forms an erect, plain, narrow collar around the bases of the cirri. A single pair of long,

slender, cirriform branchiæ; they arise, close together, on the dorsal surface of the front of the 1st distinctly setigerous segment; a few small setæ occur on the branchial segment. Capillary dorsal setæ are borne by at least 17 segments (the posterior segments are wanting). Series of ventral uncini begin on about the 3d setigerous segment; all simple. The uncini are rounded basally and have no lateral tubercle; apical denticles few. A large semicircular lip projects strongly.

Protothelepus tenuis, sp. nov.

The two branchiæ are very long and slender, about 6 times as long as the diameter of the body, about equal to the cirri in diameter, and crenulated on the anterior side. Edge of buccal collar nearly even, or slightly crenulated; it has a few small, irregular pigment-spots that may be the remains of ocelli. The cirri are numerous, long and slender, strongly crenulated.

The dorsal fascicles contain 8-12 setæ, which are distinctly lanceolate, bilimbate, minutely denticulate, acuminate, with slender tips; those of the first fascicles are smaller, shorter, and less flattened; those on the branchial segment are almost rudimentary. A few small capillary limbate setæ occur on the 21st segment.

The uncini form short rows of 8-10 on the 3d setigerous segment. They increase gradually in number and form a simple row of 14-17 on segments 20-21; they are short, with a rounded incurved base and obtuse angles, and have two or three small apical hooks; the large rostral one is strongly incurved, nearly as long as the basal plate; the others are much smaller, being closely appressed to the primary one. In a top-view there are 3 series of small apical denticles, with 1, 2, and 3; or 1, 2, and 5; the last are very minute.

Length of the type (with only 21 segments remaining) about 15^{mm}.

Nicolea modesta, sp. nov.

A small, slender species with two pairs of small, slender, sparingly branched, stipate branchiæ; the second one smaller. The first segment forms a low collar, slightly scalloped dorsally, and with two rounded lobes on each side; it has a row of small ocelli.

There are 17 setigerous segments, and about 34, more posterior, which carry rows of uncini. The setæ begin on the 2d branchial segment; uncini begin on the 2d setigerous segment; they form long simple rows, turned forward, on the first six segments, but on several

following ones they are in two close, parallel rows, facing one another. They are minute, with a wide base, broad anteriorly; the rostrate hook is large, acute; the two apical hooks are very small. They resemble the uncini of *N. simplex* V. and of *N. venustula*, as figured by St. John, but the base is broader anteriorly than in the latter.

The setæ are slender, 3 or 4 longer and 2 to 4 smaller and shorter; all are slender, smooth, narrowly bilimbate, acute.

Length, in formalin, 15^{mm}. Bailey Bay, low-tide.

Loimia Bermudensis, sp. nov.

A rather stout species with three pairs of large, subequal, truly arborescent branchiæ, which have a rather long stem and very numerous branchlets, taking a somewhat conical arrangement when expanded. The lower lip is large, broadly rounded, and projects freely. There is also a large lobe partly behind it on each side. The buccal segment forms a broad hood-like fold in front of the bases of the cirri. There are also two lateral lobes on each side, on the 1st and 2d segments, below the bases of the anterior branchiæ. The fascicles of setæ commence, of full size, on the 3d branchiate segment, and are present on 17 segments. The fascicles contain about 32, in two rows, decreasing gradually in length. The larger ones are scarcely limbate, and taper gradually to sharp points. They are smooth except at the tips, where they are, in most cases, finely denticulate. The smaller ones are much more distinctly pennate on one side along the distal portion. Rows of uncini begin on the 2d setigerous segment; the rows are long, with very numerous large uncini, which on certain segments stand back to back in two parallel rows, with a parabolic ventral prolongation. They are higher than long, with five large, sharp, incurved hooks, decreasing somewhat distally; the base is oblique and convex, with an angular posterior lobe for the attachment of the ligamental filament and with a slender proximal process for the muscle attachment.

Color, salmon or pale flesh-color, in life.

Diameter 5 to 6^{mm}; length of the longest, in formalin, 45^{mm}, mutilated posteriorly.

The tube consists of a thin tough lining, covered with loosely adherent coarse fragments of shells, etc. Two specimens were taken.

Bailey Bay, low-tide, under stones.

***Polycirrus corallicola*, sp. nov.**

A small, slender species, swollen anteriorly, attenuated posteriorly, consisting of about 45 segments in the type (perhaps immature). Cirri very numerous, slender, often clavate.

Fascicles of capillary setæ are present on 23 segments; rows of uncini begin on the 7th setigerous segment and continue to the end of the body; setæ and uncini are both present on 17 segments; 16 posterior ones have uncini only, the last rows with very few (2 or 3) minute ones, but they have filiform posterior ligaments.

The setæ are of two kinds: 4-6 smooth, slender, narrowly limbate, acute ones, often bent distally; and 5-8 more slender, bipennate ones, with rather long, hair-like denticles and very acute tips. Farther back each kind becomes shorter, stouter and fewer.

The uncini are minute, in single rows, the longest rows with about 25; they are usually longer than high, with a long, narrow base, tapering to a narrow, subacute anterior end, which terminates in a small muscle-tubercle; the posterior end of the basal plate is prominent, with a distinct ligament-tubercle; the rostral hook is large, long, incurved, nearly as long as the base; there are two small appressed apical hooks, the second one very small. In a top-view there seems to be a row of three very minute, distal, apical denticles.

The color, in life, is red. Bailey Bay, 3-4 feet, in corals.

Length of the type, 10^{mm}; diameter, 1^{mm} in formalin.

***Polycirrus pennulifera*, sp. nov.**

A small, slender species, composed of about 65 segments, elongated posteriorly and swollen anteriorly, with numerous slender, highly contractile cirri. The setæ are present on 20 segments. Uncini begin on the 21st in very small rows and continue on about 40, or close to the end. They are very minute, and none of the rows are very long (15 or 16); they are longer than high, with a long wedge-shaped base, acute anteriorly, with a small terminal muscle-tubercle; the posterior angle is rounded and prominent; the posterior upright edge is concave in the middle; the rostral hook long, very acute, scarcely incurved, considerably shorter than the base and nearly parallel with it; there are two small, apical, closely appressed hooks, the second very small.

The setæ are slender, with the blade flattened and rather strongly bilimbate, so that they have a linear-lanceolate form, acuminate at tip; the limbus is obliquely striated, and the edge is minutely pen-

nate, so that they somewhat resemble narrow feathers, hence the name. Their form is unusual in the genus, but is similar to that of *P. denticulatus* St. Joseph.

Color, in life, bright red. Length, about 35^{mm}. In dead corals.

Polycirris luminosus, sp. nov.

A third species of *Polycirrus* has long, slender, simple setæ on at least 31 anterior segments, accompanied by long rows of minute uncini after the 7th segment.

The setæ are numerous in the 17 anterior fascicles, of two sizes, the larger about $\frac{1}{3}$ as long as the breadth of the body, very slender, not limbate, flexuous, tapering to a long sharp point; the small ones are similar to the larger ones, and about as numerous. On segments 25–31 they are few and small. Uncini begin on the 8th setigerous segment and continue to very near the posterior end, being present on over 40 segments; they form long simple series anteriorly, but back of the 30th segment they are on pinnulæ, in smaller rows of 10–15, but with very distinct posterior capillary ligaments. The anterior ones are very minute, longer than high, with a shoe-shaped base, a little turned up and subacute anteriorly, and with a prominent heel and concave sole; the upright part is concave above the heel; the large rostral hook is about half the length of the base, little incurved; apical denticles 2 or 3, the more distal ones very minute. On the posterior segments the uncini become higher, with a shorter base, and with two minute apical hooks in a side-view.

Color in life, bright red. It is brilliantly phosphorescent with a bluish light. Bailey Bay, 30–40 feet, among dead corals.

The descriptions of the two following very interesting species have been prepared by Miss Katharine J. Bush:—

Sthenelais setosa Bush, sp. nov.

Although only the anterior portion of an example belonging to the genus *Sthenelais* was found, it seems so to differ from all the species previously described from the West Indian and southern Atlantic faunæ as to deserve description.

The 27 segments occupy a length of about 10^{mm}, with a width, including the setæ, of 3^{mm}.

The cephalic lobe is about twice as broad as long, but little rounded posteriorly and well rounded anteriorly, with a large, trilobed basal

portion of the median tentacle arising from the middle of its dorsal surface and reaching well forward. The central portion, to which the long, smooth, tapered, median tentacle was attached, is about three times as long as broad, vase-shaped, and attached to the cephalic lobe by a slender, short stem, with a narrower, shorter, leaflike lateral lobe (etenidium) on each side. There are four eyes; the very large posterior pair are situated just at the base of this lobe and the very small anterior pair lie just underneath the posterior edge of the lateral lobes. There is a pair of conspicuous setigerous lobes, reaching forward from the anterior surface of the cephalic lobe, each of which bears a cirrus of moderate length, arising from its median dorsal surface, above which is a cluster of numerous very fine, hair-like setæ, corresponding in number and form to those of the dorsal bunch of the lobes of the parapodia. Arising from the ends of these lobes are setæ of various forms, similar to those of the ventral bunch of the feet. Arising from the sides of the head, and partly consolidated with the cephalic lobe, are a pair of long setigerous lobes similar in form to those on the following segments. The first one is without a cirrus, but at its base is a conspicuous fleshy lobe, to the upper surface of which is attached the first pair of scales, or elytra; underneath and reaching out from the side of this lobe is the short dorsal cirrus of the second pair, which has a large swollen basal portion and a short tapered end.

Each of the following segments is furnished with a similar, but larger, dorsal cirrus, to the upper surface of the swollen basal portion of which the elytra are attached (on segments 1, 2, 4, 6, 8, 10, 12, 14, 16, 18, etc.). Only a few of the anterior elytra are present. These, which have a somewhat rounded form, are white and very thin, with the posterior edge ornamented with a few short, unequal, somewhat tapered filaments, and on the upper surface having very minute, scattered spinules. A slender ventral cirrus is present on all the setigerous lobes, those on the front of the head being much longer than the others.

From the ventral surface of the head arise the tentacle and palpi (only those on one side of the head are perfect, but they were presumably arranged in pairs). Attached underneath the base of the lateral setigerous lobe is a moderately slender, smooth, tapered, lateral cirrus, reaching to about the end of the ventral setæ.

Underneath the frontal, setigerous lobe arises a very long (3^{mm}), stout, smooth, tapered palpus; attached to the side of this and somewhat underneath, is a moderately slender, smooth tapered tentacular cirrus, about as long as, and similar to, the lateral cirrus.

From near the center of the head and below these other organs, arises a peculiar shaped one, attached to the head by a long, slender stem, having a rounded swollen central portion, with a moderately long, rather blunt, articulated, curved terminal portion.

Setæ of the dorsal bunch of one form, very numerous, like fine tapered hairs of graduated lengths, very delicately microscopically spinulose. There are four distinct forms in the ventral bunch. There are 8 or 10 in the lowest series, of graduated lengths, having smooth, slender, tapered, 2-4-jointed terminal portions, with delicate bifid tips, affixed in broader, shorter basal portions; above, a series of 8-10 with short, broad, graduated terminal portions having conspicuously curved, bifid ends, affixed in much broader, very long basal portions; above these, 3 or 4 long, slender ones, with 3-4-jointed, smooth, terminal portions having delicately tapered ends, affixed in broader, conspicuously spinulose basal portions; above these, 3 or 4 shorter stiff ones, conspicuously spinulose and rather broad, with regular tapered, striated or delicately banded ends.

Other species from this region belonging to the Sigalionidæ (*Sigalionina* Kinberg, 1855-58) are *Sthenelais articulata* Kinberg, 1855-58; *Sigalion Edwardsi* Kinberg, 1855-58 (= *Thalanesa* Baird, 1865); ? *Sigalion pergamentaceum* Grubé, 1855; and *Sigalion Pourtalesii* Ehlers, 1887.

The *S. articulata* differs in having long, articulated palpi, a smaller tentacular lobe, and smaller eyes.

***Chrysopetalum elegans* Bush, sp. nov.**

Two specimens of a very beautiful species belonging to the above genus were collected in 1-3 feet. The larger one has about 65 segments and measures 15^{mm} in length and 2^{mm} in greatest breadth, including the setæ, and about 1^{mm} in thickness.

The palæ are of a beautiful light golden color and are arranged in two series of from 15-20 on each segment, spreading out like a bunch of palm leaves, and from about the ninth segment meeting over the center of the back, forming a conspicuous ridge along the dorsum of the body. They have the form of long, narrow leaves, with coarsely serrulate margins, curved upward, and long spinulose tips; the center having coarse, equally separated, longitudinal ribs, 5 or 6 in number, running the entire length; the entire surface is also cross-striated and covered with microscopic granules.

The dorsal and ventral rami are well-separated, making the body somewhat angular in outline. Each is supported by a single aciculum. The dorsal one the shorter, with a prominent, swollen, brown-

ish terminal portion, to which the rather stout, abruptly tapered cirrus is attached; this reaches a little further than the paleæ and often shows a dark color-patch near its inner end; the surface of both is distinctly microscopically granular. At the base and in front of this swollen portion, the setæ, about 10 in number, arise; they are of one kind, being similar in form to the paleæ, but narrower and more regularly tapered, and often have a conspicuous triangular process attached near their bases for their entire width.

The ventral ramus is less rounded and broader, and bears numerous, fine, jointed setæ of one form, their terminal portions being rather long and narrow, but little tapered, finely serrulate along their inner edge, with curved bifid tips, the shafts conspicuously pointed and longitudinally ribbed. The ventral cirrus is of moderate length, abruptly tapered.

On the back of the head there are three pairs of subequal black spots, apparently ocelli; those of the first and third are well-separated; those of the second pair, which is midway between these, are close together, nearly touching each other. On the perfect example the paleæ do not meet in the center so that they are readily seen on the first eight segments.

Only two other related species have been described from these waters:—*Palmyra elongata* Grubé, 1856, and *Bhawania Goodei* Webster, 1884; the latter was also found by Professor Verrill at Bermuda.

GEPHYRÆA.

Four or five species of Gephyræa were obtained with large numbers of interesting annelids, by breaking up masses of dead, or partly dead, massive corals from the reefs. Several large and beautiful species of *Leodice*, *Marphysa*, *Nicidion*, and *Paramarphysa* were secured in this manner.

The commonest gephyræan in corals is *Physcosoma varians* (= *Phascolosoma varians* Kef.). It is 1.5 to 2 inches long, clavate posteriorly, and thickly covered dorsally with black or brownish black specks and transverse patches, especially on the anterior part, where the blackish color is usually crossed by pale bands of varying breadth; ground-color pale salmon. Posterior region closely covered with large, conical, brown grains or papillæ, becoming longer near the tip. The grains are lower with rounded tops on the mid-dorsal region; smaller and fewer beneath; near the base of the proboscis they become conical and crowded. The distal part of the proboscis is surrounded by about 20–30 close rows of minute, black, curved,

acute, hooks, arranged closely side by side in each row; these are followed by close circular rows of minute rounded granules, which increase in size proximally.

The integument is firm, but somewhat translucent, and contains about 30 principal muscular bands, with irregular smaller ones between them.

This species appears to be the same as *Sipunculus granulatus* Pourt., 1851, from Florida, but it is probably distinct from the European *Physcosoma granulatum* (Leuck.).

It is evidently very closely related to, and perhaps identical with, *P. puntarenæ* (Erst & Gr., 1858), described from St. Croix.

Phascolosoma cylindratum Kef.

The second species is about 40^{mm} long and 3-4^{mm} in diameter, translucent whitish, tapering posteriorly, and almost perfectly smooth, but with microscopic pale granules posteriorly and with rows of minute, obtuse hooks on the anterior part of the proboscis; tentacles small, papilliform. This was more abundant in shell-sand at low-tide and under stones. The original type was from Bermuda.

Aspidosiphon spinulosum, sp. nov.

A third species, belonging to *Aspidosiphon*, was found in dead corals. The body is about 20^{mm} long; the proboscis 24^{mm}, as preserved, and slender. The posterior shield is round, convex, light brown, with many radii; the siphonal shield is round, dark brown, covered with angular chitinous grains. The body is granulated with minute chitinous points close to the posterior end; the proboscis is covered above with minute black, sharp, recurved spinules, becoming fewer and smaller beneath. The large retractor muscles are attached far back.

Golfingia elongata, sp. nov.

The fourth species is, perhaps, a *Golfingia*. Its body is slender, about 20^{mm} long, 2^{mm} in diameter; the extended proboscis is 15-20^{mm} long and about 1^{mm} in diameter. Color, yellowish brown. The horny ring at the base of the proboscis is dark brown, wide, and gibbous dorsally, much narrower beneath, tapered anteriorly, covered with strong longitudinal and divergent ridges. The posterior shield is round, conical, with fine radial lines. The proboscis is rugulose, wrinkled, covered with minute, sharp, erect spinules, arranged without order. It is darker brown than the body, which is white posteriorly and smooth for about $\frac{1}{3}$ of its length.

EXPLANATION OF PLATE.

PLATE LXX.

