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No. VIII.

ZOÖLOGICAL RESULTS OF THE HASSLER EXPEDITION,

PUBLISHED BY PERMISSION OF THE SUPERINTENDENT OF THE
U. S. COAST SURVEY.

II.

OPHIURIDÆ AND ASTROPHYTIDÆ,

INCLUDING THOSE DREDGED BY THE LATE DR. WILLIAM STIMPSON.

By THEODORE LYMAN.

WITH FIVE PLATES AND FIVE FIGURES PRINTED IN THE TEXT.

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LIST OF THE OPHIURIDÆ AND ASTROPHYTIDÆ

Collected by the HASSLER EXPEDITION and by DR. WILLIAM STIMPSON.

ABBREVIATIONS. — H. E., Hassler Expedition; W. S., William Stimpson.

- OPHIURA APPRESSA *Say.* St. Thomas, West Indies. H. E.
 CINEREA *Lym.* Off Contoy, Cuba. W. S.
 “ ? Lat. 11° 39' S., Long. 37° 20' W., Brazil Coast; 75 fathoms. H. E.
 TERES *Lym.* Panama. H. E.
 “ Galapagos. H. E.
 BREVISPIÑA *Lym.* West Florida; 16 fathoms. W. S.
 “ Guadiana Bay, Cuba. W. S.
 “ Southwest of Garden Key, Florida; 63 fathoms. W. S.
 “ Key West. W. S.
 BREVICAUDA *Lym.* St. Thomas, West Indies. H. E.
 PANAMENSIS *Lym.* Panama. H. E.
 “ var. Sequina Bay, Lower California. H. E.
 “ ? Payta, Peru. H. E.
 VARIEGATA *Lym.* Panama. H. E.
 OPHIOPEPALE GOESIANA *Ljn.* Barbadoes; 100 fathoms. H. E.
 OPHIOLEPIS PAUCISPINA *M. & T.* St. Thomas, West Indies. H. E.
 ELEGANS *Ltk.* Off Charlotte's Harbor, Florida; 13–30 fathoms. W. S.
 “ St. Thomas. H. E. — Key West; 8½ fathoms. W. S.
 “ Guadiana Bay, Cuba. W. S.
 OPHIOZONA IMPRESSA *Lym.* St. Thomas, West Indies. H. E.
 PACIFICA. Panama. H. E.
 NIVEA sp. nov. Barbadoes; 100 fathoms. H. E. — Cape S. Antonio, Cuba; 424 fathoms. W. S.
 OPHIOCERAMIS ALBIDA *Lym.* Off Rio La Plata; 19–44 fathoms. H. E. — East Argentina; 34 fathoms. H. E. — Rio Janeiro Harbor. H. E. — Barbadoes, 100 fathoms. H. E.
 OPHIOCERAMIS JANUARI *Lym.* Brazil? H. E.
 “ Off Bahia, Brazil; 40 faths. Cape Frio, Brazil; 35 faths. H. E.
 “ Barbadoes; 100 fathoms. H. E.
 “ San Matias Bay, East Patagonia. H. E.

- OPHIOPLOCUS ESMARKI *Lym.* Five miles south of Santa Barbara, California; 22 fathoms. H. E.
- OPHIOLYPTA LYMANI *Ljn.* Lat. 51° 26' S., Long. 68° 5' W.; 55 fathoms. H. E.
- OPHIOLYPTA ACERVATA *Lym.* Barbadoes; 100 fathoms. H. E.
- “ Off Sand Key, Florida; 128 fathoms. W. S.—South of Sombrero K., Florida; 41 fathoms. W. S.
- “ West coast of Florida; 42 fathoms. W. S.—Lat. 21° 14' N.; 100 fathoms. W. S.]
- LÜTKENI *Lym.* Five miles south of Santa Barbara; 22 fathoms. H. E.
- OPHIOMUSIUM ACUPERUM sp. nov. West of Florida; 42 fathoms. W. S.—Barbadoes; 100 fathoms. H. E.
- TESTUDO sp. nov. Barbadoes; 100 fathoms. H. E.
- OPHIOCOMA ETHIOPS *Ltk.* Galapagos. H. E.—Panama. H. E.
- PUMILA *Ltk.* St. Thomas, West Indies. H. E.
- ECHINATA *Agas.* St. Thomas, West Indies. H. E.
- RIISEI *Ltk.* St. Thomas, West Indies. H. E.
- PAPILLOSA sp. nov. Off Santa Barbara; 22 fathoms. H. E.
- OPHIOPHOLIS CARYI *Lym.* South of Santa Barbara, California; 22 fathoms. H. E.
- OPHIACANTHA PENTACRINUS *Ltk.* Off Sand Key, Florida; 74 fathoms. W. S.
- STELLATA sp. nov. Barbadoes; 100 fathoms.
- HIRSUTA sp. nov. Sombrero Key, Florida; 240 fathoms. W. S.—Barbadoes; 100 fathoms. H. E.
- MARSUPIALIS sp. nov. Juan Fernandez; 240 fathoms. H. E.
- OPHIOMITRA VALIDA *Lym.* Barbadoes; 100 faths. H. E.—Sand Key, Fla.; 128 faths. W. S.
- CERVICORNIS sp. nov. Off Contoy, Cuba? W. S.
- OPHIOMYCES FRUTECTOSUS *Lym.* West Florida; 100 faths. W. S.—Barbadoes; 100 faths. H. E.
- OPHIACTIS MÜLLERI *Ltk.* St. Thomas. H. E.—Key West. W. S. [var. QUINQUERADIA]. Off the Abrolhos; 30 fathoms. H. E.—Southwest of Garden Key; 8–15 fathoms. W. S.
- HUMILIS *Lym.* Off Sombrero Key, Florida; 240 fathoms. W. S.
- MAGELLANICA *Ljn.* Sandy Point, Pat. H. E.—Gulf of San Matias, Santa Magdalena, H. E.—Puerto Bueno, Eden Harbor, Pat. H. E.—Conner Cove, Pat.; 44 fathoms. H. E.—Southeast coast of South America near Bahía Blanca; 44 fathoms. H. E.
- KROYERI *Ltk.* Pisco Bay, Peru. H. E.—Talcahuano Bay, Chili. H. E.
- OPHIONEREIS RETICULATA *Ltk.* Key West. W. S.—Rio Janeiro Harbor. H. E.—Off Cape Frio, Brazil. H. E.—St. Thomas. H. E.
- ANNULATA *Ltk.* Panama; 35 fathoms. H. E.—Panama. H. E.—Jaufrés Island, Galapagos. H. E.
- AMPHIURA GRANDISQUAMA *Lym.* Off Sombrero; 240 fathoms. W. S.—Southwest of Sand Key; 134 fathoms. W. S.
- STIMPSONI *Ltk.* Off Cape Frio, Brazil; 35 fathoms. H. E.
- TENERA *Ltk.* Off Cape Frio, Brazil; 35 fathoms. H. E.
- DUPLICATA sp. nov. Barbadoes; 100 fathoms. Brazil. H. E.

- AMPHIURA BARBARÆ sp. nov. Santa Barbara, California; 22 fathoms. H. E.
 FLEXUOSA? *Ljn.* Barbadoes; 100 fathoms. H. E. — Key Biscayne, Fla. Dr. Palmer.
 CHILENSIS? *Ltk.* Chili. H. E.
 EUGENIÆ *Ljn.* East Patagonia. Lat. 51° 26' S., Long. 68° 5' W.; 55 fathoms. H. E.
 " var.? Northeast Patagonia. Lat. 40° 22' S., Long. 60° 35' W.; 30 fathoms. H. E.
 REPENS sp. nov. West coast of Florida; 14 fathoms. W. S.
 ANOMALA sp. nov. Juan Fernandez; 220 fathoms. H. E.
 MAGELLANICA? *Ljn.* Northeast of Patagonia; Lat. 41° 40' S., Long. 63° 13' W.; 30 fathoms. H. E.
 SQUAMATA *Sars.* Talcahuano Bay, Chili. H. E.
 OPHIOGNIDA SCABRIUSCULA *Lym.* var. Sombrero Key, Fla. W. S.
 OLIVACEA *Lym.* Off Florida Reefs; 100–120 fathoms. W. S. — Sombrero Key; 74 faths. W. S. — Lat. 35° S., Long. 50° 15' W.; 70 faths. H. E.
 FILOGRANEA sp. nov. Cedar Key, Florida. Dr. Palmer.
 OPHIOSTIGMA ISACANTHUM *Ltk.* Off Cape Frio, Brazil; 35 fathoms. H. E. — Inside Sombrero Key. W. S. — West Florida; 13–20 fathoms. Southwest of Garden Key; 63 fathoms. W. S. — Key West, Florida. W. S.
 OPHIOSILA RISEI *Ltk.* Key West, Florida. W. S.
 OPHIOPLAX LUNGMANI gen. et sp. nov. Barbadoes; 100 fathoms. H. E.
 OPHIOTHRIX MAGNIFICA *Lym.* Payta, Peru. H. E.
 " var. Galapagos. H. E.
 SUENSONII *Ltk.* Barbadoes; 100 fathoms.
 SPICULATA *LeConte.* Magdalena Bay, Cal. H. E. — Panama. H. E.
 VIOLACEA *M. & T.* Aspinwall; Rio Janeiro Harbor. H. E. — Near Bahia, Brazil; Lat. 11° 49' S., Long. 37° 27' W. H. E. — Off Cape Frio, Brazil; 35 fathoms. Barbadoes; 100 faths. H. E. — St. Thomas. H. E. — West coast of Florida? Guadiana Bay, Cuba. W. S. — Key West. W. S. — Off Charlotte's Harbor, Florida; 11–50 fathoms. W. S. — Sombrero; 54 fathoms. W. S. — Mugeris Island, Yucatan. W. S.
 ORSTEDII *Ltk.* Key West. W. S. — St. Thomas. H. E.
 OPHIOPHRAGMUS WURDEMANI *Lym.* var.? Off Sombrero Key, Florida; 47 fathoms. W. S.
 OPHIOSCOLEX STIMPSONII sp. nov. Sombrero Key, Florida; 240 fathoms. W. S.
 OPHIOMYXA FLACCIDA *Ltk.* West Florida; 50 fathoms. W. S. — Near Bahia, Brazil. H. E.
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- ASTROPHYTON KREBSII *Ltk.* Barbadoes. H. E. Gov. Rawson.
 ASTROPHYTON POURTALESII sp. nov. Off East Patagonia, Lat. 44° 52' S., Long. 64° 10' W., Lat. 51° 26' S., Long. 68° 5' W.; 55 fathoms. H. E.
 SPINOSUM sp. nov. Panama. Mr. Landsberg.
 ASTROTOMA AGASSIZII gen. et sp. nov. Straits of Magellan, Pacific side; 135 fathoms. H. E.
 ASTROSHEMA TENUE sp. nov. 100 fathoms. Barbadoes. H. E.
 OLIGACTES *Ltk.* 100 fathoms Barbadoes. H. E.

