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GEODIDAE.

I. INTRODUCTION.

This monograph is the first part of a report on the Siliceous Sponges collected during the cruises of the "Albatross" in the Pacific Ocean. It deals with the Geodidae and contains detailed descriptions of the species and varieties of this family represented in the collection, a systematic account of the known Pacific Geodidae, and a discussion on their distribution.

There are altogether eighty-nine specimens in the collection. Two of them are dry, all the others are preserved in spirit. To make the identification of these sponges positive and to be able to give fuller diagnoses of some species which were insufficiently described, I have in addition to those collected by the "Albatross" examined several type specimens in the British Museum and in the collection of the Geological Survey of Canada.

In my report on the Tetraxonia of the Deutsche Tiefsee-Expedition I gave an account [1] of my method of fractional sedimentation for obtaining spicule-preparations. This method has been employed also in preparing the material for the present report.

For the graphic representation of sponges and of their parts, photographs reproduced mechanically (phototypically) are, in my opinion, far superior to drawings reproduced lithographically. It is not only that drawings never can be so accurate as photographs, but in drawing such objects as sections or spicules of sponges the author who draws them or has them drawn under his supervision, and who sees that the points he considers important are correctly reproduced,

[1] *R. v. Lendenfeld.* Die Tetraxonia. Wissensch. ergebn. deutschen Tiefsee-Expedition, 1898–1899. 1907, **11**, p. 82.

does not always pay sufficient attention to those other points which seem unimportant. This will often lead to the omission or inadequate representation in drawings of such characters as seem unimportant, whereas, in the mechanically reproduced photographs, they will be just as fully and correctly shown as all other points. It is quite probable, that at some future time, when science is more advanced, one or more of the points considered unimportant now, and consequently not carefully represented in drawings, may become important.

These considerations induced me to represent the sponges and their parts in my reports on the Tetraxonia of the Deutsche Tiefsee-Expedition (Lendenfeld, *loc. cit.*), and the Deutsche Südpolar-Expedition [1] so far as possible photographically. During the years I was engaged in preparing these reports I gained considerable experience in this photographic work. By the construction of a diaphragm, placed just above the objective, I overcame the difficulties which had formerly prevented a photographic reproduction of the megascleres; and though I was hampered by the quality of my microphotographic outfit and the insufficiency of the light at my disposal I obtained quite satisfactory photographs of these spicules. My attempts similarly to delineate the microscleres were not nearly so successful and I was frequently obliged to draw them.

When I began the study of the Sponges collected by the "Albatross" I obtained in the first place a first-class microphotographic outfit, replaced the Welsbach burner, formerly used as a source of light, by a Nernst lamp with crossed rods and was thus enabled to improve considerably the microphotographic reproductions of the sections and megascleres. The difficulty of photographing the microscleres with high powers, however, still remained. Like the megascleres the microscleres consist of colourless, transparent silica and are rendered visible only by the difference in the refractive indices of the silica and the surrounding medium. When, as is the case in the spines and other parts of most microscleres, such colourless structures are very thin, less than a light wave-length in diameter, no sharply defined image of them can be produced on the photographic plate, no matter how excellent the lenses of the microscope may be. The only way to get well-defined images of them is to make use of light of shorter wave-length; the lower limit of the size (thickness) of minute structures of this kind, still clearly reproducible microphotographically, must, *ceteris paribus*, be in inverse proportion to the wave-length of the light employed. The shortest light-waves obtainable would accordingly be the best for work of this kind. Since, however, the employment of very short light-waves

[1] *R. v. Lendenfeld.* Tetraxonia. Deutsche Südpolar-Expedition, 1901–1903, 1907, **9**.

for microphotography is connected with great technical difficulties, we must for the present content ourselves with light-waves 275–280 $\mu\mu$ long, that is about half of the length of the waves of ordinary light. Even this light is not convenient to work with, because it is quite invisible to the human eye and does not pass through glass. All the optical parts of the apparatus used for its employment must be made of some material like quartz, and fluorescent substances like uranium-glass must be utilized for making the image obtained visible and focusable. An apparatus for microphotography with light of these wave-lengths has recently been made by Koehler (Zeiss) of Jena.

To overcome the difficulties previously experienced in photographing the microscleres I obtained this apparatus and succeeded, after a number of trials, in producing satisfactory photographs also of these spicules.

To work this apparatus 4.8–5 amperes of the ordinary three phase-current of 120–125 volts supplied by the Prag Municipal Works were employed. This current is converted, in a transformer, to one of from 15,000 to 15,560 volts, which is made to pass, in sparks, between cadmium- or magnesium-electrodes. The sparks are strengthened by eight Leyden jars attached to the circuit, and are very brilliant. For photographing the microscleres of sponges I soon found magnesium-electrodes more suitable than cadmium-electrodes, and I have worked with the former ever since. The magnesium spark-light produced passes through a quartz-lens and two quartz-prisms. In the ultraviolet part of the magnesium-spectrum thus obtained there is an exceedingly intense line produced by light of a wave-length of 280 $\mu\mu$. This light was used. It passes through another quartz-lens, is reflected upwards by a quartz-prism placed below the microscope, and concentrated and thrown on the preparation by a quartz-condenser.

After many trials I found the following the best way to make the microsclere-preparations to be photographed with this light: to make a sterraster-preparation, a quartz-slide is covered by a thin layer of gum and, before the gum is dry, a number of these microscleres, previously obtained by sedimentation, are allowed to fall on the gummed quartz-slide. This is then placed in the thermostat oven. When it is quite dry, a small drop of a concentrated solution of chloral hydrate in glycerine, a liquid with sufficiently high refractive index and permeable to these ultraviolet rays, is put on and the whole covered with a quartz-cover. To make a preparation of the euasters the minute spicules obtained by centrifuging are spread out on an object glass and dried, whereupon they appear quite firmly attached to the glass. A portion of these microscleres is then scraped off with a knife and immersed in a small drop of water placed on the quartz-slide. In this water they disperse and when they are scattered a little gum may be added and the whole allowed to dry. The spicules then appear attached to the quartz-slide. A small drop of the chloral hydrate glycerine is put on and this covered with a quartz-cover.

The slide thus prepared is placed on the stage of the microscope, and a spicule to be photographed sought with ordinary light and ordinary lenses. When a spicule of which a photograph is desired is found, the ordinary lenses are replaced by a quartz-objective and a quartz-eyepiece, the spicule brought to focus and centred, the ordinary light switched off and the magnesium-u. v. light switched on. A disc of uranium-glass with a lens attached at a slightly oblique angle is then placed over the eyepiece and the tube of the microscope lowered until a sharp fluorescence-image of the spicule becomes visible on the uranium-glass. When the spicule is thus focused for the 280 $\mu\mu$-light the uranium-glass arrangement is removed and the camera placed over the microscope.

As it is difficult to focus quite correctly with this fluorescent arrangement and as in many cases the shape of the microscleres can be clearly revealed only by a series of photographs obtained by focusing at different levels, I usually took four differently focused photographs of each spicule. After having focused the spicule and put the camera on, I usually raised the tube of the microscope with the micrometer-screw 3 μ. At this level I took the first photograph. I then lowered the tube 2 μ and took a second photograph, and so on, the third 4 μ and the fourth 6 μ lower than the first. The intervals between these levels were sometimes more, sometimes less. Four such photographs 6 by 9 cm. can easily be taken rapidly in succession by means of a sliding-plate arrangement.

I found the most useful combination of lenses to be immersion-quartz monochromat 1.7 mm., quartz-eyepiece 10. This gives, with a suitable length of camera, a magnification of 1800. Most of the u. v. photographs of the microscleres on the plates accompanying this report have been taken with this combination.

I have taken some u. v. photographs without an eyepiece. In these cases the focusing was done by means of a uranium-glass with attached lens, placed in a ruler-like frame, which was laid across the (open) top of the camera. In this way excellently defined photographs can be procured but, the magnification even with the 1.7 mm. quartz monochromat and the camera drawn out long, is insufficient.

The time of exposure, even with the aperture in the diaphragm of the condenser quite small, is very short, for magnifications of about 100 only about one second, for magnification of 1800, 15–30 seconds.

I must record my obligations to the late Mr. Alexander Agassiz and to the Smithsonian Institution for placing this large and interesting collection of sponges at my disposal; and to Mr. R. Kirkpatrick of the British Museum and Mr. L. M. Lambe of the Geological Survey of Canada, for the types they sent me for examination and comparison.

With all this material and with all my energy and experience, however, this report could not have been produced had not Mr. Agassiz supplied the costly apparatus necessary and in every way furthered the work with so generous a liberality.

The method of microphotography with ultraviolet light, employed in this monograph for the delineation of the microscleres, will, I do not doubt, when utilized more generally for the representation of minute structures of this kind, increase the exactitude, and thus raise the standard of descriptive zoölogy; and am most grateful to Mr. Agassiz for enabling me to introduce the method into this branch of science and thus to assist in its advancement.

II. DESCRIPTION OF THE SPECIES COLLECTED BY THE "ALBATROSS."

Geodidae.

Tetraxonia with rhabd, teloclade, and usually also mesoclade, megascleres, and a superficial armour composed of massive, spheroidal or ellipsoidal sterrasters. Euasters are always, ataxasters or microrhabds sometimes, present. Without desme megascleres and without thin, disc-shaped sterrasters.

This family was established by Gray [1] under the name of Geodiadae. It has been retained by all later authors under the same or a similar name. Sollas [2] included in the family the genera Erylus Gray, Caminus O. Schmidt, Pachymatisma Johnston, Cydonium Fleming, Geodia Lamarck, Synops Vosmaer, and Isops Sollas. Later Sollas [3] substituted the name Sidonops for Synops. I [4] united Cydonium with Geodia and established the new genera Caminella [5] and Geodinella.[6] The examination of the sponges collected by the "Albatross" belonging to these genera shows that Erylus differs very considerably from Geodia, the type genus of the Geodidae, and should form a separate family, Erylidae.

In the extent I now give the Geodidae it comprises the genera Caminella Lendenfeld, Pachymatisma Johnston, Caminus O. Schmidt, Isops Sollas, Sidonops Sollas, Geodia Lamarck, and Geodinella Lendenfeld.

Three of these genera, Sidonops, Geodia, and Geodinella, are represented in the collection made by the "Albatross." There are eighteen different species, five of which are further subdivided into thirteen varieties.

[1] *J. E. Gray.* Notes on the arrangement of sponges.... Proc. Zool. soc. London, 1867, 492–558.

[2] *W. J. Sollas.* Tetractinellida. Rept. voy. "Challenger," 1888, **25**, p. cxlvii–cxlix.

[3] *W. J. Sollas.* On the geodine genera Synops Vosmaer and Sidonops, a correction. Proc. Roy. Dublin soc., 1889, **6**, p. 277.

[4] *R. v. Lendenfeld.* Die Tetractinelliden der Adria. Denk. Akad. wissensch. Wien, 1894, **61**, p. 179.

[5] *R. v. Lendenfeld.* *Loc. cit.*, p. 150.

[6] *R. v. Lendenfeld.* Tetraxonia. Tierreich, 1903, **19**, p. 117.

Of the eighteen species, three have been previously described, and fifteen are new. In one of the previously known species two new varieties are described.

SIDONOPS Sollas.

Among the megascleres are regular triaenes. The tetraxon megascleres are confined to the superficial part of the sponge and are arranged radially. The dermal microscleres are asters. The afferents are cribriporal; the efferents uniporal.

There are twenty-three specimens of Sidonops in the collection made by the "Albatross." These belong to four species; all are new, and one is divided into three varieties.

Sidonops californica, sp. nov.

Plate 5, figs. 1–37.

Shape and size. The two specimens in the collection were obtained off Lower California, and to this locality the specific name refers. They are somewhat fragmentary. Both are elongate tuberous, somewhat finger shaped. The larger (Plate 5, fig. 6) is 24 mm. long and 6–10 mm. broad, the other measures 18×7–9 mm. Both appear to be digitate processes, broken off from a larger mass; the smaller one was attached at one side. The surface is undulating, and no trace of a spicule-fur can be made out with the unassisted eye. The microscopic investigation of radial sections, however, shows that minute dermal styles protrude slightly beyond it. In several places circular efferent pores, 100–300 μ wide, are observed. These pores are not numerous. They congregate in groups, one of which is situated on the rounded tip of the larger specimen. Parts of the surface are covered with a thin desmacidonid sponge-crust.

The *colour* (in spirit) is yellowish white, slightly darker in the interior than on the surface.

The *cortex* is about 500 μ thick and composed of a sterraster-armour.

Canal-system. Radial canals, 100–300 μ wide, traverse the sterraster-armour. Most of these are covered distally with sieve-membranes, the pores of which are oval, 30–100 μ wide, and occasionally so close together as to be separated only by slender threads. These threads exhibit, when observed with higher powers, a longitudinal striation. The radial cortical canals not covered by such sieves, which I consider as efferents, form the groups above described. The remainder of the surface is occupied by the afferent, cribriporal, cortical canals. The radial cortical canals, both the afferent and the efferent, are cylindrical and restricted below by chonal sphincters, which usually protrude slightly into the choanosome. Below these chones subcortical cavities (Plate 5, fig. 27b) are met with.

The *skeleton* of the inner parts of the choanosome consists of rather irregularly scattered amphioxes (Plate 5, fig. 27e), a few styles, and numerous large oxyasters and sterrasters (Plate 5, fig. 27d). Orthoplagiotriaenes, similar to the subcortical ones, are also occasionally found in the depth of the choanosome. It seems doubtful however whether these are here in their natural postion; they may very likely have been carried into the interior in cutting the sections. The remarkable abundance of sterrasters in the choanosome on the other hand (Plate 5, fig. 27) is without doubt natural. Towards the surface the megascleres join to form radial strands which abut more or less vertically on the cortex. These strands (Plate 5, fig. 27c) are composed chiefly of amphioxes and orthoplagiotriaenes. Anatriaenes, anatriaenederivates, and mesoplagioclades often with reduced cladomes also occur in them, but in much smaller numbers. The cladomes of the orthoplagiotriaenes lie at the limit between the cortex and the choanosome. The cortex is occupied by dense masses of sterrasters. Small dermal styles are implanted more or less obliquely into its superficial (distal) part. The rounded ends of the styles are situated proximally; their distal, pointed ends protrude freely beyond the surface. These spicules are not very numerous and form tuft-like groups. Those near the afferent pore-sieves and the efferent pores incline towards these apertures and thus form protecting fringes. Groups of such spicules, and single ones, are also met with in the distal part of the choanosome. Numerous minute strongylosphaerasters, forming a dense single layer just below the outer surface, are imbedded in the dermal membrane. A few small oxysphaerasters also occur. Besides these numerous other forms of spicules are observed in the spicule-preparations. Most of these probably belong to the incrusting desmacidonid; there is one, however, an exceedingly minute and slender microamphiox, about which I have my doubts. This may be proper to the sponge and possibly forms dragmes within it. I have, however, not succeeded in finding any of these spicules, either singly or in dragmes, *in situ* in the sections.

The *large choanosomal amphioxes* (Plate 5, figs. 11, 12, 27e) are straight or slightly curved, fairly isoactine, and rather abruptly and quite sharply pointed. They are 1.2–2, usually 1.6–1.8 mm. long, and 30–48, usually 38–42 μ thick.

The rare *large styles* are shorter and thicker than the amphioxes; some attain a transverse diameter of 55 μ at the rounded end.

The *minute, dermal styles* are usually slightly curved, 175–290 μ long and in the central parts 3–7 μ thick. They taper slightly towards the proximal rounded end. The distal end is sharp pointed.

The *minute microamphioxes* which may be foreign to the sponge, and possibly form dragmes, are quite straight, about 50 μ long and 1μ thick.

The orthoplagiotriaenes (Plate 5, figs. 13–19) have a rather small clade-angle and might therefore perhaps also be termed orthotriaenes. The rhabdome is straight, conic, and usually sharp pointed, rarely blunt. It is 0.9–1.45 mm. long and at the cladomal end 20–78, usually 35–55 μ thick. I do not think that the great differences in the thickness of the rhabdome, which are clearly noticeable in comparing the spicules represented in figures 13 and 18 on Plate 5, can be altogether ascribed to differences in their age. The clades are 160–400 μ long, conic, often rather blunt, and uniformly curved, concave to the rhabdome. Their chords enclose angles of 104–120° with the axis of the rhabdome. The three clades of the same cladome often differ in size and sometimes exhibit a sagittal character.

The *anatriaenes* (Plate 5, figs. 1–4) have long and more or less curved rhabdomes, which are 10–17 μ thick at the cladomal end. The clades are relatively stout and 22–45 μ long. Their proximal part is quite strongly curved, their distal part straight. Their chords enclose angles of 45–66° with the axis of the rhabdome. A slight apical knob is usually discernible on the summit of the cladome.

Anatriaene-derivates of similar dimensions with two clades (anadiaenes) (Plate 5, fig. 5) and one clade (anamonaenes) also occur, but they are rare. The branched end of a very peculiar spicule, which may be an anatriaene-derivate, is represented in fig. 10 on Plate 5. This spicule is a rhabd with two small, recurved, clade-like branches, arising a little below one of the pointed ends, and a very large straight branch-ray, also pointing downwards and enclosing an exceedingly small angle (about 4°) with the rhabdome, arising some distance below the small branch-rays.

The *mesoplagioclades* (Plate 5, fig. 7–9) have a long rhabdome which is, just below the clades, 6–15 μ thick. The epirhabd is conic and 45–125 μ long. The number of clades is one (Plate 5, fig. 7), two (Plate 5, fig. 9) or three (Plate 5, fig. 8). The clades are nearly straight, pointed or rounded at the end, and 20–42 μ long. They are directed obliquely upwards and their axes enclose angles of 102–118° with the axis of the rhabdome. These plagioclade spicules replace the mesoprotriaenes of other geodine sponges, and I am inclined to consider them as derivates of ordinary mesoproclades produced by a change in the position of the clades.

The *large choanosomal oxyasters* (Plate 5, figs. 21–26c, 31c, 28, 29) have from six to fourteen, rarely as many as twenty straight, conic, and quite uniformly distributed rays. There is no central thickening. The rays vary from sharp pointed (Plate 5, fig. 28) to blunt (Plate 5, fig. 29). Apart from the very short, smooth, basal parts, the rays are entirely covered with spines, which appear to be directed backwards, towards the centre of the spicule. On the apex of the blunt rays a terminal spine is usually observed (Plate 5, fig. 29). The rays are at the base 1.7–3 μ thick. The whole aster is 22–48 μ in diameter. An inverse proportion between size and number of rays is clearly pronounced. The oxyasters with six to eleven rays are 27–48 μ, those with twelve or more rays 22–26 μ in diameter.

The rare, *small oxysphaerasters* (Plate 5, fig. 30b) have stout, pointed, conical, spined rays and measure 7–9 μ in total diameter.

The *small strongylosphaerasters* (Plate 5, figs. 24a, 26a, 30a, 31a, 32–35) have a centrum 2–3.5 μ in diameter, from which six to seventeen rays arise. These are usually regularly, more rarely irregularly distributed and 1.6–2.8 μ long. They are cylindrical, 0.8–1.5 μ thick, and rounded at the ends. They always bear spines, which are either quite uniformly distributed or massed at the ends, where a verticil of larger spines sometimes appears to be present. A conspicuous terminal spine, arising from the end of the rays, is often observed. The whole aster measures 4.5–9 μ in diameter. A correlation between number of the rays and size is not discernible.

The *sterrasters* (Plate 5, figs. 20, 36, 37) are flattened ellipsoids, 116–130 μ long, 97–105 μ broad, and 70–90 μ thick. The proportion of length to breadth to thickness is usually about 100 : 81 : 69. In the centre a nearly spherical cluster, 4 μ in diameter, composed of numerous small but conspicuous granules, is met with. In the youngest sterrasters observed, which appear as spheres of slender rays, 18 μ in diameter, this central cluster of granules has the same size and structure as in those fully developed. The umbilicus lies in the centre of one of the flat faces of the ellipsoid. It is about 12 μ deep and 12 to 15 μ broad. In the great majority of sterrasters the free distal ends of the rays are uniformly distributed, 2–3 μ thick and 1.5–2 μ apart. In a small minority, perhaps 2 % of all the sterrasters, these free ray-ends are irregularly distributed and in some places much farther apart, more or less extensive parts of the surface of such sterrasters being free from them. These altogether rayless parts of the sterraster surface are covered with spines. In the normal sterrasters each ray bears a terminal verticil of from three to seven conic not very stout spines about 1.5 μ long (Plate 5, figs. 36, 37).

The two specimens of this species were caught with the tangles at Station 2829 on May 1, 1888, off Lower California, in 22° 52′ N., 109° 55′ W., depth 56 m. (31 f.); they grew on a rocky bottom; the bottom temperature was 23.4° (74.1° F.).

Should the uniporality of the efferent cortical canals observed be due merely to a local rubbing off of the superficial parts after capture, and should sieve-membranes cover them in the living state, this sponge would of course have to be placed in Geodia. Since however no indication of the former presence of sieve-membranes can be discovered at the mouths of the now uniporal efferent cortical canals, I think that these efferents must by nature be uniporal and the sponge accordingly placed in Sidonops.

Among the species of Geodia and Sidonops hitherto described there are only three which at all resemble these sponges: *Geodia ramodigitata* Carter 1880; the sponge described by Dendy [1] as *Geodia ramodigitata* Carter, which differs however so considerably from Carter's type that I do not think it specifically identical with it; and *Synops alba* Kieschnick 1896 = *Sydonops* (recte *Sidonops*) *alba* Thiele 1900. From *Geodia ramodigitata* Carter and also from the species described under this name by Dendy the above mentioned Californian specimens differ by possessing plagiomesoclades often with more or less reduced clades instead of the normally developed protriaenes or promesotriaenes, a difference which is in itself, apart from the difference in the superficial part of the canal system, quite sufficient for specific distinction. *Sidonops alba* (Kieschnick) Thiele [2] is obviously much more closely allied to them. Most of the spicules are identical in shape and not very different in size. The differences between them most important systematically appear to be that *Sidonops alba* (Kieschnick) Thiele possesses small anaclades, which Thiele terms exotyles, whilst the Californian specimens are destitute of such spicules; that the latter contain minute microamphioxes which are absent in the former; and that the reduction of the mesoclade-cladomes is carried considerably further in the former than in the latter. As regards the minute microamphioxes I do not attach very much systematic importance to their presence or absence because it is quite possible

[1] *A. Dendy.* Report on the sponges. Rept. pearl oyster fisheries. 1905, pt. 3, p. 88.

[2] *J. Thiele.* Kieselschwämme von Ternate I. Abhandl. Senckenb. gesellsch., 1900, **25**, p. 46, pl. 2, fig. 16.

that these spicules are foreign to the sponge. The presence of minute anaclades (exotyles) and the far greater reduction of the mesoclade-cladomes in *Sidonops alba* (Kieschnick) Thiele seem, together with the differences in the dimensions of the other spicules, sufficient for specific separation; and the more so as *Sidonops alba* (Kieschnick) Thiele occurs near Ternate while the specimens described above have been found on the opposite side of the Pacific Ocean, off the coast of Lower California. The differences between these closely allied species are given in the following table.

	Sidonops alba	Sidonops californica
Large choanosomal amphioxes.	2.5 mm. and more long; 30 μ thick.	1.2–2 mm. long; 30–48 μ thick.
Large choanosomal styles.	similar to the amphioxes, but shorter (?)	shorter than the amphioxes; up to 55 μ thick.
Small dermal styles.	250 μ long; 5 μ thick.	175–290 μ long; 3–7 μ thick.
Minute microamphioxes.	absent.	50 μ long; 1 μ thick; perhaps foreign.
Plagiotriaenes.	rhabdome 2 mm. long; about 50 μ thick; clades 450 μ long; clade-angles a little over 90°.	rhabdome 0.9–1.45 mm. long; 20–78 μ thick; clades 160–400 μ long, clade-angles 104–120°.
Ordinary anatriaenes.	rhabdome 2.5 mm. long; 14 μ thick; clades about 20 μ long; clade-angles 41°.	rhabdome long; 10–17 μ thick; clades 22–45 μ long; clade-angles 45–66°.
Mesoclades.	rhabdome 3 mm. long; 14 μ thick; epirhabd 80 μ long; 1–2 clades 18–21 μ long; clade-angles 84–102°.	rhabdome long; 6–15 μ thick; epirhabd 45–125 μ long; 1–3 clades 20–42 μ long; clade-angles 102–118°.
Minute anaclades (exotyles).	170 μ long and over; with 1–3 clades.	absent.
Large oxyasters.	length of each ray 15–30 μ; without centrum.	6–20 rays; 22–43 μ in total diameter; without centrum.
Small sphaerasters.	total diameter 8 μ.	total diameter 4.5–9 μ.
Sterrasters.	110 μ long ; 90 μ broad.	116–130 μ long; 97–105 μ broad; 70–90 μ thick.

Sidonops angulata, sp. nov.

megana, var. nov.

Plate 12, figs. 1–8, 16, 17, 19, 20; Plate 13, figs. 1–12, 22–25; Plate 14, figs. 1–6, 16–22; Plate 15, figs. 1–4, 7–9, 11.

microana, var. nov.

Plate 12, figs. 11–15, 18, 21, 22; Plate 13, figs. 13–17, 21; Plate 14, figs. 7–9; Plate 15, fig. 10.

orthotriaena, var. nov.

Plate 12, figs. 9, 10; Plate 13, figs. 18–20; Plate 14, figs. 10–15, 23–30; Plate 15, figs. 5, 6, 12.

I establish this species for four specimens obtained at three different stations off the coast of southern California, in the vicinity of Santa Barbara Island. Some of the amphioxes and also a few of the rhabdomes and clades of the teloclades are angularly bent, and to this character the specific name refers. Two specimens from Station 2975 are identical. The other two differ from these and from each other so much that it is necessary to recognize three varieties. In the specimen from Station 2945, var. *orthotriaena*, the subcortical triaenes are orthoclade, in the three others plagioclade. In the two specimens from Station 2975, var. *megana*, some of the anaclade-cladomes are large, while in the specimen from Station 4417, var. *microana*, all the anaclade-cladomes are small.

Shape and size. One of the specimens of var. *megana* is more lobose, the other more massive. The lobose specimen (Plate **12**, fig. 19) has the shape of a stout fan, 86 mm. broad, 75 mm. high, and 28–38 mm. thick. Rounded protuberances rise from its surface and give to the margin of the fan a somewhat serrated appearance. On one side these protuberances attain a greater height than on the other, and here the depressions between them in one place join, leaving a part of the sponge, 11 mm. thick, suspended like a bridge between them. The surface is rough, shagreened. The greater part of this roughness is due to the presence of slight pit-like depressions which are about 1 mm. wide and are close together. Apart from a few holes, about 1 mm. wide, which do not seem to be oscules, no apertures visible to the unassisted eye occur. In a few sheltered places remnants of a spicule-fur are observed. The massive specimen of this variety (Plate **12**, fig. 20) has the shape of an inverted cone with a strongly rounded margin. It is 77 mm. high. The largest and smallest transverse horizontal diameters are 112 and 107 mm. respectively. There are a few broad and low protuberances, chiefly on the margin of the upper, somewhat concave face. From the base a digitate process, 25 mm. long and up to 14 mm. thick, arises. The most exposed parts of the surface are smooth; the rest of it is rough and shagreened. On the sides, this roughness is due to the presence of shallow pits, separated by a network of ridges somewhat raised at their junctions; on the upper face it is due to numerous wart-like protuberances varying in size and about 1 mm. apart. There are no larger oscules. On some of the more protected parts of the surface a spicule-fur, up to 5 mm. high, is observed. The specimen of var. *microana* (Plate **12**, fig. 18) is irregularly spherical, 49 mm. broad and 40 mm. high. The lower part of the body is somewhat drawn out to form a peduncle, 30 mm. broad and 15 mm. thick, which is attached to a coral. The upper side is flattened. The greater part of the surface is covered by a dense spicule-fur which is in places 5.5 mm. high (Plate **13**, fig. 21b). The specimen of var. *orthotriaena* is a fragment of an irregular lobose mass. It measures 33 mm. in length, 23 mm. in breadth, and 14 mm. in thickness. The surface is quite smooth and without larger oscules. In places there are remnants of a spicule-fur. A few insignificant symbionts, chiefly small crusts of calcareous and monoaxonid silicious sponges, are attached to the surface of all the specimens. The specimen of var. *microana* bears a dense growth of diatoms on its surface.

The *colour*, in spirit, is yellowish in the interior and white to reddish or purplish brown on the surface. The lobose specimen of var. *megana* is quite white on one side and has a reddish brown tinge on the other. The massive specimen of this variety is partly yellowish, partly reddish white on the sides (below) and reddish brown on the upper face (above). This colour is not uniform, some parts of the upper face being considerably darker than others. Variety *microana* is dirty white below and purplish brown above, var. *orthotriaena* brownish white.

The superficial part of the body is differentiated to form a *cortex* composed of a thin outer dermal layer (Plate **14**, fig. 20a), a central sterraster-armour layer (Plate **13**, fig. 21a, 25a) 0.7–1 mm. thick, and an inner fibrous layer (Plate **14**, fig. 22a) excavated by subcortical cavities.

Numerous granular cells, extended paratangentially and measuring 12–18 μ by about 7 μ, lie in the dermal membrane just below the surface (Plate **14**, fig. 20b). Below these, between them and the most distal sterrasters of the armour, slender fibres extend paratangentially. Those adjacent to the pores are circularly bent and surround the pores sphincter-fashion. These fibres are strongly stained with haematoxylin but only slightly with azure. In the choanosome of the massive specimen of var. *megana* numerous irregularly polyedric spaces, 40–70 μ in diameter, occupied by dense masses of small cells (Plate **15**, fig. 4a), were observed. Each of these cells contains a small, strongly staining nucleus. Perhaps these cells are young spermatozoa.

Canal-system. The sides of the massive specimen of var. *megana* are covered with afferent pore-sieves (Plate **13**, figs. 23, 24), which coalesce to form extensive, nearly continuous poral tracts. The pores are oval or, more rarely, circular, and generally measure 25–300 μ in diameter. The strands of dermal tissue separating them are as broad or broader than the pores themselves. These pores lead into elongate subdermal cavities, from five to seven of which join to form stellate groups 0.4–1 mm. in diameter. These groups of radiating subdermal cavities are sunk in the sterraster-armour layer and the spaces between them in great part occupied by sterrasters. In consequence of this the stellate cavity groups are very conspicuous in superficial paratangential sections of appropriate thickness (Plate **13**, fig. 23). The cavities of each group converge to a common centre and here they join to form a radial cortical canal which penetrates the cortex and leads down into the interior. These radial cortical canals are 1–1.4 mm. apart, and in the sections examined are strongly contracted, usually quite closed. They are surrounded by mantles of circular fibres. These mantles increase in thickness proximally and form chones (Plate **13**, fig. 25b), which protrude into the subcortical cavities. Around these chones I have often noticed extensive dome-shaped excavations of the proximal (inner) surface of the sterraster-armour. When such excavations are present the chones hang down as it were from the apices of the domes and are thus situated some distance above the general lower limit of the sterraster-armour layer. Below this layer, in the inner zone of the cortex, a system of subcortical cavities (Plate **13**, fig. 25c, Plate **14**, fig. 22b) extends. From these cavities the afferent choanosomal canals take their rise. These canals, and also the choanosomal efferents, are narrow, the choanosome appearing very solid in consequence. The flagellate chambers (Plate **14**, fig. 21a) are spherical or oval and small. The efferent choanosomal canals lead up to and open out into extensive systems of subcortical cavities which underlie the parts of the cortex bearing the uniporal efferent apertures. From these cavities radial cortical canals with chones, similar to the afferent ones described above, arise. On the walls of some of the efferent cortical canals of the lobose specimen of var. *megana* I observed a few large, broad, and blunt conic spines (Plate **15**, fig. 7a) which protrude into the canal-lumen. As these structures are rare and as I failed to find them in thin sections, where they could have been studied with higher powers, I was unable to ascertain their nature. Each efferent cortical canal leads up to a single circular pore up to 100 μ wide (Plate 13, fig. 22). In the massive specimen of var. *megana* and also in var. *microana* the efferent pores occupy the upper depressed or flattened side of the sponge. In the other two specimens they appear to be distributed less regularly. As stated above the upper face of the massive specimen of var. *megana* is covered with wart-like protuberances, unequal in size and on the average about 1 mm. apart. Many of these warts bear on their summit an efferent pore, many however are without an apical aperture. I presume that all these warts are pore-bearing elevations and that on those on which no pore was seen, the pore had been quite closed by excessive contraction of the sphincter surrounding it. In the specimen of var. *microana*, on the other hand, nearly all the efferent pores seem to be open. In this sponge many of them lie on the level of the surface and are not raised above it.

Skeleton. Spicule-bundles, extending radially and abutting vertically on the surface, traverse the choanosome. In the interior these bundles are chiefly composed of quite stout amphioxes, to which a few thick styles or branched style-derivates may be added. Towards the surface also plagiotriaenes (in var. *megana* and var. *microana*) or orthotriaenes (in var. *orthotriaena*), anaclades, and long and slender amphioxes (much more numerous in var. *microana* than in the other varieties) are added to the stout amphioxes (and styles and style-derivates). In var. *microana* and var. *orthotriaena* the cladomes of the plagio- or ortho-triaenes lie on the level of the lower limit of the sterraster-armour layer. In the two specimens of var. *megana* they are situated a little higher up, within this layer, and entirely enveloped in sterrasters. The anaclades are not numerous. Most of them are anatriaenes. In var. *microana* also anadiaenes are met with. The cladomes of some of the anaclades lie in the inner zone of the cortex; by far the greater number, however, protrude freely beyond the surface. Some long and slender amphioxes lie altogether within the sponge; numerous spicules of this kind protrude beyond it. Together with the anaclades they form the spicule-fur. In it the slender amphioxes are much more numerous than the anaclades. Some of both the stout choanosomal and the slender chiefly dermal amphioxes, and a few of the teloclade-rhabdomes and clades are angularly bent.

In the spicule-preparations of var. *microana* two or three dichotriaenes and some mesoprotriaenes were observed. Since however I failed to find such spicules *in situ* in the sections, I do not believe that they belong to the sponge.

The microscleres are smooth oxyasters and oxysphaerasters, spined strongylosphaerasters and sterrasters. The oxyasters are confined to the choanosome and are not numerous. The oxysphaerasters are very abundant, particularly in the inner layer of the cortex, where they line the walls of the subcortical cavities in large numbers (Plate **14**, fig. 22c). These asters also occur in the walls of the chonal canals and they extend distally along the walls of the dermal cavities, right up to within a short distance of the outer surface. The strongylosphaerasters occupy the dermal membrane (Plate **13**, figs. 22–24; Plate **14**, fig. 20a) in a single or in several layers and are met with also in the walls of the cortical canals and subcortical cavities. On the whole the strongylosphaerasters situated superficially appear to be larger than those in the interior of the cortex. The sterrasters form dense masses in the middle armour layer of the cortex and occur scattered also in the choanosome, where they are particularly abundant in the lobose specimen of var. *megana* and in var. *microana*.

Besides these microscleres, I found, in the centrifugal spicule-preparations of var. *microana*, two oxyasters with more slender, spined rays, and in those of the lobose specimen of var. *megana* numerous minute rhabds. Both these kinds of spicules I consider as foreign.

The *stout choanosomal amphioxes* (Plate **12**, fig. 17c; Plate **13**, figs. 1, 2, 17a, b, 20b) are fairly isoactine and quite sharply pointed. They are usually straight (Plate **13**, fig. 2, 17b) or slightly curved (Plate **13**, fig. 1), more rarely angularly bent (Plate **13**, fig. 17a) near the middle. The angular bend amounts to 8–12°, so that the two actines of these angular amphioxes enclose angles of 168–172°. These angularly bent choanosomal amphioxes are more frequent in the lobose specimen of var. *megana* and in var. *microana* than in the other two specimens.

The stout choanosomal amphioxes are 1.6–3.7 mm. long and 20–72 μ thick. Their thickness is on the whole proportional to their length. They are considerably longer in var. *megana* than in the other two varieties.

DIMENSIONS OF STOUT CHOANOSOMAL AMPHIOXES OF SIDONOPS ANGULATA.

	Length, mm.	Maximum thickness, μ
Var. megana, lobose specimen	2–3.7	40–60
Var. megana, massive specimen	2.4–3.5	53–72
Var. microana	1.8–2.8	20–52
Var. orthotriaena	1.6–2.5	20–70

The *slender dermal amphioxes* (Plate **12**, figs. 16a, b, 17a; Plate **13**, fig. 21b) are usually simply curved (Plate **12**, figs. 16a, 17a), rarely angularly bent (Plate

12, fig. 16b). In the angularly bent spicules the angular bend amounts to 7–12°, and is usually, as in the spicule represented in Plate **12**, fig. 16b, not in the middle, but considerably nearer one end than the other, the two straight parts of the spicule thus enclosing an angle of 168–173° and being unequal in length. The slender dermal amphioxes are fairly isoactine, thickest in the middle, gradually attenuated towards the ends, and terminally abruptly and sharply pointed. They are 2.9–9.5 mm. long and 5–34 μ thick. Those of var. *orthotriaena* are much smaller than those of the others.

DIMENSIONS OF SLENDER DERMAL AMPHIOXES OF SIDONOPS ANGULATA.

	Length, mm.	Maximum thickness, μ
Var. megana, lobose specimen	4.9–7.1	18–34
Var. megana, massive specimen	4.2–9.5	25–32
Var. microana	5.5–7	10–22
Var. orthotriaena	2.9–4.5	5–17

Styles and style-derivates (Plate **13**, fig. 20a) were not found in the massive specimen of var. *megana* at all and in the three other specimens they are very rare. The *regular styles* are straight, conic, sharp pointed at one end, and considerably thickened and club shaped at the other. They are 2.1–2.5 mm. long and 60–100 μ thick at the rounded end. In var. *microana* I found a *style-derivate* 2.3 mm. long and 110 μ thick at the rounded end, which bore, 400 μ below the rounded end, a terminally rounded branch-ray, 120 μ long, directed obliquely towards the rounded end of the main shaft.

The *plagio- and ortho-triaenes* (Plate **12**, figs. 16d, 17d, 21, 22; Plate **13**, figs. 3–16, 18, 19) have a straight or slightly curved rhabdome, which is usually on the whole conical, and attenuated towards the pointed acladomal end, more rapidly in the acladomal terminal part than in the cladomal and central parts. These normal plagio- and ortho-triaene-rhabdomes are 1.5–2.8 mm. long and 47–82 μ thick at the cladomal end. In var. *orthotriaena* I found two abnormal orthotriaenes, one with a cylindrical, terminally rounded, and considerably shortened and thickened rhabdome only 550 μ long but 105 μ thick, and another with an angularly bent rhabdome (Plate **13**, fig. 19). The angle enclosed between the cladomal and acladomal parts of the latter is 109°. The clades are conic and usually pointed, rarely (Plate **13**, fig. 8) rounded at the end. They are 330–700 μ long, those of the plagiotriaenes of var. *megana* being a good deal longer than those of the plagio- and ortho-triaenes of the other two varieties. The clades of the same cladome are equal (Plate **13**, figs. 9, 11, 15, 18), or slightly (Plate **13**, figs. 5, 6, 8, 10, 13, 14, 19) or considerably (Plate **13**, figs. 7, 12, 16) unequal in length. Generally the clades extend in a longitudinal plane passing through the axis of the rhabdome; sometimes, however, (Plate **13**, fig. 4) an angular bend in a transverse plane is observed. Short clades are often (Plate **13**, fig. 7, 12), long ones rarely (Plate **13**, figs. 9, 12), nearly straight. Generally the clades are markedly curved, concave to the rhabdome. This curvature increases towards the ends of the clades. In some (Plate **13**, figs. 3, 13–16, 19) the degree of this increment of curvature is slight, in others (Plate **13**, figs. 5–8) it is considerable. Sometimes the distal part of the clade is bent down abruptly (angularly) (Plate **13**, figs. 5, 10). The angles enclosed between the clade-chords and the axis of the rhabdome are in the two specimens of var. *megana* on an average 101.3 and 103°, in var. *microana* 105.6°, and in var. *orthotriaena* 93.7°. These spicules are accordingly in the first two plagiotriaenes, in the last orthotriaenes. The clade-angles of the three clades of the same rhabdome are usually about equal, rarely (Plate **13**, fig. 6) considerably different.

Very rarely one of the clades becomes quite rudimentary. Such diaene spicules were found only in var. *orthotriaena*.

DIMENSIONS OF NORMAL PLAGIO- AND ORTHOTRIAENES OF SIDONOPS ANGULATA.

	Length of rhabdome	Thickness of rhabdome at the cladome	Length of clade-chords	Angle between clade-chords and axis of rhabdome °	
	mm.	μ	μ	limits	average
Var. megana, lobose specimen	1.8–2.8	50–82	350–700	92–104	101.3
Var. megana, massive specimen	1.6–2.6	50–80	330–650	89–111	103
Var. microana	1.5–2.6	50–77	380–580	91–112	105.6
Var. orthotriaena	2–2.35	47–78	380–500	91–98	93.7

The rhabdomes of the *anaclades* (Plate **12**, figs. 1–15; Plate **13**, fig. 17c) are for a great part of their length nearly cylindrical. Of the long ones none were found intact in the spicule-preparations, all being broken. The longest fragment measured was 9 mm., the longest rhabdome observed intact was 6 mm. in length. The rhabdomes of the anaclades of var. *microana* appear to be considerably shorter than those of the anaclades of the other two varieties. The acladomal end of the rhabdome is attenuated and pointed, or cylindrical and terminally rounded (Plate **12**, fig. 15). At the cladomal end the rhabdomes are in var. *megana* 7–39 μ, in the two other varieties 10–18 μ thick. There is always on the summit of the cladome an apical protuberance which, however, does not contain a prolongation of the axial thread of the rhabdome, the latter terminating at the point where the axial threads of the clades arise from it. The axial threads of the clades are directed obliquely downwards in their basal portion (Plate **12**, figs. 1, 5, 13, 14). After extending a short distance in this direction they bend outward angularly and then follow the axes of the clades. This peculiarity of the axial threads of the clades is doubtlessly the cause of the formation of the apical protuberance of the cladome. Most of the anaclades have three fairly equal clades (Plate **12**, figs. 1–6, 8, 9, 12–14). In some there are two longer and one short clade (Plate **12**, fig. 7). In not a few of the anaclades of var. *microana* one clade has disappeared entirely, so that these spicules are diaenes (Plate **12**, figs. 10, 11). The clades are conical, pointed, and when long, distinctly curved, concave towards the rhabdome (Plate **12**, figs. 1, 3, 5–10). In short clades (Plate **12**, figs. 2, 4, 11–14) this curvature is usually slighter, often hardly perceptible. The distal part of the clade is usually curved less than the basal. Sometimes (Plate **12**, figs. 3, 5, 6) an abrupt angular bend is observed where the curved proximal part passes into the more straight distal part. The chords of the clades are in the anaclades of var. *megana* 45–210 μ, in those of var. *orthotriaena* 33–80 μ, and in those of var. *microana* only 30–50 μ long. The angles between the clade-chords and the axis of the rhabdome are 27–66°, on an average 47°.

DIMENSIONS OF CLADES OF SIDONOPS ANGULATA.[1]

	Thickness of rhabdome at the cladome µ	Length of clade-chords µ	Angle between clade-chords and axis of rhabdome °	
			limits	average
Var. megana, lobose specimen	11–39	45–210	35–65	47
Var. megana, massive specimen	7–38	48–142	27–66	45
Var. microana	10–18	30–50	50–62	47
Var. orthotriaena	14–18	33–80	43–54	48

[1] Rhabdome length not known.

The various *oxyasters and oxysphaerasters* (Plate **14**, figs. 1–15a, b, c, 16, 23, 24) form a continuous series. They have from one to twenty-three rays. Forms with more than thirteen rays are much more frequent than forms with fewer, and among the latter those with from one to three rays much scarcer than those with four or more. These asters form a fairly continuous series ranging from large oxyasters without centrum and few rays (Plate **14**, fig. 24) to small oxysphaerasters with large centrum and numerous rays (Plate **14**, figs. 16, 23). The rays are straight, usually on the whole conical, attenuated towards the sharp-pointed end in the basal and middle parts more gradually than in the terminal part, and perfectly smooth (Plate **14**, figs. 16, 23, 24). Their shape varies in correlation to their size, the longest rays being the most slender and the shortest the stoutest. Sometimes, chiefly in the two- to four-rayed oxyasters (Plate **14**, figs. 3b, 13b), short, rounded or truncate rudiments of reduced rays occur in addition to the properly developed conical and pointed ones. These ray-rudiments are generally smooth, rounded knobs not longer than broad (Plate **14**, fig. 3b), more rarely longer and in this case sometimes crowned with a few terminal spines. The rays are always concentric. Their arrangement is in the few-rayed oxyasters often irregular, in the many-rayed ones nearly always regular. In none of the two-rayed forms observed were the two rays regularly arranged, that is, situated exactly opposite each other in a straight line, the angle enclosed by them being always considerably less than 180°. In several of these asters this angle was under 120° and in one even under 90°. These diactine asters consequently look like more or less opened compasses. Also in the three-rayed oxyasters (Plate **14**, figs. 3b, 13b, 24) irregular ray-arrangement is the rule. In the oxyasters with four (Plate **14**, fig. 1b) or more (Plate **14**, figs. 4b, 16, 23) properly developed pointed rays, on the other hand, the rays are usually regularly arranged.

The oxyasters and oxysphaerasters are 11–64 μ in total diameter, the centrum attaining a maximum diameter of 12 μ. The normal conically pointed rays are 2.5–40 μ long, and at the base 1.6–5 μ thick. Roughly speaking, the size of the rays and of the whole aster is in inverse proportion to the number of rays. Only the monactine oxyasters appear as an exception to this rule. Since however these spicules are rare and I was able to measure but few, I do not attach much importance to this fact. The one- to five-rayed oxyasters are 25–64 μ in diameter, their normal conical rays measuring 13–40 by 1.7–5 μ. The six- to ten-rayed oxyasters are 23–44 μ in diameter, their rays measuring 8.5–25 by 1.6–4.5 μ. The eleven- to twenty-three-rayed oxyasters are 11–25 μ in diameter, their rays measuring 2.5–13 by 1.7–3.3 μ.

The development (size) of the centrum is, roughly speaking, in true proportion to the number of rays and in inverse proportion to the size of the aster. In some of the large two- to five-rayed oxyasters the knob-like ray-rudiments clustering round the centre form an irregular thickened mass, but none of these asters have a true centrum. The largest oxyaster with such a centrum observed was 38 μ in diameter. Most of the six- and seven-rayed oxyasters are also without centrum, but among the oxyasters with eight to ten rays a great many are provided with one, and in the oxyasters with eleven or more rays a spherical central thickening is invariably present. In the larger oxyasters with centrum the diameter of the latter is always much less than the ray-length, while in the smallest oxyasters (oxysphaerasters), which also possess the greatest number of rays, the diameter of the centrum considerably exceeds the ray-length.

The oxyasters and oxysphaerasters of the four specimens are very similar. The differences observed, which are recorded in the appended table (page 34), are well within the limits of the accidental inaccuracies due to the smallness of the number (only about one hundred) of oxyasters measured.

The *strongylosphaerasters* (Plate **14**, figs. 1d, 2d, 5d, 7d, 9d, 10d, 17–19, 25–30) usually have a spherical centrum and about ten to twenty radial rays. In most of the strongylosphaerasters all the rays are about equal in size (Plate **14**, figs. 17, 25–28). In not a few strongylosphaerasters of var. *megana* and var. *orthotriaena* however, some of the rays are reduced to insignificant protuberances of the surface of the centrum and are much shorter than the others. On Plate **14** two strongylosphaerasters of this kind are represented, one (Figs. 18, 19) with all but three, the other (Figs. 29, 30) with all but one ray thus reduced. The properly developed rays are cylindrical or cylindroconical and truncate, very rarely conical and pointed. In var. *microana* they are on the whole more slender, longer, and distally more attenuated than in the other two varieties, and the strongylosphaerasters with pointed, conical rays have been observed only in this variety. The rays are 1–12 μ long and at the base 2–6 μ thick, the dimensions of the fully developed ones being in inverse proportion to their number. Strongylosphaerasters with only one fully developed ray are rare and have been found only in var. *orthotriaena*. In these the single ray is 12 μ long and 6 μ thick. In the strongylosphaerasters with two or three fully developed rays, which are quite frequently met with in both specimens of var. *megana* and in the specimen of var. *orthotriaena*, these rays are 8 μ long and 4–4.5 μ thick. In the strongylosphaerasters with from four to nine fully developed rays which are still more abundant in var. *megana* and var. *orthotriaena*, these rays are

DIMENSIONS OF OXYASTERS AND OXYSPHAERASTERS OF SIDONOPS ANGULATA.

Number of fully developed rays	Var. megana, lobose specimen				Var. megana, massive specimen				Var. microana				Var. orthotriaena				Sidonops angulata			
	Total diameter, μ	Diameter of centrum, μ	Length of rays (without centrum, when present), μ	Basal thickness of rays, μ	Total diameter, μ	Diameter of centrum, μ	Length of rays (without centrum, when present), μ	Basal thickness of rays, μ	Total diameter, μ	Diameter of centrum, μ	Length of rays (without centrum, when present), μ	Basal thickness of rays, μ	Total diameter, μ	Diameter of centrum, μ	Length of rays (without centrum, when present), μ	Basal thickness of rays, μ	Total diameter, μ	Diameter of centrum, μ	Length of rays (without centrum, when present), μ	Basal thickness of rays, μ
1					27	6.5	22	4.5	33	4.5	27	3.5					27–33	4.5–6.5	22–27	3.5–4.5
2–3	64	none	33	3.5	25–52	none –5.5	13–28	2–3.7	35–54	none	20–31	2.5–4	40–60	none	25–40	2.5–4.2	25–64	none –5.5	13–40	2–4.2
4–5	44–50	none	22–25	2–3.5	26.5–59	none –5.7	12.5–30	2.3–5	40–53	none	20–27	2.2–3.5	35–57	none	18–30	1.7–3	26.5–59	none –5.7	12.5–30	1.7–5
6–7	29–38	none –8	14.5–20	2–4	26–44	none –7	8.5–23	3–4.5	33	none	19	2	32–40	none	19–25	1.7–3	26–44	none –8	8.5–25	1.7–4.5
8–10	26–27	none –8	11–14	2–2.6	25–34	none –7	10–17	2–4	24–33	none –6	9–16	2.3–3	23–34	none –10	9–17	1.6–4	23–34	none –10	9–17	1.6–4
11–13	23–24	9	7	2–2.2	23–23.5	6.5–8.2	9–10	2.5–3	19–25	5–10	6–13	2–2.7					19–25	5–10	6–13	2–3
14–23	13–17	6–9	3–6	1.7–2	11–23	6–12	2.5–8	2–3	15–23	6–7	5–8	2	13–19	7–9	3.5–6	2–3.3	11–23	6–12	2.5–8	1.7–3.3

5.5–6 μ long and 4 μ thick. In the ordinary strongylosphaerasters with from ten to twenty equal rays, which occur in great numbers in all the specimens, the rays are 2–4 μ thick, in var. *microana* 3–9 μ, and in the other two varieties 1–7 μ long.

The size of the centrum and of the whole aster is, like the size of the rays, in inverse proportion to the number of the number of the latter. In the strongylosphaerasters of var. *megana* and var. *orthotriaena* with from one to nine fully developed rays, the centrum is 11–13 μ and the whole aster 21–26 μ in diameter. In the strongylosphaerasters with from ten to twenty equal rays these dimensions are 7–14 μ and 14–24.5 μ respectively in all the three varieties.

The distal parts of the fully developed rays bear numerous spines while their basal part and the centrum are smooth. The spines are conic, usually 0.5–1 μ long, rarely smaller, and not recurved. Those situated on the terminal face of the ray appear to radiate from a common centre within the tip of the ray and diverge accordingly; those on the sides of the ray are slightly oblique, inclined towards the end of the ray. When the ray is reduced in length the spines on its terminal face retain their full size. Consequently the low protuberances representing greatly reduced, rudimentary rays of this kind, are covered with tufts of spines (Plate **14**, figs. 18, 19, 29, 30).

In the rays of some of the strongylosphaerasters of var. *orthotriaena* I observed thick axial threads. These were joined in a regularly concentric manner in the centre of the spicule and extended in straight lines along the axes of the rays to within a short distance of their ends, where they appeared to terminate with slight irregular thickenings. Occasionally it seemed that exceedingly fine branches extending towards the spines arose from the distal parts of these axial threads. These being near the limit of microscopic visibility, it is doubtful whether such structures really exist, or whether the impression of them was merely an optical illusion.

Besides the strongylosphaerasters described above I found in the centrifugal spicule-preparations of the massive specimen of var. *megana* some small ones, 7.5–14 μ in total diameter with a centrum measuring only 1.5–2.5 μ, and seventeen to nineteen minutely spined rays 0.5–1 μ thick. These asters appear to be young stages of the ordinary strongylosphaerasters.

The *sterrasters* (Plate **13**, figs. 22–25; Plate **15**, figs. 1–3, 5–12) are more or less regular flattened ellipsoids. When seen from above, with the umbilicus in the centre of the upper side, their contour generally appears as a regular ellipse, sometimes nearly approaching a circle (Plate **15**, figs. 9–11). In var.

DIMENSIONS OF STRONGYLOSPHAERASTERS OF SIDONOPS ANGULATA.

Number of fully developed rays		1–3	4–9	10–20
Total diameter of asters μ	var. megana, lobose specimen	24	23.5	14–22.5
	var. megana, massive specimen	26	21	16–24.5
	var. microana			19–24
	var. orthotriaena	24		17–22
Diameter of centrum μ	var. megana, lobose specimen	12	12	8–14
	var. megana, massive specimen	12	13	7–13.7
	var. microana			7–13.5
	var. orthotriaena	11		8.5–12
Length of rays (without the centrum) μ	var. megana, lobose specimen	8	6	2–7
	var. megana, massive specimen	8	5.5	1–6.5
	var. microana			3–9
	var. orthotriaena	12		3.5–5.5
Basal thickness of rays μ	var. megana, lobose specimen	4	4	2–4
	var megana, massive specimen	4.5	4	2–4
	var. microana			2–4
	var. orthotriaena	6		2–4

orthotriaena, however, a good many sterrasters have, when seen in this position, a somewhat rhomboidically distorted outline (Plate 15, fig. 12). The sterrasters are 85–122 μ long, 75–113 μ broad, and 57–86 μ thick. They are largest in var. *megana*, smaller in var. *orthotriaena*, and still smaller in var. *microana*.

DIMENSIONS OF STERRASTERS OF SIDONOPS ANGULATA.

	Length μ	Breadth μ	Thickness μ
Var. megana, lobose specimen	105–122	90–105	73–86
Var. megana, massive specimen	110–120	100–114	70–83
Var. microana	85–97	75–90	57–65
Var. orthotriaena	90–111	80–94	65–79

The average proportion of length to breadth to thickness is in the sterrasters of the lobose specimen of var. *megana* 100 : 87 : 68, in those of the massive specimen of var. *megana* 100 : 92 : 63, in those of var. *microana* 100 : 89 : 66, and in those of var. *orthotriaena* 100 : 88 : 73.

In a thin radial splinter of a very young sterraster of the massive specimen of var. *megana* with long, slender, and pointed ray-ends, which lay opportunely for examination with high powers in a centrifugal spicule-preparation, I clearly saw that a radial axial thread, extending right up to its end, is contained in each ray. In the centre of a young sterraster of var. *orthotriaena* a little cluster of a few very small granules, lying close together, was observed. In the centre of a slightly heated, adult sterraster of the massive specimen of var. *megana* I observed an apparently solid black sphere, 15 μ in diameter, from which black rays radiated to some distance. Such a blackening has been observed several times. It seems to show that the central part of the spicule contains more organic substance than the superficial part, and that the axial threads of the rays are distally silicified to a greater extent than proximally.

The distal, freely protruding parts of the rays are in normal sterrasters everywhere, except in the vicinity of the umbilicus, 4–5 μ thick and provided with a terminal verticil of usually four to six stout, blunt, and often somewhat curved, lateral spines (Plate **15**, figs. 5, 6). The distal ends of the rays surrounding the umbilicus have a transverse section, elongated in a direction radial to the umbilicus, usually 4–5 μ broad and 6–7 μ long. They are generally provided with from seven to nine lateral spines and also bear several spines on their terminal face (Plate **15**, figs. 1–3). The spines of these rays, which are directed towards the centre of the umbilicus, are a little larger than the others and often curved.

Besides these normal sterrasters some abnormal ones, for which I propose the term sterroids, were observed, chiefly in var. *orthotriaena* and the massive specimen of var. *megana*. The most frequent kinds of abnormities met with are sterrasters in which the distal ray-ends are thicker, as much as 6–9 μ in transverse diameter, farther apart, and provided with a greater number of spines than in the normal sterrasters. In some of these sterrasters single scattered spines, similar to those forming the verticils on the rays, arise here and there between the protruding distal ray-ends directly from the surface of the solid centrum of the spicule. Much more rarely strongylosphaeraster-like sterrasters with relatively long, terminally rounded, protruding rays were observed. In some of these the protruding ray-ends were smooth, in others densely covered with small spines.

The two specimens of var. *megana* were trawled at Station 2975 on February 12, 1889, in 34° 1′ 30″ N., 119° 29′ W., depth 66 m. (36 f.); they grew on a bottom of gravel and broken shells; the bottom temperature was 73.9° (57° F.). The specimen of var. *microana* was caught with the tangles at Station 4417 on April 12, 1904, near Santa Barbara Islands, S. W. rock Santa Barbara Island, N. 8° W., 11.7 km. (6.3 miles), drift S. 73° W.: depth 53 m. (29 f.); it grew on a bottom of fine yellow sand and coralline rock. The specimen of var. *orthotriaena* was trawled at Station 2945 on February 6, 1889, in 34° N., 119° 29′ 30″ W., depth 55 m. (30 f.): it grew on a pebbly bottom.

The similarity of the rather peculiar smooth oxyasters and oxysphaerasters and the smallness of the differences of most of the other skeletal elements and the soft parts of these sponges show that they are nearly related to one another, a conclusion which is corroborated by the fact that they all come from the same region. The differences between the two specimens from Station 2975 are so slight that I do not hesitate to place them in the same systematic unit. Several of the differences between these and the other two and between the latter are, on the other hand, considerable. Some of these differences, as for instance the much smaller size of both kinds of amphioxes in the smaller specimen from Station 2945, may be due merely to differences of age or growth and are therefore systematically unimportant; other differences appear to be of greater significance, and of these the following may be noted: the subcortical triaenes of the specimen from Station 2945 are orthotriaenes, while those of the others are plagiotriaenes; the strongylosphaerasters of the specimen from Station 4417 have more slender and conical rays, those of the other specimens stouter and more cylindrical ones. Many of the sterrasters of the specimen from Station 2945 are rhomboidically distorted, while all or nearly all the sterrasters of the others have regularly elliptical contours. The sterrasters of the specimen from Station 2945 are slightly, those of the specimen from Station 4417 very considerably, smaller than those of the specimens from Station 2975. The anaclades of the specimen from Station 4417 are all small; in the specimen from Station 2945 medium sized, and in the specimens from Station 2975 large anaclades occur besides the small ones. In the specimen from Station 4417 the anaclades are partly triaene and partly diaene, in the two latter all the anaclades observed were triaene. There can, I think, be no doubt about these differences being due to congenital particularities and not to mere individual (somatic) adaptations or differences of chromatin-separation or mixture before and during fertilization. For this qualitative reason, and also for the quantitative reason that these differences are by no means inconsiderable in extent, I think that they must find systematic expression. As these variations are due mostly to peculiarities of parts lying either, like the strongylasters and sterrasters, close to the surface, or, like the anaclades, even protruding beyond it; as structures thus directly exposed to the influence of external forces are, *a priori*, liable to be somewhat different even in most closely related individuals; and finally as the difference in the subcortical triaenes, which is the only valid difference of the less exposed internal parts, is, as a comparison of the cladomes of these triaenes (Plate **26**) shows, not very great; it appears advisable to place these four sponges in one and the same species, with three varieties within this species.

DIFFERENCES BETWEEN THE VARIETIES OF SIDONOPS ANGULATA.

	Var. megana	Var. microana	Var. orthotriaena
Colour	white, yellowish, reddish brown.	dirty white, purple-brown.	brownish white.
Stout, choanosomal amphioxes	2–3.7 mm. long, 40–72 μ thick.	1.8–2.8 mm. long, 20–52 μ thick.	1.6–2.5 mm. long, 20–70 μ thick.
Slender, dermal amphioxes	not numerous; 4.2–9.5 mm. long, 18–34 μ thick.	very abundant; 5.5–7 mm. long, 10–22 μ thick.	not numerous; 2.9–4.5 mm. long, 5–17 μ thick.
Styles (style-derivates)	2.1–2.5 mm. long, 60–100 μ thick (not found in the massive specimen).	as in the lobose specimen of var. *megana*.	as in the lobose specimen of var. *megana*.
Plagio- or orthotriaenes	plagiotriaenes. rhabdome 1.6–2.8 mm. long, 50–82 μ thick; clades 330–700 μ long; clade-angle 92–104°, average 102.15°.	plagiotriaenes. rhabdomes 1.5–2.6 mm. long, 50–77 μ thick; clades 380–580 μ long; clade-angle 91–112°, average 105.6°.	orthotriaenes. rhabdome 2–2.35 mm. long, 47–78 μ thick; clades 380–500 μ long; clade-angle 91–98°, average 93.7°.
Anaclades	anatriaenes. rhabdome long, 7–39 μ thick; clades 45–210 μ long; clade-angle 27–66°, average 46°.	anatriaenes and anadiaenes. rhabdome shorter, 10–18 μ thick; clades 30–50 μ long; clade-angle 50–62°, average 47°.	anatriaenes. rhabdome long, 14–18 μ thick; clades 33–80 μ long; clade-angle 43–54°, average 48°.
Oxyasters and oxysphaerasters	1–23 rays; 11–64 μ in total diameter.	1–18 rays; 15–54 μ in total diameter.	2–20 rays; 13–60 μ in total diameter.
Strongylosphaerasters	3–20 more cylindrical rays; 14–26 μ in total diameter.	10–17 more conic rays; 19–24 μ in total diameter.	1–17 more cylindrical rays; 17–21 μ in total diameter.
Sterrasters	all regularly ellipsoidal; 105–122 μ long; 90–114 μ broad, 70–86 μ thick.	all regularly ellipsoidal; 85–97 μ long, 75–90 μ broad, 57–65 μ thick.	besides the regular ellipsoidal also rhomboidically distorted ones, 90–111 μ long, 80–94 μ broad, 65–79 μ thick.

The structure of the skeleton and the canal-system with its cribriporal afferents and its uniporal efferents clearly show that this species belongs to Sidonops. None of the previously described species either of Sidonops or

Geodia, which latter I have, for the reasons given in the description of *Geodia agassizii*, also compared, at all resemble these sponges in their spiculation. The only species similar to *S. angulata* is *S. bicolor* described in this Memoir, and from this it is distinguished by the possession of anaclades and angularly bent amphioxes, the smoothness of the oxyasters and oxysphaerasters, and the smaller size of the sterrasters.

Sidonops oxyastra, sp. nov.

Plate 6, figs. 1–23; Plate 7, figs. 1–20; Plate 8 figs. 1–15.

I establish this species for two specimens from Duncan Island, Galapagos.

The asters of this species are all oxyasters (oxysphaerasters) and to this the specific name refers.

The larger of the two specimens (Plate **6**, fig. 5) forms a mass 94 mm. in maximum diameter, attached to a flat, water-worn pebble, half of which it has overgrown. Deep incisions partly divide this mass into lobes; the central undivided part is 76 mm. broad; the lobes (Plate **6**, fig. 4) taper distally and are rounded. The surface appears undulating, smooth, and, to the unaided eye, destitute of a spicule-fur. Large parts of the strongly convex and most exposed portions of the surface are altogether without pores. In other exposed parts a few minute pores are observed. The flat and the concave, more sheltered parts of the surface are perforated by very numerous pores, two kinds of which can be distinguished. The whole of the extensive flat surface of the central mass and considerable parts of the surface of the lobes are occupied by sieves containing small afferent pores. In some places, where the dermal membrane forming these pore-sieves has been rubbed off the entrances to the radial afferent cortical canals are exposed to view. There is a tract 4–14 mm. in extent occupied by a group of large and conspicuous efferent pores (Plate **6**, fig. 4) on nearly every lobe.

The smaller specimen, which measures 56 mm. in maximum diameter, resembles the larger one, described above, in every respect. It also grew, as the impression in the detached base shows, on a flat pebble perhaps another part of the one to which the larger specimen is attached.

A monaxonid sponge (Plate **6**, figs. 19a, 20a; Plate **7**, figs. 1b, 2b, 6b) and composite ascidians incrust parts of the afferent areas of both specimens.

The *colour* of the surface of the large undivided central mass is in both specimens (in spirit) purplish brown, that of the other parts much lighter, brownish white. The interior is light brown.

A *cortex* (Plate 7, figs. 1a, 2a, 6a), composed of a thin outer dermal layer, a thick middle sterraster-armour layer, and a thin inner fibrous layer, is developed superficially. The whole cortex is, under most parts of the surface, 700–750 μ, in some parts of the efferent areas up to 1.6 mm. thick. As such thicknesses of the cortex have been observed only between widely open efferent cortical canals they may be produced by the dilatation of the latter. The dermal layer is in the afferent areas on an average about 40 μ thick and excavated by systems of subdermal canals. In the efferent areas it is on an average about 60 μ thick, solid, and occupied by numerous paratangentially disposed spindle-cells. The sterraster-armour layer is in the afferent areas about 600 μ thick and everywhere, except in the walls of the cortical canals, occupied by dense masses of sterrasters. In parts of them the portions of the middle layer free from sterrasters around the cortical canals are rather extensive and considerably widened distally (Plate 7, fig. 6). The inner fibrous layer is 35–70 μ thick and occupied by paratangential, somewhat undulating fibres, staining strongly with aniline-blue.

The *choanosome* is traversed by strands composed of large and conspicuous elongated cells (Plate 6, figs. 1, 2). These strands are 60–90 μ broad. The cells composing them are arranged rather irregularly, but on the whole distinctly longitudinally. They are mostly spindle shaped, 20–30 μ long and 4–7 μ thick. Here and there (Plate 6, fig. 1, to the left below) thicker, more oval elements, measuring 20 × 11 μ, are observed in the strands. The plasma of these cells is occupied by large granules, staining strongly with haematoxylin.

Canal-system. The afferent areas of the surface are occupied by sieve-like pore-groups 0.5–1 mm. in diameter (Plate 8, fig. 13). These pore-sieves lie close together, being separated only by narrow poreless tracts. The afferent pores themselves (Plate 8, fig. 15) are in the preparations, probably in consequence of *post mortem* shrinkage, somewhat irregular in shape, 40–120 μ wide, and separated by dermal bands of varying breadth. The broader bands, which form a sort of primary network, are thick, reach down to the middle layer of the cortex, and contain asters and dermal rhabds. The narrower bands which connect these primaries, are quite thin and contain only a few small asters or no spicules at all (Plate 8, fig. 15). The pores of each group (pore-sieve) lead into a system of subdermal cavities, which converge and unite to form a radial canal. These radial afferent cortical canals, which penetrate the sterraster-armour layer, are circular in transverse section and about 45 μ wide. They are distributed somewhat regularly over the afferent areas, their centres being 0.7–1 mm. apart.

Below the cortex of the afferent areas numerous cavities, which appear connected with each other by paratangential canals are met with (Plate **7**, figs. 1, 2, 6). Into this system of subcortical cavities the radial afferent cortical canals open out, and from it numerous narrow afferent canals, which extend downwards into the choanosome, take their rise.

The intermediate tissue is poorly developed, the final ramifications of the canals and the flagellate chambers being separated only by thin membranes (Plate **6**, fig. 3). The flagellate chambers are, so far as I could make out, spherical and measure 17–25 μ in diameter.

The efferent canals join to very wide (up to 1.5 mm.) efferent canal-stems (Plate **7**, figs. 1d, 2d) which extend towards the efferent areas of the cortex, below which they join to form a more or less continuous efferent subcortical cavity. From this the radial efferent cortical canals take their rise. These canals are 0.1–1 mm. wide, have a circular transverse section, and open out freely on the surface. They are destitute of dermal pore-sieves (uniporal). Their openings, the efferent pores (Plate **6**, fig. 4; Plate **7**, figs. 1e, 2e; Plate **8**, fig. 14), which occupy the efferent areas above described, are circular and, like the canals which terminate in them, 0.1–1 mm. wide. The great difference in size between the smallest and the largest of these pores is remarkable. The small ones are few in number and scattered irregularly among the much more numerous large ones. The centres of the efferent pores are, irrespective of the width of the pores, quite uniformly 1.2 mm. apart, and the distance between the margins of adjacent pores is consequently in inverse proportion to their size. This and the fact that the cortex is thicker between large pores than between small ones, seem to indicate that the great differences of width observed in the efferent pores (cortical canals) are due to differences in degree of contraction.

Skeleton. In the interior of the choanosome numerous, rather irregularly scattered amphioxes, some amphistrongyles, a few styles, large oxyasters, and some sterrasters, mostly young forms, are met with. Towards the surface rhabds, similar to those mentioned above, together with the rhabdomes of numerous subcortical plagiotriaenes and a few small subcortical anaclades, form radial bundles which abut vertically or somewhat obliquely on the cortex (Plate **7**, figs. 1, 2, 6). In this subcortical region of the choanosome and in the inner layer of the cortex also minute dermal rhabds occur; the (young) sterrasters are here much less abundant than in the interior, and the large oxyasters of the latter for the most part replaced by large oxysphaerasters. In the middle layer of the cortex the sterrasters form a dense mass. The dermal layer contains numerous small oxyasters and oxysphaerasters, numerous minute dermal rhabds, and a few small anaclades. The small oxyasters and oxysphaerasters form a dense coating at the surface. The minute dermal rhabds and anaclades traverse the dermal layer more or less radially. Their proximal ends are implanted in the distal part of the sterraster-armour layer, and their distal ends protrude freely beyond the surface. The dermal rhabds are styles with attenuated, proximally situated, rounded ends. In the efferent areas of the surface (Plate 6, fig. 21) these spicules form dense masses. In the afferent areas they are not nearly so numerous. The freely protruding ends of these spicules are in the efferent areas very close together and nearly parallel, like grass on a good lawn. In the afferent areas they form tuft-like groups of diverging spicules like grass on arid ground. The anaclades are confined to the afferent areas. In one place (Plate 6, fig. 23) I found them in great numbers. Generally they are scarce. Where the monaxonid sponge-crusts, above mentioned, extend, these spicules penetrate it, their cladomes lying within the attached sponge-crust (Plate 6, figs. 19b, 20b), anchoring it to the Sidonops. These anaclades are mostly anatriaenes, but anadiaenes, anamonaenes, and mesanaclades, chiefly mesanatriaenes, also occur.

The *large choanosomal amphioxes* (Plate 6, fig. 14; Plate 8, figs. 4a, 5) are straight or slightly curved, 1.1–1.55 mm. long and 10–32 μ thick.

The rare *large amphistrongyles* are straight, isoactine, and 0.8–1 mm. long. They are in the middle 18–23 μ thick and taper towards the two equal, rounded ends. The degree of attenuation is variable, as the following three measurements show.

Thickness in the middle	Thickness at the ends
23 μ	21 μ
20 μ	17 μ
18 μ	12 μ

The very rare *large styles* are straight and shorter and, at the rounded end, thicker than the amphioxes and amphistrongyles. One that I measured was 850 μ long and, at the rounded end, 38 μ thick.

The *minute dermal styles* (Plate 6, figs. 21, 22) are more or less, sometimes rather abruptly, curved, 130–230 μ, usually about 200 μ long, and, at the thickest point, which lies between the middle and the rounded end, 3–5.5 μ thick. They taper towards both ends; the distal end is sharp pointed; the proximal end rounded and 1.5–3 μ thick, usually a little less than half as thick as the spicule at its thickest point.

The *plagiotriaenes* (Plate 6, figs. 6–13; Plate 8, fig. 4b, c) have a conical sharp-pointed rhabdome, which is straight or slightly curved in its acladomal part. The rhabdome is 1–1.65 mm. long and, at the cladome 24–40 μ thick. The clades are usually conical and pointed; rarely one (Plate 6, fig. 7), two, or all three (Plate 6, fig. 6) are reduced in length and rounded off terminally. The normal pointed clades of the same cladome are usually about equal in length, more rarely distinctly unequal (Plate 6, figs. 8, 10). The basal part of the clades is directed obliquely upward and always curved, concave to the rhabdome, their distal part is directed outward and straight or slightly curved in the opposite direction. The development of this upward bend of the distal part of the clade is usually proportional to its length. The chords of the normal (pointed) clades are 250–285 μ long and enclose angles of 100–118°, on an average 108.5°, with the axis of the rhabdome.

In a spicule-preparation I found a triaene with a clade-chord 350 μ long, enclosing an angle of 90° with the rhabdome. Perhaps this orthotriaene is a foreign spicule.

The rhabdomes of the *small dermal anaclades* (Plate 6, figs. 15–18, 19b, 20b, 23) appear — I found none intact in the spicule-preparations — to be over 1 mm. long. They are, at the cladome, 5–12 μ thick. Their cladomes are very variable. The most frequent forms are anatriaenes (Plate 6, figs. 17, 18, 19b, 20b) with a protuberance on the apex of the cladome. Their clades are pointed, very rarely blunt, more or less angularly bent, concave to the rhabdome and often rather unequal. This inequality is sometimes carried to the extent of a complete suppression of one or two clades, whereby diaene and monaene forms are produced. Not infrequently the apical protuberance is replaced by a long, blunt (Plate 6, fig. 15, 16) or, more frequently, pointed epirhabd. Most of these mesanaclades are quite regular mesanatriaenes (Plate 6, fig. 15). Some of them are, however, rendered irregular by one of the clades extending upwards, proclade-fashion (Plate 6, fig. 16). These mesanatriaenes were found only at the place where the anaclades are abundant. The chords of the clades of the more regular triaene and mesotriaene anaclades are 15–24 μ long and enclose angles of 40–65°, on an average 57°, with the axis of the rhabdome. The clades of the diaene and monaene anaclades are longer, some of them attaining a length of 30 μ. The epirhabd is, when fully developed, straight, conic, sharp pointed, and 65–75 μ long.

Although the different kinds of *euasters* are, to some extent, connected by transitional forms, three categories can readily be distinguished: large choanosomal few-rayed forms, without large centrum (large oxyasters); large subcortical many-rayed forms, with large centrum (large oxysphaerasters); and small, dermal, mostly many-rayed forms, with or without large centrum (small oxyasters and oxysphaerasters).

The *large choanosomal oxyasters* (Plate 7, figs. 3–5a, 7, 8, 13–15) have a slight central thickening 2.5–4.5 μ, that is two to three times the basal thickness of the rays, in diameter, and from four to ten, most frequently seven, straight, conical and pointed or blunt, concentric, and quite regularly distributed rays. With the exception of its proximal end, the whole of the ray is covered with rather large and uniformly distributed spines (Plate 7, figs. 13–15). The rays are 11–25 μ long and at the base usually 1.2–2 μ thick, the total diameter of the aster being 18–45 μ. A few asters of this kind, with much thinner rays also occur. These asters, which are less than 20 μ in total diameter, have rays, at the base, only 0.5–0.7 μ thick. They are probably young forms.

The *large subcortical oxysphaerasters* (Plate 7, figs. 3c, 19, 20) have a spherical centrum 4.2–6.5 μ, that is from a quarter to a third of the whole aster, in diameter, and from sixteen to twenty-three concentric and regularly distributed rays. The rays are straight, conical, sharp pointed, covered with rather large spines, 6–7 μ long and at the base 1.1–1.4 μ thick. The whole aster is 16–22 μ in diameter.

The *small dermal oxyasters and oxysphaerasters* (Plate 7, figs. 3–5b, 9–12, 16–18) form a continuous series. One end of this series is represented by forms which have hardly any central thickening at all and appear as true oxyasters (Plate 7, figs. 9 and 10 right above, 18). The other end of the series is represented by forms with a centrum more than a third of the whole aster in diameter. The small dermal oxyasters and oxysphaerasters have from nine to eighteen straight, conical, and regularly distributed rays. The rays always appear to bear numerous small spines. Often however these spines are so minute that they cannot be made out as such, a roughness of the ray then being the only indication of their presence. The rays are (without the centrum) 2–4.5 μ long and at the base 0.7–1.5 μ thick, the total diameter of the aster being 6–13.5 μ.

The *sterrasters* (Plate 6, fig. 21; Plate 8, figs. 1–3, 6–12) are flattened ellipsoids, 76–85 μ long, 66–73 μ broad, and 50–64 μ thick, the average proportion of length to breadth to thickness being 100 : 90: 76.

Very young sterrasters, some hardly 10 μ in diameter, were observed. These appear as spheres composed of equal and regularly distributed, immeasurably thin, straight, radial rays. In a spicule-preparation I found a chip of an adult sterraster, which I was able with a high power to photograph (Plate 8, fig. 12). This photograph shows that the centre of this spicule is occupied by a cluster of granules (a), from which the radial lines, traversing the body of the sterraster, arise. The central granule-cluster is about 4 μ in diameter.

The rays protruding over the surface of the solid centrum are in most of the adult sterrasters (Plate 8, figs. 10, 11) 2–3 μ thick and provided with terminal verticils of usually five or six lateral spines. In some of the sterrasters (Plate 8, figs. 6–8) these rays are 3.5–4.5 μ thick and usually provided with seven or eight lateral and one or more obliquely arising terminal spines.

Both specimens were collected on April 13, 1888, at Duncan Island, Galapagos. They were labeled F. C. 1354 and 539 Tetractinellida.

The structure of the skeleton, the cribriporal afferents, and the uniporal efferents show that this species belongs to Sidonops. It is not at all closely allied to any other species of Sidonops or to any species of Geodia. The species approaching it most closely appears to be *Geodia media* Bowerbank from which however it differs by the small euasters for the most part being thick- and short-rayed strongylosphaerasters and by the presence of mesomonaenes.

Sidonops bicolor, sp. nov.

Plate 9, figs. 1–19; Plate 10, figs. 1–15; Plate 11, figs. 1–17.

I establish this species for fifteen specimens obtained off California. All the specimens agree closely and most of them are very much lighter in colour on one side than on the other. The specific name, *bicolor*, refers to this conspicuous character.

Shape and size. These sponges are irregularly tuberous, and generally considerably elongated (Plate 11, figs. 15, 16) or flattened (Plate 11, fig. 17). The largest elongated one, which was obtained at Station 2958, is 101 mm. long and 40 mm. thick. The largest flattened one, collected at Station 2981, is 62 mm. long, 59 mm. broad, and 28 mm. thick. The others are 39–73 mm. in maximum diameter. Most of the efferent pores are situated on the less extensive concave parts of the surface, while the afferents are chiefly on the more extensive convex parts. The areas bearing chiefly the efferent pores are either quite smooth or slightly raised around these pores, some of which are situated on the summits of low elevations. The areas bearing chiefly the afferent pores are more uneven and appear to have been entirely covered with a spicule-fur. Although rubbed off in many places, remnants of this spicule-fur can easily be found on the more sheltered parts. Incrusting symbionts, desmacidonid sponges, two species of Bryozoa, etc., grow on the afferent portions of the surface of most of the specimens, while the efferent areas are free from symbionts.

The colour of the surface varies in these spirit specimens from whitish to reddish or purple-brown; some parts of it are, as mentioned above, usually much lighter in colour then others, the under side appearing to be less pigmented than the upper side. Occasionally, particularly in the specimens from Station 4420, I have noticed that the margins of the efferent pores are somewhat lighter in colour than the adjacent parts of the surface. The interior is dirty brownish or greenish white.

The superficial parts form a *cortex* (Plate 9, figs. 15–17) which contains a sterraster-armour 0.9–1.8 mm. thick. The sterrasters do not always extend down to the choanosome, a thin fibrous layer often intervening between them and the latter. This layer, which is composed of paratangential fibres similar to those connecting the sterrasters, is more clearly made out in one of the specimens from Station 4420 than in the others. In the darker parts of the cortex pigment cells are observed. These contain large spherical granules, brown in colour, which stain deeply in azure. The number of these granules in each cell is not great. On or just below the outer surface the pigment cells are very numerous and often form a continuous layer which has the appearance of an epithelium. This I observed chiefly in a specimen from Station 4420. These cells are here massive, or somewhat elongated, irregular in outline, about 10 μ broad and 12–25 μ long. Pigment cells also occur in the lower parts of the cortex, within the sterraster layer, but here they are long and slender, and arranged radially around the sterrasters. This shape and position of the deep-lying pigment cells are apparently due to the position of the connective-tissue fibres which radiate from the sterrasters and between which they lie.

In the choanosome of a specimen from Station 3168 I found numerous oval bodies 20–35 μ long and 10–20 μ broad which consist of a nearly hyaline substance uniformly staining with haematoxylin and azure. In these bodies neither an enveloping membrane nor a nucleus could be detected. Most of them are densely crowded in band-like zones, some isolated and scattered. Similar bodies, scattered singly throughout the choanosome, have also been observed in a specimen from Station 4420.

Canal-system. In many of the specimens I have been able to make out the afferent pores. These are, as stated above, chiefly distributed over the convex parts of the surface and arranged in more or less circular groups (Plate 10, fig. 15)

0.5–1.5 mm. in diameter. The centres of these pore-groups are 1.5–2.5 mm. apart. When the groups are large and their centres close together, as is the case on parts of the surface of one of the specimens from Station 4531, the pore-groups come in contact with each other and form a fairly continuous sieve. When however, as is more frequently the case, the pore-groups are smaller and farther apart, they appear divided by a network of belts free from pores. The pores themselves are oval, measure 100–300 μ in diameter, and perforate the thin dermal membranes covering the distal widened parts of the afferent canals (Plate 9, fig. 16), which traverse the cortex in a radial direction. These canals are cylindrical in the centre, and up to 400 μ wide. They widen above in a funnel-shaped manner, and are contracted below by a stout chonal sphincter, which lies at the level of the limit between cortex and choanosome. They lead into subcortical cavities of no great size which lie just below the cortex and from which the afferent choanosomal canals take their origin. The flagellate chambers (Plate 9, fig. 18) are spherical and 20–32 μ in diameter. The efferent canals are provided with sphincter-membranes at frequent intervals and join to form tubes, often as much as 1–1.6 mm. in diameter, which lead up to the efferent areas of the cortex (Plate 9, fig. 17). Some appear to end at the limit between cortex and choanosome, while others bend round and continue their course paratangentially for some distance just below this level, thus forming efferent subcortical cavities. From the ends of the former and the roofs of the latter the efferent cortical canals arise. These are constricted at their origin by chonal sphincters lying at the level of the limit between cortex and choanosome. Beyond the sphincter the canal widens to a cylindrical tube 250 μ–1 mm. in diameter, which traverses the cortex radially (Plate 9, fig. 15) and opens out freely on the surface (Plate 10, fig. 14). The efferent pores, in which these canals terminate, either have nearly the same width as the canals themselves or they are slightly smaller. The centres of these efferent pores are 1–2.5 mm. apart, their distance being on the whole proportional to their size, small ones lying much closer together than large ones. These efferents, though usually restricted to concave parts of the surface which are generally free from afferent pores, are also found on other parts of the surface, irregularly distributed between the groups of afferents. On large parts of the surface no pores of any kind can be made out.

Skeleton. Spicule-bundles which widen out distally traverse the choanosome (Plate 9, fig. 17) radially and abut vertically or somewhat obliquely on the surface. These bundles consist chiefly of amphioxes, of which two kinds, stout and slender ones, can be distinguished. The former occur chiefly in the axial parts of the bundles, while the latter predominate in their superficial parts. In the distal portions of the spicule-bundles plagiotriaenes also occur. The cladomes of most of these plagiotriaenes lie at or just above the limit between choanosome and cortex, the clades being often quite enveloped by sterrasters; their rhabdomes extend radially inward. The radial spicule-bundles abutting on the afferent areas do not terminate at the cortex, but penetrate it (Plate 9, fig. 16) and protrude beyond it, thus forming the fur. The fur consists chiefly of amphioxes but plagiotriaenes also take part in its formation. In the spicule-fur of a specimen from Station 2958 I found a good many plagiotriaenes, with rhabdomes implanted in the cortex, and free cladomes lying a considerable distance above the surface of the sponge. Where these spicules arise from it, the surface is often raised conulus-fashion. In a specimen from Station 4551 I have found a few styles and in the spicule-preparations of specimens from Stations 2958 and 3168 two small protriaenes. The latter are probably foreign spicules. Very small and slender rhabds are often found imbedded in the superficial part of the cortex. I think it highly probable that these belong to the symbiotic monaxonid sponges which incrust parts of the surface.

The microscleres are strongylosphaerasters, smaller oxysphaerasters with numerous rays, larger oxyasters with fewer rays, and sterrasters. The strongylosphaerasters form a dense layer on the outer surface (Plate 10, fig. 15) and are absent in the interior. The oxysphaerasters occur chiefly in the walls of the cortical canals and are also met with in the region of the subcortical cavities. The oxyasters are restricted to the choanosome, in the walls of the canals of which they are very numerous. The sterrasters occupy the whole or nearly the whole of the thickness of the cortex (Plate 9, figs. 15–16) in dense masses. In most of the specimens the choanosome is free from sterrasters. In some however, particularly in the specimens from Stations 3168 and 4420, considerable numbers of sterrasters, chiefly young ones, were found in it.

The *stout amphioxes* (Plate 9, figs. 9–11) are curved, isoactine, or slightly anisoactine, attenuated towards the rather blunt ends, gradually in the central parts and rather abruptly in the distal parts. They are 2.3–5.6 mm. long and 35–105 μ thick. An inverse proportion between length and thickness is indicated. Those of the specimens from Station 4551 attain a greater maximum thickness than those from the other stations.

DIMENSIONS OF STOUT AMPHIOXES.

Stations	2958	2981	3168	4420	4531	4551
Length mm	3–4.2	2.3–5.3	3.1–4.2	3.1–3.7	3.8–5.6	3.8–5.6
Thickness μ	50–82	35–93	60–92	53–79	60–85	65–105

The *slender amphioxes* (Plate 9, figs. 7, 8) are curved in a simple (Fig. 7) or wavy (Fig. 8) manner, cylindrical in the central parts, and attenuated to fine points at the ends. They are 3.5–9 mm. long and 15–40 μ thick. The longest measured were from specimens from Stations 4531 and 4551, but as the long ones are usually broken in the spicule-preparations it is probable that slender amphioxes, considerably longer than those observed and measured, occur also in the specimens from the other stations.

DIMENSIONS OF SLENDER AMPHIOXES.

Stations	2958	2981	3168	4420	4531	4551
Length mm	5.2–5.9	5.2–6.7		4.7–5.8	3.5–9	6–9
Thickness μ	25	15–25	23–33	18–40	24–40	22–38

The exceedingly rare *styles*, which I observed only in the specimens from Station 4551, are a little over 4 mm. long and at the somewhat thickened rounded end 100–120 μ thick.

The *plagiotriaenes* (Plate 9, figs. 1–6, 12–14) generally have a straight conical rhabdome, rather abruptly attenuated at the acladomal end and pointed (Plate 9, figs. 13, 14). The rhabdome, when thus normally developed, is 2.1–4 mm. long and at the cladomal end 62–110 μ thick. Just below the cladomal end it is markedly thickened and here attains a transverse diameter of 73–120 μ. This thickest part of the rhabdome is 5–20, most frequently about 11 % thicker than the cladomal end, which consequently appears constricted in a neck-shaped manner. In some plagiotriaenes the rhabdome is reduced in length, more cylindrical in shape, and simply rounded off at the acladomal end (Plate 9, fig. 12). Occasionally this reduction goes so far that the rhabdome measures only 290 μ in length. Such very short rhabdomes are cylindrical and not constricted at the cladomal end. They have been observed only in a specimen from Station 4420 and here also they are rare. The clades are conical, quite blunt, and fairly straight (Plate 9, figs. 1, 3–6, 12) or slightly curved, either simply, concave towards the rhabdome (Plate 9, fig. 2), or in the shape of an S, in such a manner that the proximal part is concave, the distal part convex towards the rhabdome (Plate 9, fig. 13). The clades are 280–700 μ long; their chords enclose angles of 103–122° with the rhabdome.

DIMENSIONS OF THE NORMAL PLAGIOTRIAENES.

Stations			2958	2981	3168	4420	4531	4551
Rhabdome	length mm.		2.5–3.5	2.1–3.5	2.7–3	2.3–3.15	3.1–3.9	3.4–4
	thickness	at the cladomal end μ	70–93	62–110	68–80	68–83	73–100	80–100
		of the thickest part a little below the cladomal end μ	73–98	78–120	78–90	80–100	86–107	98–120
Clades, length μ....................			320–620	350–590	280–530	400–550	400–700	360–650
Angle between clade-chords and rhabdome............................			100–118	108–122	103–112	108–116	104–122	111–120

The *large choanosomal oxyasters* (Plate 10, figs. 6–13a; Plate 11, figs. 6b, 8b, 9) have from one to twelve rays. Forms with one ray are exceedingly rare and were observed only in a specimen from Station 4420. Forms with two rays were not found. Three-rayed forms are met with in small numbers in the specimens from Stations 3168 and 4551, four-rayed ones also in the specimens from Station 4531. By far the most frequent forms are those with from five to nine rays which occur in large numbers in all the specimens. The many-rayed oxyasters pass into the oxysphaerasters. The rays are 1–2.8 μ thick at the base, conical and straight. In the many-rayed oxyasters they are always, in the few-rayed ones usually, sharp pointed. In the few-rayed oxyasters the rays are irregularly distributed and apparently not always quite concentric, many of these spicules appearing somewhat metastrose. In the oxyasters with five or more rays, the rays are quite regularly distributed and concentric, but these asters are also occasionally rendered somewhat irregular by one of their rays being bifid. The distal parts of the rays are always spiny. In most cases the spines are confined to the distal third of the rays, in some they cover as much as the distal two thirds. The spines are either numerous and small, or sparse and large. The sparse, large spines are slender and rise vertically from the ray. A central thickening 2.8–6 μ in diameter is nearly always developed. The whole oxyaster measures 20–34 μ in diameter. The length and thickness of the rays and, apart from the one-rayed forms, also the total diameter of the aster are roughly in inverse proportion to the ray-number. In the rare one-rayed form the centrum is 5 μ in diameter, and the ray 18 μ long and 5 μ thick at the base. The oxyasters with from three to five rays measure 28–34 μ, the oxyasters with six or more rays 19–29 μ in total diameter. The oxyasters of the specimens from Station 4531 are slightly smaller than those of the others.

DIMENSIONS AND NUMBER OF RAYS OF OXYASTERS.

Stations	2958	2981	3168	4420	4531	4551
Total diameter μ	24–33	22–34	23–34	20–32	19–28	22–33
Diameter of centrum μ	3.3–4.2	3–6	3.5–4	2.8–5	3–4.5	3–5
Basal thickness of rays μ	1.3–2.3	1.5–2.8	2–3	1.5–5	1–2.5	1.6–2.5
Number of rays	7–8	6–10	3–9	1.5–10	4–12	3–12

The *oxysphaerasters* (Plate **11**, fig. 7b) have a spherical centrum 4.5–10 μ in diameter, from which from twelve to twenty-five rays arise radially. The rays are concentric, distributed regularly, 0.7–2.5 μ thick at the base, conical, straight, and pointed at the end. The distal part of each ray, usually about the distal half of it, is covered with spines. Not infrequently a group of somewhat larger spines, arranged in a more or less verticillate manner is situated a short distance below the end of the ray. In the centrifugal spicule-preparations of the specimen from Station 2958 I found several oxysphaerasters with rays entirely destitute of spines, otherwise similar to the ordinary ones. These may possibly be foreign to the sponge. In total diameter the oxysphaerasters measure 10–23 μ. The largest ones pass into the oxyasters described above. The oxysphaerasters of the specimens from Stations 4531 and 4551 have on the whole more rays than those from other stations, and specimens with more than twenty rays have been observed only in the specimens from these stations.

DIMENSIONS AND NUMBER OF RAYS OF OXYSPHAERASTERS.