- Figure 1.—*Lineus albocinctus*, sp. nov. Dorsal view. $\times 1\frac{1}{2}$.
 Figure 1a.—The same. Side view of head. Enlarged.
 Figure 1b.—The same. Dorsal view of head. Enlarged.
 Figure 2.—*Lineus albonasus*, sp. nov. Dorsal view. Natural size.
 Figure 3.—*Teniosoma curtum* (Hubr.). Dorsal view. $\frac{1}{2}$.
 Figure 4.—*Barentsia timida*, sp. nov. $\times 10$. From a photograph.
 Figure 5.—*Pseudoceros superbis* Lang. Dorsal view. Natural size.
 Figure 6.—*Pseudoceros pardalis*, sp. nov. Dorsal view. $\frac{2}{3}$.
 Figure 6a.—The same. Posterior part. Ventral view; *a*, mouth; *b*, male genital pores; *c*, female genital pore; *d*, sucker. Enlarged.
 Figure 7.—*Cistella cistellula*. Dorsal and ventral sides. $\times 10$.
 Figure 8.—*Diazona picta*, sp. nov. One small lobule. About natural size.
 Figure 9.—*Ammonothea* (*Ammonothea*) *rugulosa*, sp. nov. Much enlarged; from a photograph.
 Figure 10.—*Achelina* (?) *gracilis*, sp. nov. Much enlarged; from a photograph.

ERRATA.

- Page 21, line 4, for 15 read 14; line 7, for 14 read 13; line 12, for 14 read 13; line 17, for 13 read 16; line 20, for 16 read 15.
- Page 48, line 38, for matter read water.
- Page 58, line 24, for Linné read Müller; line 32, for Linné read Müller.
- Page 59, line 15, for Linné read Müller.
- Page 62, line 20, for D. read P.
- Page 72, line 30, for Chemn. read Müller.
- Page 78, line 23, for *Mülleri* read *striatus*.
- Page 91, line 11, for P. read N; line 25, add C. bifrons, 55.
- Page 91, line 27, add 76 after 67; line 27, omit 76 after 68.
- Page 92, line 29, omit 73.
- Page 93, line 26, for *parvus* read *nanus*.
- Page 102, line 19, for are read were.
- Page 103, line 11, for 1848 read 1842.
- Page 108, line 10, for or read *nee*.
- Page 121, line 4, for pillow read pillar.
- Page 124, line 3, for callus read callous; line 36, for callus read callous.
- Page 133, line 15, for 1865 read 1883.
- Page 134, line 16, for 202 read 201.
- Page 139, line 36, for lvi read lviii.
- Page 201, line 6, for Ludiinæ read Luidiinæ.
- Page 342, line 11, for Ophietodia read Ophientodia.
- Page 357, line 15, for Ophioscolicid read Ophioscolicidæ.
- Page 359, line 22, for *Ophioscolicidæ* read *Ophioscolicidæ*.
- Page 361, line 18, for *Ophioscolicidæ* read *Ophioscolicidæ*.
- Page 381, line 10, for Ophiobranchiontidæ read Ophiobranchiontidæ.
- Page 493, line 6 for 1876 read 1853, as *sancta-georgiensis*; line 7, for 1888. Heilprin, Stone, read 1878. Bartram.
- Pages 494, 495, 496, 501, 502, for Cook read Cooke.
- Pages 495, 497, for M. C. Cook read C. M. Cooke, Jr.
- Page 496, line 2, from bottom, for 1888 read 1878.
- Page 506, line 25, add Prime's list is in the Bermuda Almanac for 1853.
- Page 507, line 9, after *sancta-georgiensis* add=*H. appressa*.
- Page 513, foot note, for M. C. Cook read C. M. Cooke, Jr.
- Page 515, line 29, for *Pleurorbranchus* read *Pleurobranchus*.
- Page 521, line 26, for *reticulâ* read *reticulatâ*.
- Page 525, line 5, for *Montrouzier* read *Montrouzieri*.
- Page 539, line 36, for *Mangonia* read *Manzonia*.
- Page 544, line 2, for 15 read about 11; line 3, for 15 read about 8; line 21, for 12 read 16; line 22, for 6 read 9; line 33, for about 4 read 12.
- Page 554, line 5, for 1876 read 1872; line 25, for 1887 read 1889.
- Page 584, line 16, for 40 read 41; for all read nearly all.
- Page 584, line 23, for *Ophidiaster* read *Linckia*.
- Page 615, line 4, for P read H.
- Page 616, line 18, for Typanosyllis read Trypanosyllis.

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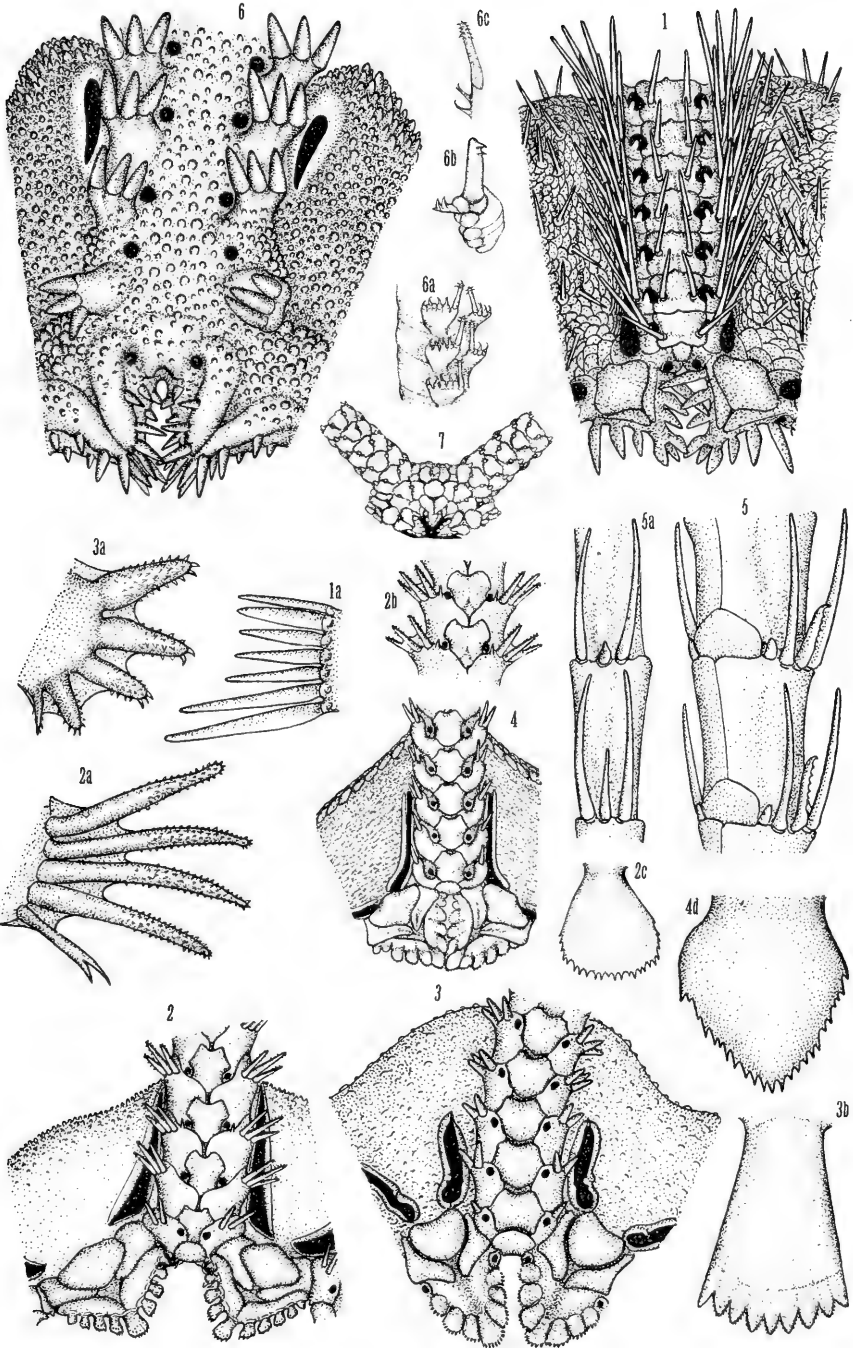
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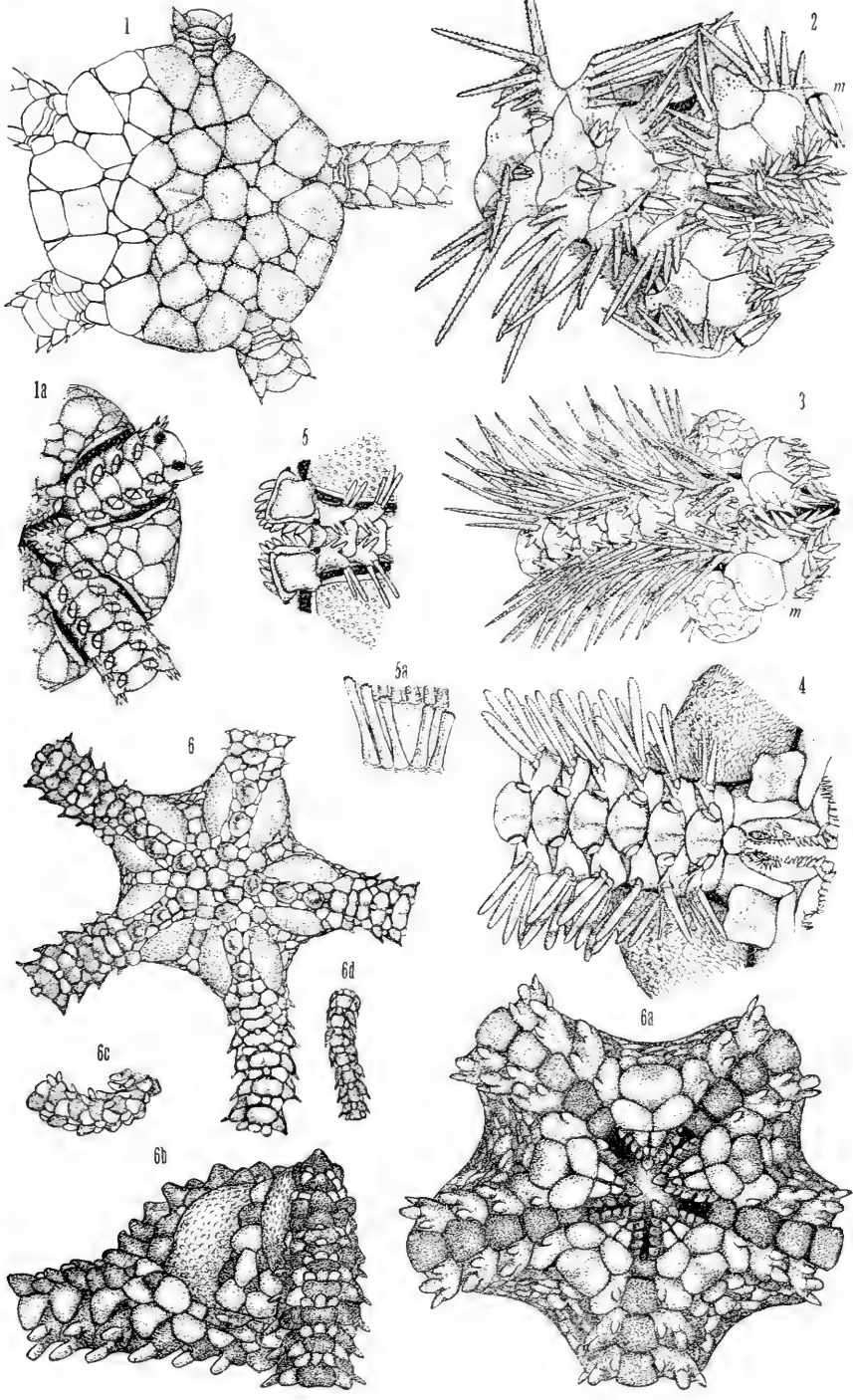
- Verrill, A. E.—Nudibranchs and naked Tectibranchs of the Bermudas (one plate), 545-550.
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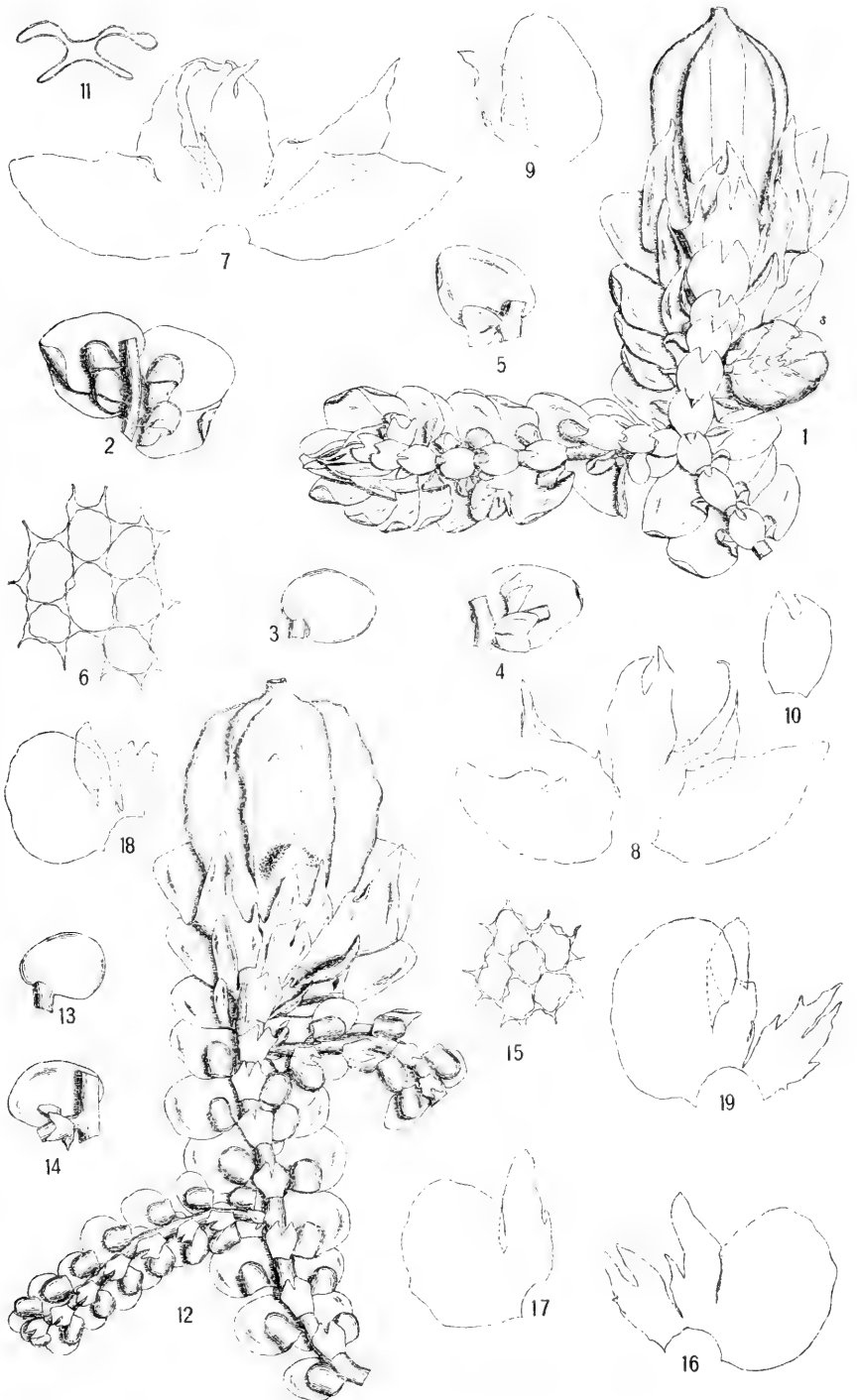
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Page 666, line 6, for *Polycirris* read *Polycirrus*.









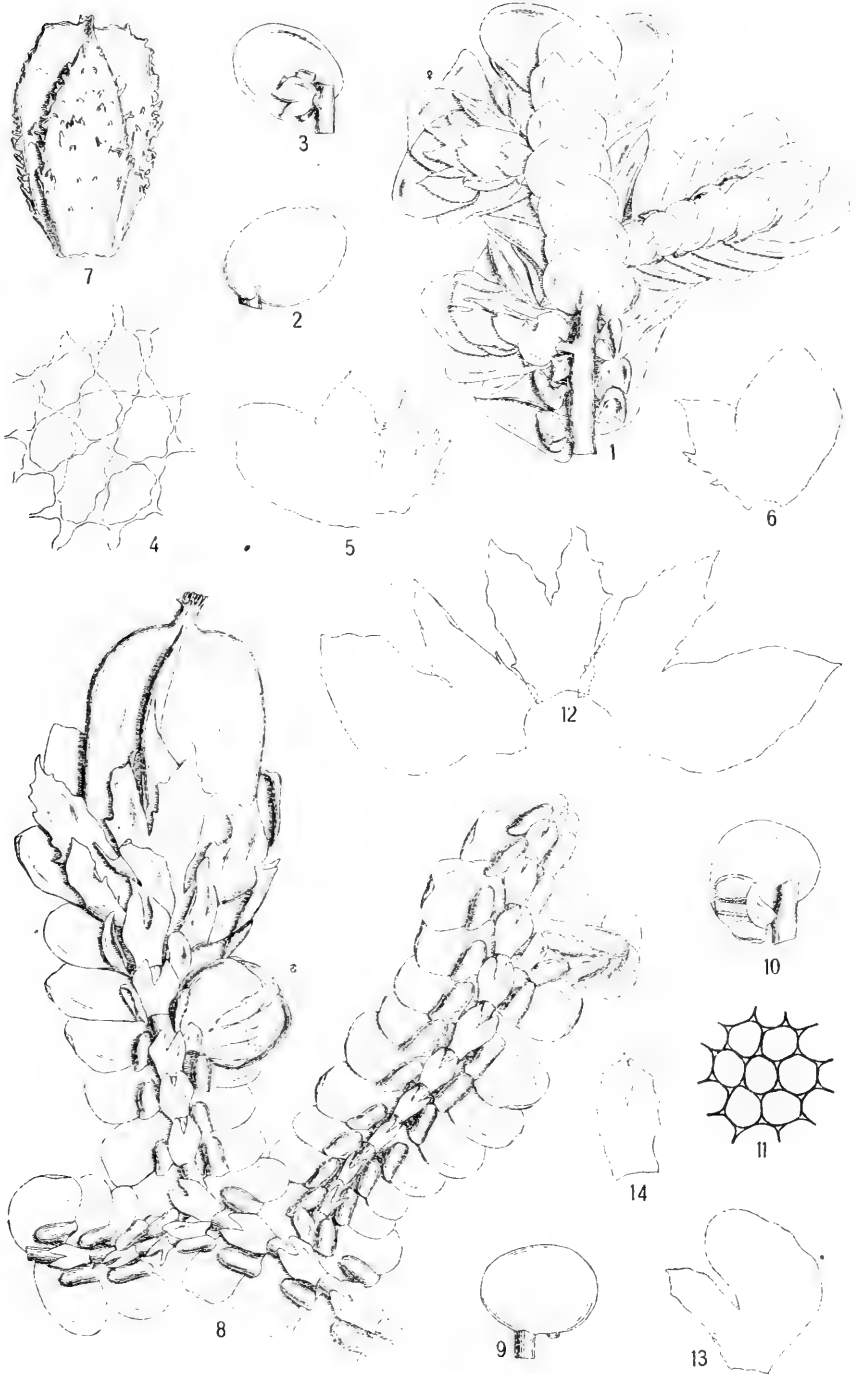
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Holboell. From C. Eaton.