- ASTROCYNIDA ISIDIS *Lym.* Barbadoes? H. E.
ASTROPORPA ANNULATA *Ltk.* Barbadoes; 100 fathoms. H. E.
ASTROGOMPHUS VALLATUS *Lym.* Sombrero Key, Florida; 128 fathoms. W. S. — Off Sand Key;
270 fathoms. W. S.
OPHIOCREAS LUMBRICUS *Lym.* Off Sand Key; 75–128 fathoms. W. S.
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The above list of seventy-six species, whereof nineteen are new, may be called a remarkable one. It embraces depths from the littoral zone to 424 fathoms, the greatest number of interesting things having been brought up in 100 fathoms, off the Barbadoes. Thence came the simple-armed Astrophytons, thus far chiefly characteristic of the West Indies, though exploration may find others elsewhere, since already we have an *Astrochema* from the Great Ocean, *Astrotoma* from the Straits of Magellan, and *Astronyx* from North Europe. The West-Indian fauna is extended to Patagonia by *Ophioceramis Januarii*. That of extreme South America shows a resemblance to the northern, since *Ophiactis magellanica*, *Ophioglypha Lymani*, and *Astrophyton Pourtalesii* are comparable to *O. Ballii*, *O. ciliata*, and *A. Linckii* of the opposite zone. Other species, however, such as *Astrotoma Agassizii* and the *Amphiuræ* do not bear out this resemblance. From Chili comes an *Amphiura* not to be distinguished from *A. squamata* of the northern seas. The genus *Ophioscolex*, thus far known from polar waters only, finds a representative in the West Indies. In my generic distinctions, especially those which centre about *Ophiucantha*, I desire not to be held strictly accountable: the classification needs a revision which we have not yet materials to warrant.

DESCRIPTIONS OF NEW GENERA AND SPECIES.

Ophiomusium acuferum sp. nov.

Plate I. f. 1-5.

Special Marks.— A supplementary arm-spine on the upper surface of the side arm-plate. A few large grains on the back of the disk. The margin of the interbrachial space formed by a swelled plate having a deep indentation.

Description of an Individual.— Diameter of disk, 7^{mm}. Width of arm without spines, 2^{mm}. Length of arm about 15^{mm}. Mouth-papillæ four on each side, and one diamond-shaped, at the apex of the jaw; all forming a continuous line, as is usual in the genus. The mouth-frames and jaws seen from the side (*Fig. 4*) have a humpy, shapeless look, and bear at their apex a small jaw-plate which carries two or three small spiniform teeth. Mouth-shields large, five-sided, with a long acute angle within, whereof a part is bounded by the inner ends of the genital openings; length to breadth, 1.4 : 1.3. Side mouth-shields long triangular, with variously curved sides; they scarcely meet within, and are partly separated from the mouth-shield by the inner ends of the genital openings. There are only two under arm-plates of conspicuous size: these are the second and third, which are pentagonal, with an angle inward, and lateral and inner lateral sides re-enteringly curved; length to breadth (3d plate), 8 : 8. Beyond, the under arm-plates are minute triangular scales just at the angle of junction of the side arm-plates. These last are thick, swollen, meeting broadly above and below, and composing the almost entire covering of the arm on the part beyond the disk. Near the tip of the arm (*Fig. 3*) there is neither upper nor under plate, and the joints are elongated and larger at their outer end. Upper arm-plates minute, triangular, with an angle inward; length to breadth, on joints near the disk, 4 : .7. Disk covered with plates, of which some are unusually thick and swollen; the central space inside the radial shields is set with flat angular plates,

many of them rudely hexagonal, and each bearing usually from one to four large grains. Almost the entire margin of each interbrachial space is occupied by a thick swollen plate having a depression in its border; it descends to the lower surface, where it joins the mouth-shield; the covering of the lower interbrachial space is completed by two massive genital scales which run from the mouth-shield to join the outer corners of the radial shields, which are so large and swollen as to resemble the halves of an egg. They touch at their middle point, but diverge both outward and inward. Within they are separated by a large disk-plate, and without by a triangular button which rests on the top of the arm; length to breadth, 1.8 : 1.4. Arm-spines two, cylindrical, tapering, about .4^{mm}. long. Besides these there is on the upper surface of the side arm-plate a supplementary spine somewhat longer than the others. Tentacle-scales are only on the second and third plates; they are circular, and situated at the inner corners. The tentacles are slender, pointed, and smooth (*Fig. 5*).

Color, in alcohol, white.

Hassler Expedition; Barbadoes, 100 fathoms. Dr. William Stimpson; West Florida, 42 fathoms.

This species agrees with *O. validum* Ljn. as to its under arm-plates, but differs in having supplementary arm-spines, only two regular arm-spines, and grains on the disk.

Ophiomusium represents the maximum development of external plates, and the minimum of internal skeleton. The figure shows how poorly formed are the mouth-frames, jaws, and jaw-plate; and the arm-bones are still more insignificant. Instead of the strong disks found in genera with delicate skins, such as *Ophiomyxa* and *Ophiura*, there are only weak bones, which, in profile, are pinched in the middle like an hour-glass.

Ophiomusium testudo sp. nov.

Pl. I. f. 6-s.

Special Marks.—Two or three minute arm-spines. No under arm-plates beyond the third.

Description of an Individual.—Diameter of disk, 5.5^{mm}. Width of arm, without spines, 1.8^{mm}, close to disk. Length of arm, 12.5^{mm}. Mouth-papillæ four on each side, and one diamond-shaped, at the apex of the jaws, all forming a closely soldered line. Mouth-shields longer than broad, pentangular, with a

short angle within, at the corners of which begin the genital openings; length to breadth, 1.1 : .7. Side mouth-shields large, long triangular, wide without, and with straight sides, touching by their narrow ends within. There are only two under arm-plates besides the first at the corner of the mouth-slit. They are pentagonal, with an angle inward, and the lateral sides re-enteringly curved; length to breadth, .7 : .7. Beyond the third there are no under arm-plates at all. Side arm-plates thick, and composing the entire covering of the arm beyond the disk, excepting the small upper arm-plate. Upper arm-plates very small, diamond shape, with an angle without and within; length to breadth, .4 : .5. Disk rather high and angular, covered by closely soldered swollen plates, having decided grooves between them; the upper margin is occupied by two large rounded plates, one above the other, touching the radial shield on either side; the central space within the radial shields is covered by a large pentagonal primary plate surrounded by two irregular concentric rows of smaller and rounder plates. The interbrachial space below is covered by five pieces besides the mouth-shield, to wit, three lumpy plates, arranged in a triangle just outside the mouth-shield, and two wide solid genital scales, which start at the inner corner of the genital openings and touch the radial shields with their outer ends. Radial shields roughly triangular, not much swollen, touching without, separated within by a small wedge-scale and a large round plate; length to breadth, 1.3 : 1.2. Arm-spines very small, rounded, blunt; two or three in number, and set in a notch low down on the outer edge of the side arm-plate (*Fig. 8*). Tentacle-scales only on the second and third plates; they are circular, and situated at the inner corners.

Color, in alcohol, white, clouded with pale brown.

Hassler Expedition, one specimen; Barbadoes, 100 fathoms.

It differs from *O. validum* Ljn. in wanting rudimentary under arm-plates, and from *O. Lymani* W. Thoms. in fewer and shorter arm-spines; from both these species it differs in the smaller radial shields, higher disk, and more swollen disk-plates, which besides are differently arranged.

Ophiozona nivea sp. nov.

Outline figures, 85, 86.

Special Marks.—Primary plates forming a conspicuous rosette in centre of disk. A radiating line of plates in each upper interbrachial space. Lower arm-plates hexagonal.

Description of an Individual.—Diameter of disk, 9^{mm}. Width of arm without spines, 3^{mm}. Length of arm, 32^{mm}. Mouth-papillæ thirteen to each angle, all similar, blunt, rounded, spiniform; the outer ones largest, and all standing on the jaws, except the outer one on either side, which touches the side mouth-shield. Mouth-shields longer than broad, oval with a peak inward; length to breadth, 1.5 : 1. Side mouth-shields meeting within, strongly bent outwards. Under arm-plates hexagonal, with an angle towards each side; lateral sides re-enteringly curved; length to breadth, 1 : 1.2. Side arm-plates not prominent, and not meeting either above or below. Upper arm-plates rudely hexagonal, wider than long; length to breadth, 1 : 2. The first two or three are small, and more or less distorted by the encroachment of irregular supplementary scales or plates. Disk covered with large plates, whereof a portion only are surrounded by smaller ones. On the back and in the centre a conspicuous rosette of the six large primary plates, partly separated by some minute ones; from these radiate single lines of plates in each interbrachial space, separated by smaller ones from the radial shields. The interbrachial spaces below are covered by large imbricated plates and wide genital scales. Radial shields wide, triangular, strongly diverging, touching by their outer ends; separated by a wedge of a large and a small scale; length to breadth, 2.1 : 1.8. Arm-spines four, short, rounded, tapering, of about equal lengths, 1.2^{mm}. Tentacle-scales rounded, standing close together on the side arm-plate; and outside them is a lip or little ridge.

Fig. 85.



Fig. 86.



Color, in alcohol, white.

Hassler Expedition; Barbadoes, 100 fathoms. Dr. William Stimpson; Cape San Antonio, Cuba, 424 fathoms.

Ophioceramis albida.

Amphipholis albida, LJUNGMAN. Ophiuroidea Viventia, 314.

Pl. III. f. 29-31.

Many specimens which agree with the descriptions and with my notes on the originals at Stockholm were brought from moderate depths in the neighborhood of Rio La Plata. As Ljungman has suggested, the species comes under *Ophioceramis*.

Ophiocoma papillosa sp. nov.

Special Marks.—Numerous (twenty or thirty) tooth-papillæ. One or two scale-like spines overlapping the base of each upper arm-spine.

Description of an Individual.—Diameter of disk, 10^{mm.}. Length of arm, 45^{mm.}. Mouth-papillæ small, four on each side. Tooth-papillæ from twenty-two to thirty, crowded, those in centre smallest. Teeth four. Mouth-shields and arm-plates similar to those of *O. Alexandri*, except that the upper arm-plates are not so regular nor so wide. Disk closely, finely, and evenly granulated, with about seven grains in the length of a mm.; below, the granulation is less close. Arm-spines four, smooth, tapering, rather slender; lengths, 2, 2, 1.5, 1.3. Besides these, there are usually two scale-like spines overlapping each other and the base of the upper arm-spine. One large tentacle-scale. Tentacles, in alcohol, purple and set with many papillæ, while those of *O. Alexandri* are nearly or quite smooth.

Color, in alcohol, pale brown.

Hassler Expedition; Santa Barbara, California, 22 fathoms. A young one from the same locality had a disk of 4^{mm.}. It had already fifteen tooth-papillæ, while the large specimens of *O. Alexandri* have only nine; and there were to be seen the supplementary scale-like arm-spines.

O. papillosa belongs with *O. pumila*, *O. Valenciae*, and *O. Alexandri*, in the division of *Ophiocoma* having flat arms, one tentacle-scale, and a light structure.

Ophiacantha stellata sp. nov.

Pl. II. f. 16-18.

Special Marks.—Disk beset above with minute stumps, each with a crown of four or five thorns. A strong stricture between the joints of the arm. Upper arm-spines long and needle-like.