Stations	2958	2981	3168	4420	4531	4551
Total diameter μ	14.5–21.5	17–21	19–23	14–18.5	14–16.5	10–19
Diameter of centrum μ	4.5–10	6–7.5	6–7	5.5–7	6–6.5	4–7.5
Basal thickness of rays μ	1–2.5	1.5–2	1–2.5	1.5–2.5	1.5–2	0.7–1.8
Number of rays	12–16	14–18	14–17	14–17	19–23	19–25

The *strongylosphaerasters* (Plate **10**, figs. 6b, 11–13b; Plate **11**, figs. 1–5, 6–8a, 10) have a spherical centrum 4–14 μ in diameter, from which generally from nine to thirty rays arise radially. Exceptionally there is only one ray. The rays are concentric, regularly distributed, straight, and at the base 0.7–3.5 μ thick. They are cylindrical or cylindroconical, truncate, and 1.5–6 μ long. Their terminal face and the distal parts of their sides are covered with numerous small spines; the proximal parts of the rays and the central thickening are usually quite smooth. The only exception to this is the one-rayed strongylosphaeraster found in a specimen from Station 4531, in which the whole of the ray and also the central thickening are covered with spines. The centrum of this spicule is 9 μ in diameter and the single ray 2.5 μ thick at the base and 5 μ long. Two- to eight-rayed strongylosphaerasters were not observed, and the nine- to eleven-rayed forms were found only occasionally in specimens from Stations 2981 and 4420. The strongylosphaerasters of the specimens from Stations 4531 and 4551 have on the whole more rays than those of the others. The total diameter of the strongylosphaerasters is 9–22 μ.

DIMENSIONS AND NUMBER OF RAYS OF STRONGYLOSPHAERASTERS.

Stations		2958	2981	3168	4420	4531	4551
Total diameter μ		11.5–21	9–22	11.5–16	9–22	11–15	9–16
Diameter of centrum μ		6.5–12	4–10	5.5–9.5	6–14	7–10	4.5–9
Rays	length μ	2.5–1.5	2.5–6	2–3.5	2–4.5	1.7–5	1.5–4
	basal thickness μ	1.5–2.8	1.5–3.5	1.5–2.5	1.5–3.5	1.2–2.5	0.7–3
Number of rays μ		12–21	9–25	14–22	10–19	1.17–27	18–30

The *sterrasters* (Plate **10**, figs. 1–5; Plate **11**, figs. 11–14) are usually flattened ellipsoids, 130–170 μ long, 100–133 μ broad, and 77–97 μ thick. A few are somewhat rounded, triangular (Plate **10**, fig. 1), not oval, in outline. In the ellipsoidal sterrasters the ratio between the length and breadth is on an average 100 : 76. The specimens from Stations 2958 and 4531 have on the whole somewhat broader (ratio 100 : 78 and 100 : 82 respectively), those from Station 4551 somewhat narrower (ratio 100 : 70) sterrasters. The specimens from Station 2981 have slightly larger sterrasters than those from the others. The umbilical pit is usually about 12–15 μ deep and situated in the centre of one of the broad faces of the flattened sterraster. The distal free parts of the rays composing the sterraster are 2.5–4 μ thick and about 2 μ apart. Those surrounding the umbilicus usually have an elongated (Plate 11, fig. 12), those remote from the umbilicus, a circular or polygonal (Plate 11, figs. 13, 14) transverse section. Each ray bears a terminal verticil of from two to eight stout, conical, lateral spines arising vertically from the ray.

The young sterrasters observed in great numbers in the choanosome of the specimens from Stations 3168 and 4420 were surrounded by stratified capsules readily stainable with azure and apparently composed of flat endothelial cells. The smallest of these young sterrasters was a sphere, 20 μ in diameter, composed of exceedingly fine radial rays.

DIMENSIONS OF STERRASTERS.

Stations	2958	2981	3168	4420	4531	4551
Length μ	130–145	145–170	140–165	135–155	135–155	140–145
Breadth μ	100–120	105–133	105–120	105–118	115–120	100–120
Thickness μ	80–92	90–97	85–90	85–87	88–90	77–85

LOCALITY AND NATURE OF ENVIRONMENT.

No. of Station	Locality	Date	Depth	Bottom temperature	Bottom	No. of specimens
2958	Off southern California, 34° 04′ N., 120° 19′ 30″ W.	9 Feb., 1889	47 m. (26 f.)	12.7° (54.9° F.)	Gray sand	1
2981	Off southern California, 33° 18′ N., 119° 24′ W.	13 Feb., 1889	82 m. (45 f.)	—	Coarse gray sand and broken shells	2
3168	Off central California, 38° 01′ 25″ N., 123° 26′ 55″ W.	24 March, 1890	61 m. (34 f.)	—	Rocks and corals	4
4420	Off southern California, E. of Point San Nicolas Island, S. 77° W. 10.5 km. (5.7 miles), drift S. 60° W.	12 April, 1904	58–60 m. (32–33 f.)	—	Fine gray sand	4
4531	Monterey Bay, Cal., Point Pinos Light House, N. 64° E., 3.8 km. (2.1 miles).	28 May, 1904	—	—	Fine gray sand, pebbles, and rock	3
4551	Monterey Bay, Cal., Point Pinos Light House, S. 9° E., 8.4 km. (1.5 miles), drift S. 37° E.	7 June, 1904	102 m. (56 f.)	—	Coarse sand, shells, and rock	1

The agreement between the specimens described above as *Sidonops bicolor* is so great that there cannot be any doubt as to their identity; in fact not even varieties or forms can be established.

Since the spiculation is geodine in character, the afferent cortical canals cribriporal, and the efferents uniporal, this sponge must be placed in Sidonops. For the reasons given in the description of *Geodia agassizii*, I have compared it not only with the known species of Sidonops but also with those of Geodia. The species of these genera which seems to be most closely allied to it is the one described in this report as *Sidonops angulata*. This differs from *S. bicolor* by the possession of anatriaenes and angularly bent amphioxes, by the smaller size of the sterrasters, and by the oxyasters and oxysphaerasters always having perfectly smooth rays. These differences are certainly sufficient for specific distinction.

GEODIA Lamarck.

Among the megascleres are regular triaenes. The tetraxon megascleres are confined to the superficial part and arranged radially. The dermal microscleres are asters. The afferents and efferents are both cribriporal.

There are sixty-two specimens of Geodia in the collection made by the "Albatross." These belong to thirteen species, ten of which are new. Two species, one previously known and one now described for the first time, are further divided into seven varieties, five of which are new.

Geodia variospiculosa Thiele.

Zoologica, 1898, **24**, p. 10, taf. 6, figs. 6–7. Lendenfeld, Tierreich, 1903, **19**, p. 107.

intermedia, var. nov.

Plate 17, figs. 23–26, 34–40, 49; Plate 18, figs. 8, 10, 13–20, 22, 27; Plate 19, figs. 9–11, 19, 20, 22, 24, 31.

micraster, var. nov.

Plate 17, figs. 27–33, 41–48, 50; Plate 18, figs. 1–7, 9, 11, 12, 21, 23–26; Plate 19, figs. 1–8, 12–18, 21, 23, 25–30, 32.

Two specimens collected by the "Albatross" off Honshu Island, Japan, differ from the typical *G. variospiculosa* Thiele, from the var. *clavigera* Thiele, and from each other, sufficiently to rank as new varieties. In both these new varieties the choanosomal oxyasters are considerably smaller than in the type, and in one of them they are not so large as in the other. The variety in which they are smallest I name *micraster*, the one in which they are not so small *intermedia*.

Shape and size. The specimen of var. *micraster* (Plate **17**, fig. 41) is tuberous and measures 42 mm. in length, 34 mm. in breadth, and 24 mm. in height. The surface is somewhat undulating. Here and there slight, abrupt, step-like changes of level of about 0.3 mm. are observed in it. In one place there is a round hole, a little over 1 mm. wide. This appears to be the entrance to a tubular cavity occupied by an annelid, and not an osculum. Apart from this no apertures are visible. Large parts of the surface are occupied by shallow pits, the centres of which are less than 1 mm. apart. A dense fur of minute spicules, about 100–200 μ high (Plate **18**, fig. 26c), visible only with the microscope in sections, covers the whole of the surface. Besides this, remnants of a sparse fur of large spicules, 2–3 mm. high, are observed in unexposed places.

The specimen of var. *intermedia* (Plate **17**, figs. 39, 40) is thick oval, slightly constricted near one end, 22 mm. long and 15 mm. broad. It was attached at one side. The surface is continuous, without undulations or step-like changes of level, free from apertures visible to the eye, and for the greater part covered with shallow pits, more conspicuous on one side than on the other. Where these pits are more conspicuous their centres are 1–1.2 mm., where they are less conspicuous 0.6–0.9 mm., apart. A low dense spicule-fur is also present in this variety, but there are hardly any traces of a sparse, high spicule-fur.

The *colour* (in spirit) of var. *micraster* is nearly white, that of var. *intermedia* light coffee-brown.

The superficial part of the body forms a *cortex* composed of three layers: an outer dermal layer free from sterrasters, a central sterraster-armour layer, and an inner fibrous layer containing but few sterrasters or none at all. In the pits the dermal layer is considerably thickened, on other parts of the surface it is very thin. The sterraster-armour layer is chiefly composed of sterrasters. The connective-tissue fibres radiating from the sterrasters and connecting them with each other are very conspicuous. Around the proximal parts of the radial canals which penetrate the sterraster-armour rather extensive zones of chonal, fibrous tissue, free from sterrasters, occur (Plate **18**, fig. 21). The sterraster-armour layer and the dermal membrane are together 0.5–1 mm. thick. Sections show that the above mentioned step-like changes of level in the surface of var. *micraster* are caused by abrupt changes of thickness of the sterraster-armour layer, the lower limiting surface of this layer passing smoothly and unchanged beneath the steps. The fibrous layer of the cortex (Plate **18**, figs. 21, 26) is for the most part over 1 mm. thick and in many places excavated by cavities. The walls separating these are chiefly composed of fibres arranged obliquely or radially. Strands of such fibres extend from this layer far down into the choanosome.

Canal-system. The pits on the surface are covered by pore-sieves. These are so numerous and so close together that they join to form extensive continuous pore-areas. The pores are generally broad-oval, 20–75 μ long and 15–55 μ broad. They seem to be larger in var. *intermedia* than in var. *micraster*. The strands of tissue separating them vary very much in width. Some are so narrow as to appear as slender threads, while others are as broad as or even broader than the pores. On examining pore-sieves, removed by a paratangential section in transmitted light, one clearly sees that these sieves are composed of stout, primary, non transparent bars, the interstices between which are occupied by secondary nets of thin, transparent strands (Plate **18**, fig. 9). The stout bars of the primary network usually exhibit a somewhat radial arrangement round the centre of the pore-sieve (pit). Below these sieves rather extensive cavities occur into which the pores lead. These cavities join under the centre of each pore-sieve, that is, in the centre of each pit, to form a radial canal which penetrates the cortex and either opens out below into a subcortical cavity (Plate **18**, fig. 21) or is continued as a narrow, usually tortuous canal leading down into the choanosome (Plate **18**, fig. 26). The proximal third or half of each radial cortical canal is surrounded by a stout chonal sphincter, which does not extend proximally beyond the lower limit of the sterraster-armour layer. In the sections examined the radial cortical canals are constricted and their proximal portions, which pass through the chonal sphincter, are often quite closed. In the interior some large canals, in var. *intermedia* up to 0.8, in var. *micraster* up to 2 mm. wide, are observed. In the latter a cavity, about 1 mm. wide, surrounded by sterrasters, was observed 2 mm. below the surface.

Skeleton. Rather loose strands of amphioxes and a few tylostyles and styles traverse the inner part of the choanosome. These internal spicule-strands are not arranged in a regularly radial manner. Many are very oblique, and once I saw one extending paratangentially about 6 mm. below the surface. Distally the megascleres form bundles which penetrate the inner layer of the cortex and terminate at, or a little above, the lower limit of the sterraster-armour. These distal spicule-bundles (Plate **18**, fig. 8b) are vertical or oblique to the surface and contain, besides the large amphioxes and occasional monactines found in the interior, numerous rhabdomes of orthoplagiotriaenes and some rhabdomes of dichotriaenes, large anatriaenes, and mesoclades, chiefly mesoprotriaenes. The cladomes of most of the orthoplagiotriaenes and dichotriaenes lie at, or just above, the lower limit of the sterraster-armour layer; the cladomes of the anatriaenes and mesoproclades lie at different levels. The sparse high spicule-fur is composed of the distal, freely protruding parts of mesoproclades, chiefly mesoprotriaenes, and large anatriaenes. On small parts of the surface of the specimen of var. *micraster* freely protruding orthoplagiotriaenes occur. I do not believe, however, that these spicules normally take part in the formation of the fur, but consider that the sponge must, at a previous time, have received some injury in the places where these spicules are found.

In the inner layer of the cortex numerous small styles and minute anaclades (Plate 18, figs. 8c, 26c) are observed. These are situated radially or obliquely, rarely paratangentially. Some of them form groups, others are scattered singly. Some lie between the bundles of large spicules (Plate 18, fig. 26c), others form clusters around them (Plate 18, fig. 8c). In the thin walls of tissue separating the subcortical cavities strand-like rows of these small spicules occur. They are also met with in small numbers in the sterraster-armour layer. The low dense fur, referred to above, is entirely composed of these spicules. In the spicule-fur of var. *intermedia* and also in that covering the parts of the surface with thick cortex in var. *micraster* the styles predominate greatly, only a few minute anaclades being here scattered between the dense masses of small styles. In the low spicule-fur covering the parts of the surface of var. *micraster* which lie at a lower level and below which the sterraster-armour is thin, the minute anaclades are very abundant, more numerous than the small styles (Plate 18, fig. 24a). The spicules forming this low dense fur protrude for the greater part of their length beyond the surface of the sponge; the pointed ends of the small styles and the cladomes of the minute anaclades being situated distally and free, the rounded ends of the styles and the acladomal ends of the minute anaclades being situated proximally and implanted in the sponge. The manner in which these minute dermal styles and anaclades are distributed shows that they are formed in the distal layer of the choanosome or the proximal layer of the cortex, that they travel up from this, their place of birth, to the surface, first, up to the sterraster-armour layer, slowly, then, through the sterraster-armour layer, rapidly, and that their movement in this distal direction is retarded to a great extent or quite discontinued on their reaching their final position in the low spicule-fur, where they remain for a considerable time.

Four kinds of *microscleres* occur; large oxyasters, smaller oxysphaerasters, small strongylosphaerasters, and sterrasters. The large oxyasters are confined to the choanosome. They are not uniformly distributed; in the distal zone of the choanosome these asters are very numerous; in parts of the interior they are scarce. The oxysphaerasters are very numerous in the walls of the cortical canals, zones exceedingly rich in them indicating the position of these canals (Plate 18, figs. 21b, 23a, 26b). In the walls of the dermal canals these oxysphaerasters extend right up to within a short distance of the surface, and they are also met with in the walls, chiefly the roofs, of the subcortical cavities. A few are scattered between the sterrasters. The small strongylosphaerasters form a dense layer on the outer surface which increases in thickness in the pits where the dermal membrane itself is thickened, and are also scattered throughout the cortex. The sterrasters occur in the sterraster-armour, and are also scattered in the choanosome. In all parts of the sterraster-armour layer, with the exception of the thin portions of it in var. *micraster*, the sterrasters are rather densely packed, in the thin parts of the cortex of the var. *micraster* they are farther apart. The sterrasters in the choanosome are mostly young forms.

The *large choanosomal amphioxes* (Plate 17, fig. 42) are usually curved, often in an irregular wavy manner, gradually attenuated to the rather sharp-pointed ends, and isoactine or — as the one represented in the figure — slightly anisoactine. In var. *micraster* they are 2.3–3.9 mm. long and 25–42 μ, usually 32–37 μ thick; in var. *intermedia* considerably stouter, 2.5–3.1 mm. long and 42–50 μ, usually 42–44 μ thick.

The *large choanosomal tylostyles and styles* (Plate 17, figs. 33, 43) are usually curved. One of var. *micraster* which was intact measured 1.35 mm. in length. These spicules gradually increase in thickness towards the rounded or tyle end. Just below this they are in var. *micraster* 40–50 μ, in var. *intermedia* 25–35 μ thick. Only a few of these spicules are true styles, in most the rounded end is thickened more or less, sometimes so much so that the tyle is twice the diameter of the shaft. But however great this thickening may be, it is never sharply defined and passes gradually into the shaft, so that these spicules appear more or less club shaped. The thickened end (tyle) measures in var. *micraster* 46–62 μ and in var. *intermedia* 30–70 μ in diameter.

The *small dermal styles* (Plate 19, figs. 4, 5) are fairly straight or slightly curved, nearly cylindrical in the central part, and gradually attenuated towards both ends. Distally these spicules nearly always terminate in a sharp point. Very rarely the distal end is rounded and blunt. The thickness of the proximal end, which is always rounded off, is from 25–67 % of the maximum thickness. The small styles with a particularly thin proximal, rounded end are amphiox-like. Many of these spicules are slightly thickened locally at a point nearer the rounded than the pointed end. I presume that this thickening is situated at the point where the spicule penetrates the surface and that it is formed after the spicule has taken up its definite position in the low spicule-fur. In var. *micraster* these small dermal styles are 210–320 μ long, 3–7 μ thick in the centre, and 1–3.5 μ thick at the proximal, rounded end. In var. *intermedia* they are somewhat shorter, 200–310 μ long, 3.5–7 μ thick in the centre, and 1–2.5 μ thick at the proximal, rounded end.

A concrescent form of these spicules, consisting of three or four straight rays, some pointed, others rounded at the end, is very rarely met with.

The *large orthoplagiotriaenes* (Plate **17**, figs. 34–37, 38a, 44–47, 49) have generally a straight, or slightly curved, conical rhabdome, pointed at the acladomal end, more or less thickened at a distance of about 150 μ below the cladomal end, and considerably constricted above this thickest point, just below the cladome. In the neck-like subcladomal constriction the thickness of the rhabdome is from 65–85 % of the thickness of its thickest part. At this point, weakened as it is by the constriction, the rhabdome readily breaks, and parts of these spicules (cladomes and rhabdomes) broken at that point are frequently found in the spicule-preparations. The chords of the clades form angles of 99°–111° with the axis of the rhabdome. These spicules are consequently intermediate between orthotriaenes and plagiotriaenes, and are named orthoplagiotriaenes accordingly. The clades are conical, not sharply pointed, frequently quite blunt. They always arise in an ascending direction. Their proximal part is concave to the rhabdome, their distal part straight (Plate **17**, figs. 34–37, 47) or slightly undulating (Plate **17**, figs. 44, 45). A slight, abrupt, angular bend is frequently observed at the point where the proximal part, concave to the rhabdome, passes into the distal straight or undulating part. This and a slight thickening of the axial thread of the clade often observed at this point seem to indicate that these orthoplagiotriaenes are dichotriaene-derivates. The three clades of the same cladome usually arise at similar angles from the rhabdome; forms like the one represented, Plate **17**, fig. 38a, in which the rhabdome angles of the three clades differ to a greater extent, being rare. In length the clades of the same cladome may be equal or unequal. The forms with unequal clades are as numerous as the ones with equal clades, if not more so. Most of the cladomes composed of unequal clades are sagittal, two clades being fairly equal, while the third is very much shorter, only one half or a third as long, as the other two. The angles between the clades are independent of the clade-length and nearly always about 120°. Rather frequently a neck-like constriction, similar to the one at the cladomal end of the rhabdome, is observed at the proximal end of the clades. In var. *micraster* the rhabdomes of the orthoplagiotriaenes are 2.6–3 mm. long, and in the neck-like constriction at the cladome 30–50 μ thick, their maximum thickness below this constriction being 43–64 μ. The chords of their clades are 240–760 μ long and enclose angles of 99–105° with the axis of the rhabdome. In var. *intermedia* the rhabdomes of these spicules are 2.4–3 mm. long, and in the neck-like constriction at the cladome 35–65 μ thick, their maximum thickness below this constriction being 50–75 μ. The chords of the clades are 220–550 μ long and enclose angles of 100–111° with the axis of the rhabdome.

Besides these normal orthoplagiotriaenes, irregular forms are met with in small numbers. In some of these one or two clades are bifurcate: these spicules are transitional to the dichotriaenes. In others one or two of the clades are cylindrical and not attenuated distally, or angularly recurved at the end. An irregular triaene with one cylindrical and one terminally angularly recurved clade is shown in Plate 17, fig. 46. In examining the rounded end of these abnormal cylindrical clades with the highest powers, I found the distal part of the axial thread irregularly thickened at frequent intervals. At the end itself the axial thread appeared split up into a bunch of very slender, thread-like, divergent branches, which seemed to extend right up to the rounded, terminal face of the clade. It seems that this terminal face is clothed with numerous exceedingly small spines, and that one of the terminal branches of the axial thread leads up to each of these spines. But as these structures are, in consequence of their exceedingly small size, on the verge of visibility, even with the ultraviolet light ($\lambda = 280$ μ) employed, I could not make them out with any degree of certainty.

The *dichotriaenes* (Plate 17, figs. 38b, 48, 50), apart from the bifurcation of the clades and the smaller size of the clade-rhabdome angles, are similar to the orthoplagiotriaenes described above. In var. *micraster* their rhabdomes are 1.7–2.6 mm. long and in the neck-like constriction at the cladome 30–40 μ thick; their maximum thickness is 45–58 μ. Their clade-rhabdome angles are little over 90°. The clade-stems are 160–340 μ, the clade-branches 140–400 μ long. In the preparations of var. *intermedia* no intact dichotriaene-rhabdomes were found, so that their length is unknown. Their thickness is 45–48 μ at the neck-like constriction at the cladome, and 55–60 μ at the thickest point. The clade-rhabdome angles are a little over 90°. The clade-stems are 150–160 μ, the clade-branches 170–280 μ long.

The *mesoproclades* observed were nearly all mesoprotriaenes. I found only a single mesopromonaene.

In the *mesoprotriaenes* (Plate **17**, fig. 32) the epirhabd is straight, conical, and usually shorter than the clades. The latter are conic, pointed, and curved, concave to the epirhabd. Their curvature increases distally. This distal increase of curvature is most marked in the mesoprotriaenes with strongly diverging clades (large clade-epirhabd angles). In the preparations of var. *micraster* no intact mesoprotriaene-rhabdomes were found, so that I can not state their length. The thickness of the rhabdome at the cladome is 7–20 μ; the epirhabd is 25–90 μ long; the clade-chords are 40–140 μ long and enclose angles of 30–63° with the axis of the epirhabd. In var. *intermedia* the rhabdomes of these spicules are 2.9–3.2 mm. long and at the cladome 18–23 μ thick. The epirhabd is 60–75 μ long; the clade-chords are 100–142 μ long and enclose angles of 37–44° with the axis of the epirhabd.

Besides these normal mesoprotriaenes a few with one or two stunted cylindrical clades, rounded off at the end, have been observed. One of these is represented in Plate **17**, fig. 32.

In the preparations of var. *micraster* I found one *mesopromonaene* with a broken rhabdome, 30 μ thick at the cladome. Its epirhabd is 180 μ long, its clade is recurved in a hook-like manner at the end and slightly concave to the epirhabd. The clade-chord is 175 μ long and encloses an angle of 35° with the axis of the epirhabd.

The *large anatriaenes* (Plate **17**, figs. 23–31; Plate **18**, fig. 8d), when fully and normally developed, have a long rhabdome, thickened towards the cladome, and three fairly equal, conical and uniformly curved, pointed clades (Plate **17**, figs. 25, 26, 29, 30). Sometimes the clades are bent down abruptly at their ends (Plate **17**, fig. 27). The apex of the cladome is simply rounded or, more rarely, crowned by a very slight protuberance. In var. *micraster* the rhabdome is 3.6–5.2 mm. long and at the cladome 20–46 μ thick. The clade-chords are 65–130 μ long and enclose angles of 37°–70° with the axis of the rhabdome. In var. *intermedia* I found only one intact rhabdome, 4.2 mm. in length. In this variety the rhabdomes are 20–40 μ thick at the cladome and the clade-chords 50–135 μ long. The clade-rhabdome angle is considerably smaller than in the other variety, measuring only 35–48°.

Besides these normal large anatriaenes four other, abnormal or derivate forms are observed: 1, regular anatriaenes with pointed clades but of much smaller dimensions; 2, irregular anatriaenes of normal dimensions and clade-position, in which one, two, or all three clades are stunted, short, and rounded at the end; 3, anatriaenes of normal dimensions with two simple and one bifurcate clade; and 4, anatriaene-derivates of normal dimensions, in which one of the clades is directed upward, proclade-fashion. (1) is very, and (2) fairly abundant in both varieties; (3) and (4) are very rare and have been found only in var. *intermedia*. In the small anatriaenes with pointed clades (Plate **17**, figs. 23, 28) the rhabdome is only 12–20 μ thick at the cladome, the clades being 30–50 μ long in var. *intermedia*, and 30–65 μ long in var. *micraster*. Of course these anatriaenes may be young forms of the normal ones. Their abundance on and close to the surface, however, renders this assumption somewhat doubtful. The anatriaenes with stunted clades (Plate **17**, fig. 31) exhibit very different degrees of clade-reduction. In most of them only one or two clades are shortened and rounded; in some, however, one or two clades are reduced to low, rounded protuberances and the others (other) shortened to half or less than half of the normal length. These extreme forms have been met with chiefly in var. *intermedia*. In the few anatriaenes with one bifurcate clade the two other (simple) clades were more or less stunted. In the anatriaene-derivates with one clade directed upwards the clades are pointed, but much shorter than in the normal anatriaenes.

The *minute dermal anaclades* (Plate **18**, fig. 24a; Plate **19**, figs. 3, 6–10, 14) are mostly anatriaenes with well-developed clades. A few of them have, however, by a more or less complete clade-reduction become anadiaenes, anamonaenes (Plate **19**, fig. 6), or even tylostyles. These latter are, however, very rare. The rhabdome is more or less curved, simply or in an S-shaped manner, and thickest at a point from a fifth to a third of its length above its acladomal end. From this thickest point it is gradually attenuated towards both ends. The acladomal end is rounded. The thickness of the two ends of the rhabdome is from 25–60 % of its maximum thickness. In many of these spicules a slight local thickening of the rhabdome, situated nearer the acladomal than the cladomal end, similar and probably analogous to the local thickening of the small dermal styles, has been observed. The apex of the cladome is simply rounded off or crowned by a protuberance (Plate **19**, fig. 9). In var. *micraster* the minute anaclades without apical protuberance greatly predominate, in var. *intermedia* a much greater proportion of them possess such a protuberance. The clades are conic, sharp pointed, strongly recurved in their basal part, and nearly straight in their terminal part (Plate **19**, figs. 3, 14). In var. *micraster* the rhabdomes of the anaclades are 275–410 μ long, 1.5–4 μ thick at the cladomal end, 4–6 μ thick at the thickest point, and 1.5–2 μ thick at the rounded acladomal end. The chords of the clades are 5–12 μ long and enclose angles of 38°–54° with the axis of the rhabdome. In var. *intermedia* the rhabdomes of these spicules are 205–560 μ long, 1–3.5 μ thick at the cladomal end, 3–7.5 μ thick at the thickest point, and 1–4.5 μ thick at the rounded, acladomal end. The clade-chords are 3–13 μ long and enclose angles of 40°–52° with the axis of the rhabdome.

The *large choanosomal oxyasters* (Plate **18**, fig. 1, 2a, 3, 4, 5d, 6, 7b, 10a, b, 12, 14b, 15–20, 22a, b, 25a, b, 27a, b; Plate **19**, figs. 25–30) have no central thickening and are composed of fairly concentric but often not quite regularly distributed rays. The rays are straight, conical, usually very blunt, truncate, rarely pointed, and everywhere, except at the proximal (central) end, covered with spines. The size of these spines is variable. Sometimes they are so small as to be hardly discernible, sometimes they are large, 1 μ or more long. When large enough to be distinctly seen, they show an increase in size from the base to the tip of the ray. These spines rise vertically from the ray and appear to be bent back at the end towards the centre of the aster in a claw-shaped manner. There are usually from one to eight rays. In the form where only one ray is developed, short, rounded, knob-like rudiments of two or three other, reduced rays are observed (Plate **18**, figs. 5d, 6; Plate **19**, fig. 28). Such ray-rudiments also occur in most of the diactine and in some of the triactine forms. The terminal rounded faces of these ray-rudiments are densely covered with large spines (Plate **19**, fig. 28). The monactine oxyasters appear as blunt tylostyles with irregularly lobate tyles. In the diactine forms the fully developed rays seem never to extend in a straight line, the angle enclosed by them being 60°–140°, always much less than 180°. Thus these spicules appear as more or less widely opened compasses. The three rays of the triactine oxyasters may be situated in a plane and regularly arranged so as to enclose angles of 120° (Plate **18**, fig. 10a); or they may not be situated in a plane and form the edges of a low triangular pyramid which may be regular (Plate **18**, fig. 2a) or irregular (Plate **18**, fig. 16); or finally they may be so arranged that two lie in a straight line to which the third is vertical or oblique (Plate **18**, fig. 4). Among the asters with from four to eight rays both regular forms with fairly equal angular intervals between the rays (Plate **18**, figs. 1, 15, 19), and irregular forms with unequal angular ray-intervals (Plate **18**, figs. 17, 18, 20) are met with. In these tetr- to oct-actine asters the rays are, in the same aster, usually of equal size. The tri- to hex-actine asters are far more numerous than those with one or two, or seven or more rays.

The number of rays is, as shown by the following table, roughly speaking, in inverse proportion to their size.

NUMBER AND SIZE OF RAYS OF OXYASTERS.

Variety	Number of rays	Total diameter of asters	Length of rays	Thickness of rays at base
micraster	1–4	40–132 μ	25–72 μ	1.5–8 μ
intermedia	1–4	27–180 μ	14–90 μ	1–8 μ
micraster	5–6	21–105 μ	11–58 μ	1.5–7 μ
intermedia	5–6	20–140 μ	10–78 μ	1–7 μ
micraster	7–8	17–31 μ	9–16 μ	1–3 μ
intermedia	7–8	25–37 μ	13–21 μ	1–3 μ

Oxyasters with from nine to eleven rays are very rare. The largest of them observed was 23 μ in total diameter and had rays 12 μ long and 2 μ thick at the base.

The *oxysphaerasters* (Plate **18**, fig. 23; Plate **19**, figs. 12a, 13a) are composed of a spherical centrum and numerous regularly distributed, concentric, radial rays. The rays are in the same aster of equal size, conical, sharp pointed, and sparsely spined. Often a verticil of larger spines, situated some distance below the end of the ray is observed. The oxysphaerasters of var. *micraster* usually have from eighteen to twenty-two rays. Their total diameter is 14–19 μ, the diameter of the centrum 5–6 μ. The rays are 4–7 μ long and 1–2 μ thick at the base. The oxysphaerasters of var. *intermedia* usually have from fourteen to twenty-two rays. Their total diameter is 17–22 μ, the diameter of the centrum 5–6 μ. The rays are 5–8 μ long and 1.5–2 μ thick at the base. A correlation between ray-number and spicule-size is not apparent.

The *small dermal strongylosphaerasters* (Plate **19**, figs. 12b, 13b, 19–24) consist of a spherical or irregularly tuberous centrum and numerous short rays. The rays are usually stout, cylindroconical, or cylindrical, and truncate, rarely more slender, conical, and blunt pointed. Not infrequently the rays of the same aster are unequally distributed and unequal in size, one of the rays being sometimes fully twice as large as any of the others. The distal parts of the rays, chiefly their terminal faces, bear numerous small spines. In var. *micraster* the strongylosphaerasters usually have from ten to eighteen rays. Their total diameter is 5–8 μ, the diameter of the centrum 2–4 μ. The rays are 0.5–2.5 μ long and 0.6–2 μ thick at the base. In var. *intermedia* these asters usually have from twelve to nineteen rays. Their total diameter is 5–7 μ, the diameter of the centrum 2–4 μ. Their rays are 0.6–2 μ long and 0.5–1.6 μ thick at the base. A correlation between ray-number and spicule-size is not apparent. Occasionally irregular tuberous structures with spiny surface, which I consider as derivates of these spicules with reduced rays, have been observed. One of these, which I found in var. *micraster* had the shape of a stout, short, slightly curved sausage and was 9 μ long and 4 μ broad.

The *sterrasters* (Plate **19**, figs. 1, 2, 11, 15–18, 31, 32) are flattened ellipsoids. The proportion of length to breadth to thickness is on an average 100 : 82 : 65. In the normal sterrasters the distal parts of most of the rays have a circular or rather regularly polygonal transverse section, are 2–3 μ thick, and bear a terminal verticil of usually from four to six stout lateral spines (Plate **19**, figs. 1, 2). The transverse sections of the distal parts of the rays which surround the umbilicus are elongated in a direction radial to the centre of the latter, 2–3 μ broad, and about 5 μ long. These umbilical rays bear from six to eight or more spines, one of which is often (Plate **19**, fig. 1) considerably larger than the others. This larger spine is directed towards the centre of the umbilicus. In the centre of young sterrasters, 22–26 μ in diameter, of both varieties, a spherical cluster, 4–5 μ in diameter, of numerous radially arranged, elongated, somewhat rod-shaped granules, are observed. The sterrasters of var. *micraster* are 120–133 μ long, 100–116 μ broad, and 82–90 μ thick. Those of var. *intermedia* are 109–125 μ long, 90–100 μ broad, and 70–75 μ thick.

Besides these normal sterrasters, a few abnormal ones, similar in regard to shape and size, but very different in regard to the structure of the surface, have been observed. Two kinds of such sterroids can be distinguished. In one of these the rays are much thicker than in the normal sterrasters. In the other the rays are of the same thickness as in the normal sterrasters but destitute of spines. A sterroid of the first kind is represented in Plate **19**, figs. 17, 18. In this sterraster the ends of the rays have more or less polygonal terminal faces, 10–20 μ in diameter, densely covered with spines. A sterroid of the second kind is shown in Plate **19**, fig. 15, 16.

The specimen of var. *intermedia* was caught with the tangles at Station 3746 on May 19, 1900, off Honshu Island, Japan, Suno Saki N. 87°, E. 15.8 km. (8.5 miles); depth 90 m. (49 f.); it grew on a bottom of gray sand and pebbles. The specimen of var. *micraster* was trawled at Station 3758 on May 22, 1900, off Honshu Island, Japan, Suno Saki S. 55°, E. 3.9 km. (2.1 miles); depth 95–133 m. (73; 52 f.); it grew on a bottom of black clay and rock.

As the description given above shows, these sponges are so similar to those described by Thiele as *Geodia variospiculosa* (Studien über pazifische spongien. Zoologica, 1898, **24**, p. 10, taf. 6, fig. 6) and *variospiculosa* var. *clavigera* (Thiele, *loc. cit.*, p. 11, taf. 6, fig. 7), which also came from Japan, that I do not hesitate to assign them to this species. Still, they differ from Thiele's description and also from each other in so many respects, that the question arises whether the peculiarities wherein they differ are germinal in nature and systematically important or merely due to differences of germ-separation or mixture before and during fertilization, age, or individual adaptation to different conditions, and systematically unimportant. Thiele describes the small dermal rhabds of *G. variospiculosa* and of *G. v.* var. *clavigera* as amphioxes, while the corresponding spicules of the "Albatross" sponges are styles. Since, however, these styles are attenuated towards both ends and consequently similar to amphioxes, Thiele might easily have designated the small dermal rhabds of *Geodia variospiculosa* as amphioxes even if they had exactly the same shape as the spicules here described as styles. The same applies to the large subcortical orthoplagiotriaenes, which Thiele terms orthotriaenes. According to one of Thiele's figures (*loc. cit.*, taf. 6, fig. 6b) the "orthotriaenes" of his *Geodia variospiculosa* are orthoplagiotriaenes in my sense. Apart from these apparent rather than real differences, there are, however, differences in the dimensions of the spicules, many of which are very considerable.

The specimen described by Thiele as var. *clavigera* is the smallest of the four. The typical *Geodia variospiculosa* is larger, var. *intermedia* still larger, and var. *micraster* by far the largest. If we were to assume that these differences in size are due to differences of age, it would be only natural to suppose that corresponding spicule-dimensions should be smallest in var. *clavigera*, larger in the typical *Geodia variospiculosa*, still larger in var. *intermedia*, and largest in var. *micraster*. All dimensional differences which accord with this must therefore be set aside in studying the relative systematic position of these sponges. After eliminating these differences possibly due to differences of age, there remain the following: the large amphioxes and the rhabdomes of the orthoplagiotriaenes and the dichotriaenes of the smaller var. *intermedia* are thicker than those of the larger var. *micraster*. The dichotriaene-rhabdomes of the still smaller typical *Geodia variospiculosa* are thicker than those of both the larger varieties *intermedia* and *micraster*. The choanosomal tylostyles of var. *intermedia* have relatively larger tyles than those of var. *micraster*. Long dermal tylostyles are present in var. *clavigera* but absent in the three others. The mesoprotriaene-clades are relatively and, to a smaller degree, also absolutely longer in the smaller var. *intermedia* than in the larger var. *micraster*. The clades of the larger anatriaenes are longest and the clade-rhabdome angles smallest in the small typical *Geodia variospiculosa;* the former are smaller and the latter larger in the larger var. *intermedia*, and the former still smaller and the latter still larger in the still larger var. *micraster*. On comparing the figures 23–26 and 28–31 on Plate **17**, with each other and with Thiele's figure (*loc. cit.* Plate **6**, fig. 6e) the differences in the appearance of the cladomes of the large anatriaenes caused by these differences in the clade-length and clade-rhabdome angle will be noticed. The minute dermal anaclades of the smaller var. *intermedia* are larger than those of the larger var. *micraster*. The size of the choanosomal oxyasters of the typical *Geodia variospiculosa* and the two varieties *intermedia* and *micraster* is, like the length of the clades of the large anatriaenes, in inverse proportion to the size of the specimen in which they occur. Besides these differences there are others, in the structure of the surface, the size of the pores, the relative frequency of monactine asters and anatriaene-cladomes with stunted, rudimentary clades, etc.

Some of these differences, but hardly all of them, may be due to differences in the forces acting on the different individuals. In particular I should say that the differing peculiarities in the shape and size of the cladomes of the large anatriaenes and in the size of the oxyasters, should be considered as germinal and therefore systematically important. The reason why these differences of the anatriaenes and oxyasters should be considered as due to germinal peculiarities are: in the tetraxon sponges studied in this respect [1] the anatriaenes of young (small) specimens have not only shorter clades but also larger clade-rhabdome angles than those of older (larger) specimens, the clade-length increasing and the clade-rhabdome angle decreasing with the age of the sponge. In the sponges here under discussion, inversely, the clade-length decreases and the clade-rhabdome angle increases with the size of the sponge. The size of the oxyasters is in these sponges in inverse, the size of the sterrasters in true proportion to the size of the specimens. The former lie in the interior of the sponge and must therefore be less influenced by external forces than the latter which lie near the surface. Differences of the internal oxyasters, not also seen in the external sterrasters, cannot therefore, in my opinion, be ascribed to differences of the forces acting on the growing sponge. This view is further supported by

[1] For instance in *Cinachyra vertex*, see R. v. Lendenfeld, Tetraxonia. Ergeb. Deutsche Südpolar-Expedition, 1901–1903, 1907, **9**, p. 318.

the fact that in var. *intermedia* and var. *micraster* the size of the dermal strongylosphaerasters is also in true proportion to the size of the sponge.

Formerly (Tetraxonia. Tierreich, 1903, **19**, p. 107) I united var. *clavigera* with the typical *Geodia variospiculosa*, but now, having been able to examine sponges belonging to this species I think it better to keep these two systematically apart. In view of the above discussion on the germinal nature and systematic importance of the differences between the two "Albatross" specimens here described and between them and Thiele's sponges referred to above, I establish varieties for them. Thus *Geodia variospiculosa* Thiele is divided into four varieties: the typical *Geodia variospiculosa*, for which I propose the name var. *typica*, var. *clavigera* Thiele, var. *intermedia*, and var. *micraster*.

DIMENSIONS OF THE SPICULES OF GEODIA VARIOSPICULOSA THIELE.

		Var. typica	Var. clavigera	Var. intermedia	Var. micraster
Large choanosomal amphioxes	length mm.	over 2	1-1.1	2.5-3.1	2.3-3.9
	maximum thickness μ	nearly 20	26*[1]	42-50	25-42
Large choanosomal tylostyles (styles)	length mm.				1.35
	diameter of tyle (rounded end) μ			30-70	46-62
	thickness of shaft μ			25-35	40-50
Large dermal tylostyles	length mm.	absent	1.6	absent	absent
	diameter of tyle μ		18*		
	thickness of shaft μ		11*		
Minute dermal styles	length μ	200		200-310	210-320
	maximum thickness μ	4		3.5-7	3-7
	thickness of rounded end μ			1.2-5	1-3.5

[1] The dimensions marked * are taken from Thiele's figures.

DIMENSIONS OF THE SPICULES OF GEODIA VARIOSPICULOSA THIELE (*continued*).

			Var. typica	Var. clavigera	Var. intermedia	Var. micraster
Orthoplagio-triaenes	rhabdome	length mm.	2	1.25	2.4–3	2.6–3
		thickness at cladome μ			35–65	30–50
		maximum thickness μ	70		50–75	43–64
	clades	length μ	400–460	250–300	220–550	240–760
	angle between clade-chords and rhabdome °		103*		100–111	99–105
Dichotriaenes	rhabdome	length mm.	2	1.25		1.7–2.6
		thickness at cladome μ	75*		45–48	30–40
		maximum thickness μ	90*		55–60	45–58
	main clade	length μ	200*		150–160	160–340
	end clade	length μ	300*		170–280	140–400
	angle between main clade-chords and rhabdome °		90*		a little over 90	a little over 90
Mesoprotri-aenes	rhabdome	length mm.	2.5		2.9–3.2	
		thickness at cladome μ	12*		18–23	7–20
	epirhabd	length μ	95	30–60	60–75	25–90
	clades	length μ	220	60–70	100–142	40–140
	angle between clade-chords and epirhabd °		40*		37–44	30–63
Large anatri-aenes	rhabdome	length mm.			4.2	3.6–5.2
		thickness at cladome μ	20*		12–40	12–46
	clades	length μ	160–180	30–40	30–135	30–130
	angle between clade-chords and rhabdome °		28–42*		35–48	37–70
Minute dermal anaclades	rhabdome	length μ	286*		205–560	275–410
		thickness at cladome μ	1*		1–3.5	1.5–4
		maximum thickness μ	2*		3–7.5	4–6
	clades	length μ	5		3–13	5–12
	angle between clade-chords and rhabdome °		50*		40–52	38–54

[1] The dimensions marked * are taken from Thiele's figures.

DIMENSIONS OF THE SPICULES OF GEODIA VARIOSPICULOSA THIELE (*continued*).

				Var. typica	Var. clavigera	Var. intermedia	Var. micraster
Choanosomal oxyasters	number of rays			3–6*		1–8	1–11
	dimensions of oxyasters with 1–4 rays	total diameter μ		156–164*		27–180	40 132
		rays	length μ	84*–135		14–90	25–72
			basal thickness μ	8*		1–8	1.5–8
	dimensions of oxyasters with 5–6 rays	total diameter μ		40–104*		20–140	21–105
		rays	length μ	52–56*		10–78	11–58
			basal thickness μ			1–7	1.5–7
	dimensions of oxyasters with 7–8 rays	total diameter μ				25–37	17–31
		rays	length μ			13–21	9–16
			basal thickness μ			1–3	1–3
Oxysphaerasters	number of rays					11–22	18–22
	total diameter μ			16*–30		17–22	14–19
	diameter of centrum μ					5–6	5–6
	rays	length μ				5–8	4–7
		thickness μ				1.5–2	1–2
Dermal strongylosphaeraster	number of rays					12–19	10–18
	total diameter μ			6–8		5–7	5–8
	diameter of centrum μ					2–4	2–1
	rays	length μ				0.6–2	0.5–2.5
		thickness μ				0.5–1.6	0.6–2
Sterrasters		length μ		80–115	100	109–125	120–133
		breadth μ		65–95	80	90–100	100–116
		thickness μ				70–75	82–90

[1] The dimensions marked * are taken from Thiele's figures.

Geodia japonica (SOLLAS).

Plate 37, figs. 15–30; Plate 38, figs. 1–29; Plate 39, figs. 1–41.

Thiele, Zoologica, 1898, **24**, p. 7, taf. 2, fig. 1; taf. 6, fig. 3. Lendenfeld, Tierreich, 1903, **19**, p. 111.
Cydonium japonicum SOLLAS. Rept. voy. "Challenger," 1888, **25**, p. 256.

There is in the collection a fine, dry sponge from Japan, which appears to be identical with the species described by Sollas as *Cydonium japonicum* and by Thiele as *Geodia japonica*. A part of the type of the former in the British Museum I have, through the kindness of Mr. Kirkpatrick, been able to reexamine.

The sponge (Plate **38**, fig. 8) has the shape of a low and broad, thick-walled cup. It is 19 cm. high; its maximum and minimum transverse diameters are 24 and 22 cm. Near its margin the wall of the cup is about 3 cm. thick; the margin itself is bent inward; it is interrupted in two places by broad indentures. The cavity of the cup is $8\frac{1}{2}$ cm. deep. The base of the sponge measures 11×13 cm. and exhibits a cup-shaped depression like the upper one, but much smaller, only $4\frac{1}{2}$ cm. deep. The inner surfaces of both the upper and the lower cup are rather irregular and undulating but destitute of higher protuberances. The outer surface of the sponge is covered by large and conspicuous, terminally rounded, lobose protuberances, $1\frac{1}{2}$–3 cm. broad and about as long, which hang down stalactite-fashion. Most of them are attached with a considerable portion of one side to the body of the sponge. In external appearance and in size it corresponds with the specimens examined by Sollas and Thiele.

In some of the narrowest, most sheltered fissures between adjacent stalactite lobes a rather dense spicule-fur about 1.5 mm. high is observed. Apart from this the surface is now entirely destitute of a spicule-fur. The whole of the surface, also that of the margin of the cup, is dotted with small holes, the entrances to the radial cortical canals. Some of these holes are partly covered by remnants of pore-sieves. In the specimen examined by Sollas there were no holes (canal-entrances) on the margin of the cup. On the outer, lobose surface the width of and the distances between these holes are quite constant, their diameter here being about 300 μ and the distances between their centres about 700 μ. On the margin of the upper cup the holes are much smaller and farther apart. In this upper cup the holes are more variable in size and much less regularly distributed than on the outer surface, some being as much as 500 μ wide. In extensive tracts of the lower cup, these holes are 400–450 μ wide and the distances between the margins of adjacent ones smaller than their diameter.

The *colour* (in the dry state) is white.

The sterraster-armour layer of the *cortex* is a little over 0.5 mm. thick. Sollas gives the thickness of the cortex as 0.8 mm., Thiele the thickness of the sterraster-armour layer as 0.3 mm. According to my measurement it is in Sollas's type about 0.65 mm. thick.

Skeleton. In the interior of the choanosome numerous large, stout amphioxes are found, also less numerous large, slender amphioxes, a few large styles, numerous large oxyasters, numerous small strongylosphaerasters, and very few sterrasters. In the superficial (subcortical) part of the choanosome the same three kinds of large choanosomal rhabds, numerous orthotriaenes, a few plagiotriaenes, many large anatriaenes, various promesoclades, numerous minute dermal amphioxes, a few minute dermal styles and minute dermal anaclades, some large oxyasters, and a good many large oxysphaerasters and small strongylosphaerasters occur. In this region the large rhabds and the rhabdomes of the large telo- and mesoclades form radial bundles. The minute dermal amphioxes, styles, and anaclades are situated radially or obliquely, and scattered; the asters chiefly occupy the canal-walls. The sterraster-armour of the cortex is composed of dense masses of sterrasters. Where the surface has not been rubbed off or otherwise injured numerous minute amphioxes and some minute dermal styles and minute dermal anaclades, implanted in the distal part of the sterraster-armour, and an outer covering of small strongylosphaerasters are observed. Large spicules situated radially and broken off distally also occur occasionally in this region. These are probably rhabdomes of mesoclades and perhaps also of large anatriaenes similar to the ones found intact in the subcortical layer. The spicule-fur is composed of anatriaenes and mesoproclades. The large slender amphioxes, the large styles, the mesoproclades, the minute dermal styles, and the minute dermal anaclades are not mentioned either by Sollas or by Thiele. The latter also failed to find any large oxysphaerasters but, on the other hand, observed sphaeres, which were not found in the specimens examined by Sollas and by myself. In the type of Sollas reexamined by me, some large styles and a good many minute dermal rhabds with one end very blunt and more or less style in character were met with. Mesoproclades and minute dermal anaclades appear, however, to be absent.

The *large stout amphioxes* (Plate **37**, figs. 18–21, 22a) are generally simple, straight or slightly curved, and rather abruptly pointed. They are 2.4–3.2 mm. long and 30–51 μ thick. According to Sollas they measure 2.7 mm. by 32 μ, according to Thiele 2 mm. and over by 35–40 μ. In the type of Sollas reexamined by me these amphioxes were 2.4–3.3, mostly 2.8–3.2 mm. long and 32–50 μ thick.

It is known that sometimes the amphioxes of tetraxonid sponges are bifurcate at one end. Such forms are, however, very rare and usually considered pathologic. In the specimen of *Geodia japonica* examined by me large stout amphioxes, bifurcate at one end, are remarkably frequent. I found no less than six in one spicule-preparation. The two branches of these bifurcate amphioxes are equal or unequal and 10–80 μ long. The angle they enclose is always small; the largest observed was 12°. When very short the two branches are nearly parallel to each other and appear as terminal spines.

The rare *large styles* are 2.1–2.8 mm. long; their maximum thickness is 40–43 μ; the rounded end measures 10–31 μ, about one third to two thirds of the maximum thickness in transverse diameter. Such spicules are not mentioned either by Sollas or Thiele. I found them, however, in Sollas's type.

The *large slender amphioxes* (Plate **37**, fig. 22d) are strongly and very irregularly curved, 1–2.2 mm. long and, in the middle, 12–22 μ thick. Their ends are exceedingly slender, thread-like. Though not mentioned by Sollas or by Thiele, I found such spicules in Sollas's type.

The *minute dermal amphioxes* (Plate **39**, figs. 1–9) are usually somewhat anisoactine and rather abruptly pointed. They are straight (Plate **39**, fig. 9) or more or less, sometimes very considerably curved, usually in an irregular manner (Plate **39**, figs. 1–8). They are 195–280 μ long and, in the middle, 3.5–7 μ thick. In Sollas's specimen they were small and fusiform. Thiele gives their length as 300 μ. Neither Sollas nor Thiele mentions the remarkable irregular curvature of so many of them. In the type of Sollas reexamined by me these spicules are 190–270 μ long and 3–6 μ thick. Most of them are more or less anisoactine, and some strongly and irregularly curved.

The rare *minute dermal styles* are not so strongly curved as the amphioxes, somewhat shorter, and in the middle 5.5–6.5 μ thick. The rounded end is 2.4–3.5 μ, about half the maximum thickness of the spicule in transverse diameter. These spicules can be considered as derivates of the minute dermal amphioxes in which the anisoactinity has been carried to the extent of the rounding off of the proximal end. I found such spicules in Sollas's type though they are not mentioned by him or by Thiele.

The *orthotriaenes* and *plagiotriaenes* (Plate **37**, figs. 15–17, 22b, c, 23–28; Plate **38**, figs. 1–7) have a straight conic rhabdome, 2.3–3.2 mm. long and, at the cladome, 64–85 μ thick. A little below it is usually somewhat thickened and here measures 65–89 μ in transverse diameter. This thickest part of the rhabdome is, on an average, about 6 % thicker than its cladomal end. The acladomal end is usually blunt pointed, rarely rounded and slightly thickened. The clades are, when normally developed, stout, conic, usually blunt pointed, and 180–350 μ long. Their basal part is slightly curved, concave to the rhabdome, their distal part straight. Their chords enclose angles of 90–102°, on an average 96.4°, with the axis of the rhabdome. The orthotriaene forms (with clade-angles 90–100°) greatly predominate, the plagiotriaene forms (with clade-angles over 100°) forming only about 15% of these spicules. The clades of the same cladome are, in the normally developed triaenes, usually rather unequal in length. In the normal cladome (Plate **37**, fig. 17), the three clades measured 250, 300, and 340 μ. Sometimes one, two, or all three clades are considerably reduced in length, cylindrical and rounded terminally. According to Sollas these spicules have a rhabdome 2.4–2.6 mm. by 78 μ and clades 230–380 μ long; according to Thiele a rhabdome 2.5 mm. by 50–60 μ, clades 200–300 μ long, and clade-angles of 92°. In Sollas's type I found these spicules had a rhabdome 2.3–2.9 mm. by 50–70 μ, clades 200–300 μ long, and clade-angles of 93–100°, on an average 95.5°.

The *mesoproclades* (Plate **38**, figs. 9–17) have a rhabdome 2.8–4.3 mm. long and 11–21 μ thick at the cladomal end. At the acladomal end the rhabdome thins out to a slender, irregularly curved thread. The cladomes are variable, irregular forms with partly reduced clades predominating over the regular mesoprotriaenes. The epirhabd is usually straight, conical, sharp pointed, and 40–105 μ long. Sometimes (Plate **38**, fig. 16) it is shortened, rounded at the end, and curved, rarely reduced to a mere knob on the apex of the cladome. The clades are, when properly developed, conical, pointed and 65–125 μ long. Their basal part is curved, concave to the epirhabd, their distal part straight (Plate **38**, figs. 9, 11, 17) or curved in the opposite direction (outwards) (Plate **38**, figs. 12, 15). An abrupt angular bend often intervenes between these two parts. In the majority of these spicules one or two clades are more or less reduced in length, cylindrical, and terminally rounded (Plate **38**, figs. 15, 17). Sometimes this reduction has gone so far that one, two, or all three clades appear as mere knobs (Plate **38**, figs. 11, 13, 16) or are altogether absent (Plate **38**, fig. 12). The chords of the clades enclose angles of 22–48°, on an average 34°, with the axis of the epirhabd. In young mesoproclades (Plate **38**, fig. 14) not only are the epirhabd and the clades shorter but also the clade-epirhabd angles much greater. Mesoproclades or proclades are not mentioned as occurring in this sponge either by Sollas or by Thiele, neither could I find any in the type of the former.

The *large anatriaenes* (Plate **37**, figs. 29, 30; Plate **38**, figs. 18–29) have a more or less curved rhabdome, 3.3–4.3 mm. long, and at the cladome, 8–16 μ thick. At its acladomal end it is usually attenuated to a fine, often considerably and irregularly curved thread (Plate **38**, figs. 29, 30). Exceptionally the rhabdome is somewhat shortened and thickened to a tyle at the acladomal end. The clades arise at an angle of about 80° from the rhabdome. In very young anatriaenes, such as the one with clades only 20 μ long represented in Plate **38**, fig. 18, the clades are uniformly curved, concave to the rhabdome throughout their entire length. This curvature not being great, however, the chords of the clades of such young anatriaenes enclose angles of over 50° with the axis of the rhabdome. During the further development the direction of growth undergoes a change, the silica being thenceforth apposed to the growing clade in such manner that its tip becomes a straight, slender, and sharp-pointed cone, strongly inclined to the rhabdome and enclosing with it an angle of only about 20°. The further growth of the clade may go on in the same direction: then clades with straight distal parts are formed (Plate **38**, figs. 19–22); or there may be a continuous change in a direction opposite to that of the curvature of the proximal part: then clades with distal ends curved outward are formed (Plate **38**, figs. 23–29). This curvature gives, when well pronounced (Plate **38**, figs. 28, 29), a sigmoid appearance to the clades. The anatriaenes with such sigmoid clades are very characteristic of this sponge. The chords of the clades of the full-grown anatriaenes are 80–130 μ long and enclose angles of 23–41°, on an average 32.2°, with the axis of the rhabdome. The anatriaenes have, according to Sollas, a rhabdome 18 μ thick and clades 100 μ long. According to Thiele the anatriaene-clades are 70 μ long. The remarkable outward curvature of the ends of the clades of many of the anatriaenes is indicated in Thiele's figure but is not mentioned in the text either by him or by Sollas. In the type of Sollas examined by me a few anamonaenes of similar dimensions besides the regular anatriaenes were found. The latter have a rhabdome 2.4–5 mm. by 11–23 μ, clades 70–110 μ long and clade-angles of 32–45° on an average 36.7°.

The *minute dermal anaclades* (Plate **39**, figs. 13c, 14–17, 38, 39) have a more or less curved rhabdome, 235–310 μ long and rounded at the acladomal end. At the cladome the rhabdome is 1–2 μ, in its thickest part, which usually lies below the middle, 2.8–5 μ, and at the rounded, acladomal end 1.3–3 μ thick. The proportion of the thickness of the cladomal end to the thickest part to the acladomal end is, on an average, 10: 28: 17. I have observed triaene, diaene, and monaene forms. The clades are always curved, concave to the rhabdome; their length is very variable. The chords of the clades are 3–10 μ long and enclose angles of 30–54°, on an average 39°, with the axis of the rhabdome. Such spicules are not mentioned either by Sollas or by Thiele neither could I on examination find any in the type of Sollas.

The *large oxyasters* (Plate 39, figs. 13a, 18–26, 27a) usually have no central thickening, and from three to seven equal, concentric, regularly distributed rays. The rays are straight, conic, blunt, and everywhere, except quite at the base, thickly covered with spines. The spines appear to increase in size towards the end of the ray; those large enough to be clearly made out, are somewhat recurved, claw shaped. The size of the whole aster and of the rays is in inverse proportion to the number of the latter.

NUMBER OF RAYS AND DIMENSIONS OF OXYASTERS.

Number of rays	Total diameter of asters	Length of rays	Thickness of rays at base
3–4	30–46 μ	18–23.5 μ	2–2.8 μ
5–6	27–39 μ	15–21 μ	1.2–2.7 μ
7	25–31 μ	13–16 μ	1.3–1.8 μ

Occasionally small oxyasters with a distinct centrum and more than seven rays are observed. These may be considered as transitional between the true large oxyasters described above and the large oxysphaerasters described below. According to Sollas the large oxyasters are 32 μ in diameter. He describes their rays as smooth. Thiele says that the rays of the oxyasters are few in number and 6–14 μ long. In the type of Sollas I found that the large oxyasters have from three to seven straight, spined rays. The rays are usually conical and pointed; very rarely some of them are reduced in length and terminally rounded. The rays are, at the base, 1.8–2.8 μ thick. The total diameter of the aster is 21–36 μ.

The *large oxysphaerasters* (Plate 39, figs. 27c, to the right, 33, 40, 41) have a spherical centrum, 5–7.5 μ, usually not quite a third of the whole aster, in diameter, from which from fifteen to twenty-one concentric, regularly arranged radial rays arise. Usually the rays are equal, rarely one or more reduced in length and rounded at the end. The normal rays are conical, sharp pointed, (without the centrum) 5.5–8 μ long, and, at the base, 1.9–2.5 μ thick. They bear a small number of spines, which are usually restricted to a belt lying some distance below the end. Sometimes the spines are rather large and then one perceives that they are slender and directed obliquely outward. More often they are so small that they can hardly be made out and in some of these asters the rays seem to be quite smooth. The total diameter of the oxysphaerasters is 17–22 μ. As stated above transitional forms connect these oxysphaerasters with the oxyasters. Sollas also mentions these asters. He gives their diameter as 20 μ. Thiele did not find any such asters in the specimens examined by him and expresses the opinion that the ones described by Sollas were young sterrasters. In the type of Sollas I found these asters fairly abundant; they have a centrum about 5 μ in diameter, from sixteen to twenty conical, sharp-pointed rays, at the base 1.4–2 μ thick, and measure 15–21 μ in total diameter.

Most of the *small strongylosphaerasters* (Plate 39, figs. 10–12, 13b, 27b, 36, 37) are regular, but irregular forms also occur in small numbers. The *regular forms* have a spherical centrum, 1.2–5 μ, usually about one to two thirds of the whole aster, in diameter, from which from twelve to twenty-one equal, concentric, and regularly arranged radial rays arise. The rays are (without the centrum) 0.6–2 μ long, at the base 0.5–1.2 μ thick, and cylindrical. The end is truncate or rounded. The basal part of the ray is smooth, the end bears spines, which often form a verticil just below the tip. The total diameter of the regular small strongylosphaerasters is 4–6, usually 5–5.5 μ. In the few-rayed forms with 12–13 rays the rays are, as a rule, relatively longer and more slender than in the many-rayed forms with 15–22 rays.

The *irregular small strongylosphaerasters* have a centrum 1.5–3.6 μ in diameter, from which from six to nineteen rays arise. These are irregularly arranged, unequal in length, not always concentric, and usually entirely covered with spines. The rays are (without the centrum) 1.6–3 μ long and, at the base, 0.6–1.3 μ thick. The total diameter of the irregular strongylosphaerasters is 5.8–7.3 μ.

The diameters of the small strongylosphaerasters given by Sollas and Thiele are 5 μ and 4 μ respectively. In the type of Sollas reexamined by me these asters have a centrum 1.5–2.2 μ in diameter, from sixteen to twenty rays 0.6–0.8 μ thick, and measure 4–5.5 μ in total diameter.

The *sterrasters* (Plate 39, figs. 28–32, 34, 35) are flattened ellipsoids 80–89 μ long, 65–78 μ broad, and 55–61 μ thick. The average proportion of length to breadth to thickness is 100: 83: 58. The freely protruding rays which surround the umbilicus have transverse sections elongated in a direction radial to the centre of the umbilicus, mostly measuring 2.5×4 μ, and bear five or six lateral spines. The spines directed towards the umbilicus are larger than the others.

The other protruding rays, away from the umbilicus, have more or less circular transverse sections, about 2.5 mm. in diameter, and generally bear four or five spines. The measurements of the sterrasters given by Sollas and Thiele are 77.5 or 90 by 77.5 by 58 μ, and 75 by 65 μ respectively. In the type of Sollas examined by me the sterrasters measure 84–92 by 70–80 by 61 μ.

This sponge was labeled Acc. No. 31982, *Cydonium japonicum*, Japan, and, as seen from the above description, although very similar to the sponges described by Sollas as *Cydonium japonicum* and by Thiele as *Geodia japonica* in many respects, appears to differ from them very considerably in others. The most important of these apparent differences are the presence of large styles, large, slender amphioxes, minute dermal styles, mesoproclades, and minute dermal anaclades in the "Albatross" specimen and the absence of any reference to them in the descriptions of Sollas and Thiele. If these differences were real I should not consider these sponges the same species. Since, however, I have found large slender amphioxes and styles and also minute dermal styles in the type of Sollas, the differences due to these spicules not being mentioned in the descriptions of Sollas and Thiele in reality do not exist. It is different, however, with the mesoproclades and the minute dermal anaclades, which I failed to find in Sollas's type. Since, however, these spicules protrude beyond the surface and are, in much worn specimens, broken off and lost, and since, judging from the descriptions given by Sollas and Thiele and from the type examined by me the specimens at their disposal had been much worn, I do not think their presence in the "Albatross" specimen and their absence in *Cydonium japonicum* Sollas and *Geodia japonica* Thiele sufficient for systematic distinction. For this reason and on account of the great similarity of these sponges in every other respect, I consider them all as belonging to the same species.

Geodia ataxastra, sp. nov.

angustana, var. nov.

Plate 43, figs. 9–25, 28–38; Plate 44, figs. 1–12, 14–49.

latana, var. nov.

Plate 43, figs. 26, 27; Plate 44, fig. 13.

I establish this species for eight specimens in spirit from Perico Island, Panama. It is characterized by the possession of ataxasters, and to this the specific name refers. Seven of the specimens are similar and have narrow anatriaene-cladomes: for these I establish the var. *angustana*. One is somewhat different and has broad anatriaene-cladomes: for this I establish the new var. *latana*.

The seven specimens of var. *angustana* (Plate **44**, fig. 25) are attached to a stone and partly joined. The smallest are quite regularly spherical, the larger ones more irregular, elongated, divided into lobes, or tuberous. The largest, which is tuberous, measures 44×41×29 mm. Two, which are elongated, have a length of 46 and 50 mm. The others are spherical or tuberous and 17–37 mm. in maximum diameter. The branch-like lobes of the lobate specimens are 8–11 mm. broad. Except in the sheltered places adjacent to the base of attachment, where remnants of a spicule-fur can be detected, the surface is bare. In the smaller specimens it is almost continuous, in the larger undulating. At one place on the surface of the largest specimen (Plate **44**, fig. 25, right above) there is a row of five low warts. Apart from these warts and the most prominent convexities of the larger specimens the whole of the surface is occupied by pore-sieves. The dermal membrane is, probably in consequence of *post mortem* shrinkage, more or less depressed over the radial cortical canals and their distal branches, so that the surface appears more or less pitted. In a restricted area, 6–10 mm. in maximum diameter, which is in the larger specimens situated in a concavity, the dermal pores are rather large, everywhere else they are quite small. I consider the small pores, which occupy by far the greater part of the surface, as the afferents, the large ones, confined to the restricted areas mentioned, as the efferents.

The single specimen of var. *latana* is fragmentary. It has the shape of a disc and measures 23×19×9 mm. Its contour is pear shaped, and it was attached to a stone. The natural surface is destitute of a spicule-fur, quite smooth, and occupied throughout by small, apparently afferent pores.

The *colour* of the specimens of var. *angustana* is, in spirit, nearly white throughout; one has a slight lilac-gray tinge. The specimen of var. *latana* is gray with a lilac tinge throughout.

The superficial part of the body forms a *cortex*, which consists of a thin, in many places hardly perceptible, outer dermal layer; a middle sterraster-armour layer (Plate **43**, fig. 25a; Plate **44**, fig. 26a), for the most part 400–700 μ thick; and a thin, inconspicuous inner fibrous layer. In one place, where a foreign body appears formerly to have been attached to the surface (Plate **43**, fig. 25a, to the left), the sterraster-armour is only 150–250 μ thick.

Canal-system. More or less stellate groups of afferent pores (Plate **43**, fig. 26) occupy the largest part of the surface. These sieve-like pore-groups are 250–500 μ in diameter and quite close together, their centres being only 300–600 μ apart. The pores themselves are oval or circular, 10–50 μ wide, and separated by rather broad strands of dermal tissue. The pores of each group lead into a system of lacunose, subdermal canals, which converge and unite below the centre of the pore-group to form an afferent radial canal (Plate **44**, fig. 26b). The subdermal afferent canals are wide, separated only by relatively thin walls, vertical to the surface of the sponge, which radiate from a common centre. These walls attach the pore-sieves to the sterraster-armour and give to them, when viewed *en face*, the stellate appearance referred to above (Plate **43**, fig. 26). The radial cortical afferent canals are 120–230 μ wide and circular in transverse (paratangential) section. Their centres are 300–600 μ apart.

Below the sterraster-armour layer numerous small cavities, measuring on an average about 100 μ in radial diameter, are met with (Plate **44**, fig. 26). The radial cortical canals open out into these cavities, and from them the choanosomal afferents take their rise. The flagellate chambers (Plate **44**, fig. 24) are spherical and measure 15–20 μ in diameter. In the interior of the choanosome large canals, some 1 mm. and more wide, are observed (Plate **43**, fig. 25).

The efferent cortical canals, which are confined to the efferent areas referred to above, also have a circular transverse section. They are 200–300 μ wide and their centres mostly 600 μ–1 mm. apart. In places, particularly towards the margins of the areas occupied by them, they are more distant. The outer openings of these canals are covered by nets of dermal strands, only 10–20 μ broad. The meshes of these nets are oval or polygonal, 70–200 μ broad, and up to 400 μ long (Plate **43**, fig. 28). Thus, when the efferent area is viewed *en face* one sees only a few strands or a loose net work of strands spread out over the entrances of the efferent cortical canals.

Skeleton. Strands of rhabds, extending obliquely or paratangentially, traverse the deeper parts of the choanosome. The rhabds composing them are chiefly amphioxes, but amphistrongyles, styles, and angularly bent or irregularly branched amphiox-derivates also occur in them in small numbers. In var. *latana*, the amphistrongyles and styles are relatively much more numerous than in var. *angustana*. In the distal part of the choanosome similar rhabds and the rhabdomes of orthoplagiotriaenes, anatriaenes, and mesoproclades, chiefly mesoprotriaenes, form radial bundles. The rhabdomes of some of the orthoplagiotriaenes are reduced in length and rounded at the end. Orthoplagiotriaenes with such rhabdomes have been chiefly observed below the thin part of the cortex of a specimen of var. *angustana*, mentioned above. The cladomes of nearly all the orthoplagiotriaenes and of a large number of the anatriaenes lie in the level of the lower limit of the sterraster-armour. A few anatriaene- and mesoproclade-cladomes were found further down in the choanosome. Most of the mesoproclades seen protruded 800 μ–1 mm. beyond the surface. The small remnants of spicule-fur observed consisted nearly entirely of the distal parts of such spicules (Plate **44**, fig. 27b).

In the interior no minute rhabds are observed; in the distal part of the choanosome and in the inner and middle (sterraster-armour) layers of the cortex, on the other hand, such spicules, for the most part situated radially, occur in considerable numbers. Where the dermal layer is better preserved, particularly over the entrances to the radial cortical canals, large numbers of minute rhabds are observed. They are here situated radially, their distal ends protruding a little beyond the surface. These minute dermal rhabds are arranged in groups, those of the same group being either parallel or diverging distally tuft-fashion. Most of these spicules are amphiox, a few amphistrongyle or style. Minute amphistrongyles and styles are relatively much more numerous in var. *latana* than in var. *angustana*. In var. *angustana* a few minute dermal anaclades are intermingled with these minute dermal rhabds.

In the interior of the choanosome a few sterrasters and large, few-rayed oxyasters occur. The latter are situated in the canal-walls. In the distal part of the choanosome and the inner layer of the cortex oxysphaerasters, acanthtylasters, small strongylosphaerasters, and ataxasters are met with. The middle layer of the cortex is occupied by dense masses of sterrasters. It also contains the parts of the rhabdomes of the fur-spicules which traverse it, the minute rhabds mentioned above, and small strongylosphaerasters and ataxasters. In the dermal membrane a thin but dense layer, composed of small strongylosphaerasters and ataxasters is observed. The strongylosphaerasters are much more numerous than the ataxasters.

The *large choanosomal amphioxes* (Plate **43**, figs. 23d, 27d) are usually slightly curved, fairly isoactine, and gradually attenuated to sharp points, much more rarely blunt at one or at both ends. The last-named forms are relatively much more frequent in var. *latana* than in var. *angustana*. The measurements of three amphioxes, two isoactine and one anisoactine, given in the subjoined table, indicate the degree of attenuation towards the ends.

AMPHIOXES

of	Thickness				
	100 μ	200 μ	in the middle	200 μ	100 μ
	below one end			below the other end	
Var. angustana	17 μ	20 μ	30 μ	20 μ	17 μ
Var. latana	12 μ	16 μ	27 μ	16 μ	12 μ
Var. latana	12 μ	17 μ	32 μ	25 μ	17 μ

In var. *angustana* the large choanosomal amphioxes are 1.2–2.8, mostly 1.6–1.8 mm. long, and 17–43, mostly 22–38 μ thick. In var. *latana* they are considerably smaller, measuring only 0.6–1.9 mm., mostly 1.2–1.6 mm., by 12–37, mostly 20–34 μ.

I have subjected the length of the large amphioxes (and also the length of the rhabdomes of the orthoplagiotriaenes) of this species to a biometric investigation for the purpose of attaining an insight into the relative frequency of the different lengths of these spicules. In all, the length of about a hundred and fifty amphioxes of the two varieties, taken at random, were measured. The amphiox-lengths within ranges of 0.1 mm. (from 0.45–0.55 mm., from 0.55 to 0.65 mm., and so on) were counted, these numbers reduced to percentage, and the percentage frequency-numbers thus obtained plotted on the ordinates erected at the points of the horizontal axis indicating the amphiox-lengths (of 0.5 for 0.45–0.55 mm., 0.6 for 0.55–0.65 mm., and so on). By connecting the points thus plotted the two curves for the two varieties (Fig. A) were obtained.

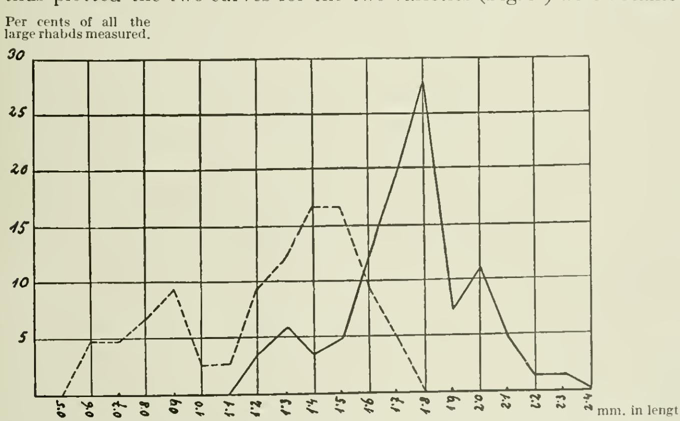


Fig. A. Percentage frequency of lengths of the large choanosomal rhabds (chiefly amphioxes) measured
——— Geodia ataxastra var. angustana, – – – – Geodia ataxastra var. latana.

Although somewhat irregular, both curves have one very well-pronounced main culmination, broad in the var. *latana* curve, and narrow in the var. *angustana* curve. These main culminations show that one amphiox-length is much more frequent than any other. The most frequent lengths represented by these culminations are 1.4 to 1.5 mm. in var. *latana* and 1.8 mm. in var. *angustana*. These may be considered as the *normal amphiox-lengths*. That the "normal" amphiox-length is greater in var. *angustana* than in var. *latana* accords with the fact that the specimen of var. *angustana* selected for this examination is much larger than the specimen of var. *latana*.

The var. *latana* curve has one, the var. *angustana* curve two, minor culminating points besides the main one. The left one (at 1.3 mm.) of the latter appears to correspond to the single one (at 0.9 mm.) of the former. Since the majority of amphioxes shorter than those of "normal" length (1.4–1.5 mm. in var. *latana* and 1.8 mm. in var. *angustana*) are probably young, still growing spicules, the minor culmination which precedes the main one in both curves indicates that the rate of longitudinal growth of these spicules is not uniform, a stage of cessation or retardation of growth at 0.9 mm. in var. *latana* and at 1.3 mm. in var. *angustana* intervening between the earlier and the later periods of rapid growth.

The rare *large amphistrongyles* have similar dimensions to the large amphioxes.

The rare *large styles* are 0.5–1.6 mm. long and 11–30 μ thick. Their thickness is by no means proportional to their length.

The rare *angularly bent and irregularly branched amphiox-derivates* have similar dimensions as the regular amphioxes. In the angularly bent amphiox-derivates the bend is always near one end. The angle may be over or under 90°. Most of the branched forms are amphiclade in character and consist of a shaft with a short branch-ray near each end. In some only one branch-ray, situated near one end of the shaft, is observed. Generally the branch-rays are simple, straight, conical, and pointed, rarely irregularly curved or divided into secondary branchlets. The simple branch-rays are 20–100 μ long and rise vertically or obliquely from the shaft. The oblique ones are inclined outward, proclade-fashion.

The *minute rhabds* of the distal part of the choanosome, the cortex, and the dermal groups (Plate **44**, figs. 31a, 32, 33a, 40a) are, in var. *angustana*, mostly fairly straight, rather abruptly pointed amphioxes. In var. *latana* minute dermal rhabds rounded at one end or at both occur in fair numbers besides the ordinary amphiox forms with both ends sharp pointed. In var. *angustana* these spicules are 120–200, mostly 160–200 μ long and 3–5 μ thick; in var. *latana* somewhat larger, 145–215 μ long and 4–7 μ thick. The shorter ones are on the whole thicker than the longer ones. In var. *angustana* the average thickness of the minute rhabds less than 160 μ in length is 4.6 μ, that of the ones more than 160 μ in length 3.9 μ.

The *orthoplagiotriaenes* (Plate 43, figs. 9–22, 24a, 27a) have a straight, usually conical and sharp-pointed, rarely shortened, cylindrical, and terminally rounded rhabdome. The ordinary pointed rhabdomes are, in var. *angustana*, 1.6–2.3, mostly 1.9–2.2 mm. long and, at the cladome, 29–70, mostly 40–60 μ thick, in var. *latana* they are considerably smaller, 1.3–1.7, mostly 1.5–1.6 mm. long and 30–45, mostly 30–40 μ thick. The cylindrical, terminally rounded rhabdomes are as thick as the conical ones at the cladome but only 330 μ–1.4 mm. long.

I have studied the frequency of the different lengths of the ordinary pointed orthoplagiotriaene-rhabdomes in a similar manner to the amphiox-lengths. The curves representing the frequency of the different lengths measured are here reproduced (Fig. B).

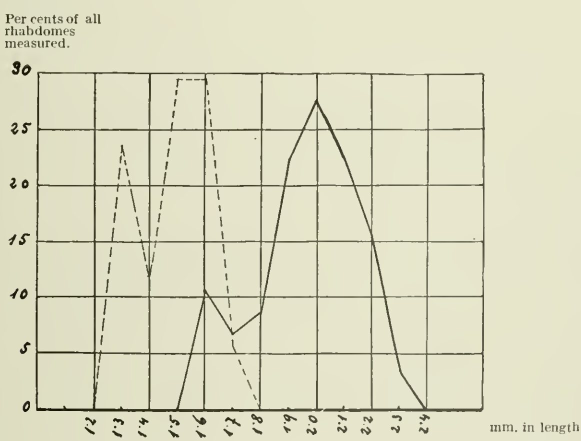


Fig. B. Percentage frequency of lengths of rhabdomes of the orthoplagiotriaenes measured.
——— Geodia ataxastra var. angustana.
– – – – Geodia ataxastra var. latana.

They are similar to the frequency-curves of the amphiox-lengths, and like them exhibit a distinct main culmination, broad in var. *latana* and narrow in var. *angustana*, which shows that the "normal" lengths of the orthoplagiotriaene-rhabdomes are 1.5–1.6 mm. in var. *latana* and 2 mm. in var. *angustana*. Also in these curves a minor culmination, preceding the main one, is observed, and I think there can be little doubt that this indicates, as in the case of the amphiox-lengths, a temporary cessation or a retardation of longitudinal growth of the orthoplagiotriaene-rhabdomes, in this case when they are 1.3 mm. long in var. *latana* and when they are 1.6 mm. long in var. *angustana*. In these curves, as in the ones pertaining to the amphioxes, the part beyond the main culmination descends very rapidly at first and less rapidly later on. This seems to show that most of the amphioxes and orthoplagiotriaene-rhabdomes becoming longer than the normal grow beyond this very rapidly.

Fig. C. Correlation between the lengths and angles of the clades of the orthoplagiotriaenes of Geodia ataxastra var. angustana.

The cladomes of most of the orthoplagiotriaenes are regular, the three clades of the same cladome being nearly equal in length, position, and curvature. The clades of these regular orthoplagiotriaene-cladomes are conical, pointed, and curved, concave to the rhabdome, rather strongly in their proximal and central parts but only slightly or not at all in their distal part. In var. *angustana* they are 170–290, mostly 230–270 μ long, in var. *latana* shorter, only 130–220 μ long. The angle enclosed between the clade-chords and the rhabdome-axis is in var. *angustana* 85–116°, on an average 100.3°, in var. *latana* 95–111°, on an average 101°. Considering, as I do, teloclades with a clade-angle between 80° and 100° as orthoclades and teloclades with a clade-angle of 100–120° as plagioclades, I name these spicules orthoplagiotriaenes.

For the purpose of ascertaining the correlation between the clade-length on the one hand and the clade-angle and the rhabdome-thickness (at the cladome) on the other I measured these dimensions in eighty-one cladomes taken at random. I arranged these measurements in the order of the clade-length, and divided up the series at intervals of 10 μ, considering all clade-lengths from 145 to 155 as about 150 μ, all from 155 to 165 as about 160 μ and so on. All the measurements of clade-angles and rhabdome-thickness pertaining to clades of similar length (150, 160, and so on) were combined and their averages taken. These averages were then plotted on the ordinates erected in the points of the horizontal axis representing the clade-length (150, 160 μ, and so on). The curves connecting the points thus plotted in are here reproduced.

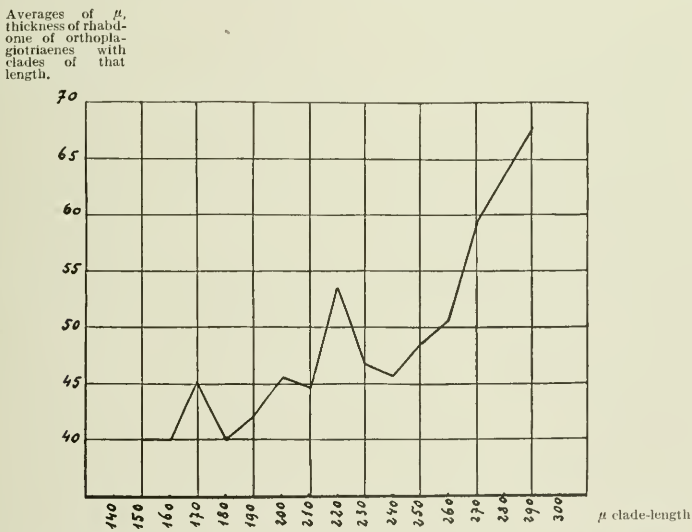


Fig. D. Correlation between the clade-length and rhabdome-thickness of the orthoplagiotriaenes of Geodia ataxastra var. angustana.

These curves are very irregular, but they show nevertheless that the clade-angle on the whole decreases with increasing clade-length, while the rhabdome-thickness increases with it. That is to say, that, roughly speaking, the width of the clade-angle is in inverse, the thickness of the cladomal end of the rhabdome in true proportion to the clade-length. According to the curves the clade-angle and the thickness of the cladomal ends of the rhabdomes do not seem to be correlated with each other any more closely than with the clade-length. On the whole it may therefore be said, that, although there undoubtedly exists a correlation between the three cladome dimensions, they are subject to considerable, apparently independent variations.

Besides the orthoplagiotriaenes with regular cladomes, above described, a few occur in which the clades are irregularly and unequally curved (Plate **43**, fig. 10). Very rarely monaene and amphiclade derivates of orthoplagiotriaenes are met with. A monaene form observed had a bifurcate clade. An amphiclade possessed, besides the ordinary three terminal clades, a fourth clade, which arose some distance down the rhabdome.

The *mesoproclades* of var. *angustana* (Plate **43**, fig. 24b; Plate **44**, figs. 1–12, 14) have a straight or slightly curved rhabdome 1.6–3.4, mostly 2.1–2.8 mm. long. At the cladome the rhabdome is 9–20 μ, most frequently 10–15 μ thick. Farther down it thickens, and at its thickest point, which is situated near the middle, it is usually half again as thick as at the cladomal end. At the acladomal end the rhabdome is usually attenuated to a fine point. Generally the cladome is regularly triaene. The clades are usually conical, about 70 μ long, slightly curved, concave to the epirhabd basally and straight distally. Their chords enclose angles of 40–50° with the epirhabd. The latter is straight, conical, pointed, and 40–50 μ long. Besides these regular forms various irregular ones are observed. In some of these a fourth clade is added to the three normal ones, so that the spicule appears as a mesoprotetraene. The clades of these tetraene mesoproclades (Plate **44**, fig. 1) are somewhat unequal in length and position. The longest clade of the cladome is 50–75 μ long. The chords of the clades enclose angles of 36–62° with the axis of the epirhabd. The latter is conical, pointed, and 35–58 μ long. Other derivates are produced by one or more clades being abruptly (angularly) bent outward in the middle (Plate **44**, fig. 14). These spicules are also very rare. More frequently irregularities due to one or two of the clades being reduced in length, cylindrical, and terminally rounded, are observed (Plate **44**, figs. 11, 14). Rarely one clade is absent altogether, so that the spicule appears as a mesoprodiaene (Plate **44**, fig. 12). Taking all the mesoproclades together, but leaving out of account the exceptionally large, quite abnormal angles of some of the tetraene clades, which, as mentioned above, measured up to 62°, we find that the longest clade of the cladome is 44–80 μ and the epirhabd 40–60 μ long, the angle between the clade-chords and the epirhabd axis being 33–48°, on an average 41.3°.

In var. *latana* the mesoproclades (Plate **44**, fig. 13) have a rhabdome 2–2.4 mm. long and, at the cladome, 7–13 μ thick. As in the mesoproclades of var. *angustana* the rhabdome thickens towards the middle. Regular mesoprotriaenes, like those predominant in var. *angustana*, are rare in var. *latana*, one, two, or even all three clades (Plates **44**, fig. 13) being reduced in length and terminally rounded in most of the mesoproclades observed in this variety. Most of the pointed, fully developed clades are angularly bent outward in the middle like some of the clades of the mesoproclades of var. *angustana* (Plate **44**, fig. 14). The dimensions of the cladomes of the mesoproclades of var. *latana* are: length of longest clade of the cladome 25–58 μ, mostly 32–50 μ; length of epirhabd 28–50 μ, mostly 34–47 μ; angle between clade-chord and epirhabd axis 25–58°, on an average 43.6°.

The *large anatriaenes* (Plate **44**, figs. 15–23, 40d, 41) have in var. *angustana* a rhabdome 2.1–3.1 mm. long and, at the cladome, 3–10 μ thick. In var. *latana* the anatriaene-rhabdome is somewhat shorter and thicker, measuring 2.–2.8 mm. in length and 7–12 μ in thickness. The cladomes are generally regular, irregular anatriaene-cladomes with one clade shorter than the others (Plate **44**, figs. 17, 41) being rare. Exceptionally all three clades are greatly reduced in length, so that the whole cladome appears as a three-lobed tyle (Plate **44**, fig. 23). In the anatriaenes of var. *angustana* the cladome is usually destitute of an apical protuberance. The clades of these anatriaenes are regularly conical, taper uniformly to a sharp point, are strongly curved, concave to the rhabdome basally, straight or just perceptibly bent outward distally, and 17–68 μ, mostly 30–65 μ long. Their chords enclose angles of 20–42°, on an average 34°, with the axis of the rhabdome. The cladomes of the large anatriaenes of var. *latana* are different in appearance. Most of them have a distinct apical protuberance and their clades are very thick and not very strongly curved, concave to the rhabdome at the base, and abruptly attenuated to very slender, straight or slightly outwardly curved, sharp-pointed tips. They are 30–55 μ long, their chords enclose angles of 41–55°, on an average 47°, with the axis of the rhabdome.

The *minute dermal anaclades* (Plate **44**, figs. 28d, 42, 46–49), which have been observed only in var. *angustana*, have a slightly curved rhabdome 190–340 μ long. At the cladomal end it is 0.5–2 μ thick, and it increases in thickness towards the middle to 1.4–3.5 μ, the central part of the rhabdome being usually not quite twice as thick as its cladomal end. The acladomal end of the rhabdome is rounded and usually slightly thicker, rarely thinner, than the cladomal end. Most of these minute anaclades are regularly triaene. The basal parts of their clades are generally quite strongly curved, concave to the rhabdome, while their central and distal parts are straight. The chords of the clades are

2–6 μ long and enclose angles of 33–57°, on an average 47.6°, with the axis of the rhabdome.

Geodia ataxastra is very rich in *asterforms.* Eight different kinds of asters can be distinguished. 1. Large oxyasters with few rays. 2. Oxysphaerasters with numerous slender, spiny rays. 3. Oxysphaerasters with numerous stout, smooth rays. 4. Small strongylosphaerasters. 5. Ataxasters. 6. Acanthtylasters. 7. Irregular sterraster-derivates. 8. Regular sterrasters. *Three* and *seven* are very rare and have been observed only in centrifugal spicule-preparations of var. *latana.* *Six* also, which occurs in both varieties, is by no means frequent. The five other kinds, particularly *four,* are abundant, *five* being more numerous in var. *latana* than in var. *angustana.* *One* and *two,* and also *four, five,* and *six* are connected by some transitional forms; *seven* may also belong to the series of forms represented by the three latter, and at the same time exhibits great affinities to *eight.*

The *large oxyasters* (Plate **43**, figs. 35, 36, 37a, 38; Plate **44**, figs. 28c, 29c, 30c, 33–35c, 39, 40c) occur in both varieties. Those of var. *angustana* are usually destitute of a centrum, only the two-rayed forms possessing a slight central thickening. They have from two to ten concentric and regularly distributed, straight or slightly curved, usually simple rays. In some oxyasters, however, one or more of the rays are bifurcate, the terminal branches being nearly equally long and strongly divergent. Very rarely trifurcate rays have been observed. The simple rays are conical, gradually or abruptly pointed, and always spiny. When abruptly pointed and distally covered with very numerous spines they have a somewhat strongyle appearance. As a rule nearly the whole ray is covered with spines, only a narrow belt at the base being smooth. The spines increase in size towards the end, just below which they occasionally form a conspicuous verticil. The spines of the proximal half of the ray are often so minute as merely to render the appearance of this part of it rough. When large enough to be clearly made out, the spines are seen to arise vertically from the ray and to bend down at the end in a claw-shaped manner. In regard to their spines the branched rays agree with the simple ones. The size of the aster is in inverse proportion to the number of its rays. The two-rayed (diactine) asters are 40–50 μ, the three- to seven-rayed 21–40 μ, and the eight- to ten-rayed 15–28 μ in diameter. The rays are half or a little more than half of the diameter of the whole aster in length, and, at the base, 0.6–2.6 μ, usually 1–2 μ thick. The basal thickness is by no means in proportion to the length of the ray, shorter rays being often much thicker than longer ones. As, however, the relatively thick-rayed oxyasters (Plate **43**, figs. 36, 37a) are connected with the relatively thin-rayed ones (Plate **43**, figs. 35, 38) by numerous transitions, which form a continuous series, it does not appear advisable to separate them.

The large oxyasters of var. *latana* are on the whole similar to those of var. *angustana*, but considerably smaller. Diactine oxyasters and asters with branched rays were not observed in this variety. The increase in the size of the spines towards the end of the ray is not so marked in the oxyasters of this variety as in those of var. *angustana*. The large oxyasters of var. *latana* have from three to eleven rays, the three- to seven-rayed are 17–28 μ, the eight- to eleven-rayed 15–21.5 μ in total diameter. The basal thickness of the rays is 0.7–1.8 μ.

The *oxysphaerasters with slender spiny rays* (Plate **43**, figs. 29–32; Plate **44**, fig. 29c, 34e) occur in fair numbers in both varieties. Those of var. *angustana* consist of a spherical centrum 2.6–5.5 μ, that is about a third, of the whole aster, in diameter, from which eighteen to twenty-eight regularly distributed rays arise radially. The rays are straight, conical, and sharp pointed. Their distal parts bear spines of considerable size, some of which are often arranged in a verticil, situated some distance below the tip. The rays are, without the centrum, 3.5–5 μ long and at the base 0.7–1.3 μ thick, the total diameter of the aster being 8–13 μ. The spined oxysphaerasters of var. *latana* have eighteen to twenty-one rays and resemble those of var. *angustana* very closely but are somewhat larger and have relatively smaller centra. Their dimensions are: centrum 2.4–3.5 μ, a fifth to a third of the whole aster, in diameter; rays, without the centrum, 4–5.5 μ long and at the base 1.2 μ thick; total diameter 10–14.4 μ.

In both varieties a few *asters transitional between the oxyasters and oxysphaerasters* above described, in regard to ray-number, size, and development of the centrum, have been met with.

The rare *oxysphaerasters with stout smooth rays*, which have been observed only in var. *latana*, have a centrum 4.5 μ, that is a little over a third of the whole aster, in diameter, and about eighteen, regularly distributed, straight, smooth, conical, and rather blunt rays, which are, without the centrum, 4.5 μ long and at the base 2 μ thick. The total diameter of the aster is about 13 μ.

The *small strongylosphaerasters* (Plate **43**, figs. 33, 34, 37b; Plate **44**, figs. 30b, 31b, 33–35b, 40b) are exceedingly abundant in both varieties. Those of var. *angustana* have a more or less regularly spherical centrum, 0.6–2.3 μ, exceptionally as much as 3 μ, a sixth to a half of the whole aster, in diameter, from which from seven to twenty, very rarely as many as thirty, fairly regularly distributed rays arise radially. The rays are straight or slightly curved, and appear as short cylinders, rounded and often somewhat thickened at the end. Indications of the presence of exceedingly small spines have frequently been observed. The rays are, without the centrum, 0.7–2.6 μ long and 0.2–0.8 μ thick. The total diameter of the aster is 2.6–6, usually 3–4.5 μ. The small strongylosphaerasters of var. *latana* are very similar. They have a centrum 1–3 μ, a fifth to a third of the whole aster, in diameter, and from eleven to nineteen, rarely as few as nine, rays. The rays are, without the centrum, 0.6–1.5 μ, rarely as much as 2.5 μ long, and 0.3–0.8 μ thick. The total diameter of the aster is 3–6.4, usually 3.4–4.3 μ.