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12-19. *FRULLANIA OAHUENSIS* Hampe.

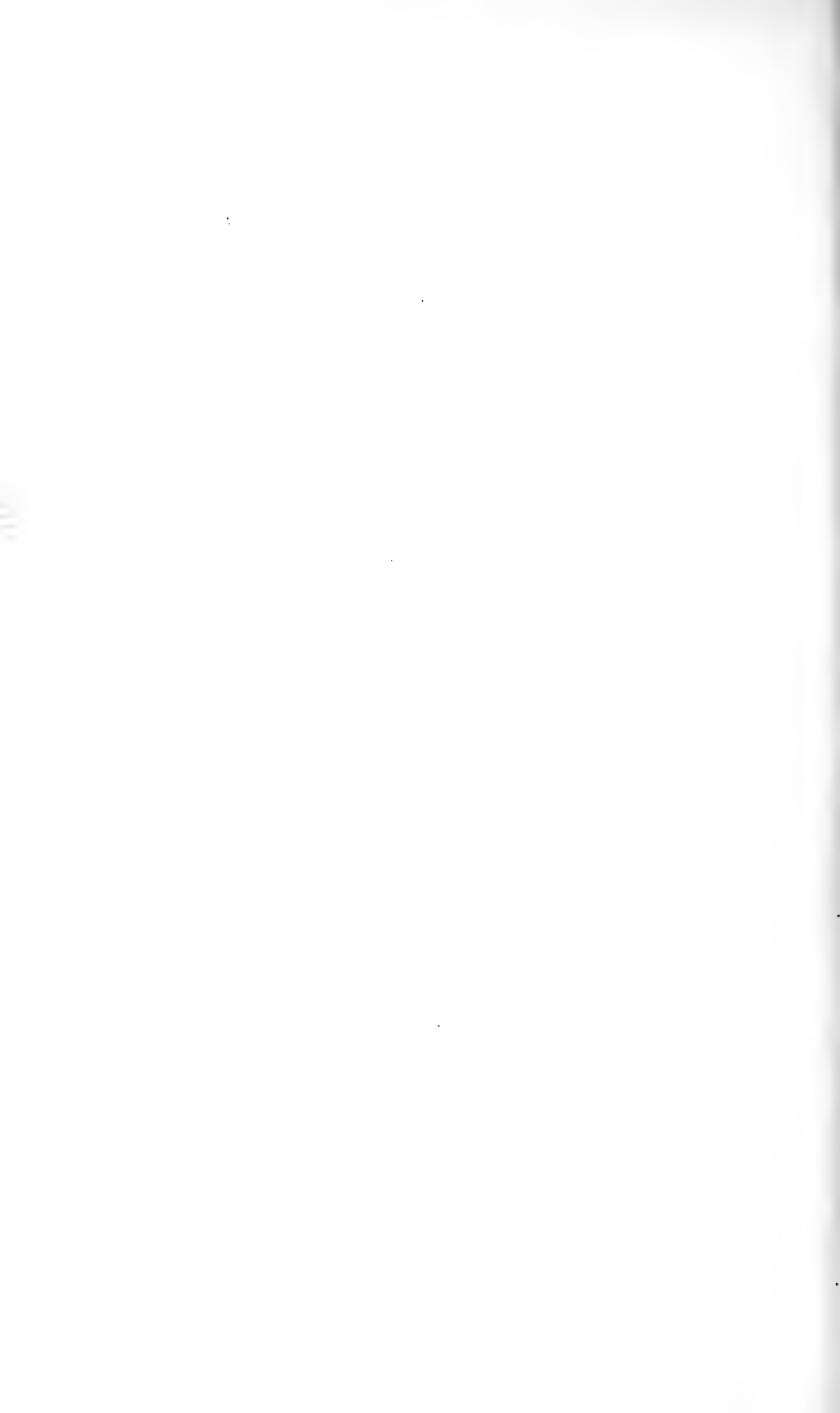


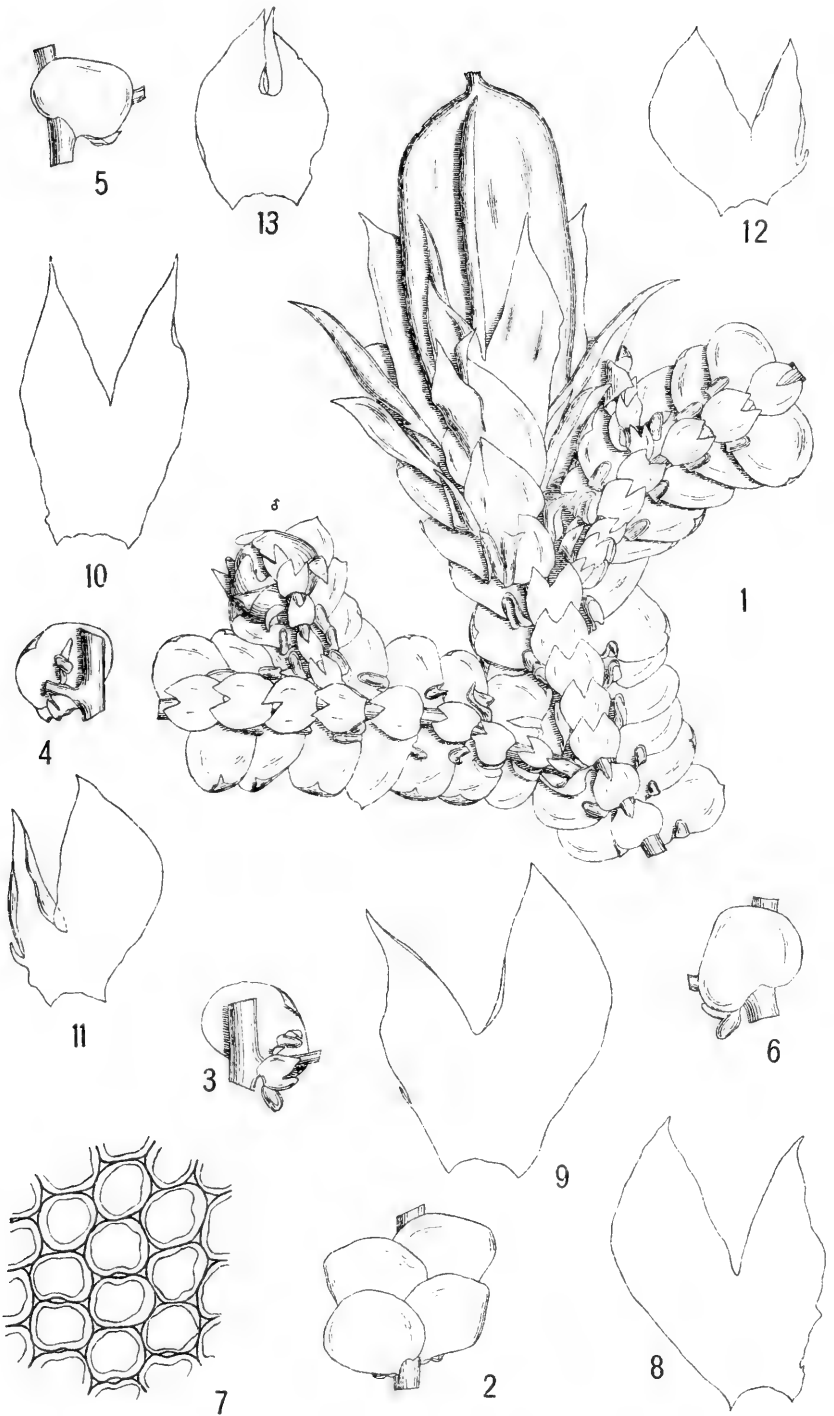


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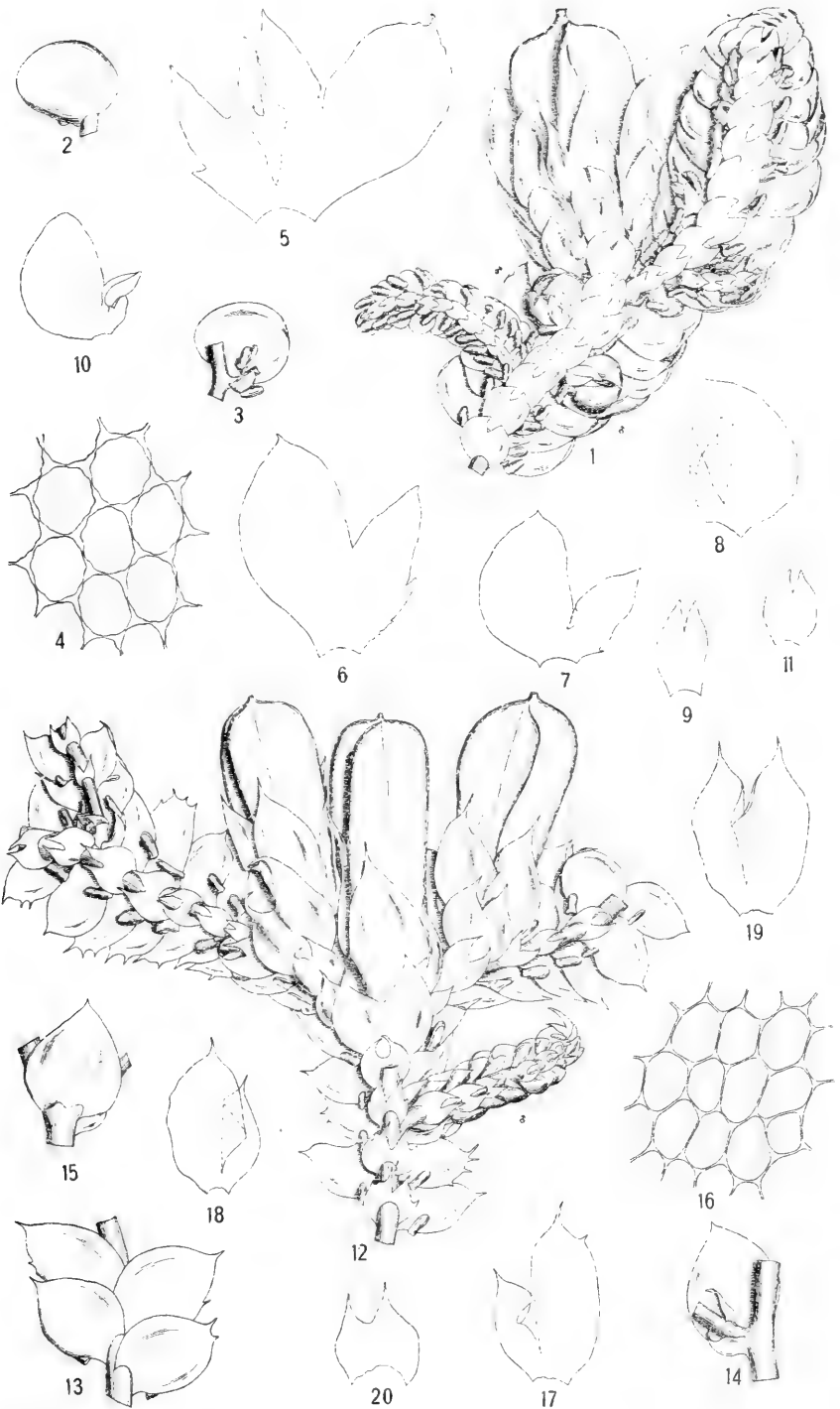
1-7. *FRULLANIA SANDVICENSIS* Angstr.
 8-14. *FRULLANIA MEYENIANA* Lindenb.





FRULLANIA APICULATA (R. Bl. and Nees) Dumort.

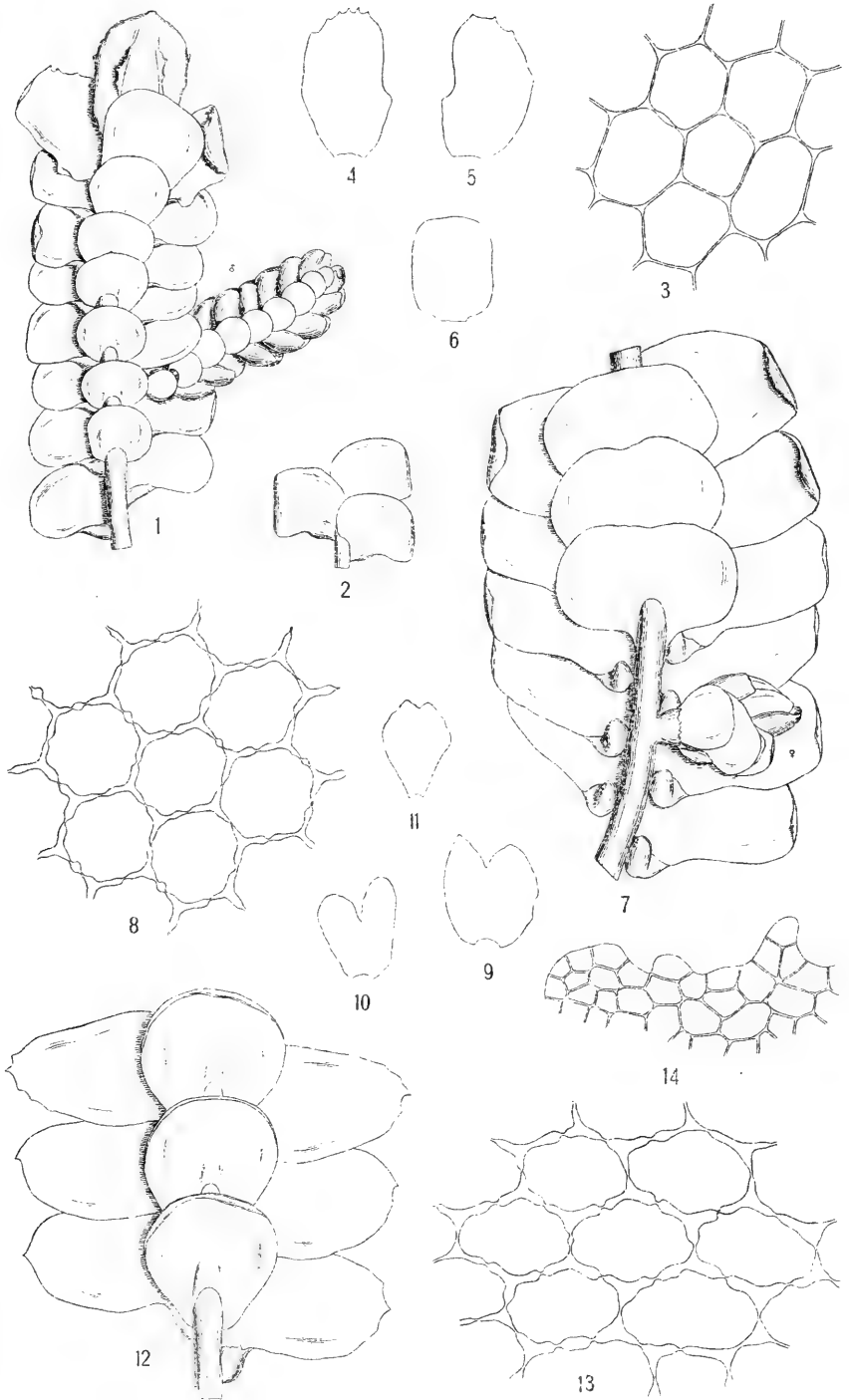




1-11. FRULLANIA HYPOLEUCA Nees

12-20. JUBULA PILIGERA (Aust.) Evans.