Description of an Individual.—Diameter of disk, 3.5^{mm.}. Width of arm without spines, 1.1^{mm.}. Length of arm, 26^{mm.}. Mouth-papillæ seven, stout, spiniform, not set close together, all similar in form, but the odd one under the teeth larger; those on each side stand on the jaws. Mouth-shields very wide diamond-shape, with a rounded angle without, and an acute one on either side; length to breadth, 5 : 1. Side mouth-shields narrow, their outer side curved, meeting within. The first under arm-plate at the corner of the mouth-slit is hexagonal; the second triangular with an angle inward, bounded without by a curve, and on the sides by re-entering curves; the third plate,

and those beyond it, squarish, with a slight peak within and the sides re-enteringly curved. Side arm-plates very large, widely meeting above and below; their outer portion rises in a thick ridge, to carry the arm-spines, which gives a knotted look to the arm (*Fig. 18*). Upper arm-plates small, triangular, with an acute angle inward; the outer margin curved; the laterals re-enteringly curved; length to breadth, .5 : .5. The outer part of each plate is bent downward. Disk strongly contracted in the interbrachial spaces, giving to it a star shape. Above, closely set with minute stumps, each bearing a crown of four or five thorns and sitting on a thin round disk-scale which is not readily seen. There are about six stumps in the length of a mm. Below, the interbrachial space is naked, or has but few stumps. Radial shields only visible at their outer ends, as two narrow swellings lying in contact. Arm-spines seven, the upper very long; all of them slender, glassy, and with a few sharp thorns. The joints within the disk have four short, very jagged spines; the longest one .6^{mm}. long. Beyond the disk the two upper spines attain a length of 1.8^{mm}. Tentacle-scales long and narrow; one to each of the tentacles, which are small and slender.

Color, in alcohol, yellowish-brown.

Hassler Expedition : Barbadoes, 100 fathoms.

Ophiacantha hirsuta sp. nov.

Pl. II. f. 21-23.

Special Marks. — Jaws elongated, and bearing about seven spine-like papillæ on each side, besides one larger under the teeth. Disk beset above with short fine spines. Arm-spines serrated. Two large tentacle-scales. Radial shields covered except their outer ends.

Description of an Individual. — Diameter of disk, 6^{mm}. Width of arm without spines, 1.6^{mm}. Mouth-papillæ seven or eight on each side and one under the teeth; the lateral ones are spiniform, the outer ones longest, and all mounted on the jaws, which are prolonged in an acute angle; the papilla under the teeth is broader and diamond-shaped. Mouth-shields wider than long, rounded diamond-shape; length to breadth, .6 : .9. Side mouth-shields narrow, slightly widened without, meeting within. Under arm-plates wider than long, bounded by a very obtuse angle within, a gentle curve without, and re-entering curves on the sides; length to breadth within the disk, .5 : .7. The first plate, at the corner of the mouth-slit, has each margin curled downward,

so as to make a sort of sheath to the mouth-tentacles. Side arm-plates large, meeting above, and nearly below, and having a narrow, prominent ridge for arm-spines. Upper arm-plates small, irregular diamond-shape, with a rounded angle without and within, and an acute angle on each side; on the median line a hump or ridge; length to breadth, .6 : .7. Disk finely scaled below, about six scales in the length of a mm., and with a short thin spine here and there; above, the scaling is not apparent, and the surface is pretty closely beset with short slender spines about .5^{mm.} long. Radial shields covered, their outer ends only being marked by swellings. Arm-spines usually six, near disk, the second and third longest; flattened, somewhat glassy, with the edges strongly serrated, especially those of the lowest spine; lengths to that of an under arm-plate (near the disk).7, 1.3, 1.2, 1, .8, .6 : .6. Tentacle-scales two, large, pointed oval, lying side by side. The tentacles, especially those of the mouth, are thick and smooth.

Color pale greenish, in alcohol.

Dr. William Stimpson; off Sombrero Key, Florida, 240 fathoms. Hassler Expedition; Barbadoes, 100 fathoms.

***Ophiacantha marsupialis* sp. nov.**

Pl. I. f. 9, 10.

Special Marks.—Upper arm-plates diamond shape; side arm-plates meeting above; small oval radial shields; a few stout, short thorns on the disk.

Description of an Individual.—Diameter of disk, 3.7^{mm.}. Width of arm without spines, .9^{mm.}. Length of arm, 10^{mm.}. Mouth-papillæ eleven to each mouth-angle; thin, spiniform; of these two on either side are much longer than the rest and stand on the broad and conspicuous jaws, just inside the mouth-shields; the rest are much smaller, and make a clump at the inner point of the angle, some standing on the jaws and some on the jaw-plate. Mouth-shields wide diamond-shape; length to breadth, .4 : .5. Side mouth-shields narrow, of about uniform width; not extending beyond the mouth-shields; meeting within. Under arm-plates narrow, longer than broad, curved without, re-enteringly curved on the sides, and presenting a rounded angle within; length to breadth within the disk, .4 : .2. The first plate, instead of being rudimentary, differs little in size and shape from the rest. Side arm-plates meeting fully above and nearly below. Upper arm-plates diamond-shape, with one of the angles rounded and directed outward; length to breadth,

.4 : .4. Disk soft and smooth; naked below; but thin imbricated scales may be distinguished above. There are some scattered spines, which are pointed, a little rough, and not over .2^{mm}. long. Radial shields not conspicuous, oval; touching at their outer points, but separated within by a scale. Arm-spines three, slender, rounded, tapering; the upper one the longest, .6^{mm}. One tentacle-scale, which is small, spiniform, and placed on the side arm-plate. The tentacles are smooth and rather thick.

Color, in alcohol, pale greenish-gray.

Hassler Expedition; Juan Fernandez, 240 fathoms.

The genus *Ophiacantha*, as now limited, contains species which vary extremely from the type *O. setosa*. Indeed, there is no genus in which the admitted species are so varied in their detail of structure. *O. marsupialis* may be placed in it as properly as some other species already there; and that, too, despite the fact that the mouth-parts and under surface in general recall, to a certain extent, *Ophioscolex*. The interbranchial pouches had large young ones in them, whose arms protruded through the genital openings.

***Ophiomitra cervicornis* sp. nov.**

Pl. II. f. 19, 20.

Special Marks.—Ten mouth-papillæ, whereof three are on each side of the jaws; two at the apex, under the teeth; and two on the under surface of the jaws on each side of the median line. One tentacle-scale, having the form of a small toothed plate.

Description of an Individual.—Diameter of disk, 8^{mm}. Width of arm without spines, 2.5^{mm}. Length of arm about 42^{mm}. Mouth-papillæ ten, all blunt, stout, spiniform, except the outer one on each side, which is rounded like a very thick scale: there are three on each side of the jaws; two at the apex, under the teeth; and two on the under surface of the jaws just inside the junction of the side mouth-shields. Mouth-shields diamond-shape; length to breadth, 1 : 1.2. Side mouth-shields short, straight, of nearly equal width, meeting within. Under arm-plates hexagonal, with the lateral angle cut off, where the tentacle comes out; length to breadth, .8 : 1. The first plate, at the corner of the mouth-slit, has its sides bent downwards, making a sort of sheath for the mouth-tentacle. Side arm-plates stout, meeting above, but not below, having a prominent ridge for the arm-spines. Upper arm-plates triangular, with an angle inward and the outer side curved; length to

breadth, .8 : 1. Disk covered with somewhat thin and irregular scales, beset with a few thorny stumps. Above, the scales are somewhat elongated, two or three in the length of a mm. ; below, they are smaller and rounded. The upper disk has a few coarse stumps or short thick spines, the longest about .6^{mm.}, with strong thorns ; the interbrachial spaces below have fewer and shorter stumps. Radial shields large, of an irregular four or five-sided shape, meeting at their outer ends, but separated within by a broad scale. Their outer ends bear three thorny stumps. Arm-spines eight or nine, the three uppermost longest, stout, somewhat flattened, coarsely serrated ; lengths to that of an under arm-plate 3, 2.8, 2.8, 2.5, 2, 2, 1.5, 1.5, 1 : .8. One tentacle-scale to each pore, which on the second and third plate has the shape of a toothed crescent ; on the plates beyond, it is a thick scale with a toothed edge.

Color, in alcohol, pale yellowish, with brown spots in radial shields and brown bands on arms.

Dr. William Stimpson ; probably from deep water on the coast of Cuba.

Amphiura anomala sp. nov.

Pl. III. f. 26-28

Special Marks.— Sometimes two and sometimes three mouth-papillæ on each side, of which the innermost is stoutest and is under the teeth ; scaling of disk rather coarse ; radial shields small and wholly separated.

Description of an Individual.— Diameter of disk, 6.5^{mm.}. Width of arm without spines, 1.3^{mm.}. Length of arm about 39^{mm.}. Mouth-papillæ either three or two on a side : of these one is stout, blunt, and rounded, and stands beside its fellow at the point of the mouth-frames under the teeth ; the second is short, spiniform, and sits on the inner part of the side mouth-shield ; there may or may not be a third intermediate one, also spiniform. Besides these the spiniform tentacle-scale of the first mouth-tentacle may be seen. Mouth-shields longer than broad, rounded diamond-shape ; length to breadth, .8 : .7. Side mouth-shields stout, triangular, with re-entering sides ; not quite meeting within. Under arm-plates longer than broad, rectangular, with lateral sides slightly re-entering ; length to breadth, .5 : .4. Side arm-plates wide, but not prominent, nearly meeting above. Upper arm-plates not covering the surface of the arm, rounded, with a peak inward. Disk rather thick, and rising well off the arms ; the scaling is coarse, thickened, and rather irregular, with-

out conspicuous primary plates; usually about four scales in the length of a mm., and even fewer on the under surface. Radial shields small, irregular oval, slightly diverging, separated by a wedge of four scales in a line and one or two smaller ones on the sides; length to breadth, 1 : .5. Arm-spines, near disk, six, rounded, tapering, sharp, increasing in length from the upper to the under one, whose lengths to that of an under arm-plate are .7, .9 : .5. Tentacle-scales two, minute, and standing at right angles. Tentacles, especially those of the mouth, thick and cross-wrinkled.

Color, in alcohol, nearly white.

In young specimens the lower disk-scales are feeble.

Hassler Expedition; Juan Fernandez, 220 fathoms.

I have been of the opinion that Ijnungman's genus *Amphiipholis* was not sufficiently grounded, differing from *Amphiura* only in having three or four mouth-papillæ on a side, instead of two with a space between them. The present species comes in as a connecting form; and a glance at Plate V. will show that the variety in number, shape, and position of mouth-papillæ in the genus *Amphiura*, including *Amphiipholis*, is considerable.

Amphiura squamata Sars.

I am not able to distinguish a specimen from Chili from the *A. squamata* of South and North Europe, or of North America. Already (*Bull. Mus. C. Z.*, III. 335) I have called attention to the possible identity of species nearly allied to this and coming from distant localities. Ijnungman endeavors to distinguish these species by the number of upright scales along the margin of the disk in each interbrachial space; but I satisfied myself, by counting those of many specimens, that this number varies. Thus, thirteen specimens from Spezia, having disks from 1.2^{mm.} to 2.5^{mm.}, had from five to eight interbrachial scales, and the number was not always in proportion to the size of the specimen. Two specimens from the Adriatic, with disks of 2.2^{mm.} and 2.8^{mm.}, had eight, nine, or ten scales. Two from Naples, having disks of 2.2^{mm.} and 3.8^{mm.}, had eight, nine, eleven, or twelve scales. This Chilian specimen, with a disk of 2.5^{mm.}, had nine interbrachial scales.

Hassler Expedition; Talcahuano Bay.

Amphiura Barbaræ sp. nov.*Pl. III. f. 32-34.*

Special Marks.— Three sharp arm-spines. Under arm-plates with a notch without. Side mouth-shields narrow and bent and nearly meeting on the arm.