The *ataxasters* are more abundant in var. *latana* than in var. *angustana*. Those of var. *angustana* consist of a spherical or irregularly tuberous centrum, 1.4–3.5 μ in diameter, from which from one to eight rays arise. The rays are conical or, more frequently, cylindrical and always rounded, sometimes thickened at the end. They are rough or distinctly spined, without the centrum, 0.3–2.8 μ long and 0.4–1.2 μ thick. This distribution is most irregular, and they arise radially or obliquely. Those of the same aster often differ very considerably in size. When only a few, two to four, rays are developed, they usually stand close together and form a bunch arising from one point of the surface of the centrum, the rest of the latter being often rough or spiny, but free from rays. When more rays are present they are usually somewhat scattered, but in this case also a large part, generally more than a half, of the surface of the centrum is free from rays. The whole aster is 4–7 μ in diameter. The ataxasters of var. *latana* have from two to fourteen rays. They are very similar to those of var. *angustana*, but on the whole larger and covered with somewhat larger spines. Among the ataxasters of this variety a few with branched (bifurcate) rays have been observed. Their dimensions in this variety are: centrum 2–4.5 μ, a third to three quarters, of the whole aster, in diameter; rays, without the centrum, 0.3–2.5 μ long and 0.7–1.5 μ thick; total diameter 5.3–8.3 μ.

Strongylosphaerasters with a less pronounced irregularity in the distribution of the rays connect these ataxasters with the small strongylosphaerasters described above.

The *acanthtylasters* occur in both varieties, but they are far from numerous, and particularly scarce in var. *angustana*. Those of var. *angustana* have from ten to fifteen rays and measure 8–16 μ in diameter; those of var. *latana* have from four to nine rays and measure 10–14.5 μ in diameter. The acanthtylasters have no central thickening. Their rays are usually distributed fairly regularly, cylindrical, 1–2 μ thick, and rounded at the end. The end, which usually appears distinctly thickened, is densely covered with large spines, which are for the most part directed outward. The central and proximal parts of the rays are quite smooth. In the asters of this kind which I have found in var. *angustana* the rays were always simple, while in several of the acanthtylasters of var. *latana* some of the rays were terminally divided into two or, rarely, three short branches, each provided with a special acanthtyle.

The rare *irregular sterraster-derivates,* which have been observed only in var. *latana,* consist of a central mass from which tufts of large, slender spines arise. The central mass is either simple and spherical, or oval, in which case two tufts of spines, lying nearly opposite each other, rise from it; or it is lobate, in which case the distal convex face of each lobe is covered with spines. The number of the lobes of the lobate form is from two to five. Sometimes the lobes are separated by rather deep recesses. The spines are 4–8 μ long, the whole spicule measuring 21–50 μ in diameter. In their dimension and in the shape, size, and position of the spines these spicules agree with young sterrasters, and they make, on the whole, the impression of being early stages of abnormal spicules of this kind. Abnormal sterrasters, which might be considered as their adult forms, have, however, not been observed.

The *sterrasters* (Plate **44**, figs. 36–38, 43–45) are abundant in both varieties. They are flattened ellipsoids. Those of var. *angustana* are 65–98 μ long, 58–67 μ broad, and 47–57 μ thick, the average proportion of length to breadth to thickness being 100 : 89 : 74. The sterrasters of var. *latana* are similar but smaller and relatively thicker. They are 55–65 μ long, 50–60 μ broad, and 47–50 μ thick, the average proportion of length to breadth to thickness being 100 : 90 : 79.

In the centre of the sterraster a cluster, about 4 μ in diameter, of small granules is observed. Outside the umbilical area the rays protruding beyond the surface are about 2.3 μ thick and have a circular or broad-oval transverse section. The transverse section of the rays surrounding the umbilicus is greatly elongated in a direction radial to the centre of the latter and measures about 2.4 by 7 μ. The terminal spine verticils are, in the rays away from the umbilicus, composed of from six to ten, in those of the rays surrounding the umbilicus of a much larger number of lateral spines. On some of the periumbilical rays I counted as many as sixteen. The spines are broad, conical, and small, mostly under 1 μ in length. The terminal faces of the periumbilical rays are very oblique, strongly inclined inwards (Plate **44**, figs. 43–45). The umbilicus is about 10 μ deep.

The eight specimens of the two varieties of this species were collected on October 26, 1904, on the shore of Perico Island, Panama.

Although these specimens belong without doubt to the same species, they are not quite identical. Seven of them are quite or nearly white and have the same structure, one is gray and differs from the rest by its ataxasters being larger, by its megascleres and sterrasters being smaller, by the clade-angles of its large anatriaenes being considerably wider (averages 34° and 47° respectively), by its mesoproclade-cladomes being different in shape, by the rays of none of its large oxyasters being branched, by possessing a few oxysphaerasters with thick, smooth rays and irregular sterraster-derivates, and by being destitute of minute dermal anaclades. Some of these differences, particularly those of the asters and the ana- and mesoproclades, seem to me to be germinal in character.

The spiculation and the cribriporal nature of the afferents and efferents show that these sponges belong to Geodia. For the reasons given in the description of *Geodia agassizii* I have compared them not only with the described species of Geodia but also with those of Sidonops. The species most nearly allied to them are *Geodia tuber* (*tuberosa*) O. Schmidt, *G. distincta* Lindgren, *G. hilgendorfi* Thiele, *G. mülleri* (*mulleri*) Fleming, that described by Dendy as *G. ramodigitata* Carter and here described as *G. mesotriaenella*. *Geodia tuber, G. distincta, G. mülleri, G. ramodigitata* (Dendy), and *G. mesotriaenella* are distinguished from *G. ataxastra* by being destitute of ataxasters and by having much larger dermal strongylosphaerasters. *Geodia hilgendorfi* differs from *G. ataxastra* by possessing small oxysphaerasters instead of the strongylosphaerasters.

DIMENSIONS AND CHARACTERS OF THE SPICULES OF THE TWO VARIETIES OF GEODIA ATAXASTRA.

Spicules.	var. angustana.	var. latana.
Large choanosomal rhabds	chiefly amphiox, amphistrongyles and styles rare; 1.2–2.8, mostly 1.6–1.8 mm. long and 17–43, mostly 22–38 μ thick.	chiefly amphiox, but amphistrongyles and styles relatively much more frequent; 0.6–1.9, mostly 1.2–1.6 mm. long, and 12–37 μ thick.
Minute dermal rhabds	nearly all amphiox, styles exceedingly rare; 120–200, mostly 160–200 μ long, and 3–5 μ thick.	chiefly amphiox, but also a fair number of styles; 145–215 μ long, and 4–7 μ thick.
Orthoplagiotriaenes	rhabdome 1.6–2.3, mostly 1.9–2.2 mm. long, and at cladome 29–70, mostly 40–60 μ thick; clades 170–290, mostly 230–270 μ long; clade-angle 85–116°, average 100.3°.	rhabdome 1.3–1.7, mostly 1.5–1.6 mm. long, and, at cladome, 30–45, mostly 30–40 μ thick; clades 130–220 μ long; clade-angle 95–111°, average 101°.
Mesoproclades (nearly all are triaene)	rhabdome 1.6–3.4, mostly 2.1–2.8 mm. long, and, at cladome, 9–20 μ thick; (longest) clades 44–80 μ long; clade-epirhabd angles 33–48°, average 41.3°; epirhabd 33–73, mostly 40–60 μ long.	rhabdome 2–2.4 mm. long, and, at cladome, 7–13 μ thick; longest clades 25–58, mostly 32–50 μ long; clade-epirhabd angle 25–58°, average 43.6°; epirhabd 28–50, mostly 34–47 μ long.
Large anatriaenes	rhabdome 2.1–3.1 mm. long; at cladome, 3–10 μ thick; (longest) clades 17–68, mostly 30–65 μ long; clade-angles 20–42°, average 34°.	rhabdome 2–2.8 mm. long, and, at cladome 7–12 μ thick; (longest) clades 30–55 μ long; clade-angles 41–55°, average 47°.
Minute dermal anaclades	rhabdome 190–340 μ long; at cladome, 0.5–2 μ thick; clades 2–6 μ long; clade-angles 33–57°, average 47.6°.	not observed.
Large oxyasters	two-rayed 40–50, three- to seven-rayed 21–40, eight- to ten-rayed 15–28 μ in diameter.	three- to seven-rayed 17–28, eight- to eleven-rayed 15–21.5 μ in diameter.
Oxysphaerasters with slender, spined rays	8–13 μ in diameter.	10–14.4 μ in diameter.
Oxysphaerasters with stout, smooth rays	not observed.	13 μ in diameter, rare.
Small strongylosphaerasters	2.6–6 μ in diameter.	3–6.4 μ in diameter.
Ataxasters	4–7 μ in diameter.	5.3–8.3 μ in diameter.
Acanthtylasters	with ten to fourteen rays, 8–16 μ in diameter, very rare.	with four to nine rays, 10–14.5 μ in diameter.
Irregular asters (sterraster-derivates)	not observed.	21–50 μ in diameter.
Sterrasters	65–78 μ long, 58–67 μ broad, 47–57 μ thick.	55–65 μ long, 50–60 μ broad, 47–50 μ thick.

Geodia mesotriaena, sp. nov.

pachana, var. nov.

Plate 21, fig. 1; Plate 23, figs. 3, 5, 6, 8, 9; Plate 24, figs. 3, 5, 9.

microana, var. nov.

Plate 23, figs. 1–2; Plate 24, figs. 2, 6, 7, 10–13, 16, 19, 21.

megana, var. nov.

Plate 21, figs. 2–6; Plate 22, figs. 1–10; Plate 23, figs. 4, 7, 10–25; Plate 24, figs. 1, 4, 8, 14, 15, 17, 18, 20, 22–32; Plate 25, figs. 1–11.

I establish this species for three sponges, a complete dry specimen, a complete spirit specimen, and some fragments, also preserved in spirit. These specimens were collected at Stations 2909, 2942, 2958, off the coast of southern California. Their spicule-fur is composed of large and conspicuous mesotriaenes and to this the specific name refers. Although these three specimens are similar enough to be considered as the same species, each possesses peculiar characters so that it seems advisable to separate them as varieties. The most conspicuous differences between them are those of their anatriaenes. In the specimen from Station 2909, var. *pachana,* the anatriaene-cladomes are small and stout; in that from Station 2942, var. *microana,* the anatriaene-cladomes are small and slender; and in that from Station 2958, var. *megana,* the anatriaene-cladomes are large.

The specimen of var. *microana* is cake shaped and appears as a low and broad inverted cone with bulging sides, 72 mm. high, with largest and smallest horizontal diameters of 116 and 104 mm. respectively. The upper side, forming the base of the cone, is quite flat, the lower side, forming its apex, rounded. Judging from the fragments of var. *megana* this was similar (Plate **21**, fig. 2) but larger, probably as much as 200 mm. in maximum diameter. The specimen of var. *pachana* (Plate **21**, fig. 1) is relatively broader than the other two and somewhat similar to a plane-convex lens with vertical axis and flat upper face. It is 230 mm. in horizontal diameter and 120 mm. high. The basal part, the apex of the lower convex side wherewith the sponge was attached, has been torn off — in its complete state, with this apex, its height may have been 140 mm.

The *colour* of var. *microana* is yellow, that of var. *megana* brown and that of var. *pachana* dirty olive-brown on the surface and a lighter, yellowish brown in the interior. The first two are in spirit. The last is dry.

On the upper face and on the sides depressions are met with. In the smaller specimens (var. *microana* and var. *megana*) these are few in number, large parts of the surface being without any trace of them (Plate **21**, fig. 2). In the larger specimen of var. *pachana* they are more numerous and larger, 15–30 mm. wide (Plate **21**, fig. 1). Between the depressions on the upper face and the sides of the latter low elevations, 18–27 mm. broad, arranged in curved rows and forming gyrus-shaped ridges arise. Some of the depressions are isolated and shallow, most of them join to form furrows, 6–12 mm. deep, separating the gyri. At the bottom of these furrows apertures, 5–8 mm. in diameter, which lead into irregular tubes, 4–13 mm. wide, traversing the interior of the sponge and occasionally anastomosing, are observed. These tubes must not be confounded with true canals; they are, as will be shown, praeoscular cavities. Masses of sponge-tissue, on an average 30 mm. thick, separate these tubes from each other. In var. *megana* and var. *microana* tubes of this kind are also met with. Here, however, they are wider, in var. *megana* 20 mm. in diameter, and less numerous (Plate **21**, fig. 2b).

In all the specimens portions of the outer surface (Plate **21**, figs. 1, 2a), chiefly the sheltered parts in the depressions, are covered with protruding spicules which form a fur. This spicule-fur is 5 (var. *microana*) to 10 (var. *megana* and var. *pachana*) mm. high. The walls of the praeoscular tubes are also hirsute, but here the protruding spicules are less numerous and do not extend nearly so far beyond the surface. I do not doubt that the fur is produced by partial ejection of radial spicules on all parts of the surface, and that, wherever it is now wanting, it has been lost by friction, either during life or *post mortem*. As stated above, the protruding spicules forming this fur are mostly mesotriaenes.

Where the large protruding spicules have been lost, slight depressions 1.3 (var. *megana*) to 2 mm. (var. *microana*) apart are observed on the surface. Apart from these the surface appears, to the unaided eye, quite smooth.

The superficial parts, abutting on the outer surface and the praeoscular tubes, are differentiated to form a cortex free from flagellate chambers.

This *cortex* (Plate **21**, fig. 2; Plate **22**, figs. 1–7, 10; Plate **23**, figs. 24, 25; Plate **25**, fig. 1) is composed of three layers: an outer layer, containing small dermal amphioxes and various euasters but no sterrasters, and traversed by systems of mostly oblique canals (Plate **23**, figs. 24, 25, Plate **25**, fig. 1); a middle layer filled with dense masses of sterrasters and traversed by the distal parts of the narrow, radial, chonal canals (Plate **22**, figs. 3–5, 7a; Plate **23**, figs. 24b, 25b; Plate **25**, fig. 1e); and an inner layer, poor in microscleres, traversed by the proximal parts of the chonal canals (Plate **22**, figs. 5, to the right, 6, 7b; Plate **23**, figs. 24, 25). All three layers are penetrated by the rhabdomes of the protruding mesotriaenes, the inner layer also by the distal parts of the rhabdomes of those orthotriaenes and anatriaenes the cladomes of which lie near its outer limit. The outer layer is 300–500 μ thick. The middle layer, being chiefly composed of sterrasters, firmly held together by connective fibres, appears as a strong armour (sterraster-armour). Below the outer part of the surface this layer is in all the three varieties 1–1.5 mm. thick, in the walls of the praeoscular tubes thinner, in var. *megana* hardly half as thick (Plate **21**, fig. 2). The tissue composing the inner layer extends along some of the large, radial, choanosomal canals a considerable distance into the interior; between these canals it is usually 300–600 μ thick.

As stated above the outer surface is covered with slight depressions 1.3–2 mm. apart. These are situated between the points where the radial spicule-bundles abut on the surface (Plate **23**, fig. 24), so that it appears as if these depressions had been produced by a subsidence of the parts of the surface (cortex) not supported by the radial spicule-bundles. The depressions are obviously homologous to the depressed parts of the surface of horny sponges lying between the conuli, while the elevated parts, supported by the radial spicule-bundles, correspond to the conuli. Not only the outer surface but also the surface forming the limit between the outer and middle layers of the cortex is raised in the radii of the spicule-bundles, so that this also appears conulated; the "conuli" of this limiting surface are even higher than those of the outer surface. The surface forming the lower limit of the middle cortical layer is not thus raised in the radii of the spicule-bundles and nearly continuous. The thickness of the outer and middle layers of the cortex are consequently far from uniform; in the depressions the outer layer is thicker and the middle layer (sterraster-armour) thinner than in the radii of the spicule-bundles (under the conuli). The small amphioxes in the outer layer of the cortex form radial tufts. Their outer ends protrude some distance beyond the surface (Plate **23**, fig. 25i; Plate **25**, fig. 1b); on the outer surface of var. *megana* usually 50–80 μ, in the praeoscular tubes of this variety 200–300 μ. Where the spicules penetrate it, the dermal membrane is drawn up tent-fashion (Plate **25**, fig. 1). Thus a great number of small, one might say secondary, conuli are formed rising, everywhere from the surface between the large (primary) conuli.

The *canal-system proper*. In the depressions between the conuli, groups of pores, penetrating the dermal membrane and rendering it sieve-like, are met with. On the outer, exposed surface of var. *megana* these pores are more or less circular and 40–60 μ in diameter. They lead into canals (Plate **22**, figs. 1b, 2b;

Plate **23**, figs. 24c, 25c; Plate **25**, fig. 1c) 120–300 μ wide. All the canals originating from the pores of the same group converge to a point below its centre and there join to form a cavity of considerable extent, which lies in the outer layer of the cortex below the dermal membrane (Plate **23**, figs. 24, 25). From this subdermal cavity a narrow tube, the chonal canal (Plate **22**, figs. 3–7c; Plate **23**, figs. 24, 25k) extends radially downwards, penetrating the middle and inner layers of the cortex. This chonal canal, particularly its proximal part, which passes through the inner layer of the cortex, is surrounded by a ring of contractile tissue, the chone (Plate **22**, fig. 6; Plate **23**, figs. 24d, 25d), according to the degree of the contraction of which the width of the chonal canal varies. In most of the sections it is about 200 μ wide above, where it enters the middle cortical layer, and narrows centripetally to about 50 μ at its proximal end (Plate **22**, figs. 3–6; Plate **23**, fig. 25).

At the lower limit of the inner layer of the cortex, the chonal canal opens out into a wide choanosomal canal, likewise radial, extending down towards the interior. These radial choanosomal canals (Plate **23**, figs. 24, 25e) are usually 300–600 μ, sometimes as much as 1 mm. wide. Transverse membranes, protruding from their walls at intervals of 150–250 μ, partially divide the canal-lumen into a row of chambers. Some of these radial canals are short and soon split up into numerous narrow branch-canals which lead to the superficial flagellate chambers, others are long and open into larger canals, 3–5 mm. wide, which extend in a paratangential or oblique direction into the deeper parts of the choanosome (Plate **21**, fig. 2). Some of the radial canals leading down from the chones are surrounded by thick mantles free from flagellate chambers (Plate **23**, figs. 24f, 25f), which appear as centripetal continuations of the tissue forming the lower cortical layer. The chamber-bearing tissue (Plate **23**, fig. 24g) occupies the interstices between the canals (canal-mantles). Within this tissue the flagellate chambers are numerous and close together. They appear to be more or less spherical and have a diameter of 20–30 μ.

It will be seen by the above that in general structure and in the character of its canal-system this sponge is very similar to the Mediterranean *Geodia mülleri* (*cydonium*).[1] I have been able to examine this species in various stages of growth and thus to ascertain the true nature of the tubes leading down from the large depressions on the surface and the different parts of the canal-system proper. I think there can be little doubt that in *G. mesotriaena*, as in *G. mülleri*, both the

[1] *R. v. Lendenfeld.* Die Tetractinelliden der Adria. Denk. Akad. wissensch. Wien, 1894, **61**, p. 138, ff.

afferent and efferent canals proper are cribriporal, some of the pore-groups being the beginnings of the afferent, the others the termini of the efferent system. Some of the radial choanosomal canals, as stated above, are surrounded by thick mantles of tissue free from flagellate chambers, others are not so surrounded. I think that the former are efferent, the latter afferent canals. Since in *G. mesotriaena* the walls of the tubes leading down from the large depressions on the outer surface have, as in *G. mülleri*, a cortex, continuous and virtually identical with the cortex of the outer, exposed parts, I do not doubt that the tubes themselves are in the former, as in the latter, produced by a plicature and local fusion of the growing sponge in such a manner that their lumina are in reality outside the sponge and the tubes themselves not to be considered as canals proper. As the afferent pores seem to predominate on the outer, exposed surface, and as efferent pores only seem to occur in the walls of the tubes, I consider the lumina of the latter as annexes of the efferent canal-system, that is, as praeoscular cavities.

The specimen of var. *megana*, the best preserved of the three, is, in its *histological structure* on the whole similar to *G. mülleri*, but also exhibits some peculiarities. There is no accumulation of stainable cells (nuclei) at the surface. The dermal membrane is traversed paratangentially by slender spindle-shaped elements, drawn out at each end to a fine thread. The central swelling measures 1.5–2 μ, each terminal thread 0.3 μ in thickness. These elements consist of a somewhat granular substance, the granulation being coarser and more distinct in the spindle-shaped thickening than elsewhere. Lower down in the outer layer of the cortex similar fibres, not situated paratangentially but arranged irregularly, occur. The fibres joining the sterrasters stain only very slightly with azure but deeply with iron-haematoxylin. In the proximal part of the cortex paratangential threads are often observed. These are not homologous to the threads in the distal part of the outer cortical layer but appear as the connecting fibres, stretched out between the most proximal of the sterrasters. Since these sterrasters at the proximal limit of the sterraster-layer are usually much farther apart than those above, the fibres connecting them are often of considerable length. The differentiated contractile tissue, forming a ring, 300–400 μ broad, round the proximal part of the chonal canal, the chone, is brown in colour. I assume that all the chones observed are considerably contracted. The greater, outer part of the chone consists of a tissue composed of circular fibres (Plate 22, fig. 10c) and scattered euasters. This tissue does not extend right down to the chonal canal, a layer of massive or radially elongated cells and a coating of densely packed euasters intervening between the layer of circular fibres and its lumen. The transverse membranes, crossing the radial canals, are composed of three layers, an upper and a lower superficial granular layer, and a central transparent, and more highly refractive, apparently fibrous layer about 10 μ thick.

In the tissue free from flagellate chambers which as stated above, envelops some of the radial canals, large elongate cells are here and there met with singly and in groups. These cells (Plate **22**, fig. 9a, b) appear to be destitute of a membrane; their protoplasm is coarsely granular; their nucleus oval or spherical. Most of these cells are thick spindles drawn out at each end to a point (Plate **22**, fig. 9a); some of them, however, are thus drawn out at one end only and rounded off at the other, so that they appear pear shaped (Plate **22**, fig. 9b). They attain a length of 30–50 and a breadth of about 12 μ. The nucleus measures 4 μ in diameter. In some of them I have observed small masses of easily stainable granules close to the nucleus. In others, areas, more transparent and less stained than the other parts, are met with in the protoplasm. These cells seem to be ova.

Skeleton. In the innermost parts of the choanosome, that is, those farthest from the outer surface and the praeoscular tubes, masses of large amphioxes and a few large styles are found. Some of these are spicules irregularly scattered; the majority join to form loose strands extending towards the elevated parts. Bundles of spicules arise from these central masses (strands) and extend radially towards the surface. In the smaller and more solid specimens of var. *microana* and var. *megana* most of these bundles are straight or only slightly curved and abut vertically on the surface (Plate **21**, fig. 2). In the larger specimen of var. *pachana*, the structure of which is more complicated, only the bundles extending towards the summits of the elevations (gyri) are straight and in their distal parts vertical to the surface, while the others curve strongly, attempting as it were, to reach the flanks of the gyri vertically, which, however, they do not succeed in, so that their distal ends abut obliquely on the surface. Like the central spicule-masses (strands), the proximal parts of these radial bundles are composed entirely of large rhabds (numerous amphioxes and few styles). In the distal parts of the radial bundles also rhabdomes of telo- and meso-clades occur. The teloclades are mostly anatriaenes and ortho- or plagio-triaenes, the mesoclades mesoprotriaenes. Besides these normal forms triaene-derivates with two clades or only one occasionally occur. The rhabds (amphioxes and styles) extend to the distal part of the choanosome, but usually do not reach the cortex.

Most of the cladomes of the anatriaenes lie in a zone, about 1 mm. thick, just below the lower limit of the sterraster-armour. The cladomes of most of the adult ortho- and plagio-triaenes are situated at the lower limit of the sterraster-armour, appearing as if they supported this layer of the cortex. Lower down only young ortho- and plagio-triaene-cladomes are found. These are remarkably few in number. In the middle and outer layers of the cortex no teloclade- or mesoclade-cladomes occur. The rhabdomes of the protruding mesotriaenes penetrate the whole cortex; their cladomes lie high above the surface. The free, distal parts of these mesoprotriaenes compose the fur of the sponge.

Besides these large spicules numerous small spicules, small rhabds, various euaster forms, sterrasters, and, occasionally, sterroids are met with.

The small rhabds are irregularly scattered in the interior of the choanosome and form tuft-like groups in the outer layer of the cortex (Plate **23**, fig. 25i; Plate **25**, fig. 1b). Those in the proximal part of the choanosome are on the whole similar to but smaller than those in the superficial tufts. It is therefore to be supposed that these spicules are formed in the depth of the choanosome and then pushed up to the surface. The fact, however, that hardly any such spicules occur in the distal part of the choanosome and the lower and middle layers of the cortex, which they would have to pass through on their way from the interior of the choanosome to the superficial tufts, makes it somewhat doubtful whether this supposition is correct. These small rhabds are anisoactine, the thinner, more pointed end of those forming the superficial tufts being directed outward. The tufts of these spicules in the outer cortical layer appear as conical groups, the apices of which are situated at the limit between the outer and middle cortical layers. From these apices the spicules of each group (tuft) radiate outwardly, penetrate the whole of the outer layer of the cortex, and extend, as stated above, some distance beyond it, so that their distal ends protrude freely over the surface. These spicule-tufts lie quite close together, the neighbouring ones coming distally nearly or quite in contact with each other.

The sterrasters, between which occasionally a few sterroids occur, form a rather dense mass in the middle layer of the cortex (Plate **22**, figs. 3–5, 7; Plate **23**, figs. 24b, 25b; Plate **25**, fig. 1c). Here only adult sterrasters occur; young stages of these spicules are found in the lower cortical layer and the distal part of the choanosome. In all the three specimens examined such young sterrasters are, however, remarkably rare, which shows that, at the time of capture, these spicules were in none of them being produced at all rapidly.

The sponge is very rich in euasterforms. On the surface, both the outer and that surrounding the praeoscular tubes, numerous small strongylosphaerasters, forming a thin superficial layer, are met with (Plate **22**, fig. 8). Similar strongylosphaerasters occur in the lower parts of the outer layer of the cortex and in the choanosome. Occasionally I have observed much larger strongylosphaerasters apparently transitional to the sterroids. In all parts of the sponge asters with small centra, or with no central thickening at all, are found. In many of these the rays are quite slender and fairly pointed, in others thicker and blunt. Since in all, however, the rays taper more or less towards their distal end and innumerable transition-forms connect the blunt-rayed with the pointed-rayed ones, I think that all these euasters, the blunt-rayed ones as well as the pointed-rayed ones, should be considered as oxyasters. Of these oxyasters two kinds, a larger and a smaller, can be distinguished. The larger kind is restricted to the choanosome. The smaller kind is met with chiefly in the cortex and the distal part of the choanosome. Most of these asters lie superficially in the canal-walls. In the proximal part of the cortex and in the choanosome, chiefly in its distal part, large oxysphaerasters with numerous rays occur.

The *large choanosomal amphioxes* are 4.3–8.2 mm. long and 50–105 μ, usually 80–100 μ thick. Those of var. *microana* are considerably thinner than those of the other two varieties. They are straight or slightly curved and generally sharply and rather abruptly pointed. The two ends are similar (isoactine) or slightly dissimilar (anisoactine). Very rarely spicules of this kind, blunt at both ends, are met with. In one or two this bluntness is such that these spicules might be termed amphistrongyles.

DIMENSIONS OF LARGE CHOANOSOMAL AMPHIOXES OF GEODIA MESOTRIAENA.

	Var. pachana	Var. megana	Var. microana
Length mm	5.5–7.1	5.3–8.2	4.3–7.8
Thickness μ	75–105	70–105	50–77

The *large styles*, scattered in small numbers among the large choanosomal amphioxes, are 3–4 mm. long and 70–110 μ thick. The thickest part of the spicule is close to the rounded end. These spicules are to be considered as amphiox-derivates in which one of the actines has become rudimentary. They are more frequent in var. *megana* than in the other two varieties.

The *small dermal rhabds* of the superficial tufts (Plate **24**, figs. 1–6a; Plate **25**, fig. 1d) are amphioxes and styles. They measure 380–680 μ in length and 9–19 μ in thickness. In var. *megana* (Plate **24**, figs. 1a, 4a; Plate **25**, fig. 1d) and in var. *microana* (Plate **24**, figs. 2a, 6a) most of these rhabds are quite or nearly isoactine amphioxes, usually nearly cylindrical in the middle, and abruptly attenuated towards the blunt ends. A few are distinctly anisoactine and rounded at the thicker end so that they appear as styles. In var. *pachana* (Plate **24**, figs. 3a, 5a) these spicules are more spindle shaped and usually taper more gradually towards the ends. It is also to be noted that strongly anisoactine amphioxes and true styles are much more numerous among these spicules in var. *pachana* than in the other two varieties.

DIMENSIONS OF SMALL DERMAL RHABDS OF GEODIA MESOTRIAENA.

	Var. pachana	Var. megana	Var. microana
Length mm..	420–680	335–571	380–550
Thickness μ...	10–19	10–18	9–15

The *small amphioxes* of the interior of the choanosome are similar to those in the tufts but somewhat smaller. In var. *megana* they measure 170–440 μ in length and 7–17 μ in thickness. As stated above these spicules may be young stages of the small superficial rhabds in the tufts.

The rhabdomes of the *ortho- and plagio-triaenes* (Plate **21**, figs. 3–5; Plate **23**, figs. 16, 20–23) are nearly straight or curved, more or less cylindrical in their cladomal part, and conical in their acladomal part. The acladomal end is sharp pointed or blunt. The observation of thin transverse splinters lying flat, with the rhabdome-axis vertical, shows the axial rod of the rhabdome to be triangular in transverse section. Usually this rod (the canal wherein it lies) is quite narrow, 1 μ broad or less. In some of these spicules, however, I found, after boiling them in nitric acid, the axial canal in the acladomal part of the rhabdome as much as 9 μ in diameter and wide open at the end, the latter having the shape of a very thin-walled tube. The rhabdome is 4.6–7.2 mm. long and at the cladomal end 75–120 μ thick. The clades are 200–670 μ long; their chords enclose angles of 85–117°, on an average 98.5°, with the axis of the rhabdome. Very often the three clades of the same cladome differ considerably in size; ortho- and plagio-triaenes showing such an irregularity appear in fact to be more frequent than the regular ones. At the base the clades are always curved, concave towards the rhabdome; their distal part is generally straight (Plate **24**, figs. 16, 21, 22), or slightly curved in the opposite direction (Plate **24**, fig. 20), more rarely abruptly bent towards the rhabdome (Plate **24**, fig. 23). In var. *megana* the clade-rhabdome angle of these spicules is on an average only 91.9°, while it is in the other two on an average 99.4° and 104.2° respectively. Thus these spicules are mostly orthotriaenes in var. *megana*, but partly (var. *pachana* or mostly (var. *microana*) plagiotriaenes in the other two. By the complete suppression of one or two of the clades ortho- and plagio-diaenes and monaenes are produced. These are, however, rare. A plagiomonaene which I found among the spicules of var. *megana* had a rhabdome 100 μ thick at the cladomal end, and a clade 530 μ long, the chord of which enclosed, with the rhabdome-axis, an angle of 102°.

DIMENSIONS OF ORTHO- AND PLAGIO-TRIAENES OF GEODIA MESOTRIAENA.

		Var. pachana	Var. megana	Var. microana
Rhabdome	length mm.	4.6–6.6	6.1–7.2	5.7–7.2
	thickness at cladome μ	85–115	90–120	75–100
Clades	length μ	250–660	200–670	320–630
Angles between the clade-chords and the axis of the rhabdome	minimum and maximum °	94–108	85–96	95–117
	average °	99.4	91.9	104.2

The *mesoprotriaenes* (Plate **21**, fig. 6; Plate **23**, figs. 13, 14, 18, 19) have a rhabdome 6–14 mm. long. It is thickest in the middle. Here it measures 38–70 μ in transverse diameter and from here it tapers towards both the cladomal and the acladomal end. At the cladome it is usually half as thick or less than at its thickest point near the middle of its length, and here measures only 15–40 μ in transverse diameter. As an example of this I give the following measurements of a mesoprotriaene of var. *megana*. The rhabdome of this spicule was 10.5 mm. long. At the thickest point, which was situated 4.8 mm. below the cladome, it was 59 μ, and at the cladome 27 μ thick. The epirhabd is 95–330 μ long and usually simple, straight, conic, and pointed (Plate **23**, figs. 14, 18, 19). Sometimes (Plate **23**, fig. 13) it bears branches, forming an imperfect secondary cladome above the cladome proper. The clades are not nearly so constant in shape as the epirhabd, and mesoprotriaenes with irregular clades of very frequent occurrence. In the most regular mesoprotriaenes (Plate **23**, figs. 18, 19) the clades are conical, pointed, or blunt, and more or less curved, concave towards the epirhabd. Although this curvature appears rather uniform in the clades themselves, the observation of their axial rods shows clearly that it is in reality greatest at the base and decreases distally. The irregularities of the cladomes are caused by retardation of growth or irregular bending of one, two, or, rarely, all three clades. The first leads to irregularities in the length of the clades, the last to other irregularities of the cladome. Not only the clades but also the epirhabd of the mesotriaenes may become rudimentary, whereby forms like the one, represented in Plate **23**, fig. 15, are reproduced. Such *irregular teloclades* are, however, rare. The clades are 90–310 μ long; their chords form angles of 29–54°, on an average 42.4° with the epirhabd-axis. The mesoprotriaenes of var. *megana* have longer clades than those of the other two varieties. In the mesoprotriaenes of var. *pachana* the epirhabd is shorter than in those of the two others.

DIMENSIONS OF MESOPROTRIAENES OF GEODIA MESOTRIAENA.

		Var. pachana	Var. megana	Var. microana
Rhabdome	length mm.	6–14	8.8–11	
	thickness at the cladome μ	15–40	18–40	17–22
	maximum thickness μ	70	38–65	
Epirhabd	length μ	95–230	140–330	100–300
Clades	length μ	90–230	140–310	130–210
Angles between clade-chords and epirhabd-axis	maximum and minimum °	29–56	35–53	35–54
	average °	43.7	43.5	40

The *anatriaenes* (Plate **23**, figs. 1–12) have a rhabdome 11–16 mm. long, 22–40 μ thick at the cladomal end, and attenuated to a fine, more or less twisted thread at the acladomal end. The clade-chords are 90–270 μ long and enclose angles of 34–58° with the axis of the rhabdome. They are curved, concave towards the rhabdome, either (Plate **23**, figs. 3, 6) quite uniformly or (Plate **23**, figs. 10–12) more strongly between the first and second third of their length than elsewhere. There is always a small protuberance on the summit of the cladome. The clades of the anatriaenes of var. *megana* are considerably longer than those of the other two varieties. The rhabdomes and clades of var. *microana* are considerably thinner than those of the other two varieties.

Rarely irregular, mesoclade *anatriaene-derivates* (Plates **23**, fig. 17) with three regular anatriaene-clades and a curved epirhabd are met with. In their dimensions these spicules agree with the regular anatriaenes described above. The epirhabd of the mesanatriaene of var. *megana*, Plate **23**, fig. 13, is 200 μ long.

DIMENSIONS OF ANATRIAENES OF GEODIA MESOTRIAENA.

		Var. pachana	Var. megana	Var. microana
Rhabdome	length mm.	11–16	15	11
	thickness at the cladome μ	27–40	22–38	8–25
Clade-chords	length μ	90–170	160–270	70–175
Angles between clade-chords and axis of the rhabdome	maximum and minimum °	39–56	34–58	39–55
	average °	48.2	45.2	47.9

Among the normal *euasters* which occur in great numbers, small strongylosphaerasters, small and large oxyasters with small centrum or without centrum, and large oxysphaerasters can be distinguished. Besides these a few large strongylosphaerasters are found. These aster-forms are connected by numerous transitions.

The *oxyasters* (Plate **24**, figs. 1b, 6b, 7a, 9b, 10–14a, 15, 19, 22, 23, 24a, b, 25a, b, 26–31) are 11–54 μ in total diameter. They have a relatively small centrum, the diameter of which is from one eleventh to one seventh of the total diameter of the spicule, or no central thickening at all. Their rays are concentric, straight, and conical. In some of these asters the rays are in their proximal parts nearly cylindrical and decrease in thickness with increasing rapidity towards the distal end (Plate **24**, fig. 23). In others the rays are more regularly conical and attenuated quite uniformly from base to tip (Plate **24**, fig. 25a). The end of the ray is usually blunt pointed, not so frequently either sharp pointed or truncate. The basal part of the ray is smooth, the distal part, rarely also smooth (Plate **24**, fig. 26), usually covered with a varying number of smaller or larger spines (Plate **24**, figs. 27–31). The u. v. photographs (Plate **24**, figs. 28–31) show that these spines arise vertically and that they are often recurved towards the centre of the spicule, in a claw-shaped manner. These oxyasters have from five to twenty rays. Small oxyasters 11–20 μ in diameter with from nine to twenty rays, and large oxyasters 19–54 μ in diameter with from five to fifteen rays can be distinguished. The largest oxyasters, that is those over 40 μ in diameter, have from six to eleven rays, while the smallest oxyasters have from sixteen to twenty. The oxyasters attain a larger size in var. *megana* than in the other two varieties.

DIMENSIONS OF EUASTERS OF GEODIA MESOTRIAENA.

			Var. pachana	Var. megana	Var. microana
1	Large oxyasters	number of rays	6–15	5–13	6–14
		total diameter μ	19–37	22–51	24.5–42
		diameter of centrum μ	2.5–8	2–8	2–7
		length of rays μ	8–17	11–28	8–17
		basal thickness of rays μ	1.5–2.7	1–3.5	1.3–4
2	Small oxyasters	number of rays	9–10	8–15	11–20
		total diameter μ	17	17–20	11–17.5
		diameter of centrum μ	1.5–2.5	3.5–5	3–5
		length of rays μ	7–8	6–6	3.5–7
		basal thickness of rays μ	1–1.5	1–3	0.7–1.5
3	Large oxysphaerasters	number of rays	20–25	15–21	19–23
		total diameter μ	20–30	19–32	26–27
		diameter of centrum μ	3–5.5	4.5–8.5	5.5–10
		length of rays μ	7.5–8	7–12	7–11
		basal thickness of rays μ	1–1.5	1.6–3	1.8–1.9
4	Small strongylosphaerasters	number of rays	11–20	6–18	8–17
		total diameter μ	8.2–14.5	6–11	7.5–14
		diameter of centrum μ	2.5–5	2–4	2.5–6
		length of rays μ	2.2–5.5	2–7	2.5–6
		basal thickness of rays μ	1–1.8	0.5–2.5	0.8–2.1

The *large oxysphaerasters* (Plate **24**, figs. 5b, 7c, 8b) are 19–32 μ in total diameter and have a spherical centrum 3–10 μ in diameter from which from fifteen to twenty-five straight, conical, sharp-pointed, and uniformly distributed rays arise radially. The diameter of the centrum is from one seventh to one third of the diameter of the whole aster. The rays are very spiny, particularly in their distal part, 7–12 μ long, and 1–3 μ thick at the base.

The *small strongylosphaerasters* (Plate **24**, figs. 5–6c, 7d, 10–14b, 16–18, 20, 21b, 32) have from six to twenty concentric rays, usually equal in size, and quite regularly distributed. Rarely such asters with unequal rays occur. In these there are three or more long rays, and a number of more or less shortened, rudimentary ones. The rays are cylindrical or cylindroconical, usually rounded off terminally, covered with small spines, without the centrum 2–7 μ long, and 0.5–2.5 μ thick. The centrum is 2–6 μ, and the whole aster 6–14.5 μ in diameter. The small strongylosphaerasters of var. *pachana* have more numerous and more slender rays than the strongylosphaerasters of the other two varieties.

The rare *large strongylosphaerasters* (Plate **24**, figs. 7b, 9a, 21a), transitional between the small strongylosphaerasters and the sterroids, have numerous, usually cylindroconical rays densely covered with large spines. Their centrum is from one third to a half of the whole aster in diameter. Their total diameter is 16–33 μ.

The rare *sterroids* (Plate **24**, fig. 8a), which have been observed in var. *megana* only, have a very large centrum, two thirds or more of the whole aster in diameter, from which very numerous, short and stout, cylindrical rays arise. These are 5–8 μ long and 4–6 μ thick. Their sides are smooth, their convex terminal faces covered with numerous spines. These asters measure 39–58 μ in total diameter.

DIMENSIONS OF STERRASTERS OF GEODIA MESOTRIAENA.

	Var. pachana	Var. megana	Var. microana
Length μ	102–125	100–115	92–120
Breadth μ	90–102	80–105	78–107
Thickness μ	75–82	75–82	67–78
Average proportion of length to breadth to thickness	100 : 91 : 70	100 : 90 : 71	100 : 79 : 71

The *sterrasters* (Plate **22**, figs. 1–7; Plate **23**, figs. 24, 25; Plate **25**, figs. 1–11) are flattened ellipsoids 92–125 μ long, 78–107 μ broad, and 67–82 μ thick. Their average length and average thickness is nearly the same in all the three varieties: their average breadth, however, is greater in var. *megana* and var. *pachana* than in var. *microana*. The proportion of length to thickness is in the sterrasters of all three varieties 100 : 70–71; the proportion of length to breadth, on the other hand, in var. *pachana* and var. *megana* 100 : 90–91, in var. *microana* 100:79.

The umbilicus is a round (Plate **25**, figs. 2, 3, 9–11), or more (Plate **25**, fig. 6) or less (Plate **25**, fig. 7) elongated, cup-shaped depression or pit, 10–18 μ in maximum diameter. On the walls of the umbilical pit low irregular elevations, covered with numerous minute spines, often forming protruding tufts, are met with (Plate **25**, figs. 9, 10). These elevations appear as ridges, extending from the rays which surround the umbilical pit down towards its bottom, or as isolated patches, the transverse diameter of which is similar to that of the rays. The lowest part, bottom, of the umbilical pit is usually quite free from spined protuberances. The whole of the sterraster-surface, with the exception of the part occupied by the umbilicus, is covered with protruding, cylindrical rays, circular in transverse section, and usually about 3 μ thick, which terminate with a rather flat apical face. From the margin of the latter stout and blunt, conical spines arise. The axes of these spines are more or less vertical to the ray-axis, so that they appear as verticils round the summits of the rays (Plate **25**, figs. 6–8, 11). Away from the umbilicus the rays are mostly crowned by regular verticils of five or six spines (Plate **25**, fig. 8). The rays surrounding the umbilicus are provided with a greater number of spines, sometimes with as many as eleven (Plate **25**, figs. 6, 7). From the ends of many of these periumbilical rays, not only the lateral spines forming the verticil, but also more or fewer upright spines arise (Plate **25**, fig. 6). The spines attain a length of about 1.3 μ and are, at the base, about 1 μ thick. They are conical, straight, or more or less curved, and blunt. Those of the periumbilical rays are on the whole larger and more strongly curved than those of the rays on other parts of the sterraster. In a few sterrasters, one in a hundred or less, the rays are larger and distally crowned with a greater number of spines. These abnormal sterrasters appear as transitions between the regular sterrasters and the sterroids.

The specimen of var. *pachana* was trawled at Station 2909 on January 8, 1889, in 34° 22′ N., 120° 8′ 30″ W., depth 375 m. (205 f.); it grew on a bottom of green mud; the bottom temperature was 7.3° (45.2° F.); that of var. *microana* was trawled at Station 2942 on February 5, 1889, in 33° 38′ 45″ N., 118° 13′ 45″ W., depth 37 m. (20 f.); it grew on a bottom of gray sand and broken shells; the specimen of var. *megana* was caught with the tangles at Station 2958 on

February 9, 1889, in 34° 4′ N., 120° 19′ 30″ W., depth 47 m. (26 f.); it grew on a bottom of gray sand; the bottom temperature was 12.7° (54.9° F.).

These three varieties differ in many details. The specimen from Station 2909, var. *pachana*, is meandric and rich in praeoscular cavities, the other two are nearly solid. The rhabdomes of all the three kinds of teloclades, the large choanosomal amphioxes, and the small dermal rhabds, are considerably thinner in var. *microana* than in the other two. Among the small dermal rhabds styles are frequent in var. *pachana* but rare in the other two. The average clade-rhabdome angle of the orthoplagiotriaenes is in var. *megana* 91.9°, in var. *pachana*, 99.4°, and in var. *microana* 104.2°. The mesoprotriaene-epirhabds are shorter in var. *pachana*, the mesoprotriaene-clades longer in var. *megana*, and the clade-epirhabd angles smaller in var. *microana* than in the others. The anatriaene-clades are considerably longer and less divergent in var. *megana* than in the other two, which latter differ from each other by the anatriaene-clades being stout in var. *pachana* and slender in var. *microana*. The oxyasters and, to a smaller extent, also the oxysphaerasters are larger in var. *megana* than in the other two. The sterrasters are relatively narrower in var. *microana* than in the other two.

Since these specimens are all large and apparently full grown, these differences cannot be ascribed to differences in age. Some of them might of course be mere individual adaptations or due to differences of germ-separation or mixture before or during fertilization; others, however, particularly the differences in the clade-rhabdome angles of the orthoplagiotriaenes, the shape of the dermal rhabds, and the relative breadth of the sterrasters, seem to be germinal in nature and sufficient for varietal distinction. (See table on p. 112.)

On account of their cribriporal afferents and efferents and their spiculation these sponges belong to Geodia. The only other species with similar spiculation, either of this genus or of Sidonops, which I have also compared with *Geodia mesotriaena*, are *G. arabica* Carter, *G. agassizii*, *G. mesotriaenella*, *G. breviana*, and *G. ovis*.

According to the description and figures given by Carter[1] and Topsent[2] the choanosomal euasters of *G. arabica* are different from those of *G. mesotriaena;* the megascleres of the former are much smaller than those of the latter, and *G. arabica* has hitherto been found only in the Red Sea, while *G. mesotriaena* appears to be confined to the coast of California. *G. agassizii* has no

[1] *H. J. Carter.* A descriptive account of four subsphcrous sponges. Ann. mag. nat. hist., 1869, ser. 4, **4**, p. 4, pl. 1, figs. 13, 13a.

[2] *E. Topsent.* Éponges de la Mer Rouge. Mém. Soc. zool. France, 1892, **5**, p. 23.

DIFFERENCES BETWEEN THE THREE VARIETIES OF GEODIA MESOTRIAENA.

	Var. pachana	Var. megana	Var. microana
Shape	meandric	more solid	more solid
Large choanosomal amphioxes	5.5–7.1 mm. long, 75–105 μ thick	5.3–8.2 mm. long, 70–105 μ thick.	4.3–7.8 mm. long, 50–77 μ thick.
Small dermal rhabds	420–680 μ long, 10–19 μ thick; styles numerous	335–571 μ long, 10–18 μ thick; styles rare.	380–550 μ long, 9–15 μ thick; styles rare.
Ortho- and plagio-triaenes	chiefly plagiotriaenes; rhabdome 4.6–6.8 mm. long, at cladome 85–115 μ thick; clades 250–660 μ long; clade-rhabdome angle 94–108°, average 99.4°.	chiefly orthotriaenes; rhabdome 6.1–7.2 mm. long, at cladome 90–120 μ thick; clades 200–670 μ long; clade-rhabdome angle 85–96°, average 91.9°.	chiefly plagiotriaenes; rhabdome 5.7–7.2 mm. long, at cladome 75–100 μ thick; clades 320–630 long; clade-rhabdome angle 95–117°, average 104.2°.
Mesoprotriaenes	rhabdome 6–14 mm. long, at cladome 15–40 μ thick; epirhabd 95–230 μ long; clades 90–230 μ long; clade-epirhabd angles 29–56°, average 43.7°.	rhabdome 8.8–11 mm. long, at cladome 18–40 μ thick; epirhabd 140–330 μ long; clades 140–310 μ long; clade-epirhabd angles 35–53°, average 43.5°.	rhabdome at cladome 17–22 μ thick; epirhabd 100–300 μ long; clades 130–210 μ long; clade-epirhabd angles 35–54°, average 40°.
Anatriaenes	rhabdome 11–16 mm. long at cladome 27–40 μ thick; clades 90–170 μ long; clade-chord rhabdome angle 39–56°, average 48.2°.	rhabdome 15 mm. long, at cladome 22–38 μ thick; clades 160–270 mm. long; clade-chord rhabdome angle 34–58°, average 45.2°.	rhabdome 11 mm. long, at cladome 8–25 μ thick; clades 70–175 mm. long; clade-chord rhabdome angle 39–55°, average 47.9°.
Small strongylo-sphaerasters	Total diameter 8.2–14.5 μ	total diameter 6–14 μ.	total diameter 7.5–14 μ.
Oxyasters	total diameter 17–37 μ	total diameter 17–54 μ	total diameter 11–42 μ.
Oxysphaerasters	total diameter 20–30 μ	total diameter 19–32 μ	total diameter 26–27 μ.
Sterrasters	102–125 μ long, 90–102 μ broad, 75–82 μ thick; average proportion of length to breadth to thickness 100:91:70.	100–115 μ long, 80–105 μ broad, 75–82 μ thick; average proportion of length to breadth to thickness 100: 90: 71.	92–120 μ long, 78–107 μ broad, 67–78 μ thick; average proportion of length to breadth to thickness 100: 79: 71.

praeoscular cavities, differently shaped small strongylosphaerasters, and much smaller megascleres and choanosomal oxyasters. *Geodia breviana* also has much smaller megascleres; this species is also distinguished from *G. mesotriaena* by its minute, dermal anaclades and the thickness of the clades of the large anatriaenes. The species most nearly allied to *G. mesotriaena* are *G. mesotriaenella* and *G. ovis*. Of *G. mesotriaenella* there is only a small specimen in the collection, and at first I thought that it was a young *G. mesotriaena.* A more careful examination showed, however, that it differs from the latter not only by the smaller size of its spicules, which, in view of the small size of its body, would not, by itself, be of any systematic importance, but also by the shape of its mesotriaenes, orthotriaenes, and oxysphaerasters. The mesotriaene-epirhabds are in *G. mesotriaena* as long as or longer than the clades in *G. mesotriaenella,* as a rule, they are very considerably shorter. The ortho- or plagio-triaene-clades are in *G. mesotriaena* nearly straight or somewhat turned upward at the end, in *G. mesotriaenella* concave towards the rhabdome right up to the tip. The oxysphaerasters of *G. mesotriaenella* have stouter and less spiny rays than those of *G. mesotriaena. Geodia mesotriaena* differs from *G. ovis,* by the possession of praeoscular cavities in the interior; by its spicule-fur being not nearly so highly developed; by having much smaller dermal strongylosphaerasters, and by the absence of the minute anatriaenes and the oxyasters with very stout, regularly conical, sharp-pointed rays, which characterize *G. ovis.*

Geodia agassizii, sp. nov.

Plate 26, figs. 1–21; Plate 27, figs. 1–19; Plate 28, figs. 1–28; Plate 29, figs. 1–17; Plate 30, figs. 1–17; Plate 31, figs. 1–10; Plate 32, figs. 1–46; Plate 33, figs. 1–14; Plate 34, figs. 1–17.

Cydonium mülleri L. M. LAMBE (non Fleming), Trans. Roy. soc. Canada, 1893, **11**, p. 36, pl. 4, fig. 2.

I establish this species for twenty-two specimens obtained at nine different stations on the west coast of North America; eight at Station 2886, one at Station 2887, two at Station 2978, one at Station 3088, one at Station 3168, two at Station 4193, four at Station 4199, two at Station 4228, and one at Station 4551.

The reexamination of the sponge determined by L. M. Lambe (*loc. cit.*) as *Cydonium mülleri* Fleming in the collection of the Geological Survey of Canada, and which was kindly placed at my disposal for examination, shows that it differs specifically from the typical *Geodia* (*Cydonium*) *mülleri* and is an immature form of the sponges here described. A new species with another specific name must therefore be established for these sponges and *Cydonium mülleri* Lambe 1893.

Although much has been written on the variability of sponges, our knowledge concerning this subject is still very vague. The results of the examination of the differences between these sponges, given below, throw some light upon it so that greater general interest attaches to this species than to most of the others here described. For this reason I have selected for it the name *agassizii.*

One of the two specimens from Station 4228 is, like the one described by Lambe, in some respects immature in character; all the others, although of various sizes, are apparently adult. In the case where more than one adult specimen was obtained at the same station, these are fairly identical in structure. The adult specimens from different stations, on the other hand, differ more or less, but although these differences are not inconsiderable, I have, for the reasons given below, united all in one species and have refrained from further subdividing this into subspecies, varieties, or forms.

Shape and size. All the specimens have a more or less continuous surface and are massive and destitute of vestibular or praeoscular cavities. The greater number are attached by a small base and are either quite regularly spherical (Plate **26**, figs. 16, 19, 20; Plate **34**, fig. 17), oviform (Plate **26**, figs. 17, 18), or somewhat irregular (Plate **26**, fig. 21). Some are more cushion shaped and attached by an extended base. The largest specimen, which is a stout oviform one (Plate **26**, fig. 17), was obtained at Station 4193. It is 130 mm. long, 105 mm. broad, and 100 mm. high. Smaller, more or less regularly spherical specimens, 20–55 mm. in diameter, were obtained at Stations 2886, 4228, and 4551. The smallest one of these, which is at the same time the smallest of all the twenty-two, is the immature specimen above referred to. Two elongated ones, measuring $68 \times 35 \times 35$ mm. and $46 \times 20 \times 20$ mm. respectively, were trawled at Station 2886, and another elongated one, $47 \times 32 \times 30$ mm., at Station 2887. The specimens from Stations 2978, 3088, 3168, and 4199 are broad-based, more or less cushion shaped, and not so regular in outline. The largest of these was obtained at Station 4199. It measures 50 mm. in length, 46 mm. in breadth, and 34 mm. in height. The maximum diameter of the others is 24–46 mm. The specimens from Station 4199 show a predilection for the concave, inner side of tubular hexactinellid skeletons. One of them quite fills such a tube, three quarters of the circumference of which is still present. The immature specimen described by Lambe is smaller than any of these. It measures only 12 by 10 mm.

In all the specimens by far the greater part of the *surface* is free from projecting spicules and finely granular, or, as in the specimens from Station 4228, nearly smooth. In some remnants of a spicule-fur have been observed. In the large specimen from Station 4193 there are a few areas with projecting spicules up to 16 mm. long and lying very obliquely to the surface. In the cushion-shaped specimens from Stations 2978 and 4199 a well-developed spicule-fur, up to 9 mm. in height, is observed in sheltered places near the base of the sponge.

Also in the immature specimen from Station 4228 spicules protruding up to 5 mm. beyond the surface occur. From these observations I infer that large spicules are protruded and a spicule-fur is thus formed by all these sponges, and that this has been wholly or partly lost during life or after capture.

Larger apertures (oscules) are absent, but minute holes in the sterraster-armour are observed in large numbers. Minute holes of two different sizes can be distinguished. The larger, which are clearly visible to the unaided eye, and through which the efferent cortical canals pass, are restricted to certain areas of the surface. The smaller, which are not visible to the naked eye and through which the afferent cortical canals pass, occupy the remainder of the surface. In one of the specimens from Station 4199 the area perforated by the large efferent holes is roughly circular in outline, 18 mm. in diameter, and slightly concave, thus forming a shallow depression. In the other specimens the efferent areas are not depressed. In the large specimen from Station 4139 there are two efferent areas, one a horseshoe-shaped zone 20 mm. broad and 64 mm. in total diameter, the other an irregularly circular patch 15 mm. wide. In the smaller specimens there are one or two, rarely three, generally more or less circular efferent areas 8–24 mm. in diameter. The holes piercing the sterraster-armour in these efferent areas (Plate **26**, fig. 13) are circular and measure 300–700 μ in diameter, their centres being 1–1.5 mm. apart.

Concerning the *mode of attachment* it is to be noted that the young specimen from Station 4228 has grown quite over part of the hexactinellid skeleton-net which forms its support, the siliceous bars of the latter partly penetrating the sterraster-armour of the Geodia and entering its choanosome which surrounds them as if they formed a portion of the true internal skeleton of the Geodia.

Most of the specimens are light brown in *colour*. The larger one of the two from Station 4193 has a few extensive darker, rust-brown patches on the surface. Of the eight specimens from Station 2886 some also are light brown, while the others are dark blue. The specimens from Stations 4228 and 4551 are lighter in colour than the others, nearly white. The true colour of these sponges, when preserved in spirit, is probably light brown or white; the rust-brown and dark blue pigmentations of some of the specimens may possibly have been produced after capture.

The sponge has a *cortex*, which is in the adult specimens about 1 mm. thick and composed of three layers, the dermal layer outside, the sterraster-armour layer in the middle, and a fibrous layer within. The dermal layer is in the young specimen from Station 4228 (Plate **32**, figs. 8, 11, 12) and in several of the adult ones (Plate **27**, fig. 1) merely a thin dermal membrane. In other adult specimens (Plate **27**, fig. 2a) it is 150–200 μ, rarely as much as 230 μ, thick and composed of loose tissue, containing small amphioxes and strongylosphaerasters, but no sterrasters or oxyasters. The sterraster-armour layer (Plate **27**, figs. 1b, 2b; Plate **32**, figs. 8a, 11a, 12a) is in the young specimen from Station 4228 350–400 μ, in the adult specimens usually about 800 μ thick. The inner, fibrous layer is free from sterrasters and quite thin. The limit between the dermal layer and the sterraster-armour layer is very clearly defined, the limit between the latter and the inner, fibrous layer is somewhat indistinct.

Canal-system. The areas of the large efferent holes in the sterraster-armour are, in all sufficiently well-preserved specimens, covered by a dermal membrane perforated by numerous small afferent pores. These lead into systems of canals traversing the dermal layer and converging to points lying in the level of the limit between this layer and the sterraster-armour layer. Here the canals of each system join to form a radial tube, surrounded by a chonal sphincter, which occupies one of the small afferent holes in the sterraster-armour. The afferent cortical canals are in all the sections examined very narrow, or quite closed. Below the sterraster-armour layer these canals open out into subcortical cavities (Plate **27**, fig. 2c) which are higher than broad and often attain a radial dimension (height) of 1 mm. The chonal sphincters do not protrude into these cavities. From the majority of these subcortical cavities narrow afferent canals lead down to the adjacent flagellate chambers. Some of the subcortical cavities join below to form large afferent canals (Plate **27**, figs. 1d, 2d) 1–2 mm. wide, which, repeatedly ramifying, supply the more distant flagellate chambers. The flagellate chambers are spherical and measure 27–35 μ, usually about 30 μ, in diameter. The efferent canals arising from them join to form large tubes (Plate **27**, fig. 1e; Plate **32**, fig. 5a), 1 mm. or more in diameter, which extend towards the areas of the large efferent holes in the sterraster-armour layer. The afferent canals are not separated from the chamber-bearing choanosomal tissue by special mantles and have smooth surfaces. The efferent canal-stems on the other hand are, particularly in their wider distal parts (Plate **27**, fig. 1e; Plate **32**, fig. 5a), enclosed in sheaths, about 500 μ thick, free from flagellate chambers, and greatly constricted at very frequent intervals by transverse sphincter-membranes, protruding far into their interior. Distally these efferent canal-stems divide into branches which lead up to the cortex. From the summits of these branches arise radial cortical canals (Plate **26**, figs. 13, 14a, 15a), surrounded by chonal sphincters, generally found open and usually 120–500 μ wide. Many of these efferent chonal canals are destitute of dermal sieves and open out freely on the surface (Plate **26**, fig. 13, those to the right). In some of the specimens nearly all of them are thus naked; in most, however, some of these efferents are covered by dermal sieves, composed of nets of threads, 50–120 μ broad, with round meshes of very variable size (Plate **26**, fig. 13, those to the left, figs. 14b, 15b). Thus, at first sight, it appears as if there were, in this sponge, two different kinds of efferents, cribriporal and uniporal ones. A closer examination, however, reveals remnants of dermal sieves in most of the apertures appearing at first sight uniporal. I think it therefore highly probable that all the efferents are, like the afferents, provided with sieve-membranes (cribriporal) in the living sponge, and that, where they are now missing, they have been lost *post mortem*.

The *skeleton* consists chiefly of large choanosomal and small dermal amphioxes, orthoplagiotriaenes, mesoprotriaenes, anatriaenes, large oxyasters, large oxysphaerasters, small strongylosphaerasters, and sterrasters. To these spicules, which occur in all the specimens, a few large amphistrongyles, slender and cylindrical or thick and club-shaped styles, mesoclade or amphiclade orthoplagiotriaene-derivates, anadiaenes, sterroids, and other irregular forms may be added. In the specimens attached to hexactinellid skeletons, particularly in the young specimen from Station 4228, small hexactinellid spicules, hexactines, and scopules are also found imbedded in the choanosome. These foreign spicules are by no means restricted to the base of the sponge which is attached to the dictyonine network of the hexactinellid, but are found in all parts.

The large choanosomal amphioxes are arranged radially and form loose, conical bundles extending from the centre or base to the surface of the sponge. Some of the outermost of these spicules protrude beyond the surface and thus take part in the formation of the fur (Plate **27**, figs. 1, 2). The rare amphistrongyles, which I have observed only in the young specimen from Station 4228, are scattered in small numbers between them. The rare, large styles, both the thinner cylindrical and the thicker club-shaped ones, are arranged radially like the large amphioxes among which they occur, their rounded end being situated distally, their pointed end proximally. These spicules are more numerous in the distal than in the proximal parts of the bundles and often protrude their rounded end beyond the surface. I have found the thick club-shaped styles only in the specimens from Stations 3168 and 4193, the thin cylindrical ones in all the specimens with the exception of those from Stations 2887, 2978, 4228, and 4551. The small dermal amphioxes form radial, tuft-like groups, which arise from the sterraster-armour, traverse the dermal layer and expand above (Plate **27**, fig. 2), their distal ends protruding more or less beyond the surface. In some specimens, as in the one from Station 3168, a section of which is represented in Plate **27**, fig. 2, this protrusion is very slight; in others, as in a specimen from Station 4193 and in the young specimen from Station 4228, the small amphioxes protrude as much as 200–280 μ beyond the surface. It seems that these differences in the degree of protrusion of the small dermal amphioxes are, partly at least, due to differences in the state of preservation and degree of shrinkage of the tender dermal layer; in the well-preserved and not much shrunken specimens their protrusion is slight, in specimens not so well preserved, it is great. Some small amphioxes, similar to those forming the tufts in the dermal layer, are occasionally observed in the proximal layer of the cortex and in the distal part of the choanosome. The cladomes of the orthoplagiotriaenes generally lie at the limit between the cortex and the choanosome; their clades extend paratangentially in this level, their rhabdomes are directed radially inwards. Sometimes, particularly in the young specimen from Station 4228, the orthoplagiotriaene-cladomes are situated a little higher, within the sterraster-armour layer (Plate **32**, figs. 8, 11, 12). The orthoplagiotriaenes do not protrude beyond the surface and take no part in the formation of the fur. The rare mesoclade and amphiclade orthoplagiotriaene-derivates and the quite irregular forms belonging to this category of spicules have been found only in spicule-preparations, so that I am unable to say what position they occupy in the sponge. I have found mesorthotriaenes in the spicule-preparations of the specimens from Stations 2978 and 4199, amphiclade orthoplagiotriaene-derivates in such preparations of the specimens from Stations 3168 and 4199 and the young specimen from Station 4228. The mesoprotriaenes, the anatriaenes, and their various derivates are also radially arranged. The cladomes of a few of them lie a short distance beneath the surface, most of them protrude freely beyond it. These spicules form the principal part of the spicule-fur. In this fur the mesoprotriaenes are generally much more numerous than the anatriaenes. Anadiaenes and other, irregular anatriaene-derivates have been observed only in the specimens from Stations 3168 and 4228.

The small strongylosphaerasters form a single but dense layer on the surface of the dermal membrane (Plate **26**, fig. 15) and also occur in the interior. The large oxysphaerasters, which appear to be much more numerous in the specimens from Stations 2886 and 3168 than in those from the other stations, are chiefly met with in the walls of the cortical and subcortical canals (Plate 26, fig. 14) and in the inner layer of the cortex. The large oxyasters are scattered throughout the choanosome, where they chiefly occupy the canal-walls. The sterrasters occupy the middle layer of the cortex in dense masses (Plate 27, figs. 1b, 2b; Plate 32, figs. 8a, 11a, 12a). In some specimens, particularly the adult specimen from Station 3168 and the young specimen from Station 4228, a good many sterrasters, chiefly young ones, also occur in the choanosome (Plate 32, figs. 8, 11, 12). A small number of sterroids are usually associated with the sterrasters.

The *large amphioxes* (Plate 28, figs. 15, 16a, 17a; Plate 32, figs. 9, 10) are numerous in all the specimens. They are cylindrical in their central part and rather abruptly and not very sharply pointed, sometimes blunt at the ends. They are usually isoactine or slightly anisoactine, a few are strongly anisoactine. In the adult specimens they are 2.3–4.8 mm. long and 60–112 μ thick, their general average maximum [1] dimensions being 3.9 mm. $\times$ 86.3 μ. In the specimens from Station 2886 and the adult specimen from Station 4228 they are smaller, both shorter and thinner, than in those from any of the others. In the specimens from Station 4193 they are very slender, longer than in any and thinner than in most of the others. In the specimens from Station 2978 they are of medium length, but very much thicker than in any of the others. In the young specimen from Station 4228 the large amphioxes are 2.1–3.4 mm. long and 20–66 μ thick, their average maximum dimensions being 3.1 mm. $\times$ 57 μ. In the immature specimen described by Lambe these amphioxes measure 1.8–3.4 mm. by 33–47 μ. (See table p. 120.)

The rare *large amphistrongyles,* which have been observed in the young specimen from Station 4228 are somewhat shorter than the large amphioxes, about 55 μ thick in the middle, and attenuated to about 40 μ at the rounded, somewhat truncate ends.

The *large, slender, cylindrical styles* (Plate 28, fig. 17b) which have been found in small numbers in all the specimens, with the exception of those from Stations 2887, 2978, 4228, and 4551, are 1.5–3.4 mm. long and 60–110 μ thick, gently curved, and only slightly thickened, or not thickened at all, at the rounded end.

[1] In all cases these average maxima were obtained as follows:— first the averages of the dimensions of the three largest amphioxes of the (adult) specimens from each of the nine stations were taken. From these special maximum averages (of three), which are given in the subjoined table, the averages were again taken. These latter averages (means) which appear in the subjoined table in the column headed "from all stations" are the "general maximum averages."

DIMENSIONS OF LARGE CHOANOSOMAL AMPHIOXES OF GEODIA AGASSIZII.[1]

Station		2886	2887	2978	3088	3168	4193	4199	4228	4551	All Stations	4228
Length	of apparently full-grown spicules, mm.	2.4–3.8	2.4–4.1	3.5–4.2	3.5–4.4	3.1–4.5	3.1–4.8	2.4–3.9	2.3–3.5	2.7–4	2.3–4.8	2.1–3.4
	average of the three longest, mm.	3.4	3.8	4.1	4.	4.2	4.6	3.8	3.2	3.8	3.9	3.1
Thickness	of apparently full-grown spicules, μ	60–81	80–100	90–112	65–82	80–93	72–95	61–85	35–80	68–100	60–112	20–66
	average of the three thickest, μ	75	93	111	76	89	87	79	74	93	86.3	57

The *large, thick, club-shaped styles* (Plate **28**, figs. 12–14), which occur in small numbers in the specimens from Stations 3168 and 4193, are straight or slightly curved, always thickened at the rounded end, and 115–145 μ thick.

The minute *dermal amphioxes* (Plate **27**, figs. 3a, 7a, 8a) occur in all specimens. They are slightly curved and usually not very sharply pointed at the ends. Sometimes one end is much more blunt than the other, but the bluntness never seems to be great enough to make the spicule appear as a style. In the adult specimens these spicules are 160–480 μ long and 5–12 μ thick, their average maximum dimensions being 342 $\times$ 9.06 μ. Those of the specimens from Station 2886 are considerably larger, both longer and thicker, than those of the others. Particularly slender ones are met with in the adult specimen from Station 4228. In the young specimen from Station 4228 these spicules are 225–300 μ long and 4–7 μ thick. In the immature specimen described by Lambe they are 180–480 by 3–8 μ.

DIMENSIONS OF SMALL DERMAL AMPHIOXES OF GEODIA AGASSIZII.

Station	2886	2887	2978	3088	3168	4193	4199	4228	4551	From all Stations	4228
Length, μ	220–480	210–340	230–270	260–360	160–290	270–390	290	185–330	310–330	160–480 maximum average 342	225–300
Thickness, μ	7–12	8–10	7–8	8–10	7	7–10	8	5–8.5	8	5–12 maximum average 9.06	4–7

[1] In this and the following tables the specimen from Station 4228 is a young specimen; those from the other stations are adults.

The *orthoplagiotriaenes* (Plate **26**, figs. 3–12; Plate **29**, figs. 1–6, 8–12, 14–17; Plate **34**, figs. 1–12, 14, 15) occur in large numbers in all specimens. Their rhabdomes are straight or slightly curved and usually regularly conic, occasionally more cylindrical. The conical rhabdomes are generally pointed (Plate **26**, figs. 3, 5–12; Plate **34**, figs. 1–7), more rarely blunt (Plate **26**, fig. 4; Plate **34**, fig. 9). The more cylindrical rhabdomes are more or less shortened and thickened to tyles at the acladomal end (Plate **32**, figs. 12b; Plate **34**, fig. 8, 10–12, 14, 15). Orthoplagiotriaenes with conical rhabdomes occur in all the specimens. The orthoplagiotriaenes with more cylindrical, shortened and terminally thickened rhabdomes are exceedingly rare in the adult specimens, but quite numerous in the young specimen from Station 4228. The ordinary conical orthoplagiotriaene-rhabdomes of the adult specimens are 1.5–4.2 mm. long and 65–150 μ thick at the cladome, their average maximum dimensions being 3.39 mm. $\times$ 115.44 μ. In the ordinary orthoplagiotriaenes of the specimen from Station 4551 the rhabdome is remarkably stout, shorter and at the same time thicker than in the ordinary orthoplagiotriaenes of any of the others. In the ordinary orthoplagiotriaenes of the specimens from Station 4193 on the other hand the rhabdome is very slender, its length being above the mean and its thickness less than in the orthoplagiotriaenes of any of the others. The conical rhabdomes of the orthoplagiotriaenes of the young specimen from Station 4228 are 2–3.5 mm. long and at the cladome 50–100 μ thick, their average maximum dimensions being 3.3 mm. $\times$ 90 μ. The orthoplagiotriaene-rhabdomes reduced in length and terminally thickened (Plate **34**, figs. 8, 10–12, 14, 15) are more cylindrical, and much less attenuated towards the distal end than the ordinary ones. The degree of this attenuation is proportional to the length, very short ones (Plate **34**, fig. 15) being not attenuated at all and regularly cylindrical. The terminal thickening is usually fairly spherical. Its diameter is 15–25 % greater than the thickness of the part of the rhabdome lying just above it. Sometimes one or more slight thickenings of the rhabdome are observed above the terminal thickening. A cylindrical, terminally thickened orthoplagiotriaene-rhabdome of an adult specimen from Station 2978 was 900 μ long and 155 μ thick at the cladomal end, the thickness of the thickened acladomal end being 170 μ. In the young specimen from Station 4228 these more cylindrical orthoplagiotriaene-rhabdomes are 760 μ–2.35 mm. long, and at the cladome 60–105 μ thick. Their thickness is, roughly speaking, in inverse proportion to their length. The two shortest observed, one of which is represented on Plate **34**, fig. 15, were 950 and 760 μ long and 95 and 105 μ thick respectively.

In young orthoplagiotriaenes the entire clade, in the fully developed ones its basal part only, is directed obliquely upward. In their further course the clades of the fully developed orthoplagiotriaenes bend downwards, so that their distal parts lie more or less in a plane vertical to the rhabdome. The chords of the clades of the orthoplagiotriaenes of the adult specimens enclose angles of 73–117°, on an average 98.2°, with the axis of the rhabdome. In the adult specimens from Stations 3168 and 4228 the clade-rhabdome angles do not exceed 100°, so that here all these triaenes appear as orthotriaenes. In the adult specimens from the seven other stations a smaller or a greater number of such triaenes with clade-chord angles exceeding 100° and appearing as plagiotriaenes in consequence, are observed. The *average* clade-angle, however, exceeds 100° only in the specimens from Stations 2886, 2887, and 4193. The angles of the three clades of the same cladome are usually nearly equal. It is very rarely that they become so different as to give the cladome a position oblique to the rhabdome. Such orthotriaenes with oblique cladomes are represented on Plate **26**, fig. 3, and Plate **29**, fig. 4.

The size and the shape of the clades are far from constant, not only the clades of different orthoplagiotriaenes of the same specimen but even the clades of one and the same triaene often being very dissimilar. Their maximum average dimensions are, however, about the same in all the specimens. At the base the clades are a little thinner than the cladomal end of the rhabdome, the ratio between these two dimensions varying between 7 to 10 and 9 to 10. The clades are 240–560 μ long, their average maximum length being 490.89 μ. The maximum average of those of the orthoplagiotriaenes of the specimen from Station 4551 is the smallest, of those of the orthoplagiotriaenes of the specimens from Station 4199 the largest. The orthoplagiotriaenes of the young specimen from Station 4228 have clades 300–500 μ long, their average maximum length being 490 μ. Their chords enclose angles of 88–108°, on an average 97° with the axis of the rhabdome.

In all specimens orthoplagiotriaenes with simple clades, gradually decreasing in thickness and curvature towards the usually not very sharp-pointed end (Plate **26**, figs. 3, 4, 6, Plate **29**, figs. 1–5, 8, 11), are met with. In the specimens from six of the stations all the orthoplagiotriaenes, or at least a very great majority of them, have regular clades of this description. In the specimens from Stations 3168, 4193, and 4199 on the other hand the orthoplagiotriaenes with such simple and regular clades are not so numerous as orthoplagiotriaenes with one or more clades rendered irregular by being either abruptly bent down near the end, or branched. Clades abruptly bent down at the end are represented on Plate **26**, fig. 8, Plate **29**, figs. 6, 15, Plate **34**, figs. 5, 8. The ramified clades (Plate **26**, figs. 8–12; Plate **29**, figs. 9, 10, 12, 14, 16, 17; Plate **34**, fig. 15) are so variable, that it is difficult to find two alike. Their branches either extend in a longitudinal plane passing through the rhabdome, or less frequently they diverge in different directions forming, if numerous, a terminal bunch. They hardly ever lie in the plane of the cladome and therefore differ fundamentally from dichotriaene-end clades. The simplest and most frequent forms of these branched clades are those in which one straight, conical, thorn-like branch arises from the lower (rhabdomal) side of the distal part of the clade. This branch is either directed vertically downward (Plate **29**, fig. 12), or, more frequently, obliquely downwards and outwards (Plate **26**, figs. 9–12; Plate **29**, figs. 9, 16). Its size is in proportion to the distance of its origin from the end of the clade; when it arises near the end of the clade it is small (Plate **29**, fig. 16) when it arises farther away from it, it is larger (Plate **29**, fig. 9). In some clades of this kind the branch is terminally divided into small secondary branchlets (Plate **29**, fig. 17). Sometimes the clades bear two simple or secondarily ramified branches (Plate **29**, fig. 10). The most complicated forms are those in which the clade terminally divides into a greater number of divergent simple, or more often, secondarily ramified branches (Plate **29**, figs. 14, 16). In the immature specimen, described by Lambe, orthoplagiotriaenes and dichotriaenes occur. According to Lambe (*loc. cit.*, p. 37), the latter are much more numerous than the former, "few examples of the simple orthotriaenes" being found. I, on the contrary, found the orthoplagiotriaenes quite as numerous as the dichotriaenes if not more so. The orthoplagiotriaenes have a rhabdome 2.1–3 mm. by 70–90 μ, and clades 300–450 μ long; the clade-angles are 91–103°. The dichotriaenes have a rhabdome 1–2.2 mm. by 50–75 μ, main clades 150–300, and end clades 30–130 μ long; the breadth of the whole cladome is 350–700 μ, the main clades enclose angles of 109–112° with the rhabdome.

DIMENSIONS OF THE ORTHOPLAGIOTRIAENES OF GEODIA AGASSIZII.

Station			2886	2887	2978	3088	3168	4193	4199	4228	4551	From all Stations	4228
Rhabdome	length	of apparently full-grown spicules, mm.	2–3 2	1 9–3.1	2.1–4.2	2.5–3 7	2 4–4	2.9–3 8	2 8–3.4	1 5–2 8	2.3–3.3	1.5–4.2	2–3.5
		average of the three largest dimensions, mm.	3 1	3 1	4	3 6	3 9	3 6	3 7	2 5	3	3 39	3.3
	thickness	of apparently full-grown spicules, μ	73–110	90–110	95–145	80–120	90–137	65–95	70–103	80–105	90–150	65–150	50–100
		average of the three largest dimensions, μ	103	110	139	120	132	92	102	98	143	115 44	90
Clades	length	of apparently full-grown spicules, μ	270–500	250–530	270–520	270–530	320–520	400–550	320–560	440–520	240–450	240–560	300–500
		average of the three largest dimensions, μ	467	507	483	493	483	520	540	497	428	490 89	490
	angle	of apparently full-grown spicules, °	94–104	95–109	92–104	73–110	83–100	94–117	90–105	95–100	86–105	73–117	88–108
		average, °	100	102	96	99	92	104	98	97	96	98.2	97

The *mesorthotriaenes* (Plate **26**, fig. 1; Plate **29**, fig. 7; Plate **34**, fig. 16) are very rare and have been found only in the adult specimens from Stations 2978, 4199, and 4228, and the young specimen from Station 4228. They consist of a style-like shaft, from which three clades arise. The shaft is conical, 1.8–3 mm. long and 78–164 μ thick at the rounded end. It usually tapers to a simple point at the other end. In one of these spicules, however, the thin end of the shaft was bifid, terminating in two points, lying close together. The three clades form a verticil situated 150–280 μ below the rounded end. They are 78–300 μ long. Their basal part is directed obliquely downward towards the pointed end of the shaft. Distally they curve round towards its rounded end, either uniformly, or abruptly. It is not quite easy to say which of the two parts of the shaft on either side of the clade-verticil is to be considered as the rhabdome and which as the epirhabd. The fact that the pointed part is very much longer than the rounded part is in favor of the view that the former is the rhabdome and the latter the epirhabd. Since, however, the rounded part is the thicker of the two, since the clades have their concave side turned towards this shorter and thicker part; and since there can be little doubt that these spicules are derivates of the orthoplagiotriaenes, in which the concave side of the clades is invariably turned towards the rhabdome, it seems that the short, thick, and rounded part of the shaft should be considered as the rhabdome and the long, thin, and pointed part as the epirhabd.

The *amphiclade orthoplagiotriaene-derivates* (Plate **26**, fig. 2; Plate **29**, fig. 13; Plate **34**, fig. 13) are also very rare. They have been found only in the adult specimens from Stations 3168 and 4199 and in the young specimen from Station 4228. They differ from the orthoplagiotriaenes described above only by possessing, besides the terminal cladome proper, a short, rounded or pointed clade about 100–150 μ long, which arises at the acladomal end of the rhabdome or some other part of it more or less remote from the true cladome.

Besides these orthoplagiotriaene-derivates a few *quite irregular spicules* have been observed, which, to judge from their general character, appear to be derivates either of the orthoplagiotriaenes or of the large choanosomal amphioxes. On Plate **28** photographs of some of these spicules are reproduced. One, fig. 8, is a triaene with a shaft 35 μ thick at the cladomal end, and three straight, conical clades, 130 μ long, approximately extending in a plane which passes through the rhabdome. One, fig. 10, is a stout, large amphiox with two straight and pointed, clade-like branch-rays, 165 μ long, arising 250 μ below one of the ends and extending very obliquely downward towards the centre of the amphiox. One, fig. 9, has the appearance of a large amphiox, one end of which is replaced by a centrally attached, obliquely situated, style-like rhabd, 430 μ long. One, fig. 11, is a large amphiox, from which, at a distance of 260 μ from one of the ends, a straight, conical, clade-like branch, 240 μ long, arises vertically.

Of other irregular spicules observed I mention an amphistrongyle, about 1 mm. long and thicker at one end than the other, with a straight, conical, branch-ray 80 μ long, arising obliquely 70 μ below the thinner end and directed towards the thicker end.

The *mesoprotriaenes* (Plate **28**, figs. 1–7, 16d; Plate **32**, figs. 40, 41) occur in all specimens. Their rhabdome, which is thicker in the middle than at either end, is straight or only slightly curved, and in the adult specimens 2–6 mm. long and at the cladome 7–40 μ thick, the average maximum dimensions being 5.1 mm. $\times$ 25.11 μ. The rhabdomes of the mesoprotriaenes of the young specimen from Station 4228 are, at the cladome, 9–13 μ thick, the maximum average of this dimension being 12 μ. The clades are conical, pointed, and always curved, concave towards the epirhabd, in their basal part. In their distal part they are either curved in the same direction (Plate **28**, figs. 3, 5, 6), or nearly or quite straight (Plate **28**, figs. 2, 4, 7; Plate **32**, figs. 40, 41), rarely abruptly bent (Plate **28**, fig. 1). The angles between the chords of the clades and the epirhabd are in the mesoprotriaenes of the adult specimens 22–55°, on an average 38°. The mesoprotriaenes of the specimens from Station 4193 have exceptionally large, those of the specimens from Station 2886 exceptionally small, clade-epirhabd angles. As a rule the three clades of the same cladome are fairly equal in size; mesoprotriaenes with unequal clades are, however, by no means rare. Sometimes their inequality is so great that the longest clade of a cladome is more than twice as long as the shortest. Sometimes one clade is reduced to a mere knob, and the spicule appears as a promesodiaene. A few such promesodiaenes I found in the spicule-preparations of the young specimen from Station 4228. The rhabdomes of these spicules are much stouter and their clade-angles much smaller than those of the mesoprotriaenes and it is possible that they are foreign to the sponge. The chords of the clades of the mesoprotriaenes of the adult specimens are 60–250 μ long, their average maximum length being 161.78 μ. The longest clades are observed in the mesoprotriaenes of the specimens from Station 2978, the shortest in those of the specimens from Station 4193. The chords of the clades of the mesoprotriaenes of the young specimen from Station 4228 are 95–125 μ long (maximum average 120 μ) and enclose angles of about 42° with the axis of the epirhabd.

The epirhabd is straight, conical, and pointed. In the majority of the mesoprotriaenes it is about as long as the clades (Plate **28**, figs. 1–6; Plate **32**, figs. 40, 41). In not a few, however, it is either considerably shorter or considerably longer (Plate **28**, fig. 7). It is in the adult specimens 25–320 μ long, its average maximum length being here 140.33 μ. Of all the spicule-dimensions the length of the mesoprotriaene-epirhabd is the most inconstant, the differences of the adult specimens from the nine stations in this respect being very great indeed. The longest epirhabds are met with in the mesoprotriaenes of the specimens from Station 4199, the shortest in those of the specimens from Station 4193. In the young specimen from Station 4228 the epirhabds of the mesoprotriaenes are 85–100 μ long, their average maximum length being 95 μ. In the immature specimen described by Lambe the rhabdome is 20 μ thick, the clades are 60–90 μ long, the clade-angles are 36–47°, and the epirhabd is about 70 μ long.

DIMENSIONS OF MESOPROTRIAENES OF GEODIA AGASSIZII.

Station			2886	2887	2978	3088	3168	4193	4199	4228	4551	From all stations	4228
Rhabdome	length	of apparently full-grown spicules, mm.			2–5	3.5–5.8	4.5–5.5		4.1–6	6	3.6–4.3	2–6	
		average of the three longest, mm.			4.7	5.5	5.1		5	6	4	5.1	
	thickness	of apparently full-grown spicules, μ	20	25–27	15–40	15–30	20–30	18–20	7–32	12–22	10–23	7–40	9–13
		average of the three thickest, μ	20	27	34	26	28	19	30	21	21	25.11	12
Clades	length	of apparently full-grown spicules, μ	120	150–180	125–250	60–150	150–200	90–100	100–210	90–180	90–175	60–250	95–125
		average of the three longest, μ	120	180	250	143	178	95	203	145	142	161.78	120
	angle	of apparently full-grown spicules, °	26	35–40	30–50	32–55	30–40	39–55	22–48	32–50	33–55	22–55	42
		average, °	26	37	39	39	36	47	36	41	41	38	42
Epirhabd length		of apparently full-grown spicules, μ	110	110–150	70–210	60–135	25–150	60–100	90–320	78–125	60–110	25–320	35–100
		average of the three longest, μ	110	150	192	125	136	80	268	109	93	140.33	95

The *anatriaenes* (Plate 28, figs. 16c, 18–27; Plate 32, figs. 43, 45, 46) occur in all specimens. They appear to be particularly numerous in the specimens from Station 2887. The rhabdomes of the anatriaenes of the adult specimens are 4–9 mm. long and at the cladome 10–50 μ thick, their average maximum dimensions being 6.5 mm. × 32.56 μ. The rhabdomes of the anatriaenes of the specimens from Station 4199 are considerably thicker than those of the others. The rhabdome is straight or slightly curved and thicker in the middle than at either end (Plate **28**, fig. 16c). The acladomal end usually thins out to a fine point, it is rarely blunt. The rhabdomes of the anatriaenes of the young specimen from Station 4228 are at the cladome 18–27 μ (average maximum 25 μ) thick. Among them a few with rhabdomes shortened and terminally thickened, like the rhabdomes of some of the orthoplagiotriaenes, have been observed.

The basal parts of the clades are curved, concave to the rhabdome, the distal parts straight. Where the basal curved part passes into the distal straight part, a slight, abrupt, angular bend is sometimes discernible (Plate **28**, figs. 19, 20, 25). In most of the anatriaenes the distal straight part of the clade is about as long as the proximal curved part (Plate **28**, figs. 18–21, 24, 25); in some the former is considerably longer than the latter (Plate **28**, figs. 23, 26; Plate **32**, figs. 43, 45, 46). Anatriaenes of this kind occur in the specimens from Stations 4199 and 4228. The chords of the clades of the anatriaenes of adult specimens enclose with the axis of the rhabdome angles of 32–65°, on an average 45.8°. In the anatriaenes of the specimens from Station 2886 this angle is considerably larger than in those of the others. The three clades of the same cladome are usually about equal in length (Plate **28**, figs. 19–26). Sometimes, however, their length is unequal (Plate **28**, figs. 18, 27; Plate **32**, fig. 45). In the adult specimen from Station 3168 and in the young specimen from Station 4228 anatriaenes with clades of unequal length are relatively more numerous than in the specimens from the other stations. The chords of the clades of the anatriaenes of the adult specimens are 40–155 μ long, their average maximum length being 118.11 μ. In the specimens from Station 2886 the clades of the anatriaenes are very considerably shorter than any of the others. The chords of the clades of the anatriaenes of the young specimen from Station 4228 are 60–110 μ (average maximum 95 μ) long and enclose angles of 31–45° (average 38°) with the axis of the rhabdome. In the immature specimen described by Lambe the anatriaenes have a rhabdome 3.3–4.7 mm. by 22–28 μ, clades 45–100 μ long, and clade-angles of 41–52°.

In the centrifugal spicule-preparations of this specimen also a few *minute dermal anaclades* were observed. These have a rhabdome about 290 μ by 1–1.5 μ at the cladome and 3–5 μ at the thickest point below the middle; their clades are 4–6 μ long; the clade-angles are 38–62°. These spicules may be foreign.

DIMENSIONS OF ANATRIAENES OF GEODIA AGASSIZII.

Station			2886	2887	2978	3088	3168	4193	4199	4228	4551	From all Stations	4228
Rhabdome	length	of apparently full-grown spicules, mm.		5.3–9	4.1–5.8	7.2–7.5	6–7.5			4–8.2	4.6	4–9	
		average of the three longest, mm.		8.7	5.4	7.3	7			6	4.6	6.5	
	thickness	of apparently full-grown spicules, μ	10–50	17–35	17–35	20–32	22–36	25–33	20–40	30–37	22–32	10–50	18–27
		average of the three thickest, μ	29	35	33	31	32	31	40	36	26	32.56	25
Clades	length	of apparently full-grown spicules, μ	40–95	70–150	90–140	70–115	75–155	90–140	100–130	95–140	80–140	40–155	60–110
		average of the three longest, μ	67	133	140	98	145	123	120	130	107	118.11	95
	angle	of apparently full-grown spicules, °	50–60	40–65	33–60	40–55	33–53	32–47	38–46	32–51	40–48	32–65	31–45
		average, °	55	49	43	46	44	43	42	44	46	45.8	38

The *anadiaenes* (Plate **28**, fig. 28; Plate **32**, fig. 44) are rare. They have been found only in the adult specimens from Station 3168 and the young specimen from Station 4228, where also anatriaenes with clades of different length are more frequent than in the specimens from the other stations. In shape and size they perfectly resemble those anatriaenes, and I consider them as such anatriaenes, in which the inequality of the clades is carried to the extent of the complete suppression of one of them.

The *irregular anatriaene-derivates* differ from the ordinary anatriaenes by one of the three clades being directed upwards. These anatriaene-derivates are rare. I have observed them only in the specimens from Station 4228.

The *large choanosomal oxyasters* (Plate **27**, figs. 3b, 6–14b; Plate **30**, figs. 1b, 2b, 4, 5, 10b; Plate **32**, figs. 4, 6, 7) of the adult specimens have from four to sixteen rays and a small centrum the diameter of which is usually from two to three times as great as the basal thickness of the rays. The rays are usually radial and quite regularly distributed only in the rare, exceptionally large, few-rayed oxyasters of the adult specimen from Station 4228 is an irregular distribution of the rays observed. The rays are straight, at the base 0.8–3.2 μ thick and conical. They taper uniformly to the end, which is pointed, blunt, rounded, or rarely, truncate. The distal parts of the rays are always more or less spiny. In some oxyasters the spines extend down nearly to the base of the rays, in others they are confined to the distal two thirds, and in a few — such as I have found chiefly in the specimens from Station 4199 — they are more or less restricted to verticils lying just below the tips of the rays. The oxyasters with spines arranged in this manner appear somewhat acanthtylaster-like. The oxyasters of the adult specimens measure 9–31 μ in diameter, their average maximum diameter being 24.22 μ. Oxyasters more than 26 μ in diameter with irregularly distributed rays have been met with only in the adult specimen from Station 4228. Among the others the specimens from Stations 3168 and 4551 have the largest, those from Station 4199 the smallest oxyasters. The size of these asters is in inverse proportion to the number of their rays. None of the oxyasters over 20 μ in diameter observed by me had more than nine rays, all those with ten or more rays being less than 20 μ in diameter. The large choanosomal oxyasters of the young specimen from Station 4228 are similar to those described above, usually have from nine to fourteen rays 0.8–1.7 μ thick at the base, and measure 13–25 μ in total diameter. In the immature specimen described by Lambe the oxyasters have from seven to nine rays 1.3–2.3 μ thick and a central thickening; their total diameter is 13–20 μ.

TOTAL DIAMETERS OF THE LARGE OXYASTERS OF GEODIA AGASSIZII.

2886	2887	2978	3088	3168	4193	4199	4228	4551	From all Stations	4228
14–21μ	10–22μ	12–23μ	18–25μ	14–26μ	13–24μ	13–20μ	12.5–31 μ	9–26 μ	9–31 μ maximum average 24.22 μ	13–25μ

The *large oxysphaerasters* (Plate **26**, fig. 14; Plate **27**, figs. 4c, 14c; Plate **30**, fig. 3) appear to be more numerous in the specimens from Stations 2886 and 3168 than in those from the other stations. The oxysphaerasters of the adult specimens consist of a spherical central thickening (centrum), 3.5–11 μ in diameter, from which from fourteen to twenty-eight and perhaps more (it is exceedingly difficult to count them accurately) equidistant radial rays arise. These are usually shorter than the diameter of the centrum, regularly conical, 1–2 μ thick at the base, and sharp or blunt pointed. From the distal parts of the rays a few quite large spines arise. These are often arranged in a somewhat verticillate manner near the tip of the ray. These oxysphaerasters are 10–21 μ in total diameter, the average maximum being 18.2 μ. In the young specimen from Station 4228 the large oxysphaerasters have from eighteen to perhaps thirty rays and measure 12.5–18 μ in total diameter, the diameter of the centrum being rather less than in the oxysphaerasters of the adult specimens and rarely exceeding 4 μ. In the immature specimen described by Lambe the oxysphaerasters have from ten to twenty rays, 0.9–2 μ thick, the centre is 2.7–7 μ, the whole aster 8–21 μ, in diameter.