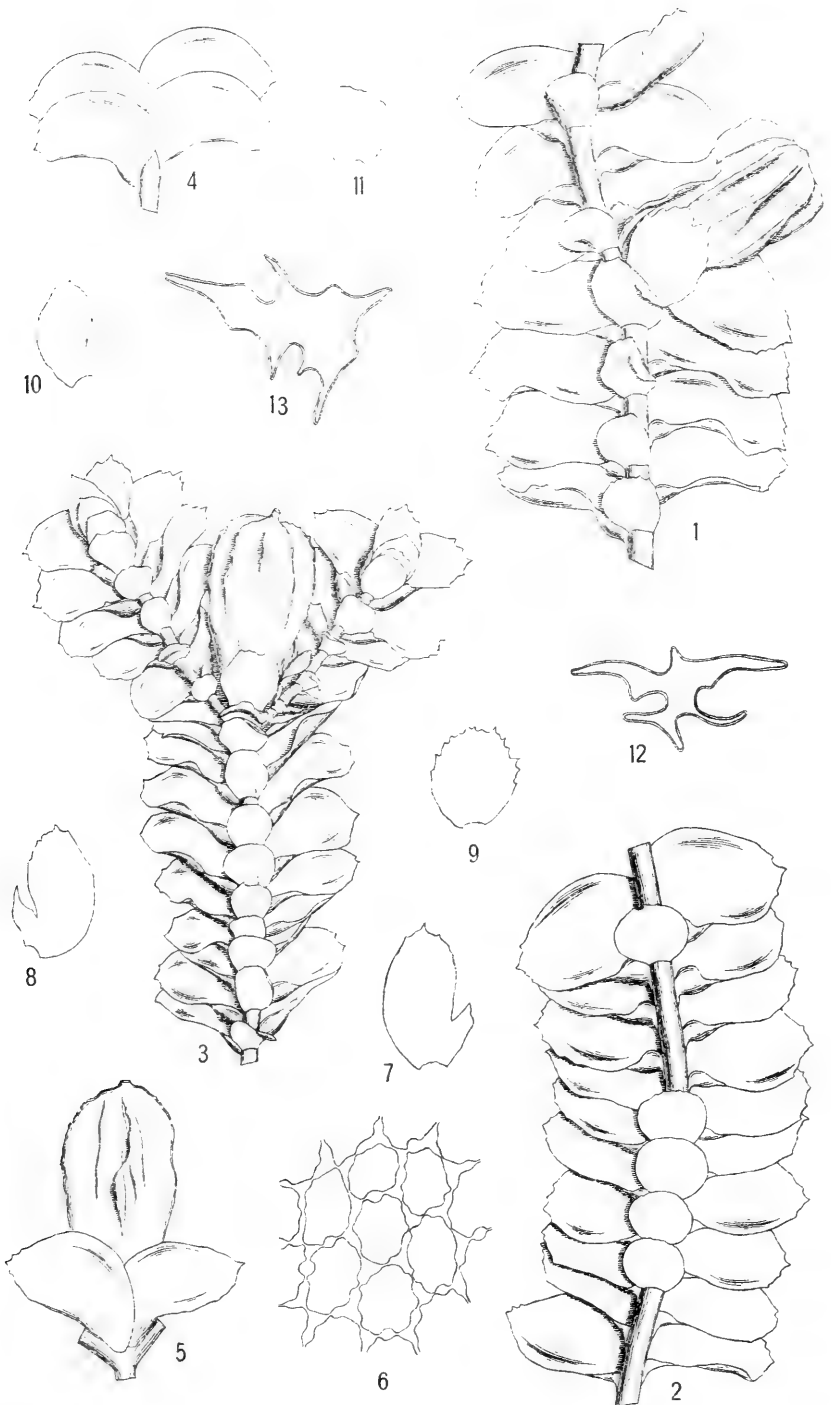




AMEvans from Newm.

- 1-6. *LOPHOLEJEUNEA SUBNUDA* (Mitt.) Steph.
- 7-11. *PLATYLEJEUNEA BACCIFERA* (Tayl.) Steph.
- 12-14. *MARCHESINIA MITTENII* Evans.

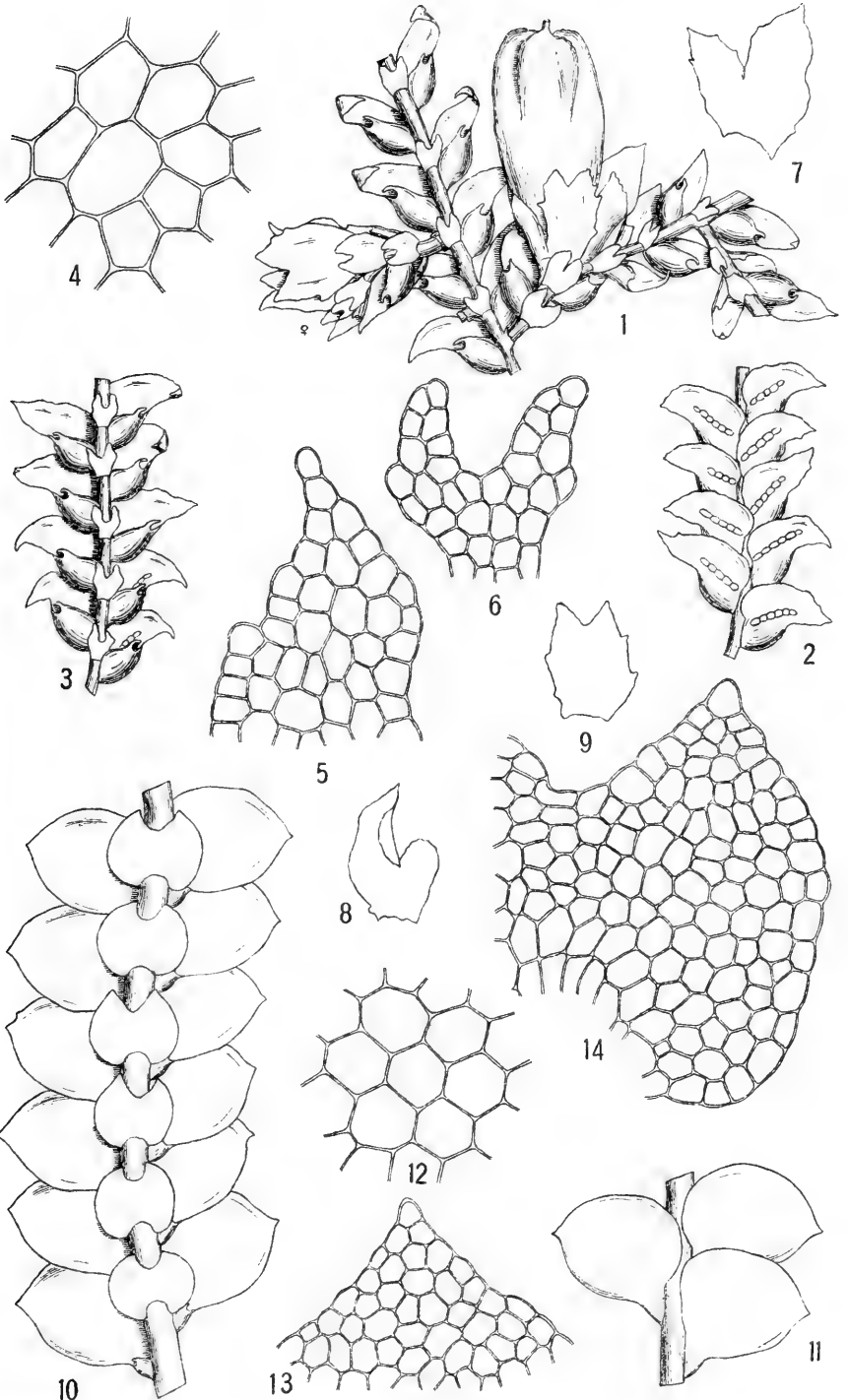
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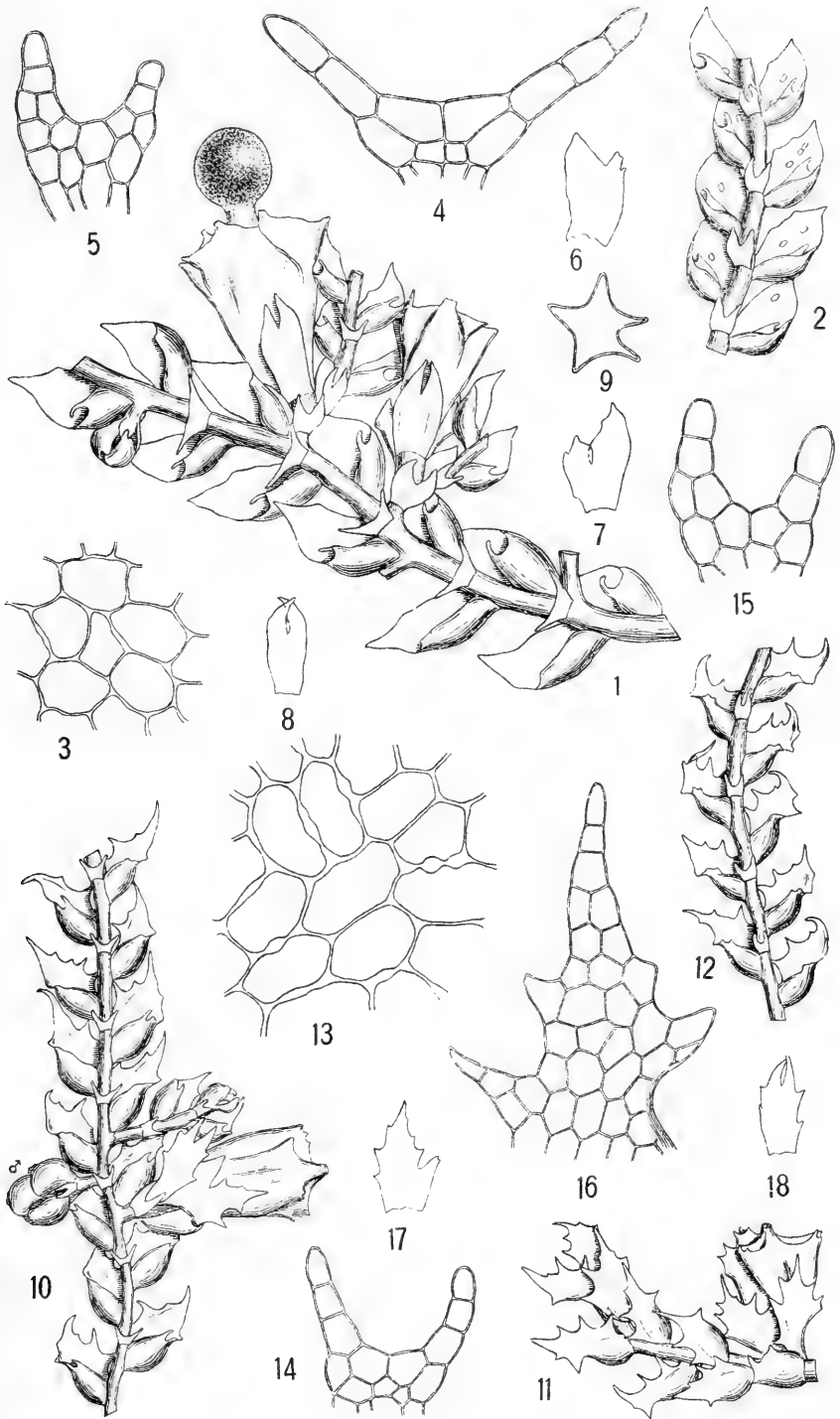
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THYSANANTHUS ELONGATUS (Aust.) Evans.



1-9. *HARPALEJEUNEA PSEUDONEURA* Evans.

10-14. *HARPALEJEUNEA OWAIHIENSIS* (Gottsche) Evans.

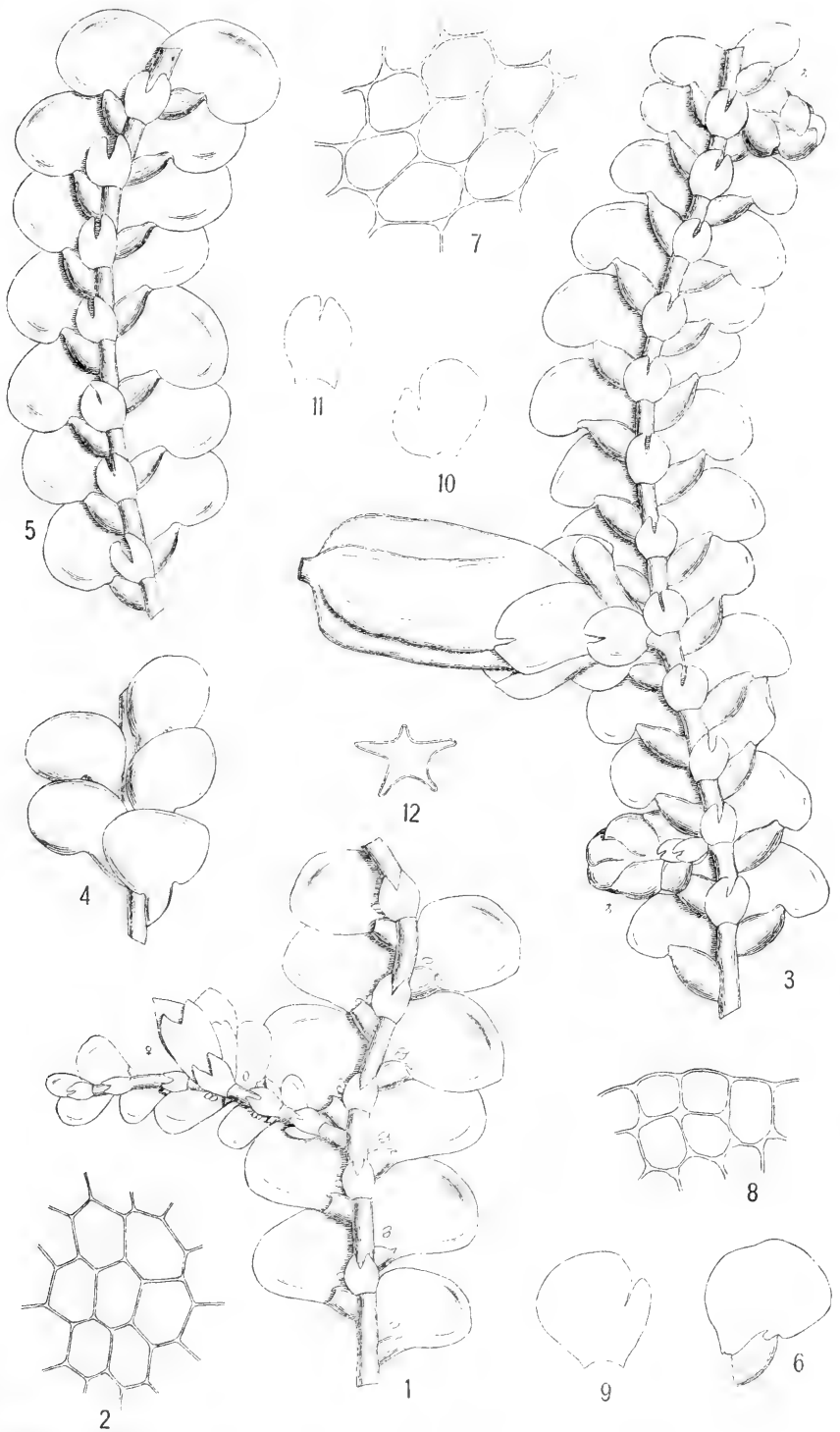


Andersson, in Nature

Stephenson, Bot. Soc.

1-9. *DREPANOLEJEUNEA ANDERSSONII* (Ångstr.) Evans.

10-18. *DREPANOLEJEUNEA UNCINATA* (Mitt.) Steph.



1-2. *CERATOLEJEUNEA OCLATA* (Gottsche) Steph.

3-12. *TRACHYLEJEUNEA OAHUENSIS* Evans.