Description of an Individual.— Diameter of disk, 4^{mm}. Width of arm without spines, .8^{mm}. Length of arm, 26^{mm}. Mouth-papillæ six to each mouth-angle, of which the two innermost run upward towards the teeth, under which they stand; the two on each side are stout, flat, with rounded edges; the outermost one stands partly on the prominent mouth-frame and partly on the side mouth-shield. Mouth-shields small, rounded diamond-shape; length to breadth, .4 : .3. Side mouth-shields narrow and much bent; meeting within, and nearly reaching the median line of the arms without. Under arm-plates squarish, with rounded corners; an obtuse angle within, and a re-entering curve without; length to breadth, .3 : .3. Side arm-plates rather weak; nearly meeting below, but widely separated above. Upper arm-plates much wider than long, pointed oval; length to breadth, .3 : .7. Disk beset with fine thin delicate scales, which are much smaller on the inter-brachial spaces below. Only the central primary plate is conspicuous by its larger size. Above there are six or seven scales in the length of a mm.; below, about sixteen. Radial shields large, pointed pear-seed shape, closely joined, or partly separated by a very narrow line of scales; length to breadth, 1 : .4. Arm-spines three, sharp, rather slender, rounded, tapering; lowest one longest; lengths to that of lower arm-plate .4, .4, .6 : .3. Tentacle-scales two, small, wider than long; set at right angles, one on the under, the other on the side arm-plate. Tentacles large and thick.

Color, pale straw, in alcohol.

Hassler Expedition; Santa Barbara, California, 22 fathoms.

It bears some resemblance to the descriptions of *A. Chilensis*, but the radial shields are joined, and the three arm-spines are sharp and rather long.

Amphiura flexuosa? Ljng.

LJUNGMAN. Ophiuroidea Viventia, p. 319. Brazil.

Pl. III. f. 35-37; Pl. V. f. 68.

This corresponds to Ljungman's description and to my notes on his origi-

nals at Stockholm, except, 1st, the outer mouth-papilla can scarcely be called "spiniform"; 2d, the peculiar microscopic beak at the end of the third and fourth arm-spines is not mentioned by him, but might easily have escaped notice.

Hassler Expedition; one small specimen, Barbadoes, 100 fathoms. Also several larger specimens (disk, 6.5^{mm}; arm, 45^{mm}), by Dr. Palmer, from Bay of Biscayne, Florida. Its general appearance is that of *Ophiopsila Rüsei*.

Amphiura repens sp. nov.

Pl. III. f. 38-40.

Special Marks.—Disk naked below, finely scaled above, and without conspicuous primary plates. Three blunt arm-spines. One tentacle-scale.

Description of an Individual.—Diameter of disk, 4.5^{mm}. Width of arm, without spines, .7^{mm}. Arms long. Mouth-papillæ small, rounded, flat, scale-like; three on each side of the narrow, prominent mouth-frames; the innermost one touching the inner part of the side mouth-shield. Mouth-shields rounded heart-shape, having a slight peak without; length to breadth, .3 : .3. Side mouth-shields triangular, with re-entering sides; they do not meet within. Under arm-plates pentagonal, with somewhat rounded corners and an angle inward; length to breadth, .3 : .3. Side arm-plates weak, narrow, not prominent; nearly or quite meeting above and below. Upper arm-plates wider than long, with a strong curve within, and a gentle one without; length to breadth, .3 : .6. Disk flat and delicate, covered above with a fine, thin scaling; about fourteen scales in the length of a mm., among which the primary plates are not conspicuous; below, the interbrachial space, except next the margin, is naked. Radial shields long and narrow, joined for their entire length, except their sharp inner points, which are separated by a single scale; length to breadth .8 : .2. At their outer ends are two little radial scales, making a small notch in the margin of the disk. Arm-spines three, short, rounded, blunt, nearly of equal lengths, the upper one stoutest; about as long as an under arm-plate. Tentacle-scale one, sitting on the side arm-plate.

Color yellowish in alcohol, with a faint stripe along the upper side of the arm.

Dr. William Stimpson; west coast of Florida; 14 fathoms.

The back of the disk and arms is like *A. levis*, which is from the Philip-

pires, and which has four mouth-papillæ on a side and two tentacle-scales. It also resembles *A. pulchella*, but differs from it by being naked below and having no prominent primary plates.

***Amphiura magellanica* ? L.J.N.**

LJUNGMAN. Ophiuroidea Viventia, 320.

The specimens agree well with the description, except that, 1st, the upper arm-plates are rather rounded fan-shape than "oval"; and, 2d, the arm-spines are but feebly "thorny." The originals, at Stockholm, are in poor preservation; they stand near *A. capensis*, as do also these specimens, which, however, differ from it in having longer and more slender arm-spines. The largest had a disk 7^{mm}. in diameter, and arms four or five times as long; there were seven slender tapering arm-spines, increasing in length from above downward. Small radial-shields wholly separated by a row of scales. One tentacle-scale. One mouth-papilla on either side, besides the thick pair just under the teeth. The species is viviparous.

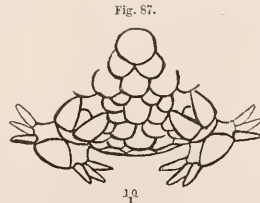
Hassler Expedition; Lat. 41° 40' S., Long. 63° 13' W., N. E. Patagonia, 30 fathoms.

***Amphiura duplicata* sp. nov.**

Pl. V. f. 78. Outline 87.

Special Marks.—First (rudimentary) under arm-plate transversely divided in two. Radial shields separated by a wedge of scales and only touching at their outer ends.

Description of an Individual.—Diameter of disk, 4^{mm}. Width of arm without spines, 1.1^{mm}. Length of arm, 20^{mm}. Mouth-papillæ, seven; three on each side, which are stout, blunt, spiniform, and all on the mouth-frames, and one under and similar in shape to the teeth. Mouth-shields short, heart-shape, with an angle inward; length to breadth, .8 : .8. Side mouth-shields long, narrow, slightly curved, wider without than within, where they meet. Under arm-plates; the first is transversely divided, the inner half reaching into the mouth-slit, while the outer joins the side mouth-shields on each side. Second plate hatchet-shaped, with an angle within, strongly re-entering curves on



either side, and a curve without, where it is widest; length to breadth, .8 : .9. Side arm-plates robust, and nearly or quite meeting above and below. Upper arm-plates broader than long, bounded by a strong curve within, and by a gentle one without; length to breadth, .5 : .7. Disk covered with large, but not swollen scales, whereof the central primary one is conspicuous, having a diameter of .6^{mm}. In a line between it and the inner ends of the radial shields there are only three scales. Radial shields pear-seed shape, diverging inward and touching only at their outer extremities; separated by a wedge of two or three scales; length to breadth, .7 : .3. Arm-spines, near disk, four; stout, rounded, tapering, blunt, of nearly equal length, which to that of an under arm-plate is .5 : .7. Tentacle-scales two, small, rounded, placed at right angles, one on the under, the other on the side arm-plate.

Color, in alcohol, nearly white.

Hassler Expedition; Barbadoes, 100 fathoms. Brazil?

***Amphiura chilensis?* LTK.**

Ophiolepis chilensis, MÜLL. and TROSCH. Wieg. Archiv. IX. 120.

Pl. V. f. 77.

A specimen from Talcahuano Bay, Chili, agrees well with the description and with my notes on the original at Berlin, except that the arms of this specimen are shorter, and the tentacle-scales larger. The description of Müller and Troschel says *one* tentacle-scale, but the specimen in the Berlin Museum has *two*.

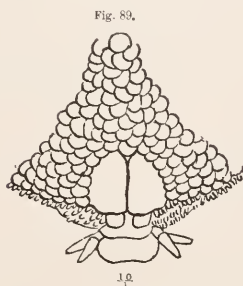
***Ophiocnida filigranea* sp. nov.**

Outline figures 88, 89.

Special Marks.—Close set granules along margin and on a part of inter-brachial spaces of disk. Radial shields very wide and short, and joined along their whole length. Three mouth-papillæ on each side, the innermost one stoutest. Arms long and slender.

Description of an Individual.—Diameter of disk, 7^{mm}. Width of arm without spines, 1.1^{mm}. Length of arm, 72^{mm}. Mouth-papillæ six to each mouth-angle; the innermost two are largest, run upwards to the teeth, and are rounded; the next on either side is smaller and spiniform, and the outermost is flat with a curved edge. Mouth-shields small, longer than broad, five-sided,

with an angle inward; length to breadth, $.7 : .5$. Side mouth-shields very narrow, curved, of equal width, and meeting within. Under arm-plates small, squarish, with rounded corners; length to breadth, $.5 : .5$. Side arm-plates narrow and feeble, meeting neither above nor below. Upper arm-plates large, wider than long, oval, overlapping; length to breadth, $.5 : 1$. Disk covered above with not very regular imbricated scales; five or six in the



length of a mm. Among them, the primary plates may be distinguished by their larger size; the scaling below is much finer and more delicate; six or eight scales in the length of a mm. The margin of the disk and the outer portion of each interbranchial space is closely beset with granules. Radial shields wide, joined for their whole length, which to the breadth is $1.1 : .7$; each has a small, squarish radial scale just over the arm. Arm-spines three, short, rounded, tapering; of about equal lengths, $.6^{\text{mm}}$. Tentacle-scales two, at right angles to each other.

Color, in alcohol, greenish-gray.

Dr. E. Palmer; Cedar Keys, Florida.

This species has very much the general habit and appearance of *Hemipholis cordifera*. It perhaps stands nearest to *Ophiocnida* (*Ophiophragmus* Ljn.) *Loveni*, but the mouth-papillæ of this last are bead-like and nearly equal; and there are many other differences.

Ophiophragmus Wurdemani VAR. ?

A specimen by Dr. Stimpson, from Sombrero Key, 47 fathoms, had the disk-scaling flatter and coarser and the mouth-papillæ somewhat more bead-like than in the type. It is probably a variety.

OPHIOPLAX gen. nov.

Teeth; no tooth-papillæ; numerous mouth-papillæ. Scaling of disk beset with granulation. Arms long and rather stiff. Arm-spines few and smooth, arranged on the ridges of the side arm-plates. One very large tentacle-scale on the side arm-plate, and others, minute, on the under arm-plate. Two long genital openings in each interbrachial space.

The genus stands near *Ophiocnida*, but is distinguished by the numerous mouth-papillæ arranged as in *Ophiura*, and by the singular tentacle-scales.

Ophioplax Ljungmani sp. nov.

Pl. II. f. 24, 25.

Special Marks.—Interbrachial spaces below and margin of disk minutely granulated; upper surface finely scaled, and with small, separated radial-shields. One large and three minute tentacle-scales. Arms pretty long and rather stiff.

Description of an Individual.—Diameter of disk, 6^{mm.} Width of arm without spines, 1.7^{mm.} Length of arm, 60^{mm.} Mouth-papillæ five on each side, and one under and similar in form to the teeth. The papillæ are flat and crowded; the one next the outermost much wider than the others. Mouth-shields small, egg-shape, with the point inward; length to breadth .8 : .7. Side mouth-shields very small and narrow; joining the side arm-plates with their outer ends; not meeting within. Under arm-plates rather wider than long, with a curve without, an obtuse angle within, and re-entering curves on the sides; length to breadth, .7 : .8. Side arm-plates nearly meeting below, but well separated above. Upper arm-plates much wider without than within; the outer side curved; the lateral sides straight and sloping towards the median line; length to breadth, .7 : 1.4. Disk finely scaled above, six scales in the length of a mm., where they are finest. The margin and under surface covered by a minute granulation, about sixteen grains in the length of a mm. Radial shields small, irregularly oval, widely separated by three or four parallel lines of scales; length to breadth, 1 : .4. Arm-spines three, of nearly equal lengths; slender, rounded, smooth, tapering; the longest, .8^{mm.} One very large, nearly oval tentacle-scale standing on the margin of the side arm-plate; and three minute ones arranged along the lateral side of the under arm-plate. The tentacles are smooth and moderately stout.