TOTAL DIAMETER AND DIAMETER OF THE CENTRUM OF THE LARGE OXYSPHAERASTERS OF GEODIA AGASSIZII.

Station		2886	2887	2978	3088	3168	4193	4199	4228	4551	All Stations	4228
Diameter of	aster μ	14–15	14–18	14–20	18–21	10–13	15–19	14–20	10–18	15–20	10–21 maximum average 18.2	12.5–18
	centrum μ	7–9	7–7.5	7–11	7–9	6	10	5–8	3.5–7	6–8	3.5–11 maximum average 8.4	3.5–4

The *small strongylosphaerasters* (Plate **26**, fig. 15; Plate **27**, figs. 3–14d; Plate **30**, figs. 1a, 2a, 6–9, 10a; Plate **32**, figs. 2, 3) are abundant in all specimens. They consist of a central sphere (centrum), from which from six to twenty fairly equidistant rays arise radially. The length of these rays is usually smaller, rarely as great as or greater, than the diameter of the centrum. In the small strongylosphaerasters of the adult specimens the rays are at the base 0.6–1.6 μ thick and taper towards the truncate end, or are nearly cylindrical (Plate **30**, figs. 6–9). The rays bear small spines, which often appear massed at their ends. The total diameter of these asters is 3.5–11 μ, the average maximum being 9.1 μ. The centra are 1.5–6 μ in diameter, the average maximum being 4.3 μ. The centra of the small strongylosphaerasters of the specimens from Stations 2978 and 4193 are smaller than the centra of those of the others. The small strongylosphaerasters of the young specimen from Station 4228 are similar to those of the adult specimens. They usually have from twelve to nineteen rays 0.5–1 μ thick; and a centrum 2–3 μ in diameter; their total diameter is 5.5–9 μ. In the immature specimen described by Lambe the small strongylosphaerasters have from ten to twenty-eight rays 0.6–1 μ thick, the centre is 2–3.5, the whole aster 5–7 μ, in diameter.

TOTAL DIAMETER AND DIAMETER OF THE CENTRUM OF THE SMALL STRONGYLO-SPHAERASTERS OF GEODIA AGASSIZII.

Station		2886	2887	2978	3088	3168	4193	4199	4228	4551	All Stations	4228
Diameter of	aster μ	4–8.5	4–9	4–10	4–11	5–9	3.5–7	1.5–9	3.5–10	4–8	3.5–11 maximum average 9.1	5.5–9
	centrum μ	2–4	3.5–5.5	1.5–2.5	3.5–6	2–4	2.5–3.2	2.5–4.5	1.5–4	3–4.5	1.5–6 maximum average 4.2	2–3

The *normal sterrasters* (Plate **27**, figs. 15–19; Plate **30**, figs. 11–17; Plate **31**, figs. 1, 2, 5–7; Plate **32**, figs. 32, 35; Plate **33**, figs. 1–8, 12, 13) are abundant in all specimens. The full-grown sterrasters of the adult specimens are flattened ellipsoids 82–118 μ long, 75–100 μ broad, and 58–83 μ thick, their average maximum dimensions being 103.55 by 88.56 by 69.22 μ. The largest are those of the specimen from Station 3088. The proportion of length to breadth to thickness is fairly constant. Those of the specimen from Station 3088 are relatively somewhat longer and those of the specimens from Stations 2886 and 4228 relatively somewhat thinner than those of the others. In the young specimen from Station 4228 the full-grown sterrasters are similar in shape, 76–100 μ long, 70–85 μ broad, and 60–70 μ thick, their average maximum dimensions being 95 by 83 by 68 μ. In the immature specimen described by Lambe the sterrasters are 90–110 by 74–92 by 67–75 μ. (See table p. 133.)

On one of the two broader sides of the normal full-grown sterrasters an umbilicus, usually more or less circular in outline, 12–15 μ in transverse diameter, and 6 μ deep, is observed (Plate **27**, figs. 15–19; Plate **31**, figs. 1, 2, 5–7). With the exception of a small, smooth, central patch at its bottom, the wall of the umbilical pit appears to be roughened (Plate **31**, figs. 5, 7). I am not quite positive, however, whether there really is a roughness there, it being quite possible that its appearance in this place may be an optical illusion, caused by a refraction at the surface of the umbilical pit, that in fact this apparent roughness is in reality nothing but a blurred ultraviolet light-image of the rays and spines on the other side of the surface, which are traversed by the light before it reaches the umbilicus. Observations with high powers in ordinary light failed to decide this question.

From the whole of the surface of these normal, full-grown sterrasters, with the exception of the part occupied by the umbilicus, the distal ends of the rays composing the sterraster protrude a short distance. The freely protruding distal parts of these rays are usually circular or somewhat polygonal, four- to seven-sided, in transverse section, 1.3–4 μ thick, regularly distributed, and hardly 1 μ apart. They are truncate, and from the margin of their terminal face a verticil of from four to seven, most frequently six, spines arises. These spines extend either transversely, vertical to the axis of the ray, or, less frequently, obliquely outward and a little upward. The spines of the rays remote from the umbilical pit are stout, straight cones, about 1.7 μ long and 1.3 μ thick at the base (Plate **31**, figs. 1, 2, 6, 7; Plate **33**, figs. 12, 13). Those of the spines of the rays surrounding the umbilical pit, which extend towards the umbilicus, are often larger, as much as 2.5 μ long, and not regularly conical but irregular, their ends being broad and sometimes covered with small, secondary spinelets.

DIMENSIONS OF STERRASTERS OF GEODIA AGASSIZII.

Station		2886	2887	2978	3088	3168	4193	4199	4228	4551	All stations	4228
Length	of apparently full-grown sterrasters, μ	90–100	97–104	90–112	110–118	100–110	82–97	85–97	95–100	95–110	82–118	76–100
	average of the three longest, μ	96	102	111	118	109	94	97	98	107	103.55	97
Breadth	of apparently full-grown sterrasters, μ	78–83	81–90	85–100	87–95	90–96	80–83	75–88	80–90	83–90	75–100	70–85
	average of the three broadest, μ	82	88	91	91	94	82	85	88	90	88.56	83
Thickness	of apparently full-grown sterrasters, μ	58–60	65–72	74–75	78–83	65–70	63–70	67–70	58–61	69–73	58–83	60–70
	average of the three thickest, μ	59	71	75	81	70	66	69	61	72	69.22	68

Besides these normal forms of full-grown sterrasters, which form the great majority, some others with fewer and usually stouter protruding rays and more numerous or larger and differently shaped spines, which I propose to name *sterroids* (Plate **31**, figs. 3, 4, 8–10; Plate **32**, figs. 13–28, 33, 34, 36–39; Plate **33**, figs. 9–11, 14), are met with.

In one kind of sterroid (Plate **31**, figs. 3, 4; Plate **32**, figs. 33, 34, 36–39; Plate **33**, fig. 10) the free distal parts of the rays are considerably thicker, 4–13 μ in transverse diameter, and farther apart than in the normal sterrasters. Some of them, chiefly those surrounding the umbilicus, but also others, have an irregularly elongated transverse section. In these sterrasters the thick rays bear, besides a terminal verticil of from eight to fourteen lateral spines, rather larger than those of the normal sterrasters, several others which arise obliquely from their terminal face.

In another form of sterroid (Plate **31**, figs. 8–10; Plate **33**, figs. 9, 14) the freely protruding distal parts of the rays are not very much thicker, but very much farther apart than in the normal sterrasters, and provided with very different spines. The part of the surface of the solid centrum lying between the protruding rays is in these sterroids covered by large numbers of small projections of various shape, and appears irregularly granular. Each ray bears from two to eight mostly lateral, but in part also terminal, spines, which are 2.5–5 μ long, up to 3 μ broad, slightly curved down at the end and covered with numerous small secondary spinelets. When viewed from above, the spines are somewhat similar to serrated leaves.

In a third kind of sterroid (Plate **32**, figs. 25–28; Plate **33**, fig. 11) the rays are thicker, up to 15 μ in transverse diameter, and farther apart than in the forms above described. They are terminally rounded and covered with large numbers of recurved, somewhat claw-like spines. In most of these sterrasters the rays are all fairly equally developed, their free distal parts covering the whole of the solid centrum of the spicule and protruding equally far beyond it (Plate **32**, figs. 25, 26). In some, however, there are only a few groups of protruding rays, the greater part of the surface of the centrum being destitute of such (Plate **32**, figs. 27, 28) but covered with groups of spines similar to the spines on the protruding rays.

In the specimens from Station 4228, both the young and the adult, I have found a few oxysphaerasters, about as large as the sterrasters, three in the former and one in the latter. These spicules have from thirteen to fifteen straight, conical and smooth, radial and concentric, rather irregularly distributed rays. They measure 90–100 μ in total diameter; the diameter of the centrum is 25–27 μ; the rays are (without the centrum) 35–40 μ long and 10–17 μ thick at the base. I found these asters *in situ* in sections in the subcortical layer and I do not think that they are foreign to the sponge. For the reasons given below, I considered them as sterroid-derivates.

In the choanosome of several of the specimens of *Geodia agassizii*, particularly the adult one from Station 3099, and the young one from Station 4228, numerous young sterrasters in various stages of development have been observed. In the adult specimens all these young sterrasters exhibit the well-known form of spheres composed of very numerous, regularly distributed, slender, radial rays. In the young specimen from Station 4228 young sterrasters of this kind are also abundant, but here besides these ordinary forms numerous other asters, similar in dimension, but very different in appearance occur. A close examination showed the latter to be the young forms of the sterroids. By comparing a large number of these and the ordinary young sterrasters with each other and with the fully-developed ones I was able to trace the development both of the normal sterrasters and the sterroids.

On Plate **30**, figs. 11–17, Plate **32**, figs. 29–31, and Plate **33**, figs. 1–8, two series of developmental stages of the normal thin-rayed sterrasters, the first from an adult specimen from Station 3188, the second from the young specimen from Station 4228, are represented. One of the youngest stages observed, Plate **33**, figs. 1, 2, is a sphere 17 μ in diameter. This young sterraster consists of about 460 straight and exceedingly slender, thread-like, concentric rays, which are equal in length, regularly distributed, and jointed proximally. Adjacent rays enclose angles of about 10°. As the spicule grows these rays increase in thickness, their proximal parts thickening first and this process of thickening then extending distally. The basal thickening parts of the rays coalesce, as they come in contact with each other, to form a solid centrum. In the next stage (Plate **33**, figs. 3, 4) the basal parts of the rays protruding from the solid centrum thus formed show a slight bulbous thickening which increases so that in young sterrasters 50 μ in diameter (Plate **33**, figs. 5–7) the rays are at the base already 2 μ thick, their distal ends, however, being still quite thin. In this stage each ray appears as a cone, widened below like a bulb, and drawn out to a fine thread above. As development progresses the thickening of the rays extends farther and farther towards their distal ends (Plate **30**, figs. 11–13), the whole sterraster and its solid centrum increase in size, and the fine terminal points of the rays become shorter and shorter, until they are entirely enveloped in the ascending thickening and thus altogether disappear. In this stage (Plate **30**, fig. 14; Plate **33**, figs. 7, 8) the young normal sterrasters appear as solid, at first still fairly spherical, central masses from which cylindrical rays, which stand close together and are about 4 μ thick and simply rounded at the end, protrude. Without changing much in appearance, these young sterrasters increase in size and begin to assume the flattened ellipsoidal appearance of the full-grown ones (Plate **32**, figs. 29–31). Then the basal parts of the protruding rays coalesce farther and spines begin to grow out from the margin of their terminal face (Plate **30**, figs. 15, 16). These spines at first appear as small rounded knobs. Later (Plate **30**, fig. 17) the rays are thickened terminally and the spines grow in length. They are in such young sterrasters very slender and do not attain their full thickness for some time.

The early stages of the sterroids differ from those of the normal sterrasters described above by the rays composing them being not nearly so numerous and usually also not so regularly arranged. In accordance with the smallness of the number of the rays the angles between them are much larger than in the young forms of the normal sterrasters. The thickening and concrescence of the basal parts of the rays, which in the latter lead to the early formation of a solid centrum, here therefore does not have this effect until a very much later stage. Young stages of the thick- and few-rayed sterrasters 60–70 μ in diameter (Plate **32**, figs. 13–20), which correspond to the stages of the normal sterraster represented on Plate **32**, figs. 29, 30, accordingly have a much smaller centrum and much longer cylindroconical, terminally rounded protruding rays. As stated above these rays are often irregularly distributed and the angular distances between them are very unequal. Rays of such young sterrasters standing particularly close together coalesce as early as all rays of the normal sterrasters do, whereby the irregularity in the appearance of these spicules is greatly enhanced (Plate **32**, figs. 15, 16, 19, 20). The distal parts of the rays cover themselves with numerous small spines, which later grow in size. Subsequently, through the continued thickening and concrescence of the basal parts of the rays, the centrum increases in size (Plate **32**, figs. 21–26). Finally sterroids are formed, the centra of which are as large as the centra of the normal sterrasters, the surface of which, however, bears much fewer and usually thicker rays covered with a much larger number of spines. While the rays of the normal sterrasters are nearly always equal in length, the rays of the sterroids are occasionally unequal. In such sterroids with rays unequally long the concrescence may reach up to or even beyond the shorter rays, which are then totally enveloped by the mass of the centrum, their positions being indicated in the full-grown sterroid only by the groups of spines on the parts of the surface of the centrum free from protruding rays. In this way irregular few- and thick-rayed sterroids like the one represented on Plate **32**, figs. 27–28 are formed.

The sterroids differ from the normal sterrasters accordingly not only when full grown but also, and even to a greater degree, when young.

The large oxysphaerasters of the specimens from Station 4228 above referred to, which in their dimensions equal the sterrasters, are rather similar to some of the young stages of the sterroids. They may therefore be such spicules, in which the development has, as it were, gone wrong, the thickening of the rays, which normally leads to the formation of a large solid centrum, and the formation of the spines on the rays having been suppressed.

LOCALITIES AND NATURE OF ENVIRONMENT.

Number of Station	Locality	Date	Depth	Bottom temperature	Bottom	Number of specimens
2886	Off Oregon, 43° 59′ N., 124° 56′ 30″ W.	19 Oct., 1888	91 m. (50 f.)	9° (48.1° F.)	Rocky	8
2887	Off Oregon, 43° 58′ N., 124° 57′ W.	19 Oct., 1888	77 m. (42 f.)	8.4° (47.1° F.)	Clay, pebbles	1
2978	Off southern California, 33° 59′ 45″ N., 119° 22′ 15″ W.	12 Feb., 1889	84 m. (46 f.)	13.6° (56.5° F.)	Gray sand	2
3088	Off Oregon, 44° 28′ N., 124° 25′ 30″ W.	3 Sept., 1889	84 m. (46 f.)	8° (46.3° F.)	Clay, pebbles	1
3168	Off central California, 38° 01′ 25″ N., 123° 26′ 55″ W.	24 Mar., 1890	62 m. (34 f.)	—	Rocky coral	1
4193	Gulf of Georgia: Halibut Bank; Cape Roger Curtis, Bowen Island: S. 89° E., 20 km. (10.8 miles), drift S. 1° E.	20 June, 1903	33–40 m (18–23 f.)	10.2°- (50.3° F.)	Fine green sand	2
4199	Queen Charlotte Sound: off Fort Rupert, Vancouver Island, B. C. Centre of Round Island. S. 46° W., 11.5 km. (6.2 miles), drift S. 85° E.	25 June, 1903	124–196 m. (68–107 f.)	7.7° (45.9° F.)	Soft green mud and volcanic sand	4
4228	Vicinity of Naha Bay: Behm Canal. S. E. Alaska, Indian Point. N. 18° E., 1.7 km. (0.9 miles), drift N. 2° W.	7 July, 1903	75–245 m. (41–134 f.)	8.8° (47.8° F.)	Gravel and sponge spicules	2
4551	Monterey Bay, Cal.; Point Pinos Light House. S. 9° E., 8.4 km. (4.5 miles), drift S. 37° E.	7 June, 1904	102 m. (56 f.)	—	Coarse sand, shells, rock.	1
—	Houston Stewart Channel, Queen Charlotte Island.	1893	—	—	—	1

The young stages of the sterroids have been observed only in the young specimen from Station 4228 and in the immature specimen described by

Lambe. They are much more numerous in the former than in the latter. Fully developed sterroids occur sparingly in all adult specimens. In other Geodidae, where I have found them, they also occur in small numbers. These facts lead me to consider the sterroids as spicules produced, like the milk-teeth of mammals, in the immature state only. If this assumption is correct, the sterroids might be similar to the ancestral form of the normal sterrasters, and represent a link connecting the latter with the sphaerasters from which I should be inclined to derive them.

To simplify the references to these sponges, I will, in the following discussion of their relative systematic position, designate:—

Those	from	Station	2886 as A	Those	from	Station	4193 as F
"	"	"	2887 " B	"	"	"	4199 " G
"	"	"	2978 " C	"	"	"	4228 " H
"	"	"	3088 " D	"	"	"	4551 " I
"	"	"	3168 " E				

To avoid confounding characters immature in nature with the systematically important peculiarities of the full-grown sponges, the young specimen from Station 4228 and the immature specimen described by Lambe are not taken into account in the following discussion.

In the character of their shape these sponges are very similar, their differences in this respect not exceeding the individual variations usually met with in the species of geodine sponges. In the structure of their canal-system, their soft parts, and the general arrangement of their skeleton they are also uniform. In their colour and in the shape, relative frequency, and dimensions of their spicules however, only the specimens collected at one and the same station agree. The differences in the colour of specimens from different stations are certainly very considerable. But since it is very likely that these differences have been produced *post mortem* through differences in the external influences to which the different lots were exposed after capture, they are without systematic significance. The differences in the spicules, on the other hand, are systematically important, and it is therefore necessary to study them with care if we wish to decide in what systematic relation these otherwise similar sponges stand to each other.

The differences in the shape and relative frequency of the spicules of the several lots of these sponges are as follows: in *E* and *F* both thick club-shaped and thin cylindrical styles are met with in small numbers; in *A*, *D*, and *G* thin ones only; and in *B*, *C*, *H* and *I* no styles at all. In *E*, *F*, and *G* the ortho-plagiotriaenes with clades either abruptly bent down at the end or terminally branched are more numerous than the orthoplagiotriaenes with simple and regular clades. In the others all, or nearly all, orthoplagiotriaenes have simple and regular clades, orthoplagiotriaenes with clades like those of the majority of *E*, *F*, and *G* being very rare or absent altogether. In the clades of the anatriaenes of *G* and *H* the straight distal part is considerably longer than in those of the others. In *E* and *H* anatriaenes with clades unequal in length or position have been met with. In some of the anaclades of *E* one clade is absent altogether, these spicules appearing as anadiaenes. Oxyasters over 26 μ in diameter with irregularly arranged rays have been found only in *H*. The small strongylosphaerasters of *C* and *F* have on an average smaller centra than those of the others. In *A* and *E* the large oxysphaerasters are much more numerous than in the others.

In dimension the spicules of the lots from the different stations differ more or less. To obtain a base for studying these differences the sets of measurements of the fifteen spicule-dimensions obtainable with the greatest accuracy of each of the nine lots of adult specimens from the nine stations, were selected for further study. These dimensions are: — the diameter of the oxyasters; the length and breadth of the sterrasters; the length and thickness of the large choanosomal amphioxes, the small dermal amphioxes, and the rhabdomes of the orthoplagiotriaenes; the thickness of the rhabdomes of the anatriaenes and mesoprotriaenes; the length of the clades of the orthoplagiotriaenes, anatriaenes, and mesoprotriaenes; and the length of the epirhabds of the mesoprotriaenes. Of each of these ($15 \times 9 =$) 135 sets of measurements the largest alone were taken into account. Of three, the length and thickness of the small dermal amphioxes and the diameter of the large oxyasters, the largest dimension observed in each lot was taken by itself. Of the twelve other dimensions averages of the three largest dimensions measured were taken. These single maxima and maximum averages of three of the fifteen spicule-dimensions taken into account in the nine lots are given in IV of the subjoined table. From these maximum averages (maxima) the general averages (means) were taken. These general maximum averages (means) are given in II of the table. The deviation of the average maximum (maximum) of each of the fifteen dimensions of each of the nine lots (IV) from the mean (general maximum average, II) of the same dimension was ascertained by subtraction. These (135) deviations are given in V of the table. Referring as they do to spicule-dimensions of very different size the numbers giving these deviations are not commensurate and directly comparable with each other. To obtain numbers expressing these deviations from the general maximum averages (per cent) in a commensurate manner, the number, different in each case, with which the general maximum average must be multiplied to make the product 100 mm. was ascertained by dividing 100 mm. by the general maximum average of the dimension in question (II). With these numbers, which are given in III, the deviation of each dimension from the means (V) was then multiplied. The product thus obtained is the percentage (commensurate) deviation given in VI.

To bring out more clearly the significance of the commensurate numbers given in VI, I have represented the variations of the spicule-dimensions ex-

I			II	III	IV								
Spicule-dimensions			General maximum averages.	Number with which to multiply the general average dimension (col. II) to make it 100 mm. (100 mm. divided by the number in col. II).	Averages of the three largest dimensions measured of the large amphioxes, the orthoplagiotriaenes, mesoprotriaenes, anatriaenes, and sterrasters; and maximum dimensions measured of the small dermal amphioxes and the oxyasters.								
					A Station 2886	B Station 2887	C Station 2978	D Station 3088	E Station 3168	F Station 4193	G Station 4199	H Station 4228	I Station 4551
Large amphioxes		length mm.	3.9	25.65	3.4	3.8	4.1	4.3	4.2	4.6	3.8	3.2	3.8
		thickness μ	86.3	1158.75	75	93	111	76	89	87	79	74	93
Small dermal amphioxes		length μ	34.2	292.4	480	340	270	360	290	390	290	330	330
		thickness μ	9.06	11037.5	12	10	8	10	7	10	8	8.5	8
Orthoplagiotriaenes	rhabdome	length mm.	3.39	29.5	3.1	3.1	4	3.6	3.9	3.6	3.7	2.5	3
		thickness μ	115.44	866.2	103	110	139	120	132	92	102	98	143
	clades	length μ	490.89	203.72	467	507	483	493	483	520	540	497	428
Mesoprotriaenes	rhabdome	thickness μ	25.11	3982.48	20	27	34	26	28	19	30	21	21
	clades	length μ	161.78	618.13	120	180	250	143	178	95	203	145	142
	epirhabd	length μ	140.33	712.59	110	150	192	125	136	80	268	109	93
Anatriaenes	rhabdome	thickness μ	32.56	3071.26	29	35	33	31	32	31	40	36	26
	clades	length μ	118.11	846.66	67	133	140	98	145	123	120	130	107
Large oxyasters		total diameter μ	24.22	4128.44	21	22	23	25	26	24	20	31	26
Sterrasters		length μ	103.56	965.66	96	102	111	118	109	94	97	98	107
		breadth μ	88.56	1129.24	82	88	94	94	94	82	85	88	90

pressed by these numbers also graphically. This graph, Figure F, was obtained by erecting fifteen ordinates, representing the fifteen spicule-dimensions under discussion, at equal intervals on a baseline. These ordinates are arranged in the order of the maximum variations of the dimensions they represent, the one to the left representing the most constant dimension. The mean general averages (II) multiplied by the corresponding numbers in III of course all gave products of 100 mm. The points graphically representing these numbers, plotted on the fifteen coordinates 100 mm. from the axis, all lie in the straight horizontal line m. This line graphically represents the ideal mean of all the sponges

V								
Deviations of the maximum averages (maxima) in col. IV from the mean general maximum average in col. II								
A Station 2886	B Station 2887	C Station 2978	D Station 3088	E Station 3168	F Station 4193	G Station 4199	H Station 4228	I Station 4551
—0.5	—0.1	+0.2	+0.4	+0.3	+0.7	—0.1	—0.7	—0.1
—11.3	+6.7	+24.7	—10.3	+2.7	+0.7	—7.3	—12.3	+6.7
+138	—2	—72	+18	—52	+48	—52	—12	—12
+2.94	+0.94	—1.06	+0.94	—2.06	+0.94	—1.06	—0.56	—1.06
—0.29	—0.29	+0.61	+0 21	+0.51	+0.21	+0.31	—0.89	—0.39
—12.49	—5.44	+23.56	+4.56	+16.56	—23.44	—13.44	—17.44	+27.56
—23.89	+16.11	—7.89	+2.11	—7.89	+29.11	+49.11	+6.11	—62.89
—5.11	+1.89	+8.89	+0.89	+2.89	—6.11	+4.89	—4.11	—4.11
—41.78	+18.22	+88.22	—18.78	+16.22	—66.78	+41.22	—16.78	—19.78
—30.33	+9.67	+51.67	—15.33	—4.33	—60.33	+127.67	—31.33	—47.33
—3.56	+2.44	+0.44	—1.56	—0.56	—1.56	+7.44	+3.44	—6.56
—51.11	+14.89	+21.89	—20.11	+26.89	+4.89	+1.89	+11.89	—11.11
—3.22	—2.22	—1.22	+0.78	+1.78	—0.22	—4.22	+6.78	+1.78
—7.56	—1.56	+7.44	+14.44	+5.44	—9.56	—6.56	—5.56	+3.44
—6.56	—0.56	+5.44	+5.44	+5.44	—6.56	—3 56	—0.56	+1.44

VI								
Commensurate percentage expression of the deviations in col. V, obtained by multiplying the numbers in col. III and col V. mm.								
A Station 2886	B Station 2887	C Station 2978	D Station 3088	E Station 3168	F Station 4193	G Station 4199	H Station 4228	I Station 4551
—12.82	—2.56	+5.13	+10.26	+7.69	+17.96	—2.56	—17.96	—2.56
—13.09	+7.77	+28.62	—11.94	+2.67	+0.81	—8.46	—14.26	+7.77
+40.35	—0.58	—21.06	+5.27	—15.21	+14.04	—15.21	—3.51	—3.51
+32.45	+10.38	—11.69	+10.38	—22.74	+10.38	—11.69	—6.25	—11.69
—8.56	—8.56	+18.00	+6.2	+15.05	+6.2	+9.15	—26.26	—11.51
—10.78	—4.72	+20.41	+3.97	+14.35	—20.30	—11.64	—15.10	+23.88
—4.86	+3.28	—1.61	+0.43	—1.61	+5.93	+10.00	+1.24	—12.97
—20.35	+7.53	+35.41	+3.55	+11.51	—24.34	+19.46	—16.39	—16.39
—25.83	+11.26	+54.53	—11.61	+10.03	—41.28	+25.48	—10.37	—12.23
—21.62	+6.89	+36.82	—10.93	—3.09	—42.99	+90.98	—22.33	—33.73
—10.94	+7.50	+1.35	—4.79	—1.72	4.79	+22.85	+10.57	—20.15
—43.28	+12.61	+18.54	—17.03	+22.77	+4.14	+1.60	+10.07	—9.41
—13.30	—9.17	—5.04	+3.22	+7.35	—0.91	—17.42	+28.0	+7.35
—7.30	—1.51	+7.19	+13.94	+5.26	—9.23	—6.34	—5.37	+3.32
—7.41	—0.63	+6.15	+6.15	+6.15	—7.41	—4.02	—0.63	+1.63

of this group examined in respect to the fifteen spicule-dimensions under discussion. From the fifteen points forming this line of mean general averages, the numbers in VI, giving the deviations from the means in a commensurate manner were plotted on their respective ordinates,— above if positive and below if negative — and designated with the letters A — I standing for the lots from the nine different stations. The points with the same letter, commensurately representing the different dimensions of the spicules of the same lot, were then connected by lines. The nine lines (curves) thus obtained are maximum spicule-dimension curves and graphically represent the peculiarities of each of the nine lots in respect to the fifteen spicule-dimensions selected.

The nine stations where these sponges were collected are situated on the Pacific coast of North America, between 33° and 56° N. They are not uniformly distributed but form five groups separated by wide intervals, and thus these sponges may be said to come from five distinct regions. These are, from north to south: 1. Behm Canal Station (4228, H); 2. Vancouver Island Stations (4193, 4199, F. G.); 3. South Oregon Stations (2886, 2887, 3088, A. B. D.); 4. Middle California Stations (3168, 4551, E. I.); and 5. South California Station (2978 C).

The spicule-curves, Figure F, pertaining to the lots from these five different regions are differently drawn as follows: Behm Canal (H, 4228) ------; Charlotte Sound and Gulf of Georgia (F, G, 4193, 4199) –··–··–··–; coast of southern Oregon (A, B, D, 2886, 2887, 3088) ————; coast of middle California (E, I, 3168, 4551) —·—·—·; and coast of southern California (C, 2978) ———

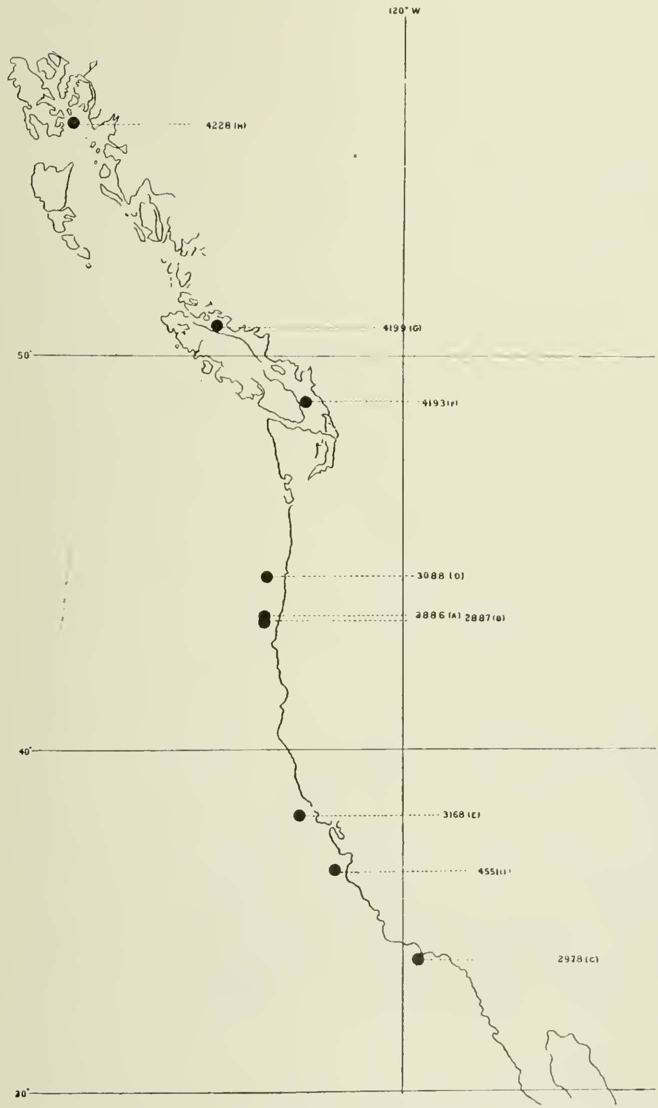


Fig. E. Pacific coast of North America, showing Stations of *Geodia agassizii*. A. Station 2886. B. Station 2887. C. Station 2978. D. Station 3088. E. Station 3168. F. Station 4193. G. Station 4199. H. Station 4228. I. Station 4551. (See page 144.)

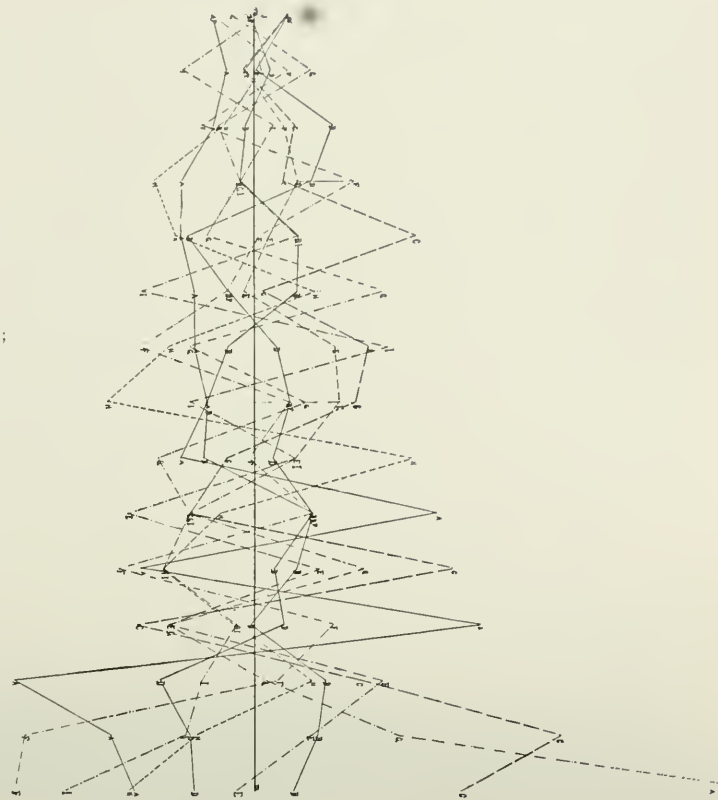


Fig. F. *Geodia agassizii.* Spicule curves.

The graph shows that only very few of the maximum averages (maxima) of the same dimensions of spicules from different lots are identical with each other, and that not a single one coincides with the mean. The extent of their maximum and average deviations from the mean are tabulated below.

Dimension	Maximum deviation		Total range of maximum deviation	Averages of the deviations of the 9 lots
	above the mean	below the mean		
	per cents of the respective dimensions			
Breadth of sterraster	6.1	7.4	13.5	4.46
Length of orthoplagiotriaene-elade	10	12.8	22.8	4.61
Length of sterraster	13.9	9.2	23.1	6.61
Length of large amphiox	17.9	17.9	35.8	8.83
Thiekness of large amphiox	28.6	14.3	42.9	10.60
Thiekness of anatriaene-rhabdome	22.8	20.1	42.9	9.41
Thiekness of orthoplagiotriaene-rhabdome	23.9	20.3	44.2	13.91
Length of orthoplagiotriaene-rhabdome	18	26.3	44.3	12.17
Diameter of oxyaster	28	17.4	45.4	10.20
Thickness of small dermal amphiox	32.5	22.7	55.2	14.18
Thickness of mesoprotriaene rhabdome	35.4	24.3	59.7	17.21
Length of small dermal amphiox	40.4	21	61.4	13.19
Length of anatriaene clade	22.7	43.3	66	15.49
Length of mesoprotriaene clade	54.5	41.3	95.8	22.51
Length of mesoprotriaene epirhabd	91	43	134	29.93

Having thus ascertained the differences in the spicules and stated them in a manner suitable for discussion, the question of their systematic and zoögeographic significance may be taken up.

There can be no doubt that external forces, acting on the growing sponge, exert an influence on the shape and the dimensions which the spicules attain. We know that at the stations where these sponges were obtained the bottom temperature and the nature of the bottom differ more or less. From this it follows that the forces which acted on the several lots during growth were, generally speaking, different, and we may therefore expect to find certain differences in the spicules. The question therefore arises whether all the differences observed are entirely due to the differences of the external forces which acted on the growing sponges, or whether they are in part germinal (hereditary) in character.

None of the differences in the shape and relative frequency of the spicules seems to me to exceed the limits allowable for such somatic (individual) non-germinal (non-hereditary) variation. The average and maximum deviations of the dimensions of the oxyasters, sterrasters, large amphioxes, and orthoplagiotriaenes from the mean are only 4.46–13.91 and 6.1–28.6 % respectively, and also fairly within these limits. The average and maximum deviations of the dimensions of the small dermal amphioxes, anatriaenes, and mesoprotriaenes, which range from 9.41 to 29.93 and from 20.1 to 91 % respectively, are so considerable that at first sight it seems necessary to consider them as germinal. The greatest deviations are observed in the length of the clades of the anatriaenes and the clades and epirhabds of the mesoprotriaenes, the total range of maximum deviation of the latter exceeding 130 %.

The position of the oxyasters, sterrasters, orthoplagiotriaenes, and large amphioxes is different from that of the small amphioxes, anatriaenes, and protriaenes. The former lie within the sponge and are thus to a certain extent sheltered from the influence of the external forces; the latter lie superficially and are protruded more or less beyond the sponge and thus more exposed to the external forces. These external forces are different in the nine stations. It is therefore only to be expected, that the last named, exposed, spicules on which the external forces act more directly, should be much less constant than the first named, sheltered ones, on which they act more indirectly.

These facts and considerations clearly show that the peculiarities of the internal spicules must be systematically much more important than the peculiarities of the protruding ones. I therefore thought it desirable to ascertain what systematic result an examination of the internal spicules by themselves — leaving the external ones out of account — would lead to. To do this I selected the most accurately determinable dimensions of the internal spicules, namely the length of the sterrasters and orthoplagiotriaene-clades and the length and thickness of the large choanosomal amphioxes and orthotriaene-rhabdomes. These six dimensions of each lot I compared with the six corresponding dimensions of each of the other eight lots. In each of the thirty-six possible pairs (combinations of nine in the second class without repetition) I added up the differences of the commensurate proportional amounts of the maximum averages of the homologous dimensions and then divided the sums by six. In this way the average percentage differences of the nine lots in respect to the dimensions of these internal spicules, least subject to the influence of external forces, were obtained. In the following table, where the thirty-six pairs are arranged in the order of their similarity in respect to these dimensions, the numbers thus arrived at are given.

Pairs of lots.	Average percentage differences in the length of the sterrasters, the orthoplagiotriaene-rhabdomes, orthoplagiotriaene - clades, and large amphioxes, and the thickness of the orthoplagiotriaene - rhabdomes and large amphioxes.	Pairs of lots.	Average percentage differences in the length of the sterrasters, the orthoplagiotriaene-rhabdomes, orthoplagiotriaene - clades, and large amphioxes, and the thickness of the orthoplagiotriaene - rhabdomes and large amphioxes.	Pairs of lots.	Average percentage differences in the length of the sterrasters, the orthoplagiotriaene-rhabdomes, orthoplagiotriaene - clades, and large amphioxes, and the thickness of the orthoplagiotriaene - rhabdomes and large amphioxes.
AH	6.1	GH	11.6	DI	15.6
CE	6.5	BH	11.9	FH	16.2
DE	7.8	DF	12.2	AE	16.8
FG	8.1	BD	12.3	DH	17.
AG	8.2	CI	12.7	GI	17.4
AB	8.5	EG	12.7	CG	18.4
BG	8.7	EF	12.9	HI	18.8
BI	8.7	AD	13.3	CF	19.5
DG	10.7	AF	13.6	FI	20.1
EI	10.7	CD	13.7	EH	21.1
BF	11.3	AI	14.6	AC	22.5
BE	11.6	BC	15.6	CH	26.8

The table shows that these differences are very unequal and vary between 6.1 % (AH) and 26.8 % (CH). It would therefore seem that it might be possible, by joining the pairs differing only slightly, and by keeping apart the pairs differing greatly, to arrive at some systematic grouping. The regular gradation in the increase of the average percentage difference from the lowest to the highest, however, makes it difficult anywhere to draw a line of demarcation between differences insufficiently and differences sufficiently great for systematic distinction. If we consider, as we surely may, differences in respect to these dimensions up to 10.7 % insufficient for systematic distinction, we must unite all the pairs differing 10.7 % or less. These pairs are AH, CE, DE, FG, AG, AB, BG, BI, DG, and EI. Now if these pairs are united: A joined to H, G, and B; C to E; D to E, and G; F to G; B to G, and I; and E to I; it will be seen that all nine lots are united, however different certain pairs may be. In truth, we can say that biometrically a continuous series of transitional forms connect the most aberrant members of the whole group.

One of the most remarkable features of the peculiarities of the spicules of the nine lots is the want of correlation between them. So far as their dimensions are concerned this want of correlation is most clearly brought out in the graph: no two of the spicule-dimension curves are near to each other and parallel throughout, lots similar in some respects being invariably different in others.

This want of correlation of the peculiarities and the results obtained by the comparison of thirty-six pairs given above, force us either to consider all these nine lots of sponges as representatives of the same systematic unit, or to establish a distinct group (species, subspecies, variety, or form) for each one.

Before entering upon the discussion of this question it will be well to ascertain whether there is any correlation between the degree of the difference between the pairs and the distance of the localities where they were obtained.

As stated, these sponges come from five different regions of the Pacific coast. To ascertain what correlation there is between the distances of their localities and the degree of difference between them in regard to the six spicule-dimensions here under discussion, I arranged the thirty-six pairs of specimens from the different localities in five groups: 1, pairs of specimens from localities in the same region; 2, pairs of specimens from localities in adjacent regions; 3, pairs of specimens from localities in regions between which one other region lies; 4, pairs of specimens from localities in regions between which two other regions lie; and 5, pairs of specimens from localities in regions between which three other regions lie. Then the ranges and averages of the differences of these groups of pairs were ascertained for each group.

To the first group (pairs from localities in the same region) the pairs AB, AD, BD, EI, and FG belong; the differences of these pairs range from 8.1 to 13.3, their average being 10.6.

To the second group (pairs from localities in adjacent regions) the pairs AE, AF, AG, AI, BE, BF, BG, BI, CE, CI, DE, DF, DG, DI, FH, and GH belong; the differences of these pairs range from 6.5 to 16.8, their average being 11.7.

To the third group (pairs from localities in regions with one other region between) the pairs AC, AH, BC, BH, DC, DH, EF, EG, FI, and GI belong; the differences of these pairs range from 6.1 to 22.5, their average being 14.9.

To the fourth group (pairs from localities in regions with two other regions between) the pairs CF, CG, EH, and HI belong; the differences of these pairs range from 18.4 to 21.1, their average being 19.4.

The only pair of the fifth group (pairs of localities in regions with three other regions between) is CH; the difference of this pair is 26.8.

This shows that the variation of the specimens from different localities in the same region is inconsiderable (never over 13.3) and that the averages of the differences between the specimens from localities in different regions are proportional to the distance between the regions.

As in the case of the morphological aspect of the differences between the pairs we also find, when examining them from this distributional point of view, that these differences are regularly graduated: forms intermediate in structure, growing in places intermediate geographically, connect the very different forms C and H occupying the two extremities of the stretch of coast off which these sponges grow.

This morphological and distributional continuity of the whole series of forms renders it, in my opinion, advisable to consider the great differences of the protruding spicules as due to mere individual adaptation, and to place the whole series in one species not divided into minor systematic units.

Although I refrain from systematically separating the different forms growing in the different regions, I think that they might well be considered as "incipient" varieties or subspecies, which, adapting themselves more and more to the different peculiarities of their surroundings, may, and very likely will, in course of time, become systematically distinct — particularly if, through some cause or other, they should disappear from the central stretch of coast they now inhabit.

Of course there can be no doubt, that these sponges belong to the Geodidae, but it is not so easy to decide the genus to which they should be assigned. As some of their efferents are not covered by pore-sieves I was at first inclined to place them in Sidonops. A careful investigation of the apparently uniporal efferents made it highly probable, however, that these had, like the ones over which sieve-membranes extend, been covered by such when the sponge was alive and had been lost *post mortem*. For this reason I place these sponges in Geodia. It is, in some cases, particularly when the specimens are not well preserved, difficult to decide whether a geodid sponge with apparently uniporal efferent apertures should be considered as a Sidonops or as a Geodia, and it is probable that some of the species placed by me [1] in Sidonops ought to be considered as species of Geodia. In studying the affinities of *Geodia agassizii* with other previously described species, I have, for these reasons, compared it not only with the sponges described as species of Geodia but also with those described as species of Sidonops.

The species of Geodia which have orthoplagiotriaenes, subcortical teloclades,

[1] R. von Lendenfeld. Tetraxonia. Tierreich, 1903, **19**, p. 100–104.

sterrasters, and euasters more or less similar to those of *Geodia agassizii* are *G. spherastrella* Topsent and the sponges here described as *G.* (*Cydonium*) *japonica* Sollas, *G. mesotriaena*, *G. mesotriaenella*, and *G. breviana*. *Geodia japonica* is distinguished from *G. agassizii* by being cup shaped, having rounded, lobate protuberances on the outer surface, and possessing, although very large in size, considerably smaller megascleres; the large amphioxes of this species are less than half as thick as those of *G. agassizii*. *Geodia spherastrella* is distinguished from *G. agassizii* by being incrusting and having much larger dermal strongylosphaerasters. Whether there are also differences in the size of the megascleres, as is very likely, I cannot say, since Topsent [1] gives no measurements. *Geodia mesotriaena* is more or less meandric and provided with praeoscular canals; and it has choanosomal amphioxes and orthotriaene-cladomes twice as long, and also larger euasters. *Geodia mesotriaenella* has more slender and differently shaped anatriaene-clades, no mesoprotriaenes with epirhabd exceeding the clades in length, and somewhat different strongylosphaerasters. *Geodia breviana* possesses minute dermal anaclades, its large anatriaenes have much thicker clades and its strongylosphaerasters are larger.

The only species of Sidonops which has orthoplagiotriaenes, subcortical teloclades, sterrasters, and euasters similar to those of *G. agassizii* is the sponge described by Dendy [2] as *G. areolata* Carter. This sponge differs from *G. agassizii* by the absence of mesoprotriaenes, by having somewhat smaller spicules, particularly thinner choanosomal amphioxes and orthoplagiotriaene-rhabdomes, and by the reticulate structure of its surface. The differences in the size of its spicules and the absence of mesoprotriaenes, which, if present only in the fur, have perhaps been lost *post mortem*, may not be sufficient for distinguishing it specifically from *G. agassizii*. The reticulate appearance of the surface of *G. areolata* is caused by the presence of a superficial network, which consists, according to Carter (Ann. mag. nat. hist., 1880, ser. 5, **6**, p. 133, pl. 6, fig. 37), of rows of small protruding dermal amphioxes, according to Dendy (*loc. cit.*), of subdermal pigment-cells. In none of the specimens of *G. agassizii* could I detect the slightest trace of a network of either of these kinds on the surface. I am not prepared to express an opinion on the systematic value of the presence or absence of this network. Since, however, it may be systematically important; since there is a difference in the spicules, although by itself perhaps too slight for specific distinction; and since the localities where these sponges occur, Pacific

[1] *E. Topsent.* Spongiaires des Açores. Résult. Monaco, 1904, **25**, p. 70.

[2] *A. Dendy.* Report on the sponges. Rept. pearl oyster fisheries, 1905, pt. 3, p. 87.

coast of North America and coast of Ceylon (Gulf of Manaar), are so far apart, I think it advisable to keep them systematically distinct.

Geodia (*Cydonium*) *mülleri* Fleming, to which species Lambe (*loc. cit.*) assigned the specimen of *G. agassizii* examined by him, differs from this species in having much larger and more elongated sterrasters.

Geodia mesotriaenella, sp. nov.

Plate 34, figs. 18–26; Plate 35, figs. 28–35.

I establish this species for a specimen captured off the coast of southern California at Station 4417. It is similar to the species described as *Geodia mesotriaena*, but in regard to the size of the body and the dimensions of its spicules is much smaller and to this the name refers.

Shape and size. The sponge (Plate **34**, fig. 19) is nearly spherical; its smallest and largest diameters are 15 and 19 mm. respectively. The surface is quite smooth and covered by a spicule-fur still fairly intact in several places, chiefly near the base. There are no larger oscules.

The *colour*, in spirit, is dirty white, rather darker above than below.

The superficial part of the body forms a *cortex* composed of three layers: a dermal (outer) layer free from sterrasters, 30–60 μ thick; a middle sterraster-armour layer, 320–380 μ thick; and an inner, fibrous layer, free from sterrasters, 120–220 μ thick.

Canal-system. Apart from a few patches on the upper side, the largest of which is roughly circular and 8 mm. in diameter, the whole of the surface is occupied by groups of afferent pores (Plate **34**, fig. 20), about 700 μ in maximum diameter and separated by poreless strips, usually 15–50 μ broad. The pores themselves are oval, 20–80 μ in diameter, and the strands of tissue separating them narrower the larger the pores are. In the efferent areas smaller groups, only 200–500 μ in diameter, containing a smaller number of larger pores, 40–160 μ wide (Plate **34**, fig. 25), are met with.

Skeleton. Radial bundles of megascleres traverse the choanosome and penetrate the cortex; their distal parts protrude freely beyond the surface and form the spicule-fur. The proximal parts of these bundles in the interior of the choanosome are composed entirely of amphioxes. Distally orthotriaenes, mesoprotriaenes, and anatriaenes are added to the amphioxes. Most of the orthotriaene-cladomes lie in the inner layer of the cortex. Anatriaene-cladomes are found in considerable numbers, both at this and at a lower level. The spicule-fur is composed of the distal parts of amphioxes, mesoprotriaenes, and anatriaenes.

Intact mesoprotriaene-cladomes are very numerous in the proximal portion of the fur, a short distance above the surface. The spicules forming the distal (superficial) portion of the fur are mostly broken off. So far as I could see, most of these terminally broken spicules are anatriaene-rhabdomes. In the dermal layer small, more or less radially arranged rhabds, mostly styles attenuated towards both ends, occur. Their proximally situated rounded ends are implanted in the sterraster-armour; their pointed distal ends protrude a short distance beyond the surface. Small strongylosphaerasters form a thin but rather dense and continuous layer on the outer surface (Plate **34**, figs. 20, 25) and also occur in the lower parts of the dermal layer. Large oxysphaerasters are imbedded in the walls of the cortical and subcortical canals. Oxyasters are scattered in large numbers throughout the choanosome. Everywhere, except in the vicinity of the radial canals, which traverse it, the middle layer of the cortex is occupied by dense masses of sterrasters. Many sterrasters, particularly young forms, also occur scattered in the choanosome. It is to be noted that the sterrasters are not nearly so numerous in the lower layer of the cortex and the distal part of the choanosome as in the proximal part of the latter.

The *large amphioxes* (Plate **35**, fig. 31c) are slightly curved, gradually attenuated towards the pointed ends, and isoactine or anisoactine. Anisoactine forms were chiefly found among the stouter amphioxes. The amphioxes are 2–2.6 mm. long and 20–50 μ thick.

The *minute dermal rhabds* are 196–260 μ long and 4–5 μ thick. The greater number of them are styles with attenuated rounded ends. In some of these rhabds this attenuation is so great that the proximal "rounded" end is hardly less pointed than the distal. These spicules appear as anisoactine amphioxes.

The *orthotriaenes* (Plate **35**, fig. 31a) have a fairly straight, conical rhabdome, usually sharp pointed, very rarely rounded at the acladomal end. The rhabdome is 2.1–2.4 mm. long and, at its thickest point, 75–120 μ thick. This thickest point is situated either at the cladome or a short distance below it, and, in the latter case, separated from the cladome by a slight neck-shaped constriction. The clades are always conical and curved, concave to the rhabdome in their entire length; the degree of curvature and the size of the clades are, however, variable, the clades of the same cladome often differing from each other considerably in these respects. The clades are sharp pointed or, more rarely rounded at the ends, and generally simple, but cladomes with one or two bifurcate clades have also been observed occasionally. The clades are 350–600 μ long and their chords enclose angles of 90–96°, on an average 93°, with the axis of the rhabdome.

Some intact rhabdomes of the *mesoprotriaenes* (Plate **35**, figs. 28–30, 31b) were 2.8–3.4 mm. long, but several of the fragments observed appeared to be parts of rhabdomes longer than that. The thickness of the rhabdome at the cladome is 9–19 μ. The rhabdomes which are thick at the cladome are in their cladomal half nearly cylindrical, hardly perceptibly thickened towards the middle; the rhabdomes thin at the cladome, on the other hand, are very considerably thickened towards the middle of their length. The epirhabd is straight, conical, pointed, and 70–165, usually 90–120 μ long. The clades are slender, conical, and curved, concave to the epirhabd. Their chords are 100–220 μ long and enclose angles of 30–47°, on an average 36°, with the axis of the epirhabd. The clades of the same cladome are equal or, more frequently, unequal in length (Plate **35**, figs. 28–30); all of them or, if they differ considerably in length, two, or at least one, are longer than the epirhabd. The proportion of the length of the epirhabd to the length of the longest clade of the same cladome being 100 : 130 to 100 : 233.

The *anatriaenes* (Plate **35**, figs. 32–35). The longest intact rhabdome measured was 3.7 mm. long. Fragments indicate that many anatriaenes have rhabdomes considerably longer. The thickness of the rhabdome at the cladome is 18–30, usually 20–22 μ. The clades are conical, pointed, uniformly and not strongly curved, concave to the rhabdome. Their chords are 87–140, usually 110–130 μ long and enclose angles of 41–57°, on an average 48°, with the axis of the rhabdome. Besides these normal anatriaenes with simple clades I have observed a few, similar to them in all other respects, with one of the clades bifurcate.

The *large oxyasters* (Plate **34**, figs. 18a, 21, 22, 24) have a small centrum the diameter of which is usually about double the basal thickness of the rays. From this centrum from five to eleven fairly regularly distributed rays arise radially. The rays are straight, conical, usually quite blunt, 9–14 μ long, and, at the base, 1.5–2.8 μ thick. The basal parts of the rays are smooth, the distal parts covered with spines (Plate **34**, figs. 21, 22). The size of these spines is variable and their number is, roughly speaking, in inverse proportion to their size. The largest spines measured were 0.7 μ long. The spines arise vertically from the ray. Those large enough to be properly seen are usually sharp pointed, but occasionally I have also observed stout and cylindrical, terminally rounded spines. The whole oxyaster is generally 17–26 μ in diameter. In the centrifugal spicule-preparations also large ones, up to 40 μ in diameter, have been observed. As, however, I never found such large asters *in situ* in the sections and as they are exceedingly scarce in the spicule-preparations, I am by no means sure that they are proper to the sponge. A correlation between the ray-number and the size of the spicule is not clearly discernible.

The *large oxysphaerasters* have a spherical centrum, 6–9 μ in diameter, from which from fifteen to twenty-three regularly distributed rays arise radially. The rays are straight, conical, sharp pointed, 6–7 μ long and 2–2.5 μ thick at the base. Each ray bears a small number, sometimes only one or two, vertically arising spines. The whole aster is 20–21 μ in diameter.

The diameter of the centrum of the *small strongylosphaerasters* (Plate **34**, fig. 26) is 1.6–4.5 μ, usually from a quarter to a half of the diameter of the whole aster. From this centrum generally from ten to seventeen regularly distributed rays arise radially. Very rarely strongylosphaerasters with fewer (one or three), or with more numerous (up to twenty-five) rays have been observed. The rays are cylindrical or cylindroconical and truncate. In the strongylosphaerasters with small centrum (Plate **34**, fig. 26a) the rays are much longer than thick and attenuated towards the end. In the strongylosphaerasters with large centrum (Plate **34**, fig. 26b) the rays are only twice as long as thick or even shorter, and cylindrical. The rays are covered with spines, which are larger in the one- and three-rayed than in the many-rayed forms. The ray of the one-rayed strongylosphaeraster is 7.2 μ long and 2 μ thick; the rays of the three-rayed forms are 4–5 μ long and 1 μ thick; those of the many-rayed forms are 2–4.5 μ long and 0.5–1 μ thick. The total diameter of the aster is 6–11 μ. The ray-number is in so far in inverse proportion to the size of the spicule as the one- and three-rayed forms are 8.4–11 μ, the forms with more rays 6–10 μ in total diameter.

The *sterrasters* (Plate **34**, fig. 23) are flattened ellipsoids, usually 87–97 μ, rarely as much as 107 μ long, 77–86 μ, rarely as much as 92 μ broad, and 58–69 μ thick. The proportion of length to breadth to thickness is, on an average, 100:89:71.

This sponge was caught with the tangles at Station 4417 on April 12, 1904, near Santa Barbara Islands, S. W. rock Santa Barbara Island, N. 8° W., 11.7 km. (6.3 miles), drift S. 73° W.; depth 53 m. (29 f.); it grew on a bottom of fine yellow sand and coralline rock.

The cribriporal character of the afferent and efferent apertures and the ellipsoidal sterrasters show that this sponge belongs to Geodia. It is most closely allied to the sponges described by Dendy (1905) as *Geodia ramodigitata* Carter and *G. areolata* Carter, and to those described here as *Geodia ataxastra*, *G. breviana*, *G. agassizii*, and *G. mesotriaena*. In Dendy's *Geodia ramodigitata*

Carter the oxyasters are much larger and destitute of spines. In Dendy's *Geodia areolata* (Carter) the orthotriaene-rhabdomes are much more slender, the anatriaene-clades shorter, the mesoprotriaenes absent, and the surface marked with a reticulate tracing. In *Geodia ataxastra* the mesoproclades and anatriaenes have differently shaped cladomes, the dermal strongylosphaerasters are much smaller, and ataxasters are met with; in *G. breviana* minute, dermal anaclades are present, the clades of the large anatriaenes are much stouter and the strongylosphaerasters larger; in *G. agassizii* some of the spicule-dimensions are considerably greater, the anatriaene-clades stouter and more angularly bent, the orthotriaene-clades often provided with one or more spine-like branches, some of the mesotriaene-epirhabds much longer than the clades of the same cladome, and smaller oxyasters abundant; and in *G. mesotriaena* most of the spicule-dimensions are from two to three times as great, the anatriaene-clades stouter and curved in a different manner, the mesotriaene-epirhabds usually longer than the clades of the same cladome, the rays of the strongylosphaerasters more slender, and the oxysphaerasters much more spiny and provided with relatively smaller central thickenings.

Geodia agassizii and *G. mesotriaena* appear to be more closely allied to *G. mesotriaenella* than the other four. It is true that many of the spicule-dimensions of these sponges, particularly of *G. mesotriaena*, are much greater; in view of the fact, however, that the specimen of *G. mesotriaenella* is very much smaller, and therefore probably much younger, than the specimens of *G. agassizii* and *G. mesotriaena* examined, this might be of no systematic importance. The differences between these species and *G. mesotriaenella* in regard to the shape of the spicules may, of course, also be due to differences in the degree of development (age), in which case *G. mesotriaenella* would have to be considered as a young form of one or the other of them. Since, however, this seems very doubtful, I deem it better, in order to avoid confusion, to describe this sponge as a distinct species.

Geodia breviana, sp. nov.

Plate 35, figs. 1–27; Plate 36, figs. 1–12.

1893. *Cydonium mülleri* L. M. Lambe (non Fleming), Trans. Roy. soc. Canada, 1893, **10**, p. 72, pl. 4, fig. 1; pl. 6, fig. 1, 1a-i.

I establish this species for a specimen dredged at Station 2894, off southern California. The large anatriaenes have unusually stout and relatively short clades, and to this the specific name refers. The study of the sponge determined in 1893 by Lambe (*loc. cit.*) as *Cydonium mülleri* Fleming which is in the collection of the Geological Survey of Canada and which was kindly placed at my disposal for examination, has shown that it differs from the type of *Geodia* (*Cydonium*) *mülleri* and is identical with the specimen referred to above.

Shape and size. The specimen is fragmentary, 32 mm. long, 21 mm. broad, and 10 mm. thick. Its surface is now fairly smooth, but the living sponge was probably covered with a spicule-fur. There are three small groups of circular or oval pores 300–800 μ wide, most of which open freely on the surface. The specimen described by Lambe is a thick-walled cup, 6 cm. high, with a rather small cavity, occupied by a high spicule-fur, which consists of long anaclades and mesoproclades.

The *colour*, in spirit, is dirty white on the surface, darker in the interior.

The superficial part of the body forms a *cortex*, composed of a very thin outer, dermal layer, a middle sterraster-armour layer 700–900 μ thick, and an inner fibrous layer, which latter is, like the dermal layer, destitute of sterrasters. The thinness of the dermal layer may be due to a *post mortem* collapse in consequence of indifferent preservation.

Canal-system. A closer investigation of the wide apertures 300–800 μ in diameter, mentioned above, revealed remnants of pore-sieves in many of them. From this I conclude that, in life, all of them were covered by pore-sieves and that, where the sieves are now missing, they have been lost *post mortem.* Radial canals of equal width and only very slightly constricted below, at the lower limit of the sterraster-armour layer, lead down from these apertures to the choanosome. Outside the regions occupied by the groups of these wide apertures (cortical canals) no open canals and only few pores, about 50 μ wide, were observed. I take the latter for the afferents and the large apertures in the groups for the places where, in life, the sieves with the efferent pores were spread out.

Skeleton. Radial bundles of megascleres traverse the choanosome, and penetrate the cortex. Their distal parts appear to have protruded freely and to have formed a spicule-fur. Their proximal parts are composed of amphioxes; distally orthotriaenes, anatriaenes, and probably also mesoprotriaenes are added to the amphioxes in the bundles. The cladomes of the orthoplagiotriaenes lie partly at, partly a little above, and partly a little below, the lower limit of the sterraster-armour layer, the most distal ones being partly enveloped in sterrasters. Anatriaene-cladomes are quite numerous below the sterraster-armour layer. In the spicule-preparations a few mesoprotriaenes were found, but I saw none *in situ* in the sections. Minute amphioxes and anaclades are implanted in the distal part of the sterraster-armour. These spicules are situated radially or obliquely. They traverse the thin dermal layer and protrude freely beyond its outer surface. The spicule-fur appears to have consisted of a high portion, composed of the distal parts of the large amphioxes, anatriaenes, and perhaps also mesoprotriaenes protruding several millimeters; and a low portion, forming a sort of undergrowth, composed of the distal parts of the minute dermal amphioxes and anaclades, protruding only 100–200 μ.

The microscleres are thick-rayed and perhaps also thin-rayed oxyasters, large oxysphaerasters, small strongylosphaerasters, and sterrasters. The thick-rayed oxyasters are numerous throughout the choanosome. The thin-rayed oxyasters are rare and were found only in the centrifugal spicule-preparations; they may be foreign. The large oxysphaerasters occur chiefly in the walls of the subcortical canal. The strongylosphaerasters form a single layer on the outer surface and also occur scattered in the lower parts of the cortex. The sterrasters occupy the sterraster-armour layer in dense masses.

The *large amphioxes* (Plate **35**, figs. 1–4) are slightly curved and uniformly and gradually attenuated towards their pointed ends. They measure 1.8–3.7 mm. in length and 30–88 μ in thickness. Their thickness is by no means always proportional to their length. In the specimen described by Lambe the ordinary choanosomal amphioxes are 3–5 mm. by 50–70 μ (Lambe, 1893, 2.77–3.81 mm. by 80 μ).

In this specimen I have also found some large *styles;* these are shorter than the amphioxes and up to 90 μ thick; they are not mentioned by Lambe.

The *minute dermal amphioxes* (Plate **36**, figs. 10–12) are simply curved (Plate **36**, fig. 10) or angularly bent (Plate **36**, figs. 11, 12) and gradually attenuated towards the abruptly pointed ends. Examination with high powers shows that both ends of these spicules are usually somewhat drawn out to exceedingly sharp terminal spines. The angular bend is, when present, generally not in the middle of the spicule, but considerably nearer to one end than to the other. It amounts to about 25°, so that the angle which the two parts of the spicule enclose is usually about 165°. The minute dermal amphioxes are 280–450 μ long and 4.5–8.5 μ thick. The shorter ones, 280–365 μ in length, are much more numerous than the longer ones, 366–450 μ in length. In the specimen described by Lambe these amphioxes are 340–440 μ by 2–5 μ (Lambe, 1893, 288 by 13 μ, according to his figure 8.5 μ).

The *ortho-* and *plagio-triaenes* (Plate **35**, figs. 15–17) have a fairly straight rhabdome, 1.8–3.2 mm. long and 90–130 μ thick at the cladome. Usually the rhabdome is conical and sharp pointed, rarely rounded at the acladomal end.

One of these rhabdomes possessed several irregular thickenings near the rounded end, under which the axial thread passed smoothly without any thickening or other modification. The clades are conical, pointed, and uniformly curved in their entire length, concave to the rhabdome. The degree of the curvature usually is, as in the two triaenes represented on Plate **35**, figs. 15, 16, quite considerable, rarely so slight as in the long (left) clade of the triaene (Fig. 17). Occasionally triaenes with clades bent much more strongly than those represented in Figs. 15 and 16 have been observed. The clades are nearly always simple; very rarely one of them is bifurcate. The clades of the same cladome are usually similar, irregular cladomes being exceptional. The chords of the clades are 280–500 μ long and enclose angles of 94–108°, on an average 101.6°, with the axis of the rhabdome. Of the seventeen triaenes the clade-angles of which were measured, four were orthotriaenes with clade-angles less than 100°, the other thirteen plagiotriaenes, with clade-angles 100° or more. In the specimen described by Lambe the plagio-orthotriaenes have rhabdomes 2.2–4.1 mm. (Lambe, 1893, 2.4 mm.) by 60–105 μ, clades 340–680 μ (Lambe, 1893, 700 μ) long, and clade-angles of 97–113°.

The *mesoprotriaenes* (Plate **35**, fig. 14) have a rhabdome about 15 μ thick at the cladome, an epirhabd 105 μ long and clades, curved concave to the epirhabd, the chords of which are 115–130 μ long and enclose angles of about 38° with the epirhabd-axis. In the specimen described by Lambe the mesoprotriaenes have rhabdomes 7–11 mm. (Lambe, 1893, 7.84 mm.) by 15–32 μ, clades 65–250 μ (Lambe, 1893, 95 μ) long, clade-angles of 20–44°, usually 32–44°, and an epirhabd 120–310 μ long.

The *large anatriaenes* (Plate **35**, figs. 5–7) have a nearly cylindrical rhabdome, 25–40 μ thick in its cladomal part. I found no intact rhabdomes of these spicules; the fragments observed indicate that they attain a considerable length. The clades are slightly and uniformly curved or somewhat angularly bent near the end, concave to the rhabdome. They are remarkably thick at the base, and usually simple and quite sharply pointed, but anatriaenes with one clade bifurcate have also been observed occasionally. The two terminal branches of such clades are nearly parallel and lie close together. The chords of the clades are 60–115 μ long and enclose angles of 50–65°, on an average 57.3°, with the axis of the rhabdome. In the specimen described by Lambe the large anatriaenes have a rhabdome 9–11 mm. (Lambe, 1893, 7.5 mm.) by 25–37 μ, stout clades 47–82 μ (Lambe, 1893, 60 μ) long, and clade-angles of 52–63°.

In the specimen described by Lambe a few *anadiaenes* similar to the anatriaenes but with longer clades (up to 110 μ long) and smaller clade-angles (about 45°) were also observed.

The *minute dermal anaclades* (Plate **36**, figs. 1–9) are triaene, diaene, or monaene. The triaene forms are more numerous than the other two. Their rhabdomes are usually quite strongly and somewhat irregularly curved (Plate **36**, figs. 2, 4, 6, 8), thickest about two thirds of their length from the cladome, and rounded at the acladomal end. They are 480–560 μ long and at the cladome 2.5–4.5 μ thick. At their thickest point they are about twice as thick as at the cladome and here measure 5–8.6 μ in transverse diameter. The rounded acladomal end is 3.4–7 μ thick, slightly thicker than the cladomal end. The clades are conical and usually pointed and uniformly curved, concave to the rhabdome. In the triaene forms (Plate **36**, figs. 1–5) the chords of the clades are 7–9 μ long and enclose angles of 48–58° with the axis of the rhabdome; in the diaene and monaene forms (Plate **36**, figs. 6–9) the chords of the clades are 11–12 μ long and enclose angles of 42–46° with the axis of the rhabdome. In young forms like the left one of the two represented in Plate **36**, fig. 1, the clade-angles are larger. In the specimen described by Lambe the minute dermal anaclades (not mentioned by Lambe, 1893) are exceedingly abundant. Their rhabdome is 350–610 by 1–3.5 μ at the cladome, and 5–7 μ at the thickest point below the middle; the clades are 2–12 μ long, the clade-angles 42–60°. Some of the minute anaclades of this specimen have a straight, conic, apical ray, an epirhabd, 5–8 μ long, and therefore appear as mesanaclades.

The *thick-rayed oxyasters* (Plate **35**, figs. 18a, 19a, 22a, 24, 27) have five to twelve rays and a small centrum, the diameter of which is from two to three times as great as the basal thickness of the rays. The rays are usually simple, radial, and regularly distributed. Occasionally irregularities are observed due either to an irregular position or to a bifurcation of one or more of the rays. The two branches of the bifurcate rays are nearly parallel and lie close together. The rays are straight and conical, pointed, or blunt. Their proximal part is smooth, their distal part covered with rather large spines. The spines are not very numerous and rise vertically from the rays. Their ends appear to be curved backward towards the centre of the aster in a claw-shaped manner. The rays are (without the centrum) 7.5–11 μ long and 1–2.2 μ thick at the base, the total diameter of the oxyaster being 16–26.5 μ. A correlation (inverse proportion) between the size and the ray-number is observed in so far as the oxyasters with the most numerous (twelve) rays do not exceed 18.5 μ in total diameter. In the specimen described by Lambe these asters have from five to nine rays 1.4–

2.3 μ thick, and are 19–25 μ (Lambe, 1893, 3–13, according to his figures 11–15 μ) in total diameter.

The rare *thin-rayed oxyasters* which, as above stated, may be foreign, have from nine to fourteen rays and no centrum. The rays are 3–11 μ long, and very thin, only 0.25–0.7 μ thick at the base. They are not very much attenuated towards the end and bear spines which sometimes form terminal verticillate clusters, in which case these asters appear as acanthtylasters. The total diameter of these asters is 7–23 μ. If they are not foreign, they may be young forms of the thick-rayed oxyasters described above.

The *large oxysphaerasters* (Plate 35, figs. 21c, 25, 26) have a spherical centrum, 7–9 μ in diameter, from which from twenty-three to twenty-seven straight, conical, and sharp-pointed, usually regularly distributed rays arise radially. These rays are (without the centrum) 6–8 μ long and 1–2.7 μ thick at the base. They are covered with a greater or smaller number of good-sized spines. The rays of the oxysphaerasters with twenty-six or twenty-seven rays are basally only 1–2.2 μ, those of the oxysphaerasters with twenty-three or twenty-four rays basally 2.5–2.7 μ thick. This indicates that there is an inverse proportion between the ray-number and the ray-thickness. The whole aster is 14–21.5 μ in diameter. In the specimen described by Lambe these asters have up to thirty rays 1–1.7 μ thick, the centre is 3–5.5 μ, the whole aster 12–18 μ, in diameter. They are not mentioned by Lambe (1893).

The *small strongylosphaerasters* (Plate 35, figs. 8–13, 18–22b) have a centrum 3–5.5 μ in diameter and usually from thirteen to twenty-one, very rarely only seven or three rays. The rays are generally radial and regularly distributed, rarely arranged irregularly. Such an irregularity is chiefly observed in the rare few-rayed forms which are evidently derivates of the ordinary many-rayed ones, produced by the suppression of a smaller or greater number of rays. The rays are cylindrical or cylindroconical and truncate or terminally rounded. Their basal parts are smooth, their distal parts covered with a number of good-sized spines. The rays are 1.8–5 μ long and 0.6–1.7 μ thick; the whole aster measures 7–12 μ in diameter. A correlation between ray-number and spicule-size is not pronounced. In the specimen described by Lambe these asters have from fourteen to twenty-five rays, 0.5–1.2 μ thick, the centre is 2–4 μ, the whole aster 6–9 μ, in diameter. They are not mentioned by Lambe (1893).

The *sterrasters* (Plate 35, fig. 23) are flattened ellipsoids, 87–105 μ long, 80–98 μ broad, and 70–77 μ thick. The proportion of length to breadth to thickness is on an average 100 : 91 : 74. In the specimen described by Lambe the sterrasters measure 84–97 by 75–85 by 55–70 μ (Lambe, 1893, 92 μ). In the centre of a young sterraster measuring 37 μ I observed one large granule, about 1 μ in diameter, and several quite small ones.

This sponge was dredged off southern California at Station 2894 on January 5, 1889, in 34° 7′ N. 120° 33′ 30″ W.; depth 97 m. (53 f.); it grew on a bottom of sand and broken shells; the bottom temperature was 13.7° (55.6° F.). The specimen described by Lambe was obtained in the Strait of Georgia near Comox, Vancouver Island, depth 7 m. (4 f.).

Since this sponge is provided with sterrasters and regular triaenes and many of its cortical canals open out freely on the surface while others are provided with pore-sieves, it might be supposed to belong to Sidonops. Since, however, as stated above, a closer examination reveals remnants of pore-sieves at the mouths of the apparently freely opening canals, its sidonoptic appearance is probably deceptive. Believing that, in life, it had not only cribriporal afferents, but also cribriporal efferents, I place it in Geodia. The species of Geodia and Sidonops most nearly allied to *Geodia breviana* are the sponges described by Dendy as *Geodia ramodigitata* Carter and *G. areolata* Carter, and those here described as *G. mesotriaenella*, *G. mesotriaena*, and *G. agassizii*. From all these it is distinguished by the stoutness of the clades of its large anatriaenes and the possession of minute dermal anaclades. From *Geodia* (*Cydonium*) *mülleri*, to which species Lambe assigned the specimen described by him in 1893, *G. breviana* differs by its sterrasters being larger and the clades of its large anatriaenes being much shorter, stouter, and less inclined to the rhabdome.

Geodia ovis, sp. nov.

Plate 40, figs. 1–30; Plate 41, figs. 1–20; Plate 42, figs. 1–40; Plate 43, figs. 1–8.

I establish this species for a spirit specimen from the coast of southern California (Station 2975). It has an exceedingly dense and high spicule-fur which is somewhat woolly in character, and to this the specific name refers.

The specimen is a part of a larger sponge which appears to have been horizontally extended, cake shaped, and about 4 cm. thick. The specimen itself (Plate **40**, fig. 28) is 127 mm. long, 50 mm. broad, and 27 mm. high. Its natural surface is somewhat undulating and covered with a woolly spicule-fur up to 20 mm. high (Plate **40**, figs. 5, 28).

The *colour*, in spirit, is light brown.

The superficial part of the body is differentiated to form a *cortex* (Plate **40**, figs. 5b, 28; Plate **42**, figs. 1a, b, 2a, 8a, b, 9a, b) composed of three layers: an outer dermal layer, 100–200 μ thick; a middle sterraster-armour layer, 150–300 μ thick; and an inconspicuous, inner fibrous layer, not sharply defined from the choanosome.

Canal-system. The parts of the surface which have lost their spicule-fur, and which are consequently exposed to view, are occupied by pore-sieves (Plate **40**, fig. 25). The pores in these sieves are oval or, more rarely, circular, and measure 30–45 μ in maximum diameter. The strands of dermal tissue separating the pores are narrow, usually only 10–20 μ broad. The pores lead into cavities excavated in the dermal layer. From the latter radial canals, penetrating the middle and inner layers of the cortex, arise. These radial canals are surrounded by chonal sphincters which protrude inwards 300–400 μ beyond the sterraster-armour layer. The cylindrical chonal structures thus formed (Plate **42**, figs. 1d, 8) usually are 150–200 μ in transverse diameter. The chonal canal in the axis of these chones is cylindrical and usually open and up to 50 μ wide. Some of these canals open out below with funnel-shaped extensions.

The choaonosome is traversed by canals the widest of which are 2 mm. in diameter. Many of them are provided with membranous sphincters at very frequent intervals. The pore-sieves described above I take to be afferent. I did not observe any that looked like efferents. To find these it would have been necessary to remove the spicule-fur, and this I did not want to do as it would have injured the unique and valuable specimen. From the general appearance of the sponge I am inclined to conclude that the efferents are, like the afferents, cribriporal.

The *skeleton* of the internal part of the choanosome consists of irregularly disposed large amphioxes, a few styles (tylostyles), not very numerous asters, mostly large thin-rayed oxyasters, some minute rhabds, and a few sterrasters. The distal part of the choanosome is traversed by radial bundles of large megascleres which abut vertically on the cortex. These bundles consist of numerous large amphioxes, a few styles (tylostyles) with the rounded end situated distally, and the rhabdomes of orthotriaenes, anatriaenes, mesoproclades, a few proclades, and very few anamonaenes. The cladomes of most of the orthotriaenes and of some of the anaclades are situated in the level of the lower limit of the sterraster-armour layer. A few cladomes of these spicules and of the promesoclades (proclades), chiefly young forms, also occur at lower levels. Between these spicule-bundles minute rhabds, large masses of asters, chiefly large thin-rayed oxyasters, and a few sterrasters are met with. The asters are much more numerous in this region than in the interior of the choanosome.

In the inner layer of the cortex, below the sterraster-armour, large thick-rayed oxyasters and also smaller euasters occur. The sterraster-armour layer is occupied by sterrasters lying rather loosely and on an average four deep. It is traversed by large megascleres the proximal parts of which take part in the formation of the radial spicule-bundles above referred to, and the distal parts of which protrude freely beyond the surface. The proximal parts of the minute rhabds forming the dermal tufts are implanted in the sterraster-armour layer. Many of these spicules traverse nearly the entire thickness of this layer and extend down to within a short distance of its lower limit; others quite reach that level, and some even protrude beyond it. The dermal layer is traversed by tuft-like groups of more or less radially disposed minute rhabds which diverge above (Plate **42**, fig. 9). The proximal parts of these spicule-groups are, as stated above, firmly implanted in the sterraster-armour layer; their distal parts protrude freely beyond the surface for a distance of 100–300 μ, occasionally as much as 400 μ, and form a sort of undergrowth at the base of the spicule-fur. In the lower parts of the dermal layer large thick-rayed oxyasters, similar to the subcortical ones, are met with. Its superficial part, that is, the dermal membrane, is occupied by dense masses of small asters, for the greater part strongylosphaerasters.

The spicule-fur (Plate **40**, fig. 5a; Plate **42**, fig. 2), which, as stated above, in places attains a height of 20 mm., is composed chiefly of large amphioxes, mesoproclades, and anaclades. Tylostyles, proclade mesoproclade-derivates, and orthotriaenes also occur in it. Most of these spicules are implanted in the sponge with their proximal end, some appear to lie in it quite freely. The large amphioxes of the spicule-fur (Plate **42**, fig. 2b) are fairly uniform in size and for the most part arranged radially. The mesoproclades and their proclade-derivates are more variable, particularly in regard to the shape of the cladome, but all of the same order of magnitude and mostly arranged in a fairly regular radial manner. The anaclades, which are nearly all anatriaenes, on the other hand, exhibit an extraordinary diversity in size. Besides large, radially disposed ones, numerous smaller and smallest anaclades are observed in the proximal part of the spicule-fur, particularly on the lower surface of the sponge. The rhabdomes of these small spicules are much and irregularly curved and although vertical to the surface of the sponge in their basal part, do not extend radially throughout their whole length. In places, particularly on the lower side, orthotriaenes (Plate **42**, fig. 2d) similar to the subcortical ones take part in the formation of the proximal part of the spicule-fur.

The *large amphioxes* (Plate **40**, figs. 6–13, 27; Plate **42**, fig. 2b) are slightly curved, not very sharply pointed, 4–9, mostly 7–8 mm. long, and in the middle 30–100 μ, the long ones 70–100 μ thick. Their terminal parts (Plate **40**, fig. 27) are more rapidly attenuated towards the ends than is the central part. The two ends are usually slightly unequal. Two of these amphioxes measured: —

	A	B	
100 μ from one end	20	23	μ in thickness
200 μ " " "	31	31	μ " "
300 μ " " "	39	35	μ " "
in the middle	76	72	μ " "
300 μ from the other end	32	37	μ " "
200 μ " " " "	29	30	μ " "
100 μ " " " "	19	21	μ " "

The rare *large styles* and *tylostyles* are of two different kinds. The one kind is short and stout, the other very long and slender. Those of the former are probably amphiox-derivates, those of the latter perhaps anaclade-derivates. The short and stout ones are true styles, or, if tyle, only slightly thickened at the rounded end, the tyle exceeding the adjacent parts of the spicule not more than 10 % in transverse diameter. These styles (tylostyles) are 2.6–4 mm. long; the rounded end (tyle) is 85–116 μ thick. The long and slender spicules of the latter kind are all tylostyles. Their length is considerable, but could not be exactly ascertained because all I observed were broken off. These spicules are about 40 μ thick; their elongated, oval tyle measures 60–65 μ in transverse diameter.

The *minute rhabds* (Plate **42**, figs. 3a, 4–7, 24a), which form the dermal tufts and also occur scattered in the choanosome, are mostly amphioxes. Many of them are distinctly anisoactine, and in some one end is rounded off. The latter appear as styles. These minute rhabds are much more variable in length than in thickness. They are 270–440 μ, occasionally as much as 550 μ, long or even longer, and 8–13 μ thick.

In the minute dermal rhabds of several geodine sponges, and particularly frequently in those of the species under consideration, I have noticed a remarkable anisoactinity of the axial thread (axial canal), this being very much thicker (wider) at one end than at the other. One half of the axial thread (canal) is in these spicules normally developed and appears as a thin, cylindrical thread. The other half increases in thickness (width) from the centre of the spicule to the end in a funnel-shaped manner. The end of the spicule in which this distally widened half of the axial thread (canal) terminates, appears as a thin-walled tube. In the style-rhabds it is always the pointed end which contains the distally thickened (widened) half of the axial thread (canal). I am inclined to consider the minute rhabds with such anisoactine axial threads (canals) as young, not fully developed ones. If this assumption is correct it would follow that in these minute rhabds the centre of growth (silicification) is not situated in the centre but at one end. This seems to indicate that these spicules, although usually diactine (amphiox) in shape, are in reality monactine in character.

The *orthotriaenes* (and *plagiotriaenes*) (Plate **40**, figs. 1–4, 19–23) have a rhabdome 5–8 mm. long. At the cladome it is 74–100 μ thick, farther down, it generally thickens to 77–110 μ. At this its thickest point, which lies a short distance below the cladome, the rhabdome is usually 3–15 % thicker than at the cladomal end. At the acladomal end it is in most cases attenuated to a fine, terminally pointed thread. The clades are curved, concave to the rhabdome, either uniformly throughout (Plate **40**, fig. 21) or, more frequently, less strongly towards the end of the clade than at the base (Plate **40**, figs. 19, 20). Sometimes this distal decrease of curvature is so great that the end of the clade appears as a nearly straight cone or rod (Plate **40**, fig. 22). Occasionally the end of one of the clades is bent down abruptly. This, however, is observed only in clades much reduced in length. Usually the clades are conical and blunt pointed, less frequently cylindrical and rounded at the end. Such cylindrical clades may be short or long. The clades of the same cladome are fairly equal or, more rarely, very unequal. The longest clade of the cladome is 310–640 μ long, the shortest often much shorter than 310 μ. The chords of the clades enclose angles of 86–101°, on an average 94°, with the axis of the rhabdome. Nearly all the adult spicules of this kind observed were true orthotriaenes, plagiotriaene forms with clade-angles exceeding 100° being very rare among them. Small, young forms have clade-angles of 109° and more, and appear as plagiotriaenes.

I have observed two quite *abnormal megascleres*. Both are partly broken. One (Plate **40**, fig. 26) consists of a shaft, in the middle 80 μ thick, and broken off at one end. From the other end, which is 55 μ thick, one stout clade arises at a right angle. This is only 70 μ long and divides at the end into a bunch of small truncate axial threads radiating in all directions. All but one of these branches are broken off, the one intact measures 70 × 15 μ. The other abnormal spicule is a hexactine with rays 40–55 μ thick, two of which are broken off. Of the other four three are rounded and one pointed at the end. The longest of these rays is 900 μ, the shortest only 75 μ long. This spicule is particularly interesting as hexactine abnormal megascleres are exceedingly rare in tetraxonid sponges.

The *mesoproclades* and their *proclade derivates* (Plate **43**, figs. 1–8) have a rhabdome 6–17 mm. long and, at the cladome, 20–41 μ thick. At its thickest point, which lies a little above (nearer the cladome than) the middle of the length of the rhabdome, the rhabdome is from two to three times as thick as at the cladome. The cladomes of these spicules are very variable. Triaene forms greatly predominate. In the most regular mesoprotriaenes (Plate **43**, figs. 3, 4) the clades are fairly equal, conic, blunt pointed, slightly curved, concave to the epirhabd, and 140–170 μ long. Their chords enclose angles of a little over 45° with the axis of the epirhabd. The epirhabd is straight, conic, about 110 μ long, and pointed at the end. Mesoprotriaenes with cladomes rendered irregular by the clades being of unequal length (Plate **43**, figs. 6, 8) are very abundant. In these spicules one clade may be very much longer than the other two, which latter again may be fairly equal (Plate **43**, fig. 6) or very unequal (Plate **43**, fig. 8). In these irregular mesoprotriaenes the clades are 40–260 μ and the epirhabd is 70–100 μ long.

In some of the mesoproclades one or two clades are completely suppressed; these appear as mesoprodiaenes (Plate **43**, fig. 1) and mesopromonaenes. The dimensions of the clades and epirhabds of these spicules are similar to those of the triaene forms. The clades of the mesoprodiaenes are not opposite each other but occupy the same positions — in planes passing through the rhabdome and enclosing an angle of 120° — as they would if the third clade were present.

Some of the teloclades observed I am inclined to consider as mesoprotriaene-derivates in which the epirhabd has been suppressed. These spicules have a rhabdome as long and thick as or slightly thicker than the mesoproclades, and three more or less ascending clades, convex to the rhabdome, the chords of which are 100–360 μ long and enclose angles of 31–76° with the continuation of the rhabdome-axis. The large-angled forms of these spicules (Plate **43**, fig. 2) appear as plagioclades, the small-angled ones (Plate **43**, fig. 7) as proclades.

The *anaclades* (Plate **42**, figs. 2c, 3b, 10, 11, 23b, 24b, 25–40) are nearly all anatriaenes. I have observed only one or two anamonaenes among them. The anaclades are remarkable for the great differences in their size. The small ones observed cannot be considered as the young of the large ones, because they are found in abundance, more or less extruded from the sponge, in the spicule-fur, where they can hardly be expected to continue to grow.

I measured forty-nine cladomes of anaclades of this sponge and arranged these measurements in a series according to the thickness of the cladomal end of the rhabdome. Apart from a gap between thicknesses of 7–16 μ this series is fairly continuous. Although the gap between 7–16 μ could probably be filled if the search were continued long enough, it nevertheless indicates that anaclades of these dimensions are not nearly so numerous as larger and smaller ones, so that small and large anaclades can, to a certain extent, be distinguished. This distinction is, however, not nearly so clearly marked as in the other Pacific geodine sponges which possess small as well as large anaclades.

The *small anatriaenes* (Plate **42**, figs. 3b, 10, 11, 23b, 24b, 25–27) have a rhabdome 670 μ–2.5 mm. long and, at the cladome, 2–7 μ thick. In some of these spicules (Plate **42**, fig. 3b) the rhabdome is nearly cylindrical and rounded at the acladomal end. In others (Plate **42**, fig. 25) it is distinctly spindle shaped, thickest in the middle, and attenuated towards both the cladomal and the acladomal ends, the former being less than half as thick as the thickest, central part of the rhabdome, and the latter pointed. The clades are slightly curved, concave to the rhabdome. They arise either terminally (Plate **42**, figs. 3b, 10, 23b, 25–27) or a little below the end of the rhabdome. In the latter case a more (Plate **42**, fig. 11) or less (Plate **42**, fig. 24b) clearly pronounced protuberance arises from the apex of the cladome. The chords of the clades of these spicules are 6–43 μ long and enclose angles of 41–65° with the axis of the rhabdome.

The *large anatriaenes* (Plate **42**, figs. 28–40) have a rhabdome up to 23 mm. long, which is, at the cladome, 17–45 μ thick. The clades are usually equal in size. They arise nearly terminally, and there is only a slight protuberance on the apex of the cladome. The clades are conic, pointed or somewhat blunt, and curved, concave to the rhabdome. This curvature decreases distally, the ends of the clades usually being nearly straight. An abrupt bend is sometimes observed at the point where the more strongly curved basal part passes into the nearly straight distal part (Plate **42**, figs. 31, 39). The chords of the clades are 70–205 μ long and enclose angles of 36–55°, on an average 42.5°, with the axis of the rhabdome.

Although the different kinds of *euasters* are connected by transitional forms to a much greater extent than in most of the other geodine sponges, three kinds can be fairly well distinguished. These are: 1. Large asters without centrum and with slender, conic, pointed rays, in which the length of the rays is more than five times as great as their basal thickness. These asters are here described as large thin-rayed oxyasters. 2. Large asters, here described as large thick-rayed oxyasters, with very stout, conic, pointed rays, in which the length of the rays is less than five times as great as their basal thickness. 3. Smaller asters, here described as small thick-rayed asters, with stout, truncate, blunt or pointed rays.

The *large thin-rayed oxyasters* (Plate **41**, figs. 3, 9b, 12, 15, 19; Plate **42**, figs. 13b, 14b, 17b, 21b, 22b) are destitute of a central thickening and have from three to ten usually quite concentric and simple, straight, conical, sharp- or blunt-pointed rays. The proximal third of the rays is smooth, the distal two thirds are covered by spines which are usually large and conspicuous (Plate **41**, figs. 15, 19), more rarely so small as merely to give to its distal part a slightly roughened appearance (Plate **41**, fig. 3). The rays are 11–18 μ long and, at the base, 1–3.2 μ thick, the total diameter of the aster being 20–34.5 μ.

The many-rayed *large thick-rayed oxyasters* (Plate **41**, figs. 10b, 11b, 16–18, 20; Plate **42**, figs. 12–15a, 20a, 21a) appear, in consequence of the concrescence of the basal parts of the exceedingly thick rays, as sphaerasters; in those with few rays, however, no trace of a central thickening can be detected. The rays of the many-rayed forms are fairly concentric and regularly distributed (Plate **41**, fig. 16; Plate **42**, figs. 12–15a, 20a, 21a), while those of the few-rayed forms are sometimes eccentric and, as a rule, not regularly distributed (Plate **41**, figs. 10b, 11b). The rays are straight, conic, and usually very sharp pointed. Most of them are simple but in a good many of these asters one or even two of the rays are bifurcate (Plate **41**, figs. 10b, 11b). The extreme tip and the basal portion of the rays are usually quite smooth, their remaining part covered with large, vertically arising, terminally recurved, claw-like spines. In some of these asters the spines are quite numerous, in others rather scarce and restricted to a verticillate belt situated some distance below the end. These asters have from four to nineteen rays, 14–24 μ long and, at the base, 3–6.3 μ thick. In some of the many-rayed forms the central thickening attains a diameter of 12 μ. The total diameter of the aster is 28–45 μ.

The *small thick-rayed asters* (Plate **41**, figs. 1, 2, 4–8, 9a, 10a, 11a, 13, 14; Plate **42**, figs. 16c, 21c) are without centrum or have a central thickening up to 6 μ in diameter. They have from six to fifteen concentric, regularly distributed, and usually equal, more rarely unequal (Plate **41**, figs. 13–14), truncate, blunt or pointed rays. The distal parts of the rays are densely covered with large spines which are not, as is the case in the large thick-rayed oxyasters, restricted to an intermediate zone but extend right up to the tip of the rays.

The spines arising from the terminal parts of the rays are directed obliquely outward and upward. The rays are (without the centrum, when present) 5–12 μ long and, at the base, 1–3.2 μ thick. The total diameter of the aster is 11–24 μ.

The normal *sterrasters* (Plate **40**, figs. 14–18, 24) are flattened ellipsoids, 82–92 μ long, 70–83 μ broad, and 54–61 μ thick. The average proportion of length to breadth to thickness is 100 : 87 : 66. The rays protruding beyond the surface are 3.5–4.5 μ thick and have a terminal verticil of usually five to seven lateral spines. In the sterraster represented in Plate **40**, figs. 17–18, the rays surrounding the umbilicus are hardly larger than the others. The umbilicus is 8–15 μ broad and about 10 μ deep.

Besides these normal sterrasters a few sterroid forms (Plate **40**, fig. 29) of similar dimensions, but with protruding rays 7–8 μ broad, and provided with a much larger number of lateral spines, are met with. I have also observed a larger sterraster with exceedingly thin protruding rays in one of the spicule-preparations, but this I believe to be a foreign spicule.

This sponge was trawled off southern California, at Station 2975 on February 12, 1889, in 34° 1′ 30″ N., 119° 29′ W.; depth 66 m. (36 f.); it grew on a bottom of gravel and broken shells; the bottom temperature was 13.9° (57° F.). A label marked "506 Tetractinellida" was also attached to it.

As the afferents and efferents are, with little doubt, cribriporal, and as the skeleton is geodine in character I place this sponge in Geodia.

Its nearest allies are *Geodia kükenthali* Thiele, *G.* (*Cydonium*) *mülleri* Fleming, and the sponge here described as *G. mesotriaena*.