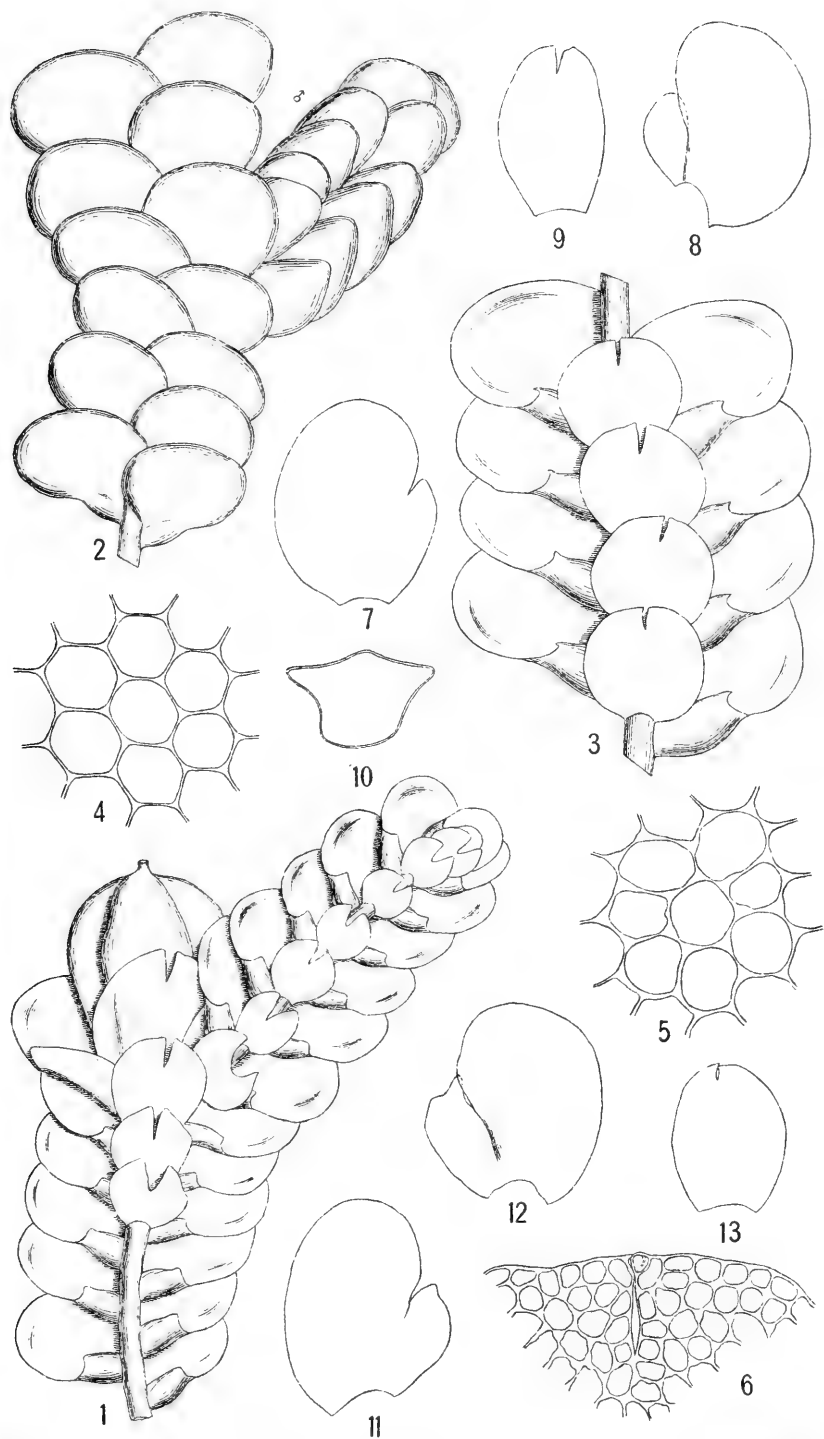


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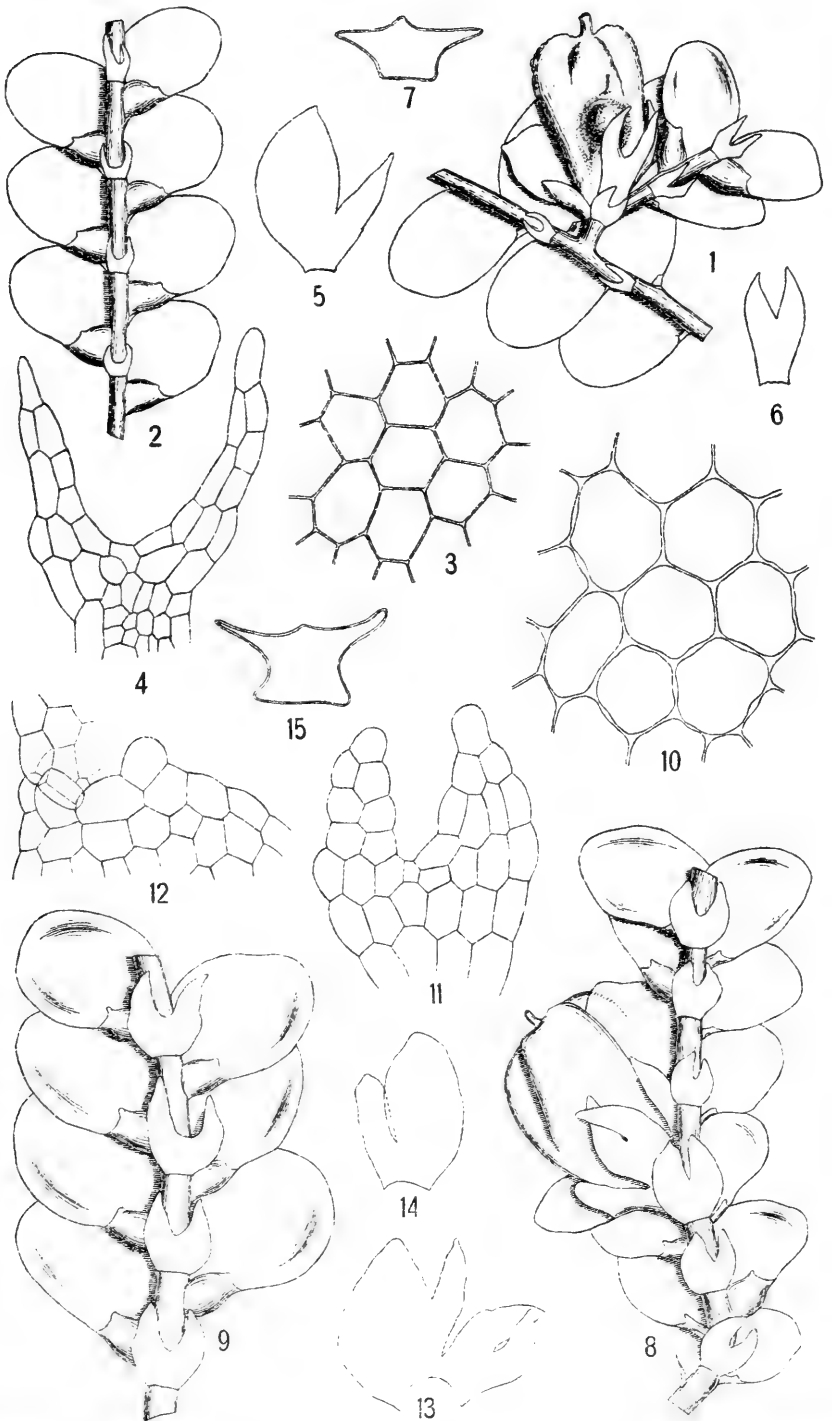
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1-7. CHEILOLEJEUNEA STENOSCHIZA (Ångstr.) Evans.

8-14. CHEILOLEJEUNEA HAWAICA Steph.



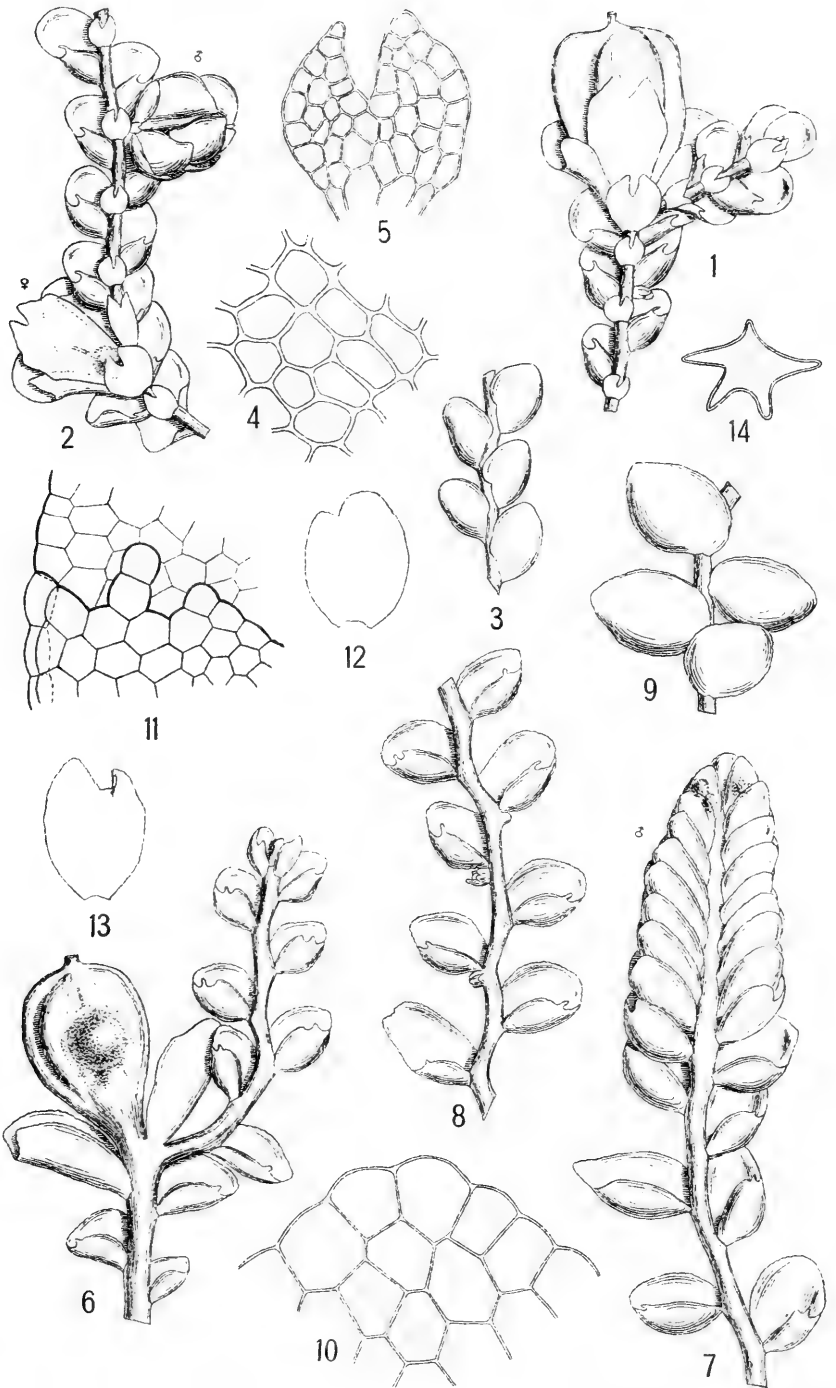
CHEILOLEJEUNEA INTERTEXTA (Lindenb.) Steph.



AL. Engelm. & A. N. S. P.

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1-7. *LEJEUNEA PACIFICA* Mont.
 8-15. *LEJEUNEA ANISOPHYLLA* Mont.

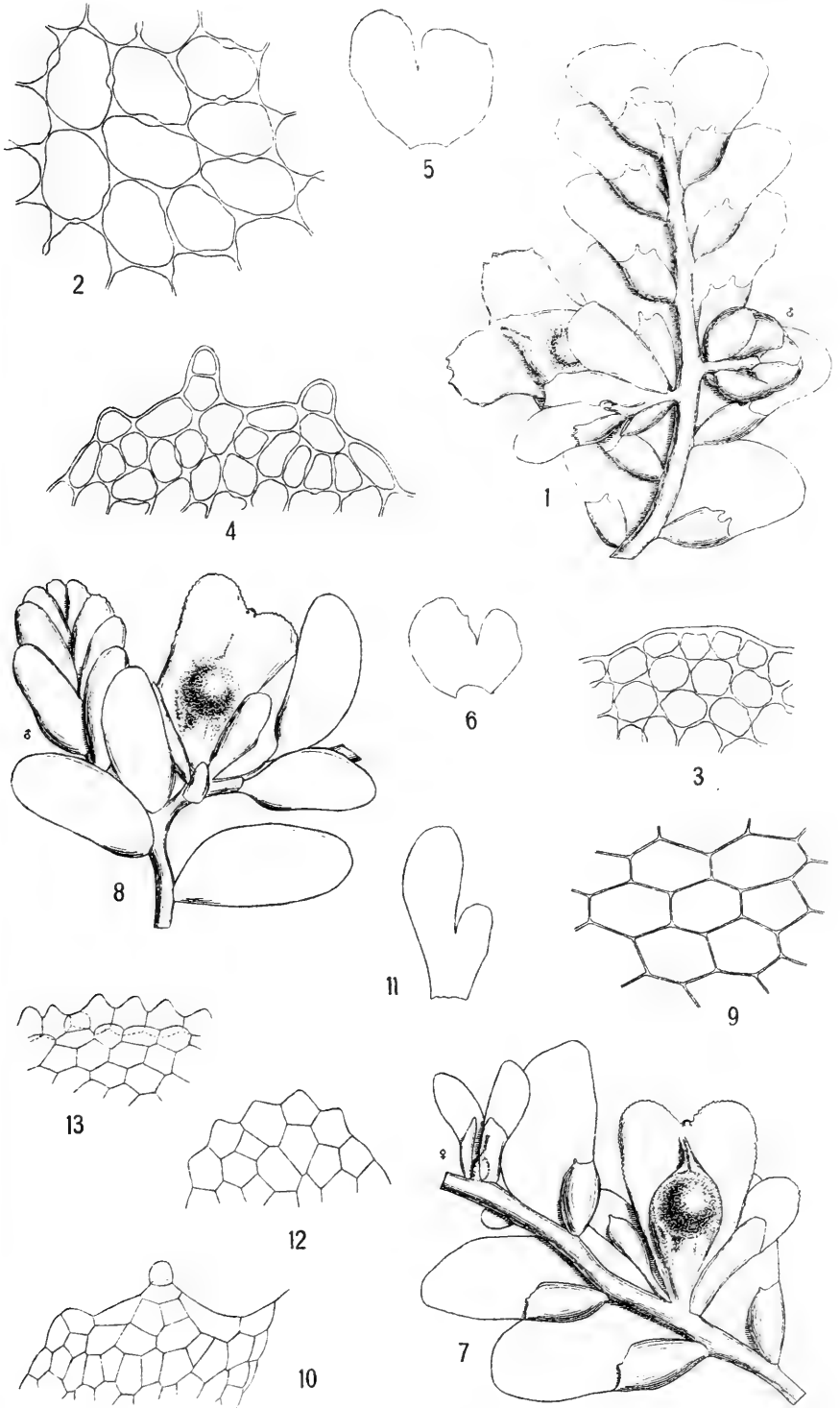


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Edmund Seligman, Bot.

1-5. *MICROLEJEUNEA ALBICANS* (Nees) Jack and Steph.

6-14. *COLOLEJEUNEA COOKEI* Evans.



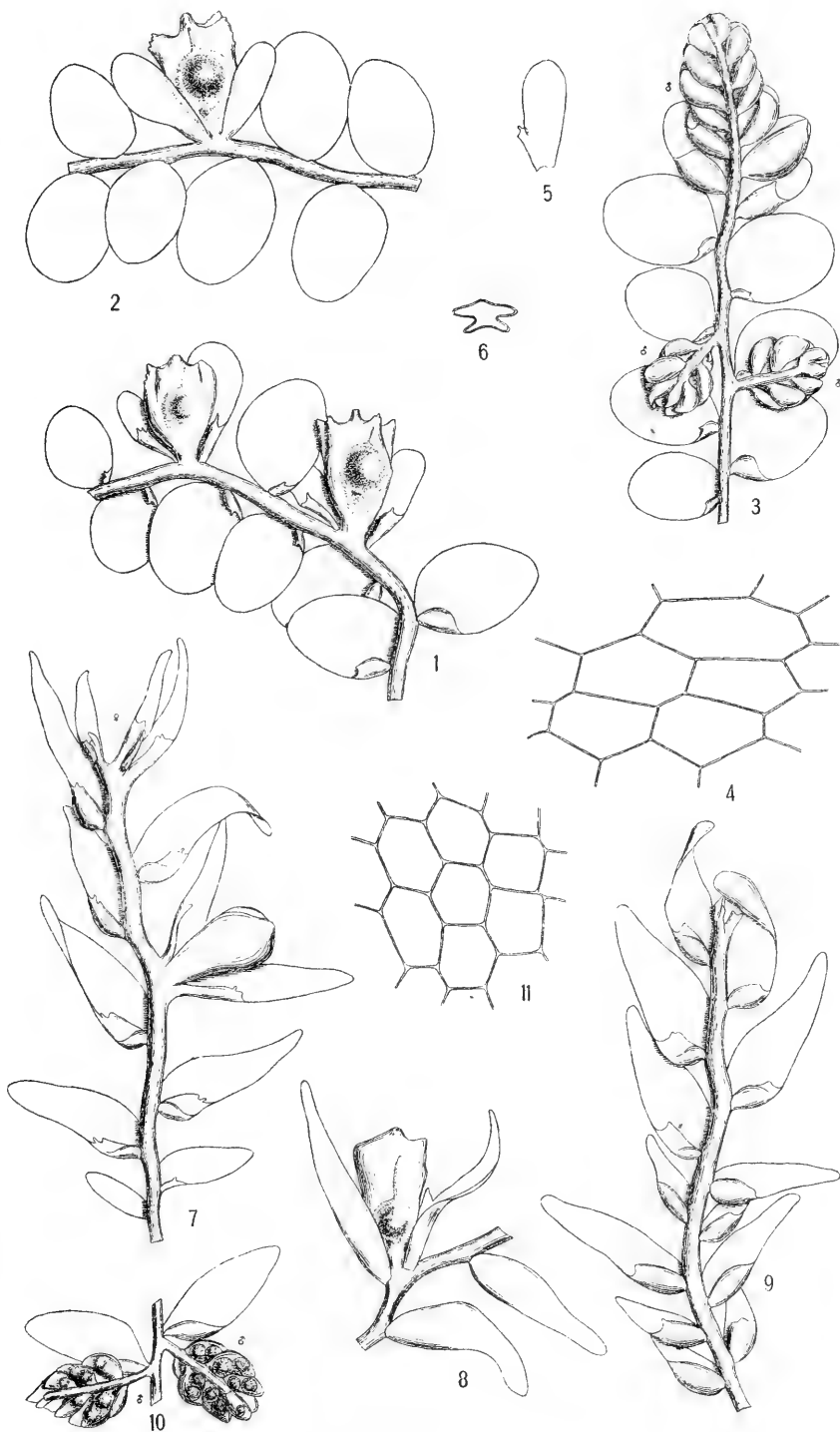
AM. Evans, from Nature.

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1-6. *COLOLEJEUNEA OBCORDATA* (Aust.) Evans.

7-13. *COLOLEJEUNEA CEATOCARPA* (Ångstr.) Steph.