Color, in alcohol, yellow brown.

Hassler Expedition; Barbadoes, 100 fathoms.

Ophiocolex Stimpsonii sp. nov.

Pl. I. f. 11-15.

Special Marks.—Upper arm covered by a thin transparent skin, through which appear the upper surfaces of the arm-bones. Each tentacle furnished with a flap of skin standing outside of it. Lower surface and upper disk covered by thick skin.

Description of an Individual.—Diameter of disk, 7^{mm}. Width of arm without spines, 1.4^{mm}. Length of arm, 31^{mm}. Mouth-papillæ spiniform, blunt, somewhat rough, imbedded in and nearly covered by the skin. There are nine to each mouth-angle, whereof one stands under the teeth. Besides these there may be seen, on each side, the spiniform tentacle-scale of the first pair of mouth-tentacles. Mouth-shields broad, oval, much obscured by the skin; length to breadth, .6 : 1. Side mouth-shields very small; not meeting within, nearly buried by the skin. Under arm-plates not visible except on drying or removing the skin, when they appear as small shield-shaped bodies, with an angle within, the sides re-enteringly curved and a strong notch without. In the same way may be distinguished the side arm-plates, which meet below, but stop above at the level of the upper surface of the arm (*Fig. 13*). At the tip of the arm the under arm-plate is nearly circular, and is set, like a wedge, between the outer ends of the elongated side arm-plates (*Fig. 15*). There are no upper arm-plates at all, and the arm-bones are to be seen through the thin skin, both at the base of the arm (*Fig. 12*) and at its tip (*Fig. 14*). Disk covered above and below with a thick but tender skin, there being neither scales nor radial shields visible. Arm-spines, outside the disk, three; short, slender, a little rough; the lowest one longest, namely, .7^{mm}. long. Tentacle-scales are represented by narrow pointed flaps of skin, one standing outside of and close to each tentacle.

Color, in alcohol, gray brown.

Dr. William Stimpson; off Sombbrero Key, 240 fathoms.

It will be seen that this species does not agree with all the characters of *Ophiocolex*. Its under arm-plates (nearly as in *Ophiomyxa*) and the flaps to the tentacles are features of difference. The type *Ophiocolex glacialis*, which seems to have a naked thick-skinned disk, is really covered by thin, fine,

regularly imbricated scales. Under the skin may be found the radial shields, which are perhaps smaller than in any other species among *Ophiuride*. There are no upper arm-plates, nor do the side arm-plates meet above; a want which is not found even in *Ophiomyxa*, whose upper arm-plates are divided in several pieces, after the analogy of *Ophioplocus*, and are covered by a thick skin.

ASTROTOMA* gen. nov.

Disk and arms granulated. Radial ribs low and narrow, running to centre of disk. Arms simple, and traversed by annular ridges bearing microscopic spines. Tentacle-spines stout, erect, standing by all the pores except those close to the mouth. No mouth-papillæ. Teeth and tooth-papillæ similar and spiniform, arranged in a clump at the inner point of the mouth-angle. Two genital openings lying at the outer corners of each interbrachial space.

This simple-armed *Astrophyton* resembles *Astronyx* in its dentition, while in the covering of the disk and arms and in the tentacle-spines it is between *Astrochema* (*Pl. IV. f. 57, 58*) and *Astrogomphus*.

Astrotoma Agassizii sp. nov.

Pl. IV. f. 52-56.

Special Marks. — Radial ribs slightly marked. Disk finely granulated; the under side of arms and surface round mouth more coarsely granulated. Tentacle-spines three or four; short, thick, slightly flattened, standing erect. Upper surface of arm with low annular ridges which bear microscopic spines. One madreporic shield.

Description of an Individual. — Diameter of disk, 20^{mm}. Width of arm without spines, 4^{mm}. Length of arm about 138^{mm}. Tooth-papillæ and teeth represented by a clump of more than a dozen short, stout, sharp spines, like those of *Astrophyton*, and arranged at the inner apex of the mouth-angle, which has no spines near its outer corners. Arms cleanly rounded above; flattened below, where they are covered by a smooth granulation extending to the mouth region, which is separated from the interbrachial spaces by lines of coarser grains connecting the bases of the arms at the point where they blend in the disk. The arched upper surface of the arm is divided into

* ἀστὴρ, star; τομή, cut.

joints by annular ridges of granules bearing microscopic spines. Close to the tip of the arm, each joint has a ridge of two annular rows of grains (*Fig. 56*), and each grain carries a microscopic spine. These two rows of spines interlock like the teeth of saws, and are folded flat to the arm. Between the ridges are depressions which are covered by three annular rows of grains. The madreporic plate lies in the mouth region inside the line of coarse grains connecting the bases of the arms; it is oval and surrounded by a setting of coarse granules. Disk roughly circular, with ten slightly re-entering curves at the brachial and interbrachial margins. Radial ribs feebly marked and running quite to the centre; they are more coarsely granulated than the rest of the upper surface (whose granulation makes a sort of network pattern), and have four or five grains in the length of a mm. Interbrachial spaces below distinguished from the mouth region by their smoothness and their minute granulation. Tentacle-spines short, stout, blunt, slightly flattened, standing erect; there are none by the first pore, two by the second, and three or four by those beyond; their bases are surrounded by a little ridge of granulation, outside which is the pore through which protrudes the small, short, smooth tentacle (*Fig. 54*). Close to the tip of the arm there are two spines to each pore; and here they are comparatively much larger, are covered with skin and hooked at the end; at their base are two microscopic spines similar to those on the ridges of the arm (*Fig. 56*). The very tip of the arm is divided into joints, but, as yet, has no grains or minute spines; there is, however, a stout curved tentacle-spine to each pore (*Fig. 55*). The genital openings are short, and lie at the outer corners of the interbrachial spaces.

Color, in alcohol, nearly white.

Hassler Expedition; Straits of Magellan, at the junction of Smythe's Channel, on the Pacific side; one specimen from 135 fathoms.

Table of the simple-armed Astrophytons.

Teeth, tooth-papillæ and mouth-papillæ represented by a clump of smooth, rounded, tapering spines, chiefly at inner angle of jaws.	{	Genital openings at outer corners of interbrachial spaces, and parallel to the arms. Skin granulate. Numerous peg-like tentacle-spines	Astrotoma
		Genital openings at inner angle of interbrachial space. Skin naked and soft. Thorny, hooked tentacle-spines	Astronyx.
Teeth, tooth-papillæ, and mouth-papillæ all spiniform, but arranged somewhat as among Ophiurans, on the point of the jaws and along the lower edges of the mouth-slits.	{	Genital openings near outer corners of interbrachial space and parallel to arms. Skin granulate and beset with stumps or spines. Arms prolonged into the disk as strong ridges occupying most of its upper surface. Numerous tentacle-spines with thorny ends	Astroporpa.
		Genital openings near outer corner of interbrachial space and parallel to arms. Skin granulate and beset with stumps or spines. Disk rising distinct from the arms. Numerous tentacle-spines with thorny ends	Astrogomphus.
True teeth as among Ophiuride. No tooth-papillæ or mouth-papillæ.	{	Genital openings vertical and at inner angle of interbrachial space. Skin naked and soft, a few (usually two) tentacle-spines to each pore	Ophiocreas.
		Genital openings vertical and at inner angle of interbrachial space. Skin granulate. A few (usually two) tentacle-spines to each pore	Astroschema.

Table of the species of Astroschema.

	A. oligactes.		A. tenue.	A. leve.		A. Steenstrupii.	A. sulcatum.
Tentacle-spines	Two, rounded tapering, to each pore. Towards middle of arm, the one next median line is much longer and stouter, and thorny at the tip, but not club-shape.		One small and spiniform on each of first two pairs of pores; beyond that, two to each pore. Towards middle of arm, the larger one is short, club-shape, 1mm. long, and slightly thorny.	None on first pair, or two pairs of pores; a single flat one till the 8th pore, where begins a small additional one, at middle of arm, about as in <i>A. oligactes.</i> (?)		None on first pair of pores; on all beyond two short and thick ones.	None on first two pairs; then a single small one; farther out, two. Near middle of arm the larger spine is long, bent club-shape, and strongly thorny at the end.
Diameter of disk	8mm.	5mm.	6mm.	9mm.	7.5mm.	7mm.	5mm.
Length of arm . .	140mm.	53mm.	200mm.	135mm.	93mm.	About as in <i>A. oligactes.</i>	
Width of arm . .	2.5mm.	1.3mm.	1.5mm.	3.5mm.	3mm.	2.5mm.	
Grains on upper surface of arm in a mm. long .	4 or 5; pointed		8 or 9; smooth	9 to 15; smooth		Grains not close, but set in lines.	About 9 to 15; smooth.
Disk	Radial ribs wide, not prominent; margin of disk angular; surface rough, with sharp grains.		Radial ribs narrow and not prominent; margin of disk angular; surface smooth, with small grains.	Radial ribs wide and arched, occupying the whole upper surface; the margin with 10 curves. Granulation fine and smooth.		Radial ribs and margin as in <i>A. leve.</i> Granulation arranged in more or less concentric lines.	Radial ribs narrow and not running to the centre. Granulation fine.

Astroschema tenue sp. nov.

Special Marks.—Arms slender, and in length more than thirty times the diameter of the disk. Radial ribs narrow and running to the centre. Disk and arms smoothly granulated.

Description of an Individual.—Diameter of disk, 6^{mm}. Length of arm, 200^{mm}. Width of arm near base, 1.5^{mm}. Teeth wider than long, with a curved cutting edge. The general granulation becomes coarser on the mouth-angles, and some of the larger grains extend upward on the sides of the mouth-slits. Arms very slender and long; above and on the sides the joints are indicated by gentle swellings, but the lower surface is flat. The upper surface of the disk presents ten narrow radial ribs which meet in the centre; the disk margin between the ribs is re-enteringly curved. Upper disk and arms closely granulated with smooth grains, whereof there are eight or nine in a mm. long; on the radial ribs they are somewhat coarser. The lower side of the arm has a much finer and more scattered granulation. Each of the first two pairs of tentacle-pores has a single small, thorn-like tentacle-spine; the pores beyond have two. Towards the middle of the arm the tentacle-spine nearest the median line becomes much longer and larger, 1^{mm}. long, and has a club-shape, with fine thorns at its end; while its fellow retains its previous form. The mouth-tentacles project from little tubes, which may also be seen on the pores of the base of the arm. Genital openings standing close together at the inner angle of the interbrachial space and separated by a partition.

Color, in alcohol, nearly white.

Hassler Expedition; Barbadoes, 100 fathoms.

This species stands nearest to *A. oligactes*, from which it is readily distinguished by the longer and more slender arms, and by a granulation smooth and fine, instead of coarse and pointed.

In a former paper (*Annales des Sc. Nat.*, 1872, p. 5) I expressed a doubt of the distinction made by Dr. Lütken between *Astroschema* and *Astromorpha*, founded on the position in the last genus of the genital openings *in a hollow*. By examining numerous alcoholic specimens of *A. oligactes*, I have been convinced that this is not a valid difference. The real peculiarity in these, as well as in *Ophiocreas*, is that the genital openings are at the inner angle of the interbrachial space and are nearly *vertical*, instead of being horizontal and placed alongside the arms. The genus *Astromorpha* may therefore be merged in *Astroschema*.