Geodia kükenthali is distinguished from *G. ovis* by the very much smaller size of its megascleres, by the absence of small anatriaenes and a particularly well-developed spicule-fur, by the smaller sterrasters, and by the euasters, the largest of which have in *G. kükenthali* blunt rays while the apparently corresponding largest asters of *G. ovis* have markedly sharp-pointed rays.

G. mülleri has, when adult, extensive praeoscular and vestibular cavities, absent in *G. ovis*, and no such highly developed spicule-fur as the latter. Its megascleres are, although the largest specimens of *G. mülleri* examined were considerably larger than the specimen of *G. ovis*, very much shorter than those of the latter, and also its sterrasters somewhat smaller. The dermal asters of *G. mülleri* are strongylasters with cylindrical rays and measure 4–10 μ in total diameter, while the superficial asters of *G. ovis* are 11–24 μ in total diameter and many of them have more or less conical rays. The remarkably large oxyasters with stout, conic, sharp-pointed rays of *G. ovis* have not been observed in *G. mülleri*, their place here being taken by strongylasters much smaller in size.

Apart from the minute anatriaenes the megascleres of *G. mesotriaena* are in shape and size very similar to those of *G. ovis*. The former is, however, distinguished from the latter by the possession of praeoscular cavities, the lower spicule-fur, and the absence of minute anatriaenes. Its sterrasters are larger, its dermal asters much smaller, and the large oxyasters with stout, regularly conical, and sharp-pointed rays, so abundant in *G. ovis*, are wanting in *G. mesotriaena*.

Geodia micropora, sp. nov.

Plate 36, figs. 13–36; Plate 37, figs. 1–11.

I establish this species for a specimen from Duncan Island, Galapagos.

The radial cortical canals, both the afferents and the efferents are very narrow and their entrances, although covered with pore-sieves, appear to the naked eye as very small, simple, open pores. To this the specific name refers.

Shape and size. The specimen (Plate **36**, fig. 32) appears as a part of a larger lobose mass, measures 63 mm. in maximum diameter, and is attached to some black pebbles and pieces of coral. The surface is fairly smooth. On its protected parts remnants of a spicule-fur are observed. With the exception of a belt about 1.5 mm. broad, which extends for a considerable distance and in which there are only few minute pores, the whole of the surface is occupied by the small cribriporal entrances to the radial cortical canals. On one side of the belt the entrances to the cortical canals are 50–200 μ wide and their centres on an average 350 μ apart; on the other side they are 200–500 μ wide and their centres on an average 600 μ apart. The small canal-entrances on the one side of the belt I consider as afferents, the wider ones on the other side as efferents.

The *colour*, in spirit, is brownish white, somewhat lighter on the surface than in the interior.

The superficial part of the body forms a *cortex* (Plate **37**, figs. 1a, 2a, 3) 450–600 μ thick. This is composed of three layers, an outer dermal layer (Plate **37**, fig. 3a) 60–101 μ thick, a middle sterraster-armour layer (Plate **37**, fig. 3c) 300–420 μ thick, and an inner fibrous layer 45–100 μ thick. The latter is occupied by paratangential fibres and by cells strongly staining with haematoxylin. Most of these cells are elongated and extend paratangentially.

Canal-system. The afferent area of the surface is covered with pore-sieves

170–330 μ in diameter, the centres of which are on an average 350 μ apart. The pores in these sieves (Plate **37**, figs. 8, 12) are very unequal, 30–130 μ wide, and separated from each other by thin and narrow bands of dermal tissue. Each pore-sieve forms the roof of a cavity from which a radial afferent cortical canal, circular in transverse section and 50–200 μ wide, arises. These afferent canals penetrate the sterraster-armour layer and open out into a subcortical cavity (Plate **37**, figs. 1, 2, 3d). From the latter the narrow afferent choanosomal canals originate.

The flagellate chambers (Plate **37**, fig. 14) appear to be sphaeroidal, depressed in the direction of the oral axis, 20–26 μ broad, and 12–17 μ high.

The choanosomal efferents join to form wide canal-stems (Plate **37**, fig. 2b) which extend radially towards the efferent area of the surface. Some distance below the cortex these canal-stems divide into branches leading up to the efferent radial cortical canals. The latter are 200–500 μ wide and covered by sieves (Plate **37**, figs. 9, 13), the pores of which are larger and more equal than the afferent pores, and usually 80–200 μ wide.

The *skeleton* consists of large choanosomal amphioxes, small dermal rhabds, orthoplagiotriaenes, mesoproclades, large oxyasters, large oxysphaerasters, small strongylosphaerasters, and sterrasters. In the spicule-preparations I also found chelotrops, which, however, are probably foreign to the sponge. In the interior of the choanosome the large amphioxes are irregularly scattered. In its distal part they, together with the rhabdomes of the orthoplagiotriaenes, form radial bundles which abut vertically on the cortex (Plate **37**, figs. 1, 2). The cladomes of the orthoplagiotriaenes lie in the level of the inner limit of the sterraster-armour layer. The rhabdomes of the mesoproclades are situated radially, their acladomal ends are implanted in the sterraster-armour layer, their cladomes protrude freely beyond the surface. The cladomal parts of these spicules appear to form the bulk of the spicule-fur. A few large, slender, radial amphioxes, however, are also found in it. Small dermal rhabds, mostly situated obliquely, occur in considerable numbers in the subcortical layer, which appears to be their place of origin (Plate **37**, fig. 3c). From here they wander rapidly — few only are found *en route* in the middle layer of the cortex — up to the dermal layer, in which they take up their final position. Here they form tufts implanted in the sterraster-armour layer. The distal parts of these tufts protrude freely beyond the surface. These spicule-tufts occupy the tracts of poreless tissue intervening between the pore-sieves. The tufts next the pore-sieves are inclined towards their centre so as partly to shelter them. Most of the pore-sieves are surrounded by a ring of five or six regularly distributed spicule-tufts; the intervals between these tufts are equal.

Hardly any euasters are observed in the interior of the choanosome; distally large oxyasters are met with in small numbers. In the subcortical layer and in the walls of the radial cortical canals large oxysphaerasters occur. The dermal membrane is occupied by small strongylosphaerasters. These are more numerous between the pore-sieves than in the narrow bands separating the individual pores from each other. A large number of sterrasters, chiefly young forms, occur in the interior of the choanosome. In its distal part there are only few sterrasters. In the proximal part of the sterraster-armour layer the sterrasters are quite far apart; in its distal part they are closely packed together and form a dense mass (Plate **37**, fig. 3).

Some of the *large amphioxes* are simple, others centrotyle. Forms with a hardly perceptible central thickening connect the centrotyle forms with the simple ones. First I thought that the centrotyle amphioxes were young stages of the others; since, however, centrotyles are found among the thickest of these amphioxes and simple, non centrotyle ones among the thinnest, I hardly think that this can be so. The large amphioxes are 1.2–1.6 mm. long, in the middle 20–28 μ thick, and usually slightly curved. The tyle is always situated in the thickest, central part of the spicule. The diameter of the properly developed central tyle is, as the following measurements show, 12 to 30 % greater than the thickness of the adjacent parts of the spicule. The thickest tyle observed measured 31 μ in transverse diameter.

Thickness of amphiox close to the central tyle.	Transverse diameter of the central tyle.
21 μ	27 μ
22 "	25 "
22 "	26 "
23 "	26 "
23 "	31 "
24 "	27 "

The *minute dermal rhabds* (Plate **36**, figs. 24a, 26a, 27a) are amphistrongyles attenuated towards both ends. They are generally isoactine, rarely anisoactine, usually slightly curved, and 125–165 μ long. In the middle they are 2–3.6 μ, at the ends 1.8–2 μ thick, the thickness of the ends being on an average about 59 % of the maximum thickness in the middle.

The *orthoplagiotriaenes* (Plate **37**, figs. 4–7) have a fairly straight, conic rhabdome 1.1–1.45 mm. long and, at the cladome, 28–47 μ thick. The acladomal end is usually blunt pointed. Sometimes irregular rhabdomes (Plate **37**, fig.

7) are observed. The clades are rather blunt, sometimes nearly truncate, and curved towards the rhabdome. In the basal part of the clade this curvature is very considerable; distally it decreases, and the ends of the clades are only slightly curved or even quite straight. The clades rise at rather large angles from the rhabdome, but, in consequence of their strong curvature, their chords enclose angles of only 97–112°, on an average 104.5°, with the axis of the rhabdome. The greater number of these spicules appear as plagiotriaenes (with clade-angles over 100°), about 20 % of them as orthotriaenes (with clade-angles 90–100°). The chords of the clades are 175–240 μ long.

The cladomal end of the axial thread of the rhabdome is often varicose and in some of the young orthoplagiotriaenes a slight thickening of the rhabdome surrounds this part of the axial thread.

In the spicule-preparations I found several *chelotrops* (Plate **37**, figs. 10, 11). These have conical, pointed, usually straight, more rarely angularly bent rays, 195–260 μ long and, at the base, 21–27 μ thick. I have not found any of these spicules *in situ* in the sections. Although they coincide in their dimensions with the orthoplagiotriaenes, I think it probable that they are foreign to the sponge.

The *mesoproclades* (Plate **36**, figs. 13–17) have a rhabdome about 1.7 mm. long and, at the cladome, 4–9 μ thick. In its central part the rhabdome is about 20 % thicker than at the cladome. The shape of the cladome is very variable. The epirhabd is usually well developed, straight, conical, pointed, and 25–43 μ long. Sometimes it is quite short, reduced to a mere knob. Of clades there may be three (Plate **36**, fig. 13), two (Plate **36**, fig. 16), or one (Plate **36**, fig. 17). In the monaene forms knob-shaped rudiments of one or two other clades, usually situated at different levels, are often present (Plate **36**, fig. 14). The clades are conic pointed or blunt, and curved, concave to the epirhabd. Their chords are 10–30 μ long and enclose angles of 32–64°, on an average 51°, with the epirhabd.

The *large oxyasters* (Plate **36**, figs. 24–26d, 34b) are without central thickening and have from six to nine, most frequently seven, concentric, regularly distributed rays. The rays are straight, conic, 8–12 μ long, and very slender, at the base, only 0.4–0.9 μ, usually 0.6–0.7 μ thick. Everywhere, except at the base, they bear small spines. Towards the end the ray proper becomes exceedingly thin; the spines, however, which are here particularly dense, make its terminal part appear thicker and its end somewhat blunt. The total diameter of the oxyasters is 14–20 μ, usually 16–17 μ.

The *large oxysphaerasters* (Plate **36**, figs. 18b, 19b, 26c, 33b) have a spherical centrum, 4–6 μ, about a quarter to a third of the whole aster, in diameter, from which from sixteen to twenty-two concentric, regularly distributed rays arise radially. The rays are straight, conical, sharp pointed, without the centrum 6–7.5 μ long and, at the base, 1–1.6 μ thick. The rays bear small spines. The latter are sometimes so minute as to be hardly discernible as such. Often somewhat larger spines form a verticillate belt some distance below the end of the ray. The total diameter of the oxysphaerasters is 14–20 μ.

The *small strongylosphaerasters* (Plate **36**, figs. 18a, 19a, 20, 24b, 26b, 28, 33a, 34a) have a centrum 2–3 μ, a third to a half of the whole aster, in diameter, from which from eight to fifteen, most frequently twelve, rays arise. These are generally regularly arranged, concentric, radial, and equal, rarely irregular. The rays are cylindrical or cylindroconical, truncate, and often provided with a terminal spine. They are 2–3 μ long, at the base 0.6–1.3 μ thick, and bear rather large spines, some of which often form a verticil some distance below the end of the ray. The total diameter of the small strongylosphaerasters is 6–9.2 μ, usually 6–8 μ.

Besides these I have observed similar but smaller strongylosphaerasters, down to 3.4 μ in total diameter, which I take to be young forms of the ones described above.

The *sterrasters* (Plate **36**, figs. 21–23, 30, 31, 35, 36) are broad, flattened ellipsoids 72–76 μ, rarely as much as 82 μ long, 65–74 μ broad, and 55–62 μ thick. The average proportion of length to breadth to thickness is 100 : 95 : 85. In the centre of the sterraster there is a cluster, 2.5–5 μ in diameter, of small granules. The umbilicus is a conic pit, 11–15 μ deep. Seen in profile the sides of this pit appear somewhat concave. Its entrance is usually irregular in shape, often considerably elongated, and measures 11–18 μ in maximum diameter. The freely protruding rays which surround the umbilicus have a transverse section elongated in a direction radial to the centre of the umbilicus, which measures 2–2.5 $\mu \times 4$ μ. These rays bear as many as 8–12 lateral and several terminal spines. The other protruding rays, away from the umbilicus, have more or less circular transverse sections, which are 2.5–3.4 μ in diameter. These rays usually bear from 5–7 lateral spines. In sterrasters not quite fully developed the spines are slender (Plate **36**, figs. 35, 36), in the fully developed ones they are stout (Plate **36**, figs. 30, 31).

This sponge was collected on April 13, 1888, at Duncan Island, Galapagos. It was labeled F. C. 1354 and 539 Tetractinellida.

The structure of the skeleton and the cribriporal character of the afferents and efferents show that this sponge belongs to Geodia. Its nearest allies appear to be *Geodia paupera* Bowerbank, *G.* (*Pachymatisma*) *inconspicua* Bowerbank, and *G.* (*Cydonium*) *cooksoni* Sollas.

The locality of *Geodia paupera* is unknown and the locality given of *G. inconspicua*, "South Seas" is hardly definite enough to be of value. Both these species have smaller sterrasters, no mesoproclades, and no centrotyle amphioxes. The choanosomal asters of *G. paupera* are strongylasters and not oxyasters as in *G. micropora*, and the megascleres of *G. inconspicua* much larger than those of *G. micropora*. I do not doubt, therefore, that these sponges are distinct from *Geodia micropora*.

I found it much more difficult to decide the question whether or not this species is specifically identical with *Geodia* (*Cydonium*) *cooksoni* Sollas, which in many respects resembles it and which also comes from the Galapagos (Charles Island). The description given by Sollas[1] is exceedingly meagre and unaccompanied by illustrations. I therefore asked my friend Mr. Kirkpatrick of the British Museum to send me a part of the type specimen of this species for examination and he had the kindness to accede to my request. I find that the sterrasters of *G. cooksoni* have nearly the same size, but are relatively thinner, than those of *G. micropora*, and that the dimensions of the other spicules are larger. This difference in size is particularly marked in the choanosomal asters, the largest of which are in the type of *Geodia* (*Cydonium*) *cooksoni* fully twice as large as the largest of *G. micropora*. It is for these reasons and also because the mesoproclades have smaller clade-angles (average in *G. micropora* 51°, in *G. cooksoni* 44°) and the large euasters relatively much larger centra in *Geodia* (*Cydonium*) *cooksoni* than in *G. micropora* that I describe the latter as a new species.

Geodia amphistrongyla, sp. nov.

Plate 20, figs. 1–41.

I establish this species for two fragments from Easter Island which may be parts of the same specimen. Its choanosomal rhabds are not, as is the rule in geodine sponges, chiefly amphioxes, but chiefly amphistrongyles, amphioxes being absent altogether. To this remarkable peculiarity the name selected for the species refers.

Shape and size. The larger fragment is an irregular, somewhat flattened mass (Plate **20**, fig. 31) 31 mm. long, 18 mm. broad, and 12 mm. thick. The other, considerably smaller fragment is similar in shape. The surface is un-

[1] Rept. voy. "Challenger," 1888, **25**, p. 255, 256.

dulating and not perforated by larger openings visible to the unaided eye. To parts of it shells, sand, and other foreign bodies are attached. It appears to be covered throughout with shallow pits, the centres of which are about 1 mm. apart. There is hardly a trace of a spicule-fur, but the numerous slender spicules broken off at the surface, seen in sections, indicate that protruding spicules were present in the living sponge.

The *colour*, in spirit, is light brown on the surface and quite dark brown in the interior.

The superficial part of the body forms a *cortex* composed of a thin outer dermal membrane, thickened in the pits; a stout central sterraster-armour layer (Plate **20**, figs. 33a, 39a) about 1 mm. thick; and an inner fibrous layer, excavated by subcortical cavities. A thin cuticular membrane was observed on parts of the surface. Whether this belongs to the sponge or whether it was formed by some symbiont growing on it, I cannot state with certainty.

Canal-system. Below the centre of each pit a radial cortical canal, penetrating the sterraster-armour, is situated. Above, these canals widen out to form subdermal cavities which are covered by pore-sieves, the pores of which are circular or broad-oval, 17–45 μ wide, and separated by quite broad strands of tissue. Below, the cortical canals are restricted by chonal sphincters (Plate **20**, fig. 33b) which protrude proximally beyond the lower limit of the sterraster-armour layer. The chonal canals passing through the sphincters, which in my preparations are strongly contracted and often quite closed, open out into the subcortical cavities (Plate **20**, fig. 33c). From the latter the choanosomal canals arise.

Skeleton. Numerous slender strands of amphistrongyles and a few styles traverse the interior in a rather irregular manner. Towards the surface these strands assume a radial direction and become consolidated to form bundles, which penetrate the cortex and abut vertically on the surface. Here, in the distal part of the choanosome and in the cortex, rhabdomes of telo-and mesoclades are found in the bundles besides the amphistrongyles and styles. These telo- and mesoclades are plagiotriaenes, anatriaenes, mesotriaenes, and a few diaene, monaene, and other derivates of these spicules. The cladomes of some, chiefly young, forms of these spicules are found in small numbers at various levels. The cladomes of nearly all the adult plagiotriaenes and their diaene and monaene derivates lie above the sterraster-armour, just below or in the dermal membrane. Here also the cladomes of a few, apparently adult mesoproclades, anatriaenes, and anatriaene-derivates are found. The slender spicules traversing the cortex radially and broken off at the surface; are probably the proximal parts of rhabdomes of these anatriaenes and mesoclades, which composed the spicule-fur in the living sponge.

The microscleres are oxyasters, oxysphaerasters, small strongylosphaerasters, and sterrasters. The oxyasters are confined to the choanosome and are not numerous; the oxysphaerasters occur chiefly in the walls of the cortical canals and in the roofs of the subcortical cavities. The small strongylosphaerasters form a dense layer on the outer surface. The sterrasters occupy the sterraster-armour layer of the cortex in dense masses and are scattered also in large numbers throughout the whole of the choanosome (Plate **20**, figs. 33, 39). The choanosomal sterrasters are mostly young forms.

The large *amphistrongyles* (Plate **20**, figs. 1–3, 17–19) are slightly or considerably (Plate **20**, figs. 2, 3) curved, 0.5–2.3 mm. long, and, in the middle, 18–32 μ thick. Their thickness is by no means in proportion to their length, the shortest amphistrongyles being quite as thick as or thicker than the longest. The long amphistrongyles (Plate **20**, figs. 1–3) usually taper from the centre towards both the rounded ends, the thickness of the latter being 40–75 % of the thickness of the former. This attenuation may be equal at both ends — then amphistrongyles appear as isoactines; or it may be unequal — then the amphistrongyles appear as anisoactines. The shorter the spicules are, the less marked is the attenuation towards their ends. The spicule represented on Plate **20**, fig. 19, which is 1.05 mm. long, is at the ends 17 μ and 20 μ, only in the middle 22 μ thick. Still shorter amphistrongyles are, if isoactine, regularly cylindrical or slightly thickened at the ends, or, if anisoactine, club shaped, like the spicule represented on Plate **20**, fig. 18, in which the thickest part is situated at one end. Slender amphistrongyles with knob-shaped thickenings (Plate **20**, fig. 17), which may be young forms, have been observed occasionally. It is certain that the short, stout amphistrongyles do not develop into the long, slender ones. That the former are cylindrical and often more or less thickened at the ends, while the latter are never thicker and usually more slender and attenuated towards the ends, leads me to suppose that the silicoblasts, which build up the ends of these spicules, wander, while they perform their allotted task, either slowly or rapidly in a distal direction. In the first case short, thick, and more cylindrical, in the second case long and relatively slender amphistrongyles, attenuated towards the ends, are produced.

The rare *large styles* (Plate **20**, figs. 20, 21) have similar dimensions as the amphistrongyles above described and may be considered as derivates of anisoactine forms of such, in which the thinner end has become attenuated to a fine point.

The *plagiotriaenes* (Plate **20**, figs. 22, 25) have conical, usually quite straight rhabdomes, 1.8–2.2 mm. long and 22–32 μ thick at the cladomal end. The acladomal end is usually simply rounded off and 3–10 μ thick, rarely slightly thickened. The clades are slightly curved, concave to the rhabdome, conical, usually regularly arranged, with angles of 120° between them, and, in the same cladome, of equal size and in nearly the same position to the rhabdome. The clades are 155–190 μ long and enclose angles of 103–120°, most frequently about 109°, with the rhabdome. Rarely the clade-rhabdome angles of the same rhabdome are very dissimilar. In one plagiotriaene-cladome of this kind one of the three clades was nearly upright, resembling in its position an epirhabd. This sword-like spicule might be termed a mesorthodiaene.

Among these plagiotriaenes similar forms with reduced cladomes, which appear as *plagiodiaenes* or *plagiomonaenes* occur. The monaene forms are more frequent than the diaene. The cladome of a normal monaene of this kind is shown in Plate **20**, fig. 23. Very rarely the rhabdome is reduced in length and in that case cylindrical and slightly thickened at the acladomal end. One of these spicules (Plate **20**, fig. 24) has a rhabdome, only 285 μ long, and a single, bifurcate clade, arising at an angle of hardly more than 90° from the rhabdome. This spicule is an orthodichomonaene. Dichoclade forms of this or any other description are, however, exceedingly rare.

Owing to the loss of nearly the whole of the spicule-fur I found but few *mesoproclades* (Plate **20**, figs. 7, 8), which presumably form the greater part of this fur. None of them had an intact rhabdome, so that I cannot give its length. Most of the mesoproclades observed were triaene, but monaene forms (Plate **20**, fig. 7) have also been met with. The rhabdomes of these spicules are, at the cladome, 3–5 μ thick; the epirhabds are straight, conical, sharp pointed, and 16–22 μ long; the clades are concave to the epirhabd, usually rather blunt, and 40–60 μ long. The clade-epirhabd angles of the intact cladomes observed were 36–41°, but some broken mesoprotriaene cladomes seen indicate that occasionally this angle is considerably larger.

The *anatriaenes* (Plate **20**, figs. 5, 6, 10, 11) are, like the mesoproclades, scarce in the preparations, and probably for the same reason. Anatriaenes with intact rhabdomes were not observed. Their rhabdomes are 1.5–4 μ thick at the cladomal end, the clades are conical and sharp pointed, more (Plate **20**, figs. 5, 10) or less (Plate **20**, figs. 6, 11) curved, concave to the rhabdome in their proximal portion and straight in their distal portion. Their chords are 26–50 μ long and enclose angles of 25–41° with the rhabdome.

I found one remarkable anatriaene-derivate (Plate **20**, fig. 4) which possesses, besides the three recurved anatriaene-clades and the rhabdome, a fifth ray, directed obliquely upwards. This spicule appears as a mesanatriaene with oblique epirhabd.

The *choanosomal oxyasters* (Plate **20**, figs. 12–16, 26–30a) have no central thickening or a hardly perceptible one, and usually straight and simple, equally distributed rays. Very rarely one or more rays are either curved (Plate **20**, figs. 13) or bifurcate. The rays are conical, smooth at the base, and spined in their distal part. In the thin-rayed, probably young, oxyasters the spines are so small as merely to give to the rays, when examined with the highest powers, a slightly rough appearance. In the thick-rayed, presumably adult, forms the spines are usually large, sometimes nearly 1 μ long. They arise vertically or slightly obliquely from the rays, and are in the latter case directed upwards, towards the tip of the ray. All the spines which were large enough to be distinctly made out, were straight. Recurved, claw-like spines were not met with. Sometimes (Plate **20**, figs. 13, 16 right upper corner) the spines are massed at the tip of the ray, more frequently (Plate **20**, figs. 14, 15, 16 middle, left) they are sparsely scattered over its distal two thirds. The ends of stout rays are often crowned by one particularly large, terminal spine. These oxyasters have from five to nine rays and measure 20–30 μ in total diameter. The rays are 10–15 μ long and at the base 0.8–2.1 μ, usually 1.5–1.8 μ thick. A correlation between the number of the rays and the dimensions of the aster is not noticeable.

The *oxysphaerasters* (Plate **20**, figs. 26b, 27b, 30b) have a spherical centrum 6–7 μ in diameter, from which from fourteen to eighteen stout, straight, conical, and sharp-pointed, equally distributed rays arise radially. The rays are 6–11 μ long and, at the base, 2–2.8 μ thick. From their distal part spines, which are usually quite large, arise. The base of the ray is always free from spines. A rather regular verticil of particularly large spines, situated some distance below the end of the ray, is sometimes observed. The total diameter of these spicules is 19–28 μ. A correlation between the number of their rays and the dimensions of the aster is not discernible.

The *small strongylosphaerasters* (Plate **20**, figs. 28c, 29c, 34–36) consist of a spherical or somewhat irregular centrum, 2.2–3 μ, rarely as much as 4 μ in diameter, from which from seven to twelve rays arise. These are regularly distributed and in the same aster equal in size, or, more rarely, unequal in position and dimensions. The rays are cylindrical or slightly thickened distally and have a flat or convex terminal face from which a bunch of stout spines arises. The spines forming this bunch are sometimes nearly parallel to each other and to the axis of the ray, sometimes they diverge, occasionally so much so that the outermost ones become nearly vertical to the axis of the ray. Generally the sides of the rays are quite smooth. Sometimes, however, I have observed small spines on them. The rays are 1–2 μ long and 0.8–1.8 μ, usually about 1 μ thick. The total diameter of the strongylosphaerasters is 4.8–8 μ, usually 5–6.5 μ. The strongylosphaerasters with numerous rays are on the whole smaller than those with few rays. Thus those with ten or more rays measured were 4.8–6.5 μ, those with from seven to nine rays 6–8 μ, in diameter.

Besides these normal strongylosphaerasters I found a few sphaerasters similar in size, with much more numerous (from fourteen to nineteen) and more slender, conical rays. Perhaps these were foreign, or — which, however, does not seem very probable — young forms of the oxysphaerasters.

The *sterrasters* (Plate **20**, figs. 9, 28d, 30d, 32, 37, 38, 40, 41) are flattened ellipsoids and measure 100–110 μ in length, 87–94 μ in breadth, and 72–78 μ in thickness. The average proportion of length to breadth and to thickness is 100 : 87 : 74. The young forms, which are very abundant in the choanosome, are enclosed in endothelial capsules (Plate **20**, fig. 9) and composed, as usual, of slender rays the proximal parts of which coalesce to form a solid mass (Plate **20**, figs. 9, 28d, 30d). In the centre of this a few irregularly distributed granules are observed. The distal parts of the rays projecting freely over the surface of the adult sterrasters (Plate **20**, figs. 37, 38, 40, 41) are everywhere, except close to the umbilicus, 3–3.5 μ thick and provided with terminal verticils of from three to five stout, conical, and straight lateral spines, 1.5–2 μ long and at the base 1.5 μ thick. The rays surrounding the umbilicus have a transverse section, elongated in a direction radial to the centre of the umbilicus, which measures 3–3.5 μ in breadth and 4–4.5 μ in length. These rays are provided with a greater number, some with as many as nine, terminal, lateral spines. The spines of these rays pointing inwards, towards the umbilicus, are larger than the others, up to 2.5 μ long, and more or less curved.

This sponge was collected on the shore at Easter Island on December 20, 1904.

On account of its cribriform pores and its spiculation this sponge must be placed in Geodia. I have compared it with the known species of Geodia and of Sidonops. The only species of these genera with similar sterrasters, in which the choanosomal rhabds are not, as usual, for the most part amphioxes, but, as in *Geodia amphistrongyla* for the most part amphistrongyles, is *Sidonops* (*Geodia*) *flemingii* (Bowerbank).[1] This species resembles *Geodia amphistrongyla* not only in respect to the rhabds and sterrasters, but also in respect to the euasters. Since, however, in *Geodia amphistrongyla* the plagioclades (orthoclades) are simple triaenes and the anatriaene-cladomes very small, while in *Sidonops* (*Geodia*) *flemingii* the former are dichotriaenes and the latter quite large; since there appears to be a difference in the efferent pores which necessitates the placing of the two in two distinct genera; and since the one comes from the south coast of Australia and the other from Easter Island, there can, I think, be no doubt that they should be kept specifically distinct.

Geodia lophotriaena, sp. nov.

Plate 47, figs. 9–36; Plate 48, figs. 1–34.

I establish this species for seven spirit specimens which came probably from New Zealand. They possess, besides ordinary dichotriaenes, a good many lophotriaenes with more than two end clades on one or two or all three main clades and to this the name refers.

The seven specimens are all cushion shaped and cut off from the surface on which they grew and to which they appear to have been attached by broad bases. Their upper surface is convex, their contour irregularly circular, rounded polygonal, or elongated. The smallest of them is 7 mm. long, 6 mm. broad, and 2.5 mm. high; the largest, which is penetrated in the middle (Plate **47**, fig. 22), 15.5 mm. long, 11 mm. broad, and 3 mm. high. The surface is entirely destitute of a spicule-fur and appears, when viewed with a lens, shagreened. It is quite continuous, neither depressions nor apertures, visible with the unaided eye, occur in it.

The *colour*, in spirit, is brownish, lighter on the surface than in the interior.

The superficial part of the body is differentiated to form a *cortex* (Plate **47**, fig. 24a), in which an outer dermal layer (Plate **47**, fig. 23a), free from sterrasters, rich in sphaerasters, and 30–65 μ thick, and an inner sterraster-armour layer (Plate **47**, fig. 23b) 60–125 μ thick, can be distinguished.

The cortex is penetrated by numerous radial *canals* which are 150–250 μ apart. Those observed were strongly contracted, only 5–15 μ wide. These

[1] *J. S. Bowerbank.* Contributions to a general history of the Spongiadae. IV. Proc. Zool. soc. London, 1873, p. 3, pl. 1, figs. 1–8. *W. J. Sollas.* Tetractinellida. Rept. voy. "Challenger", 1888, **25**, p. 252.

canals are surrounded by mantles of tissue, about 20–30 μ thick, which are free from sterrasters.

Skeleton. In the internal (basal) part of the choanosome loose, irregular strands of amphioxes occur. These mostly extend more or less paratangentially. In this region also large, smooth oxyasters and smaller, spined sphaerasters, mostly strongylosphaerasters, are met with. The distal, subcortical part of the choanosome is traversed by radial bundles composed of amphioxes and the rhabdomes of plagiotriaenes, dichotriaenes, other lophotriaenes, anatriaenes, and mesoprotriaenes. Asters, similar to those of the interior, and minute, radially arranged, mostly amphiox-rhabds also occur in this region. The sterraster-armour is occupied by not very closely packed sterrasters lying from three to five deep. In the dermal layer large masses of sphaerasters, which are particularly densely packed just below the surface, in the dermal membrane, are met with. More or less radially arranged minute dermal rhabds, for the most part amphioxes, are implanted in the cortex. Many of these spicules traverse the whole of it, their proximal ends being imbedded in the distal part of the choanosome and their distal ends protruding freely beyond the surface. A few minute dermal anatriaenes also occur in this region. The cladomes of the plagiotriaenes, the dichotriaenes, and the other lophotriaenes lie just below the sterraster-armour (Plate **47**, fig. 23). At a slightly lower level a good many anatriaene-cladomes and a few mesoprotriaene-cladomes are met with. The relative frequency of the plagiotriaenes and the dichotriaenes (lophotriaenes) is different in different specimens. In some the simple plagiotriaenes, in others the dichotriaenes (lophotriaenes), appear to form the majority.

Most of the *large choanosomal amphioxes* (Plate **48**, figs. 3–6) are quite stout, 1.2–1.8 mm. long and 25–42 μ thick. The great majority of those thinner than 25 μ are shorter than 1.2 mm. and appear as young forms of the stout amphioxes. Occasionally, however, long and very thin amphioxes (Plate **48**, fig. 7) are met with, which can hardly be considered as young stages of the stout ones. One of these slender spicules was 2 mm. long and only 10 μ thick.

Most of the *minute dermal rhabds* (Plate **48**, figs. 8, 9, 10a) are rather blunt pointed, fairly isoactine amphioxes, but anisoactine forms, with one end more slender and more sharply pointed than the other, also occur. In some of these spicules (Plate **48**, fig. 10a) the axial thread (canal) is greatly widened towards the thicker end. The minute dermal rhabds are 110–200 μ long and usually 3–6 μ thick.

The *plagiotriaenes* (Plate **47**, figs. 17, 21) usually have a conical rhabdome pointed at the cladomal end (Plate **47**, fig. 17), 0.6–1.2 mm. long and, at the cladome, 25–35 μ thick. In some the rhabdome is greatly reduced in length, cylindrical, and terminally rounded. A spicule of this kind (Plate **47**, fig. 21) has a rhabdome only 0.2 mm. in length. The clades are usually fairly equal, conical, pointed, curved, concave to the rhabdome throughout their entire length, and 140–195 μ long. Rarely one clade is reduced in length and terminally rounded. The cladome has a breadth of 240–370 μ. The chords of the clades enclose angles of 102–114°, on an average 107.4°, with the axis of the rhabdome.

The *dichotriaenes* and the *other lophotriaenes* (Plate **47**, figs. 9–16, 18–20, 25–33) usually have a simple, fairly straight rhabdome the cladomal half of which is nearly cylindrical, the acladomal half conical and sharp pointed. Just below the cladome the rhabdome is often slightly constricted. Very rarely a downwardly directed branch-ray arises from the central part of the rhabdome (Plate **47**, fig. 20). The rhabdome is 0.8–1.2 mm. long and, at the cladome, 35–59 μ thick. The three main clades of the same cladome are usually equal, straight, cylindrical, and 70–140 μ long. They enclose, with the rhabdome, angles of 105–130°, on an average 120.8°. The end clades are conical and blunt pointed. When, as is the case in the dichotriaenes, there are only two end clades on one main clade, the end clades are curved more or less, concave towards each other (Plate **47**, figs. 25–29). When, as is the case in the other lophotriaenes, there are more than two end clades on one main clade, one end clade, or rarely two (Plate **47**, fig. 31) are straight and appear as continuations of the main clade, the other end clades being curved more or less, concave towards these (Plate **47**, figs. 30–33). The end clades of the same cladome are usually unequal. The true dichotriaenes are much more numerous than the other lophotriaenes. In the latter one (Plate **47**, figs. 30, 33), two (Plate **47**, fig. 31), or, more rarely, all three (Plate **47**, fig. 32) main clades bear from three to five, instead of only two, end clades. In the most regular dichotriaenes the end clades extend in a plane nearly vertical to the rhabdome or are directed obliquely upwards (Plate **47**, figs. 9, 10, 13, 18). In other dichotriaenes and in most of the other lophotriaenes not all of the end clades are in this position, some being directed downward (Plate **47**, figs. 11, 12, 14, 19, 20). The length of the end clades is 70–180 μ, the breadth of the whole cladome 300–500 μ. The axial threads of the end clades of the dichotriaenes arise nearly at right angles from the end of the axial thread of the main clade and then bend outward to assume the direction of the end clade.

The *mesoprotriaenes* (Plate **47**, fig. 34) have a fairly straight rhabdome, about 1.3 mm. long and, at the cladome, 4–9 μ thick; in its thickest part, near the middle of its length, it measures 7–11 μ in transverse diameter. The clades are fairly equal, slender, conical, pointed, and curved, concave to the epirhabd. Their chords are 44–80 μ long and enclose angles of 32–41°, on an average 35°, with the axis of the epirhabd. The epirhabd is straight, conical, and 38–60 μ long.

The *large anatriaenes* (Plate **47**, figs. 35, 36). I found no large anatriaenes with the rhabdome intact, so that I am unable to give its length. At the cladome the rhabdome is 8–13 μ thick. The cladome is without apical protuberance. The clades are fairly equal, slender, conical, and sharp pointed. Their proximal parts are quite strongly curved, concave to the rhabdome, their distal parts straight. The chords of the clades are 60–85 μ long and enclose angles of 41–50°, on an average 44.5°, with the axis of the rhabdome.

The *minute dermal anatriaenes* have a fairly straight rhabdome, 170–210 μ long. At the cladome the rhabdome is 1–3 μ, at its thickest point, near the middle, 2–4 μ thick. The acladomal end is pointed. The fairly equal clades are conical, blunt, and not very strongly curved, concave to the rhabdome. Their chords are 4–9 μ long and enclose angles of 49–67°, on an average 56°, with the axis of the rhabdome.

The *large oxyasters* (Plate **48**, figs. 1, 2, 11, 12b, 16–18, 21, 32b) are either without a central thickening or have a small centrum up to 4 μ, that is, one eighth to one tenth of the whole aster in diameter. There are from four to eleven, rather regularly distributed and usually equal, straight, conical, sharp pointed rays. The rays are perfectly smooth, 8–22 μ long and, at the base, 1–2.2 μ thick. Very rarely one or two of the rays are reduced in length and terminally rounded. The total diameter of the aster is 15–41 μ. A correlation (inverse proportion) between ray-number and total diameter is indicated, the oxyasters with from four to seven rays being 23–41 μ, those with from eight to eleven rays only 15–30 μ, in diameter.

The *sphaerasters* (Plate **48**, figs. 10b, 12a, 13–15, 19, 20, 22–26, 32a) have a centrum 2–8 μ, from one sixth to nearly one half of the whole aster, in diameter. From this from seven to twenty-two, rarely as many as twenty-eight, quite regularly distributed rays arise radially. The rays are usually cylindroconical, and attenuated more (Plate **48**, figs. 23–26) or less (Plate **48**, figs. 20, 22, 23) towards their ends, the end itself being truncate or rounded and crowned by a terminal spine; much more rarely the rays are conical and pointed (Plate **48**, fig. 19). The rays are as a rule covered with spines which increase in size towards the end of the ray, the largest often forming a verticil at or just below its end; smooth rays (Plate **48**, fig. 19) are exceedingly rare. The rays are, without the centrum, 3–8 μ long, and, at the base, 0.8–2.4 μ thick. The diameter of the whole aster is 7–22 μ. The few-rayed of these asters are larger, have smaller centra, and more slender rays than the many-rayed. In the centrifugal spicule-preparations I have found a few smaller strongylosphaerasters, the total diameter of which was only 4.5 μ. These rare asters may be young forms of the ones described above, or foreign.

The *sterrasters* (Plate **47**, fig. 23; Plate **48**, figs. 27–31, 33, 34) are sphaeroids or relatively very broad flattened ellipsoids. They usually measure 30–45 μ in length, 30–44 μ in breadth, and 27–35 μ in thickness. Often the sterraster has, when viewed from above (with the umbilicus in the centre), a regularly circular outline, but even when this outline is oval the differences between the two axes is quite insignificant. The average proportion of length to breadth to thickness of the sterrasters is 100 : 99 : 87. In the spicule-preparations I found, besides these sterrasters, a few larger ones, similar in shape, but 57–58 μ long (Plate **48**, fig. 28). These may, very likely, be foreign spicules.

The umbilicus is 6–9 μ broad and about 6 μ deep. The rays away from it are about 2 μ thick and have circular or polygonal transverse sections (Plate **48**, figs. 33, 34); the rays surrounding the umbilicus are 3–5 μ thick and have transverse sections more or less elongated in a direction radial to the umbilicus (Plate **48**, figs. 30, 31). The ends of the rays bear from seven to eleven small spines. From one to three of these arise from the terminal face, the others are vertical to the axis of the ray and form a verticil round its end.

The seven specimens of this sponge are labeled 6312. In the list of the specimens sent, 6312 does not occur, nor, except 6311, any number near it. There is therefore some probability that 6312 should be 6311, the locality of which is New Zealand, so that New Zealand may be the habitat of these sponges.

Although I have not been able to make out quite clearly the nature of the entrances and exits of the canal-system, I think there can be little doubt that both are cribriporal. For this reason and because the skeleton is distinctly geodine in character, I place these sponges in Geodia. The sponges described by Kieschnick [1] as *Cydonium sphaeroides*, by Lindgren [2] as *Geodia arripiens*, and

[1] *O. Kieschnick.* Silicispongiae von Ternate. Zool. anz., 1896, **19**, p. 529.

[2] *N. G. Lindgren.* Beitrag zur kenntniss der spongienfauna des Malayischen Archipels. Zool. jahrb. Syst., 1898, **11**, p. 346, plate 18, figs. 10, 18, plate 20, fig. 5.

by Thiele [1] as *G. sphaeroides* seem to be allied to them. These sponges I consider[2] one species, *Geodia sphaeroides*.

The chief characters of *Geodia sphaeroides* and *G. lophotriaena* are tabulated below.

	Geodia sphaeroides	Geodia lophotriaena
Shape	small, massive, oval or spherical; in one case at least with praeoscular cavity.	small, incrusting, cushion shaped; without praeoscular cavity.
Cortex	720–900 μ thick.	90–190 μ thick.
Large choanosomal amphioxes	2.2 or 2.4 mm. by 36 or 40 μ.	up to 1.8 mm. by 42 μ and 2 mm. by 10 μ.
Minute dermal amphioxes	230 by 5 μ.	up to 200 by 6 μ.
Plagiotriaenes	not mentioned.	always present, in some specimens more numerous than the dichotriaenes; rhabdome up to 1.2 mm. by 35 μ; clades up to 195 μ.
Dichotriaenes (lophotriaenes)	rhabdome 2.35 or 3 mm. by 60 or 70 μ; main clades 120 or 220; always two end clades 150 or 180 μ.	rhabdome up to 1.2 mm. by 59 μ; main clades up to 140 μ; two or more end clades up to 180 μ.
Proclades	protriaenes; rhabdome 2.5 or 3 mm. by 16 or 20 μ; clades stout, frequently irregular, 70 or 80 μ.	mesoprotriaenes; rhabdome 1.3 mm. by up to 9 (11) μ; clades slender, regular, up to 30 μ; epirhabd up to 60 μ.
Large anatriaenes	rhabdome up to 3.3 or 3.5 mm. by 18 or 20 μ; clades stout, 50 or 60 μ.	rhabdome up to 13 μ thick; clades slender, up to 85 μ.
Small dermal or subcortical anatriaenes	rhabdome 340 or 360 by 2–3 μ; clades 8 μ.	rhabdome up to 210 by 3 (4) μ; clades up to 9 μ.
Large oxyasters (oxysphaerasters)	36 or 50 μ in diameter; with large centrum (6 or 15 μ); rays spined.	15–41 μ in diameter; without centrum or with small centrum, not more than 4 μ; rays perfectly smooth.
Small sphaerasters (mostly strongylosphaerasters)	8–15 μ in diameter.	7–22 μ in diameter.
Sterrasters	85 or 88 μ long.	30–45 μ, exceptionally perhaps up to 58 μ long.
Habitat	Cochin China; Ternate.	probably New Zealand.

[1] *J. Thiele.* Kieselschwämme von Ternate I. Abhandl. Senckenb. gesellsch., 1900, **25**, p. 41, plate 2, fig. 14.

[2] *R. v. Lendenfeld.* Tetraxonia. Tierreich, 1903, **19**, p. 110.

This table shows that these two species, although very similar in many respects, differ considerably in others. The difference in the shape of the body, the thickness of the cortex, and the length of some of the megascleres might be considered as due to differences of age or to differences in individual adaptation. That plagiotriaenes are present in *G. lophotriaena* and not mentioned as occurring in *G. sphaeroides* would, in itself, also hardly be sufficient for systematic distinction, because their relative abundance varies in the different specimens of *G. lophotriaena* and because according to Topsent [1] only ortho- plagio-triaenes or only dichotriaenes or both these kinds of spicules may be present in another species of Geodia, *G. conchilega*. That Thiele and Lindgren describe the proclades of *G. sphaeroides* (*G. arripiens*) as protriaenes, while they are mesoprotriaenes in *G. lophotriaena*, is also of but little importance, since it is known that mesoprotriaenes have often been described as protriaenes. That lophotriaenes with more than two end clades occur in *G. lophotriaena*, besides the ordinary dichotriaenes, while only true dichotriaenes with two end clades have been observed in *G. sphaeroides*, might be a more important difference, if one could only be convinced, as I am not, that such lophotriaenes are really altogether absent in the latter. Greater importance than to this is, in my opinion, to be attached to the differences in the clades of the mesoprotriaenes (protriaenes) and anatriaenes, which are very stout and, in the mesoprotriaenes (protriaenes), often partly reduced in length and irregular in *G. sphaeroides*, but regularly developed to their full length and slender in *G. lophotriaena*. Still more important than these differences are those of the sterrasters and large euasters. The sterrasters are in *G. sphaeroides* twice as large as in *G. lophotriaena*, while there is no corresponding difference in the size of the other spicules and the whole body. The large euasters are in *G. sphaeroides* oxysphaerasters, 36–50 μ in diameter, with a large centrum and stout, spined rays; in *G. lophotriaena* oxyasters, 15–41 μ in diameter, with a very small centrum or no central thickening at all, and perfectly smooth, slender rays. These differences, particularly the last named, appear to be germinal in nature and, particularly when taken together with the others, in themselves unimportant, quite sufficient for specific distinction.

[1] *E. Topsent.* Étude mongraphique des spongiaires de France I. Arch. zool. expér., 1894, ser. 3, **2**, p. 326.

Geodia acanthtylastra, sp. nov.

Plate 45, figs. 1–39; Plate 46, figs. 1–21; Plate 47, figs. 1–8.

I establish this species for five spirit specimens from the coast of Lower California (Station 2829). The choanosomal asters are chiefly acanthtylasters and to this the name refers.

Apart from differences in age which find their expression in differences of size, the five specimens are identical in structure. They are (Plate **45**, figs. 16, 29) irregularly spherical, oval, or tuberous, the smaller ones being more regular than the larger. The smallest specimen measures 10 by 8 mm., the largest 20 by 13 mm. In sheltered places, chiefly in the vicinity of the base of attachment, remnants of a spicule-fur are observed. The surface is minutely pitted. The pits, which mark the positions of the entrances to the radial cortical canals, appear in some specimens to be uniformly distributed and everywhere a little under 0.5 mm. apart. In other specimens the pits are larger and more distant, in one or two restricted areas on an average 1 mm. apart. Larger apertures, visible to the unaided eye, do not occur on the surface. One of the specimens is partly overgrown by a thin crust of a monaxonid sponge.

The *colour*, in spirit, is brownish white.

The superficial part of the body is differentiated to form a *cortex* (Plate **45**, fig. 16). This is composed of three layers: a dermal layer (Plate **45**, fig. 39a; Plate **46**, fig. 20b) 40–160 μ thick; a middle sterraster-armour layer (Plate **45**, fig. 39b; Plate **46**, fig. 20c) 150–350 μ thick; and a fibrous inner layer. This inner layer is very thin and quite inconspicuous. In many places the chamber-bearing choanosome extends right up to the sterraster-armour; in these the inner layer cannot be made out at all.

Canal-system. The dermal membrane is perforated by groups of pores. These pore-groups occupy the pits mentioned above. The pores themselves are oval, in some places 10–40 μ, in others (Plate **46**, fig. 21) 20–70 μ wide. The smaller appear to be the afferent, the wider the efferent pores.

The pores of each group lead into a system of wide, lacunose canals (Plate **45**, fig. 39d) excavated in the dermal layer, which converge and join to form a radial cortical canal. The radial cortical canals observed were all either strongly contracted or quite closed.

The flagellate chambers (Plate **45**, fig. 28b) appear oval in sections and have a maximum diameter of 20–25 μ. Numerous rather wide canals traverse the choanosome (Plate **45**, fig. 16).

Skeleton. In the inner proximal part of the choanosome rather irregularly disposed amphioxes, sterrasters, and acanthtylasters occur. In the distal part of the choanosome and the inner layer of the cortex similar amphioxes and the rhabdomes of plagio-, mesopro- and ana-triaenes form loose radial bundles. The cladomes of the plagiotriaenes and of many of the anatriaenes lie just below the sterraster-armour. Most of the mesoprotriaenes observed penetrate the cortex, their cladomes protruding freely beyond the surface (Plate **46**, fig. 20d). Minute dermal rhabds, mostly disposed radially, small strongylosphaerasters, and large oxysphaerasters are also found in this region besides acanthtylasters and sterrasters similar to those of the interior. The sterrasters are not nearly so abundant here as in the proximal part of the choanosome (Plate **46**, fig. 20). The sterraster-armour layer is occupied by sterrasters not very closely packed, a few small strongylosphaerasters, radial minute dermal rhabds, and the parts of the rhabdomes of the mesoprotriaenes which penetrate the cortex. In the walls of the radial cortical canals, which traverse this layer, large oxysphaerasters are met with. The dermal layer is occupied by groups of more or less radially disposed, minute dermal rhabds, which are nearly all amphiox. The proximal ends of these spicules are deeply implanted in the sterraster-armour; their distal ends protrude freely beyond the surface (Plate **45**, fig. 39c; Plate **46**, fig. 20a). The superficial part of the dermal layer, that is to say, the dermal membrane, is occupied by a thin but dense layer of small strongylosphaerasters. Similar spicules are also found in small numbers in the walls of the dermal canals.

The spicules to which the following descriptions refer were taken from the largest specimen.

The *choanosomal amphioxes* (Plate **45**, figs. 17–19a) are slightly curved in a simple or irregular manner, 0.7–2.2 mm. long, and 14–40 μ thick. A smaller and a larger kind of amphiox, which are connected by relatively few transitions can be distinguished. The smaller ones measure 0.7–1.4 by 14–25 μ, the larger 1.5–2.2 mm. by 23–40 μ.

The *minute dermal rhabds* (Plate **45**, figs. 20–22, 39c) are nearly all amphioxes. Styles have also been observed among them, but they are exceedingly rare. The minute dermal amphioxes are 150–300 μ long and 3–15 μ, usually 8–13 μ thick. The thickness is usually proportional to the length. Those over 265 μ long are 12–15 μ thick, while those less than 200 μ long are less than 7.5 μ thick. Among those intermediate in length both thick and thin ones were observed. Styles, although, as mentioned, very rare, were observed both among the thick and the thin rhabds. They are about 250 μ long and 4–10 μ thick.

In the centrifugal spicule-preparations I found some very *minute amphioxes* 41–53 μ long and 1–1.2 μ thick. These may belong to the sponge, but it is more probable that they are foreign.

The *plagiotriaenes* (Plate **45**, figs. 18b, 19b, 30–35, 38) have a fairly straight rhabdome. Its cladomal half is usually nearly cylindrical, its acladomal half conic and pointed (Plate **45**, figs. 18b, 19b, 31–33). Rarely the rhabdome is nearly cylindrical throughout and rounded at the acladomal end (Plate **45**, fig. 38). The rhabdome is 1.2–2.5 mm., in fully developed plagiotriaenes usually about 2.1 mm. long and, at the cladome, 40–77 μ thick. The cladome is usually simple and composed of three fairly equal stout, conic, and blunt-pointed clades, curved, concave to the rhabdome quite strongly in their proximal part. The distal part of the clades is slightly curved in the same direction, or straight (Plate **45**, figs. 18b, 19b, 30–32, 34, 35, 38). The clades of these regular plagiotriaenes are 160–260 μ long, their chords enclosing angles of 100–116°, on an average 106°, with the axis of the rhabdome. Besides these spicules, which form the great majority, similar ones with irregular cladomes have been observed in small numbers. In these spicules either a fourth clade, situated some distance below the cladome, is added to the three ordinary terminal ones, or one (Plate **45**, fig. 33) or more clades are bifurcate or provided with a short, irregular, upward-directed branch. In the spicule-preparations also some true dichotriaenes (Plate **45**, figs. 36, 37), with shorter rhabdomes and smaller clade-angles than those of the regular plagiotriaenes were seen. As, however, I failed to find regular dichotriaenes in the sections they may very likely not belong to the sponge.

The *mesoprotriaenes* (Plate **45**, figs. 1–7; Plate **46**, fig. 20d) have a straight or slightly curved rhabdome, 2.3–3.3 mm. long. At the cladome it is 13–22 μ, farther down, at its thickest point near the middle, 21–31 μ, usually not quite half again as thick as at the cladomal end. This thickening towards the middle is exemplified by the following measurements of five mesoprotriane-rhabdomes: —

THICKNESS OF THE RHABDOME.

At the cladome μ	At its thickest point near the middle μ
13	21
14	22
17	20
20	27
22	31

The clades are conic, pointed or blunt, and slightly curved, concave to the epirhabd. They are fairly equal (Plate **45**, figs. 1, 3) or considerably unequal (Plate **45**, figs. 2, 6) in length. The longest clade of the cladome is 55–130 μ long. The chords of the clades enclose angles of 31–53°, on an average 39°, with the axis of the epirhabd. The epirhabd is straight, conic, and 30–85 μ long. Its length usually is from a third to a half of the length of the longest clade.

The *anatriaenes* (Plate **45**, figs. 8–15, 19c) have a rhabdome 3–5.4 mm., mostly about 4.7 mm. long and, at the cladome, 18–28 μ thick. The cladome is without an apical protuberance. The clades are stout, fairly equal, conic, considerably curved, concave to the rhabdome, in their proximal part, and slightly curved in the same direction or straight in their distal part. Their chords are 50–110 μ long and enclose angles of 38–56°, on an average 45.3°, with the axis of the rhabdome. In the small, probably young, anatriaenes, in which the rhabdome is, at the cladome, only 5–13 μ thick and the clades only 30–46 μ long, the clade-angles are much larger, 52–58° wide (Plate **45**, fig. 9).

Besides the *microscleres* mentioned above which have been observed *in situ* in the sections, oxyasters and a large strongylosphaeraster were found in the centrifugal spicule-preparations. These, particularly the large strongylosphaeraster, may be foreign to the sponge, but since this is doubtful I think it better to describe them here, together with the asters, which undoubtedly form part of the skeleton proper.

The *oxyasters* are of two kinds, smaller and larger ones. The smaller oxyasters, which are, in the centrifugal spicule-preparations, relatively much more numerous than the larger ones, are without centrum and have from five to ten straight, conic rays, 12–15 μ long and, at the base, 0.7–3 μ thick. The distal two thirds of the rays are covered with spines. The total diameter of these asters is 22–29 μ. The larger oxyasters are similar to the small ones, have six or seven rays, about 20 μ long and 3 μ thick at the base, and measure 36–38 μ in total diameter.

The *large oxysphaerasters* (Plate **46**, figs. 10–13) are connected with the small strongylosphaerasters by transitional forms. Some might also be considered as transitions between the oxysphaerasters and the oxyasters described above. Before dealing with these transitional forms I will describe the true oxysphaerasters (Plate **46**, figs. 10–13). These have a spherical centrum, 3.5–5 μ, from a quarter to a third of the whole aster, in diameter. From this from twelve to twenty-six, rather regularly distributed concentric rays arise radially. The rays are straight, conic, sharp pointed, without centrum, 3.7–7 μ long, and, at the base, 1–2.2 μ thick. The distal parts of the rays bear a few rather large, vertically arising spines, which usually form, some distance below the end, a more or less pronounced verticil. Besides the spines forming this verticil, others, situated more proximally, are not infrequently observed. The total diameter of the oxysphaerasters is 12–16.5 μ. A correlation between size and ray-number could not be detected.

The oxysphaerasters which I consider as transitions to the small strongylosphaerasters are similar to the true ones described above, have from ten to twenty-five rays, and measure 6–9.5 μ in total diameter. Their centrum is 2–3 μ, about a third of the whole aster, in diameter. The conic, spined, and pointed rays are, without the centrum, 1.5–3 μ long and, at the base, 0.6–1.3 μ thick.

The oxysphaerasters which might be considered as transitions to the oxyasters are also similar to the true ones, have from sixteen to twenty rays, measure about 28 μ in total diameter and have a centrum 5–6 μ, from a sixth to a fifth of the whole aster, in diameter.

The *acanthtylasters* which are the chief choanosomal microscleres (Plate **45**, figs. 23–27a; Plate **47**, figs. 1, 2, 3b, 4–6, 7b, 8) have from four to twelve regularly distributed rays and usually a central thickening 1.7–3 μ in diameter. The rays are straight, cylindroconical, attenuated distally, and, at the base, 0.5–1.3 μ thick. Rays over 1 μ thick are found only in the larger, few-rayed acanthtylasters. The rays are truncate; often a small and slender terminal spine arises from their terminal face. The rays bear a terminal verticil of protuberances, which together form a conspicuous tyle 0.9–1.6 μ in transverse diameter. The individual protuberances forming this tyle, are so minute that it is difficult to make out their shape. They are always more or less recurved in a claw-shaped manner. Sometimes they appear as rounded knobs, sometimes as stout-pointed spines and sometimes as more slender and longer branches, strongly curved backward like the clades of anatriaenes. A few protuberances (spines) similar to those forming the terminal verticil (acanthtyl) are often observed farther down on the rays. The total diameter of the acanthtylasters is 11–22 μ. It is in inverse proportion to the number of the rays. Four- to five-rayed acanthtylasters are 15–22 μ, six- to seven-rayed 13.5–20.5 μ, eight- to nine-rayed 11.5–18 μ, and ten- to twelve-rayed 10.5–15 μ in diameter.

The *small strongylosphaerasters* (Plate **45**, figs. 24b, 25b, 27b; Plate **46**, figs. 1–7; Plate **47**, figs. 3a, 7a) have a spherical centrum 1.5–2.7 μ, rarely as much as 3.4 μ, from about one third to two fifths, seldom as much as one half of the whole aster, in diameter. From this from fourteen to twenty-two quite regularly distributed rays arise radially. The rays are cylindrical or, more rarely, conical, truncate, without the centrum 1–2 μ long, and 0.3–0.6, rarely up to 0.8 μ thick. Their distal part is covered with minute spines. These may either all be so small as merely to render the ray rough in appearance, or some of them, which usually form a verticil at or just below the end of the ray, may be larger and clearly distinguishable as spines. Sometimes the ray appears terminally thickened. Such asters have a somewhat acanthtyl appearance and may, if large, be considered as transitional to the acanthtylasters described above. The total diameter of the small strongylosphaerasters is 4.3–6.1 μ, usually 5–6 μ.

The *large strongylosphaeraster* found in a centrifugal spicule-preparation, which is probably a foreign spicule, has seventeen conic, truncate rays, at the base 5 μ thick. The centrum is 13 μ, the whole aster 23 μ in diameter. The convex terminal faces of the rays are densely covered with small spines. All the other parts of the aster are smooth.

The *sterrasters* (Plate **45**, figs. 28a, 39b; Plate **46**, figs. 8, 9, 14–19) are flattened ellipsoids, 65–76 μ long, 55–68 μ broad, and 42–46 μ thick. The average proportion of length to breadth to thickness is 100 : 85 : 64.

In young sterrasters of a certain developmental stage, in which the rays are still terminally rounded, from two to five small rudiments of spines, standing close together, arise from the summit of each ray. In the adult sterrasters the protruding rays away from the umbilicus are 2.5–3 μ thick and bear terminal verticils of usually five or six lateral spines, which are about 1.5 μ long and remarkably stout. The transverse sections of the rays surrounding the umbilicus are only slightly elongated in a direction radial to the umbilicus, and measure about 3 by 4.5 μ. These rays usually bear from six to eight spines. The spines directed towards the umbilicus are considerably larger than the others.

The surface of the umbilical pit is uneven and often covered with numerous conspicuous protuberances (Plate **46**, fig. 19).

The five specimens of this species were caught with the tangles at Station 2829 on May 1, 1888, off Lower California, in 22° 52′ N., 109° 55′ W.; depth 56 m. (31 f.); they grew on a rocky bottom; the bottom temperature was 23.4° (74.1° F.). They were labeled F. C. 1342.

The cribriporal nature of the afferents and efferents and the character of the skeleton show that these sponges belong to Geodia. The spiculation differs from all the other species of this genus as well as from those of Sidonops to such an extent that a new species had to be established for it.

Geodia media Bowerbank.

Plate 16, figs. 1–21; Plate 17, figs. 1–22.

Proc. Zool. soc. London, 1873, p. 13, pl. 2, figs. 24–29.
Synops (?) *media* Sollas, Rept. voy. "Challenger," 1888, **25**, p. 266.
Sidonops media (Bowerbank) Lendenfeld, Tierreich, 1903, **19**, p. 103.

There are in the "Albatross" collection eight specimens in spirit from Panama, which, as a comparison with a part of the type of *Geodia media* Bowerbank in the British Museum, kindly placed at my disposal for examination by Mr. Kirkpatrick, shows, belong to this species.

One of the eight "Albatross" specimens is digitate, the others are, like Bowerbank's type, irregularly massive. The former differs slightly in regard to the dimensions of its spicules and the character of its canal-system from the latter. As will be seen from the description given below, these differences are not sufficient, however, for the establishment of subspecies or varieties I consider them as two different forms of one species.

Shape and size. Of the seven specimens of the massive form one, the largest, is fairly complete, the other six are more or less fragmentary. The complete massive specimen (Plate **16**, fig. 16) is an irregular mass 85 mm. long, 41 mm. broad, and 29 mm. high. It is attached at several points. Between these points of attachment the lower surface is considerably raised, and thus forms the roof of rather high tunnels which undermine the sponge. On the upper side flat-bottomed depressions, irregular in outline and 9–21 mm. in diameter, are observed. These are surrounded by conspicuous elevated borders, which here and there rise to form higher, rounded protuberances. The surfaces of the depressions are occupied by small, shallow pits, the centres of which are about 1 mm. apart. These pits are separated from each other by minute ridges which form a network. The convex parts of the upper side and the unattached parts of the lower side are smooth. Here and there a few spicules protrude beyond the surface, but there is nowhere a trace of a true spicule-fur. Larger openings, oscula or openings of uniporal cortical canals, are absent. The smaller, fragmentary massive specimens are quite similar to the large one. They measure 26–38 mm. in maximum diameter. One has depressed pit-bearing areas, up to 35 mm. long.

The single specimen of the digitate form (Plate **16**, fig. 17) is a curved irregular cylinder, 65 mm. long, 6–12 mm. thick, and attached at several points along one side. Its transverse section is throughout more or less circular. The surface is smooth, slightly undulating, and destitute of a spicule-fur. There are no clearly circumscribed pit-bearing areas as in the massive form, but pits similar to those of the latter, are found singly and in groups, scattered irregularly over the concave parts of the surface. Oscules or uniporal openings of cortical canals are absent.

The *colour* of the massive form is, in spirit, brownish white. Bowerbank's dry specimen was pale buff-yellow. The surface of the elevations and the lower side are lighter in colour than the depressed pit-bearing areas and the interior. The digitate form is dirty white, a little darker in the interior.

Various space-symbionts, some specimens of Donatia, a desmacidonid sponge with exotyle spicules, Serpulae, and small composite ascidians, are attached to the specimens of the massive form.

The superficial part of the body forms a *cortex* composed of three layers: an outer dermal layer (Plate **17**, fig. 21a), a middle sterraster-armour layer (Plate **17**, figs. 21c, 22c), and an inner fibrous layer (Plate **17**, fig. 22e). The dermal layer is free from sterrasters. In the pits above described it attains a considerable thickness and here it is excavated by extensive dermal lacunose canals. Everywhere else it is but a thin membrane. The sterraster-armour layer, which forms the largest part of the whole cortex, is filled with sterrasters. The inner fibrous layer is thin and consists chiefly of paratangential fibres. It contains only a few scattered sterrasters. The thickness of the cortex is very different under different parts of the surface. In the pit-bearing depressions of the massive form it is 0.5–1 mm., on the convex parts of the upper side about 1.5 mm. thick. On the lower side it is much thinner. It attains the greatest thickness in the elevated borders surrounding the pit-bearing depressions, and is in some parts of these 2.3 mm. thick, a great part of the whole border consisting of cortical tissue. In the digitate form the cortex is 0.5 mm. (under the concave parts of the surface), 1.2 mm. (under the convex parts of the surface) thick.

Canal-system. The pits congregated in the depressed areas of the surface of the massive form and scattered over the concave parts of the surface of the digitate form are covered by pore-sieves, which appear as nets of slender strands with broad oval meshes (pores). In many places these pore-sieves (nets) consist of a primary network of stouter, pigmented strands, in the meshes of which a secondary network of more slender, mostly unpigmented strands is spread out. The meshes of the primary network are 80–100 μ, those of the secondary network, the pores proper, 15–30 μ wide. Where primary and secondary nets cannot be distinguished the pores are also 15–30 μ wide. In the depressed areas of the massive form the pits are so close together and the pore-sieves covering them so extensive that the latter often come in direct contact with each other, so that these depressions appear covered throughout by a nearly continuous pore-sieve. In the digitate form such a junction of pore-sieves has not been observed. The pores of these sieves lead into cavities up to 100 μ wide, excavated in the dermal tissue occupying the pits. The cavities of each pit join to form a radial cortical canal about 250 μ wide, which penetrates the sterraster-armour and opens out below into a subcortical cavity. These cavities are mostly 300–500 μ in radial diameter. The proximal opening of each cortical canal is restricted by a ring-shaped chonal sphincter, composed of an annular strand of contractile tissue about 90 μ thick, which protrudes into the subcortical cavity. In the sections studied nearly all these chonal sphincters were more or less dilated, the lumen of some being as much as 140 μ wide. The cortical canals leading down from the scattered pits of the digitate form are similar. As one radial cortical canal belongs to each pit, these canals are in the depressions of the massive form about 1 mm., in the digitate form farther apart.

The elevated borders surrounding the depressions of the massive form, and parts of the convex portions of the surface of the digitate form appear to be entirely destitute of pores. On other convex portions of the surface both of the massive and the digitate form, pores, arranged in groups and forming pore-sieves, are met with. These pore-sieves are much less extensive than the ones covering the pits, never composed of a primary and secondary network, and pierced by much larger holes. The latter are circular or oval and measure 30–70 μ in diameter. The pores (holes) of each group lead into cavities, joining to form a canal 200–300 μ wide, which traverses the cortex radially and is constricted below by a chonal sphincter. In some places these radial cortical canals are quite close together, their centres being only 1 mm. apart, in other places they are much farther apart.

In the basal part of the massive form very large canals, some as much as 6 mm. wide, are observed just below the cortex. In the digitate form I have not met with any wide canals of this kind. In the choanosomal canals leading up to the pit-bearing parts of the surface transverse sphincter-membranes are spread out at frequent intervals.

The chonal sphincters of the cortical canals leading down from the pits being wide open, the choanosomal canals leading up to them being traversed by sphincter-membranes, and the pits themselves being situated on concave (depressed) parts of the surface, one would suppose that the pores in the sieves covering the pits are the efferents. The fact that the pores in these sieves are smaller than those on the smooth convex parts of the surface is on the other hand in favour of the view that they are the afferents.

The *skeleton* of the interior consists chiefly of amphioxes and large asters (oxyasters and a few strongylasters). Besides these spicules also styles, various angularly bent or branched amphiox- and style-derivates, and sterrasters occur in small numbers. The amphioxes, styles, amphiox- and style-derivates are arranged rather irregularly in the interior, but assume a regular radial arrangement towards the surface. Here, just below the cortex, plagiotriaenes, mesoclades (mesomonaenes), and a few slender, amphiox-like mesoclade-derivates are added to these megascleres. The clades of the plagiotriaenes lie at the limit between the middle and inner layers of the cortex, the sterraster-armour resting, as it were, on the plagiotriaene-cladomes. Just below the cortex small oxysphaerasters, which are very numerous in some places, to a great extent replace the large asters of the interior, and here also scattered sterrasters and small dermal styles occur. The latter are situated radially, obliquely, or paratangentially (Plate 17, fig. 22d). The whole of the cortex, with the exception of the dermal layer, contains sterrasters. These are scattered in small numbers in the thin, innermost, fibrous layer, and form a dense mass in the thick middle (sterraster-armour) layer. Between the sterrasters a few small sphaerasters, dermal styles, and protruding spicules occur. Small sphaerasters form a dense and continuous layer on the outer surface of the dermal layer. Over the pits, where the latter is greatly thickened (Plate 17, fig. 21), these sphaerasters are not confined to the surface but are very numerous also for some distance below it. Tufts of small dermal styles are met with on all parts of the surface. These styles are more numerous in the thickened parts of the dermal membrane in the pits (Plate 17, fig. 21b) than elsewhere. They are situated radially or obliquely; their rounded ends lie proximally and are deeply imbedded in the sponge, their pointed ends abut on the surface or protrude more or less beyond it (Plate 17, fig. 21). The fact that these styles are abundant on the surface and rather plentiful also in the subcortical layer, but comparatively rare in the sterraster-armour layer, indicates that they move up from the distal parts of the choanosome, where they are formed, to the surface, at first, till they reach the cortex, slowly, and then, when they reach the sterraster-armour, rapidly, traversing the latter at such a rate that at any time only a few are found in the act of passing through it.

Besides the spicules above described several other forms, not met with *in* *situ* in the sections, have been observed in the spicule-preparations. One of these, an anatriaene, is, in all probability, proper to the sponge.

Among the large choanosomal *amphioxes,* two forms, a slender and a stout one, can be distinguished. These are, it is true, connected by transitions, but as the latter are not at all numerous and as the slender amphioxes are longer than most of the stout ones, and therefore cannot be considered as young forms of the latter, I am inclined to consider the slender and the stout amphioxes as distinct forms.

The *slender, choanosomal amphioxes* (Plate **16**, figs. 3–5a) are quite frequent in the digitate form but rare in the massive form. They are slightly curved, fairly isoactine, not very sharp pointed, 1.3–1.5 mm. long, and 23–30 μ thick.

The *stout choanosomal amphioxes* (Plate **16**, figs. 1–5b, 6z, 8b, z, 11z) are very numerous in both forms. They are slightly curved, fairly isoactine, and gradually attenuated to the not very sharp-pointed ends. In the digitate form they are 1.2–1.55 mm. long and 33–51 μ thick, in the massive form 1.3–1.7 mm. long and 35–51 μ thick.

In Bowerbank's type, reexamined by me, I found choanosomal amphioxes 1–1.5 mm. by 18–50 μ. Sollas gives their dimensions as 1.51 mm. by 32 μ.

The *large choanosomal styles* (Plate **16**, figs. 11f, 13f) are not numerous. They are relatively more frequent in the massive than in the digitate form. These styles are 0.9–1.3 mm. long and 30–50 μ thick. Some are for the greater part of their length cylindrical, and simply rounded off at one end, others somewhat attenuated towards, others again slightly thickened at, the rounded end. In four styles of the massive form the thickness was:—

In the centre	36 μ	at	the	rounded	end	24 μ
" " "	40 "	"	"	"	"	43 "
" " "	43 "	"	"	"	"	50 "
" " "	50 "	"	"	"	"	40 "

These spicules are not mentioned by Sollas; I found a good many, however, in Bowerbank's type.

Both the digitate and the massive forms are exceedingly rich in irregular, angularly bent or branched *derivates of the amphioxes and styles* described above. In their dimensions these spicules agree with the regular forms from which they are derived. The simplest form of amphiox-derivate is an amphiox very slightly angularly bent near one end. This bend may be in the same direction as the curvature of the spicule (Plate **16**, fig. 1y), or in a direction opposite to it (Plate **16**, fig. 9y). In other amphiox-derivates of this kind the angular bend is much more pronounced, the angle between its two limbs being smaller. Such a spicule is represented on Plate **16**, fig. 9c.

Derivates of styles, angularly bent in such a manner, are also met with (Plate 16, fig. 13g). Occasionally amphioxes angularly bent at two places have been observed (Plate 16, fig. 9w). In the simplest forms of the branched amphiox- and style-derivates a small straight branch is observed arising near one end of the spicule. This branch is generally directed upwards and encloses, with the epirhabd-like continuation of the shaft of the spicule, a smaller (Plate 16, figs. 10d, 13h) or a larger (Plate 16, fig. 10x) angle. Rarely it is directed downwards (backwards) (Plate 16, fig. 11h). Generally there is only one branch, but spicules with a cluster of two or more branches have also been observed (Plate 16, fig. 13i). Some of these derivates are both branched and angularly bent. Such forms have been found among the style-derivates (Plate 16, fig. 13k) as well as among the amphiox-derivates (Plate 16, fig. 2j). Occasionally I have observed spicules thickened and rounded at both ends which can be considered as amphityle derivates of amphioxes or styles. These spicules have not been mentioned by Bowerbank and Sollas, and in the former's type they are indeed very scarce.

The *small dermal styles* (Plate 17, figs. 21b, 22d) are straight or slightly curved and taper towards the distal pointed, and also towards the proximal rounded end. The transverse diameter of the rounded end is a little more than half the transverse diameter of the thickest central part, the average ratio between these two dimensions being about 10 : 6. In the digitate form these styles are 140–190 μ, usually 180–190 μ long and 2–5 μ, usually about 4 μ thick. In the massive form they are slightly larger, 150–265 μ long and 3–6 μ thick. These spicules are not mentioned either by Bowerbank or by Sollas, but they are very abundant in the former's type, and there measure 150–200 by 2–4 μ.

Among the *plagiotriaenes*, as among the amphioxes, two forms, a slender and a stout one, can be distinguished. As the intermediate forms connecting these are not numerous and as the slender plagiotriaenes have longer clades than most of the stout ones, showing that the former cannot be young forms of the latter, I consider them as two distinct kinds of spicules. Both these types of plagiotriaenes have been found also in Bowerbank's type.

The *slender plagiotriaenes* (Plate 16, figs. 1q, 5r, 12q, 14q), are met with in both forms but are not very numerous in either. Their rhabdome is straight or slightly curved, conic, pointed, 1–1.6 mm. long and 17–30 μ thick at the cladomal end. The clades are generally considerably curved, concave to the rhabdome, particularly in their distal part, and 160–260 μ long. The chords of the clades enclose angles of 107–114° with the axis of the rhabdome. Similar slender triaenes were also found by me in Bowerbank's type.

The *stout plagiotriaenes* (Plate **16**, figs. 1–6s, 11s, 12s) occur in large numbers in both forms. Their rhabdome is straight or very slightly curved, and usually pointed, rarely rounded at the acladomal end. It is either regularly conical throughout or slightly constricted just below the cladome. The rhabdomes of five of the plagiotriaenes of the massive form thus constricted, which I measured, were:—

60 μ thick at the cladomal end and 62 μ thick at the thickest point a little farther down.
60 " " " " " " " 61 " " " " " " " " " "
60 " " " " " " " 67 " " " " " " " " " "
65 " " " " " " " 68 " " " " " " " " " "
67 " " " " " " " 70 " " " " " " " " " "

In observing a thin transverse splinter of a plagiotriaene-rhabdome with a high power I found its axial rod to be triangular in transverse section.

In the digitate form the rhabdomes of the stout plagiotriaenes are 0.8–1.4 mm. long and 30–65 μ, usually 50–60 μ thick at the cladomal end. The clades are only slightly curved, concave to the rhabdome, conical, not sharp pointed, and 110–260 μ long. Their chords enclose angles of 107–118° with the axis of the rhabdome. The stout plagiotriaenes of the massive form are similar in shape but considerably larger. Their rhabdomes are 0.9–1.7 mm. long and at the cladomal end 30–80 μ, usually 50–70 μ thick. Their clades are 160–310 μ long and the chords of their clades enclose angles of 105–120° with the axis of the rhabdome. The length of the rhabdome and the clades is not in proportion to their thickness, the very thick ones having by no means particularly long rhabdomes or clades.

In Bowerbank's type, examined by me, the dimensions of the stout plagiotriaenes are: rhabdome 0.8–1.2 mm. by 40–60 μ, clades 200–260 μ long, clade-angles 105–120°. Sollas gives their measurements as follows: rhabdome 1.12 mm. by 450 (printers error for 45) μ, clades 254 μ long, clade-angles (according to the relation of the clade-length to the transverse diameter of the cladome, 320 μ, given by him) large.

Besides the regular plagiotriaenes described above a few irregular derivates of them occur. In some of these the clades are reduced in length and rounded at the end; in others two of the clades are single and one bifurcate (Plate **16**, fig. 12t); in others again the clades are curved convex to the rhabdome (Plate **16**, fig. 3u). I have also observed a few mesoclade plagiotriaene-derivates in which the rhabdome is much shortened, rounded at the end, and continued beyond the cladome in the shape of a long conical epirhabd (Plate **16**, fig. 1v).

The *mesomonaenes* (Plate **16**, fig. 7m, n, o, p; Plate **17**, figs. 8–12), which occur in both forms but are numerous in neither, have more or less curved rhabdomes 1.7–2.5 mm. long and 4–10 μ thick at the cladomal end. The epirhabd is 40–75 μ long, while the clade attains a length of 17–50 μ. The latter encloses an angle of 32–89° with the epirhabd. Those in which this angle is small appear as mesopromonaenes, those in which it is large as mesorthomonaenes, while the intermediate forms are mesoplagiomonaenes. The clades are generally rounded off terminally, more rarely pointed. The axial thread of the rhabdome and epirhabd bears at the point of origin of the clade, besides the axial thread of the clade itself, a number of small, rudimentary branchlets, resembling the structures observed by me in the anaclades of *Thenea valdiviae.*[1] The axial thread of the clade is rounded off at the end and often shows indications of being split up terminally into small branches. Neither Bowerbank nor Sollas mentions these spicules. I found several, however, in the former's type similar in every respect, to those described above.

I have found a few long and slender amphioxes of dimensions similar to those of the rhabdomes (and epirhabds) of the mesomonaenes. In some of these spicules (Plate **17**, fig. 7) a slight thickening near one end, enclosing a few rudimentary branchlets of the axial thread, indicates clearly that they are *mesoclade-derivates,* while in a few others hardly any trace of such a thickening, or no thickening at all, can be detected. Although these spicules appear as true amphioxes I am inclined to consider them as mesoclade-derivates. Such spicules are not mentioned either by Bowerbank or by Sollas. I found several, however, in the former's type.

The scarce *anatriaenes* have a long rhabdome, at the cladome about 12 μ thick, and clades about 23 μ long and curved concave towards the rhabdome throughout their whole length. The clade-angle is about 44°. Bowerbank says that there are "very slight indications of the presence of recurvo-spicula," Sollas, however, does not mention anatriaenes. In the spicule-preparations of Bowerbank's type, I observed a good many anatriaenes with rhabdomes 10–15 μ thick, clades 25–35 μ long, and clade-angles of 50–52°. I found in it also a mesanatriaene with similar clades, an epirhabd 165 μ long, and a shortened, terminally thickened, club-shaped rhabdome, 0.8 mm. long and, at the thickened, acladomal end, 27 μ thick.

The *large oxyasters and strongylasters* (Plate **17**, figs. 4–6b, 15b, 18b, 19b, 20) are destitute of a central thickening and have from four to eleven, most fre-

[1] *R. v. Lendenfeld.* Die Tetraxonia. Wissensch. ergebn. deutschen Tiefsee-Expedition, 1898–1899, 1907, **11**, p. 200 ff.

quently six rays. The rays are straight, and in the many-rayed forms concentric and fairly regularly distributed. In the few-rayed forms the rays are frequently not uniformly distributed and sometimes not quite concentric; many of these spicules have a somewhat metastrose character accordingly. The rays are conic and fairly pointed, or cylindroconical and blunt, or cylindrical and truncate. The asters with rays of the latter kind which appear as true strongylasters, are however rare. Quite at the base the rays are, for a short distance, smooth. Apart from this they are wholly covered with spines standing rather close together. In size the spines are subject to considerable variation, but they are never very minute. In some asters with particularly large spines I noticed that the spines are directed backwards, towards the centre of the spicule. The blunt, cylindroconic rays usually bear a terminal spine. In the digitate form these asters are 21–41 μ, in the massive form 21–45 μ, in total diameter. The basal thickness of the rays is in the former 1–2.5 μ, in the latter 1–3.5 μ. An inverse proportion between the size and ray-number is clearly expressed in regard to the thickness of the rays but not so well marked in regard to the total diameter of the spicule. In Bowerbank's type, these asters have from four to seven rays, 1.2–2.3 μ thick, and measure 20–37 μ in total diameter. Sollas gives their diameter as 26 μ.

The subcortical *oxysphaerasters* have a spherical centrum 3–4.5 μ in diameter, from which from fifteen to twenty rays arise radially. These are regularly distributed, 4–9 μ long, straight, conic, sharp pointed, and 0.8–1.7 μ thick at the base. A verticil of large vertically arising spines is observed some distance below the end of each ray. Besides these large verticil-spines smaller ones, distributed irregularly over the distal part of the ray, are often present. The total diameter of these oxysphaerasters is 9–18 μ. I have found similar spicules in Bowerbank's type, and he appears to have observed them, but they are not mentioned by Sollas. In the centrifugal spicule-preparations I have met with a few spineless oxysphaerasters with only six rays, about the size of the largest spined oxysphaerasters. It seems to me doubtful whether these spineless oxysphaerasters, which I have not observed *in situ* in the sections are proper to the sponge.

The *small dermal sphaerasters* (Plate **17**, figs. 1–3, 4–6a, 13, 14, 16, 17, 18a, 19a) have a spherical centrum 1.7–5 μ in diameter, from which from seven to eighteen rays arise radially. These rays are quite regularly distributed 1.3–3.5 μ long and 0.8–1.6 μ thick at the base. The total diameter of these asters is 4.6–8, usually 5.5–6.5 μ. The shape of the rays and the relative size of the centrum are subject to great variations. In the dermal sphaerasters most frequent in the digitate form the diameter of the centrum is always more than half and usually less than two thirds of the diameter of the whole aster. The rays of these asters are cylindrical or cylindroconical, truncate or rounded off at the end, and covered with spines, chiefly in their distal portions. The size of the spines is proportional to the thickness of the rays. In the dermal sphaerasters most frequent in the massive form the centrum is relatively a little smaller, its diameter in not a few being less than one third of the total diameter of the spicule. The rays of these asters are conical or cylindroconical, rounded off or, more rarely, pointed at the end (Plate **17**, figs. 1–3, 13, 14, 16, 17), and covered with spines, chiefly in their distal parts. Of course both the oxyastrose and the strongylastrose kinds of dermal sphaerasters occur in both forms. The difference lies in the fact that the strongylastrose forms are much more prevalent in the digitate than in the massive form. In Bowerbank's type, these spicules have from six to eighteen rays, which seem, on the whole, somewhat stouter than those of the small strongylosphaerasters of the "Albatross" specimens. The total diameter of the aster is 5.5–8 μ, that of the centrum 2–3.5 μ. Sollas gives their diameter as 6 μ.

Besides these a few other forms of asters, which may be considered as sphaeraster-derivates, are found in the dermal membrane. One of these asterforms has a very large centrum and exceedingly short and thick rays, the latter appearing as rounded knobs on the surface of the relatively overgrown centrum. In another form the centrum is very much reduced and there are only five or six cylindrical rays thickened at the end. The basal and central, cylindrical parts of the rays of these asters are smooth, their terminal thickening covered with numerous spines. Finally, there are sphaerasters the rays of which are not concentric. These appear as metasters or ataxasters.

The normal *sterrasters* (Plate **16**, figs. 15, 18, 19; Plate **17**, figs. 21c, 22c) are flattened ellipsoids, broad oval, sometimes nearly circular, in outline. The sterrasters of the digitate form are 84–98 μ long, 73–86 μ broad, and 60–65 μ thick; those of the massive form larger, 89–105 μ long, 83–90 μ broad, and about 62 μ thick. The proportion of the length to the breadth to the thickness is in both on an average about 10:9:7. With the exception of those surrounding the umbilicus, the rays protruding over the surface of the sterrasters are 2.5–3 μ thick and about 2 μ apart. They bear terminal verticils of usually from four to six stout lateral spines, many of which are curved. The rays surrounding the umbilicus (Plate **16**, fig. 15) have a somewhat oval transverse section

2.5–3 μ broad and 4–5 μ long, the longer diameter being situated radially to the umbilicus. These periumbilical rays bear from seven to ten lateral and usually also some terminal spines. In Bowerbank's type the sterrasters measure 100–110 by 82–94 by 70–74 μ. Sollas gives their dimensions as 110 by 80 μ.

Abnormal sterrasters, *sterroids*, with fewer and more distant protruding rays are met with quite frequently. In these spicules (Plate 16, figs. 20, 21) the parts of the surface destitute of rays bear spines similar to those forming the verticils on the rays of the normal sterrasters. Some of these spines are scattered singly, others arranged in rosette-like groups. The protruding rays of the sterroids attain a thickness of 12–15 μ and a length of 10–12 μ. Their sides are quite smooth; the rounded end is densely spined.

All the eight specimens of this species were collected on October 26, 1904, in the Gulf of Panama, off Panama, on the shore of the islands of the Station Pacific Mail Steamship Company or of the Taboga Islands. Bowerbank states that his specimen came from "Mexico." Thinking that the *Gulf* of Mexico must be meant, when the locality of a *marine* organism was given as Mexico, in 1903 I gave the Gulf as its locality. Now that this species has been found in the Gulf of Panama, it seems much more probable that Bowerbank's type came from the Pacific coast of Mexico and not from the Gulf of that name.

Whichever of the two kinds of dermal apertures are the afferents and which the efferents, there can be no doubt, that both are cribriporal. For this reason I now place these sponges in Geodia and not in Sidonops as, following Sollas's suggestion, I formerly (1903) did.

GEODINELLA Lendenfeld.

Without regular triaenes. The tetraxon megascleres are monaene or diaene teloclades with reduced clades, and occur not only in the superficial part of the sponge but also in the interior.

There are in the "Albatross" collection four specimens of Geodinella. These belong to one new species, which is divided into three varieties.

Geodinella robusta, sp. nov.

megasterra, var. nov.

Plate 1, figs. 1–4, 16. 18–24; Plate 2, figs. 1, 3; Plate 3, figs. 3, 4, 7, 9; Plate 4, figs. 1, 4–7, 13, 21, 22.

carolae, var. nov.

Plate 1, figs. 5–12, 17; Plate 2, figs. 4–7, 9–11; Plate 3, fig. 1; Plate 4, figs. 2, 3, 8–12, 14–20.

megaclada, var. nov.

Plate 1, figs. 13–15; Plate 2, figs. 2, 8; Plate 3, figs. 2, 5, 6, 8; Plate 4, figs. 23–25.

I establish this species for four spirit specimens, three fairly complete, one fragmentary, collected at Stations 2946, 4199, and 4228 on the Pacific slope of North America. On account of their having larger spicules than the only other known species of this genus I have named the species *robusta*. Although these sponges are similar enough to be considered as representatives of the same species, only two are really systematically identical, while the other two differ to some extent from these two and also from each other. It therefore seems advisable to consider these four sponges as three separate varieties. The most conspicuous differences between them are found in the shape and size of their sterrasters and the clades of their teloclades. In two specimens, one taken in Charlotte Sound, Vancouver Island, the other in Naha Bay, Behm Canal, S. E. Alaska (Stations 4199, 4228), the teloclades have short clades and the sterrasters are smaller and nearly always regularly ellipsoidal. In the other two specimens the sterrasters are larger and more diversified in shape, three-lobed ones not infrequently occurring besides the ellipsoidal ones. The variety I establish for the specimens from Stations 4199 and 4228 with short clades and small sterrasters, I name var. *carolae* after the locality, Queen Charlotte Sound, where one of them was found. In one of the two remaining specimens the sterrasters are not so large and the clades of the teloclades considerably longer then in the other; the variety with longer clades which was also found at Station 4228 I name var. *megaclada*. The third variety, from Station 2946, the sterrasters of which are larger than those of the other two, larger in fact than those of any sponge in the collection, I name var. *megasterra*.

The specimens of var. *carolae* (Plate 1, figs. 12, 17) are both incrusting cushion shaped and nearly of the same size, about 45 mm. long, 30 mm. broad, and 15 mm. high. From the margin of the base of the specimen from Naha Bay (Plate 1, fig. 12) several processes arise. One is large and digitate, 23 mm. long and 7 mm. thick at the base; the others are small. The surface is slightly uneven, covered with low rounded elevations. On the summit of some of the more pronounced elevations a circular aperture, up to 700 μ in diameter, is observed. This leads into a rather wide cavity, constricted below by a chonal sphincter. The appearance of some of the elevations, not thus provided with an apical vent indicates that these also possessed such an aperture which has, however, been quite closed by contraction. The specimen of var. *megasterra* (Plate 1, fig. 16) is somewhat irregularly finger shaped, slightly bent, and 43 mm. long. It is at the base 16 mm. thick; towards its upper end it tapers to a diameter of 10 mm. The surface has the same character as that of the specimens of var. *carolae*, the only difference being that the apertures on the elevations attain a larger size, the widest measuring as much as 1.5 mm. in diameter. The specimen of var. *megaclada* is 13 mm. in diameter and appears to be a fragment (the tip) of a finger-shaped sponge like the specimen of var. *megasterra*. The largest apertures on its surface are 300 μ wide. The specimens of var. *megasterra* and of var. *carolae* from Naha Bay are partly covered by thin crusts of a monaxonid sponge. In both these varieties examination of the surface with a lens shows here and there indications of hirsute spicules, broken off short; since, however, I have been unable to find in the sections any spicules penetrating the cortex, it is doubtful whether these broken, apparently hirsute, spicules are proper to the sponge.

The *colour* is white or white with a brownish tinge on the surface and dirty white or brownish in the interior. The surface of the two specimens from Naha Bay is partially covered with a darker brown coating which may be foreign to the sponge.

A hard cortical layer, composed of dense masses of sterrasters, a sterraster-armour (Plate 1, figs. 21a, 24a; Plate 2, fig. 6a), surrounds the choanosome. This *cortex* is 1–2 mm. thick in var. *megaclada* on the whole somewhat thicker than in the other two varieties.

Canal-system. The sterraster-armour (cortex) is perforated by round or oval holes 300 μ–1.5 mm. wide. Each perforation is traversed by a radial canal situated centrally. This canal may be wide and extend nearly to the sterrasters surrounding the perforation through which it passes, or it may be contracted, narrow, or altogether closed, and separated from the nearest sterrasters by a thick intervening layer of soft tissue. The canals passing through the large perforations of the sterraster-armour are usually dilated and open out on the surface of the sponge with a wide aperture. These apertures are the vents, which as stated above, crown the summits of some of the elevations. The canals passing through the smaller perforations are usually contracted. On account of the hardness of the cortex and also because I wished to preserve such valuable material, I have not been able to ascertain exactly how these narrow radial canals open out on the surface. So far as I could make out they divide distally into several oblique nearly paratangential canals, which lead to small groups of round pores, 50–80 μ wide, above the perforation of the armour through which the radial canal passes. Below, these radial canals are provided with chones composed of brownish tissue. These chones are about 200 μ broad and protrude to a distance of 400 μ into the choanosome.

The choanosome (Plate 1, figs. 21b, 24b; Plate 2, fig. 6b) is remarkably soft and traversed by numerous wide canals up to 1.5 mm. in diameter. The widest of these canals usually extend paratangentially just below the surface (Plate 1, figs. 21, 24). From the canal-walls numerous low transverse ridges protrude into the interior, partially dividing the canal-lumina into rows of chambers. Such ridges occur not only in the wide, but also in the narrow canals. The flagellate chambers (Plate 2, figs. 4b, 11a) are longitudinally compressed, the length of the main axis, passing through the chamber-mouth, usually being only from two thirds to three fourths of the length of the transverse diameter. In the specimen of var. *carolae* from Charlotte Sound, which is better preserved than the others, the flagellate chambers are 20–35 μ long and 30–45 μ broad.

In the characters of their canal-system these sponges appear on the whole to approach rather closely the species of Sidonops.

Histological structure. Many of the flagellate chambers have lost their collar-cells altogether, in others collar-cells are present, but they are never numerous (Plate 2, figs. 4, 11). Whether this sparseness of the collar-cells is due to some having dropped off *post mortem*, or whether it is a natural condition of the living sponge, I cannot say. "Sollas's membranes" about 9 μ distant from the chamber-walls are frequently observed. The nuclei of the collar-cells are about 2 μ in diameter. The dermal membrane is thin and composed of stout, spindle-shaped elements, extending paratangentially. The proximal part of the cortical tissue, just below the sterraster-armour, contains coarse paratangential fibres and granular oval or spherical cells, 15–30 μ in diameter. In the walls of the canals stout bands of longitudinal, spindle-shaped, finely granular elements, 3–5 μ thick in the centre, are met with. Occasionally more or less isolated, spindle-shaped elements, attaining a maximum transverse diameter of 10 μ, are seen in the sections. I have often noticed that the substance composing these elements differs from the surrounding tissue, not only by being less stainable, but also by having a higher refractive index, so that it to a certain extent resembles the spongin of the fibres of horny sponges. In sections of the choanosome of var. *carolae* I have observed groups of highly stainable, oval cells 20–30 μ long and 12–17 μ broad (Plate 2, fig. 7a). These cells are imbedded in an alveolar tissue, composed of a mesh-work of elongated elements (Plate 2, fig. 7b), and free from flagellate chambers. I am inclined to consider these large cells as young ova.