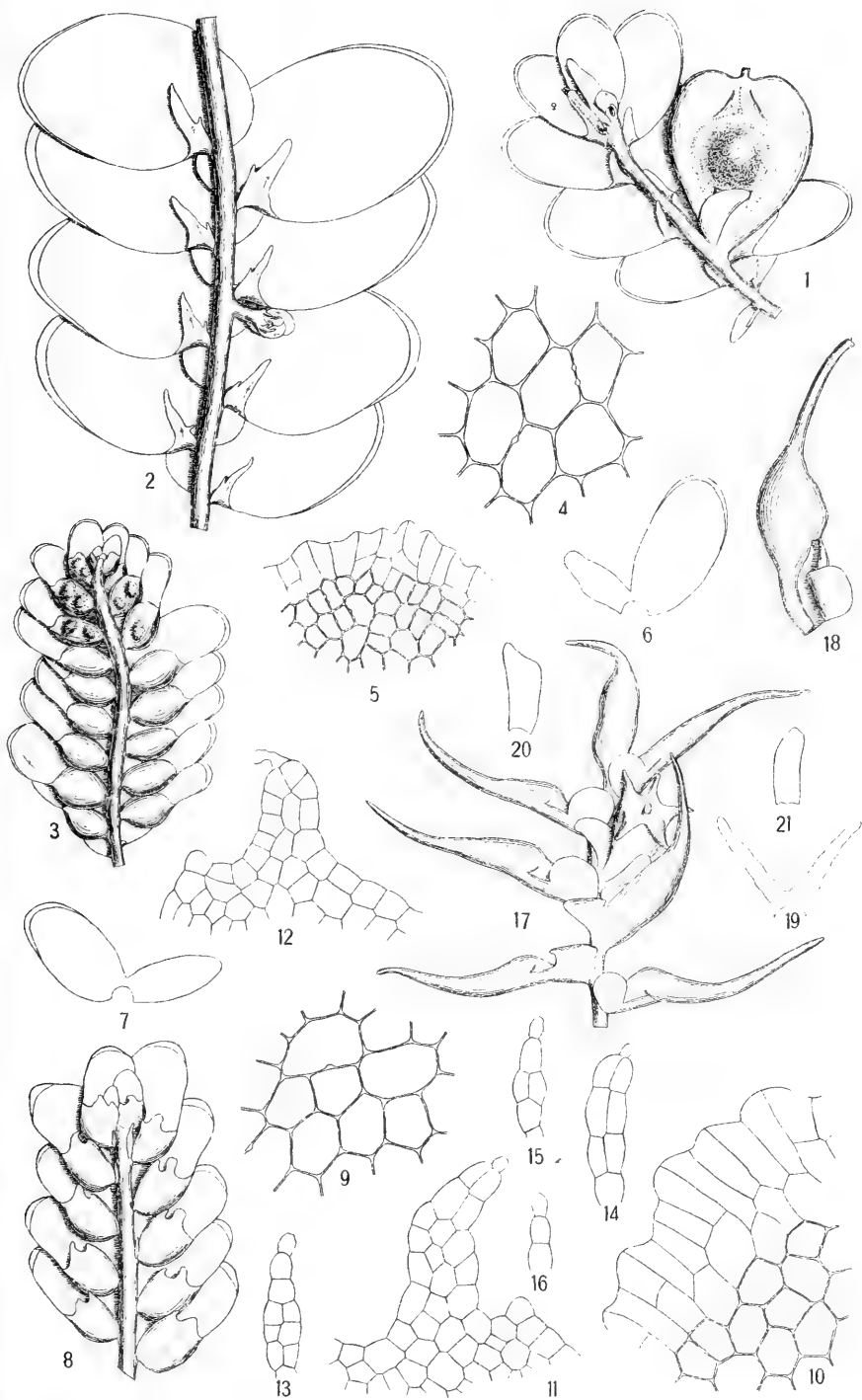


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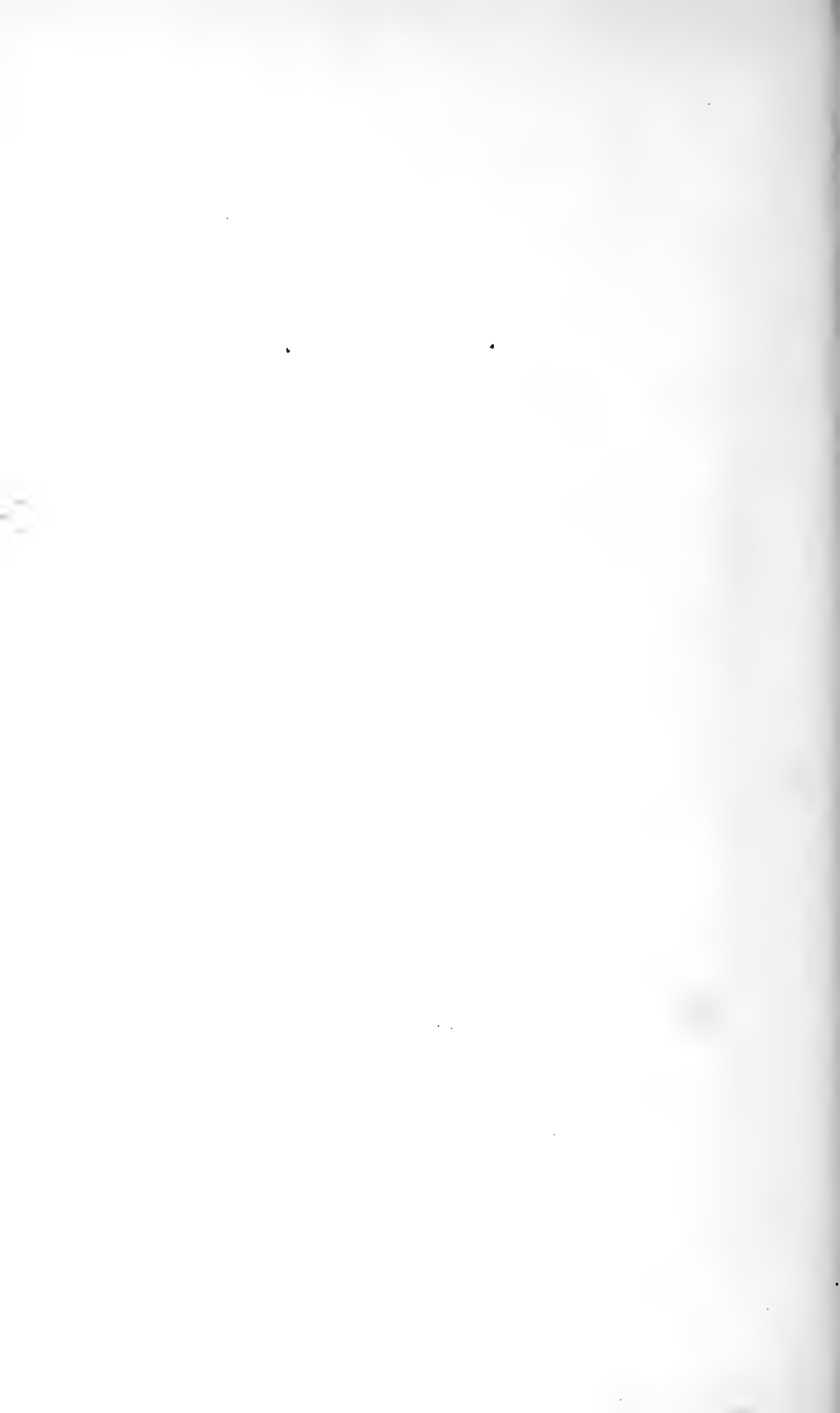
7-11. COLOLEJEUNEA HILLEBRANDII (Aust.) Steph.

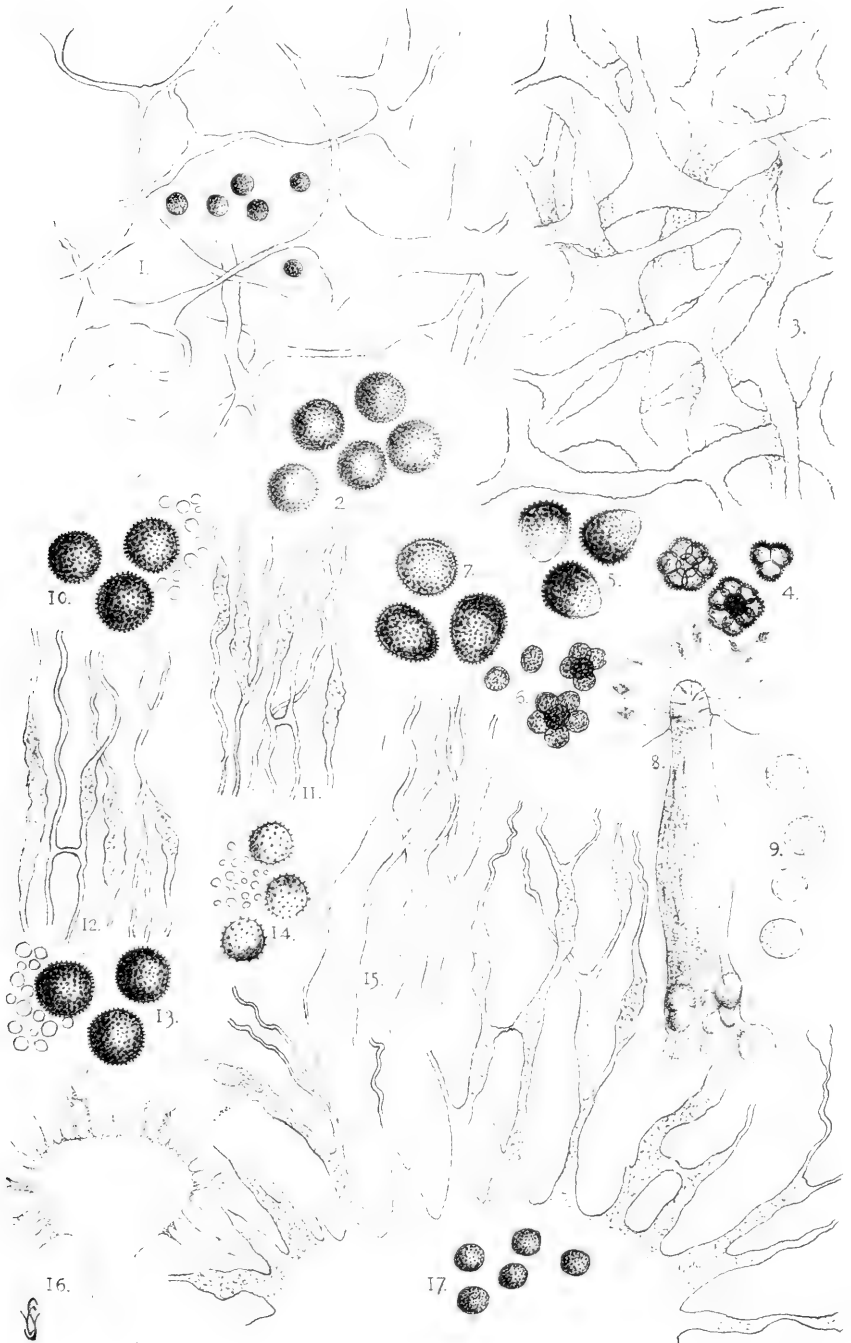


1-7. *COLOLEJEUNEA LANCILOBA* Steph.

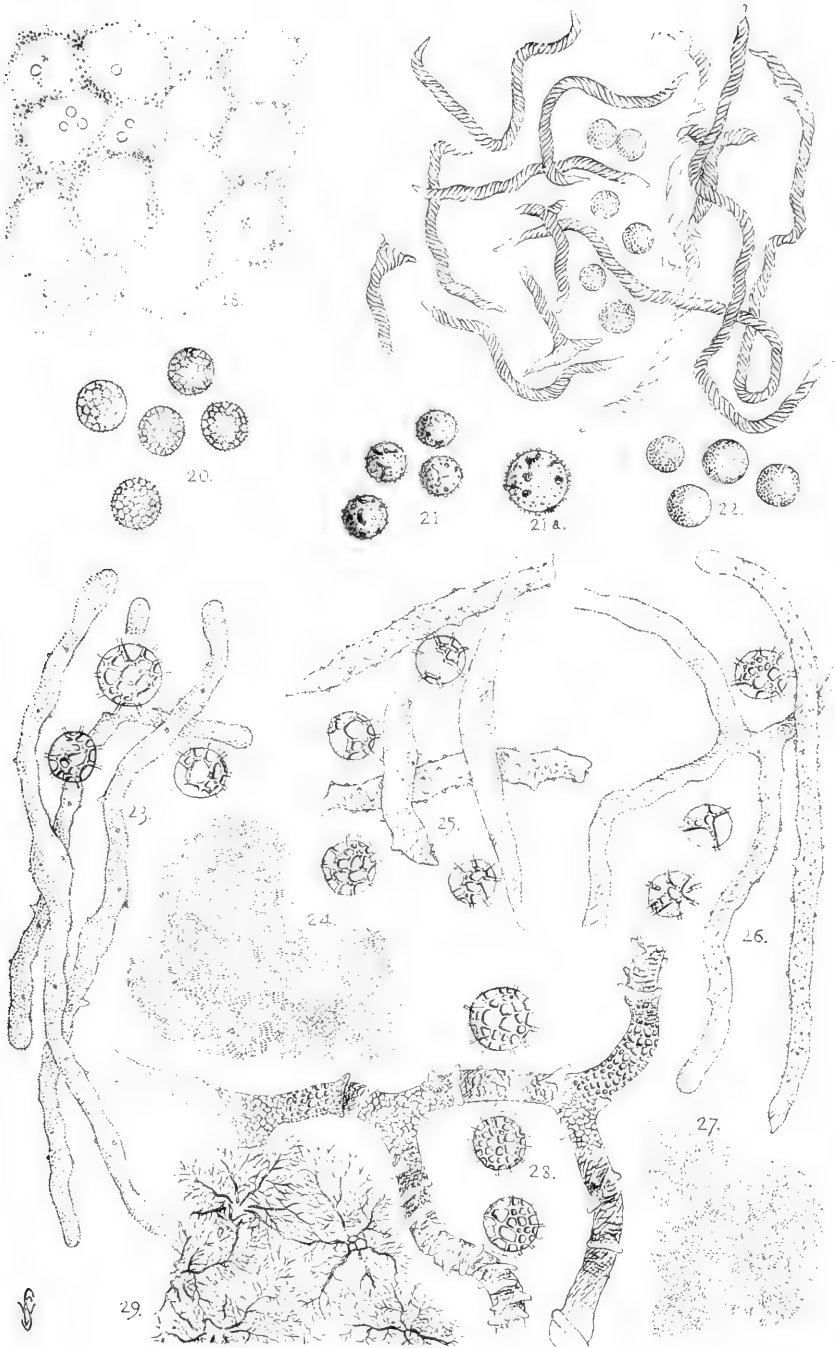
8-16. *COLOLEJEUNEA LONGISTYLIS* Evans.

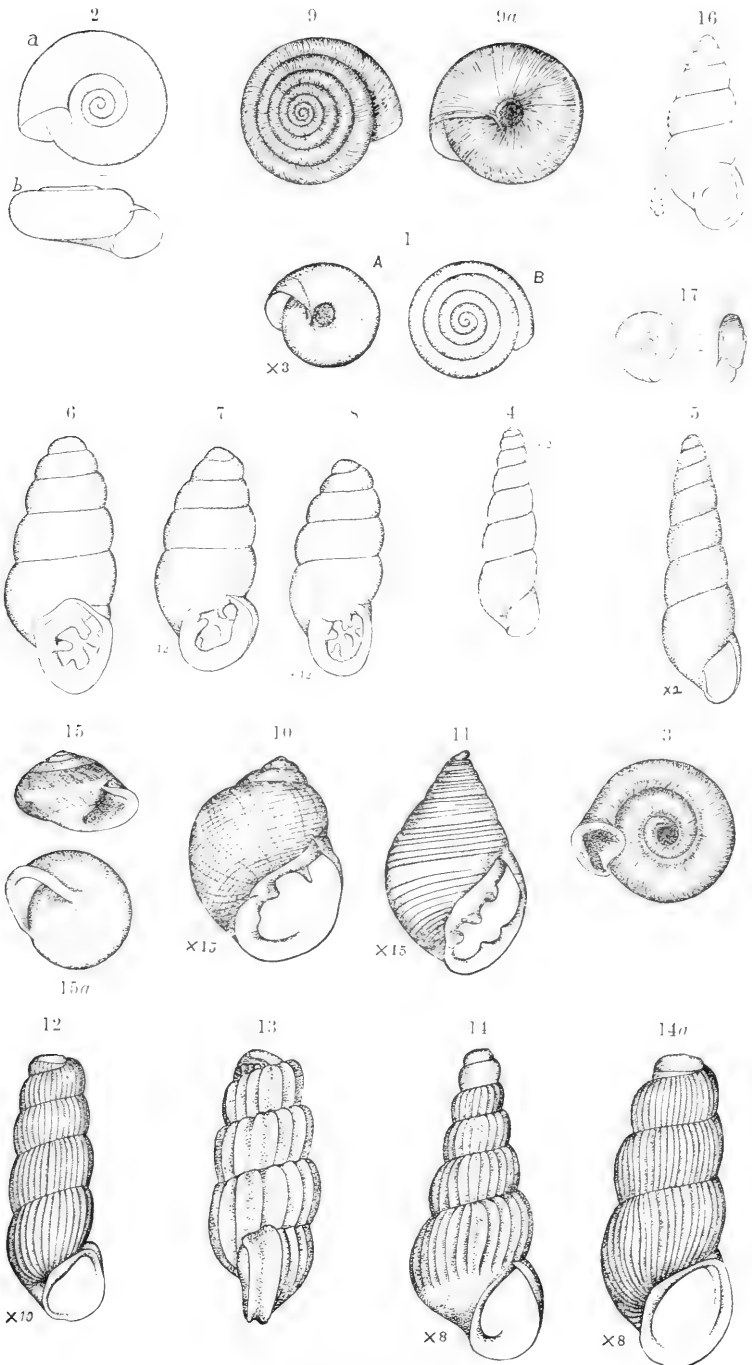
17-21. *COLUROLEJEUNEA TENUICORNIS* Evans.