Astrophyton Pourtalesii sp. nov.*Pl. IV. f. 41-43.*

Special Marks.—Disk round and fleshy, covered by a thick skin, through which show numerous grains on the upper surface. Three or four tentacle-spines to each pore, extending to within one or two pores of the mouth. One madreporic body, often covered by the skin, and situated at the inner angle of the interbrachial space.

Description of an Individual.—Diameter of disk, 63^{mm}. Width of arm where narrowest within the disk, 8^{mm}. Width of largest branch, outside disk, 8^{mm}. Total length of arm measured along its branches, 204^{mm}, to wit: 1st fork (which is within the disk) to the 2d (which is outside), 16^{mm}; 2d to 3d, 32^{mm}; 3d to 4th, 30^{mm}; 4th to 5th, 27^{mm}; 5th to 6th, 29^{mm}; 6th to 7th, 27^{mm}; 7th to 8th, 15^{mm}; 8th to 9th, 10^{mm}; 9th to 10th, 7^{mm}; 10th to 11th, 7^{mm}; 11th to end, 4^{mm}. Mouth-papillæ, teeth, and tooth-papillæ all similar and spiniform; small, nearly equal, and about a dozen to each mouth-angle. Arms smooth, covered with thick skin, and rounded. The terminal twigs have their joints marked by annular ridges (*Fig. 43*), which bear a double row of minute spines, folded down on the ridge and alternating with one another. Disk fleshy, nearly circular, and covered by a thick skin; the radial ribs slightly marked. There are neither spines nor stumps, but a quantity of scattered granules, which are most plenty near the centre of the back, and are almost wanting in the lower interbrachial spaces. At the inner angle of one of the interbrachial spaces is the madreporic shield, which is so covered by skin as to be hard to distinguish. Three or four tentacle-spines on all the larger branches; short, blunt, spiniform, of equal size; about 2^{mm} long. On the two pairs of pores nearest the mouth, no spines, or only a single one; the following three or four pores have two spines each; and those beyond, three or four. Each pore on the terminal twigs has but two tentacle-spines, in form of strong spiny stumps covered with skin (*Fig. 43, q*), close to which the tentacle (*q'*) protrudes.

Color, in alcohol, nearly white.

A larger specimen had the disk 75^{mm} in diameter. The distances from one fork of the arm to the next were as follows: 1st to 2d, 14^{mm}; 2d to 3d, 29^{mm}; 3d to 4th, 27^{mm}; 4th to 5th, 29^{mm}; 5th to 6th, 21^{mm}; 6th to 7th, 18^{mm}; 7th to 8th, 14^{mm}; 8th to 9th, 14^{mm}; 9th to 10th, 10^{mm}; 10th to 11th, 10^{mm}; 11th to 12th, 8^{mm}; 12th to 13th, 7^{mm}; 13th to end, 7^{mm}; in all,

208^{mm}. It had more abundant granulation on the upper surface of the disk, but was otherwise similar to the one first described.

Hassler Expedition; off East Patagonia, lat. 44° 52' S., long. 64° 10' W., and lat. 51° 26' S., long. 68° 5' W., 55 fathoms.

This fine *Astrophyton* belongs to the group whose arms are narrow at their base, and the forkings few and distant. The species of cold and temperate waters fall in this group, such as *A. euenemis*, *A. Lamarckii* (which resembles the one under consideration), and *A. Agassizii*. The second group, whose types are *A. costosum* and *A. spinosum*, has the arm wide at its base, and divided often and at short intervals; its habitat is in tropical seas. Where the one would have a width of 8^{mm}, and a dozen or fifteen forks in the arm, the other would have 14^{mm} and twenty-five or thirty forks (*Figs. 41 and 44*), whereof three would be within the disk, which is not circular, but deeply re-entering at each interbrachial margin.

What are spoken of as tentacle-spines are so named from their proximity to the pores. They might be called also arm-spines, because they are carried by the rudimentary side arm-plates, as may be seen in a young *Astrophyton* (Lütken, *Addimenta ad Hist. Ophiurid.*, *Pl. I.*, *Pl. II.* f. 17, b). The hooklets, or small spines, which stand on annular ridges and usually in double rows, on the arms of all *Astrophytidæ* (*Pl. IV.* f. 43, 46, 51, 56), are not immediate homologues of arm-spines, but are comparable to skin granules. Among *Ophiuridæ*, however, such hooklets are true arm-spines (*Pl. IV.* f. 60, p., *Ophiothela isidicola*), attached to side arm-plates (*i*).

***Astrophyton spinosum* sp. nov.**

Pl. IV. f. 44-46.

Special Marks. — Interbrachial spaces of disk deeply indented. Radial ribs thick and high. Little clumps of three or four spines at each joint on the upper median arm-line. Arm forked three times within the disk. No tentacle-spines on the pores near the base of the arm. Five madreporic bodies lying at the inner angles of the interbrachial spaces.

Description of an Individual.— Diameter of disk, 42^{mm}. Width of arm where narrowest, inside disk, 15^{mm}. Width of largest branch, outside disk, 6^{mm}. Total length of arm, measured along its branches, 288^{mm}, to wit: from 1st to 2d (both within margin of disk), 14^{mm}; 2d to 3d, 14^{mm}; 3d to 4th, 14^{mm}; 4th to 5th, 16^{mm}; 5th to 6th, 15^{mm}; 6th to 7th, 18^{mm}; 7th to 8th, 15^{mm}; 8th to

9th, 15^{mm.}; 9th to 10th, 16^{mm.}; 10th to 11th, 16^{mm.}; 11th to 12th, 15^{mm.}; 12th to 13th, 15^{mm.}; 13th to 14th, 13^{mm.}; 14th to 15th, 12^{mm.}; 15th to 16th, 13^{mm.}; 16th to 17th, 12^{mm.}; 17th to 18th, 10^{mm.}; 18th to 19th, 8^{mm.}; 19th to 20th, 7^{mm.}; 20th to 21st, 7^{mm.}; 21st to 22d, 6^{mm.}; 22d to 23d, 6^{mm.}; 23d to 24th, 6^{mm.}; 24th to end, 5^{mm.}. Teeth, mouth-papillæ, and tooth-papillæ all similar and spiniform; they are sharp and slender, in number twenty or more, and form a close high clump on the mouth-angle. Arms, near the disk, wide and flat below and covered by a smooth skin; above, arched and invested with a fine smooth granulation about six grains in the length of a mm. On the upper median line there is to each joint a row of four or five little spines about .5^{mm.} long; and at their base there usually is a large rounded grain (*Fig. 47*). These spines are found well out on the arm. The terminal twigs have their joints marked by annular ridges, each composed of a double row of grains, which support little hooklets. The depression between the joints is covered by a double row of rounded grains (*Fig. 46*). Disk strongly indented along its margin, and having deep radiating furrows on the back. Its skin is smooth except a number of small spines like those on the back of the arms, which are sparsely scattered in twos and threes over the upper surface. At the inner angle of each of the interbrachial spaces is a madreporic shield. There is no trace of tentacle-spines near the base of the arm; but, outside the fifth fork, there are two or three to each pore, similar in shape to those on the upper surface of the arm. Tentacle-pores closely contracted, and only recognized by the little pits that mark their position. Radial ribs high and wide, occupying a large part of the upper surface; extending to the centre of the disk and projecting over the arms.

Color, in alcohol, purplish-brown.

Panama; brought up by Wesley Clark, a noted diver, and presented by Mr. Landsberg.

This new species represents, on the Pacific side, *A. costosum* of the West Indies, although it differs widely in its details. *A. costosum* has a few thick stumps on the upper disk and the radial ribs, while *A. spinosum* has clumps of minute spines.

CAMBRIDGE, January 13, 1875.

EXPLANATION OF THE PLATES.

PLATE I.

Ophiomusium acuferum, Figs. 1-5. Fig. 1, ♀, under surface, showing the mouth-tentacles, the curved genital openings, and the two under arm-plates which have tentacles. Fig. 2, ♀, upper surface, with its peculiar plates and the spines on the back of the arm. In this species and the succeeding one the surface is shown smooth, as it appears under water; when dry, it is seen to be covered with microscopic points. Fig. 3, ♀, a portion of the arm, near its tip, from below, showing the complete investment by the side arm-plates. Fig. 4, ♂, the jaws and adjacent parts, from the side: *c*, the jaws; *e*, jaw-plate; *d'*, teeth; *d*, mouth-papillæ; *r*, *r'*, the sockets of the second and first pairs of mouth-tentacles. The rudimentary state of the apparatus will be observed: shapeless jaws, small jaw-plate, few and irregular teeth, and the closely soldered mouth-papillæ. Fig. 5, ♂, a tentacle of one of the two under arm-plates with its clapper-like scale.

Ophiomusium testudo, Figs. 6-8. Fig. 6, ♂, under surface, showing two of the mouth-tentacles, the absence of an under arm-plate on the third joint, and the peculiar marginal disk-plates. Fig. 7, ♂, upper surface, with the intimately soldered plates. Fig. 8, ♂, 3d, 4th, and 5th arm-joints, with their two or three minute arm-spines.

Ophiacantha marsupialis, Figs. 9-10, ♂. Fig. 9, under surface. The arms of a young one protrude from the genital openings. The peculiar shape of the jaws will be observed; and the unusual size of the first under arm-plate, which completely encloses the second pair of mouth-tentacles. Fig. 10, upper surface.

Ophioscolex Stimpsonii, Figs. 11-15. Fig. 11, ♀, under surface. The outlines of some of the parts are dimly seen through the thick skin. Each tentacle has a flap of skin outside it; and the arm-spines lie along the margin of the arm. Fig. 12, ♀, upper surface, covered by a thick integument, which is projected over the upper surface of the arms as a transparent film, through which the upper edges of the arm-bones may be seen, and their muscular bundles. Fig. 13, ♂, under surface of an arm-joint, with skin removed to show the plates. The small under arm-plate and the side arm-plates are much as in *Ophiomyxa*. Outside each tentacle is its peculiar flap of skin; and, next this, the lowest arm-spines slightly denticulated. Fig. 14, ♂, upper surface of a joint at tip of arm; the side arm-plates do not meet above, nor is the vacant space covered by any upper arm-plate. Fig. 15, ♂, the joint from below. Wedged between two side arm-plates is a circular under arm-plate, outside which are the tentacles with their flaps, and the undermost arm-spines.

PLATE II.

Ophiacantha stellata, Figs. 16–18. Fig. 16, 2_1^o , under surface. The difference between the second and third under arm-plates is to be noted. Just outside the second small spine of the second plate (on the arm to the right of the observer) may be seen protruding the minute tentacle. Fig. 17, 2_1^o , upper surface, showing the small, deeply indented disk and the peculiar side arm-plates, constricted between the joints, and rising suddenly into a ridge for the arm-spines. These characters, and the narrow, nearly covered radial shields, are those of the typical *O. setosa*, from which so many species now referred to the genus vary. Fig. 18, $\frac{1}{2}$, three joints, seen from above, to show their characteristic form.

Ophiacantha hirsuta, Figs. 21–23. Fig. 21, 1_1^1 , under surface, with the unusually long jaws, large mouth-tentacles, and the first under arm-plate partly rolled on itself. Fig. 22, 1_1^1 , upper surface, showing the numerous fine spines. Fig. 23, 2_1^o , the lowest arm-spine, to exhibit the peculiar thorns of its point and edges.