Skeleton. The sterraster-armour and the microscleres generally are well developed, the megascleres somewhat rudimentary; not the megascleres of the choanosome, but the hard sterraster-armour of the cortex, forms the main support of the sponge.

The megascleres are rhabds, simple teloclades, and a few multicladomal and mesoclade derivates of the latter. The rhabds are for the most part blunt, spindle-shaped, isoactine amphioxes. These pass on the one hand into pointed amphioxes, on the other into cylindrical amphistrongyles or even amphityles. Anisoactine blunt or pointed diactines and occasionally also styles and tylostyles are met with likewise. Some rhabds are rendered irregular by the presence of small protuberances. Most of the teloclades are monaenes. Besides these monaenes some diaenes occur in var. *carolae*. These are more numerous in the specimen from Charlotte Sound than in the specimen from Naha Bay. In var. *magaclada* and var. *megasterra* monaenes only, the clades of which are much longer in var. *megaclada* than in var. *megasterra*, are met with. Most of these spicules are plagioclade, some orthoclade.

These teloclades (teloclade-derivates) and rhabds are met with in all parts of the choanosome. In its central parts the teloclades are relatively less numerous than in its superficial parts. In the axial part of the choanosome of the finger-shaped var. *megasterra* these spicules form a rather loose longitudinal column or strand (Plate 1, fig. 21), from which single spicules and small spicule-bundles extend towards the surface. These are arranged in a somewhat plumose manner, abut obliquely on the sterraster-armour, and extend distally to the limit between the cortex and the choanosome, or a little beyond it, in which case they penetrate the proximal part of the sterraster-armour and terminate within it.

In the spicule-preparations I have seen a few fragments which appeared to be parts of spicules much thinner and longer than the rhabds and the rhabdomes of the ordinary teloclades. It has been stated above that on the surface indications of hirsute spicules, broken off short, are observed. It is possible that these slender spicule-fragments are parts of those hypothetical hirsute spicules. If hirsute spicules are really present they are probably teloclades with long and slender cladomes. Since, however, I have not been able to find a single cladome of such a spicule in all the numerous preparations made, I doubt whether the sponge possesses any teloclades of this kind and rather incline to the view that these fragments are parts of foreign spicules.

The microscleres are larger oxyasters passing into smaller oxysphaerasters, small strongylosphaerasters, and sterrasters. The strongylosphaerasters are very numerous on the outer surface and also occur in small numbers in the walls of the cortical and choanosomal canals. The oxyasters (and oxysphaerasters) are quite numerous in the choanosome, chiefly in the canal-walls; a few also occur in the cortex. The sterrasters are densely packed in the sterraster-armour and are, in radial sections, frequently also found scattered in the choanosome. Whether they naturally occur there, or whether those observed there have been brought to this position in cutting, I cannot say. Among the ordinary sterrasters a few sterrasters with abnormal (hypertrophic) rays, sterroids occur. These appear to be irregularly scattered among the others.

The *isoactine rhabds* (Plate **1**, figs. 22, 23; Plate **4**, figs. 8, 9, 11, 12, 16, 24) are usually straight or slightly curved and spindle shaped, tapering towards the ends; more rarely shortened and cylindrical. The ends of the spindle-shaped ones are usually blunt, less frequently sharp pointed; the ends of the cylindrical ones simply rounded off or slightly thickened. All these forms, the spindle-shaped, sharp-pointed, and blunt *amphioxes,* and the shortened cylindrical, simple *amphistrongyles,* and terminally thickened *amphityles* are connected by transitional forms to such an extent that it appears advisable to describe them together. These spicules attain a maximum length of 2.8 mm. Within this limit their longitudinal dimension is variable, particularly so in the specimen of var. *carolae* from Charlotte Sound, where a good many of the isoactine rhabds are very much reduced in length. In this specimen the isoactine rhabds are 0.37–2.5 mm., usually 1.6–2.2 mm. long and 40–65 μ thick. As will be seen from the measurements tabulated below the thickness is not in proportion to the length, the shortest spicules being nearly, if not quite, as thick as the longest.

DIMENSIONS OF ISOACTINE RHABDS OF VAR. CAROLAE FROM CHARLOTTE SOUND.

Length	Thickness in the middle
0.37 mm.	48 μ
0.43 "	47 μ
1.2 "	47 μ
1.8 "	45 μ
2.0 "	50 μ
2.2 "	52 μ

There is, however, a correlation between the length and the shape of these spicules, the long rhabds being spindle shaped, the short ones cylindrical and usually thickened at the ends, amphityle in character. The terminal thickenings of these amphityles are more or less spherical. One of the short amphityles is represented on Plate **4**, fig. 16. This spicule is 0.4 mm. long and 65 μ thick in the middle. Its terminal thickenings measure 80 μ in diameter. In other amphityles this terminal thickening is still more pronounced. In one such, 0.42 mm. long and 56 μ thick, the terminal thickenings measured 73 μ. In these shortened amphityle spicules the axial thread terminates in the centres of the spherical terminal thickenings. I think that these short amphityles may have been produced by some cause preventing the axial thread from attaining its full length, but not proportionately reducing the vital energy of the silicoblasts which deposit the silica, intended, as it were, for enclosing the (missing) terminal parts of the axial thread, at the ends of the (short) axial thread present. The influences regulating the production (growth) of the axial threads seem accordingly to be distinct from, and to a certain extent independent of, those regulating the action of the silicoblasts. In var. *megasterra* and var. *megaclada* the isoactine rhabds are as a rule spindle shaped, 1.6–2.8 mm., mostly 1.9–2.3 mm. long, and 33–60 μ, mostly 40–55 μ thick. Cylindrical rhabds reduced in length and thickened at the ends, like those described above from var. *carolae*, are exceedingly rare in var. *megasterra* and seem to be absent altogether in var. *megaclada*. As will be seen from the measurements of these spicules of var. *megasterra* tabulated below, the terminal attenuation is very variable, and the thickness of the ends correlated to the length and the thickness in the middle only in so far as the two longest spicules in the list both have slender pointed ends.

ISOACTINE RHABDS (AMPHIOXES) OF VAR. MEGASTERRA.

End	Thickness 40 μ below each end	Thickness in the middle	Length
pointed	15 μ	57 μ	1.8 mm.
"	17 "	48 "	2.7 "
"	17 "	55 "	2.6 "
rounded off	22 "	40 "	2.2 "
" "	22 "	53 "	2.1 "
" "	23 "	48 "	1.8 "
" "	28 "	53 "	2.2 "
" "	32 "	57 "	2.2 "

The *anisoactine rhabds* (*amphioxes and amphistrongyles*) and the true *styles* (Plate **4**, fig. 17) are slightly shorter and (at the stouter end) a trifle thicker than the isoactines. They measure 1.1–2.3 mm. in length and 40–80 μ in thickness. In the true styles, which represent, as it were, the end of the series of increasingly anisoactine rhabds, the thickness of the rounded end is generally speaking in inverse proportion to the length of the spicule. Some of the styles of both the specimens of var. *carolae* are somewhat thickened at the end and appear as subtylostyles.

Irregular rhabds (Plate **4**, figs. 6, 7, 10). Not a few of the rhabds of var. *carolae* have a slightly undulating surface which renders their contour perceptibly wavy. Other rhabds, both of this variety and of var. *megasterra*, possess on one side a small, rounded, well-defined protuberance 5–10 μ high, which is usually nearer to one of the ends than to the centre of the spicule. Below the protuberance the silica-layers forming the spicule conform to the outer surface, this disturbance (upheaval) reaching right down to the axial thread and thus showing that the cause of the formation of the protuberance acted before the silica-layers were produced. Sometimes more than one such protuberance is observed on a rhabd. In the spicule of var. *megasterra* (Plate **4**, figs. 6–7) quite a cluster of such protuberances rises from each end of the spicule. In some cases the protuberance is not, as in the spicules described above, confined to one side but goes nearly or quite round it, forming a more or less complete annular thickening. Among the irregular, blunt amphioxes of var. *megasterra* I have observed some with an annular thickening of this kind below each of the ends. One of these spicules was 1.7 mm. long and 60 μ thick in the middle. The two rounded ends were respectively 30 and 36 μ thick. One of the annular thickenings was quite complete and situated 230 μ below the more slender end; the other was not quite complete and situated 90 μ below the stouter end of the spicule. The former had a diameter of 50 μ and the part of the spicule from which it arose was 42 μ thick. The latter had a diameter of 43 μ and the part of the spicule from which it arose was 40 μ thick. Occasionally, but very rarely, rhabds with a clade-shaped protuberance, resembling anamonaenes (Plate **4**, fig. 10) occur.

In the rhabds with undulating surface the irregularity is probably caused by some inequality in the action of the silicoblasts during growth. The monaene-like forms just referred to are altogether abnormal, probably pathological. The rhabds with the rounded and annular protuberances I am inclined to consider as spicules transitional between regular rhabds and teloclades.

The *teloclades* and *teloclade-derivates* (Plate **1**, figs. 1–11, 13–15, 18–20; Plate **4**, figs. 23, 25). The cladome of the teloclades is always reduced. This reduction is different in degree and in kind in the three varieties. In var. *carolae* the teloclades have entirely lost one or two of the triaene-clades; in the two others invariably two. In var. *megaclada* the single remaining clade is often quite long. In the two other varieties the clades are always very short. Thus var. *carolae* possesses some diaenes besides the monaenes, both with short clades, var. *megaclada* only monaenes, many of which have a rather long clade, and var. *megasterra* only monaenes, which always have a short clade. In all three the cladome is usually simple and situated at or near the cladomal end of the rhabdome. Besides these ordinary teloclades, teloclade-derivates with more cladomes than one, and with clades arising some distance from the end or reduced to insignificant protuberances, are met with.

The *diaenes* and *monaenes* of var. *carolae* (Plate **1**, figs. 5–11) have the same dimensions. The monaenes (Figs. 6, 9–11) are much more numerous than the diaenes (Figs. 5, 7, 8), particularly in the specimen from Naha Bay. The rhabdome is 1.1–1.7 mm. long and at the cladomal end 26–40 μ thick; it is generally straight or slightly curved, rarely (Fig. 6) angularly bent, and usually attenuated towards the acladomal, blunt or, more rarely, pointed end. Sometimes (Fig. 5) this attenuation is so slight that the rhabdome appears nearly cylindrical. In such spicules it is simply rounded off at the end. The cladome is generally quite terminal (Figs. 5–9, 11), rarely situated a little below the end of the rhabdome (Fig. 10). The clades are 30–70 μ, usually 40–55 μ long, generally quite straight, irregularly conical, and pointed (Figs. 5, 6, 8–10), or, more rarely, cylindrical and rounded terminally (Fig. 11). In the diaenes a pointed clade may be associated with a rounded one (Fig. 7). The clades enclose angles of 93–130° with the rhabdome, so that some of these spicules appear as orthodiaenes or orthomonaenes (Fig. 10), others as plagio- or pro-diaenes or plagio- or pro-monaenes (Figs. 5–9, 11). The latter are much more numerous than the former. The monaenes of var. *megasterra* (Figs. 1–4, 18–20) are in every respect similar to those of var. *carolae*, the only difference being that their rhabdomes, which measure 1.4–2.1 mm. in length, are on an average slightly longer. The monaenes of var. *megaclada* (Plate 1, figs. 13, 14; Plate 4, fig. 23) have rhabdomes similar to those of the monaenes of var. *megasterra* but thicker, sometimes attaining a thickness of 42 μ. The clade which is terminal (Plate 1, fig. 14), or, more rarely, situated a little below the end of the rhabdome (Plate 1, fig. 13; Plate 4, fig. 23), is conic, pointed, 80–105 μ long, and straight or slightly bent upwards at the end. It encloses an angle of 87–135° with the rhabdome.

The *teloclade-derivates* (Plate 1, fig. 15; Plate 4, fig. 25). The teloclade-derivates with more than one cladome are rare. I have observed them only among the monaenes, and they never seem to have more than one secondary cladome. The primary (terminal) clade is similar to that of ordinary monaenes, the secondary clade is situated a considerable distance below the cladomal end and smaller than the primary clade (Plate 1, fig. 15). The mesoclades are likewise rare. They are always monoclade and appear as rhabds, attenuated towards both ends or towards one end only with a short and stout clade arising a considerable distance from either end (Plate 4, fig. 25). The teloclades with terminal clades reduced to mere rounded protuberances pass, by further cladome-reduction, into tylostyles and styles. They appear as transitional forms connecting the teloclades with the rhabds. In the teloclade-derivate tylostyles the tyle is often irregular and the axial thread of the rhabdome becomes tortuous on entering the tyle. In one of these spicules I noticed that the short, tortuous part of the axial thread lying in the tyle was not connected with the axial thread of the rhabdome. Mesoclade and multicladomal teloclade-derivates with clades further reduced are rare. They pass into the rhabds with one or more protuberances or annular thickenings (Plate 4, figs. 6, 7). These resemble the rhabds proper so closely, that I have thought it better to describe them above together with the regular rhabds.

The shape, size, and arrangement of the megascleres of these sponges and the closeness of their connection by transitional forms lead to the conclusion that the rhabds are more closely related to the teloclades than is generally assumed.

The fragments of *long and slender spicules*, which, as stated above, are met with occasionally in the spicule-preparations, are 8–12 μ thick. The longest one observed was over 2 mm. in length. Most of them are broken off at both ends. In a few one end was intact and pointed. Their slenderness would incline me to believe that they are parts of rhabdomes of teloclades, but the fact that, in spite of the most careful search, I have failed to find any cladomes belonging to them, is against this view. As stated above, these spicules may be foreign to the sponge.

The *large oxyasters and small oxysphaerasters* (Plate 2, figs. 3a, 10a, b; Plate 4, figs. 1–5, 21, 22) are so closely connected by transitional forms that it is advisable to describe them together. In var. *carolae* these spicules are 11–36 μ in diameter and have from six to eighteen rays. In many a central thickening 2–8 μ in diameter is clearly distinguishable, others are without such a centrum. The rays are straight, conic, 1–3.5 μ thick at the base, and (without the central thickening) 3–17 μ long. They are usually simple, but occasionally such asters are observed in which one or more of the rays are bifurcate, the two branches extending in a nearly parallel direction and lying close together. The rays are pointed (Plate 4, fig. 3) or, rarely, somewhat blunt (Plate 4, fig. 2). Their distal part is covered with spines, the size, number, and arrangement of which are variable. In some (Plate 4, fig. 2) the spines are so small that even with the 280 $\mu\mu$ light no distinct image of them can be procured; as a rule, however, they are large enough to be clearly shadowed on the photographic plate by these u. v. rays (Plate 4, fig. 3). The number of rays and the development of the central thickening are, roughly speaking, in inverse proportion to the size of the spicule. Oxyasters (oxysphaerasters) under 20 μ in diameter have from ten to eighteen rays and a well-developed central thickening, the diameter of which is from one fifth to nearly one half of the diameter of the whole spicule. Oxyasters (oxysphaerasters) over 20 μ in diameter usually have only from six to nine rays, and either no central thickening at all, or only a small one, never more than a quarter of the whole spicule in size. Also in the spines a certain (inverse) proportion between size and number is discernible; when the spines are numerous, they are very small, and the smaller their number is the larger they become. When, as is most frequently the case, the spines are few in number and large in size, some, generally the longest, form a verticil a little below the end of the ray, so that the spicule becomes somewhat acanthtylaster in character (Plate 4, fig. 3). The oxyasters and oxysphaerasters of var. *megasterra* are similar to those of var. *carolae*. They measure 9–38 μ in diameter and have from six to seventeen rays (without the central thickening) 2.5–21 μ long, and 0.6–4 μ thick at the base. The central thickening is small, never over 5 μ in diameter. In many of these spicules (Plate 4, fig. 4) the spines of the rays are particularly large, and very regularly arranged in verticils. These large spines arise vertically from the ray and often appear to be bent down at the end so that they become claw shaped. Also in the oxyasters and oxysphaerasters of this variety an inverse relation between the number of rays and the size of the spicule is discernible; the asters under 20 μ in diameter having from nine to seventeen, the asters over 20 μ in diameter, from six to eleven rays. The oxyasters and oxysphaerasters of var. *megaclada* are smaller than those of var. *megasterra*, only 11–30 μ in diameter, and have on an average more rays, the small ones (under 20 μ in diameter) up to twenty, the large ones (over 20 μ in diameter) eleven to fifteen.

The *strongylosphaerasters* (Plate **2**, figs. 3b, 8, 9, 10c; Plate **4**, figs. 18–20) of var. *carolae* consist of a spherical, central thickening, from which from eleven to twenty-seven radial rays arise. The whole aster is 7–12 μ in diameter. The diameter of the central thickening is usually from one half to two thirds of the diameter of the whole spicule and measures 3.5–7 μ. The rays are cylindrical and arise from the central thickening with trumpet-shaped basal extensions. They are 2–3 μ long, 1–1.7 μ thick, and terminally rounded. The distal parts of the rays are covered with small spines which often form a conspicuous terminal verticil (Plate **4**, fig. 19). A correlation between the size of the spicule and the number of rays is not discernible. In var. *megaclada* the maximum dimensions of these spicules are similar, but the minimum dimensions greater. The strongylosphaeraster of this variety measured were 10–12 μ in diameter, and had from nineteen to twenty-five rays and a central thickening 5–7 μ in diameter. Among the strongylosphaerasters of this variety I have observed many in which the verticillate arrangement of the ray-spines was particularly well marked, and I noticed that in many of these the spines of the verticils are recurved. The rays of these spicules, particularly when viewed from above, closely resemble sterraster-rays. In var. *megasterra* the strongylosphaerasters are also similar, but here they attain a somewhat larger size, measure 8–13 μ in diameter, and have fewer, only from twelve to nineteen, rays; the central thickening is 3.5–7 μ in diameter.

Sometimes *sphaerasters*, similar to these strongylosphaerasters, but with rays distinctly tapering towards the distal end, are observed. These spicules are transitional to the small oxysphaerasters. I have noticed such sphaerasters particularly in var. *carolae*.

The normal *sterrasters* (Plate **3**, figs. 1, 2, 5; Plate **3**, figs. 1–3, 7, 9; Plate **4**, fig. 13). As stated above the size and shape of the normal sterrasters are different in the three varieties, var. *carolae* having the smallest, and var. *megasterra* the largest; var. *megaclada* being in this respect intermediate between the other two. In var. *carolae* all or nearly all the sterrasters are flattened ellipsoids, the proportion between the three axes being about 5:7:9 (Plate **2**, fig. 5). In the other two varieties most of the sterrasters have a similar shape (Plate **2**, figs. 1a, 2a, c); but we find in these, among the ordinary, ellipsoidal sterrasters, also a good many flattened, three-lobed ones (Plate **2**, figs. 1b, 2b). The ellipsoidal sterrasters are in var. *carolae* 180–195 μ long, 130–160 μ broad, and 80–115 μ thick; in var. *megaclada* 190–217 μ long, 160–190 μ broad, and 105–125 μ thick; in var. *megasterra* 220–237 μ long, 165–200 μ broad, and 120–130 μ thick. The three nearly equal maximum diameters of the three-lobed sterrasters of the two last-named varieties are nearly or quite as long as the longest diameter of their ellipsoidal sterrasters. In the specimen of var. *carolae* from Naha Bay I found two tetra-lobed sterrasters.

The centre of the sterraster is, as Thiele has already noticed in another species, *Geodinella* (*Geodia* (?)) *cylindrica*,[1] surrounded by granules the refractive index of which differs from that of the silica in which they are imbedded. These granules form a hollow, spherical cluster 6–8 μ in diameter (Plate **3**, figs. 7a, 9a). Rather to my surprise I found that in the three-lobed sterrasters the position of these pericentric granules is the same as in the ellipsoidal ones. The siliceous substance surrounding this cluster of granules shows the usual radial structure. The individual granules often appear to be onion shaped and produced distally in a radial process, forming one of the radial lines which give the radially striated appearance to the siliceous substance of the sterraster. Sections, optical and other, through the sterrasters show that many of them are not only radially striated but also paratangentially stratified, one or two, very conspicuous limits (Plate **3**, figs. 7, 9b) between the superposed zones being distinctly visible. These limits are concentric and parallel to the outer surface. The radial striations pass continuously through them.

The umbilicus (Plate **3**, figs. 1–3, 7c, 9c; Plate **4**, fig. 13a) lies in the centre of one of the broad faces of the sterraster. It is generally a caliculate pit 15–25 μ deep; its circumference (mouth) is oval, 17–20 μ broad and 23–30 μ long. Proximal continuations of the rays surrounding the umbilicus project into the umbilical pit and form longitudinal (radial) ridges on its flanks. The bottom of the pit appears rough. The remainder of the surface of the sterraster is covered by freely projecting rays (Plate **2**, figs. 1, 2, 5; Plate **3**, figs. 1–3, 7, 9;

[1] Zoologica, 1898, **24**, p. 13.

Plate 4, fig. 13). These rays are cylindrical, 3 μ long and about as broad, and rather uniformly distributed over the surface, their axes being 5 μ apart. Those portions of the surface of the central mass of the sterraster which lie between the rays are more or less roughened. At the end each ray bears a verticil of stout, conic, lateral spines, 1–2 μ long and broad, the axes of which are vertical to the axis of the ray. The average number of the spines in a verticil is six; but there may be as few as one or two or as many as eight or ten.

Among these ordinary sterrasters, forming, as stated, the great majority in all the three varieties, a few *sterroids* occur, which are similar to these in shape and size, but have different rays. Two kinds of sterroids can be distinguished.

In the one, which is observed more frequently, the rays are, as in the normal sterrasters, quite uniformly distributed and close together, but wholly or in part much larger and crowned with a much greater number of spines. In these sterroids (Plate 3, figs. 4, 6; Plate 4, figs. 14, 15) the rays attain a thickness of 7–10 μ, the spine-verticils are composed of 15–20 spines, and the convex apical ends of the rays also bear several, usually 4–8, spines equalling in size the verticil-spines (Plate 4, figs. 14, 15). In these sterroids the verticil-spines are usually directed slightly downwards, the whole verticil appearing as the serrated and somewhat recurved margin of a terminal, shield-like expansion of the ray, from the distal face of which several spines arise.

The other kind of sterroid (Plate 3, figs. 5, 8), which is very rare, consists of a central mass of the usual ellipsoidal or a more spherical shape, from which rather sparse and irregularly distributed rays arise. These rays are cylindro-conical, 22–27 μ long, 11–17 μ thick at the base, and covered with numerous small spines; on the parts of the surface of the central mass free from rays such spines also occur. On the rays the spines form extensive patches within which they stand quite close together. On the central sphere they are for the most part farther apart and irregularly scattered. Here and there well marked, smooth, channel-like zones separate adjacent spine-patches.

The four specimens of this species were obtained on the Pacific slope of North America. One specimen of var. *carolae* was trawled at Station 4199 on June 25, 1903, in Queen Charlotte Sound off Fort Rupert, Vancouver Island, B. C.; centre of Round Island S. 46° W., 11.5 km. (6.2 miles), drift S. 85° E.; depth 124–196 m. (68–107 f.); it grew on a bottom of soft green mud and volcanic sand; the bottom temperature was 7.7° (45.9° F.). The specimen of var. *megaclada* and one specimen of var. *carolae* were trawled at Station 4228 on July 7, 1903, in the vicinity of Naha Bay, Behm Canal, S. E. Alaska; Indian Point, N.

18° E., 1.7 km. (0.9 miles); drift N. 2° W.; depth 75–245 m. (42–134 f.); they grew on a bottom of gravel and sponge spicules; the bottom temperature was 8.8° (47.8° F.). The specimen of var. *megasterra* was trawled at Station 2946 on February 6, 1889, off southern California, in 33° 58′ N., 119° 30′ 45″ W.; depth 274 m. (150 f.); it grew on a bottom of coarse gray sand; the bottom temperature was 13.6° (56.5° F.).

TABLE SHOWING THE VARIETAL DIFFERENCES IN GEODINELLA ROBUSTA.

Varieties	carolae	megaclada	megasterra
Shape	incrusting, cushion shaped.	finger shaped.	finger shaped.
Rhabds.	amphioxes; amphistrongyles; amphityles; styles; subtylostyles; 0.37–2.5 mm. long, 10–65 μ thick.	amphioxes, 1.6–2.8 mm. long, 33–60 μ thick.	amphioxes, 1.6–2.8 mm. long, 33–60 μ thick.
Teloclades.	monaenes and occasionally diaenes; rhabdome 1.1–1.7 mm. long, 26–40 μ thick; clades 30–70 μ long; cladal angles 93–130°.	monaenes only; rhabdome 1.4–2 mm. long, 25–42 μ thick; clades 80–150 μ long; cladal angle 85–135°.	monaenes only; rhabdome 1.4–2.1 mm. long, 26–40 μ thick; clades 30–70 μ long; cladal angles 93–103°.
Oxyasters and oxysphaerasters.	11–36 μ in diameter; with 6–18 rays; central thickening usually well developed.	11–30 μ in diameter; with 11–20 rays; central thickening usually small or absent.	9–38 μ in diameter; with 6–17 rays; central thickening usually small or absent.
Strongylosphaerasters.	7–12 μ in diameter; with 11–27 rays; central thickening 3.5–7 μ in diameter.	10–12 μ in diameter; with 19–25 rays; central thickening 5–7 μ in diameter.	8–13 μ in diameter; with 12–19 rays; central thickening 3.5–7 μ in diameter.
Sterrasters.	ellipsoidal; 180–195 μ long, 130–160 μ broad, 80–115 μ thick.	ellipsoidal or, more rarely, three-lobed; the ellipsoidal ones 190–217 μ long, 160–190 μ broad, 105–125 μ thick.	ellipsoidal or, more rarely, three-lobed; the ellipsoidal ones 220–237 μ long, 165–200 μ broad, 103–120 μ thick.

In 1898 Thiele (Zoologica, **24**, p. 12) described a geodid sponge with reduced and irregularly arranged, partly axially situated teloclades and large ellipsoidal sterrasters from the northwestern Pacific (Japan). As the specimen at his disposal was merely a small fragment, he, although convinced that it did not belong to any of the geodid genera then known, refrained from establishing a new genus for it, and named it *Geodia* (?) *cylindrica*.

When I was preparing the systematic account of the Tetraxonia for the

Tierreich I found it quite impossible to place this sponge in any of the then existing genera, and, carrying out Thiele's suggestion, established the new genus Geodinella for it.[1]

There can be no doubt that the sponges above described belong to this genus. From the only species of it hitherto known, *Geodinella* (*Geodia* ?) *cylindrica*, they differ in having a much stouter body, megascleres twice as large, and different euasters. *Geodia cylindrica* has oxysphaerasters (pycnasters) 7–8 μ in diameter only; in *G. robusta* besides the strongylosphaerasters 7–13 μ in diameter, which appear to correspond to the pycnasters of *G. cylindrica*, oxyasters attaining a diameter of 30–38 μ are present in large numbers. *Geodia cylindrica* has been found only in Japan, *G. robusta* on the Pacific coast of North America.

[1] *R. v. Lendenfeld.* Tierreich, 1903, **19**, p. 117.

III. GENERAL SYSTEMATIC ACCOUNT OF THE GENERA, SPECIES, AND VARIETIES OF GEODIDAE FROM THE PACIFIC OCEAN.

Geodidae.

Tetraxonia with rhabd, teloclade and usually also mesoclade megascleres, and a superficial armour composed of massive, spheroidal, or ellipsoidal sterrasters. Euasters are always, ataxasters or microrhabds sometimes, present. Without desmc megascleres and without thin, disc-shaped sterrasters.

This family, as now limited, comprises the genera Caminella Lendenfeld, Pachymatisma Johnston, Caminus O. Schmidt, Isops Sollas, Sidonops Sollas, Geodia Lamarck, and Geodinella Lendenfeld.

All of these, with the exception of Pachymatisma, occur in the Pacific Ocean.

Ninety-four species of Geodidae are known; forty-six occur in the Pacific Ocean, and five of the Pacific species are further divided into fifteen varieties.

CAMINELLA Lendenfeld.

Among the megascleres are regular triaenes. The tetraxon megascleres are confined to the superficial part of the sponge and arranged radially. The dermal microscleres are asters. The afferents are uniporal; the efferents larger oscula.

Two species are known; one of which, *C. nigra* (Lindgren), occurs in the Pacific Ocean.

Caminella nigra (Lindgren).

Lendenfeld, Tierreich, 1903, **19**, p. 90.
Isops nigra Lindgren, Zool. anz., 1897, **20**, p. 486. Zool. jahrb. Syst., 1898, **11**, p. 352, plate 18, fig. 11, plate 20, fig. 7a–e.

Ellipsoidal. Black.

Large amphioxes: 900 by 20 μ. *Minute amphioxes*: 72 by 2 μ. *Plagioprotriaenes*: rhabdome 960 by 20 μ; clades 96 μ long; cladome 180 μ broad and 60 μ high; clade-angles about 135°.

Choanosomal oxyasters: Rays not numerous, smooth, pointed; centrum small; total diameter 24 μ. *Oxysphaerasters*: numerous conical rays; centrum very large; total diameter 20 μ. *Sterrasters*: 62 μ long and broad, 52 μ thick.

Western Pacific. Java Sea; Gaspar Strait.

CAMINUS O. Schm.

Among the megascleres are regular triaenes. The tetraxon megascleres are confined to the superficial part of the sponge and arranged radially. The dermal microscleres are asters. The afferents are cribriporal, the efferents larger oscula.

Four species are known, one of which, *C. chinensis* Lindgren, occurs in the Pacific Ocean.

Caminus chinensis Lindgren.

Zool. anz., 1897, **20**, p. 485. Zool. jahrb. Syst., 1898, **11**, p. 339, plate 17, fig. 16, plate 20, figs. 2a–e, c. Lendenfeld, Tierreich, 1903, **19**, p. 92.

Spherical or ellipsoidal, erect. Brown. Cortex very hard.

Amphistrongyles: 720 by 24 μ. *Orthotriaenes*: rhabdome 460–600 by 36 μ, blunt; clades 325–540 μ long; clade-angles, according to the figure 90–100°.

Oxyasters: centrum small; total diameter 24–32 μ. *Sphaeres*: 2–5 μ in diameter. *Sterrasters*: 136 by 108 by 90 μ.

Northwestern Pacific. China Sea; Strait of Formosa.

ISOPS Sollas.

Among the megascleres are regular triaenes. The tetraxon megascleres are confined to the superficial part of the sponge and arranged radially. The dermal microscleres are asters. The afferents are uniporal; the efferents uniporal.

Of the seventeen species known four occur in the Pacific Ocean.

Isops contorta (Bowerbank).

Sollas, Rept. voy. "Challenger," 1888, **25**, p. 271. Lendenfeld, Tierreich, 1903, **19**, p. 97.
Pachymastina contorta Bowerbank, Proc. Zool. soc. London, 1873, p. 327, plate 31, figs. 7–11.

Branching, branches anastomosing. Dry: light brown.

Large amphioxes: 1.838 mm. by 35 μ. *Small amphioxes*: about 0.5 mm. long. *Styles*: 1.3 mm. long. *Triaenes*: rare.

Oxyasters: total diameter 32 μ. *Small sphaerasters*: rays conical; total diameter 70 μ. *Sterrasters* flattened, ellipsoidal, 160 μ long.

Western Pacific. Fiji Islands.

Isops imperfecta (Bowerbank).

Sollas, Rept. voy. "Challenger," 1888, **25**, p. 269. Lendenfeld, Tierreich, 1903, **19**, p. 97.
Geodia imperfecta Bowerbank, Proc. Zool. soc. London, 1874, p. 299, plate 46, figs. 6–13.

Massive tuberous. Dry: white.

Amphioxes and *amphistrongyles*: 1.75 mm. by 39 μ. *Teloclades*: triaene, diaene, or monaene; clades usually rounded terminally.

Sphaerasters: rays slender, cylindrical, truncate; centrum small; total diameter 21 μ. *Dermal sphaerasters*: rays terminally divided into numerous spines; centrum large; total diameter 12–19 μ. *Sterrasters*: ellipsoidal, depressed, or cylindrical, 110 by 80 μ.

? Southern Pacific. South Sea.

Isops obscura Thiele.

Zoologica, 1898, **24**, p. 6, plate 2, fig. 2; plate 6, figs. 2a–k. Lendenfeld, Tierreich, 1903, **19**, p. 96.

Irregularly massive. Dark brown.

Amphioxes: 1.2–1.6 mm. by 15–40 μ. *Plagiotriaenes*: rhabdome curved, 1.25 mm. long; clades stout, 80–120 μ long; clade-angles large.

Large thin-rayed oxyasters: rays slender, 20 μ long. *Small thick-rayed oxyasters*: total diameter 75 μ. *Oxysphaerasters*: diameter the same as in the oxyasters. *Sterrasters*: spherical, 60 μ in diameter. *Sterroids*: rare, similar to the sterrasters but with much thicker rays.

Northwestern Pacific. Japan.

Isops sollasi Lendenfeld.

Descriptive catalogue sponges Australian museum, 1888, p. 34. Tierreich, 1903, **19**, p. 97.

Cup shaped, peduncular, or lamellar. Brown.

Choanosomal rhabds: 800 by 16 μ. *Plagiotriaenes*: rhabdome 1 mm. by 25 μ; clades blunt 260 μ long.

Euasters: 16–30 μ in diameter; smaller many-rayed and larger few-rayed to be distinguished. *Sterrasters*: 48 μ in diameter.

Southwestern Pacific. East coast of Australia; Port Jackson.

SIDONOPS Sollas.

Among the megascleres are regular triaenes. The tetraxon megascleres are confined to the superficial part of the sponge and arranged radially. The dermal microscleres are asters. The afferents are cribriporal; the efferents uniporal.

Twenty species are known; nine occur in the Pacific Ocean.

The species *with anatriaenes* found in the Pacific Ocean are *S. lindgreni* Ldf., *S. picteti* (Tops.), *S. californica* Ldf., *S. alba* (Kieschnick), *S. angulata* Ldf. (var. *megana* Ldf., var. *microana* Ldf., var. *orthotriaena* Ldf.), *S. oxyastra* Ldf., *S. reticulata* (Bwk.); those *without anatriaenes* are *S. bicolor* Ldf., *S. nitida* (Soll.).

Sidonops lindgreni LENDENFELD.

Tierreich, 1903, **19**, p. 102.
Sidonops picteti LINDGREN (non Topsent 1897), Zool. anz., 1897, **20**, p. 486. Zool. jahrb. Syst., 1898, **11**, p. 349, plate 18, figs. 17, a, b, plate 20, fig. 6, a–h, c′–c″, d′. KIRKPATRICK, Proc. Zool. soc. London, 1900, p. 130.

Massive irregular, sometimes with digitate processes. Cortex brown, choanosome grayish.

Large choanosomal amphioxes: 2.5 mm. by 40 μ. *Minute dermal styles*: 240 by 5 μ. *Orthotriaenes*: rhabdome 2.4 mm. by 54 μ; clades slender, strongly concave to the rhabdome, 756 μ long. *Proclades* (*mesoproclades*): triaene, diaene, or monaene; rhabdome 4.6 mm. by 24 μ; clades 100 μ long; cladome 140 μ broad and 70 μ high. *Anatriaenes*: rhabdome 3 mm. by 12 μ; clades stout, 68 μ long; cladome 80 μ broad and 60 μ high.

Choanosomal oxyasters: rays rough, pointed, very numerous; centrum small; total diameter 20–48 μ. *Small strongylosphaerasters*: centrum large; total diameter 4 μ. *Sterrasters*: 160 by 120 μ.

? Western Pacific. Java.

Sidonops picteti TOPSENT.

Revue Suisse zool., 1897, **4**, p. 431, plate 18, fig. 2. LENDENFELD, Tierreich, 1903, **19**, p. 103.

Massive tuberous, elongated. In spirit: reddish gray.

Amphioxes: 500–600 by 30 μ. *Orthotriaenes*; rhabdome of similar dimensions as the amphioxes; clades slender, 90 μ long; cladome 185 μ broad. *Protriaenes* (? *mesoprotriaenes*): rhabdome 10 μ thick; clades 70 μ long. *Anatriaenes*: rhabdome 10 μ thick; cladome 70 μ broad and 53 μ high.

Oxyasters: usually from seven to twelve slender, spined, conical rays, 2 μ thick; centrum small; total diameter 35–40 μ. *Strongylosphaerasters*: centrum large; total diameter 4–6 μ. *Sterrasters*: 97 by 85 μ.

Topsent, 1897, states that in another specimen the sterrasters measured 140 by 115 μ. I should say that this sponge probably belongs to another species.

Western Pacific. Bay of Amboyna.

Sidonops californica Lendenfeld.

Ante, p. 18.

Elongate, tuberous. In spirit: yellowish white.

Large choanosomal amphioxes: 1.2–2 mm. by 30–48 μ. *Large styles*: rare; 55 μ thick. *Minute dermal styles*: 175–290 by 3–7 μ. *Very minute amphioxes*: 50 by 1 μ, possibly foreign. *Orthoplagiotriaenes*: rhabdome 0.9–1.45 mm. by 20–78 μ; clades concave to the rhabdome, 160–400 μ long; clade-angles 104–120°. *Mesoplagioclades*: rhabdome 6–15 μ thick; from one to three clades, 20–42 μ long; clade-angles 102–118°. *Anatriaenes*: rhabdome 10–17 μ thick; clades stout, 22–45 μ long, clade-angles 45–66°. *Anadiaenes* and *anamonaenes*: of similar dimensions; rare.

Large choanosomal oxyasters: six to fourteen rays, 1.7–3 μ thick, covered everywhere, except at the base with spines; total diameter 22–48 μ; size in inverse proportion to ray-number. *Small oxysphaerasters*: 7–9 μ in diameter. *Small strongylosphaerasters*: from six to seventeen spined rays, rounded terminally and 0.8–1.5 μ thick; centrum 2–3.5 μ, whole aster 4.5–9 μ, in diameter. *Sterrasters*: 116–130 by 97–105 by 70–90 μ.

Eastern Pacific. West coast of North America; 22° 52′ N. "Albatross" Station 2829.

Sidonops alba (Kieschnick).

Lendenfeld, Tierreich, 1903, **19**, p. 100.
Synops alba Kieschnick, Zool. anz., 1896, **19**, p. 529.
Sydonops alba (Kieschnick) Thiele, Abhandl. Senckenb. gesellsch., 1900, **25**, p. 46, plate 2, fig. 16a–h.

Irregular, depressed, with attached foreign bodies. Dirty brownish white.

Large choanosomal amphioxes: 2.5 mm. by 30 μ. *Large styles*: rare, of similar dimensions as the large amphioxes. *Minute dermal styles*: 250 by 5 μ. *Plagiotriaenes*: rhabdome 2 mm. long; clades 450 μ long. *Mesoproclade-derivates*: monaene or diaene; clades reduced, short; total length of spicule 3 mm.; its thickness 14 μ; epirhabd 80 μ long. *Large anatriaenes*: rhabdome 2.5 mm. by 14 μ; clades, strongly recurved, about 20 μ long. *Minute dermal anaclades* (Thiele, 1900, exotyles): triaene, or, more rarely, diaene or monaene; rhabdome 170 μ long and about as thick as the minute dermal styles.

Oxyasters: a smaller kind with numerous rays, not quite up to 15 μ long; and a larger kind with few, rough rays, up to 30 μ long. *Small strongylosphaerasters*: rays short and stout; centrum large; total diameter about 8 μ. *Sterrasters*: 110–90 μ.

Western Pacific. Ternate.

Sidonops angulata LENDENFELD.

Ante, p. 24.

Massive, irregularly spherical or lobose. In spirit: yellowish in the interior and white to reddish or purplish brown on the surface.

Stout chaonosomal amphioxes: straight, slightly curved or angularly bent; 1.6–3.7 mm. by 20–72 μ. *Styles and style-derivates*: rare; 2.1–2.5 mm. by 60–110 μ; the derivates with a branch-ray. *Slender dermal amphioxes*: slightly curved or angularly bent; 2.9–9.5 mm. by 5–34 μ. *Orthoplagiotriaenes*: rhabdome 1.5–2.8 by 47–82 μ, rarely shortened and thickened, up to 105 μ thick; clades concave to the rhabdome, curvature increasing distally, 330–700 μ long, clade-angles 89–112°. *Anaclades*: mostly triaene, sometimes diaene; rhabdome up to more than 9 mm. in length and 7–39 μ thick; clades 30–210 μ long; clade-angles 27–66°.

Oxyasters and oxysphaerasters: one to twenty-three perfectly smooth, conic rays 1.6–5 μ thick; centrum, when present, up to 12 μ in diameter; total diameter 11–64 μ; size on the whole in inverse proportion to the ray-number. *Strongylosphaerasters*: from ten to twenty, equal or, more rarely, unequal, truncate, distally spined rays, 2–6 μ thick; centrum 7–14 μ, whole aster 16–28 μ in diameter. *Sterrasters*: 85–122 by 75–113 by 57–86 μ.

Northeastern Pacific. West coast of North America; off southern California. "Albatross" Stations 2945, 2975, 4417.

Sidonops angulata var. **megana** LENDENFELD.

Ante, p. 24.

Stout choanosomal amphioxes up to 72 μ thick. *Slender dermal amphioxes*, not numerous, up to 34 μ thick. *Anaclades*, triaene, rhabdome up to 39 μ thick, clades up to 210 μ long. *Strongylosphaerasters* with nearly cylindrical rays. *Sterrasters* up to 122 μ long, all ellipsoidal.

Northeastern Pacific. West coast of North America; 34° 1′ 30″ N. "Albatross" Station 2975.

Sidonops angulata var. **microana** LENDENFELD.

Ante, p. 24.

Stout choanosomal amphioxes up to 52 μ thick. *Slender dermal amphioxes*, very abundant, up to 22 μ thick. *Anaclades*, triaene and, less frequently, diaene, rhabdome up to 18 μ thick, clades up to 50 μ long. *Strongylosphaerasters* with conical rays. *Sterrasters* up to 97 μ long, all ellipsoidal.

Northeastern Pacific. West coast of North America; near Santa Barbara Islands. "Albatross" Station 4417.

Sidonops angulata var. **orthotriaena** LENDENFELD.

Ante, p. 24.

Stout choanosomal amphioxes up to 70 μ thick. *Slender dermal amphioxes,* not numerous, up to 17 μ thick. *Anaclades,* triaene, rhabdome up to 18 μ thick, clades up to 80 μ long. *Strongylosphaerasters* with nearly cylindrical rays. *Sterrasters* up to 111 μ long; besides the ellipsoidal also rhomboidal ones occur.

Northeastern Pacific. West coast of North America; 34° N. "Albatross" Station 2945.

Sidonops oxyastra LENDENFELD.

Ante, p. 40.

Lobose. In spirit: brownish white to purplish brown.

Large choanosomal amphioxes: 1.1–1.55 by 10–32 μ. *Large amphistrongyles*: 0.8–1 mm. by 18–23 μ. *Large styles*: rare, 850 by 38 μ. *Minute dermal styles*: 130–230 by 3–5.5 μ. *Plagiotriaenes*: rhabdome 1–1.65 by 24–40 μ; clades equal, or some of them reduced, concave to the rhabdome, the distal part of long ones often curved in the opposite direction, when fully developed, 250–285 μ long; clade-angles 100–118°. *Anaclades*: mostly triaene, sometimes diaene or monaene, rhabdome over 1 mm. long, 5–12 μ thick; a protuberance on the apex of the cladome, sometimes elongated to form an epirhabd 56–75 long; clades 15–30 μ long; clade-angles 40–65°.

Large choanosomal oxyasters: from four to ten, usually seven rays, 0.5–2 μ thick and covered everywhere, except quite at the base, with spines; centrum very small; total diameter 18–45 μ. *Large subcortical oxysphaerasters*: from sixteen to twenty-three conical, spined rays 1.1–1.4 μ thick; centrum 4.2–6.5 μ, whole aster 16–22 μ, in diameter. *Small dermal oxyasters and oxysphaerasters*: nine to eighteen spined rays, 0.7–1.5 μ thick, centrum, when present, up to a third or more, of the whole aster in diameter; total diameter 6–13.5 μ. *Sterrasters* 76–85 by 66–73 by 50–64 μ.

Eastern Pacific. Galapagos; Duncan Island.

Sidonops reticulata (Bowerbank).

Lendenfeld, Tierreich, 1903, **19**, p. 102.
Geodia reticulata Bowerbank, Proc. Zool. soc. London, 1874, p. 300, plate 46, figs. 14–20. Sollas, Rept. voy. "Challenger," 1888, **25**, p. 253.

Massive. Dry: white.

Amphioxes: 1.75 mm. by 19 μ. *Orthoplagiotriaenes*: rhabdome 2 mm. by 31.2 μ; clades 237.5 μ long; cladome 450 μ broad. *Protriaenes*: (mesoprotriaenes ?): clades 250 μ long; cladome 120 μ broad and 206 μ high. *Anatriaenes*: clades 144 μ long; cladome 150 μ broad and 125 μ high.

Oxyasters: no centrum; total diameter 25.4 μ. *Small strongylasters*: total diameter 8.5 μ. *Sterrasters*: spherical, small.

? Eastern Pacific. Mexico.

Sidonops bicolor Lendenfeld.

Ante, p. 46.

Irregularly tuberous, elongated or flattened. In spirit: whitish to reddish or purple-brown, some parts of the surface usually much darker than others.

Stout amphioxes: rather blunt; 2.3–5.6 mm. by 36–105 μ. *Stout styles*: rare, not in all specimens; 4 mm. by 100–200 μ. *Slender amphioxes*: 3.5–9 mm. by 15–40 μ. *Plagiotriaenes*: rhabdome usually 2.1–4 mm. by 82–110 μ at the cladome, and 3–10 μ more a little below, at the thickest point; sometimes reduced in length, cylindrical and rounded; clades, concave to the rhabdome, nearly straight, or concave to the rhabdome proximally and convex to it distally, blunt, 280–700 μ long; clade-angles 103–122°.

Large choanosomal oxyasters: from one to twelve, most frequently from seven to nine, distally spined rays, 1–2.8 μ thick; centrum 2.8–6 μ, whole aster 19–34 μ, in diameter. *Oxysphaerasters*: from twelve to twenty-five distally spined rays, 0.7–2.5 μ thick; centrum 4–10 μ, whole aster 10–23 μ, in diameter. *Strongylosphaerasters*: usually from nine to thirty, very rarely only one, distally spined rays, 0.7–3.5 μ thick; centrum 4–12 μ, whole aster 9–21 μ, in diameter. *Sterrasters*: 130–170 by 100–133 by 77–97 μ.

Northeastern Pacific. West coast of North America; from 33° 18′ N. to Monterey Bay. "Albatross" Stations 2958, 2981, 3168, 4420, 4531, 4551.

Sidonops nitida (Sollas).

Proc. Roy. Dublin soc., 1889, **6**, p. 277. Lendenfeld, Tierreich, 1903, **19**, p. 104.
Synops nitidus Sollas, Proc. Roy. Dublin soc., 1886, **5**, p. 198. Rept. voy. "Challenger," 1888, **25**, p. 231, plate 22, figs. 1–18.

Lamellar, attenuated towards the margin. In spirit: faint brownish white.

Amphioxes: 1.25 mm. by 26 μ. *Orthoplagiotriaenes*: rhabdome 1.07 mm. by 28.7 μ; clades 183 μ long; cladome 358 μ broad, 50 μ high.

Choanosomal oxyasters: usually about seven, sometimes as few as two, stout blunt rays with large spines; centrum small; total diameter, 43.4 μ. *Strongylosphaerasters*: rays thick, terminally rounded; total diameter 13.5 μ. *Sterrasters*: spherical, 51.6 μ in diameter.

Southwestern Pacific. East coast of Australia; Port Jackson.

GEODIA Lamarck.

Among the megascleres are regular triaenes. The tetraxon megascleres are confined to the superficial part of the sponge and arranged radially. The dermal microscleres are asters. The afferents are cribriporal, the efferents cribriporal.

Forty-four species are known, twenty-nine of which occur in the Pacific Ocean.

SUMMARY OF THE SPECIES FOUND IN THE PACIFIC OCEAN.

A_1 Fully developed triaene mesoproclades (proclades) present.

A_2 The large choanosomal asters are oxyasters, rarely strongylasters, never acanthtylasters.

A_3 With sphaerasters up to 90 μ in diameter.

G. nux (Selenka).

B_3 The largest sphaerasters under 60 μ in diameter.

A_4 With sphaerasters up to 31 μ in diameter, with very large centrum and numerous very short and thick rays.

A_5 The rays of the sphaerasters with large centrum are conic.

G. eosaster (Sollas). G. globostella Lendenfeld.

B_5 The rays of the sphaerasters with large centrum are cylindrical, truncate, and bear terminal spines.

G. distincta Lindgren.

B_4 Without large sphaerasters with very large centrum and very short rays.

A_5 The dermal asters small, usually 5–6, the largest never over 8.3 μ in diameter. Regular or irregular (ataxastrose).

G. erinaceus (Lendenfeld). G. variospiculosa Thiele. var. typica Lendenfeld var. clavigera Thiele. var. intermedia Lendenfeld. var. micraster Lendenfeld. G. reniformis Thiele. G. japonica (Sollas). G. cooksoni (Sollas). G. hilgendorfi Thiele. var. typica Lendenfeld var. granosa Thiele. G. ataxastra Lendenfeld.

B_5 The dermal asters large, usually 8–12, the largest never under 8 μ in diameter. Usually regular.

A_6 Sterrasters over 300 μ long.

G. hirsuta (Sollas).

B_6 Sterrasters up to 70–125 μ long.

A_7 The large choanosomal rhabds are chiefly amphioxes.

G. mesotriaena Lendenfeld. var. pachana Lendenfeld. var. megana Lendenfeld. var. microana Lendenfeld. G. agassizii Lendenfeld. G. mesotriaenella Lendenfeld. G. breviana Lendenfeld. G. ovis Lendenfeld. G. sphaeroides (Kieschnick). G. micropora Lendenfeld. G. berryi (Sollas). G. kükenthali Thiele.

B_7 The large choanosomal rhabds are chiefly amphistrongyles.

G. amphistrongyla Lendenfeld.

C_6 Sterrasters under 60 μ long.

G. lophotriaena Lendenfeld.

B_2 The large choanosomal asters are acanthtylasters.

G. acanthtylastra Lendenfeld.

B_1 Regularly triaene promesoclades (proclades) absent. Promesoclades (proclades) with more or less reduced cladomes (only two or one clades) sometimes present.

G. nigra Lendenfeld. G. media Bowerbank. G. magellani (Sollas). G. exigua Thiele. G. inconspicua (Bowerbank).

Geodia nux (SELENKA).

Stelletta nux SELENKA, Zeitschr. wiss. zool., 1867, **17**, p. 569, plate 35, figs. 11–13.
Cydonium nux SOLLAS, Rept. voy. "Challenger," 1888, **25**, p. 260.

Spherical with wart-shaped protuberances. In spirit: brown on the surface, yellowish in the interior.

Amphistrongyles: 1.83 mm. by 38.7 μ. *Dichotriaenes*: (Sollas, 1888). *Plagiotriaenes* (Selenka, 1867) clades short.

Large oxysphaerasters: rays numerous, conical smooth; centrum 51.6 μ, whole aster 96 μ in diameter. *Small tylosphaeraster* (Sollas, 1888): total diameter 16 μ. *Sterrasters* (Sollas, 1888): 90 by 77.4 μ.

This is a very doubtful species. Ridley [1] was inclined to consider it as a monaxonid (Tethya, that is, Donatia), while I did not include it in my synopsis of the Tetraxonia (Tierreich, 1903, **19**). Of course, if all the spicules found by Sollas in the spicule-preparation examined by him, really belong to it, it is a geodine tetraxonid, but as one frequently finds foreign spicules in such preparations, and as Selenka himself does not mention sterrasters, the status of this sponge must remain doubtful. I therefore place *Geodia nux* here with all reserve.

Western Pacific. Samoa Islands.

Geodia eosaster (SOLLAS).

LENDENFELD, Tierreich, 1903, **19**, p. 110.
Cydonium eosaster SOLLAS, Rept. voy. "Challenger," 1888, **25**, p. 225, plate 20, fig. 22, plate 21, figs. 15–29.
Non *Geodia eosaster* TOPSENT, 1904.

Spherical. In spirit: yellowish white.

Large choanosomal amphioxes: 2.856 mm. by 32 μ. *Minute dermal amphioxes*: 250–300 by 3.5 μ. *Dichotriaenes*: rhabdome 3.57 mm. by 47 μ; main clades 110 μ, end clades 210 μ long. *Protriaenes* (? mesoprotriaenes): rhabdome 5 mm. by 19 μ at the cladome, and 26 μ at the thickest point near the middle; clades 190 μ long; cladome 190 μ broad. *Anatriaenes*: rhabdome 8.21 mm. by 29 μ; clades 95 μ long; cladome 190 μ broad and 48 μ high.

Large oxyasters: four to numerous rays; total diameter 27.6–39 μ. *Large oxysphaerasters*: rays exceedingly short and broad, appearing as low conical protuberances of the very large centrum; total diameter 19.8–31 μ. *Small strongylosphaerasters*: rays conical or cylindrical, truncate; total diameter 10 μ. *Sterrasters*: spheroidal; 64–70 μ in diameter.

[1] *S. O. Ridley*. Spongiida. Rept. voy. "Alert," 1884, p. 472, foot-note.

Topsent [1] has identified a number of sponges from the Açores as *Geodia eosaster* (Sollas). Since, however, the rays of the large strongylosphaerasters with very large centrum are in these sponges short, thick, cylindrical, and spined on their terminal face, and since they possess, besides the dichotriaenes, also orthotriaenes, I hardly think that Topsent's identification is correct.

Southwestern Pacific. East coast of Australia; Port Jackson.

Geodia globostella, nom. nov.

Geodia globostellifera Ridley, Rept. voy. "Alert," 1884, p. 480, plate 43, fig. b.
Non *Geodia globostellifera* Carter, 1880.

In spirit: gray with a crimson tinge in places.

Large choanosomal amphioxes: 3 mm. by 38 μ. *Minute dermal amphioxes*: 160 by 5 μ. *Orthotriaenes*: rhabdome 70 μ thick; cladome 580 μ broad. *Protriaenes*: rhabdome 16 μ thick; clades 1 mm. long.

Large choanosomal oxyasters: rays few in number, often curved; total diameter 38 μ. *Large oxysphaerasters*: rays conical, very short and stout; centrum very large; total diameter 28 μ. *Small strongylasters*: rays numerous; total diameter 6.3 μ. *Sterrasters*: 90 μ long.

In 1880, H. J. Carter described [2] a sponge as *Geodia globostellifera* (*globostellata* [3]) from the Gulf of Manaar. In 1884, S. O. Ridley [4] had occasion to study a sponge from Port Darwin, which, although distinguished from *G. globostellifera* Carter, 1880, by the presence of minute dermal amphioxes, by the much greater thickness of the orthotriaene-rhabdomes, the much greater length of the protriaene-clades and the larger size of the spicules generally, particularly the small strongylasters, he assigned to this species of Carter. Sollas [5] and myself [6] doubted the correctness of this identification, and in consideration of the differences between the specimens of Carter and of Ridley, I think it advisable to distinguish them specifically.

Southwestern Pacific. North Australia; Port Darwin.

[1] *E. Topsent.* Spongiairs des Açores. Result Monaco, 1904, **25**, p. 67, plate 4, fig. 7; plate 9, fig. 5.
[2] *H. J. Carter.* Report on specimens * * * from the Gulf of Manaar. Ann. mag. nat. hist., 1880, ser. 5, **6**, p. 134 (Sep., p. 488), plate 6, fig. 38a–h (err. f).
[3] *H. J. Carter.* *Loc. cit.*, p. 154 (Sep., p. 508).
[4] *S. O. Ridley.* Spongiida. Rept. voy. "Alert," 1884, p. 480, plate 43, fig. b.
[5] *W. J. Sollas.* Tetractinellida. Rept. voy. "Challenger," 1888, **25**, p. 261.
[6] *R. v. Lendenfeld.* Tetraxonia. Tierreich, 1903, **19**, p. 111.

Geodia distincta Lindgren.

Zool. anz., 1897, **11**, p. 486. Zool. jahrb. Syst., 1898, **11**, p. 343, plate 17, fig. 15, plate 18, fig. 19, plate 20, fig. 3 a–k, a′, d′. Lendenfeld, Tierreich, 1903, **19**, p. 111.

Tuberous.

Large choanosomal amphioxes: 1.5–1.8 mm. by 32 μ. *Minute dermal amphioxes*: 290 by 12 μ. *Orthotriaenes*: rhabdome 1.8–2.5 mm. by 48 μ; clades concave to the rhabdome, 240 μ long, sometimes one or two bifurcate. *Protriaenes* (probably mesoprotriaenes): rhabdome 2.33–3 mm. by 12 μ; clades 135 μ long; cladome 120 μ broad and 130 μ high. *Anatriaenes*: rhabdome 3.4 mm. by 12 μ; clades 72 μ long; cladome 84 μ broad and 60 μ high.

Large choanosomal oxyasters: rays blunt, roughened; centrum small; total diameter 44 μ. *Small subcortical oxyasters*: rays spined; centrum 4 μ, whole aster 16 μ, in diameter. *Large strongylosphaerasters*: rays numerous, short, and thick, with spines on their terminal faces; centrum very large; total diameter 28 μ. *Small strongylosphaerasters*: centrum 2.5 μ, whole aster 8 μ, in diameter. *Sterrasters*: spheroidal, 68 by 56 μ.

Western Pacific. Java Sea; Java.

Geodia erinaceus (Lendenfeld).

Tierreich, 1903, **19**, p. 107.
Cydonium erinaceus Lendenfeld, Descriptive catalogue sponges Australian museum, 1888, p. 36.

The following description is based on an examination of part of the type specimen in the British Museum.

Massive flattened, margin mostly lobose, or digitate; up to 20 cm. long. In spirit: dirty white to brown. Spicule-fur chiefly of large orthotriaenes.

Large choanosomal rhabds: attenuated towards both ends, one or both ends usually rounded; 3.5–4.6 mm. (Ldf., 1888, 2 mm.) by 23–49 μ. *Minute dermal rhabds*: mostly amphiox; 200–300 (Ldf., 1888, 320 μ) by 10–12 μ. *Orthotriaenes*: rhabdome 3.5–4.2 mm. (Ldf., 1888, 1–3 mm.) by 40–50 μ; clades concave to the rhabdome throughout their whole length, 400–550 μ long; clade-angles 90–100°. *Mesoproclades*: rare; rhabdome 4.8–5.2 mm. by 10–20 μ; clades usually irregular and one or two often reduced, fully developed ones 50–60 μ long; clade-angles 49–56°; epirhabd 30–70 μ long (not mentioned by Ldf., 1888). *Large anatriaenes*: rare; rhabdome 13 μ thick; clades 30 μ long; clade-angles 63° (not mentioned by Ldf., 1888). *Minute dermal anatriaenes*: rhabdome terminally rounded, about 280 by 2–3.5 μ at the cladome, and 3–5.5 μ in the middle; clades 6–9 μ long; clade-angles 39–54° (not mentioned by Ldf., 1888).

Large oxyasters: from five to fourteen, conical, in small ones smooth, in large ones spined, rays, 1–1.5 μ thick; total diameter 16–30 μ. *Large oxysphaerasters*: connected with the former by transitions; from fifteen to twenty rays, 1.2–3 μ thick, with sparse, stout spines near their end; centrum 3–8 μ, whole aster 22–28 μ, in diameter. *Small strongylosphaerasters*: from eight to twenty, usually equal, rarely unequal, truncate or rounded, spined rays, 0.8–1.3 μ thick; centrum 1.6–3 μ, whole aster 5.5–7.3 μ (Ldf., 1888, 3–5 μ), in diameter. *Sterrasters*: 140–160 by 127–144 by 100–108 μ.

Southwestern Pacific. East coast of Australia.

Geodia variospiculosa Thiele.

Zoologica, 1898, **24**, p. 10, plate 6a–l, 7a, b. Lendenfeld, Tierreich, 1903, **19**, p. 107. Ante, p. 55.

Massive tuberous. In spirit: dirty white to light brown.

Large choanosomal amphioxes: 1–3.9 mm. by 20–50 μ. *Large choanosomal tylostyles or styles*: 1.35 mm. by 25–50 μ; tyle 30–70 μ (observed by me in vars. *intermedia* and *micraster*, not mentioned by Thiele, 1898, in vars. *typica* and *clavigera*). *Large dermal tylostyles*: 1.6 mm. by 11 μ, tyle 18 μ (present only in var. *clavigera*). *Minute dermal styles*: 200–320 by 3–7 μ. *Orthoplagiotriaenes*: rhabdome 1.25–3 mm. by 30–65 μ at cladome and 43–70 μ at thickest point, a little below; clades 220–760 μ long; clade-angles 99–111°. *Dichotriaenes*: not numerous; rhabdome 1.25–2.6 mm. by 30–75 μ at cladome and 45–90 μ at thickest point, a little below; main clades 150–340, end clades 140–400 μ long; main clade-angles 90° or a little over. *Mesoprotriaenes*: rhabdome 2.5–3.2 mm. by 7–20 μ; clades 60–220 μ long; clade-angles 30–63°; epirhabd 25–95 μ long. *Large anatriaenes*: rhabdome 3.6–5.2 mm. by 12–46 μ; clades 30–180 μ long; clade-angles 22–70°. *Minute dermal anaclades*; rhabdome 205–560 μ by 1–4 μ at cladome, and 2–7.5 μ at thickest point below the middle; clades 3–13 μ long; clade-angles 38–54°.

Large choanosomal oxyasters: from one to eleven conical, distally spined rays, 9–135 μ long, 1–8 μ thick; total diameter in var. *intermedia* and var. *micraster* 17–180 μ. *Oxysphaerasters*: from fourteen to twenty-two rays, 1–2 μ thick; centrum 5–6 μ, whole aster 14–30 μ, in diameter. *Small strongylosphaerasters*: from ten to nineteen equal or unequal rays 0.5–2 μ thick; centrum 2.4 μ, whole aster 5–8 μ, in diameter. *Sterrasters*: 80–133 μ long, 65–116 μ broad, in vars. *intermedia* and *micraster* 70–90 μ thick.

Northwestern Pacific. Japan, off Honshu Island. "Albatross" Stations 3746, 3758; westward of Yogashima.

Geodia variospiculosa var. typica Lendenfeld.

Geodia variospiculosa Thiele, Zoologica, 1898, **24**, p. 10, plate 6, fig. 6.

Without dermal tylostyles. Orthoplagiotriaene-clades 400–460 μ long. Anatriaene-clades up to 180 μ long. Oxyaster-rays up to 135 μ long. Sterrasters up to 115 μ long.

Northwestern Pacific. Japan; westward of Yogashima.

Geodia variospiculosa var. clavigera Thiele.

Zoologica, 1898, **24**, p. 11, plate 6, fig. 7a–b.

With large dermal tylostyles. Orthoplagiotriaene-clades 250–300 μ long. Anatriaene-clades only 30–40 μ long, one or two frequently absent (anadiaenes, anamonaenes). Sterrasters 100 μ long.

Northwestern Pacific. Japan.

Geodia variospiculosa var. intermedia Lendenfeld

Ante, p. 55.

Without large dermal tylostyles. Orthoplagiotriaene-clades 220–550 μ long. Anatriaene-clades up to 135 μ long. Oxyaster-rays up to 90 μ long. Sterrasters up to 125 μ long.

Northwestern Pacific. Japan; off Honshu Island. "Albatross" Station 3746.

Geodia variospiculosa var. micraster Lendenfeld.

Ante, p. 55.

Without large, dermal tylostyles. Orthoplagiotriaene-clades 240–760 μ long. Anatriaene-clades up to 130 μ long. Oxyaster-rays up to 72 μ long. Sterrasters up to 133 μ long.

Northwestern Pacific. Japan; off Honshu Island. "Albatross" Station 3758.

Geodia reniformis Thiele.

Zoologica, 1898, **24**, p. 9, plate 1, fig. 3, plate 6, fig. 5a–h. Lendenfeld, Tierreich, 1903, **19**, p. 108.

Kidney shaped. Dry: light brown.

Large chounosomal amphioxes: 3.3 mm. by 45 μ. *Minute dermal amphioxes*: 170 μ long. *Orthotriaenes*: rhabdome 2.8 mm. by 90 μ; clades 500–600 μ long. *Mesoproclades*: mostly triaene, rarely diaene; rhabdome 1.5 mm. by 25 μ; clades

70 μ, epirhabd 30–40 μ long. *Anaclades*: mostly triaene, rarely diaene or monaene; rhabdome 4–4.5 mm. long, clades 50 μ long.

Large oxyasters: rays few, 40–70 μ long. *Small oxyasters*: rays more numerous, 15–20 μ long. *Oxysphaerasters*: rays stout and short; total diameter 12 μ. *Small strongylosphaerasters*: regular or irregular (ataxastrose); total diameter 5 μ. *Sterrasters*: 130 by 113 μ.

Northwestern Pacific. Japan; Enoshima.

Geodia japonica (Sollas).

Thiele, Zoologica, 1898, **24**, p. 7, plate 2, fig. 1, plate 6, fig. 3. Lendenfeld, Tierreich, 1903, **19**, p. 111; Ante, p. 72.

Cydonium japonicum Sollas, Rept. voy. "Challenger," 1888, **25**, p. 256.

The following description is also based on an examination of part of the type specimen in the British Museum.

Cup shaped, outside lobose, large, up to nearly 50 cm. high. Dry: white.

Stout choanosomal amphioxes: 2–3.3 mm. by 30–51 μ. *Large styles*: 2.1–2.8 mm. by 40–43 μ in the middle and 10–31 μ at the rounded end. *Slender amphioxes*: 1–2.2 mm. by 12–22 μ. *Minute dermal rhabds*: mostly amphiox, rarely style; 195–280 by 3.5–7 μ; often irregularly curved. *Orthoplagiotriaenes*: rhabdome 2.3–3.2 mm. by 50–85 μ; clades 180–380 μ long, distal part straight; clade-angles 90–102°. *Mesoproclades*: rhabdome 2.8–4.3 mm. by 11–21 μ; clades 65–125 μ long; clade-angles 22–48°; epirhabd 40–105 μ long (not mentioned by Sollas, 1888, and Thiele, 1898). *Large anaclades*: mostly triaene, rarely monaene; rhabdome 2.4–5 mm. by 8–23 μ; clades 70–130 μ long; clade-angles 23–45°. *Minute dermal anaclades*: triaene, diaene, or monaene; rhabdome 235–310 by 1–2 μ at the cladome, and 2.8–5 μ in the middle; clades 3–10 μ long; clade-angles 30–54° (not mentioned by Sollas, 1888, and Thiele, 1898).

Large oxyasters: from three to seven straight, conical, blunt, spined rays, 1.2–2.8 μ thick; total diameter 21–46 μ (Thiele, 1898, gives the ray-length as 6–14 μ). *Oxysphaerasters*: from fifteen to twenty-one straight, conical, pointed, spined rays 1.4–2 μ thick; centrum 5–7.5 μ, whole aster 15–22 μ in diameter. *Small strongylosphaerasters*: mostly regular, rarely irregular (ataxastrose); from six to twenty-two truncate or terminally rounded, spined rays, 0.5–1.3 μ thick; centrum 1.2–5 μ in diameter; the regular forms 4–6 μ, the ataxastrose ones 5.8–7.3 μ in total diameter. *Sterrasters*: 80–92 by 65–80 by 55–61 μ (Thiele, 1898, 75 by 65 μ).

Northwestern Pacific. Japan; (Thiele's specimen, near Enoshima).

Geodia cooksoni (Sollas).

Lendenfeld, Tierreich, 1903, **19**, p. 115.
Cydonium cooksoni Sollas, Rept. voy. "Challenger," 1888, **25**, p. 255.

The following description is based on an examination of part of the type specimen in the British Museum.

Probably lobose. In spirit: light brown.

Choanosomal amphioxes: 1.2–2 mm., mostly 1.7–1.9 mm. by 18–36, mostly 25–32 μ (Sollas, 1888, 41 μ). *Minute dermal rhabds*: mostly amphiox, rarely with one or both ends blunt; 150–190 μ (Sollas, 1888, 129 μ) by 2–5 μ. *Orthoplagiotriaenes*: rhabdome 1.2–1.9 mm. by 40–60 μ (Sollas, 1888, 64.5 μ); clades concave to the rhabdome throughout their length, 200–340 μ long; clade-angles 88–104°, on an average 97°. *Mesoproclades* (Sollas, 1888, *protriaenes*): rhabdome 1.6–2 mm. (Sollas, 1888, 2.38 mm.) by 7–13 μ (Sollas, 1888, error, 75 μ) at cladome and 10–18 μ in the middle; rarely three fully developed clades, usually one, two, or all three reduced or absent altogether, fully developed clades 27–45 μ long; clade-angles 34–64°, on an average 44°; epirhabd 30–70 μ long.

Large choanosomal oxyasters, with from two to thirteen usually strongly spined, straight, conical rays, 1.6–2.3 μ thick at the base; centrum small or absent; total diameter 22–42 μ (not mentioned by Sollas, 1888). Sollas, 1888, describes chiasters 19.7 μ in diameter with slender, cylindrical, truncate rays, which were not observed by me. *Oxysphaerasters*: with from eleven to thirty conical, distally sparsely spined rays, 0.5–1.6 μ thick at the base; centrum 1.3–3 μ, whole aster 12–18 μ (Sollas, 1888, up to 19 μ) in diameter. *Strongylosphaerasters*: with from ten to thirty cylindrical or cylindroconical, truncate rays, 0.5–1.1 μ thick; centrum 1.5–2.5 μ, whole aster 4–6.5 μ (Sollas, 1888, 1–6 μ), in diameter. *Sterrasters*: flattened ellipsoids, 75–80 μ by 70–75 μ by 57–60 μ (Sollas, 1888, 77.4 by 66 μ).

Eastern Pacific. Galapagos; Charles Island.

Geodia hilgendorfi Thiele.

Zoologica, 1898, **24**, p. 8, plate 1, fig. 4, plate 6, fig. 4a–k. Lendenfeld, Tierreich, 1903, **19**, p. 112.

Massive elongate, with broad and low lobose protuberances. Dry; whitish.

Large amphioxes: 1.2–1.6 mm. long. *Minute dermal amphioxes*: blunt, 140–180 μ long. *Orthoplagiotriaenes*: rhabdome 1.6–1.7 mm. long sometimes reduced and rounded; clades 250–300 μ long; cladome sometimes very irregular. *Mesoprotriaenes*: rhabdome 1.2–1.6 mm. long; clades as long as or longer than the epirhabd. *Anatriaenes*.

Large choanosomal oxyasters: with or without centrum; total diameter 15–40 μ. *Subcortical oxysphaerasters*: rays short and stout, centrum very large; total diameter 12 μ. *Irregular sphaerasters* (ataxasters): rays very short; total diameter 3–5 μ. *Sterrasters*: 53–80 by 45–60 μ.

Northwestern Pacific. Japan.

Geodia hilgendorfi var. **typica**, var. nov.

Geodia hilgendorfi THIELE, Zoologica, 1898, **24**, p. 8, plate 1, fig. 4, plate 6, fig. 4 a–h.

Oxyasters: with centrum, 15–20 μ in diameter. Without particularly small, irregular sphaerasters in the interior. *Sterrasters*: 80 by 60 μ.

Northwestern Pacific. Japan; probably from the vicinity of Enoshima.

Geodia hilgendorfi var. **granosa** THIELE.

Zoologica, 1898, **24**, p. 9, plate 6, fig. 4 i, k.

Oxyasters: without centrum, 40 μ in diameter. Small irregular *sphaerasters* only 3 μ in diameter in the interior. *Sterrasters*: 53 by 45 μ.

Northwestern Pacific. Japan; probably from the vicinity of Enoshima.

Geodia ataxastra LENDENFELD.

Ante, p. 79.

Spherical or irregularly massive, tuberous or lobose. In spirit: white to lilac-gray.

Large choanosomal rhabds: mostly amphioxes, but also some amphistrongyles and styles; 0.6–2.8 mm. by 12–43 μ. *Minute dermal rhabds*: mostly amphioxes, but also some styles, 120–215 by 3–7 μ. *Orthoplagiotriaenes*: rhabdome 1.3–2.3 mm. by 29–70 μ; clades 130–290 μ long; clade-angles 85–116°. *Mesoproclades*: mostly triaene; rhabdome 1.6–3.4 mm. by 7–10 μ; clades 25–80 μ long; clade-angles 25–58°; epirhabd 28–73 μ long. *Large anatriaenes*: rhabdome: 2–3.1 mm. by 3–12 μ; clades 17–68 μ long; clade-angles 20–55°. *Minute dermal anaclades*: observed only in var. *angustana*; rhabdome 190–340 by 0.5–2 μ; clades 2–6 μ long; clade-angles 33–57°.

Large oxyasters: from two to eleven rays, 0.6–2.6 μ thick; total diameter 15–50 μ, in inverse proportion to the ray-number. *Oxysphaerasters with slender rays*: from eighteen to twenty-eight conical, pointed, distally spined rays 0.7–1.3 μ thick; centrum 2.4–5.5 μ, whole aster 8–14.4 μ, in diameter. *Oxysphaerasters with smooth, thick rays*: observed only in var. *latana*; about eighteen conical, blunt, smooth rays, 2 μ thick; centrum about 4.5 μ, whole aster about 13 μ, in diameter. *Small strongylosphaerasters*: from seven to twenty straight or conical, distally often thickened rays, 0.2–0.8 μ thick; centrum 0.6–3 μ, whole aster 2.6–6.4 μ, in diameter. *Ataxasters*: from one to eight cylindrical, or cylindroconical, truncate, simple or rarely bifurcate, rough or spined rays, 0.3–2.8 μ long and 0.4–1.5 μ thick; the rays are very irregularly distributed and often very unequal in size; they arise from a spherical or irregularly tuberous centrum 1.4–4.5 μ in diameter; total diameter 4–8.3 μ; connected by *transitions* with the small strongylosphaerasters. *Acanthtylasters*: rare, from ten to fifteen cylindrical, simple or rarely branched rays, 1–2 μ thick; their distal ends bear dense clusters of large divergent spines and appear thickened; no centrum; total diameter 8–16 μ. *Irregular sterraster-derivates* (sterroids): observed only in var. *latana*; a simple or lobose central mass with extensive tufts of ray-like spines 4–8 μ long; total diameter 21–50 μ. *Sterrasters*: 55–78 by 50–67 by 47–57 μ.

Eastern Pacific. Gulf of Panama; Perico Island.

Geodia ataxastra var. **angustana** Lendenfeld.

Ante, p. 79.

Generally whitish. Large amphioxes up to 2.8 mm. long; orthoplagiotriaene-rhabdomes up to 2.3 mm. by 70 μ. Average anatriaene-clade angle 34°. Minute dermal anaclades present, their rhabdomes 190–340 μ long. Two-rayed oxyasters present, 40–50 μ long, the three- to seven-rayed 21–40 μ in diameter. Oxysphaerasters with stout smooth rays and sterroids not observed. Sterrasters up to 78 μ long.

Eastern Pacific. Gulf of Panama; Perico Island.

Geodia ataxastra var. **latana** Lendenfeld.

Ante, p. 79.

Lilac-gray. Large amphioxes up to 1.9 mm. long; orthoplagiotriaene rhabdomes up to 1.7 mm. by 45 μ. Average anatriaene-clade angle 47°. Minute dermal anaclades not observed. Two-rayed oxyasters not observed, the three- to seven-rayed 17–28 μ in diameter. Oxysphaerasters with stout, smooth rays present, 13 μ in diameter. Sterroids present, 21–50 μ in diameter. Sterrasters up to 65 μ long.

Eastern Pacific. Gulf of Panama; Perico Island.

Geodia hirsuta (Sollas).

Lendenfeld, Tierreich, 1903, **19**, p. 106.
Cydonium hirsutus Sollas, Proc. Roy. Dublin soc., 1886, **5**, p. 197. Rept. voy. "Challenger," 1888, **25**, p. 218, plate 21, figs. 30–42.

Irregular, lobose with digitate processes. In spirit: grayish white.

Amphioxes: shorter and stouter, 4.462 mm. by 60 μ, and longer and more slender, 9 mm. by 31.6 μ. *Tylostyles*: with large spherical tyle. *Dichotriaenes*: rhabdome over 4.46 mm. long, 84 μ thick, attenuated at first very rapidly; main clades 127 μ, end clades 350 μ long. *Protriaenes* (? mesoprotriaenes) rhabdome at cladome 20 μ, at thickest point 29 μ thick; clades 127 μ long; cladome 143 μ broad and 99 μ high. *Anatriaenes*: rhabdome long, 18 μ thick; clades 36 μ long.

Choanosomal oxyasters: rays pointed or truncate; total diameter 19.7 μ. *Cortical oxysphaerasters*: rays spined; centrum 12 μ, whole aster 32 μ, in diameter. *Strongylosphaerasters*: total diameter 11.8 μ. *Sterrasters*: 306 by 245 by 161 μ, outline oval or somewhat hexagonal.

Central Pacific. Ki Islands; 5° 49′ 15″ S., 132° 14′ 15″ W.

Geodia mesotriaena Lendenfeld.

Ante, p. 96.

Massive, cake shaped, horizontally expanded, large, up to 23 cm. in maximum diameter, with praeoscular cavities, scarce in the smaller, numerous in the larger specimens. Dry and in spirit: yellow to brown.

Large choanosomal amphioxes: 4.3–8.2 mm. by 50–105 μ. *Large styles*: rare; 3–4 mm. by 70–110 μ. *Minute dermal amphioxes and styles*: 380–680 by 9–19 μ. *Orthoplagiotriaenes*: rhabdome 4.6–7.2 mm. by 85–120 μ; clades 200–670 μ long, concave to the rhabdome proximally, straight or slightly curved in the opposite direction distally; clade-angles 85–117°. *Mesoprotriaenes*: rhabdome 6–14 mm. by 15–40 μ at the cladome, and 38–70 μ at the thickest point near the middle; clades 90–310 μ long; clade-angles 29–56°; epirhabd 95–330 μ long. *Anatriaenes*: rhabdome 11–16 mm. by 8–40 μ; clades 70–270 μ long, clade-angles 34–58°. *Mesanaclade anatriaene-derivates*: rare; dimensions as in the regular anatriaenes.

Large oxyasters: from five to fifteen rays, conical throughout or nearly cylindrical at the base, distally spined, 1–4 μ thick; total diameter 19–54 μ. *Small oxyasters*: from eight to twenty rays 0.9–3 μ thick; total diameter 11–20 μ. *Large oxysphaerasters*: from fifteen to twenty-five very spiny rays, 1–3 μ thick;

centrum 3–10 μ, whole aster 19–32 μ, in diameter. *Small strongylosphaerasters*: from six to twenty distally spined rays, 0.5–2.5 μ thick; centrum 2–6, whole asters 6–14.5 μ, in diameter. *Large strongylosphaerasters*: transitional to sterroids; rare; 16–33 μ in diameter. *Sterroids*: rare; observed only in var. *megana*, numerous rays 4–6 μ thick, with spined terminal face; 39–58 μ in total diameter. *Sterrasters*: 92–125 by 78–107 by 67–82 μ.

Northeastern Pacific. West coast of North America; from 33° 38′ 45″ to 34° 22′ N. "Albatross" Stations 2909, 2942, 2958.

Geodia mesotriaena var. pachana Lendenfeld.

Ante, p. 96.

Large amphioxes up to 105 μ thick. Among the minute dermal rhabds styles are numerous. Average angle of orthoplagiotriaene-clades 99.4°. Rhabdome of mesoprotriaenes and anatriaenes up to 40 μ thick. Anatriaene-clades thick and short, up to 170 μ long. Oxyasters up to 37 μ in diameter. True sterroids absent. Average proportion of length to breadth of sterrasters 100:91.

Northeastern Pacific. West coast of North America; 34° 22′ N. "Albatross" Station 2909.

Geodia mesotriaena var. megana Lendenfeld.

Ante, p. 96.

Large amphioxes up to 105 μ thick. Styles among the minute dermal rhabds rare. Average angles of orthoplagiotriaene-clades 91.9°. Mesoprotriaene-rhabdomes up to 40 μ, anatriaene-rhabdomes up to 38 μ thick. Anatriaene-clades thick and up to 270 μ long. Oxyasters up to 54 μ in diameter. Sterroids in small numbers present, 39–58 μ in diameter. Average proportion of length to breadth of sterrasters 100 : 90.

Northeastern Pacific. West coast of North America; 34° 4′ N. "Albatross" Station 2958.

Geodia mesotriaena var. microana Lendenfeld.

Ante, p. 96.

Large amphioxes up to 77 μ thick. Styles among the minute dermal rhabds rare. Average orthoplagiotriaene clade-angle 104.2°. Mesoprotriaene-rhabdomes up to 25 μ thick. Anatriaene-clades thin and short, up to 175 μ long. Large oxyasters up to 42 μ in diameter. True sterroids absent. Average proportion of length to breadth of sterrasters 100 : 79.

Northeastern Pacific. West coast of North America; 33° 38′ 45″ N. "Albatross" Station 2942.

Geodia agassizii Lendenfeld.

Ante, p. 113.

Cydonium mülleri Lambe (non Fleming), Trans. Roy. soc. Canada, 1893, **11**, p. 36, plate 4, fig. 2.

The following description is also based on an examination of the type specimen of *Cydonium mülleri* Lambe 1893, in the collection of the Geological Survey of Canada.

Massive, spherical, oval, elongate or somewhat irregular; without praeoscular cavities. In spirit: uniformly white to light brown, some with dark brown patches, some dark blue.

Large amphioxes: of adult 2.3–4.8 mm. by 60–112 μ; of immature 1.8–3.4 by 20–66 μ. *Large amphistrongyles*: only in the immature, a little shorter than the amphioxes, 55 μ thick. *Large, slender styles*: rather rare, not in all specimens; of adult 1.5–3.4 mm. by 60–110 μ. *Large, stout styles*: rare, only in some specimens; of adult at thickened rounded end 115–145 μ thick. *Minute dermal amphioxes*: of adult 160–480 by 5–12 μ; of immature 180–480 by 3–8 μ. *Orthoplagiotriaenes* of adult: rhabdome 1.5–4.3 mm. by 65–150 μ; clades 240–560 μ long, simple, more rarely with irregular branchlets; clade-angles 73–117°; of immature: rhabdome 2–3.5 mm. by 50–100 μ; clades 300–500 μ long; clade-angles 88–108°. *Regular dichotriaenes*: only in the smallest immature specimen; rhabdome 1–2.2 mm. by 50–75 μ; main clades 150–300, end clades 30–130 μ long; angles of main clades 109–112°; cladome 350–700 μ broad. *Mesorthotriaenes*: rare, not in all specimens; in the adult, a style-like shaft 1.8–3 mm. by 78–164 μ at the rounded end, with clades 78–300 μ long, inserted near the rounded end and concave towards it. *Irregular amphiclade orthoplagiotriaene, derivates*: rare, not in all specimens, dimensions as in the orthoplagiotriaenes, but with a branch-ray on the rhabdome, besides the ordinary clades. *Mesoprotriaenes* of adult: rhabdome 2–6 mm. by 7–40 μ; clades 60–250 μ, epirhabd 25–320 μ long; clade-epirhabd angles 22–55°; of immature: rhabdome 9–20 μ. thick; clades 60–125 μ, epirhabd 70–100 μ long; clade-epirhabd angles 36–47° *Large anatriaenes* of adult: rhabdome 4–9 mm. by 10–50 μ; clades 40–155 μ long, clade-angles 32–65°; of immature: rhabdome 3.3–4.7 mm. by 18–28 μ; clades 45–110 μ long, clade-angles 31–52°. *Irregular anatriaene-derivates*: rare, not in all specimens; dimensions as in the regular anatriaenes. *Minute dermal anaclades*: rare, observed only in the smallest immature specimen;

rhabdome 290 μ by 1–1.5 μ at the cladome and 3–5 μ at its thickest point below the middle; clades 4–6 μ long; clade-angles 38–62°; possibly foreign.

Large oxyasters of adult: from four to sixteen rays, 0.8–3.2 μ thick, distally spined, pointed to truncate; centrum small; total diameter 9–31 μ; of immature: from seven to fourteen rays 0.8–2.3 μ thick; centrum small; total diameter 13–25 μ. *Large oxysphaerasters* of adult: in some specimens rare; from fourteen to twenty-eight or more conical, pointed or blunt, distally spined rays, 1–2 μ thick; centrum 3.5–11 μ, whole aster 10–21 μ, in diameter; of immature: from ten to thirty rays, 0.9–2 μ thick; centrum 2.7–7 μ, whole aster 8–21 μ, in diameter. *Small strongylosphaerasters* of adult: six to twenty rays, 0.6–1.6 μ thick; centrum 1.5–6 μ, whole aster 3.5–11 μ in diameter; of immature: from ten to twenty-eight rays, 0.5–1 μ thick; centrum 2–3.5 μ, whole aster 5–9 μ, in diameter. *Sterrasters* of adult: 82–118 by 75–100 by 58–83 μ; of immature: 76–110 by 70–92 by 60–75 μ. *Sterroids*: rare; similar to, but mostly somewhat smaller than, the sterrasters, and with thicker rays; their strongylaster-like young stages only in the immature specimens.

Northeastern Pacific. West coast of North America; from 33° 59′ 45″ N. to the vicinity of Naha Bay, Behm Canal, S. E. Alaska. "Albatross" Stations 2886, 2887, 2978, 3088, 3168, 4193, 4199, 4228, 4551: Queen Charlotte Island, Houston Stewart Channel.

Geodia mesotriaenella Lendenfeld.

Ante, p. 151.

Nearly spherical. In spirit: dirty white.

Large amphioxes: 2–2.6 mm. by 20–50 μ. *Minute dermal rhabds*: mostly styles; 196–260 by 4–5 μ. *Orthotriaenes*: rhabdome 2.1–2.4 mm. by 75–120 μ; clades concave to the rhabdome, 350–600 μ long; mostly simple, rarely bifurcate; clade-angles 90–96°. *Mesoprotriaenes*: rhabdome 2.8–3.4 mm. by 9–19 μ at the cladome, thicker in the middle; clades 100–220 μ long; clade-angles 30–47°; epirhabd 70–165 μ long. *Anatriaenes*: rhabdome 3.7 mm. by 18–30 μ; clades usually simple, rarely bifurcate, 87–140 μ long; clade-angles 41–47°.

Large oxyasters: from five to eleven conical, blunt, distally spined rays, 1.5–2.8 μ thick; centrum small; total diameter usually 17–26 μ, rarely up to 40 μ, these large asters perhaps foreign. *Large oxysphaerasters*: from fifteen to twenty-three conical, pointed rays with a few spines, 2–2.5 μ thick; centrum 6–9 μ, whole aster 20–21 μ, in diameter. *Small strongylosphaerasters*: from three to twenty-five, usually from ten to seventeen rays, 0.5–1 μ thick; centrum 1.6–4.5 μ, whole aster 6–11 μ, in diameter. *Sterrasters*: 87–107, usually not over 97, by 77–92, usually not more than 86, by 58–69 μ.

Northeastern Pacific. West coast of North America; near Santa Barbara Islands. "Albatross" Station 4417.

Geodia breviana Lendenfeld.

Ante, p. 155.

Cydonium mülleri Lambe (non Fleming), Trans. Roy. soc. Canada, 1893, **10**, p. 72, plate 4, fig. 1, plate 6, fig. 1–1a–i.

The following description is also based on an examination of the type specimen of *Cydonium mülleri* Lambe, 1893, in the collection of the Geological Survey of Canada.

Cup shaped with small cavity. In spirit: dirty white; dry: brown.

Large choanosomal amphioxes: 1.8–5 mm. by 30–88 μ (Lambe, 1893, 2.77–3.81 mm. by 80 μ). *Minute dermal amphioxes*: 280–450 by 2–8.5 μ (Lambe, 1893, 288 by 13 μ). *Plagioorthotriaenes*: rhabdome 1.8–4.1 mm. (Lambe, 1893, 2.4 mm.) by 60–130 μ; clades 280–680 μ (Lambe 1893, 700 μ) long; clade-angles 94–113°. *Mesoprotriaenes*: rhabdome 7–11 mm. (Lambe, 1893, 7.84 mm.) by 15–32 μ; clades 65–250 μ (Lambe, 1893, 95 μ) long; clade-angles 20–44°. *Large anaclades*: mostly triaene, rarely diaene; rhabdome 9–11 mm. (Lambe, 1893, 7.5 mm.) by 25–40 μ; clades 47–115 μ (Lambe, 1893, 60 μ) long; clade-angles 45–65°. *Minute dermal anaclades*: generally without, sometimes with epirhabd (*mesanaclades*) rhabdome 350–610 μ by 1–4.5 μ at the cladome, and 5–8.6 μ at the thickest point below the middle; clades 2–12 μ long; clade-angles 42–60°; epirhabd of the mesanaclades 5–8 μ long (not mentioned by Lambe, 1893).

Large thick-rayed oxyasters: from five to twelve usually simple, rarely bifurcate, conical, pointed or blunt, distally spined rays, 1–2.3 μ thick; centrum small; total diameter 16–26.5 μ (Lambe, 1893, apparently considers all the euasterforms as oxyasters and gives 3–13 μ as their total diameter). *Large thin-rayed oxyasters*: rare, not always present, perhaps foreign; nine to fourteen distally spined rays, 0.25–0.7 μ thick; no centrum; total diameter 7–23 μ. *Large oxysphaerasters*: up to thirty rays with large spines, 1–2.7 μ thick; centrum 3–9 μ, whole aster 12–21.5 μ, in diameter. *Small strongylosphaerasters*: from thirteen to twenty-five distally spined rays, centrum 2–5.5 μ, whole aster 6–12 μ, in diameter. *Sterrasters*: 84–105 by 75–98 by 55–77 μ (Lambe, 1893, 91 μ).

Northeastern Pacific. West coast of North America; off southern California. "Albatross" Station 2894: Vancouver Island, Strait of Georgia, near Comox.

Geodia ovis LENDENFELD.

Ante, p. 161.

Cake shaped, horizontally extended. With exceedingly high spicule-fur. In spirit: light brown.

Large choanosomal amphioxes: 4–9 mm. by 30–40 μ. *Large styles and tylostyles*: of two kinds, stout and slender; the *stout*; mostly style; 2.6–4 mm. by 85–116 μ; the *slender*: always tylostyle; long; about 40 μ thick; tyle 60–65 μ in diameter. *Minute dermal rhabds*: mostly amphiox, rarely style; 270–550 by 8–13 μ. *Orthotriaenes* (and *plagiotriaenes*): rhabdome 5–8 mm. by 74–100 μ at the cladome, 77–110 μ a little farther down; clades concave to rhabdome throughout or only basally, and straight distally, 310–640 μ long; clade-angles 86–101°. *Irregular megascleres*: rare. *Mesoproclades* and *proclades*: rhabdome 6–17 mm. by 20–41 μ at the cladome, near the middle from two to three times as thick; in the normally developed mesoprotriaenes the clades 140–170 μ long, the clade-angles about 45°, the epirhabd 110 μ long; in the irregular mesoproclades (proclades) clades very unequal, the longest up to 260 μ long, sometimes one or two clades or the epirhabd suppressed. *Anaclades*: nearly all triaene; very unequal in size; small and large ones distinguishable; the *small*: rhabdome 670 μ–2.5 mm. by 2–7 μ; clades 6–43 μ long; clade-angles 41–65°; the *large*: rhabdome up to 23 mm. long by 17–45 μ; clades 70–205 μ long; clade-angles 36–55°.

Large thin-rayed oxyasters: from three to ten conical, distally spined rays, 1–3.2 μ thick; no centrum; total diameter 20–34.5 μ. *Large thick-rayed oxyasters*: from four to nineteen conical, simple or partly bifurcate rays with large spines in their middle parts, 3–6.3 μ thick; total diameter 28–45 μ; the many-rayed appear sphaerastrose. *Small thick-rayed asters*: from six to fifteen truncate or blunt-pointed, distally spined rays, 1–3.2 μ thick; centrum absent or present and then up to 6 μ in diameter; whole aster 11–24 μ in diameter. *Sterrasters*: 82–92 by 70–83 by 54–61 μ. *Sterroids*: rare; of similar dimensions, but with much thicker rays.

Northeastern Pacific. West coast of North America; 34° 1′ 30″ N. "Albatross" Station 2975.

Geodia sphaeroides (Kieschnick).