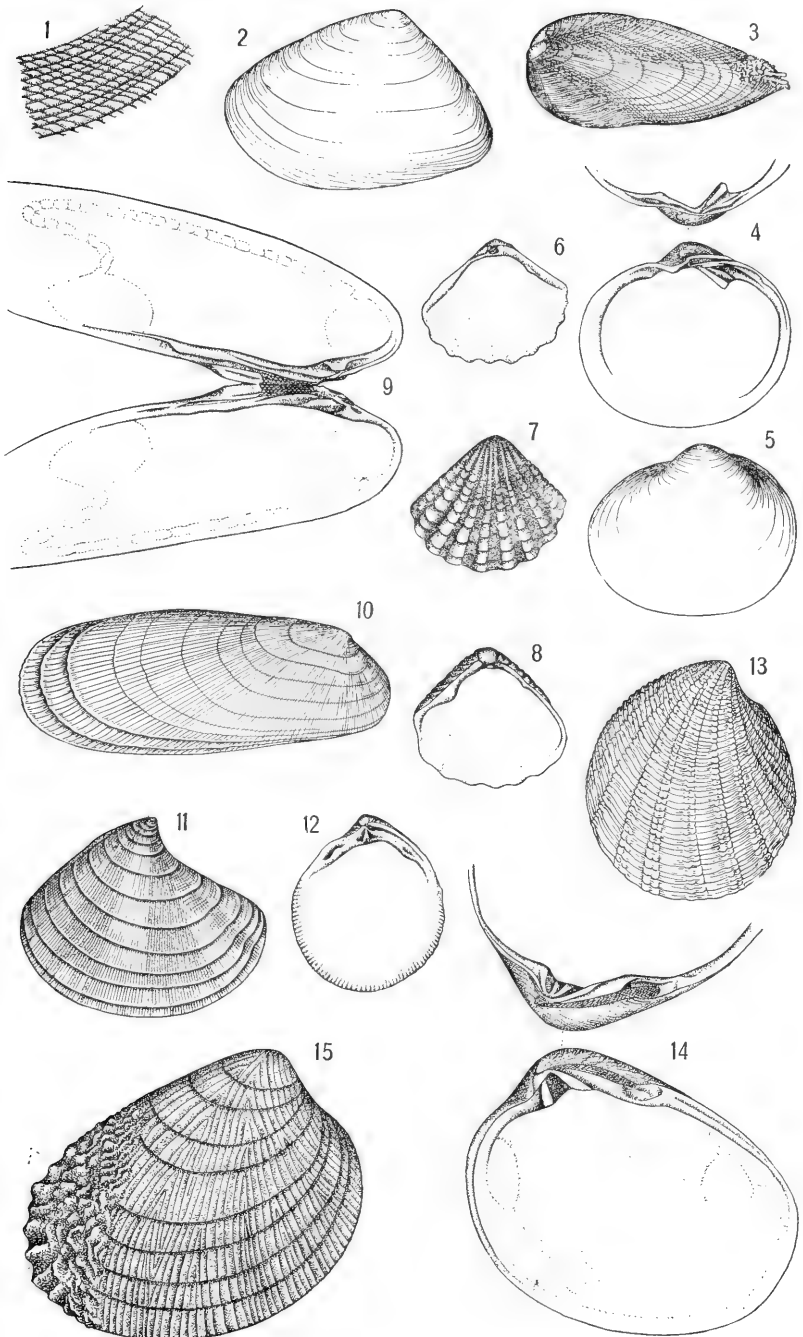






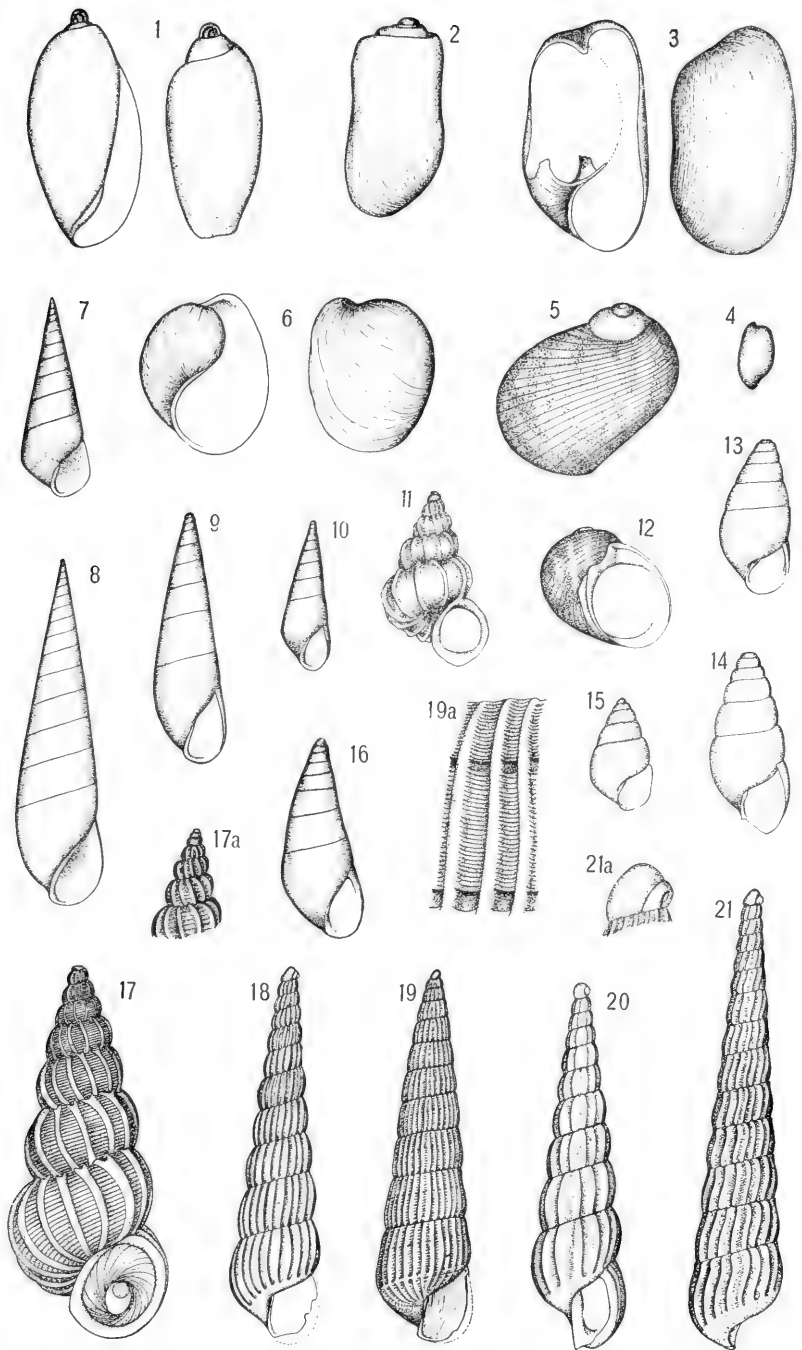


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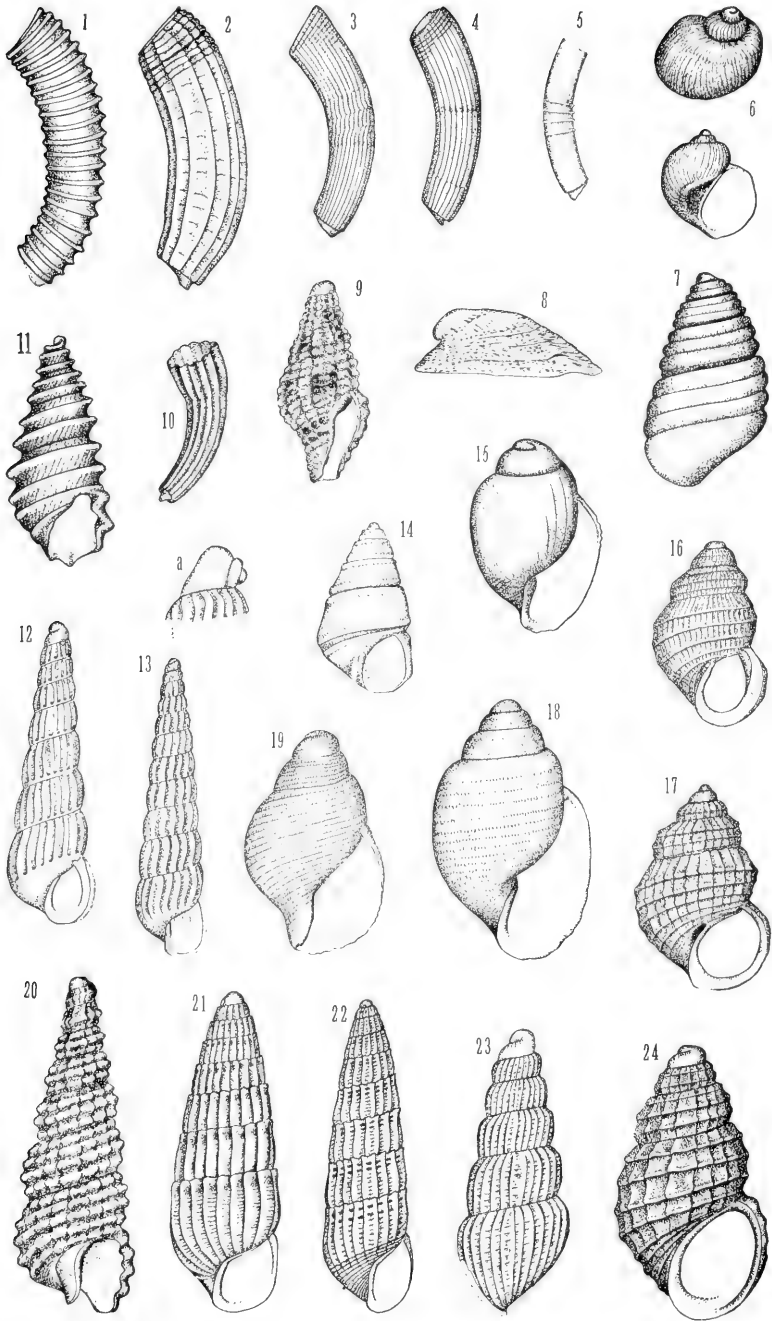
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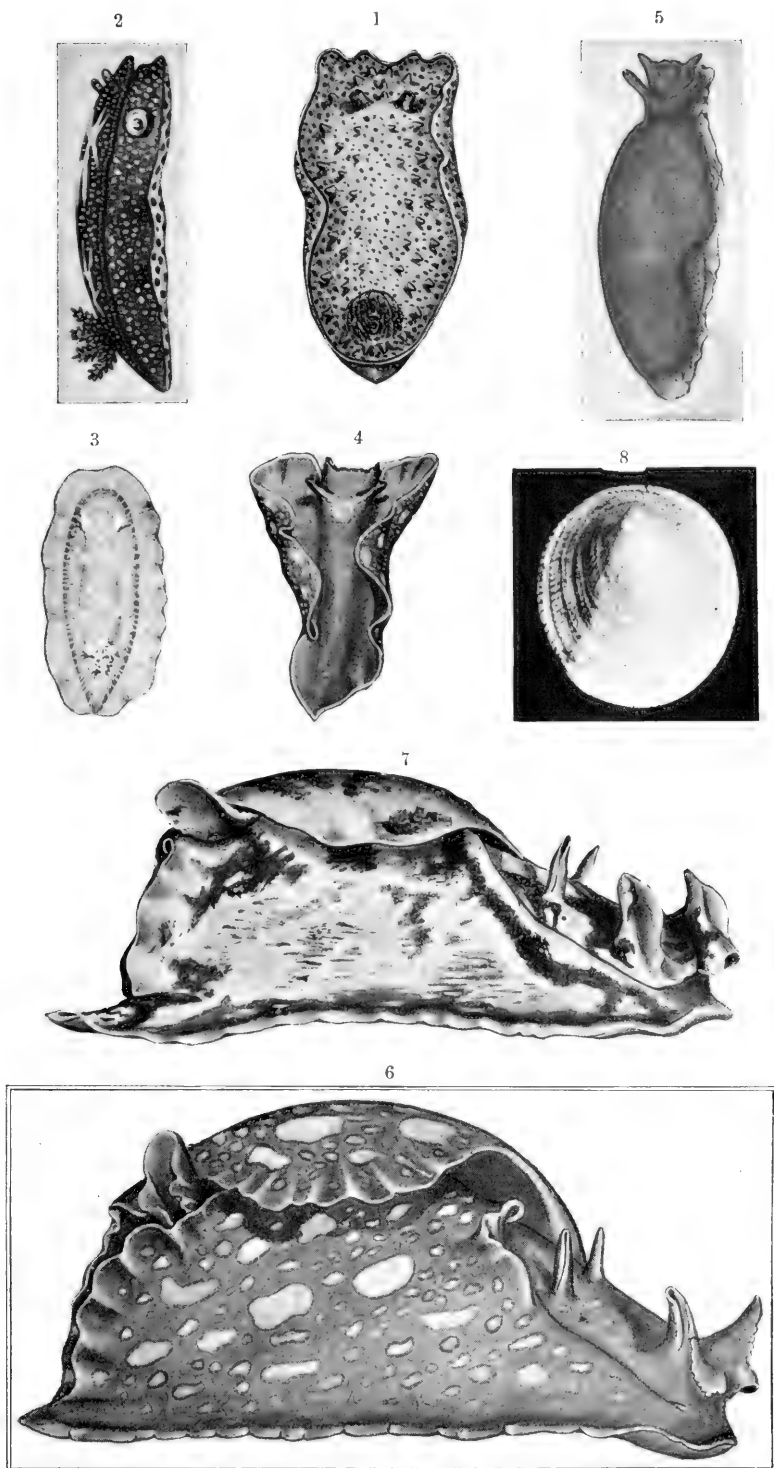
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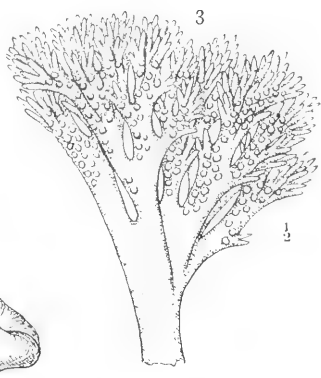
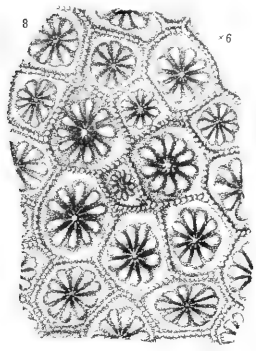
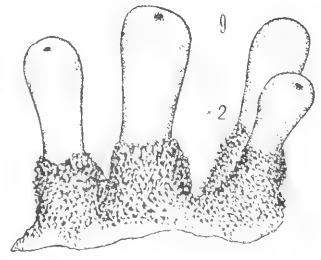
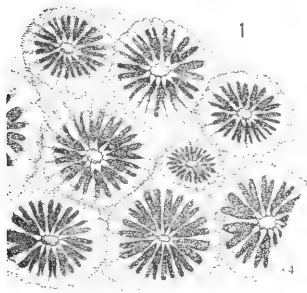
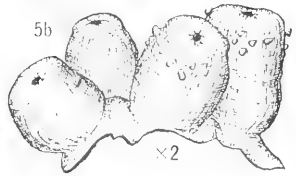
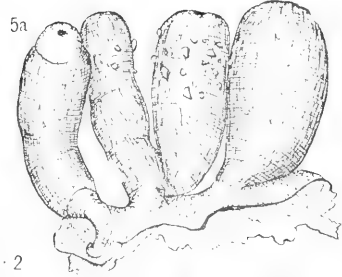
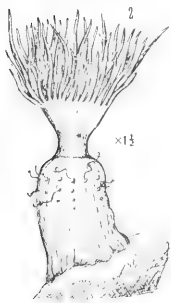
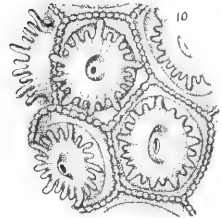
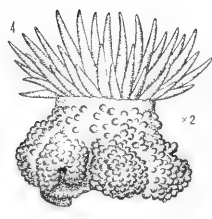
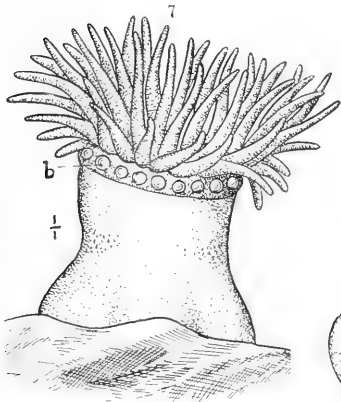
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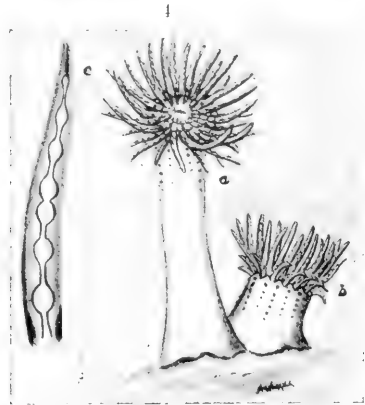
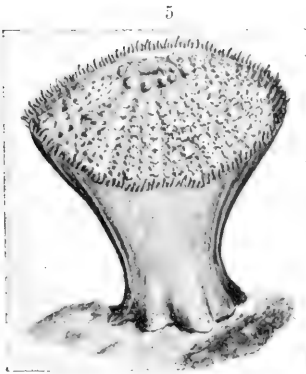
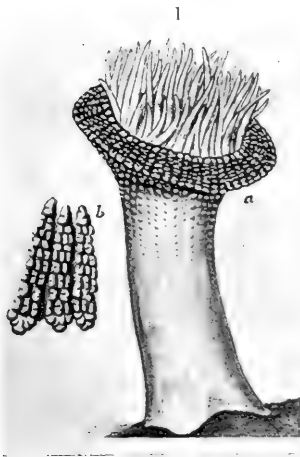
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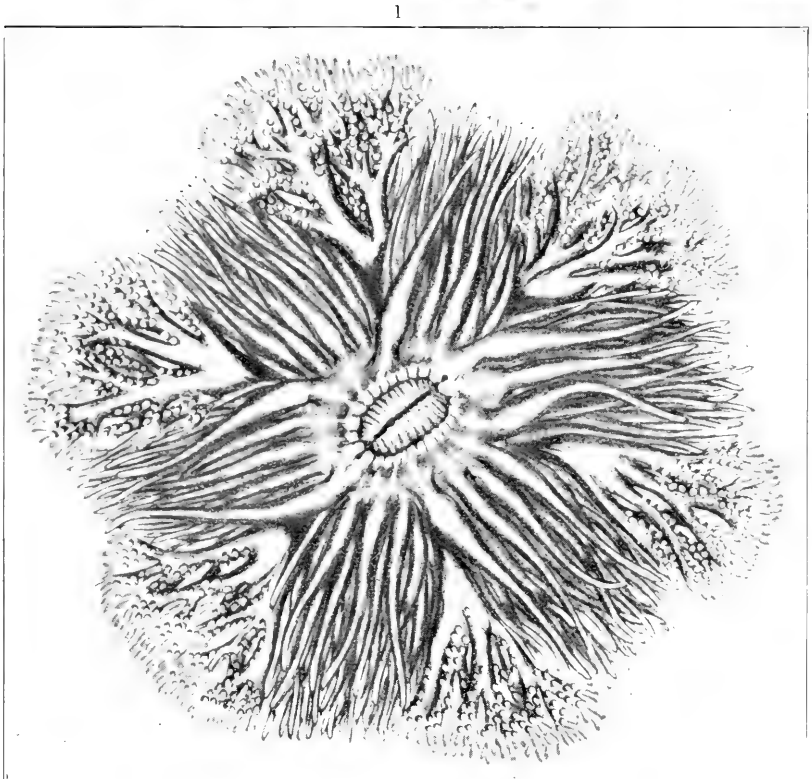
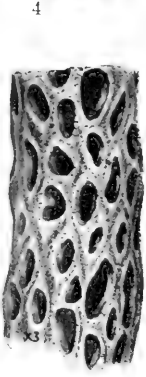
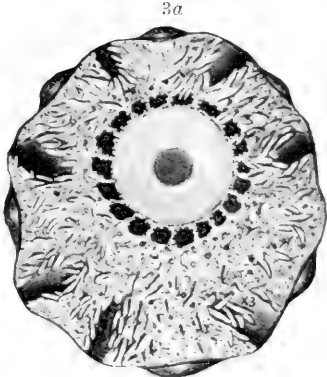
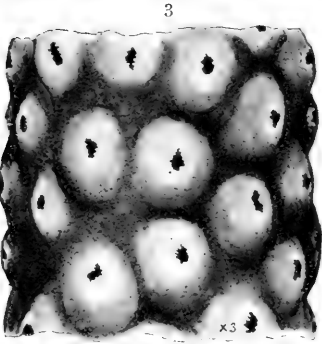
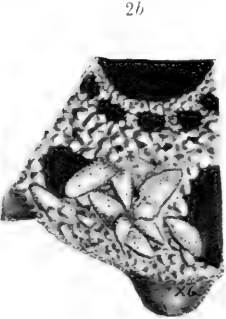
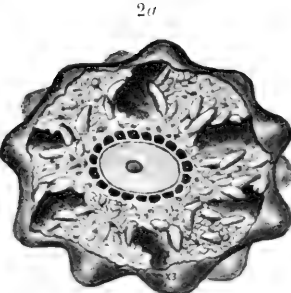
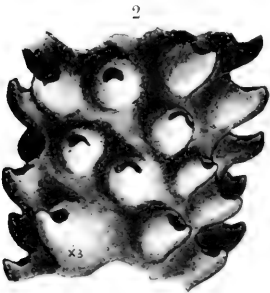