Ophiomitra cervicornis, Figs. 19–20, $\frac{1}{2}$. Fig. 19, under surface. The first under arm-plate is folded on itself, and the small mouth-tentacle of the second pair protrudes between it and the outer corner of the side mouth-shield. On the under arm-plates, beyond, the tentacle-scales have, first, the shape of thorny crescents, and then of little lobes. Fig. 20, upper surface, showing the large radial shields and the coarse spines and stumps of the disk.

Ophioplax Ljungmani, Figs. 24, 25, $\frac{1}{2}$. Fig. 24, upper surface; the scales of the margin are covered by a minute granulation. Fig. 25, under surface, showing the singular oval tentacle-scale, with three or four minute ones on the under arm-plate. The interbrachial space is finely granulated.

PLATE III.

Amphiura anomala, Figs. 26–28, 1_1^o . Fig. 26, under surface. On the right side of the mouth-angle are seen three, and on the left only two mouth-papillae. Above these are the large mouth-tentacles; and still higher may be seen the points of the scales of the first pair of mouth-tentacles. Fig. 27, upper surface. Fig. 28, arm-spines, from the side.

Amphiura Barbaræ, Figs. 32–34, 1_1^7 . Fig. 32, under surface. The tentacles are thick; their scales minute. Fig. 33, upper surface, with wide upper arm-plates. Fig. 34, arm-spines.

Amphiura flexuosa? Lox., Figs. 35–37. Fig. 35, 1_1^8 , under surface, showing its very minute, feeble scaling. Inside the mouth-shield are two small mouth-papillae, followed by the little jaws bearing the other pair of papillae; beside these are seen the second pair of mouth-tentacles, and the scales of the first pair. Fig. 36, 1_1^8 , upper surface, with the radial shields separated by a central row of scales, and some others, ill-defined, on either side. Fig. 37, 2_1^o , third and fourth arm-spines, which differ from the rest in being stouter, a little rough, and in having a microscopic beak at the tip. See also Plate V. Fig. 68.

Amphiura repens, Figs. 38–40, 1_1^6 . Fig. 38, under surface. Most of the interbrachial space is naked, as in *A. semitermis*. The narrow jaw carries six bead-like mouth-papillae. Fig. 39, upper surface, which much resembles that of the East Indian *A. levis*. Fig. 40, arm-spines.

Ophioceramis albida (Amphipholis Lox.), Figs. 29–31, 1_1^1 . Fig. 29, under surface. The large side mouth-shields, numerous mouth-papillae, and short genital openings are the char-

acters here to be seen which separate it from *Amphiura*. The small tentacles are somewhat protruding, each with its two scales. Fig. 30, upper surface, showing the strong, coarse scaling and thick upper arm-plates of the genus. Fig. 31, arm-spines.

PLATE IV.

Astrophyton Pourtalesii, Figs. 41-43. Fig. 41, †, under surface of the interbrachial space which has the madreporic body. On the mouth-angle are the few and small tooth-spines, and the mouth-tentacles. Following the arm, the first joint has tentacles with no spine; the joints beyond have, for the most part, three or four spines to each tentacle. The narrowness of the arm and the single fork within the disk will be noted as compared with the broad arm and three forks of Fig. 44. Fig. 42, †, upper surface, showing the low radial ribs, sparse granulation, and smooth arms. Fig. 43, 1st, a joint at the tip of the arm, showing the peculiar minute spines, which are folded down, more or less covered by skin, and placed in two alternating rows. Below are the large tentacles (*q*'), and their hooked spines (*q*), cased in skin, of which there are two to each pore on this part of the arm. The northern species, *A. Agassizii*, has also two large tentacle-spines to each pore at the tip of the arm (Figs. 49, 50, *q*, *q'*), with a ridge corresponding. In Fig. 50, a tentacle may be seen protruding from several of the pores.

Astrophyton spinosum, Figs. 44-47. Fig. 44, †, under surface, with one of the five madreporic shields. At the mouth-angle is a crowded clump of numerous tooth-spines, and, on either side, a mouth-tentacle; just outside is a double swelling, which is a part of the jaws. There are no tentacle-spines on the broad arms, and the pores are represented only by feeble depressions. Fig. 45, †, upper surface, with the wide high radial ribs, and the broad cicatrices at their outer ends. On the disk and arms are the characteristic groups of small spines. Fig. 46, 2nd, a joint from tip of arm. Each ridge has a double row of granules bearing minute hooks; and each depression has also a double row of granules, which have not so much of a pit in their centre as is represented in the drawing. A joint of similar character is that of *A. cacacticum*, Fig. 51, where the specimen was dried and many of the hooklets rubbed off, showing the granules on which they stood. It must be borne in mind that these granules do not correspond to side arm-plates, nor their hooklets to arm-spines. Where hooklets are found among Ophiuridae they are arm-spines and stand on side arm-plates, as may be seen in the young of *Ophiothela isidicola*, Fig. 60, where an arm-spine (*p*) and hooklets (*p'*) are found on the side arm-plate (*i*). Fig. 47, †, upper surface of arm, near the disk, to show the granulation, and the row of small spines which crowns each joint.

Astrophyton exiguum, Fig. 48, †. Upper surface, from the original and unique specimen of Lamarck in the Garden of Plants. The specimen has the granulation partly rubbed off, exposing the compound radial shields or ribs (*l*) which characterize the genus. It doubtless is a young one, which adds to the trouble of finding what the species really is.

Astrophyton Agassizii, Figs. 49, 50. Tip of arm, from a living specimen, much magnified; side, and under surface.

Astrophyton cacacticum, Fig. 51. Joint from tip of arm, dried, and much magnified.

Astrotoma Agassizii, Figs. 52-56. Fig. 52, †, disk and one arm complete, from above. Fig. 53, †, under surface, showing the finer and coarser granulation, the *Astrophyton*-like tooth-

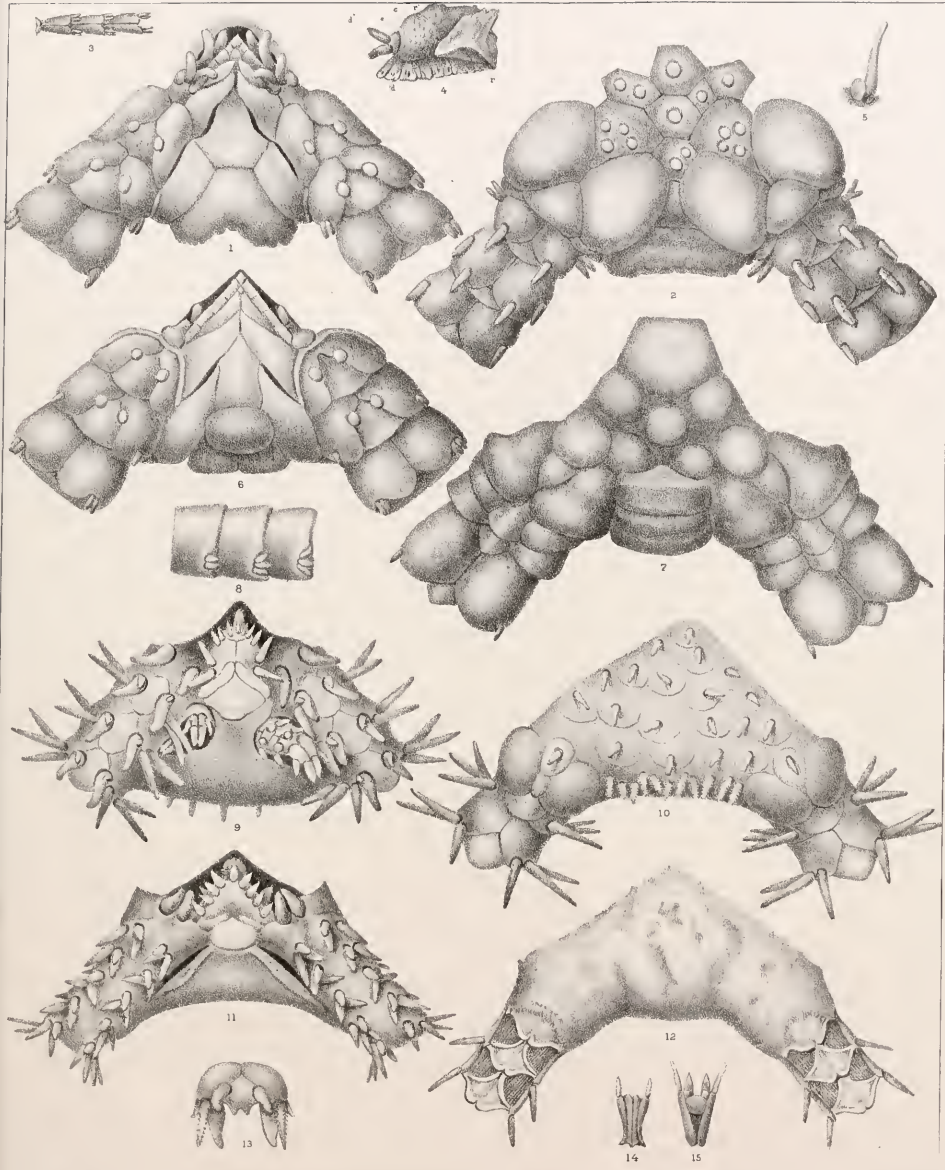
spines; the madreporic shield, and the strong, upright tentacle-spines. The first pore, outside the mouth-slit, has a small tube but no spine. From the pores on either side of the madreporic plate may be seen protruding the small tentacle covered by two spines. Fig. 54, ♀, a tentacle-pore with its three spines mounted on a granulated ridge. Fig. 55, 2[♂], tip of an arm rolled on itself; there are, as yet, no granules or small spines; but the curved tentacle-spines are formed. Fig. 56, 2[♂], a joint close to tip of arm. The ridges have two rows of granules, each bearing a minute jointed spine which is usually folded down, the whole fitting together like fingers of two hands. The intermediate sunken space is covered by three rows of granules. Below are seen the large tentacle-spines (*q*), hooked at the end and covered by thick skin; on the base of the exterior one are two little spines similar to those of the granulated ridges above.