Thiele, Abhandl. Senckenb. gesellsch., 1900, **25**, p. 41, plate 2, fig. 14a–k. Lendenfeld, Tierreich, 1903, **19**, p. 110.
Cydonium sphaeroides Kieschnick, Zool. anz., 1896, **19**, p. 529.
Geodia arripiens Lindgren, Zool. anz., 1897, **20**, p. 486. Zool. jahrb. Syst., 1898, **11**, p. 346, plate 18, figs. 10, 18, plate 20, fig. 5a–i, a′, b′, c′, i′.

Spherical or ellipsoidal. Surface brown, interior yellowish or grayish.

Large amphioxes: 1.5–2.4 mm. by 30–40 μ. *Small dermal amphioxes*: 230 by 5 μ. *Dichotriaenes*: rhabdome 2.35–3 mm. by 60–70 μ, sometimes reduced in length and rounded; main clades 120–220, end clades 150–180 μ long; main clade-angles 120°. *Large anatriaenes*: rhabdome 3.3–3.5 mm. by 18–20 μ; clades 50–60 μ long; divergent; cladome 80 μ broad and 48 μ high. *Minute anatriaenes*: dermal or subcortical; rhabdome 340–360 by 2–3 μ; clades 8 μ long; cladome 10 μ broad and 6 μ high. *Protriaenes* (? mesoprotriaenes): rhabdome 2.5–3 mm. by 16–20 μ; clades 60–80 μ long, sometimes one or two reduced; cladome 80 μ broad and 68 μ high.

Oxysphaerasters: rays numerous, spined; centrum 6–15 μ, whole aster 36–50 μ, in diameter. *Small strongylosters* (strongylosphaerasters): total diameter 8–15 μ; the dermal smaller than the choanosomal. *Sterrasters*: sphaeroidal; 35–88 by 72–80 μ.

Western Pacific. Ternate: Coast of Cochin China; 11° 5′ N., 108° 50′ E.

Geodia micropora Lendenfeld.

Ante, p. 170.

Lobose. In spirit: brownish white.

Large choanosomal amphioxes: mostly simple, occasionally centrotyle; 1.2–1.6 mm. by 20–28 μ; tyle of centrotyles 12–30 % more than adjacent parts of the spicule in diameter. *Minute dermal amphiostrongyles*: attenuated towards both ends; 125–165 by 2–3.6 μ. *Orthoplagiotriaenes*: rhabdome 1.1–1.45 mm. by 28–47 μ; clades blunt, concave to the rhabdome throughout or only basally and straight distally; 175–230 μ long; clade-angles 97–112°. *Mesoproclades*: rhabdome about 1.7 mm. by 4–9 μ at the cladome, and about 20 % more at the thickest point near the middle; clades very variable, often one or two suppressed, 10–30 μ long; clade-angles 32–64°; epirhabd conical, 25–43 μ long or reduced to a knob.

Large oxyasters: from six to nine conical rays, 0.6–0.7 μ thick, and spined everywhere, except quite at the base; no centrum; total diameter 14–20 μ.

Large oxysphaerasters: from sixteen to twenty-two conical, spined rays, 1–1.6 μ thick; centrum 4–6 μ, whole aster 14–20 μ, in diameter. *Small strongylosphaerasters*: from eight to fifteen truncate, spined rays, 0.6–1.3 μ thick; centrum 2–3 μ, whole aster 6–9.2 μ, in diameter. *Sterrasters*: 72–82 by 65–74 by 55–62 μ.

Eastern Pacific. Galapagos; Duncan Island.

Geodia berryi (Sollas).

Thiele, Abhandl. Senckenb. gesellsch., 1900, **25**, p. 43.
Cydonium berryi Sollas, Rept. voy. "Challenger," 1888, **25**, p. 256.
Geodia cydonium var. *cerryi* ! Lindgren, Zool. anz., 1897, **20**, p. 486. Zool. jahrb. Syst., 1898, **11**, p. 311, plate 18, figs. 9, 20, plate 20, fig. 4a–k, b′, c′, f′.

Small spherical, gray or brown.

Large choanosomal amphioxes: 2.16–2.54 mm. by 24–26 μ. *Minute dermal amphioxes*: 240–310 by 8–10 μ. *Orthoplagiotriaenes*: rhabdome 2.15–3.15 mm. by 51.6–72 μ; clades 175–240 μ long. *Protriaenes* (probably *mesoprotriaenes*): rhabdome 2.54–4.5 mm. by 12.9 μ at cladome, and 23–28 μ at thickest point near the middle. *Large anatriaenes*: rhabdome 4 mm. by 25.8 μ (Sollas, 1888, error 258 μ)–32 μ; clades 84 μ long; cladome 100–112 μ broad, 65–72 μ high. *Minute dermal anatriaenes*: rhabdome 480 by 2–4 μ; clades 6–8 μ long; cladome 9.5–12 μ broad, 6–8 μ high.

Large choanosomal asters: according to Sollas, 1888, *chiasters* 12–15 μ in diameter; according to Lindgren, 1898, *oxyasters* with from eight to fifteen rays, 16–20 μ in total diameter. *Oxysphaerasters*: rays numerous; total diameter 12–15 μ. *Small strongylasters* (*chiasters*): from six to twenty rays; total diameter 8 μ. *Sterrasters*: 71–80 by 65–68 μ.

Formerly I was inclined [1] to consider *G. berryi* as a synonym of *G. mülleri* (*cydonium*), and, although there can be no doubt that these forms are very similar, the experience I have recently gained with specimens from the Pacific has made me doubtful as to their identity, so that now, like Thiele, I think it better to retain *G. berryi* as a distinct species.

The species *G. mülleri* (*cydonium*) in the wider sense given to it by me in 1894 and 1903 being thus split up, I am unable to say to what part of it the East Australian sponge mentioned by me under this name,[2] and of which no material for examination is at my disposal, should be assigned. Therefore I cannot take this sponge into consideration.

[1] *R. v. Lendenfeld.* Die tetractinelliden der Adria. Denk. Akad. wissensch. Wien, 1894, **61**, p. 138. Tetraxonia. Tierreich, 1903, **19**, p. 113.

[2] *R. v. Lendenfeld.* Die tetractinelliden der Adria. Denk. Akad. wissensch. Wien. 1894, **61**, p. 146.

Northwestern and western Pacific. Coast of China; Lingin: Coast of Cochin China, 11° 5′ N., 108° 50′ E. Ternate.

Geodia kükenthali THIELE.

Abhandl. Senckenb. gesellsch., 1900, **25**, p. 43, plate 2, fig. 15. LENDENFELD, Tierreich, 1903, **19**, p. 112.

Irregularly ellipsoidal. Whitish, in the interior yellowish.

Large amphioxes: 2.8 mm. by 50 μ. *Small amphioxes*: in the choanosome among the large ones; 300 by 9 μ. *Orthoplagiotriaenes*: rhabdome over 3 mm. long, about 50 μ thick; clades either concave to the rhabdome throughout or curved in the opposite direction distally, 300 μ long. *Mesoprotriaenes*: rhabdome 3.7 mm. by 10 μ; clades over 150 μ long. *Anatriaenes*: rhabdome 20 μ thick and about as long as the mesoprotriaene-rhabdome; clades strongly recurved, 80 μ long.

Large subcortical asters: rare; rays numerous, rather stout, rough, cylindroconical and blunt; total diameter 30 μ. *Small choanosomal asters*: rays pointed or blunt; total diameter 17 μ. *Small dermal sphaerasters*: total diameter 12 μ. *Sterrasters*: 70 by 55 μ. *Sterroids*; with distant rays.

Western Pacific. Ternate.

Geodia amphistrongyla LENDENFELD.

Ante, p. 175.

Irregular, flattened. In spirit: brown.

Large amphistrongyles: 0.5–2.3 mm. by 18–32 μ. *Large styles*: rare; dimensions as in the amphistrongyles. *Plagioclades*: mostly triaene; rhabdome 1.8–2.2 mm. by 22–32 μ, sometimes much reduced in length, usually rounded at the acladomal end; clades concave to the rhabdome, 155–190 μ long; clade-angles usually 103–120°. *Mesoproclades*: mostly triaene, occasionally monaene; rhabdome 3–5 μ thick, clades 40–60 μ long; clade-angles 36–41°; epirhabd 16–23 μ long. *Anatriaenes*: rhabdome 1.5–4 μ thick; clades 26–50 μ long; clade-angles 25–41°.

Oxyasters: from five to nine usually simple, rarely bifurcate, distally spined rays, 0.8–2.1 μ thick; total diameter 20–30 μ. *Oxysphaerasters*: from fourteen to eighteen conical, distally spined rays, 2–2.8 μ thick; centrum 6–7 μ, whole aster 19–28 μ, in diameter. *Small strongylosphaerasters*: from seven to twelve cylindrical or distally slightly thickened rays, 0.8–1.8 μ thick; centrum spherical or irregular, 2.2–4 μ in diameter; total diameter 4.8–8 μ; a few have more rays, these perhaps foreign. *Sterrasters*: 100–110 by 87–94 by 72–78 μ.

Southeastern Pacific. Easter Island.

Geodia lophotriaena LENDENFELD.

Ante, p. 181.

Cushion shaped. In spirit: brownish.

Large choanosomal amphioxes: 1.2–1.8 mm. by 25–42 μ. *Minute dermal rhabds*: mostly blunt amphioxes, rarely styles; 110–200 by 3–6 μ. *Plagiotriaenes*: rhabdome 0.6–1.2 mm. by 25–35 μ, sometimes reduced in length and rounded terminally; clades concave to the rhabdome throughout, 140–195 μ long; clade-angles 102–114°. *Dichotriaenes and other lophotriaenes*: the former more frequent than the latter; rhabdome 0.8–1.2 mm. by 35–59 μ; main clades 70–140 μ, end clades, of which there are in the lophotriaenes from three to five, 70–80 μ long; main clade-angles 105–130°; breadth of cladome 300–500 μ. *Mesoprotriaenes*: rhabdome about 1.3 mm. by 4–9 μ at the cladome, and 7–11 μ at the thickest point near the middle; clades 44–80 μ long; clade-angles 32–41°; epirhabd 38–60 μ long. *Large anatriaenes*: rhabdome 8–13 μ thick; clades 60–85 μ long; clade-angles 41–50°. *Minute dermal anatriaenes*: rhabdome 170–210 by 1–3 μ at the cladome, and 2–4 μ at the thickest point near the middle; clades 4–9 μ long; clade-angles 49–67°.

Large oxyasters: from four to eleven smooth, conical rays, 1–2.2 μ thick; centrum small; total diameter 15–41 μ. *Sphaerasters*: from seven to twenty-two or more, usually cylindroconical, truncate, rarely conical and pointed, usually spined rays, 0.8–2.4 μ thick; centrum 2–8 μ, whole aster 7–22 μ, in diameter. *Sterrasters*: mostly 30–45 by 33–44 by 27–35 μ; a few larger ones, up to 58 μ long, also observed, these perhaps foreign.

? Southwestern Pacific. Probably New Zealand.

Geodia acanthtylastra LENDENFELD.

Ante, p. 188.

Irregularly spherical, oval or tuberous. In spirit: brownish white.

Large amphioxes: 0.7–2.2 mm. by 14–40 μ. *Minute dermal rhabds*: for the most part amphioxes, styles also present, but rare; 150–300 by 3–15 μ. *Minute amphioxes*: 41–53 by 1–1.2 μ; perhaps foreign. *Plagiotriaenes*: rhabdome 1.2–2.5 mm. by 40–77 μ; clades concave to the rhabdome throughout, or only basally and distally straight, 160–260 μ long; clade-angles 100–116°. *Irregular plagiotriaene-derivates*: of similar dimensions; either with another clade besides the three ordinary, or with bifurcate clades (some regular dichotriaenes were observed, but these may be foreign). *Mesoprotriaenes*: rhabdome 2.3–3.3 mm.

by 13–22 μ at the cladome, and 21–31 μ at the thickest point near the middle; clades 55–130 μ long; clade-angles 31–53°; epirhabd 30–85 μ long. *Anatriaenes*: rhabdome 3–5.4 mm. by 18–28 μ; clades 50–110 μ long; clade-angles 38–56°.

Oxyasters: a large and a small kind can be distinguished; the *large*: from six to seven rays, 3 μ thick; total diameter 36–38 μ; the *small*: from five to ten rays, 0.7–3 μ thick; total diameter 22–29 μ; in both kinds the rays are spined. *Large oxysphaerasters*: from twelve to twenty-six conical sharp-pointed rays with a few large spines on their distal part, 1–2.2 μ thick; centrum 3.5–5 μ, whole aster 12–16.5 μ, in diameter. *Transitions* between these and the other aster-forms frequent. *Acanthtylasters*: from four to twelve cylindroconical rays, 0.5–1.3 μ thick, with a terminal verticil of stout recurved knobs or spines, which together form a conspicuous acanthtyle; centrum small; total diameter 11–22 μ. *Small strongylosphaerasters*: from fourteen to twenty-two distally spined rays, 0.3–0.8 μ thick; centrum 1.5–3.4 μ, whole aster 4.3–6.1 μ, in diameter. *Large strongylosphaerasters*: rare; seventeen conical, truncate rays, 5 μ thick, smooth at the sides, the convex terminal face densely covered with small spines; centrum 13 μ, whole aster 23 μ, in diameter; perhaps foreign. *Sterrasters*: 65–76 by 55–68 by 42–64 μ.

Eastern Pacific. West coast of North America; 22° 52′ N. "Albatross" Station 2829.

Geodia nigra Lendenfeld.

Descriptive catalogue sponges Australian museum, 1888, p. 33. Tierreich, 1903. **19**, p. 116.

This description is based on an examination of part of the type specimen in the British Museum.

Massive, lobose. In spirit: dark brown or black. Surface very uneven. Cortex of type 2–2.5 mm. thick, composed of a sterraster-armour excavated at very frequent intervals by large cavities, extending right through it. These cavities are occupied by lacunose tissue containing minute styles and subtylostyles, which perhaps belongs to another sponge, burrowing in the Geodia. (Lendenfeld, 1888, cortex 480 μ thick).

Large choanosomal amphistrongyles: attenuated towards both ends; 1.3–1.9, rarely over 2 mm. by 15–30 μ (Lendenfeld, 1888, error, tylostyles). *Minute dermal rhabds*: mostly styles, often with annular thickening near blunt end; subtylostyles exceedingly abundant, perhaps foreign, rarely amphistrongyles; 190–370 by 5–11 μ (Lendenfeld, 1888, 100 by 8 (error 80) μ. *Plagio-proclades*: rhabdome rounded or blunt pointed, 1.2–1.8 mm. by 16–33 μ (Lendenfeld, 1888, 40 μ); clades usually unequal, one, two, or all three reduced and terminally rounded, fully developed ones conical, pointed, convex to rhabdome throughout their length, 90–260 μ long, over 200 μ only in monaenes; clade-angles 113–147°.

Oxyasters: from six to fifteen smooth, conical rays; total diameter 17–32 μ. *Oxysphaerasters*: from five to thirty and more conical rays, 1.4–4 μ thick, rays usually smooth, rarely with one or two stout spines; centrum 4–12 μ, whole aster 16–31 μ, in diameter. *Sterrasters*: 55–62 (Lendenfeld, 1888, 67 μ) by 50–59 by 45–54 μ.

Southwestern Pacific. East coast of Australia; Broughton Island.

Geodia media Bowerbank.

Proc. Zool. soc. London, 1873, p. 13, plate 2, figs. 21–29. Lendenfeld, Ante, p. 191.
Synops (?) *media* Sollas, Rept. voy. "Challenger" 1888, **25**, p. 266.
Sidonops media Lendenfeld, Tierreich, 1903, **19**, p. 103.

The following description is also based on an examination of part of the type specimen in the British Museum.

Massive, irregular, with depressions, in which are conspicuous sieve-covered canal-entrances; more rarely digitate. In spirit and dry: light brown or buff yellow.

Large amphioxes: slender and stout; 1–1.7 mm. by 23–51 μ. *Large styles*: not numerous; 0.9–1.3 mm. by 30–50 μ (not mentioned by Sollas, 1888). *Large irregular rhabds*: angularly bent or with one or more branch-rays, often numerous; dimensions as in the regular amphioxes and styles (not mentioned by Bowerbank, 1873, or Sollas, 1888). *Minute dermal styles*: attenuated towards the rounded end; 140–265 by 2–6 μ (not mentioned by Bowerbank, 1873, or Sollas, 1888). *Slender plagiotriaenes*: rhabdome 1–1.6 mm. by 17–30 μ; clades strongly concave to rhabdome throughout their whole length, 160–260 μ long; clade-angles 107–114°. *Stout plagiotriaenes*: rhabdome 0.8–1.7 mm. by 30–80 μ (Sollas, 1888, 45 (error 450) μ); clades slightly concave to rhabdome or nearly straight, 110–310 μ long; clade-angles 105–120°. *Mesomonaenes*: orthoplagio- or proclade; rather scarce; rhabdome 1.7–2.5 mm. by 4–10 μ; clade 17–50 μ long; clade-angle 32–89°; epirhabd 40–75 μ long (not mentioned by Bowerbank, 1873, or Sollas, 1888). *Amphiox-like derivates of the mesoclades*: of similar dimensions; with the clade more or less completely suppressed (not mentioned by Bowerbank, 1873, or Sollas, 1888). *Anatriaenes*: scarce; rhabdome 10–15 μ thick; clades 23–35 μ long; clade-angles 44–52° (not mentioned by Sollas, 1888). *Mesanatriaenes*: very rare, not always present; rhabdome 0.8 mm. long, terminally thickened and rounded; clades similar to those of the anatriaenes; epirhabd 165 μ long.

Large oxyasters: from four to eleven conical or cylindrical, pointed or truncate, spined rays, 1–3.5 μ thick; total diameter 20–45 μ (Sollas, 1888, 26 μ). *Large oxysphaerasters*: connected by transitions with the oxyasters; from fifteen to twenty conical rays; 0.8–1.7 μ thick with spine-verticils near their ends; centrum 3–4.5 μ, whole aster 9–18 μ, in diameter (not mentioned by Sollas, 1888). *Small sphaerasters*: regular, or rarely irregular, ataxastrose; from six to eighteen, cylindrical or cylindroconical, truncate or blunt-pointed, spined rays, 0.8–2 μ thick; centrum 2–5, whole aster 4.6–8 μ, in diameter. *Sterrasters*: 84–110 by 73–94 by 60–74 μ.

Eastern Pacific. Gulf of Panama: Mexico (probably Pacific coast).

Geodia magellani (Sollas).

Lendenfeld, Tierreich, 1903, **19**, p. 107. Thiele, Zool. jahrb. Suppl., 1905, **6**, p. 108.
Cydonium magellani Sollas, Proc. Roy. Dublin soc., 1886, **5**, p. 197. Rept. voy. "Challenger," 1888, **25**, p. 221, plate 21, figs. 1–14.

In spirit: brownish white.

Amphioxes: 3.927–5.71 mm. by 51.6–58 μ. *Dichotriaenes*: rhabdome 3.927–4.82 mm. by 64–90 μ; main clades 127 μ, end clades 275 μ long. *Anatriaenes*: rhabdome rounded terminally, 7.14–7.5 mm. by 19–23.7 μ; clades 110–116 μ long; cladome 160–175 μ broad and 103–119 μ high.

Choanosomal oxyasters: total diameter 16 μ. *Subcortical oxysphaerasters*: rays spined; centrum 8 μ, whole aster 21.7 μ, in diameter. *Small sphaerasters*: rays cylindroconical, truncate; centrum large; total diameter 12 μ. *Sterrasters*: spheroidal 123 by 103 μ.

Southeastern Pacific. Chile; Calbuco: Patagonia; Tom Bay, 50° 8′ 30″ S., 74° 41′ W.; Port Churruca, 52° 45′ 30″ S., 73° 46′ W.

Geodia exigua Thiele.

Zoologica, 1898, **24**, p. 11, plate 6, fig. 8a–h. Lendenfeld, Tierreich, 1903, **19**, p. 115.

Small, cylindrical. Dry: whitish.

Amphioxes 1 mm. by 11 μ. *Orthoplagiotriaenes*: rhabdome 1–1.2 mm. by 15 μ; clades 100 μ long. *Anatriaenes*: rhabdome long and slender; clades 30–40 μ long.

Large sphaerasters: rays cylindroconical, blunt pointed; centrum well developed; total diameter 18 μ. *Large strongylasters*: rare; total diameter 12 μ. *Small strongylasters*: total diameter 6 μ. *Sterrasters*: 58 by 52 μ.

Northwestern Pacific. Amami-Oshima: Liu-Kiu Islands.

Geodia inconspicua (Bowerbank).

Lendenfeld, Tierreich, 1903, **19**, p. 116.
Pachymatisma inconspicua Bowerbank, Proc. Zool. soc. London, 1873, p. 326, plate 31, figs. 1–6.
Cydonium inconspicuum (Bowerbank) Sollas, Rept. voy. "Challenger," 1888, **25**, p. 260.

Massive. Dry: light fawn.

Large choanosomal amphioxes: 1.9 mm. by 29 μ. *Minute dermal amphioxes*: 390 μ long. *Orthoplagiotriaenes*: rhabdome 2 mm. by 33 μ.

Oxyasters: rays slender; centrum small; total diameter 20 μ. *Strongylosphaerasters*: total diameter 6.5 μ. *Sterrasters*: spheroidal, 64 μ in diameter.

? Southern Pacific. South Sea.

GEODINELLA Lendenfeld.

Without regular triaenes. The tetraxon megascleres are monaene or diaene teloclades with reduced clades, and occur not only in the superficial part of the sponge but also in the interior.

Two species are known; both occur in the Pacific Ocean.

Geodinella robusta Lendenfeld.

Ante, p. 205.

Incrusting, cushion shaped or irregularly finger shaped. In spirit: white or brownish white.

Large choanosomal rhabds: mostly blunt amphioxes, but also amphistrongyles, styles, amphityles, and tylostyles; 0.37–2.5 mm. by 40–80 μ. *Plagiomonaenes*, occasionally also *ortho-* and *pro-monaenes*: rhabdome 1.1–2.1 mm. by 26–42 μ; clades 30–105 μ long; clade-angles 87–135°. Similar *diaenes*: only in var. *carolae*. Similar *teloclades with reduced clades*.

Oxyasters and oxysphaerasters: from six to twenty simple or, rarely, bifurcate, distally spined rays, 0.6–4 μ thick; centrum, when present, up to 8 μ in diameter; total diameter of aster 9–38 μ, size in inverse proportion to ray-number. *Strongylosphaerasters*: from eleven to twenty-seven distally spined rays, 1–1.7 μ thick; centrum 3.5–7 μ, whole aster 7–13 μ, in diameter. *Sterrasters*: 180–237 by 130–200 by 80–130 μ.

Northeastern Pacific. West coast of North America; southern California, 33° 58′ N. Vancouver Island, Queen Charlotte Sound: S. E. Alaska, Behm Canal, Naha Bay. "Albatross" Stations 2946, 4199, 4228.

Geodinella robusta var. carolae Lendenfeld.

Ante, p. 205.

Incrusting, cushion shaped. Among the large rhabds, amphistrongyles, amphityles, styles, and tylostyles occur besides the amphioxes. Teloclades monaene or, more rarely, diaene, with clades up to 70 μ long. Sterrasters up to 195 μ long, ellipsoidal.

Northeastern Pacific. West Coast of North America; Vancouver Island, Queen Charlotte Sound: S. E. Alaska, Behm Canal, Naha Bay. "Albatross" Stations 4199, 4228.

Geodinella robusta var. megaclada Lendenfeld.

Ante, p. 205.

Finger shaped. Large rhabds nearly all amphiox. Teloclades all monaene, clade up to 150 μ long. Sterrasters up to 217 μ long, ellipsoidal or, more rarely, three lobed.

Northeastern Pacific. West Coast of North America; S. E. Alaska, Behm Canal, Naha Bay. "Albatross" Station 4228.

Geodinella robusta var. megasterra Lendenfeld.

Ante, p. 205.

Finger shaped. Large rhabds mostly amphiox. Teloclades monaene, clade up to 70 μ long. Sterrasters up to 237 μ long, ellipsoidal or, more rarely, three lobed.

Northeastern Pacific. West Coast of North America; off Southern California; 33° 58′ N. "Albatross" Station 2946.

Geodinella cylindrica (Thiele).

Lendenfeld, Tierreich, 1903, **19**, p. 117.
Geodia (? !) *cylindrica*, Thiele, Zoologica, 1898, **24**, p. 12, plate 1, fig. 2; plate 6, fig. 9a–e.

Cylindrical. Whitish brown.

Amphioxes: one end or both ends blunt, 0.8–1 mm. by 25–30 μ. *Styles*: of similar dimensions. *Plagio- and pro-diaenes and monaenes*: rhabdome of similar dimensions as the amphioxes; clades short, more or less reduced.

Small sphaerasters: rays conical; total diameter 7–8 μ. *Sterrasters*: 180 by 145 by 115 μ.

Northwestern Pacific. Japan; Enoshima.

IV. DISTRIBUTION.

The limits here assigned to the Pacific Region extend from the South Pole along the meridian of Cape Horn to Cape Horn and along the west coast of the American continent to Cape Prince of Wales. From here across Bering Strait to Cape Deshnef and along the east coast of the Eurasian continent to Cape Buhis by Singapore. Thence across the Strait of Malacca to the north coast of Sumatra, along the eastern coast of Sumatra across the Sunda Strait to the north coast of Java and the group of islands east of it, and across the other straits separating these islands, to the northeast coast of Timor. From here across the Arafura Sea to Bathurst Island and along its north coast across Dundas Strait to the Coburg Peninsula of northern Australia. Thence along the north and east coasts of Australia, across Bass Strait, and along the east coast of Tasmania to the South Cape and farther, along the meridian of this Cape, to the South Pole.

If the Geodidae of the Pacific are compared with those of other regions it is seen that, although several of the Pacific species are similar to species found outside the Pacific, not a single one of the former is really identical with any of the latter.

With the genera, however, it is different. Of the seven genera five are represented both in the Pacific and ultra-Pacific regions, only two, Pachymatisma and Geodinella, being confined to one or the other, Pachymatisma to the ultra-Pacific and Geodinella to the Pacific region. Of the five genera common to both regions two, Caminella and Sidonops, are about equally distributed in the two regions; two, Caminus and Isops, are represented by a larger number of species in the ultra-Pacific region than in the Pacific; and one, Geodia, is richer in Pacific than in ultra-Pacific species.

The total numbers of the species of the seven genera and the absolute and percentage numbers of their Pacific species are tabulated below.

Genera	Number	Number of Pacific species	Percentage of the total number of known species
Caminella	2	1	50
Pachymatisma	5	0	0
Caminus	4	1	25
Isops	17	4	23.5
Sidonops	20	9	45
Geodia	44	29	65.8
Geodinella	2	2	100
	94	46	49

Within the Pacific region the following eleven areas can be distinguished, in no two of which the same species has been found.

West coast of North America.

Sidonops californica.	22° 15′ N.
" angulata	Southern California.
var. megana	
" microana	
" orthotriaena	
" bicolor	from 33° 18′ N. to Monterey Bay, Cal.
Geodia mesotriaena	from 33° 38′ 15″ N. to 34° 22′ N.
var. pachana	
" megana	
" microana	
" agassizii	from 33° 50′ 45″ N. to Naha Bay, Behm Canal, S. E. Alaska.
" mesotriaenella	Santa Barbara Island.
" breviana	Southern California and near Comox, Strait of Georgia.
" ovis	34° 1′ 30″ N.
" acanthtylastra	22° 52′ N.
Geodinella robusta	Southern California, Queen Charlotte Sound, and Naha Bay, Behm Canal, S. E. Alaska.
var. carolae	
" megaclada	
" megasterra	

West coast of Central America.

Sidonops reticulata	Mexico (? which coast).
Geodia ataxastra	Perico Island, Gulf of Panama.
var. angustana	
" latana	
" media.	Gulf of Panama and Mexico (? which coast).

Eastern Pacific Islands.

Sidonops oxyastra	Duncan Island, Galapagos.
Geodia cooksoni	Charles Island, Galapagos.
" micropora	Duncan Island, Galapagos.

West coast of South America.

Geodia magellani	Calbuco, Chile, Tom Bay (50° 8′ 30″ S., 74° 41′ W.) and Port Churruca (52° 45′ 30″ S., 73° 46′ W.) Patagonia.

Southeastern Pacific Islands.

Geodia amphistrongyla	Easter Island.

Central Pacific Islands.

Geodia hirsuta	Ki Island, 5° 49′ 15″ S., 132° 14′ 15″ W.

Western and Southwestern Pacific Islands.

Isops contorta	Fiji Islands.
Geodia nux	Samoa Islands.
" lophotriaena	New Zealand ?

East coast of Australia.

Isops sollasi	Port Jackson.
Sidonops nitida	Port Jackson.
Geodia cosaster	Port Jackson.
" erinaceus	East coast of Australia.
" nigra	Broughton Island.

North coast of Australia.

Geodia globostella	Port Darwin.

Coast of Southeastern Asia and Southeastern Asiatic Islands.

Caminella nigra	Gaspar Strait, Java Sea.
Sidonops lindgreni	Java (? probably northern side).
" picteti	Bay of Amboyna.
" alba	Ternate.
Geodia distincta	Java Sea and Java (? probably northern side).
" sphaeroides	Ternate and Coast of Cochin China (11° 5′ N., 108° 50′ E.).
" berryi	Lingin (China), Coast of Cochin China (11° 5′ N., 108° 70′ E.) and Ternate.
" kükenthali	Ternate.

Coast of Northeastern Asia and adjacent Islands.

Caminus chinensis	China Sea and Strait of Formosa.
Isops obscura	Japan.
Geodia variospiculosa	Off Honshu Island and westward of Yogashima, Japan.
var. typica	
" clavigera	
" intermedia	
" micraster	
" reniformis	Enoshima, Japan.
" japonica	Japan, and Enoshima, Japan.
" hilgendorfi	
var. typica	
" granosa	Japan, probably Enoshima.
" exigua	Amami-Oshima, Liu-Kiu Islands.
Geodinella cylindrica	Enoshima, Japan.

Doubtful, Southern Pacific?

Isops imperfecta	South Sea.
Geodia inconspicua	South Sea.

Three of the six genera of the Pacific Geodidae, Caminella, Caminus, and Isops, have been found only in the western and northwestern Pacific, on the coasts of eastern Australia and Asia and of the eastern Asiatic Islands; one, Geodinella, only in the northern Pacific, on the coast of Japan, and the northern part of the west coast of North America. The other two, Sidonops and Geodia, are more widely distributed, and the latter (Geodia) represented in every one of the eleven areas distinguished above.

The number of species of Geodidae found in the northern half of the Pacific is very much greater than that of its southern half. Although this difference is no doubt to some extent due to the inferiority of our knowledge of the latter compared to the former, I think that it may also, in part, be ascribed to a real relative paucity of species in the southern half of the region.

Within the eleven areas distinguished above some species, notably the western *Geodia berryi* and the eastern *G. agassizii*, are very widely distributed. The latter, which I was able to study carefully, exhibits very considerable differences in the specimens from the most distant localities. This, and the fact that the Pacific species of Geodidae differ from the ultra-Pacific species and that none of them occurs in more than one of the eleven areas distinguished, seem to indicate that these sponges are unable to retain their characters fairly unchanged when dispersed over extensive areas.

V. LIST OF STATIONS.

Station	Locality	Lat.	Long.	Date	Depth in fathoms	Surface temperature, Fahr.	Bottom temperature, Fahr.	Bottom	Instruments used
2829	Off Lower California	N.22 52 00	W.109 55 00	May 1, 1888	31	75	74.1	Rocky	Tangles
2886	Off Oregon	N.43 59 00	W.124 56 30	Oct. 19, 1888	50	57	48.1	"	Ship's dredge
2887	" "	N.43 58 00	W.124 57 00	" " "	42	59	47.1	Clay, pebbles	Large beam trawl
2894	" southern California	N.34 07 00	W.120 33 30	Jan. 5, 1889	53	60	55.6	Sand and broken shells	Ship's dredge
2909	Off southern California	N.34 22 00	W.120 08 30	Jan. 8, 1889	205	59	45.2	Green mud	Small beam trawl
2942	Off southern California	N.33 38 45	W.118 13 45	Feb. 5, 1889	20	59		Gray sand and broken shells	Large beam trawl
2945	Off southern California	N.34 00 00	W.119 29 30	Feb. 6, 1889	30	59		Pebbly	Small beam trawl
2946	Off southern California	N.33 58 00	W.119 30 45	" " "	150	59	56.5	Coarse gray sand	Large beam trawl
2958	Off southern California	N.34 04 00	W.120 19 30	Feb. 9, 1889	26	58	54.9	Gray sand	Tangles
2975	Off southern California	N.34 01 30	W.119 29 00	Feb. 12, 1889	36	60	57	Gravel and broken shells	Large beam trawl
2978	Off southern California	N.33 59 45	W.119 22 15	" " "	46	60	56.5	Gray sand	Small beam trawl
2981	Off southern California	N.33 18 00	W.119 24 00	Feb. 13, 1889	45	58		Coarse gray sand and broken shells	Large beam trawl
3088	Off Oregon	N.44 28 00	W.124 25 30	Sept. 3, 1889	46	56	46.3	Clay, pebbles	Small beam trawl
3168	" central California	N.38 01 25	W.123 26 55	Mar. 24, 1890	34	52		Rocky and coral	Tangles
3746	Off Honshu Island, Japan, Suno Saki	N. 87 E. 15.8 km. (8.5 miles)		May 19, 1900	49	64		Gray sand and pebbles	"

LIST OF STATIONS. — (*Continued.*)

Station	Locality	Lat. Long.	Date	Depth in fathoms	Surface temperature, Fahr.	Bottom temperature, Fahr.	Bottom	Instruments used
3758	Off Honshu Island, Japan, Suno Saki	S. 55 E. 3.9 km. (2.1 miles)	May 22, 1900	73;52	65		Black clay and rock	8-foot Tanner beam trawl
4193	Gulf of Georgia: Halibut Bank; Cape Roger Curtis, Bowen Island	S. 89 E. 20 km. (10.8 miles) drift S. 1° E.	June 20, 1903	18–23		50.3	Fine green sand	
4199	Queen Charlotte Sound: Off Fort Rupert; Vancouver Island, B. C. Centre of Round Island	S. 46 W. 11.5 km. (6.2 miles) drift S. 85° E.	June 25, 1903	68–107		45.9	Soft green mud and volcanic sand	
4228	Vicinity of Naha Bay: Behm Canal; s. e. Alaska, Indian Point	N. 18 E. 1.7 km. (0.9 miles) drift N. 2° W.	July 7, 1903	41–134		47.8	Gravel and sponge spicules	
4417	Off southern California, near Santa Barbara Island, s. w. rock Santa Barbara Island	N. 8° W. 11.7 km. (6.3 miles) drift S. 73° W.	Apr. 12, 1904	29			Fine yellow sand and coralline rock	
4420	Off southern California east of Point San Nicolas Island	S. 77 W. 10.5 km. (5.7 miles) drift S. 60° W.	" " "	32–33			Fine gray sand	
4531	Monterey Bay, Cal., Point Pinos Light House	N. 64° E. 3.8 km. (2.1 miles)	May 28, 1904				Fine gray sand, pebbles, and rock	
4551	Monterey Bay, Cal., Point Pinos Light House	S. 9° E. 8.4 km. (4.5 miles) drift S. 37° E.	June 7, 1904	56			Coarse sand, shells, and rock	

EXPLANATION OF THE PLATES.

PLATE 1.

PLATE 1.

Geodinella robusta Lendenfeld.

Figs. 1–4, 16, 18–24.— var. **megasterra** Lendenfeld.
Figs. 5–12, 17. — var. **carolae** Lendenfeld.
Figs. 13–15. — var. **megaclada** Lendenfeld.

1–4. — Cladomes of monaenes of the var. *megasterra*; magnified 100; phot., Zeiss, apochr. 16, compens. oc. 6:
   1, 2, of plagiomonaenes with a blunt clade;
   3, of an orthomonaene with a pointed clade;
   4, of a plagiomonaene with a pointed clade.
5–11.— Teloclades (teloclade-cladomes) of the specimen of var. *carolae* from Charlotte Sound; magnified 100; phot., Zeiss, apochr. 16, compens. oc. 6:
   5, a plagiodiaene with short, blunt rhabdome;
   6, a plagiomonaene with angularly bent rhabdome;
   7, 8, cladomes of plagiodiaenes;
   9, a regular plagiomonaene;
   10, cladome of an orthomonaene with not quite terminal, pointed clade;
   11, cladome of a plagiomonaene with short, blunt clade.
12. — The specimen of var. *carolae* from Naha Bay; natural size; phot., Zeiss, anastig. 167.
13–15. — Cladomes of monaenes of var. *megaclada*; magnified 100; phot., Zeiss, apochr. 16, compens. oc. 6:
   13, of an orthomonaene with not quite terminal clade;
   14, of a simple plagiomonaene;
   15, of a plagiomonaene with a secondary clade below the cladome proper.
16. — The specimen of var. *megasterra*; natural size; phot., Zeiss anastig. 480/412.
17. — The specimen of var. *carolae* from Charlotte Sound; natural size; phot., Zeiss, anastig. 480/412.
18–20.— Plagiomonaenes of var. *megasterra*; magnified 30; phot., Zeiss, planar 20.
21.— Axial section of var. *megasterra*; magnified 6; phot., Zeiss, planar 50:
   a, cortex (sterraster-armour); b, choanosome.
22, 23. — Amphioxes of var. *megasterra*; magnified 30; phot., Zeiss, planar 20.
24.— The specimen of var. *megasterra* halved: the cut surface; magnified 6, phot., Zeiss, planar 50:
   a, cortex (sterraster-armour); b, choanosome.

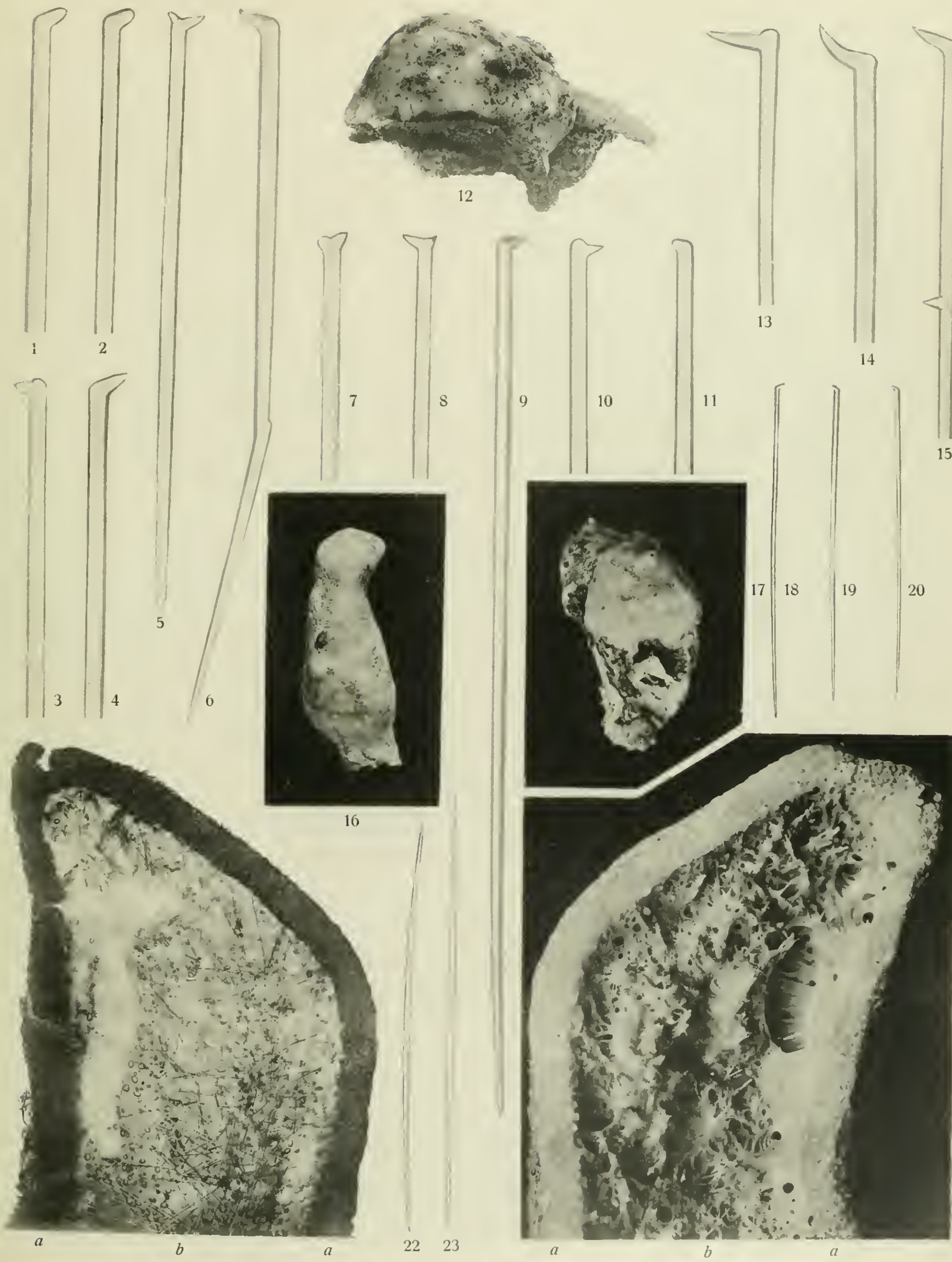


Fig. 1—24 Geodinella robusta n. sp.

1–4, 16, 18, 24 G. [illegible]; *5–12, 17 G.* [illegible]; *13–15 G.* [illegible]

PLATE 2.

PLATE 2.

Geodinella robusta LENDENFELD.

Figs. 1, 3. — var. **megasterra** LENDENFELD.
Figs. 2, 8. — var. **megaclada** LENDENFELD.
Figs. 4–7, 9–11. — var. **carolae** LENDENFELD.

1.— Group of sterrasters in a spicule-preparation of var. *megasterra*; magnified 100; phot., Zeiss, apochr. 16, compens. oc. 6:
   a, sterrasters of the usual ellipsoidal form lying flat; b, a three-lobed sterraster lying flat.

2.— Group of sterrasters in a spicule-preparation of var. *megaclada*; magnified 100; phot., Zeiss, apochr. 16, compens. oc. 6:
   a, sterrasters of the usual ellipsoidal form lying flat; b, a three-lobed sterraster lying flat; c, a sterraster of the usual ellipsoidal form standing on one of its longer narrow sides.

3.— Group of euasters in a centrifugal spicule-preparation of var. *megasterra*; magnified 300; phot., Zeiss, apochr. 4, compens. oc. 6:
   a, oxyaster; b, strongylosphaerasters.

4 — Part of a section of the choanosome of the specimen of var. *carolae* from Charlotte Sound; congo-red, aniline-blue; magnified 350; phot., Zeiss, hom. imm. 2, compens. oc. 2:
   a, surface view of a flagellate chamber with sparse collar cells; b, sectioned flagellate chambers.

5.— Group of sterrasters in a spicule-preparation of the specimen of var. *carolae* from Charlotte Sound; magnified 100; phot., Zeiss, apochr. 16, compens. oc. 6:
   a, sterrasters lying flat; c, a sterraster standing on one of its longer narrow sides.

6.— Radial section of the specimen of var. *carolae* from Charlotte Sound; magnified; phot., Zeiss, planar 50:
   a, cortex (sterraster-armour); b, choanosome; c, wide choanosomal canals.

7.— Part of a section of the choanosome of the specimen of var. *carolae* from Charlotte Sound; congo-red, aniline-blue; magnified 300; phot., Zeiss, apochr. 4, compens. oc. 6:
   a, ova; b, connective tissue forming capsules enclosing the ova.

8.— Group of strongylosphaerasters in a centrifugal spicule-preparation of var. *megaclada*; magnified 300; phot., Zeiss, apochr. 4 compens. oc. 6.

9.— Group of strongylosphaerasters in a centrifugal spicule-preparation of the specimen of var. *carolae* from Charlotte Sound; magnified 300; phot., Zeiss, apochr. 4, compens. oc. 6.

10.— Group of euasters in a centrifugal spicule-preparation of the choanosome of the specimen of var. *carolae* from Charlotte Sound; magnified 300; phot., Zeiss, apochr. 4, compens. oc. 6:
   a, large oxyaster; b, small oxyaster; c, small sphaeraster.

11.— Part of a section of the choanosome of the specimen of var. *carolae* from Charlotte Sound; congo-red, azure; magnified 300; phot., Zeiss, apochr. 4, compens. 6:
   a, flagellate chambers.

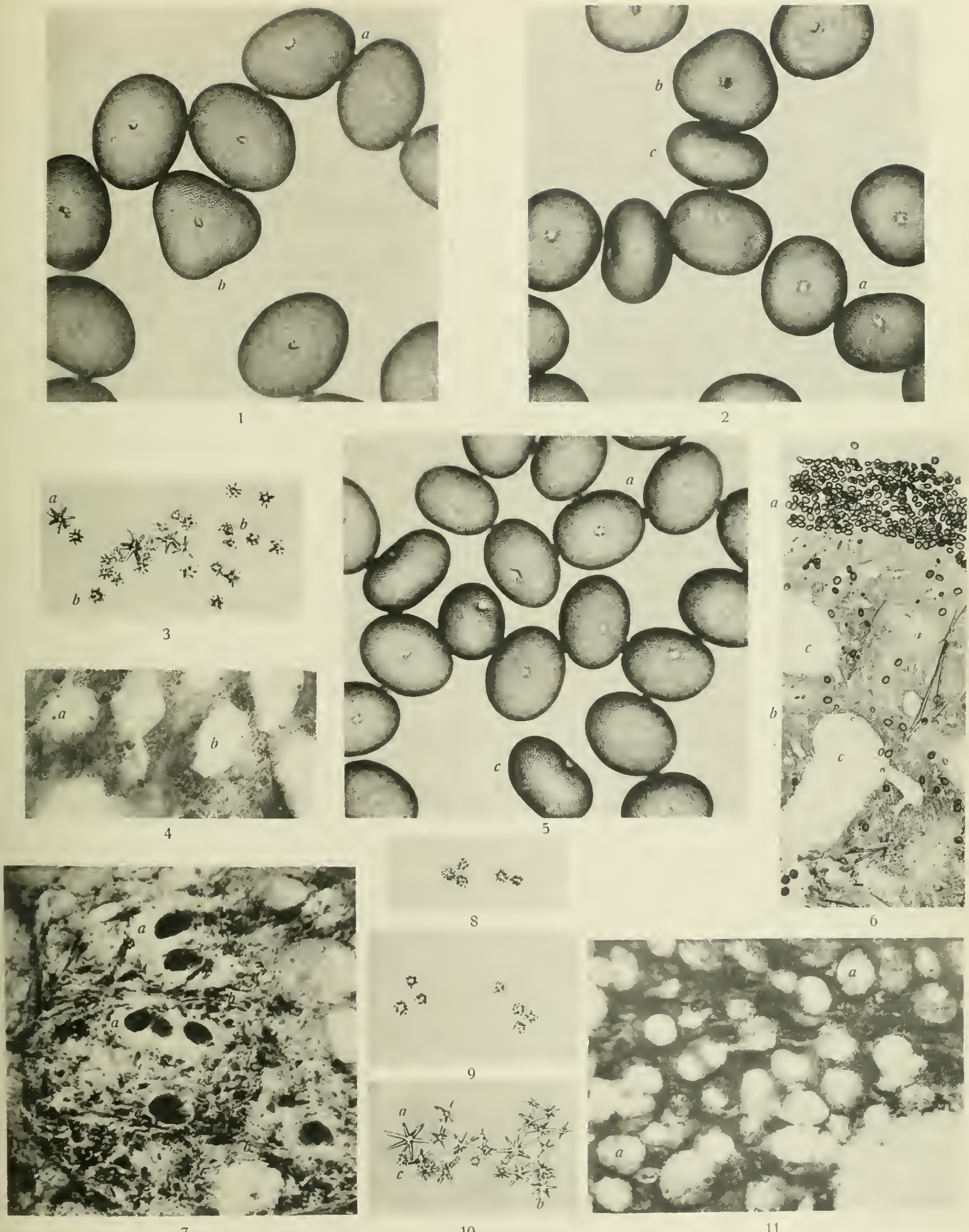


Fig. 1—11 Geodinella robusta n. sp.
1, 3 G. r. var. megasterra; 2, 8 G. r. var. megaclada; 4—7, 9—11 G. r. [illegible]rolae.

PLATE 3.

PLATE 3.

Geodinella robusta Lendenfeld.

Fig. 1. — var. **crrolae** Lendenfeld.
Figs. 2, 5, 6, 8.— var. **megaclada** Lendenfeld.
Figs. 3, 4, 7, 9.— var. **megasterra** Lendenfeld.

1.— A normal sterraster of the specimen of var. *carolae* from Charlotte Sound; magnified 300; phot., Zeiss, apochr. 4, compens. oc. 6.

2.— A normal sterraster of var. *megaclada*; magnified 300; phot., Zeiss, apochr. 4, compens. oc. 6.

3.— A normal sterraster of var. *megasterra*; magnified 300; phot., Zeiss, apochr. 4, compens. oc. 6.

4.— A sterroid of var. *megasterra*; magnified 300; phot., Zeiss, apochr. 4, compens. oc. 6.

5, 8.— A sterroid of var. *megaclada*; magnified 335; phot., Zeiss, apochr. 4, compens. oc. 6:
a, spherical (in the optical section ring shaped) group of central granules;
5, the centre in focus;
8, the upper surface in focus.

6.— A sterroid of var. *megaclada*; magnified 300; phot., Zeiss, apochr. 4, compens. oc. 6.

7, 9.— Sectioned surface of a sterraster of var. *megasterra* cut in half; magnified 300;
a, spherical (in section ring-shaped) group of central granules; b, a growth-zone; c, umbilicus;
7, phot., Zeiss, apochr. 4, compens. oc. 6, and focused higher;
9, phot., Zeiss, hom. imm. apochr. 2, compens. oc. 2, and focused lower.

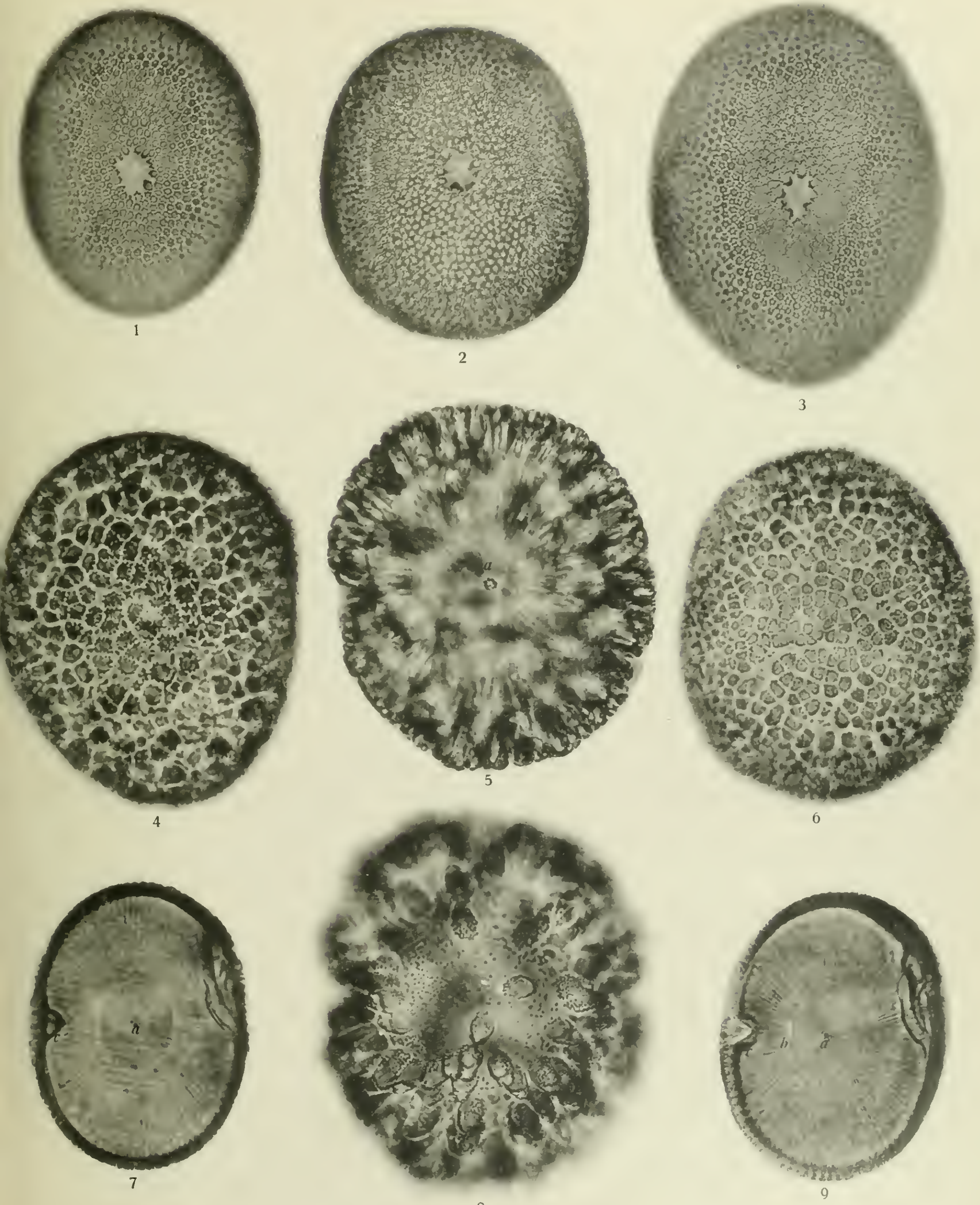


Fig. 1—9 Geodinella robusta n. sp.
1 G. r. var. carolae; 2, 5, 6, 8 G. r. var. megaclada; 3, 4. 7, 9 G. [illegible]

Lendenfeld photographed.

PLATE 4

PLATE 4.

Geodinella robusta LENDENFELD.

Figs. 1, 4–7, 13, 21, 22.— var. **megasterra** LENDENFELD.
Figs. 2, 3, 8–12, 14–20.— var. **carolae** LENDENFELD.
Figs. 23–25. — var. **megaclada** LENDENFELD.

1.— A ray of an oxyaster of the choanosome of var. *megasterra*; magnified 1800; u. v. phot., Zeiss, q. monochr. 1.7, q. oc. 10.

2.— A sphaeraster with blunt conic rays of var. *carolae*; magnified 1800; u. v. phot., Zeiss, q. monochr. 1.7, q. oc. 10.

3.— A small oxyaster (oxysphaeraster) of var. *carolae*; magnified 1800; u. v. phot., Zeiss, q. monochr. 1.7, q. oc. 10.

4.— A small oxyaster (oxysphaeraster) of the cortex of var. *megasterra*; magnified 1800; u. v. phot., Zeiss, q. monochr. 1.7, q. oc. 10.

5.— Small oxyasters (oxysphaerasters) of the choanosome of var. *megasterra*; magnified 1800; u. v. phot., Zeiss, q. monochr. 1.7, q. oc. 10.

6, 7.— The two ends of a diactine (amphiox) spicule both ends of which are lobose, of var. *megasterra*; magnified 200; phot., Zeiss, apochr. 8, compens. oc. 6.

8–12.— Ends of diactine (amphiox or amphistrongyle) spicules of var. *carolae*; magnified 100; phot., Zeiss, apochr. 16, compens. oc. 6:
8, 11, very blunt (strongyle) ends;
9, 12, more tapering ends;
10, an irregular end with a clade-like process.

13.— Part of the surface of a normal sterraster of var. *megasterra*; magnified 1800; u. v. phot., Zeiss, q. monochr. 1.7, q. oc. 10:
a, the umbilicus.

14, 15.— Surface of a sterroid of the specimen of var. *carolae* from Charlotte Sound; magnified 1800; u. v. phot., Zeiss, q. monochr. 1.7, q. oc. 10:
14, focused on the summits of the uppermost rays; 15, focused 1.5 μ lower.

16.— A short amphistrongyle of the specimen of var. *carolae* from Charlotte Sound; magnified 100; phot., Zeiss, apochr. 16, compens. oc. 6.

17.— The rounded end of a subtylostyle of the specimen of var. *carolae* from Charlotte Sound; magnified 100; phot., Zeiss, apochr. 16, compens. oc. 6.

18–20.— Strongylosphaerasters of the cortex of the specimen of var. *carolae* from Charlotte Sound; magnified 1800; u. v. phot., Zeiss, q. monochr. 1.7, q. oc. 10.

21.— Small oxyaster (oxysphaeraster) of the choanosome of var. *megasterra*; magnified 1200; u. v. phot., Zeiss, q. monochr. 2.5, q. compens. oc. 10.

22.— Oxyaster of the choanosome of var. *megasterra*; magnified 1200; u. v. phot., Zeiss, q. monochr. 2.5, q. oc. 10.

23–25.— Parts of megascleres of var. *megaclada*; magnified 200; phot., Zeiss, apochr. 8, compens. oc. 6:
23, cladome of an orthomonaene with not quite terminal clade;
24, end of a blunt amphiox;
25, central part of a mesomonaene.

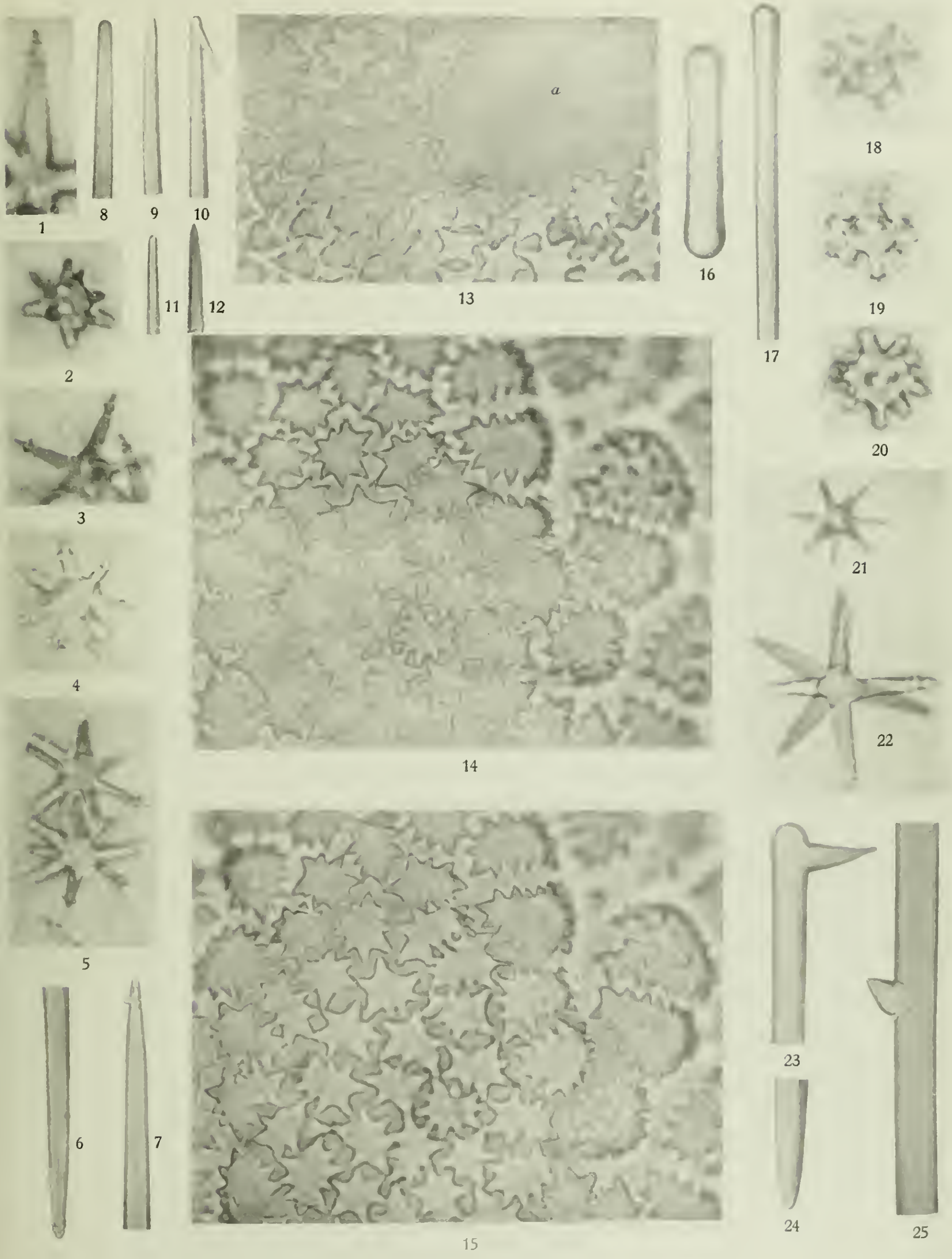


Fig. 1-25 Geodinella robusta n. sp.
1, 4-7, 13, 21, 22 G. r. var. megasterra; 2, 3, 8-12, 14-20 G. r. var. carolae; 23-25 G. r. var. megaclada.

PLATE 5.

PLATE 5.

Sidonops californica Lendenfeld.

Figures 1–37.

1–4.— Cladomes of normal anatriaenes; magnified 200; phot., Zeiss, apochr. 8, compens. oc. 6.

5.— Cladome of an anatriaene with reduced clades; magnified 200; phot., Zeiss, apochr. 8, compens. oc. 6.

6.— The larger of the two specimens; magnified 1.5; phot., Zeiss, anastig. 480 / 412.

7–9.— Cladomes of mesoplagioclades with more or less reduced clades; magnified 200; phot., Zeiss, apochr. 8, compens. oc. 6:
- 7, a monaene;
- 8, a triaene;
- 9, a diaene.

10.— Branched end of an irregular, perhaps anatriaene-derivate megasclere; magnified 200; phot., Zeiss, apochr. 8, compens. oc. 6.

11, 12.— Large amphioxes; magnified 30; phot., Zeiss, planar 20.

13, 14.— Plagiotriaenes; magnified 30; phot., Zeiss, planar 20.

15, 16.— Cladomes of plagiotriaenes; magnified 75; phot., Zeiss, apochr. 16, compens. oc. 6.

17–19.— Plagiotriaenes; magnified 30; phot., Zeiss, planar 20.

20.— Group of sterrasters and one sterroid from a spicule-preparation; magnified 200; phot., Zeiss, apochr. 8, compens. oc. 6.

21, 22.— Group of euasters from a centrifugal spicule-preparation; magnified 300; u. v. phot., Zeiss, q. monochr. 6, q. oc. 7:
- 21, focused higher;
- 22, focused lower;
  - c, larger oxyaster.

23–26.— Groups of euasters from centrifugal spicule-preparations; magnified 300; phot., Zeiss, hom. imm. apochr. 2:
- a, small strongylosphaerasters; c, large oxyasters.

27.— Part of a section vertical to the surface; magnified 20; phot., Zeiss, planar 20:
- a, sterraster-armour; b, subcortical cavities; c, subcortical plagiotriaenes; d, sterrasters in the choanosome; e, large amphioxes in the choanosome.

28, 29.— Rays of large oxyasters; magnified 1800; u. v. phot., Zeiss, q. monochr. 1.7, q. oc. 10.

30, 31.— Groups of euasters from centrifugal spicule-preparations; magnified 300:
- 30, phot., Zeiss, hom. imm. apochr. 2;
- 31, phot., Zeiss, apochr. 4, oc. 6;
  - a, small strongylosphaerasters; b, small oxysphaerasters; c, large oxyaster.

32–35.— Small strongylosphaerasters; magnified 1800; u. v. phot., Zeiss, q. monochr. 1.7, q. oc. 10.

36, 37.— Parts of the surface of two sterrasters; magnified 1800; u. v. phot., Zeiss, q. monochr. 1.7, q. oc. 10.

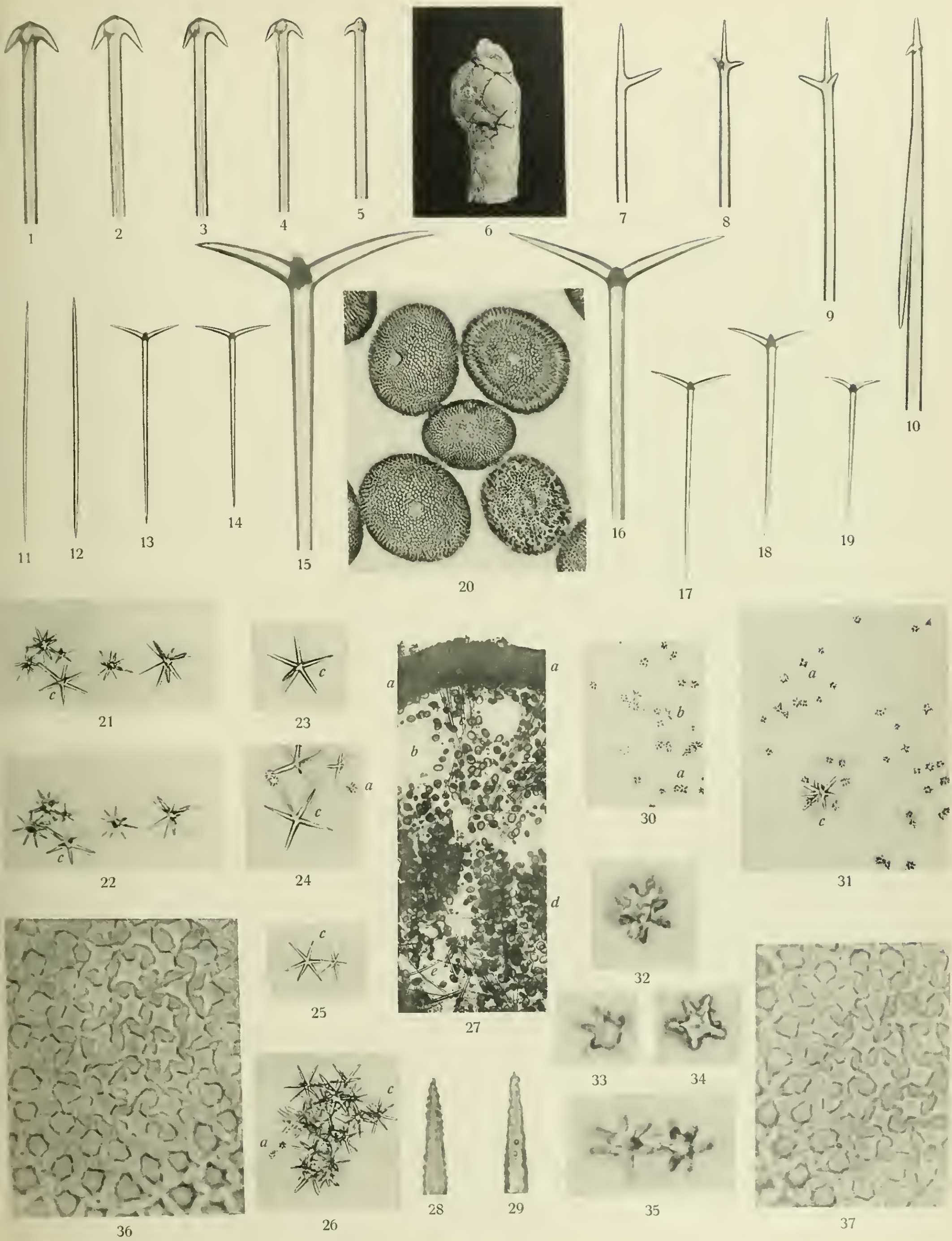


Fig. 1—37 Sidonops californica n. sp.

Lendenfeld photographed.

PLATE 6.

PLATE 6.

Sidonops oxyastra Lendenfeld.

Figures 1–23.

1, 2.— Parts of sections showing strands of spindle-cells traversing the choanosome; haematoxylin, aniline-blue:
- 1, magnified 100; phot., Zeiss, apochr. 4, compens. oc. 6;
- 2, magnified 200; phot., Zeiss, apochr. 8, compens. oc. 6.

3.— Part of section through the choanosome showing canal-end branches and flagellate chambers; haematoxylin, aniline-blue; magnified 400; phot. Zeiss, apochr. 4, compens. oc. 6.

4.— A lobe of the sponges showing a group of uniporal efferents; magnified 3; phot., Zeiss, anastig. 167.

5.— View of the largest specimen, attached to a flat stone; reduced 1 : 0.63; phot., Zeiss, anastig. 480 / 412

6–13.— Plagiotriaenes; magnified 43; phot., Zeiss, achr. aa, compens. oc. 6:
- 6, with all the clades shortened and blunt;
- 7, with one reduced, blunt clade;
- 8–13, with pointed clades;
  - 7, 8, 10, with unequal clades;
  - 6, 9, 11–13, with equal clades.

14.— Two large choanosomal amphioxes from a spicule-preparation: magnified 43; phot. Zeiss, achr. aa, compens. oc. 6.

15–18.— Cladomes of minute dermal anaclades; magnified 300:
- 15, 17, 18, phot., Zeiss, apochr. 8, compens. oc. 12;
- 19 phot., Zeiss, apochr. 4, compens. oc. 6;
  - 15, a regular mesanatriaene;
  - 16, an irregular mesanatriaene;
  - 17, 18, more or less irregular anatriaenes.

19, 20.— Parts of a radial section through a region of the cortex bearing afferent pores:
- 19, magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6;
- 20, magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6;
  - a, monaxonid sponge attached to this part of the surface of the Sidonops; b, minute dermal anaclades of the Sidonops; c, dermal membrane of the Sidonops occupied by masses of small oxysphaerasters (oxyasters).

21.— Part of a radial section through a region of the cortex bearing efferent pores, showing the dermal layer occupied by dense masses of minute dermal rhabds; magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6.

22.— A minute dermal rhabd; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6.

23.— Part of a radial section through a region of the cortex bearing afferent pores, showing numerous minute protruding dermal anaclades; magnified 50; phot., Zeiss, achr. aa, compens. oc. 6.

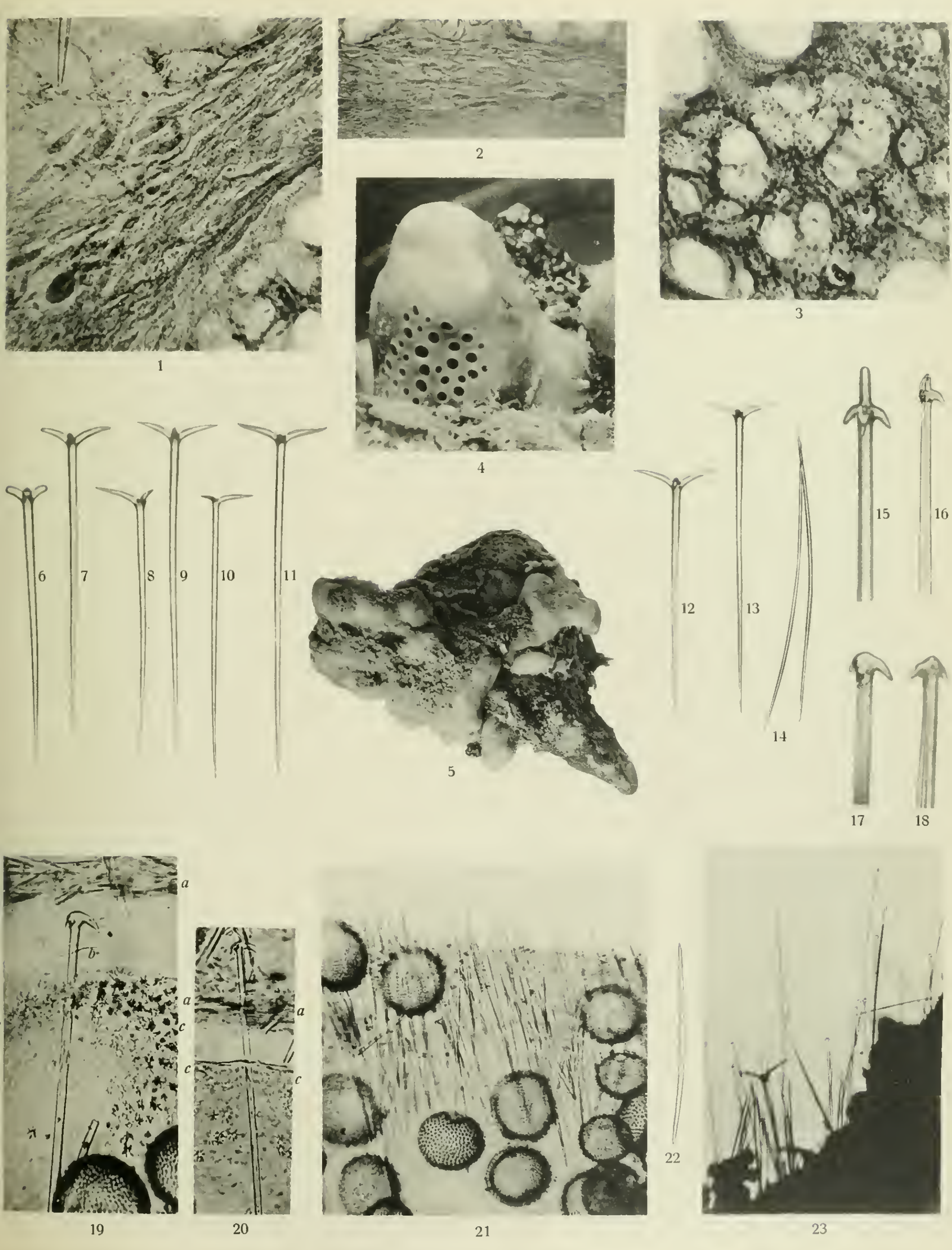


Fig. 1—23 Sidonops oxyastra n. sp.

Lendenfeld photographed.

PLATE 7.

PLATE 7.

Sidonops oxyastra LENDENFELD.

Figures 1–20.

1, 2.— Two radial sections through a lobe of the sponge; magnified 10; phot. Zeiss, planar 50:
  1, a thin section stained with haematoxylin and aniline-blue;
  2, a thick unstained section;
    a, sterraster-armour; b, monaxonid sponge attached to the Sidonops; c, afferent cortical canals; d, wide efferent canals; e, efferent pores.

3–5.— Groups of asters from a centrifugal spicule-preparation; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6:
    a, large oxyasters; b, small oxysphaerasters and oxyasters; c, large oxysphaeraster.

6.— Part of a radial section through a region of the cortex bearing afferent pores; magnified 20; phot. Zeiss, planar 20:
    a, sterraster-armour; b, monaxonid sponge attached to the Sidonops.

7, 8.— Large oxyasters from centrifugal spicule-preparations; magnified 900; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 5.

9, 10.— Group of small oxysphaerasters (oxyasters) from a centrifugal spicule-preparation; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
  9, focused higher; 10, focused lower.

11, 12.— Small oxysphaeraster; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
  11, focused higher; 12, focused lower.

13–15.— Large oxyasters; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.

16–18.— Small oxysphaerasters (oxyasters); magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.

19, 20.— Large oxysphaeraster; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
  19, focused higher; 20, focused lower.

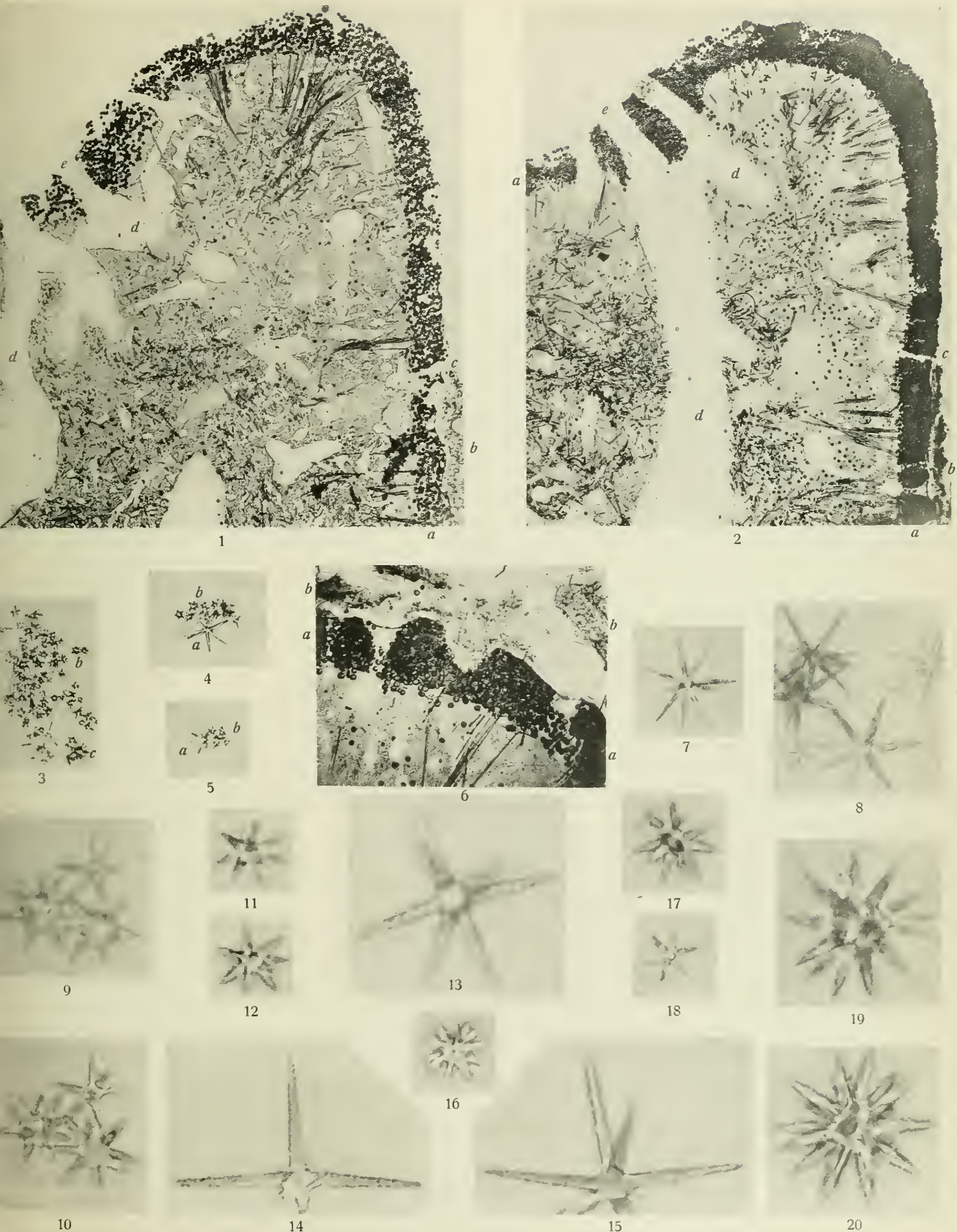


Fig. 1—20 Sidonops oxyastra n. sp.

denfeld photographed.

PLATE 8.

PLATE 8.

Sidonops oxyastra Lendenfeld.

Figures 1–15.

1–3.— Sterrasters; magnified 300:

1, phot. Zeiss, apochr. 4, compens. oc. 6;

2, 3 phot. Zeiss, hom. imm. apochr. 2.

4.— Group of spicules from a spicule-preparation; magnified 30; phot. Zeiss, planar 20:

a, large amphioxes; b, lateral views of plagiotriaenes; c, apical view of a plagiotriaene-cladome.

5.— Group of large amphioxes from a spicule-preparation; magnified 30; phot. Zeiss, planar 20.

6–8.— Part of the lateral surface of a thick-rayed sterraster; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:

6, focused high; 7, focused lower; 8, focused still lower.

9.— Part of the lateral surface of a sterraster not quite fully developed; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.

10, 11.— Part of the lateral surface of a thin-rayed sterraster; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:

10, focused higher; 11, focused lower.

12.— Sterraster; magnified 1000; phot. Zeiss, hom. imm. apochr. 2, compens. oc. 6; the centrum of the spicule in focus:

a, rosette of central granules; b, umbilicus.

13, 14.— Views of parts of the surface (superficial paratangential sections) with transmitted light; magnified 20; phot. Zeiss, planar 20:

13, of a region bearing afferent pores;

14, of a region bearing efferent pores.

15.— Part of a region of the surface with afferent pores; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6.

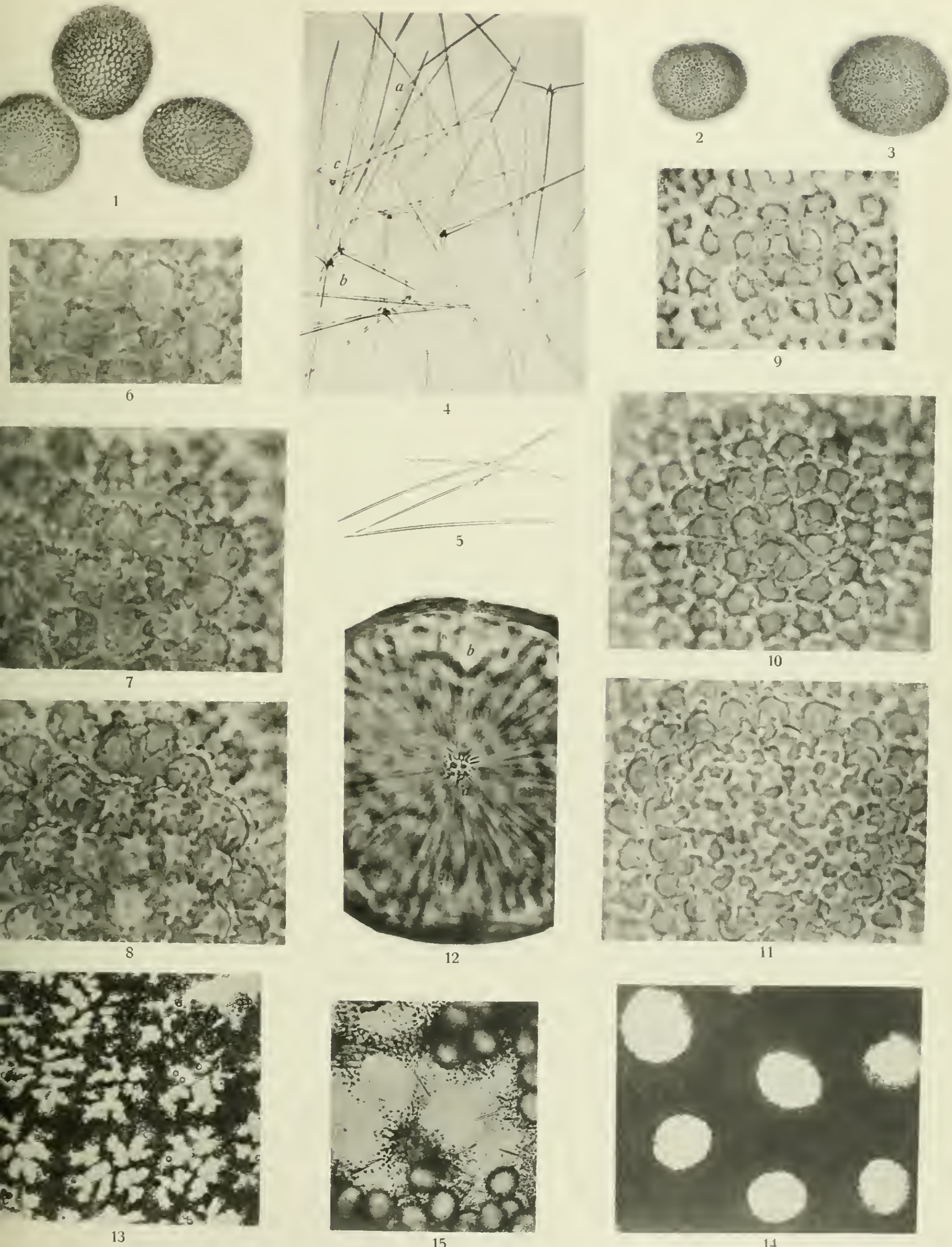


Fig. 1—15 Sidonops oxyastra n. sp.

enfeld photographed.

PLATE 9.

PLATE 9.

Sidonops bicolor Lendenfeld.

Figures 1–19.

1–6.— Cladomes of plagiotriaenes; magnified 50; phot. Zeiss, apochr. 16, compens. oc. 4:
- 1, 3–5, of a specimen from Station 2958;
- 2, 6, of a specimen from Station 4531.

7, 8.— Long slender amphioxes; magnified 20; phot. Zeiss, planar 20:
- 7, of a specimen from Station 4551;
- 8, of a specimen from Station 2781.

9–11.— Stout amphioxes; magnified 20; phot. Zeiss, planar 20:
- 9, a large one of a specimen from Station 4531;
- 10, a medium-sized one of a specimen from Station 2781;
- 11, a small one of a specimen from Station 2781.

12–14.— Plagiotriaenes; magnified 20; phot. Zeiss, planar 20:
- 12, a plagiotriaene with blunt rhabdome of a specimen from Station 2781;
- 13, a plagiotriaene with pointed rhabdome of a specimen from Station 2958;
- 14, a plagiotriaene with pointed rhabdome of a specimen from Station 2781.

15, 16.— Parts of radial sections through the cortex and adjacent parts, showing the chones of a specimen from Station 4420; magnified 30; phot. Zeiss planar 20:
- a, surface of the sponge.

17.— Part of a radial section through a specimen from Station 3168; magnified 7.5; phot. Zeiss, planar 50:
- a, surface of the sponge.

18.— Part of a section through the choanosome of a specimen from Station 4531; haematoxylin; magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6.

19.— Part of a section through the choanosome of a specimen from Station 3168; haematoxylin; magnified 30; phot. Zeiss; planar 20.

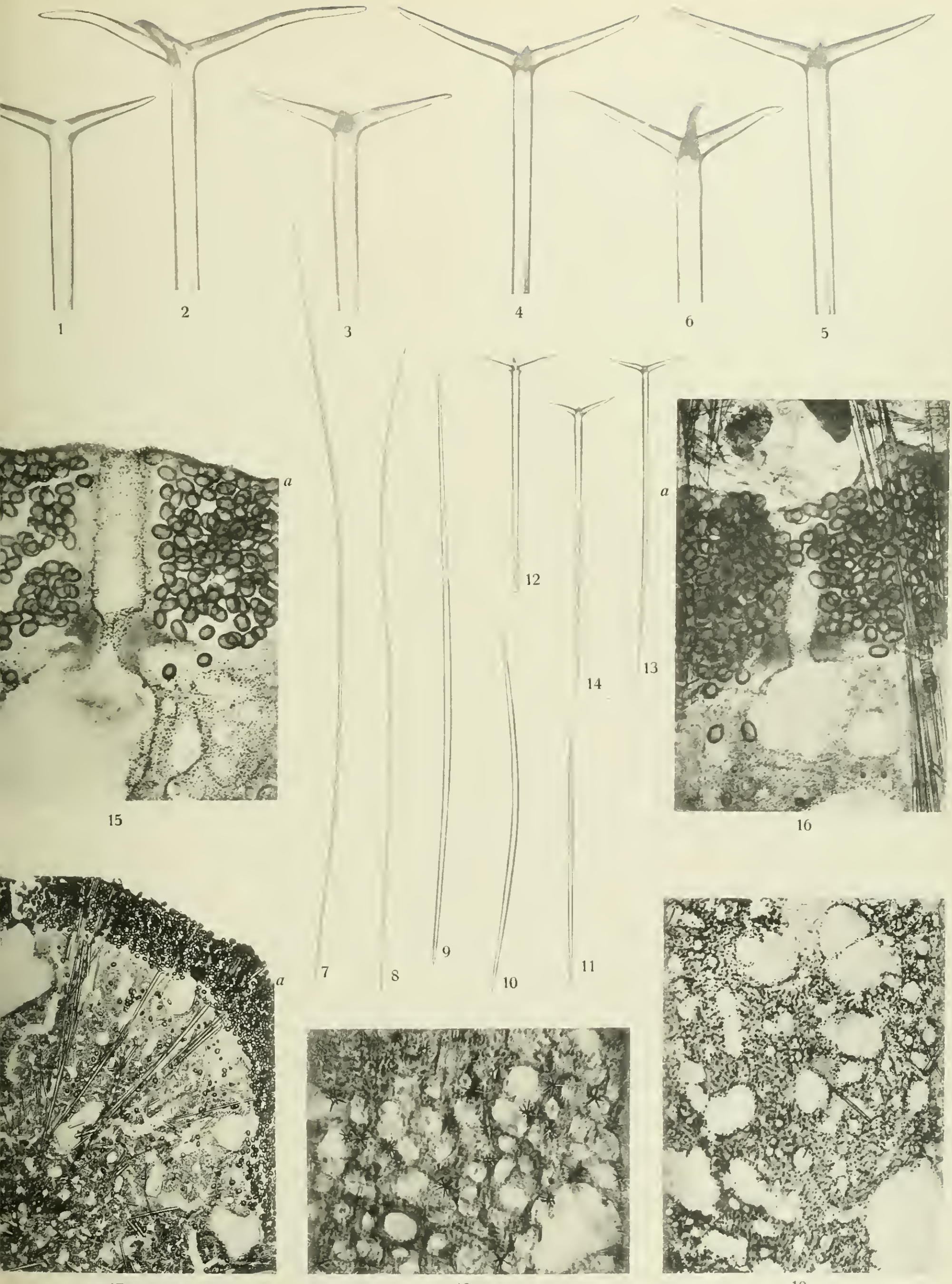


Fig. 1—19 Sidonops bicolor n. sp.
1, 3—5, 13 from station 2958; 2, 6, 9, 18 from station 4531; 7 from station 4551; 8, 10—12, 14 from station 2781; 15, 16 from station 4420; 17, 19 from station 3168.

PLATE 10.

PLATE 10.

Sidonops bicolor LENDENFELD.

Figures 1–15.

1–4.— Groups of sterrasters from spicule-preparations; magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6:

1, of a specimen from Station 2958;

2, of a specimen from Station 3168;

3, of a specimen from Station 2781;

4, of a specimen from Station 4420.

5.— Sterraster of a specimen from Station 4551; magnified 300; u. v. phot. Zeiss, q. monochr. 6, q. oc. 7.

6–12.— Groups of euasters from centrifugal spicule-preparations; magnified 300; u. v. phot. Zeiss, q. monochr. 6, q. oc. 7:

6, of a specimen from Station 3168;

7, of a specimen from Station 4420;

8, 11, of a specimen from Station 2781;

9, 10, 12, of a specimen from Station 4551;

a, oxyasters; b, strongylosphaerasters.

13.— Group of euasters from a centrifugal spicule-preparation of a specimen from Station 4551; magnified 300; u. v. phot. Zeiss, q. monochr. 1.7:

a, oxyasters; b, strongylosphaerasters.

14, 15.— Pores in the dermal membrane of a specimen from Station 3168; magnified 75; phot. Zeiss, apochr. 16, compens. oc. 4:

14, a uniporal efferent opening;

15, a cribriporal afferent opening.