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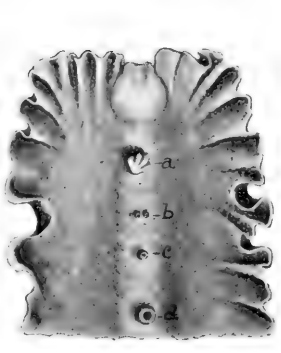
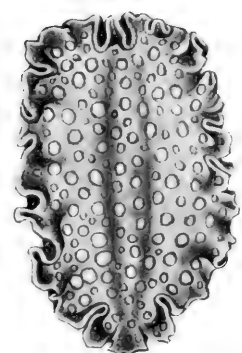
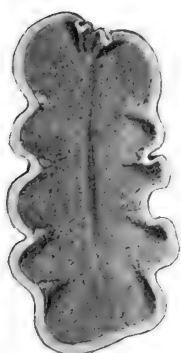
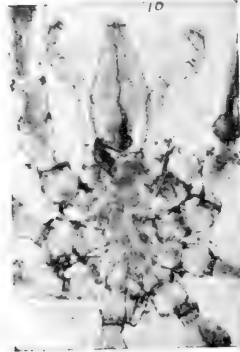
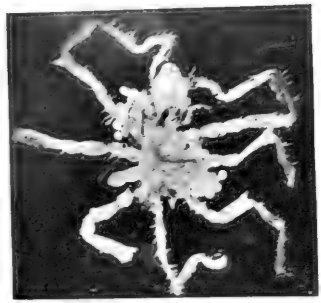
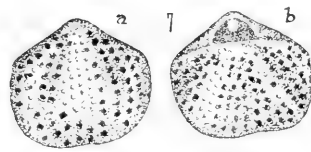
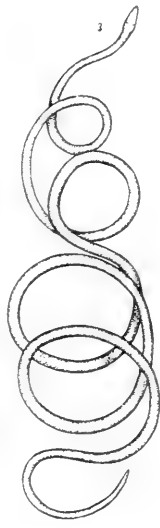
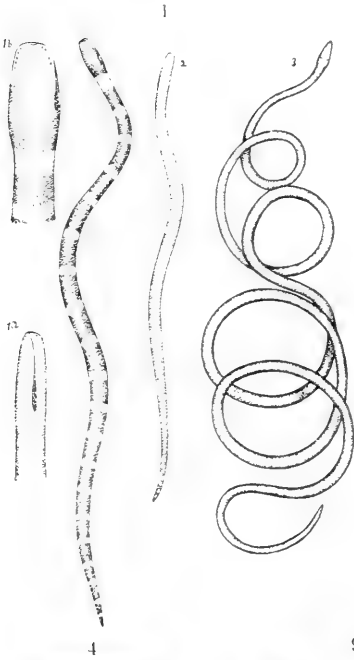
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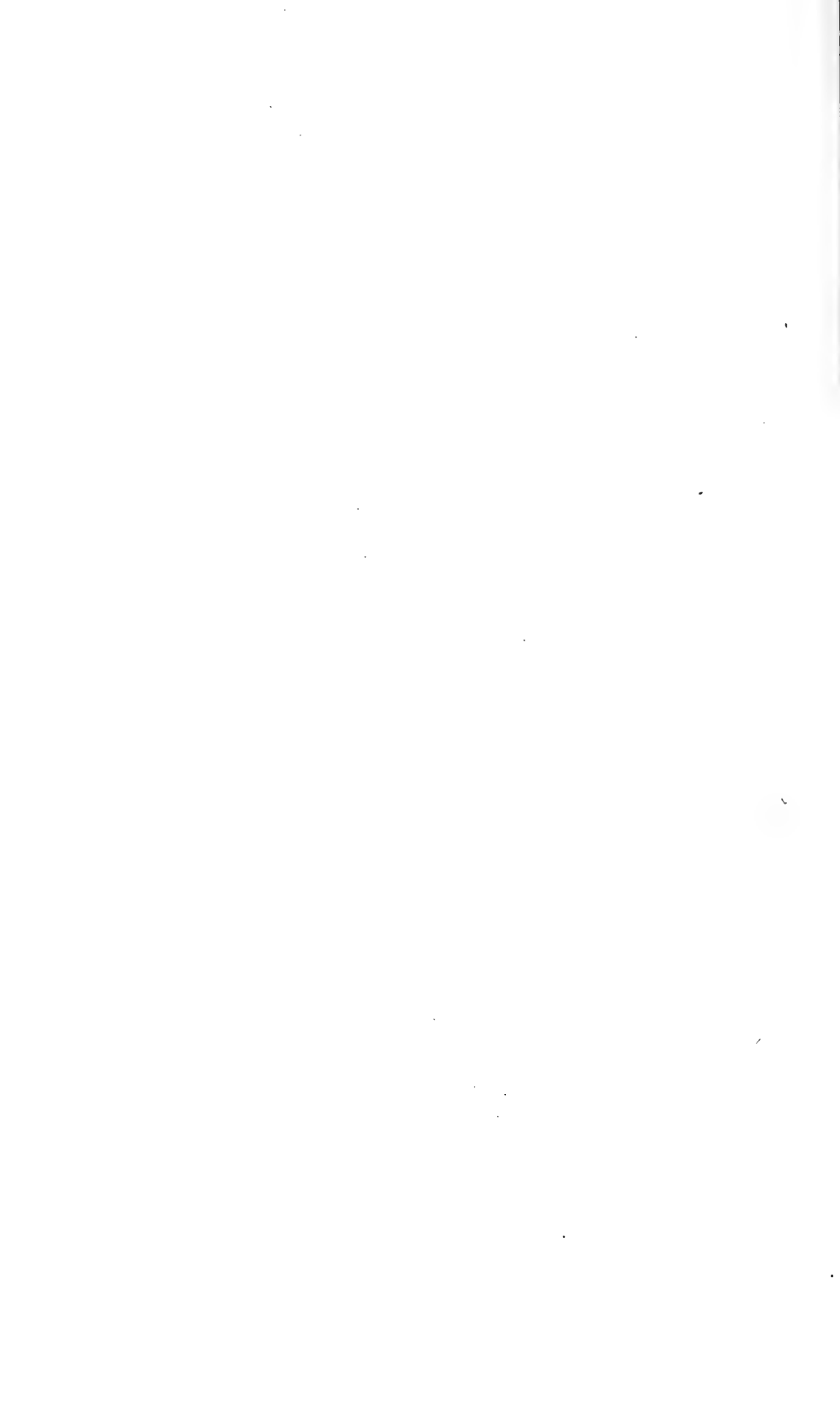
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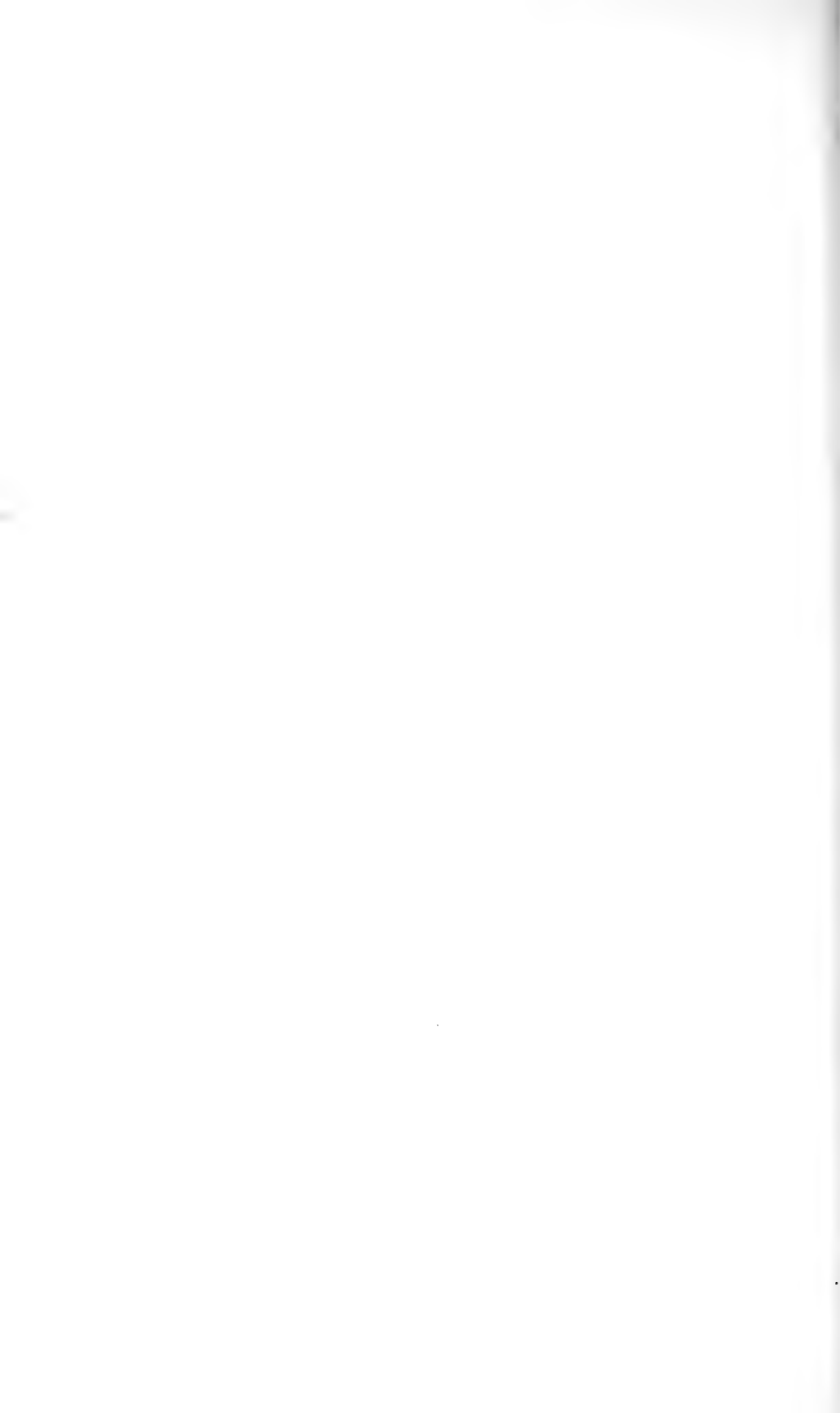


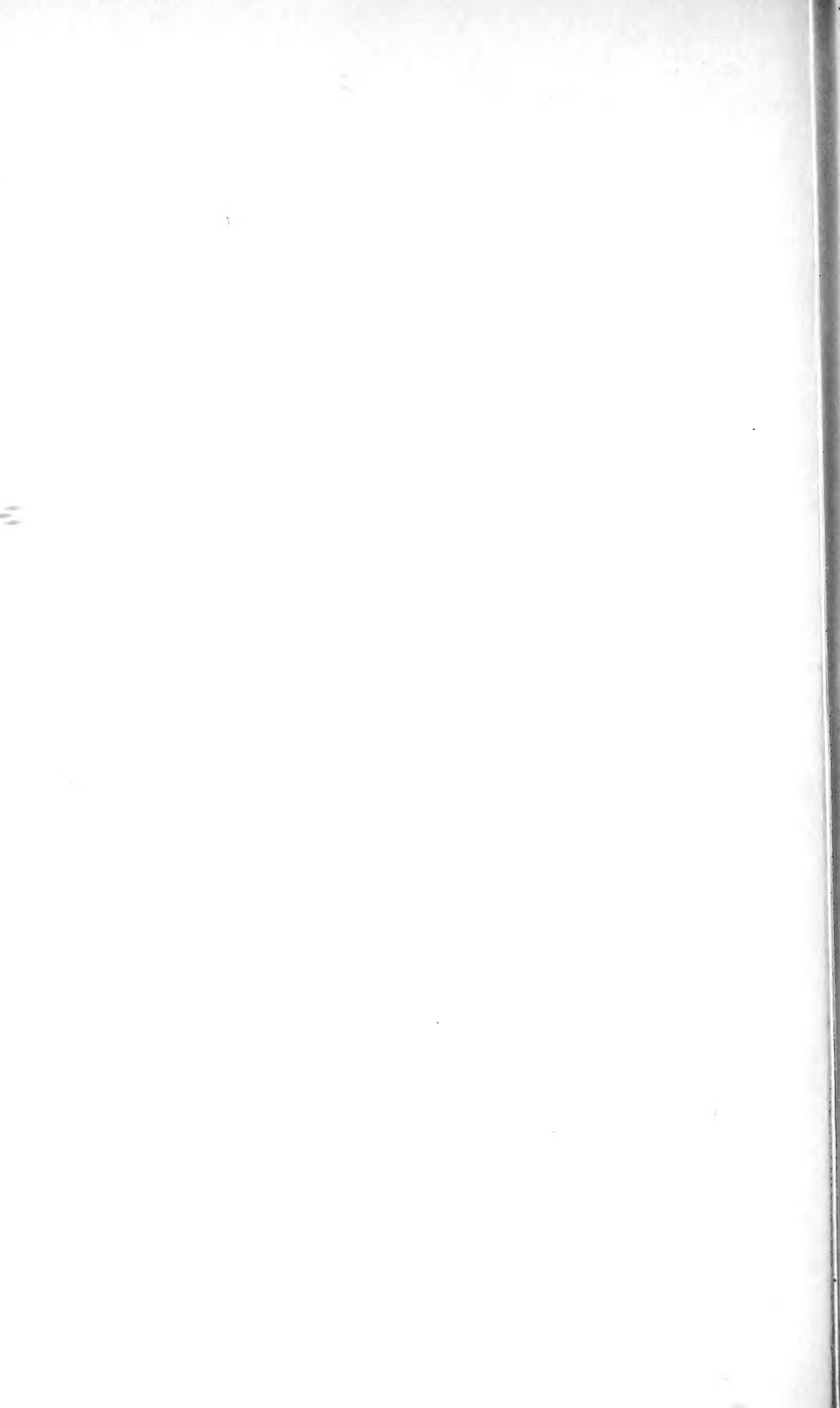


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