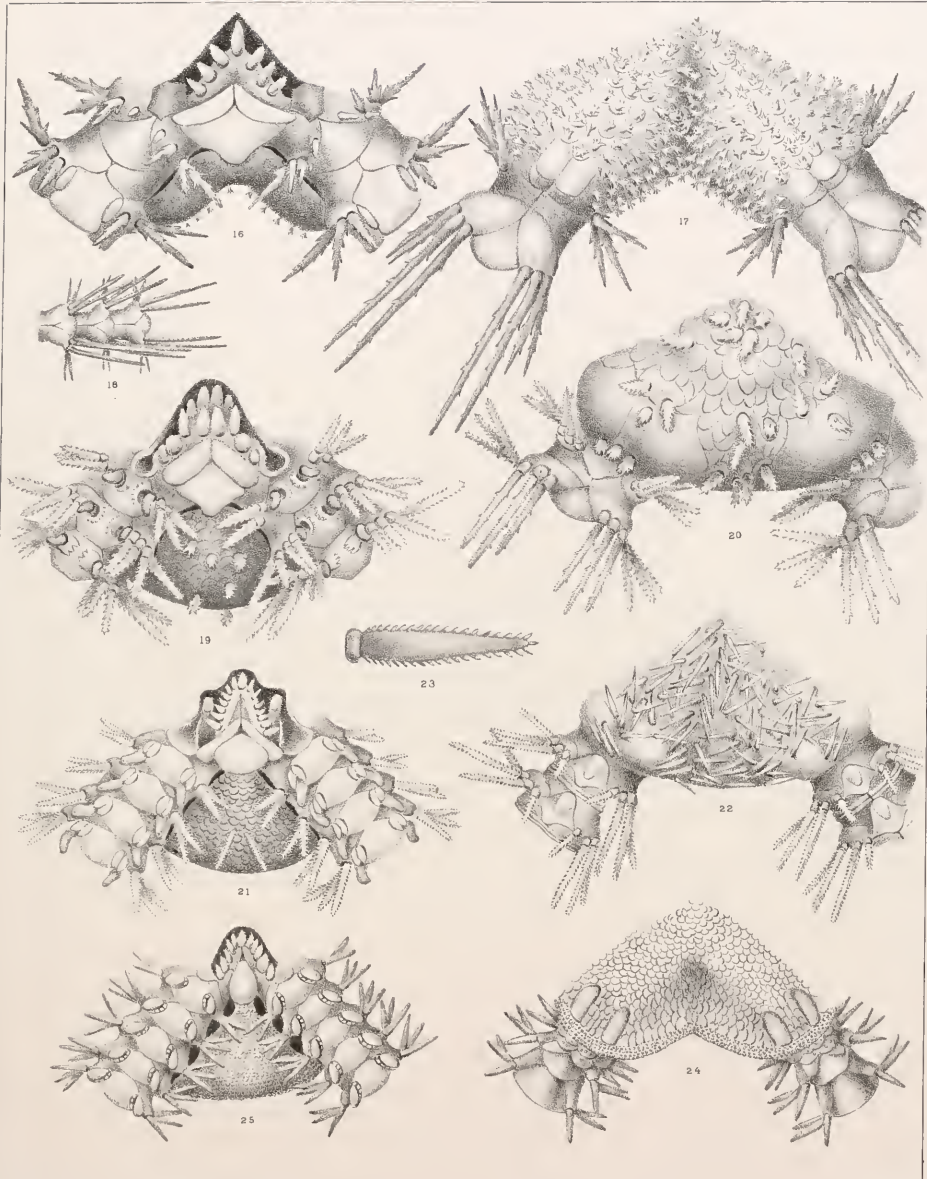
Astroschema læve, var., Figs. 57–59, from original in the Garden of Plants. Fig. 57, ♀, under surface of a dried specimen. The mouth-angles have only teeth. The first pore has no scale; the second, one. The granulation in this figure and the next is made too coarse; there should be twelve or fifteen grains in the length of 6^{mm}. Fig. 58, ♀, upper surface, showing its regular division in lobes with curved margin, and the arm-joints as successive swellings. Fig. 59, ♂, interbrachial space seen horizontally from without, exhibiting the vertical genital openings at the inner angle. The specimen varies from the type in having a finer disk-granulation.

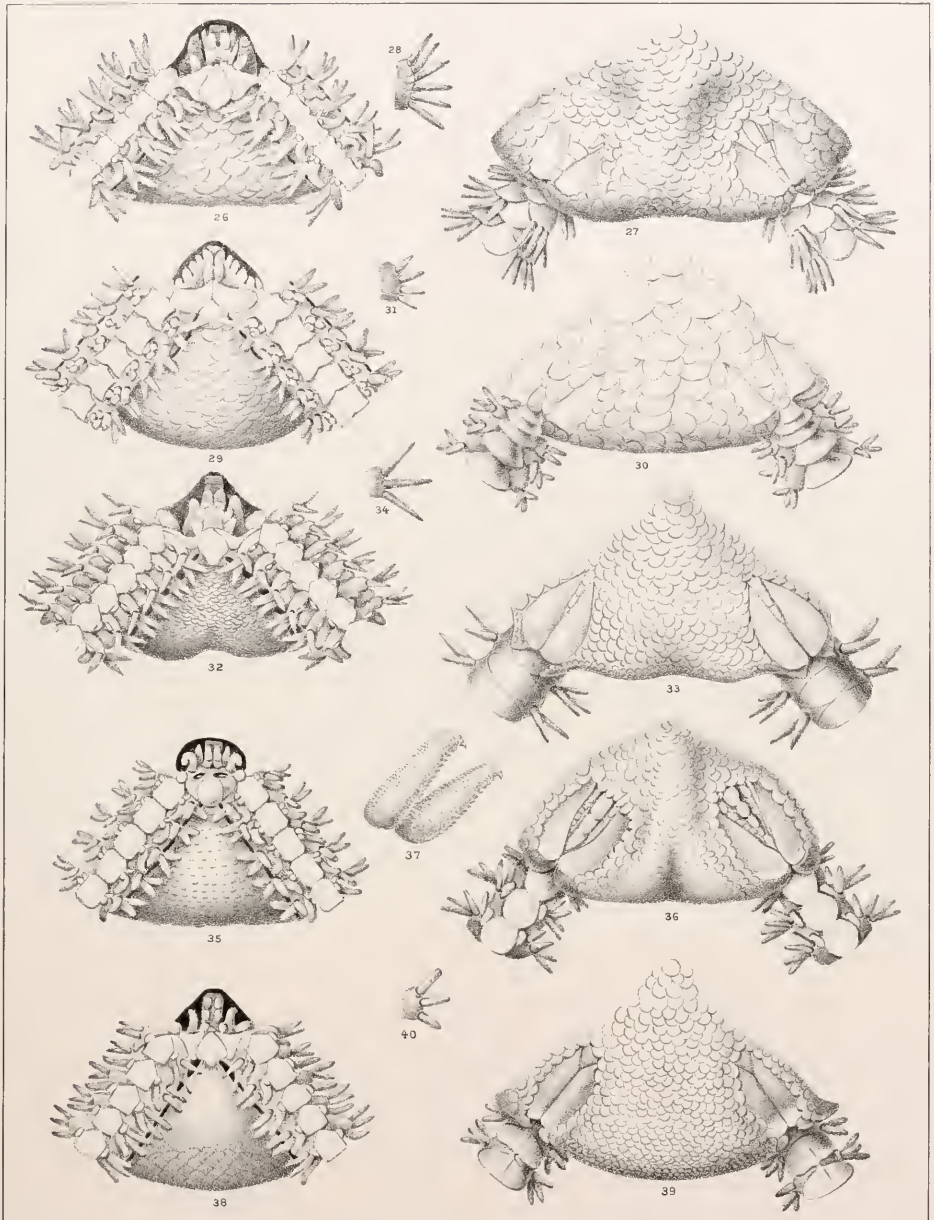
Ophiothela isidicola, Fig. 60, 4[♂], to show the relation of arm-spines (*p*) and hooklets (*p'*) to the side arm-plates (*i*) among Ophiuride.

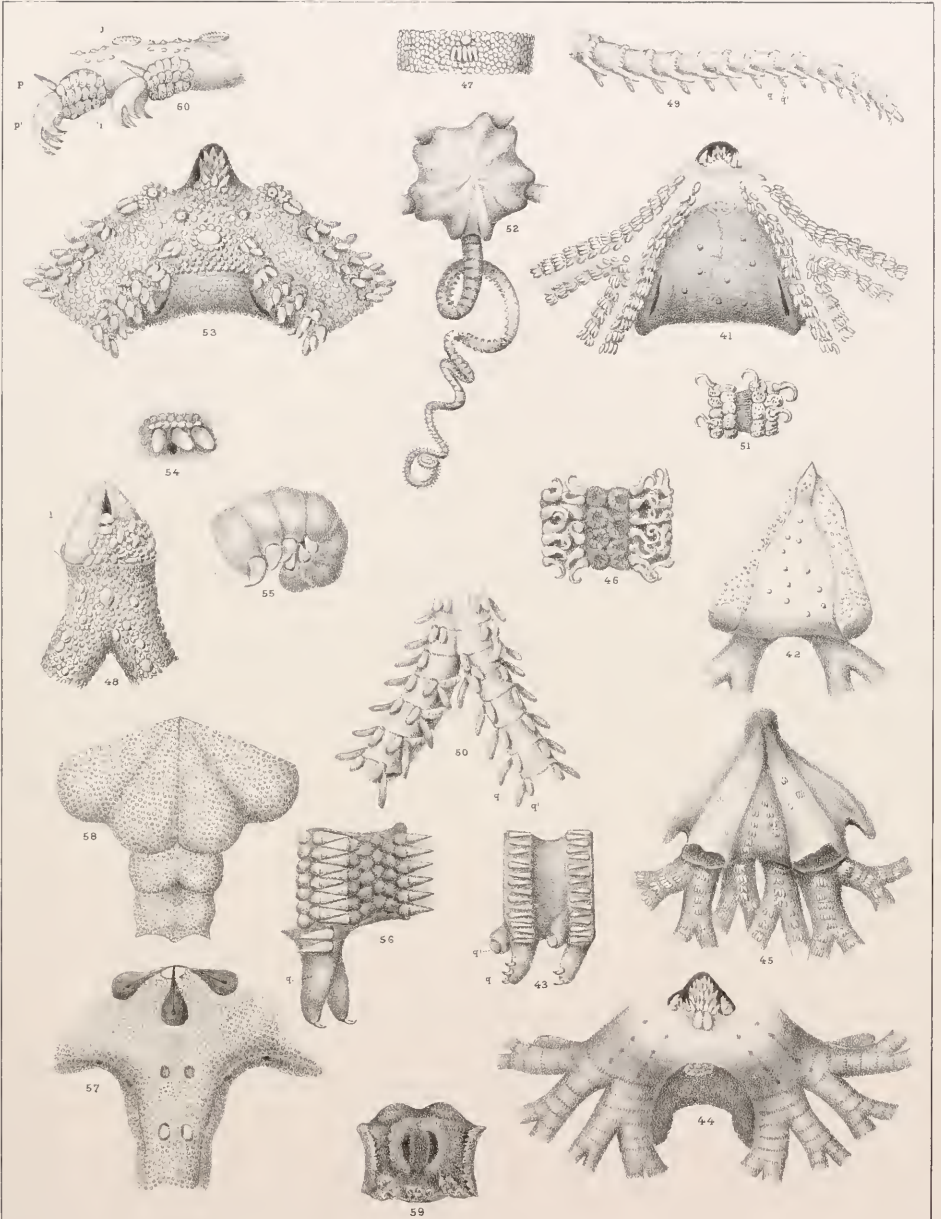
PLATE V.

Outlines of the mouth-angles, mouth-shields, and under arm-plates of twenty-four species of *Amphiura*, to exhibit the leading forms. The *Amphiura*, in the restricted sense of Ljungman, are put first (Figs. 61–68), to wit, those which have only four papillæ to each angle, while the tentacle-scales of the first mouth-tentacles are seen higher up. Then follow species that have six or eight papillæ to each angle (*Amphipholis* Ljn.), among which will be noticed a great variety in size, form, and relation of parts. Between Figs. 68 and 69 would naturally come *A. anomala*, Pl. III. Fig. 26, an intermediate form, which satisfies me that there is no reason for cutting the old genus *Amphiura* in two. Fig. 68 is from an older and larger specimen than Fig. 35, Plate III.











61. *Chiajii*



62. *Sandevalli*



63. *filiformis*



64. *semiermis*



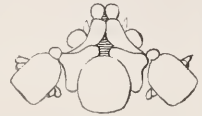
65. *granadisama*



66. *Stimpsonii*



67. *capensis*



68. *flexuosa?*



69. *scamata*



70. *gracilima*



71. *geminata*



72. *Kochii*



73. *occidentalis*



74. *urtica*



75. *pulchella*
= *capensis*



76. *pinispirina*



77. *Chilensis?*



78. *duplicata*



79. *imbata*



80. *Reizei*



81. *atra*



82. *arata*



83. *depressa*



84. *Lavis*