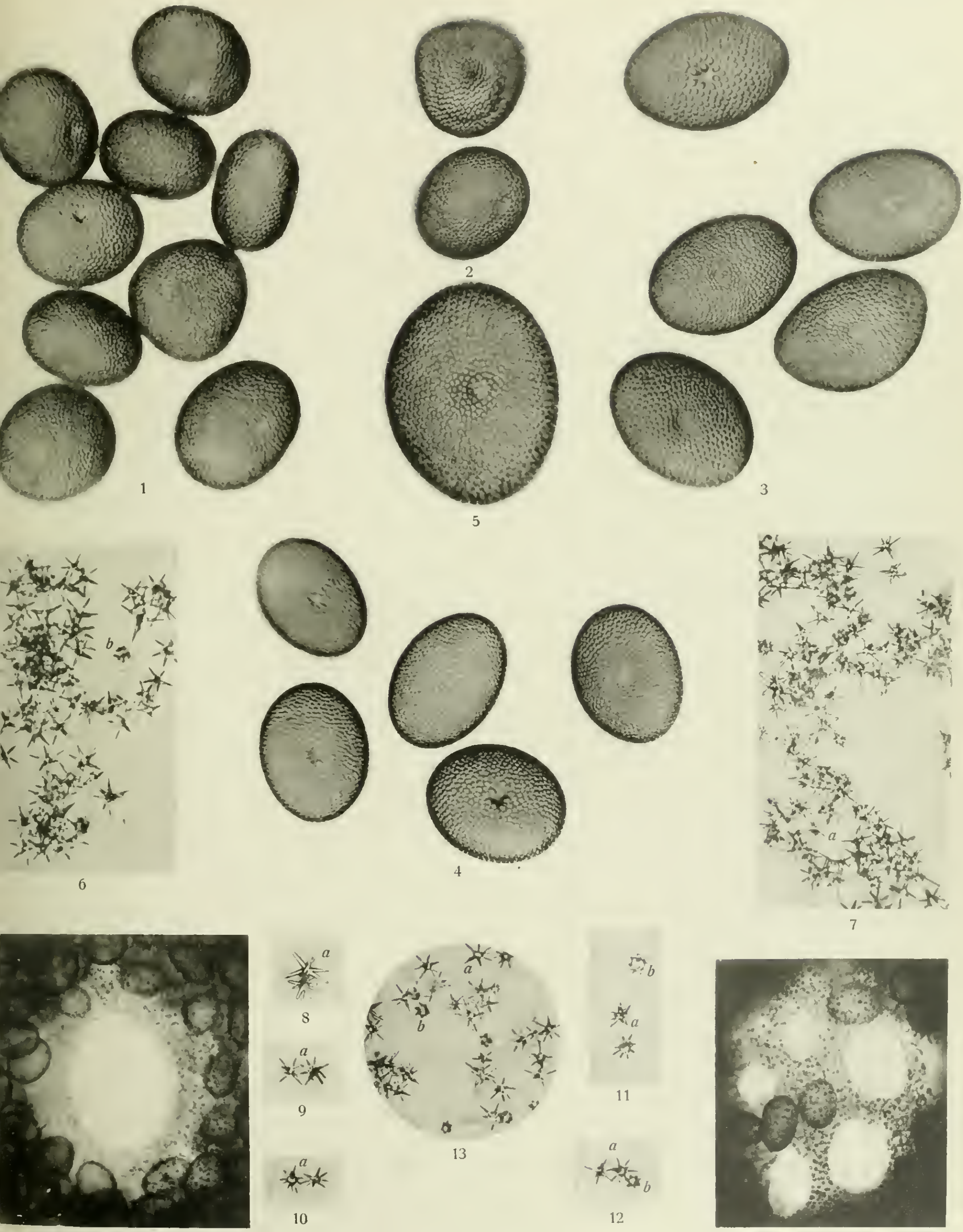


Fig. 1—15 Sidonops bicolor n. sp.

from station 2958; 2, 6, 14, 15 from station 3168; 3, 8, 11 from station 2781; 4, 7 from station 4420; 5, 9, 10. 12, 13 from station 4551.

PLATE 11.

PLATE 11.

Sidonops bicolor LENDENFELD.

Figures 1–17.

1, 2.— A larger and a smaller strongylosphaeraster of a specimen from Station 4551; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
  1, focused higher; 2, focused lower.

3–5.— Strongylosphaerasters; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
  3, 5, of a specimen from Station 2781;
  4, of a specimen from Station 3168.

6–8.— Groups of euasters from a centrifugal spicule-preparation; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
  6, a strongylosphaeraster (a) and a medium-sized oxyaster (b) of a specimen from Station 4551;
  7, a strongylosphaeraster (a), and an oxysphaeraster (b) of a specimen from Station 2781;
  8, a strongylosphaeraster (a) and a large oxyaster (b) of a specimen from Station 2781.

9.— An oxyaster of a specimen from Station 2781; magnified 900; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 5.

10.— Group of strongylosphaerasters of a specimen from Station 2781; magnified 900; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 5.

11–14.— Parts of the surface of sterrasters; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
  11, 12, of the umbilical side of sterrasters of a specimen from Station 2958;
  13, of the side opposite the umbilicus of a specimen from Station 2781;
  14, of the side opposite the umbilicus of a specimen from Station 2958.

15–17.— Three specimens; natural size; phot. Zeiss, anastig. 480 / 412:
  15, 16, two specimens from Station 4420;
  17, a specimen from Station 4551.

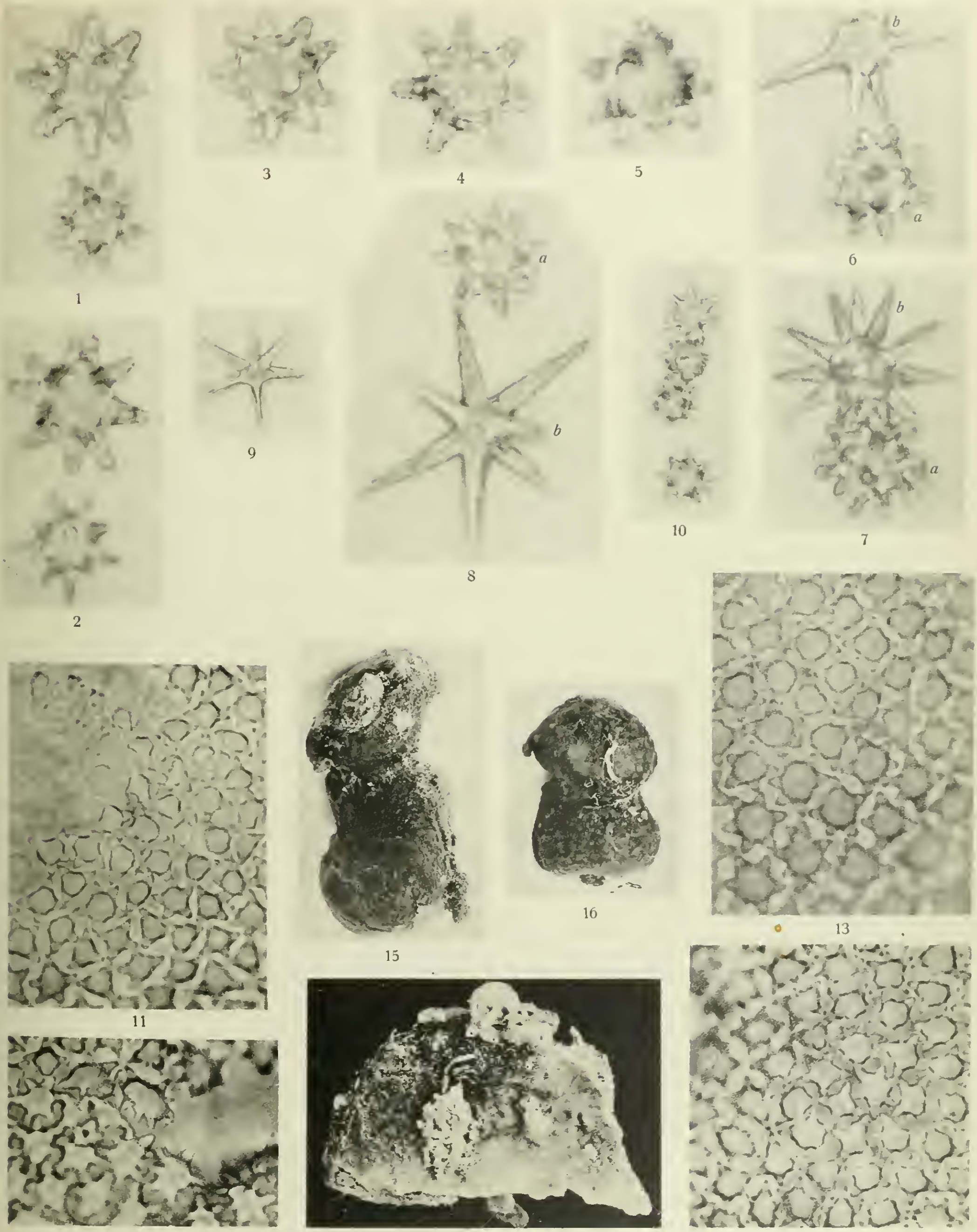


Fig. 1—17 Sidonops bicolor n. sp.

1, 2, 6, 17 from station 4551; 3, 5, 7—10, 13 from station 2781; 4 from station 3168; 11, 12, 14 from station 2958; 15, 16 from station 4420.

Lendenfeld photographed.

PLATE 12.

PLATE 12.

Sidonops angulata LENDENFELD.

Figs. 1–4, 16, 19. — var. **megana** LENDENFELD (lobose form).
Figs. 5–8, 17, 20. — var. **megana** LENDENFELD (massive form).
Figs. 9, 10. — var. **orthotriaena** LENDENFELD.
Figs. 11–15, 18, 21, 22.— var. **microana** LENDENFELD.

1–14.— Cladomes of anaclades; magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6:
1–4, of the lobose specimen of var. *megana*;
5–8, of the massive specimen of var. *megana*;
9, 10, of var. *orthotriaena*;
11–14, of var. *microana*;
1, 5, of anatriaenes with long equal clades;
2, 4, 12–14, of anatriaenes with short equal clades;
3, 6, 8, 9, of anatriaenes with medium-sized equal clades;
7, of an anatriaene with medium-sized unequal clades;
10, 11, of anadiaenes with short clades.

15.— The acladomal end of the anatriaene of var. *microana*, the cladome of which is represented in Fig. 14; magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6.

16, 17.— Groups of spicules from spicule-preparations; magnified 10; phot. Zeiss, planar 50:
16, of the lobose specimen of var. *megana*;
17, of the massive specimen of var. *megana*;
a, slender, dermal, simply curved amphioxes; b, slender, dermal, angularly bent amphiox; c, stout, choanosomal amphioxes; d, plagiotriaenes.

18–20.— Views of three of the specimens; phot. Zeiss, anastig. 480 / 412:
18, var. *microana*; magnified 1.1;
19, the lobose specimen of var. *megana*; reduced 1 : 0.86;
20, the massive specimen of var. *megana*; reduced 1 : 0.9.

21, 22.— Groups of plagiotriaenes from a spicule-preparation of var. *microana*; magnified 10; phot. Zeiss, planar, 50.

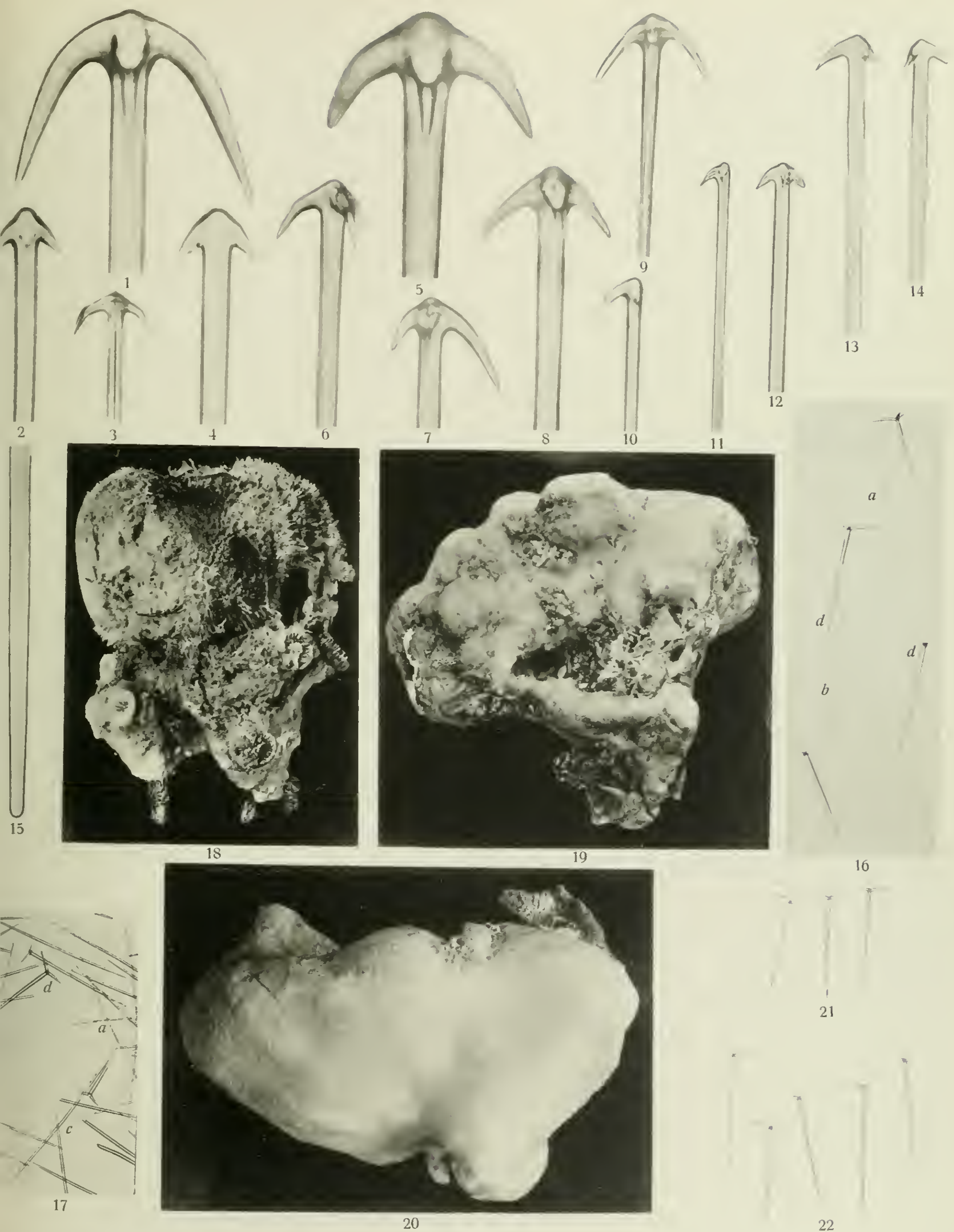


Fig. 1—22 Sidonops angulata n. sp.

1—4, 16, 19 lobose specimen of S. a. var. megana; 5—8, 17, 20 massive specimen of S. a. var. megana; 9, 10 S. a. var. orthotriaena; 11—15, 18, 21, 22 S. a. var. microana.

denfeld photographed.

Phototype by Charles Bellmann, Prague.

PLATE 13.

PLATE 13.

Sidonops angulata LENDENFELD.

Figs. 1–8. — var. **megana** LENDENFELD (lobose form).
Figs. 9–12, 22–25.— var. **megana** LENDENFELD (massive form).
Figs. 13–17, 21. — var. **microana** LENDENFELD.
Figs. 18–20. — var. **orthotriaena** LENDENFELD.

1, 2.— Stout, choanosomal amphioxes of the lobose specimen of var. *megana*; magnified 40; phot. Zeiss, planar 20.

3.— A plagiotriaene of the lobose specimen of var. *megana*; magnified 40; phot. Zeiss, planar 20.

4.— Apical view of the cladome of an irregular plagiotriaene of the lobose specimen of var. *megana*; magnified 40; phot. Zeiss, achr. aa, compens. oc. 6.

5–16.— Cladomes of plagiotriaenes seen from the side; magnified 40; phot. Zeiss, achr. aa, compens. oc. 6:

5–8, from the lobose specimen of var. *megana*;
9–12, from the massive specimen of *megana*;
13–16, from var. *microana*;
5, with long, somewhat unequal, terminally strongly recurved clades;
6, 8, with long, somewhat unequal, terminally slightly recurved clades;
7, 13, 16, with unequal, slightly recurved clades;
9, with short, equal, nearly straight clades;
10, with short, irregularly curved, somewhat unequal clades;
11, 15, with medium-sized, equal, slightly recurved clades;
12, with unequal, nearly straight clades;
14, with medium-sized, slightly unequal, rather strongly recurved clades.

17.— Group of spicules from a spicule-preparation of var. *microana*; magnified 40; phot. Zeiss, planar 20:

a, an angularly bent amphiox; b, a nearly straight amphiox; c, the cladomal half of an anatriaene.

18.— Cladome of an orthotriaene of var. *orthotriaena*; magnified 40; phot. Zeiss, achr. aa, compens. oc. 6.

19.— An orthotriaene with angularly bent rhabdome of var. *orthotriaena*; magnified 40; phot. Zeiss, achr. aa. compens. oc. 6.

20.— Two rhabds of var. *orthotriaena*; magnified 40; phot. Zeiss, planar 20:

a, a club-shaped style; b, an amphiox.

21.— Part of a radial section of var. *microana*; magnified 10; phot. Zeiss, planar 50:

a, cortex (sterraster-armour); b, spicule-fur.

22–24.— Surface views (parts of superficial paratangential sections) of the massive specimen of var. *megana*; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6:

22, an efferent uniporal opening;
23, 24, afferent cribriporal openings (pore-sieves).

25.— Part of a radial section through the superficial part of the massive specimen of var. *megana*; magnified 40; phot. Zeiss, achr. aa, compens. oc. 6:

a, sterraster-armour; b, a chone; c, a subcortical cavity.

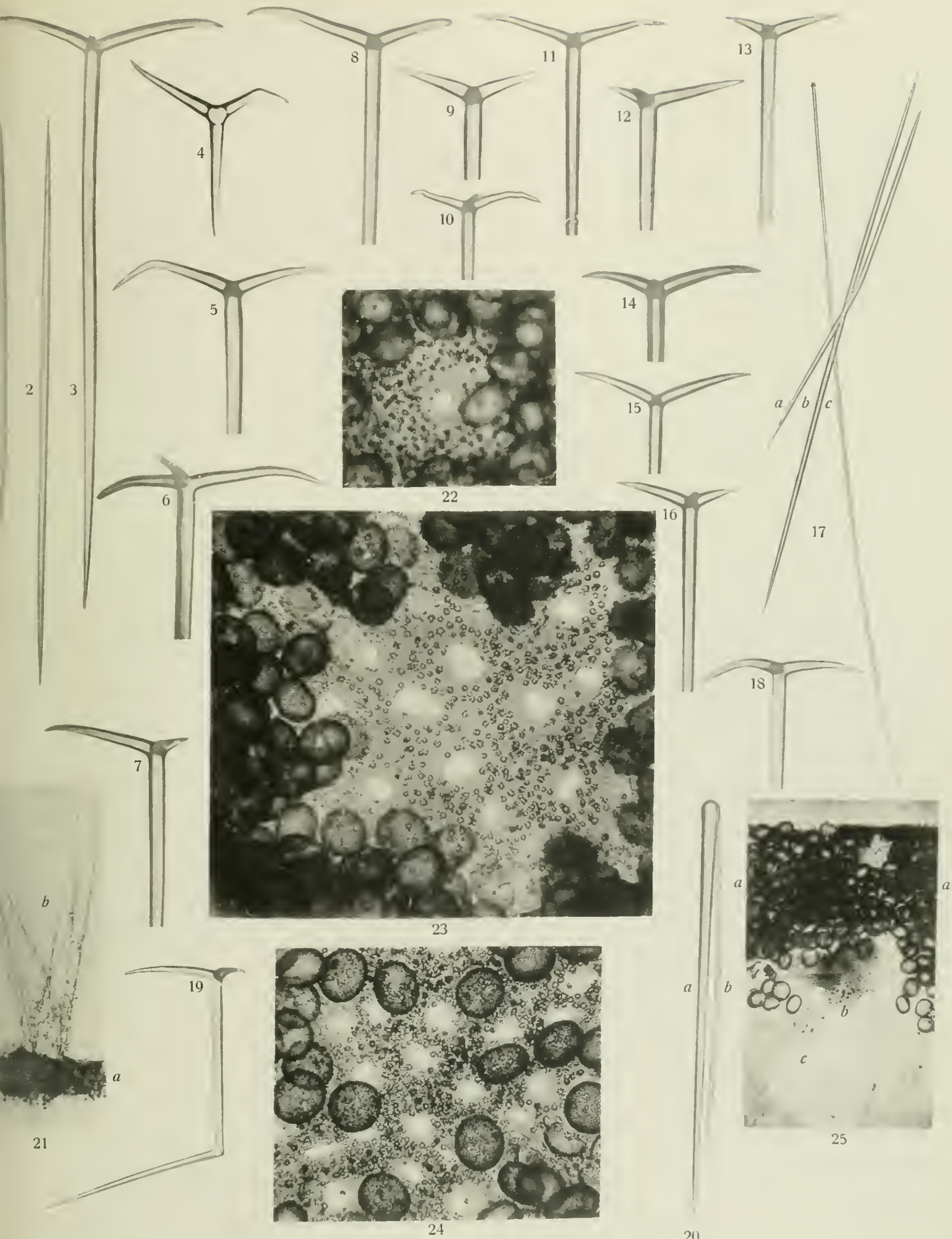


Fig. 1—25 Sidonops angulata n. sp.
1—8 lobose specimen of S. a. var. megana; 9—12, 22—25 massive specimen of S. a. var. megana; 13—17, 21 S. a. var. microana.
18—20 S. a. var. orthotriaena

enfeld photographed.

Phototype by Charles Bellmann Prague

PLATE 14.

PLATE 14.

Sidonops angulata Lendenfeld.

Figs. 1–4, 18, 19. — var. **megana** Lendenfeld (lobose form).
Figs. 5, 6, 16, 17, 20–22.— var. **megana** Lendenfeld (massive form).
Figs. 7–9. — var. **microana** Lendenfeld.
Figs. 10–15, 23–30. — var. **orthotriaena** Lendenfeld.

1–15.— Microscleres from centrifugal spicule-preparations; magnified 300:
1, 5, 7, 8, u. v. phot. Zeiss, q. monochr. 6, q. oc. 7;
2–4, 6, 9–15, u. v. phot. Zeiss, q. monochr. 1.7;
1–4, from the lobose specimen of var. *megana*;
5, 6, from the massive specimen of var. *megana*;
7–9, from var. *microana*;
10–15, from var. *orthotriaena*:
a, small oxysphaerasters with large centrum; b, large oxyasters without centrum; c, young sterrasters; d, strongylosphaerasters; e, intermediate oxyasters (oxysphaerasters) with small centrum.

16.— A small oxysphaeraster of the massive specimen of var. *megana*; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.

17.— Two strongylosphaerasters of the massive specimen of var. *megana*; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.

18, 19.– A strongylosphaeraster with few, irregularly distributed, fully developed rays, of the lobose specimen of var. *megana*; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
18, focused higher; 19, focused lower.

20.— Radial section through the dermal membrane of the massive specimen of var. *megana*; haematoxylin; magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6:
a, surface of the sponge; b, conspicuous, granular, subdermal cells; c, asters protruding beyond the surface.

21.— Radial section through the choanosome of the massive specimen of var. *megana*; azure; magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6:
a, flagellate chambers; c, asters.

22.— Radial section through the cortex of the massive specimen of var. *megana*; azure; magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6:
a, fibrous inner cortical layer; b, subcortical cavity; c, asters, protruding into the subcortical cavity.

23.— Small oxysphaeraster of var. *orthotriaena*; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.

24.— Large triactine oxyaster with rudiment of a fourth ray of var. *orthotriaena*; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.

25–30.— Strongylosphaerasters of var. *orthotriaena*; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
25, part of a regular strongylosphaeraster with cylindrical rays;
26, a strongylosphaeraster with somewhat irregularly distributed, cylindrical rays;
27, 28, two views of a regular strongylosphaeraster with somewhat conical rays;
27, focused higher; 28, focused lower;
29, 30, two views of a strongylosphaeraster with only one fully developed ray;
29, focused higher; 30, focused lower.

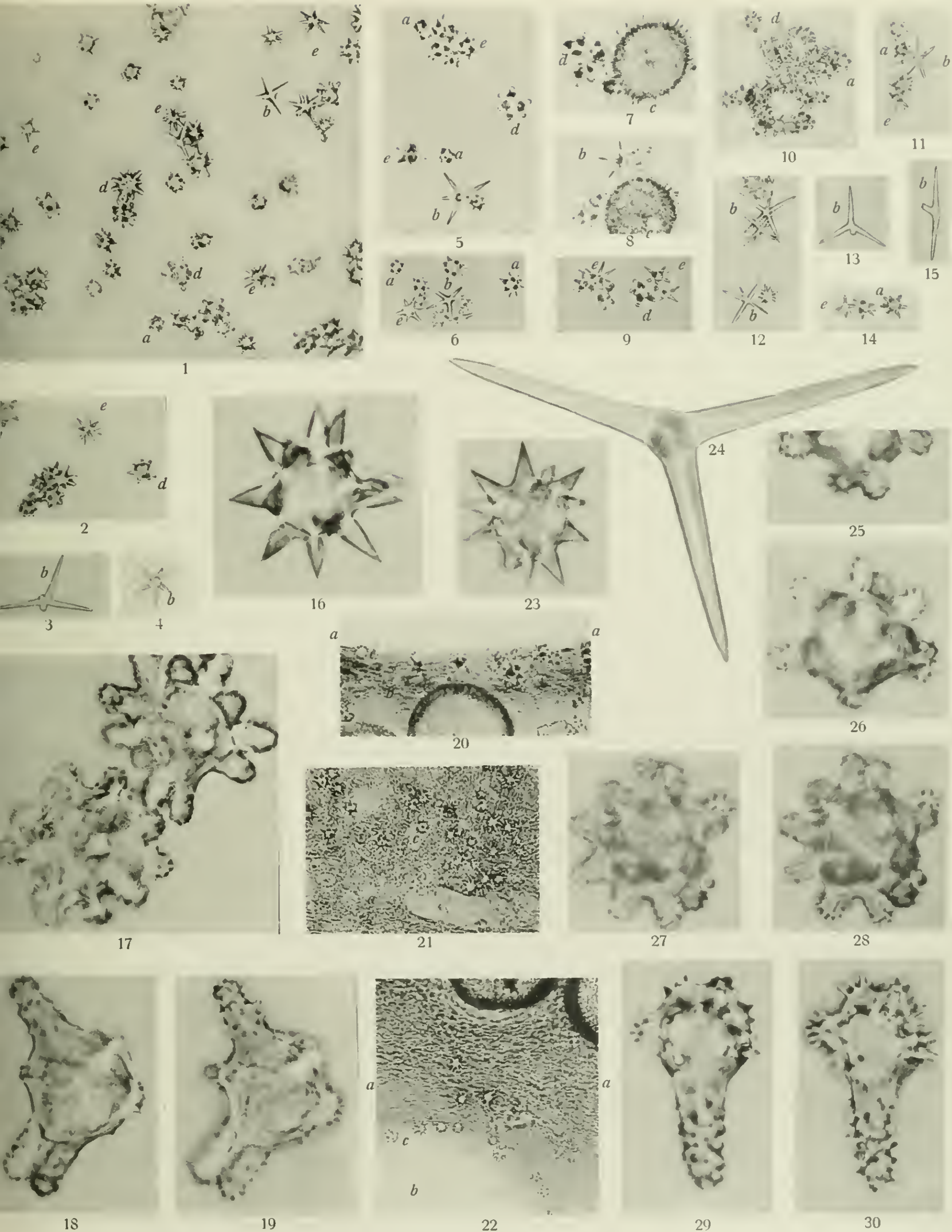


Fig. 1—30 Sidonops angulata n. sp.

—4, 18, 19 lobose specimen of S. a. var. megana; 5, 6, 16, 17, 20—22 massive specimen of S. a. var. megana; 7—9 S. a. var. microana; 10—15, 23—30 S. a. var. orthotriaena.

ıdenfeld photographed.

Phototype by Charles Bellmann, Prague.

PLATE 15.

PLATE 15.

Sidonops angulata LENDENFELD.

Figs. 1, 2, 4, 9. — var. **megana** LENDENFELD (massive form).
Figs. 3, 7, 8, 11.— var. **megana** LENDENFELD (lobose form).
Figs. 5, 6, 12. — var. **orthotriaena** LENDENFELD.
Fig. 10. — var. **microana** LENDENFELD.

1, 2.— Two views of the umbilicus and the adjacent parts of the surface of a sterraster of the massive specimen of var. *megana*; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
1, focused higher: 2, focused lower

3.— The umbilicus and the adjacent parts of the surface of a sterraster of the lobose specimen of var. *megana*; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.

4.— Part of a section through the choanosome of the massive specimen of var. *megana*; haematoxylin; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6:
a, masses of small cells; b, lumen of a canal.

5, 6.— Part of the surface opposite to the umbilicus of a sterraster of var. *orthotriaena*; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
5, focused higher; 6, focused lower.

7.— Part of a paratangential section of the cortex of the lobose specimen of var. *megana*; magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6:
a, blunt cones protruding into a radial cortical canal; b, lumen of the radial cortical canal; c, sterrasters.

8.— Part of a paratangential section of the lobose specimen of var. *megana*, transverse through a chone; magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6:
a, position of the (closed) chonal canal.

9–12.— Groups of sterrasters from spicule-preparations: magnified 200; phot. Zeiss, apochr. 8. compens. oc. 6:
9, of the massive specimen of var. *megana*;
10, of var. *microana*;
11, of the lobose specimen of var. *megana*;
12, of var. *orthotriaena*.

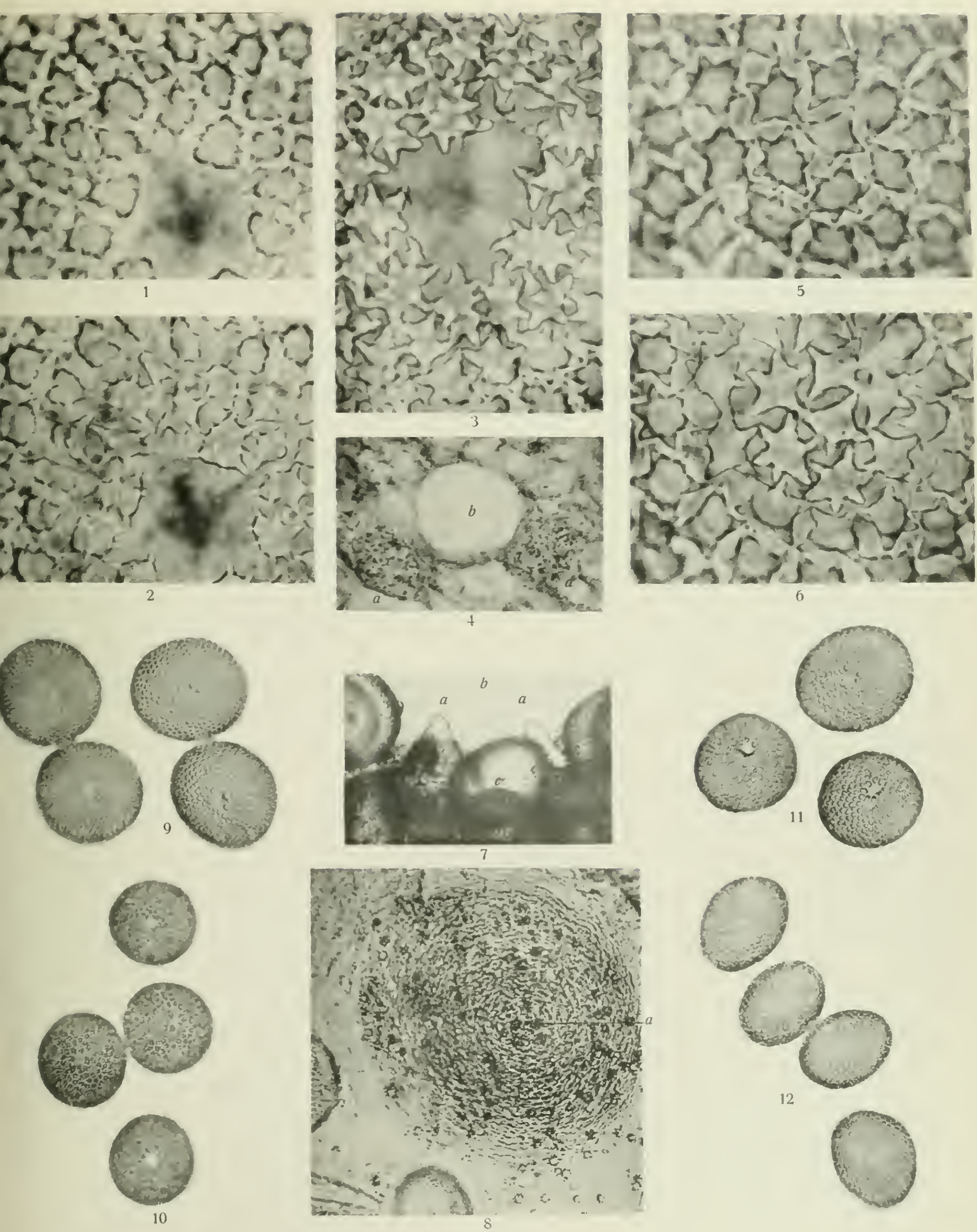


Fig. 1—12 Sidonops angulata n. sp.

2, 4, 9 massive specimen of S. a. var. megana; 3, 7, 8, 11 lobose specimen of S. a. var. megana; 5, 6, 12, S. a. var. orthotriaena; 10 S. a. var. microana.

ndenfeld photographed.

Phototype by Charles Bellmann, Prague.

PLATE 16.

PLATE 16.

Geodia media Bowerbank.

Figs. 1–21.

1–14.— Megascleres; magnified 30; phot. Zeiss, planar 20:
1–5, 7n, o, 8b, 9y, 10x, 13, 14, from the digitate specimen;
6, 7m, p, 8z, 9e, w, 10d, 11, 12, from massive specimens;
1–6, 11, groups of megascleres from spicule-preparations;
7, mesoclades with reduced clades;
8, regular stout amphioxes;
9, angularly bent amphioxes;
10, branched amphioxes;
12, 14, plagiotriaenes;
13, regular, angularly bent, and branched styles,
a, (Figs. 3–5) large, slender, regular amphioxes; b, (Figs. 1–5, 8) large, stout, regular amphioxes; c, (Fig. 9) large, stout amphiox, strongly angularly bent at one point; d, (Figs. 5, 10) large amphioxes with one simple branch near one of the ends, enclosing a small angle with the axis of the spicule; e, (Fig. 5) large amphiox with a bifid branch near one end; f, (Figs. 11, 13) large, regular, simple styles; g, (Fig. 13) large, angularly bent styles; h, (Figs. 11, 13) large styles with one simple branch; i, (Fig. 13) large style with a bunch of simple branches near the pointed end; j, (Fig. 2) large angularly bent amphiox with one simple branch; k, (Fig. 13) large angularly bent style with one simple branch; l, (Fig. 6) anatriaene, probably foreign to the sponge; m, (Fig. 7) mesoplagiomonaene with nearly straight rhabdome; n, (Fig. 7) mesopromonaene; o, (Fig. 7) mesoplagio-orthomonaene; p, (Fig. 7) mesoplagiomonaene with strongly curved rhabdome; q, (Figs. 1, 12, 14) slender regular plagiotriaenes; r, (Fig. 5) slender plagiotriaene with unequal clades; s, (Figs. 1–6, 11, 12) stout regular plagiotriaenes; t, (Fig. 12) stout plagiotriaene with one bifid clade; u, (Fig. 3) stout plagiodiaene with one bifid clade; v, (Fig. 1) stout mesoplagiotriaene with long epirhabd (pointing downwards in the figure); w, (Fig. 9) large, stout amphiox angularly bent in two places; x, (Fig. 10) large stout amphiox with one simple branch near the blunt end, enclosing a large angle (of nearly 90°) with the axis of the spicule; y, (Figs. 1, 9) large, stout amphioxes slightly angularly bent at one point; z, (Figs. 6, 8, 11) very large, stout, regular amphioxes.

15.— The umbilical part of the surface of a sterraster of a massive specimen; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.

16.— The largest of the massive specimens; natural size; phot. Zeiss, anastig. 480 / 412.

17.— The digitate specimen; natural size; phot. Zeiss, anastig. 480 / 412.

18, 19.— Groups of sterrasters from spicule-preparations; magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6:
18, of a massive specimen;
19, of the digitate specimen.

20, 21.— A sterroid of the digitate specimen; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6:
20, the upper surface in focus; 21, the equatorial profile in focus.

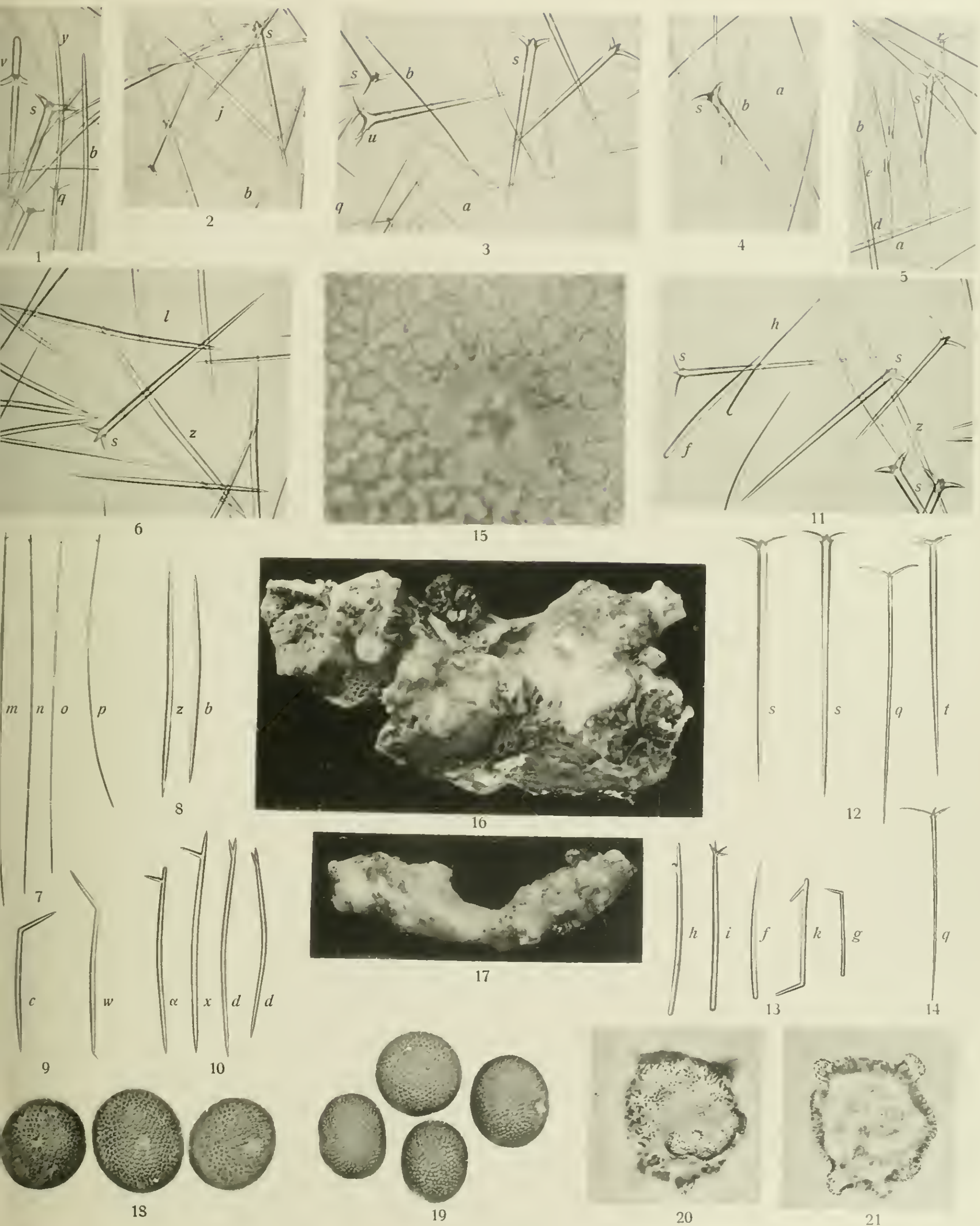


Fig. 1—21 Geodia media Bwbk.

1—5, 7 n, o, 8 b, 9 y, 10 x, 13, 14, 17, 19—21 digitate form; 6, 7 m, p, 8 z, 9 c, w, 10 d, 11, 12, 15, 16, 18 massive form.

:nfeld photographed.

Phototype by Charles Bellmann, Prague

33.— The rounded end of a style (subtylostyle) of var. *micraster*; magnified 75; phot. Zeiss, apochr. 16, compens. oc. 6.

34–38.— Cladomes of orthoplagiotriaenes and dichotriaenes of var. *intermedia*; magnified 40; phot. Zeiss, apochr. 16:

34–36, cladomes of regular adult orthoplagiotriaenes;

37, cladome of a young orthoplagiotriaene;

38, a, cladome of a rather irregular adult orthoplagiotriaene;

b, cladome of a dichotriaene.

39, 40.— Two aspects of the specimen of var. *intermedia*; phot. Zeiss, anastig. 480 / 412:

39, natural size;

40, magnified 1.14.

41.— The specimen of var. *micraster*; magnified 1.07; phot. Zeiss, anastig. 480 / 412.

42.— A choanosomal amphiox of var. *micraster*; magnified 20; phot. Zeiss, planar 20.

43.— A choanosomal style of var. *micraster*; magnified 20; phot. Zeiss, planar 20.

44–47.— Orthoplagiotriaene cladomes of var. *micraster*; magnified 40; phot. Zeiss, apochr. 16.

44, 45, with unequal but otherwise regular clades;

46, with one shortened and truncate and one abruptly bent clade;

47, with rather equal regular clades.

48.— Cladome of a dichotriaene of var. *micraster*; magnified 40; phot. Zeiss, apochr. 16.

49.— Cladome of a fairly regular orthoplagiotriaene of var. *intermedia* seen from above; magnified 40; phot. Zeiss, apochr. 16.

50.— Cladome of a dichotriaene of var. *micraster*; magnified 40; phot. Zeiss, apochr. 16.

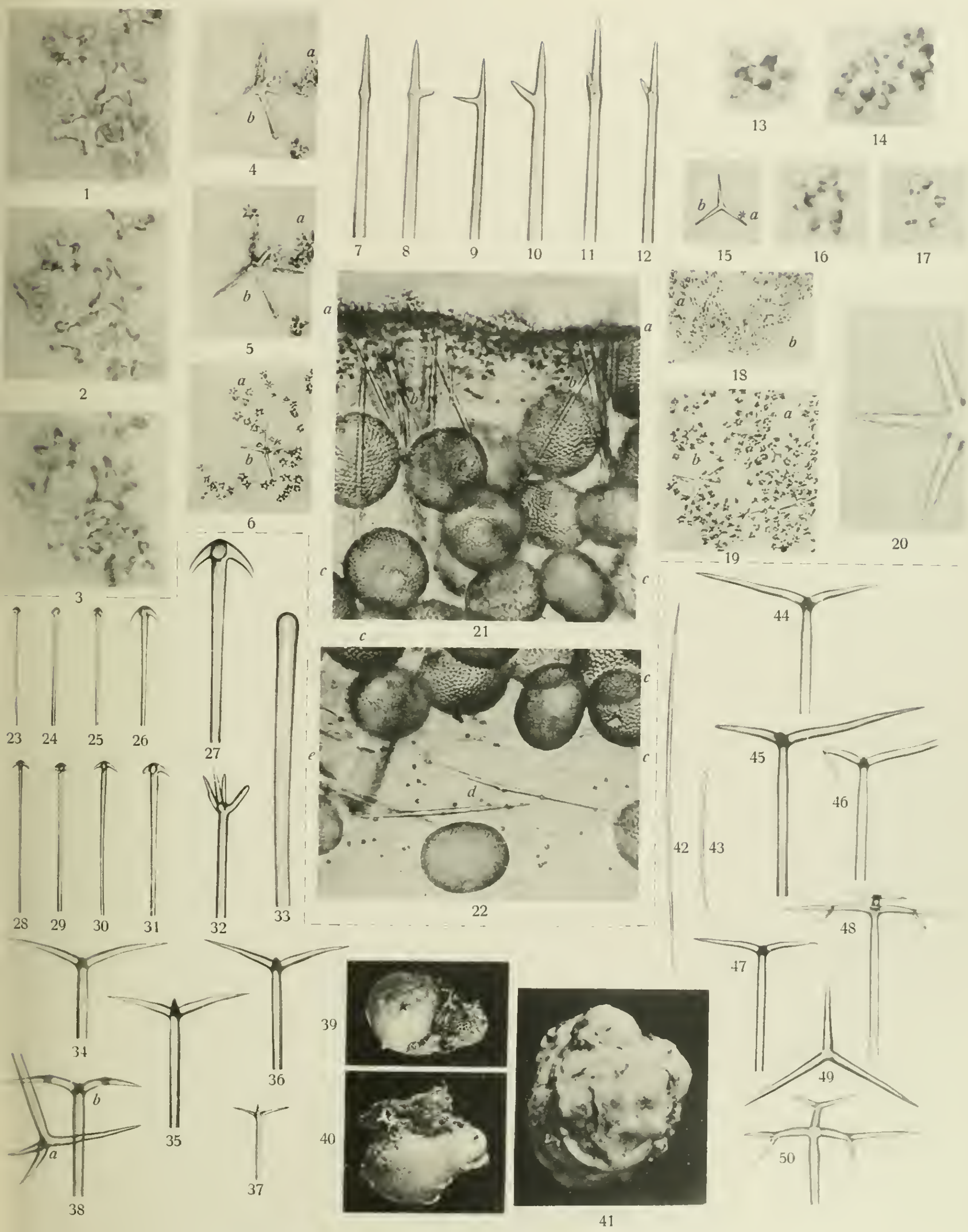


Fig. 1—22 Geodia media Bwbk.
1—10, 13, 14, 16, 17, 20—22 massive form; 11, 12, 15, 18, 19 digitate form.
Fig. 23—50 Geodia variospiculosa Thiele.
23—26, 34—40, 49 G. v. var. intermedia; 27—33, 41—48, 50 G. v. var. micraster.

endenfeld photographed.

PLATE 18.

Geodia variospiculosa THIELE.

Figs. 1–7, 9, 11, 12, 21, 23–26.— var. **micraster** LENDENFELD.
Figs. 8, 10, 13–20, 22, 27. — var. **intermedia** LENDENFELD.

1.— Large hexactine oxyaster of var. *micraster*; magnified 300; u. v. phot. Zeiss, q. monochr. 6, q. oc. 7.
2.— Group of asters from a centrifugal spicule-preparation of var. *micraster*; magnified 300; u. v. phot. Zeiss, q. monochr. 6, q. oc. 7:
a, large triactine oxyaster; b, smaller oxyasters; c, small strongylosphaerasters.
3.— Large hexactine oxyaster of var. *micraster*; magnified 300; u. v. phot. Zeiss, q. monochr. 6; q. oc. 7.
4.— Large triactine oxyaster of var. *micraster*; magnified 300; u. v. phot. Zeiss, q. monochr. 6, q. oc. 7.
5.— Group of spicules from a centrifugal spicule-preparation of var. *micraster*; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6:
c, small strongylosphaerasters; d, large monactine oxyaster; e, parts of dermal styles.
6.— A large monactine oxyaster of var. *micraster*; magnified 300; phot. Zeiss, hom. imm. apochr. 2.
7.— Group of asters from a centrifugal spicule-preparation of var. *micraster*; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6:
b, smaller oxyasters; c, small strongylosphaerasters.
8.— Part of a radial section through the subcortical layer of var. *intermedia*; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6:
a, cortical sterraster-armour; b, bundle of radial megascleres; c, a subcortical group of small dermal styles; d, cladome of an anatriaene.
9.— View of part of the surface of var. *micraster*, showing a pore-sieve; magnified 75; phot. Zeiss, apochr. 16, compens. oc. 6.
10.— Group of spicules from a centrifugal spicule-preparation of var. *intermedia*; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6:
a, large triactine oxyaster; b, small oxyaster; c, small strongylosphaerasters; f, oxysphaeraster.
11.— Group of small strongylosphaerasters from a centrifugal spicule-preparation of var. *micraster*; magnified 300; phot. Zeiss, apochr. 4; compens. oc. 6.
12.— A small oxyaster of var. *micraster*; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6.
13.— An oxysphaeraster of var. *intermedia*; magnified 300; u. v. phot. Zeiss, q. monochr. 6, q. oc. 7.
14.— Group of asters from a centrifugal spicule-preparation of var. *intermedia*; magnified 300; u. v. phot. Zeiss, q. monochr. 6, q. oc. 7:
b, smaller oxyaster; c, small strongylosphaerasters.
15–20.— Large oxyasters of var. *intermedia*; magnified 300; u. v. phot. Zeiss, q. monochr. 6, q. oc. 7:
15, 17, 19, large pentactine oxyasters;
16, a large triactine oxyaster;
18, 20, large tetractine oxyasters.
21.— Radial section through the superficial part of var. *micraster*; magnified 10; phot. Zeiss, planar 50:
a, sterraster-armour; b, a chone; c, subcortical cavities; d, choanosome.
22.— Part of a radial section of the proximal portion of the choanosome of var. *intermedia*; magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6:
a, large oxyasters; b, smaller oxyasters.
23.— Part of a radial section of the proximal portion of the cortex of var. *micraster*, passing through a (closed) chonal canal; magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6:
a, oxysphaerasters surrounding the (closed) chonal canal.
24.— Part of a radial section through the distal portion of the cortex and the spicule-fur of var. *micraster*; magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6:
a, minute dermal anaclades: b, rhabdome of a large protruding anatriaene; c, surface of the sponge.

25.— Part of a radial section through the distal part of the choanosome of var. *micraster*; magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6:

a, medium-sized oxyaster; b, smaller oxyasters.

26.— Radial section through the superficial part of var. *micraster*; magnified 20; phot. Zeiss, planar 20:

a, sterraster-armour; b, a chone; c, small dermal styles and anaclades protruding beyond the surface; d, choanosome; e, small dermal styles and anaclades in the subcortical layer.

27.— Part of a radial section of the proximal portion of the choanosome of var. *intermedia*; magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6:

a, large oxyasters; b, smaller oxyasters.

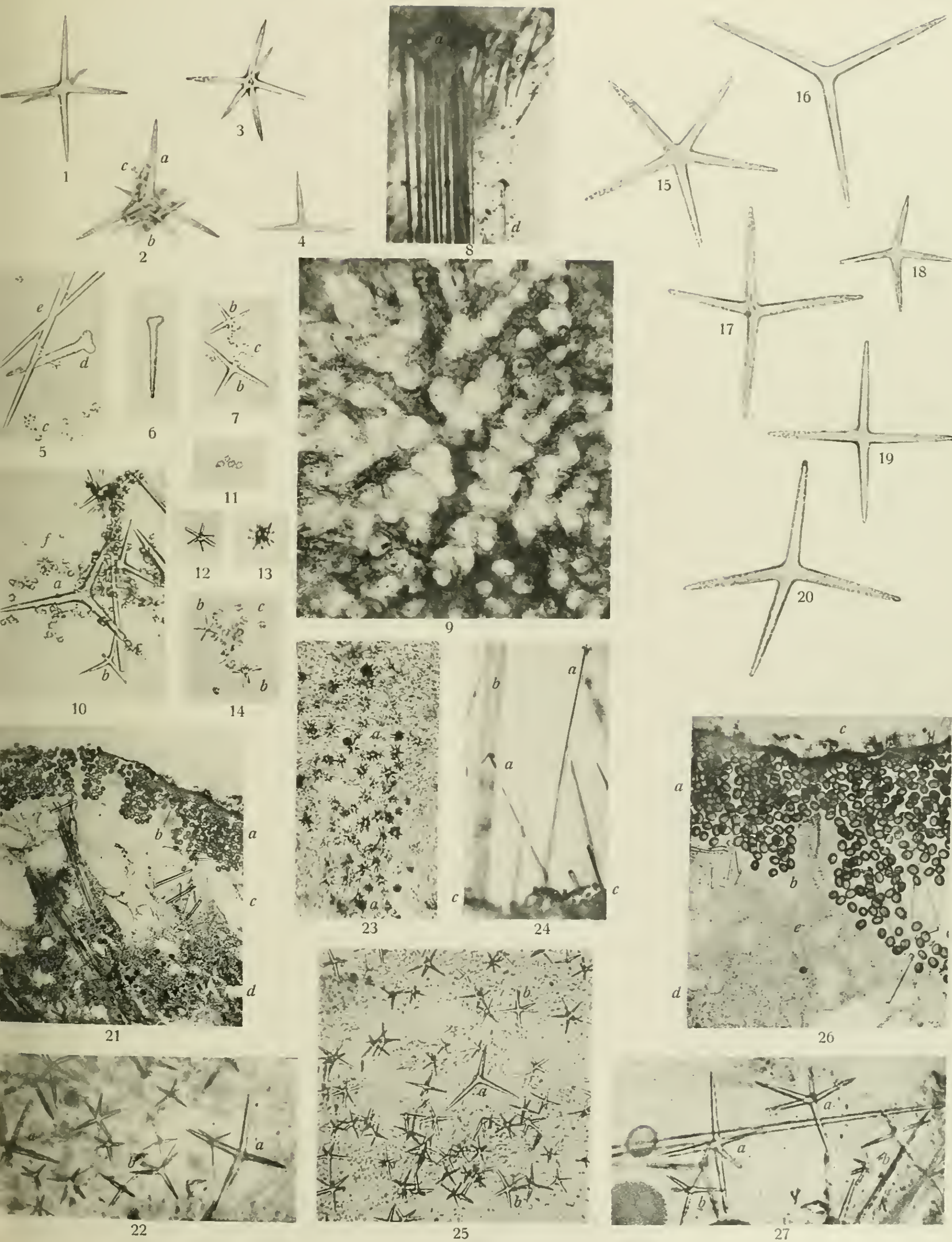


Fig. 1—27 Geodia variospiculosa Thiele.
1—7, 9, 11, 12, 21, 23—26 G. v. var. micraster; 8, 10, 13—20, 22, 27 G. v. var. intermedia.

enfeld photographed.

PLATE 19.

PLATE 19.

Geodia variospiculosa Thiele.

Figs. 1–8, 12–18, 21, 23, 25–30, 32.— var. **micraster** Lendenfeld.
Figs. 9–11, 19, 20, 22, 24, 31. — var. **intermedia** Lendenfeld.

1, 2.— An umbilical part of the surface of a normal sterraster of var. *micraster*; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:

1, focused higher; 2, focused lower.

3.— Cladome of a minute dermal anatriaene of var. *micraster*; magnified 750; phot. Zeiss, hom. imm. apochr. 2, compens. oc. 6.

4, 5.— Small dermal styles of var. *micraster*; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6.

6.— Minute dermal anamonaene of var. *micraster*; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6.

7, 8.— Minute dermal anatriaenes of var. *micraster*; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6.

9, 10.— Minute dermal anatriaenes of var. *intermedia*; magnified 300; u. v. phot. Zeiss, q. monochr. 6, q. oc. 7.

11.— An umbilical part of the surface of a normal sterraster of var. *intermedia*; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.

12, 13.— Group of asters from a centrifugal spicule-preparation of var. *micraster*; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7 q. oc. 10:

12, focused higher; 13, focused lower;

a, oxysphaeraster; b, small strongylosphaerasters.

14.— Cladome of a minute dermal anatriaene of var. *micraster*; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.

15, 16.— Sterroid with stout, smooth, spineless rays of var. *micraster*; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6:

15, focused higher (the upper surface in focus); 16, focused lower (the contour in focus).

17, 18.— Sterroid with very stout, terminally densely spined rays of var. *micraster*; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6:

17, focused higher (the upper surface in focus); 18, focused lower (the contour in focus).

19–24.— Small strongylosphaerasters and groups of such from centrifugal spicule-preparations; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:

19, 20, 22, 24, of var. *intermedia*;

21, 23, of var. *micraster*.

25–27.— Rays of oxyasters of var. *micraster*; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.

28.— A monactine aster of var. *micraster*; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.

29, 30.— Rays of oxyasters of var. *micraster*; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.

31.— Group of sterrasters from a spicule-preparation of var. *intermedia*; magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6.

32.— Group of sterrasters from a spicule-preparation of var. *micraster*; magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6.

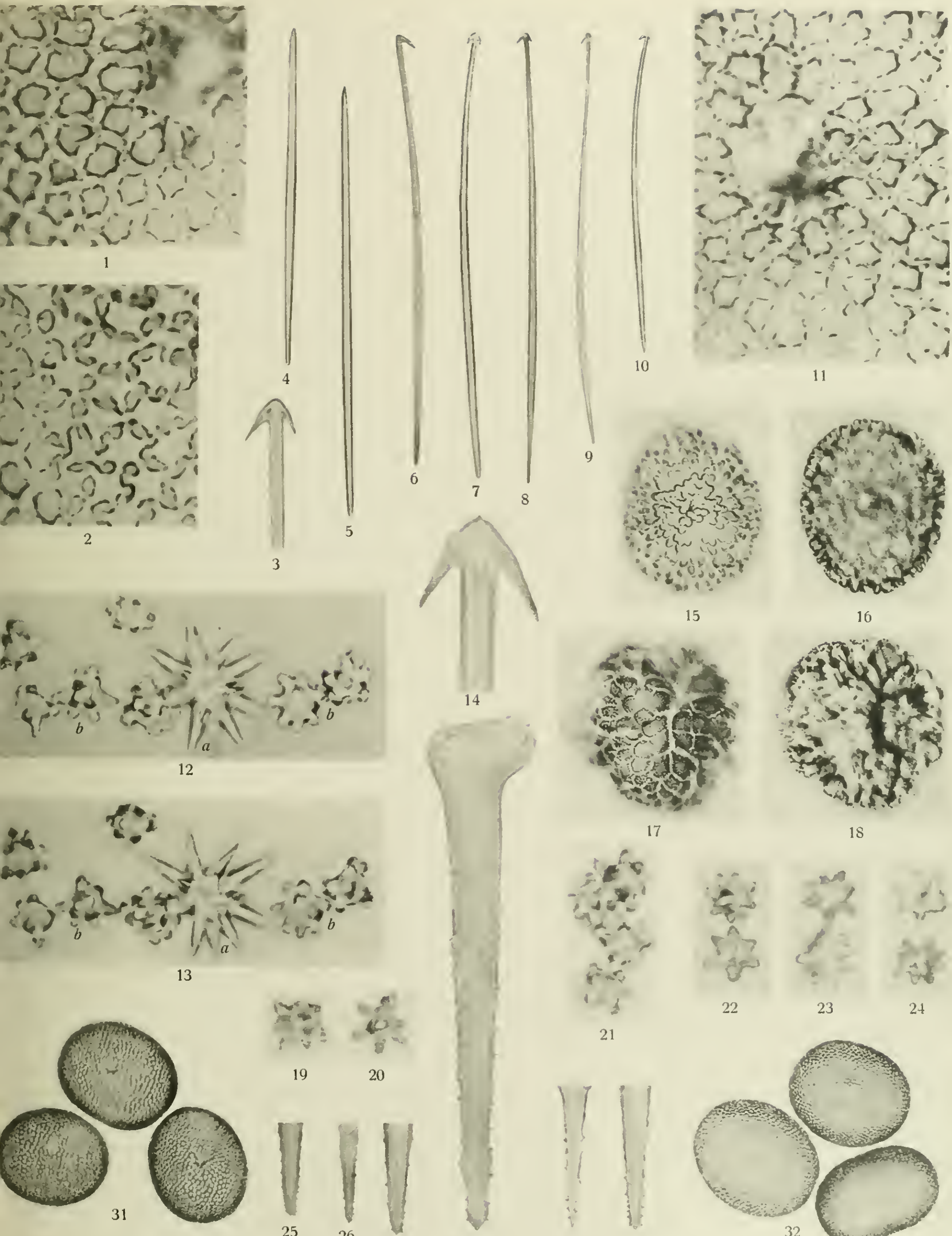


Fig. 1—32 Geodia variospiculosa Thiele.

1—8, 12—18, 21, 23, 25—30, 32 G. v. var. micraster; 9—11, 19, 20, 22, 24, 31 G. v. var. intermedia.

ndenfeld photographed.

PLATE 20.

PLATE 20.

Geodia amphistrongyla Lendenfeld.

Figures 1–41.

1–3.— Choanosomal amphistrongyles; magnified 30; phot. Zeiss, planar 20.

4.— Cladome of a mesanatriaene with oblique epirhabd; magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6.

5, 6.— Cladomes of anatriaenes; magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6:
  5, with smaller clade-rhabdome angle;
  6, with larger clade-rhabdome angle.

7, 8.— Cladomes of mesoproclades, magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6:
  7, of a mesopromonaene;
  8, of a mesoprotriaene.

9.— Part of radial section through the distal portion of the choanosome, showing a cluster of young sterrasters *in situ*; magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6.

10.— Cladome of an anatriaene; magnified 300; phot. Zeiss, hom. imm. apochr. 2.

11.— Cladome of an anatriaene; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6.

12.— Large choanosomal oxyaster; magnified 450; u. v. phot. Zeiss, q. monochr. 6, q. oc. 10.

13, 14.— Parts (rays) of large choanosomal oxyasters; magnified 750; phot. Zeiss, hom. imm. apochr. 2, compens. oc. 6.

15, 16.— Parts (rays) of large choanosomal oxyasters; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.

17.— One end of a cylindrical amphistrongyle with thickenings; magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6.

18–21.— Large choanosomal rhabds and parts of such; magnified 100; phot. Zeiss, apochr. 100, compens oc. 6.:
  18, a short anisoactine, somewhat style-like amphistrongyle;
  19, a larger, nearly isoactine, cylindrical amphistrongyle;
  20, the rounded end of a large style (the pointed end of this spicule is represented in Fig. 21);
  21, the pointed end of a large style (the rounded end of this spicule is represented in Fig. 20).

22–25.— Cladomes of plagiotriaenes and derivates of such: magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6:
  22, cladome of a regular plagiotriaene with short clades;
  23, cladome of a plagiomonaene with normal rhabdome and simple clade;
  24, an orthodichomonaene with shortened rhabdome;
  25, cladome of a regular plagiotriaene with long clades.

26–30.— Groups of microscleres from a centrifugal spicule-preparation; magnified 300:
  26–28, 30, phot. Zeiss, apochr. 4, compens. oc. 6;
  29, phot. Zeiss, hom. imm. apochr. 2;
    a, large choanosomal oxyasters; b, large oxysphaerasters; c, small strongylosphaerasters; d, young sterrasters.

31.— View of the sponge; magnified 1.1; phot. Zeiss, anastig. 480 / 412.

32.— Group of sterrasters from a spicule-preparation; magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6.

33.— Radial section through the superficial part of the sponge; magnified 20; phot. Zeiss, planar 20:
  a, cortex; b, a chone; c, subcortical cavities; d, choanosome.

34–36.— Small strongylosphaerasters, two single ones and a group, from a centrifugal spicule-preparation; magnified 1800; u. v. phot. Zeiss, monochr. 1.7, q. oc. 10.

37, 38.— The umbilicus of a sterraster and the adjacent parts; magnified 1800; u. v phot. Zeiss, q. monochr. 1.7, q. oc. 10:
  37, focused lower; 38, focused higher.

39.— Radial section through the superficial part of the sponge; magnified 10; phot. Zeiss, planar 50:
  a, cortex; c, subcortical cavities; d, choanosome.

40, 41. Part of the surface of the side of a sterraster; magnified 1800; u. v. phot. Zeiss. q. monochr. 1.7, q. oc. 10:
  40, focused lower; 41, focused higher.

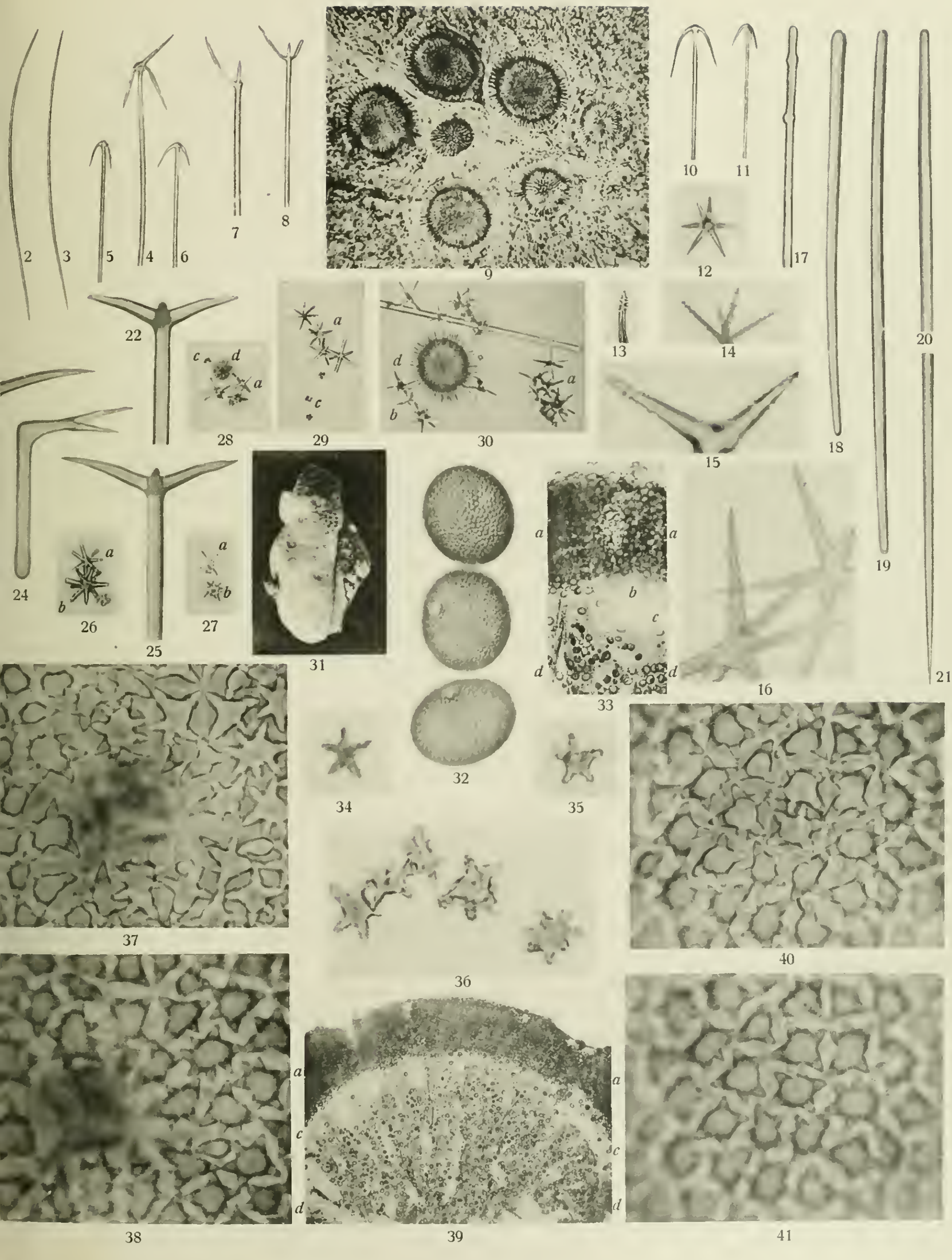


Fig. 1—41 Geodia amphistrongyla n. sp.

enfeld photographed.

PLATE 21.

PLATE 21.

Geodia mesotriaena LENDENFELD.

Fig. 1. — var. **pachana** LENDENFELD.
Figs. 2–6.— var. **megana** LENDENFELD.

1.— Dry specimen of var. *pachana* seen from above; reduced 1 : 0.67; phot. Zeiss, anastig. 480 / 412.

2.— Radial section of a spirit specimen of var. *megana*; reduced 1 : 0.67; phot. Zeiss, anastig. 480 / 412:

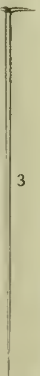
a, hirsute part, where the projecting spicules have not been broken off; b, praeoscular cavity.

3–6.— Teloclades of var. *megana*; magnified 10: phot. Zeiss, planar 50:

3, 5, orthotriaenes fully developed;

4, young orthotriaene;

6, mesoprotriaene.



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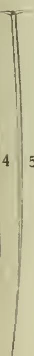

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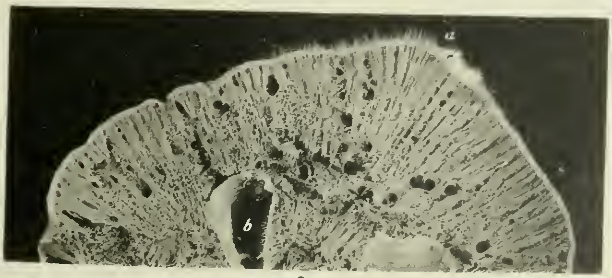

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Fig. 1—6 Geodia mesotriaena n. sp.
1 G. m. var. pachana; 2—6 G. m. var. megana.

endenfeld photographed.

PLATE 22.

PLATE 22.

Geodia mesotriaena var. **megana** Lendenfeld.

Figures 1–10.

1–6.— A series of paratangential sections through a chone and the canals leading to it from the dermal pores (a chonal system); magnified 30; phot. Zeiss, planar 20:

1, first section, the central part in the level of the centre of the concave pore-sieve;

2, second section, the central part half way down the ectochrotal layer overlying the sterraster-armour;

3, 4, third and fourth section, in the distal and proximal part of the sterraster-armour respectively;

5, fifth section, at the proximal limit of the sterraster-armour;

6, sixth section, through the chone, below the sterraster-armour;

a, dermal pores (in Fig. 1); b, oblique superficial canals leading from the pores to the chonal canal (Figs. 1, 2); c, chonal canal (Figs. 3–6).

7.— Slightly oblique paratangential section, the lower part a, a little higher than the upper part, b, magnified 10; phot. Zeiss, planar 50:

c, chones.

8.— The central part of the first of the paratangential sections represented in Fig. 1; magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6.

9.— Part of a radial section through the choanosome, showing large granular cells; azure; magnified 750; phot. Zeiss, hom. imm. apochr. 2, compens. oc. 6:

a, spindle-shaped granular cells, pointed at both ends; b, a granular cell, pointed at only one end.

10.— Part of a paratangential section, a transverse section through a chone; magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6:

a, chonal canal; b, dense mass of small asters; c, circular fibres.

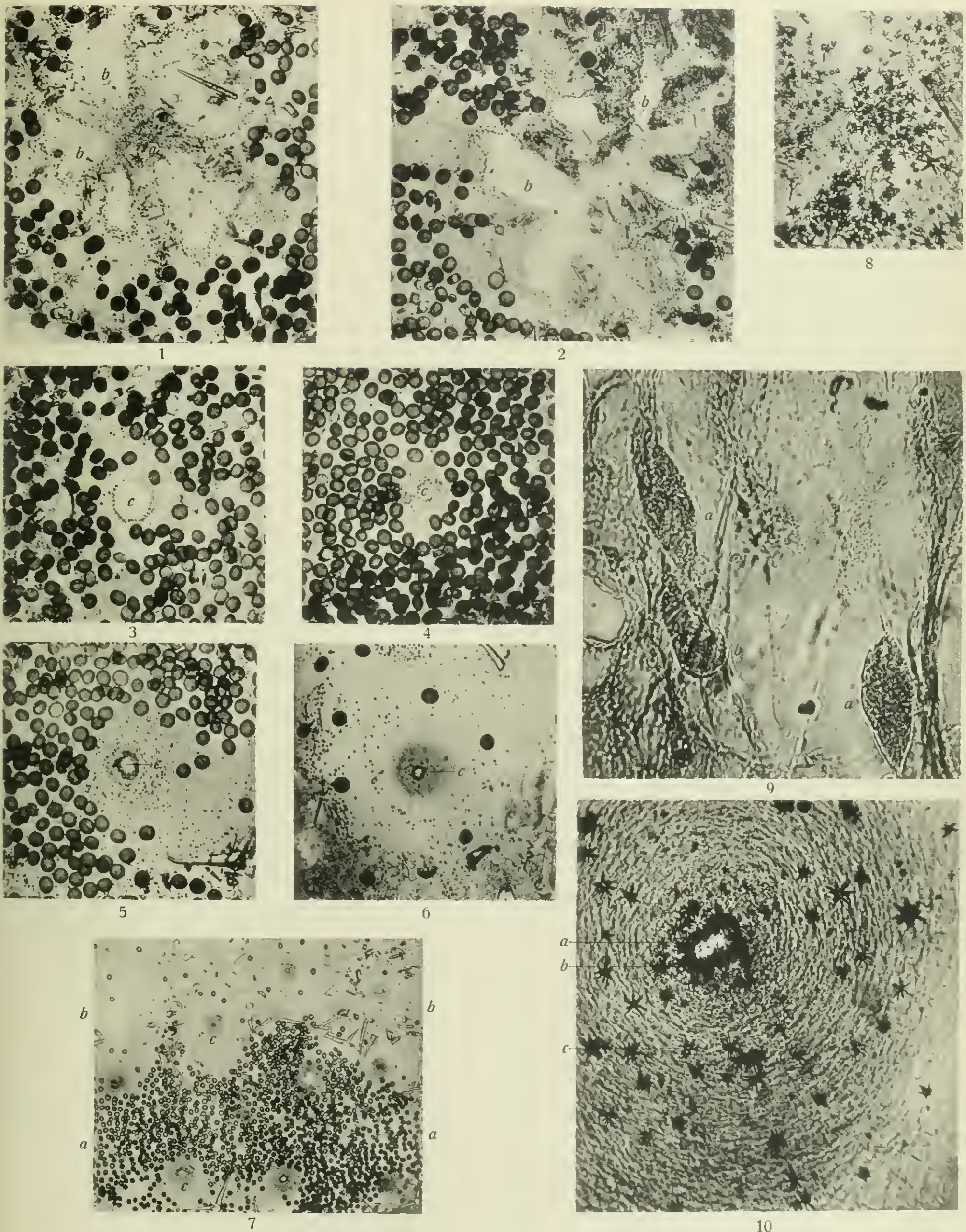

Fig. 1—10 Geodia mesotriaena n. sp. var. megana.

Lendenfeld photographeo.

PLATE 23.

PLATE 23.

Geodia mesotriaena LENDENFELD.

Figs. 1, 2. — var. **microana** LENDENFELD.
Figs. 3, 5, 6, 8, 9.— var. **pachana** LENDENFELD.
Figs. 4, 7, 10–25.— var. **megana** LENDENFELD.

1–12.— Cladomes of anatriaenes; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6:
- 1, 2, of fully developed anatriaenes of var. *microana*;
- 3, 5, 6, 8, 9, of fully developed anatriaenes of var. *pachana*;
- 4, 7, of a young anatriaene of var. *megana*;
- 10–12, of fully developed anatriaenes of var. *megana*.

13–19.— Cladomes of teloclades and mesoclades of var. *megana*; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6:
- 13, of an irregular mesoprotriaene with branches forming a second verticil of clades on the epirhabd;
- 14, of a mesoprotriaene with one clade abruptly bent, and one strongyle;
- 15, of an irregular protriaene with one clade nearly vertical;
- 16, of a regular orthotriaene;
- 17, of an irregular mesanatriaene with strongly deflected epirhabd;
- 18, of a young regular mesoprotriaene;
- 19, of a regular mesoprotriaene fully developed.

20–23.— Cladomes of orthotriaenes of var. *megana*; magnified 50; phot. Zeiss, apochr. 16, compens. oc. 4:
- 20, of an orthotriaene fully developed with clades not very different in size;
- 21, of a young quite regular orthotriaene;
- 22, of an orthotriaene fully developed with one clade much shorter than the others;
- 23, of an orthotriaene fully developed with one clade abruptly bent and shorter than the others.

24, 25.— Radial section through a part of the cortex and the adjacent choanosome of var. *megana*:
- 24, magnified 10; phot. Zeiss, planar 50;
- 25, (a part of 24) magnified 30; phot., Zeiss, planar 20;
  a. outer surface; b, sterraster-armour; c, superficial canals; d, chone; e, radial main choanosomal canal; f, tissue free from flagellate chambers surrounding the radial main choanosomal canal; g, tissue containing flagellate chambers; h, radial spicule bundles; i, small, more or less radial, dermal rhabds protruding beyond the surface; k, chonal canal.

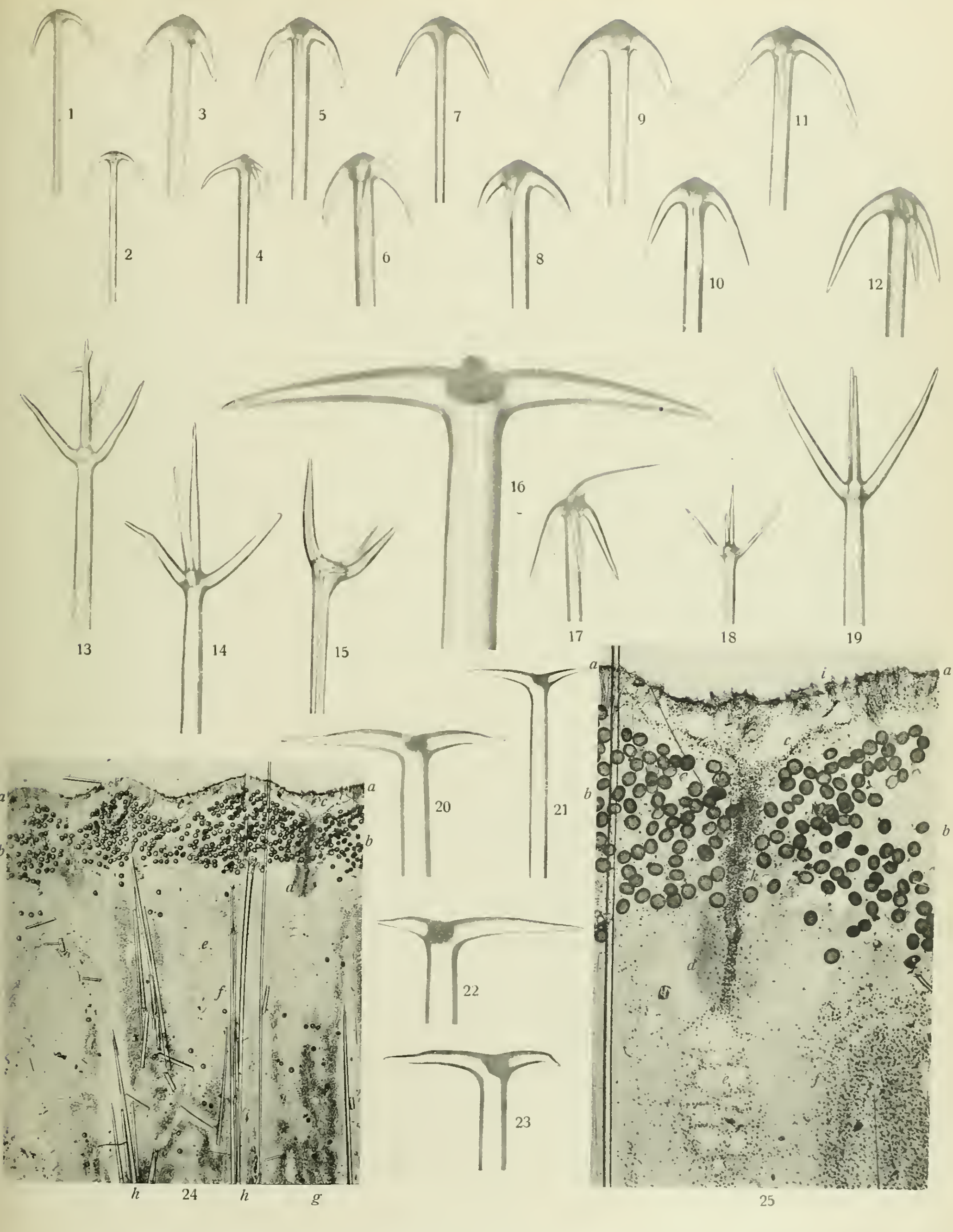

Fig. 1—25 Geodia mesotriaena n. sp.
1, 2 G. m. var. microana; 3, 5, 6, 8, 9 G. m. var. pachana; 4, 7, 10—25 G. m. var. megana.

Lendenfeld photographed.

PLATE 24.

Geodia mesotriaena LENDENFELD.

Figs. 1, 4, 8, 14, 15, 17, 18, 20, 22–32.— var. **megana** LENDENFELD.
Figs. 2, 6, 7, 10–13, 16, 19, 21. — var. **microana** LENDENFELD.
Figs. 3, 5, 9. — var. **pachana** LENDENFELD.

1.— Group of small spicules in a centrifugal spicule-preparation of var. *megana*; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6:
a, parts of small dermal rhabds; b. medium oxyasters.

2.— Group of small spicules in a centrifugal spicule-preparation of var. *microana*; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6:
a, small dermal rhabds; b, euasters.

3.— Group of small spicules in a centrifugal spicule-preparation of var. *pachana*; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6:
a, small dermal rhabds; b, euasters.

4.— Group of small spicules in a centrifugal spicule-preparation of var. *megana*; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6:
a, small dermal rhabds; b, euasters.

5.— Group of small spicules in a centrifugal spicule-preparation of var. *pachana*; magnified 300. phot. Zeiss, apochr. 4, compens. oc. 6:
a, parts of small dermal rhabds; b, oxysphaerasters; c, small strongylosphaerasters.

6.— Group of small spicules in a centrifugal spicule-preparation of var. *microana*; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6:
a, part of a small dermal rhabd; b, large oxyaster; c, small strongylosphaerasters; d, medium oxyaster.

7.— Group of euasters in a centrifugal spicule-preparation of var. *microana*; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6:
a, large oxyaster; b, large strongylosphaeraster; c, oxysphaeraster; d, small strongylosphaerasters.

8.— Group of euasters in a centrifugal spicule-preparation of var. *megana*; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6:
a, sterroid; b, oxysphaeraster.

9.— Group of euasters in a centrifugal spicule-preparation of var. *pachana*; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6:
a, large strongylosphaeraster; b, small oxyaster.

10, 11.— Groups of euasters in a centrifugal spicule-preparations of var. *microana*; magnified 600; u. v. phot. Zeiss, q. monochr. 2.5, q. oc. 5:
a, large medium oxyaster with blunt conic rays; b, small strongylosphaeraster.

12, 13.— Group of euasters in a centrifugal spicule-preparation of var. *microana*; magnified 600; u. v. phot. Zeiss, q. monochr. 2.5, q. oc. 5:
12, focused higher; 13, focused lower;
a, large medium oxyaster with stout blunt rays; b, small strongylosphaerasters.

14.— Group of euasters in a centrifugal spicule-preparation of var. *megana*; magnified 600; u. v. phot. Zeiss, q. monochr. 2.5, q. oc. 5:
a, medium oxyasters; b, small strongylosphaeraster.

15.— Group of large medium oxyasters in a centrifugal spicule-preparation of var. *megana*; magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6.

16.— Small strongylosphaeraster with numerous rays of var. *microana*, magnified 600; u. v. phot. Zeiss, q. monochr. 2.5, q. oc. 5.

17, 18.— Small strongylosphaerasters with a medium number of rays of var. *megana*; magnified 900; u. v. phot. Zeiss, q. monochr. 2.5, q. oc. 7.

19.— Medium oxyaster of var. *microana*; magnified 600; u. v. phot. Zeiss, q. monochr. 2.5, q. oc. 5.

20.— Group of small strongylosphaerasters in a centrifugal spicule-preparation of var. *megana*; magnified 600; u. v. phot. Zeiss, q. monochr. 2.5, q. oc. 5.

21.— Group of euasters in a centrifugal spicule-preparation of var. *microana*; magnified 600; u. v. phot. Zeiss, q. monochr. 2.5, q. oc. 5:

a, large strongylosphaeraster; b, small strongylosphaerasters.

22, 23.— Large oxyasters of var. *megana*; magnified 1200; u. v. phot., Zeiss, q. monochr. 2.5, q. oc. 10.

24, 25.— Group of euasters in a centrifugal spicule-preparation of var. *megana*; magnified 900; u. v. phot. Zeiss, q. monochr. 2.5, q. oc. 7:

24, focused higher; 25, focused lower;

a, large oxyaster with slender rays; b, medium oxyasters; c, small strongylosphaeraster.

26–31.— Tips of rays of oxyasters of var. *megana*; magnified 2650; u. v. phot., Zeiss, q. monochr. 1.7, q. oc. 14:

26, a nearly smooth ray;

27, a slightly spined ray;

28–31, strongly spined rays.

32.— Two small strongylosphaerasters of var. *megana*; magnified 2650; u. v phot., Zeiss, q. monochr. 1.7, q. oc. 14.

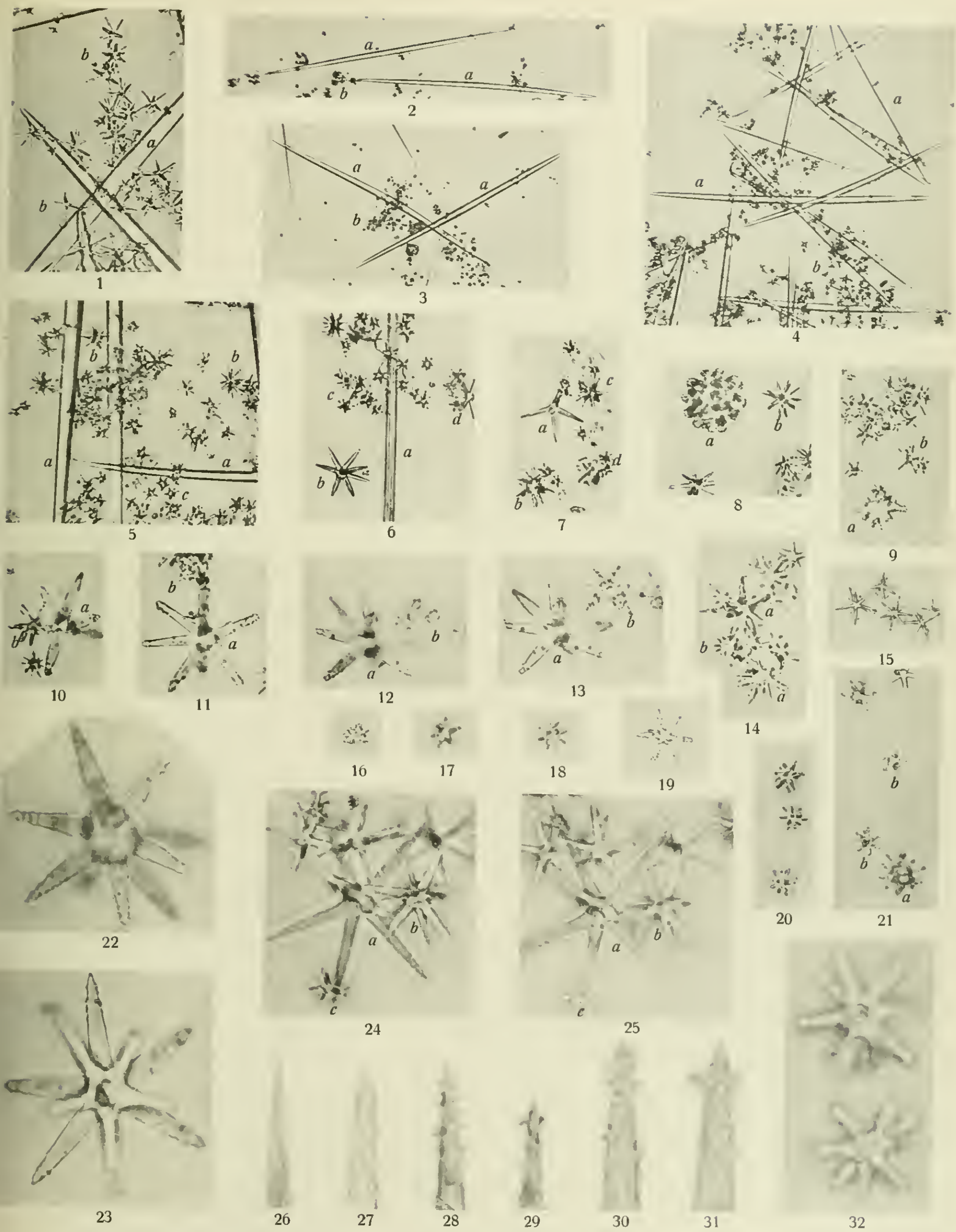

Fig. 1—32 Geodia mesotriaena n. sp.

1, 4, 8, 14, 15, 17, 18, 20, 22—32 *G. m. var. megana*; 2, 6, 7, 10—13, 16, 19, 21 *G. m. var. microana*; 3, 5, 9 *G. m. var. pachana.*

Lendenfeld photographed.

PLATE 25.

PLATE 25.

Geodia mesotriaena var. **megana** LENDENFELD.

Figures 1–11.

1.— Radial section through the outer, ectochrotal layer of the cortex; magnified 100; phot., Zeiss, apochr. 16, compens. oc. 6:

a, surface of the sponge; b, distal, freely projecting ends of the small dermal rhabds: c, oblique superficial canals; d, radial tufts of small dermal amphioxes; e, sterraster-armour.

2, 3.— Sterraster; magnified 300; u. v. phot., Zeiss, q. monochr. 1.7:

2, focused higher; 3, focused lower.

4.— Sterraster; magnified 300; phot., Zeiss, apochr. 4, compens. oc. 6.

5.— Group of sterrasters in a spicule-preparation; magnified 150; phot., Zeiss, apochr. 8, compens. oc. 4.

6, 7.— The umbilicus and the adjacent parts of the surface of two sterrasters; magnified 1800; u. v. phot., Zeiss, q. monochr. 1.7, q. oc. 10.

8.— Surface of a sterraster opposite the umbilicus; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.

9–11.— The umbilicus of a sterraster and the adjacent parts of the surface; magnified 1200; u. v. phot., Zeiss, q. monochr. 2.5, q. oc. 10:

9, focused near the bottom of the umbilical pit; 10, focused halfway up the umbilical pit;
11, focused on the surface round the umbilical pit.

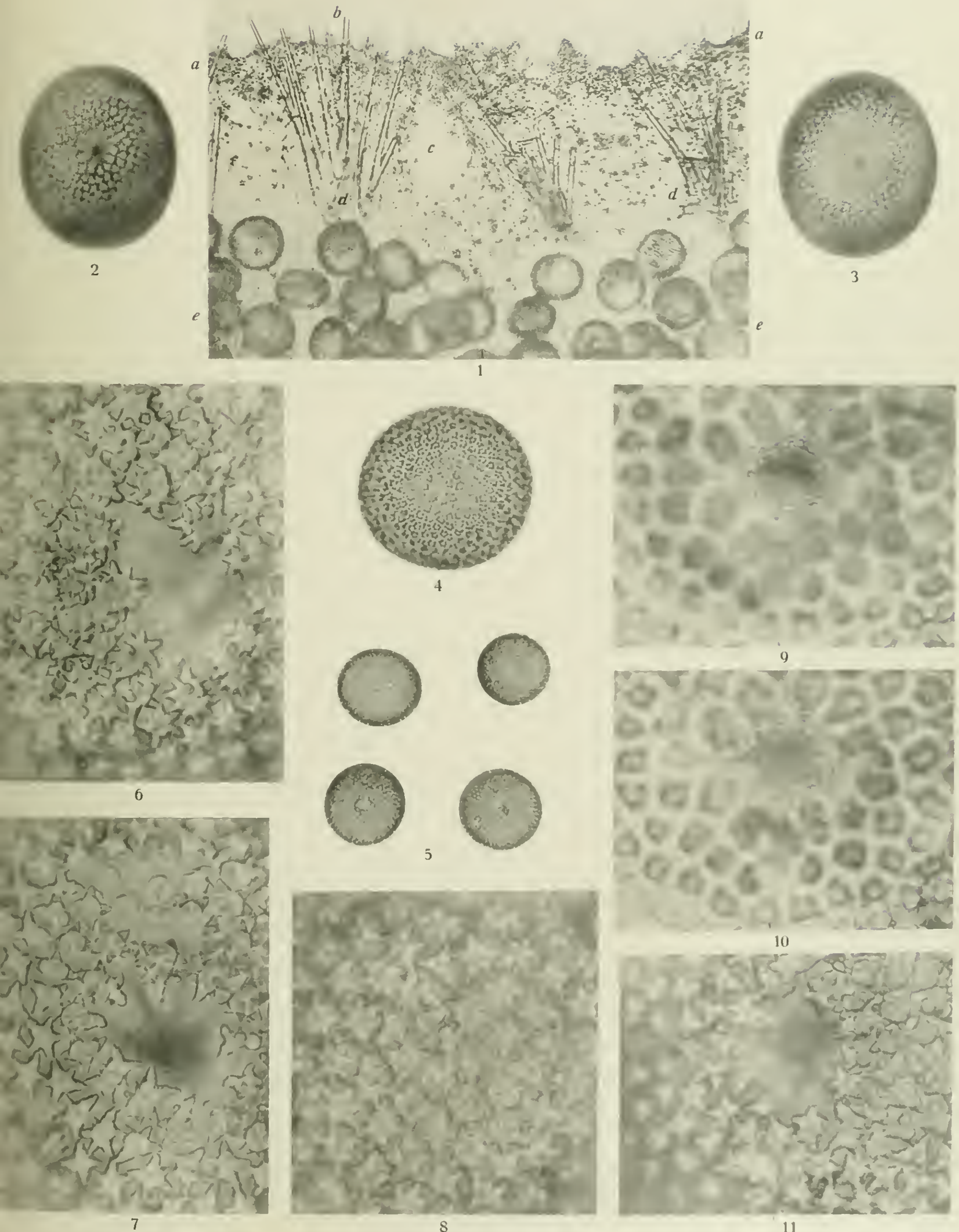

Fig. 1—11 Geodia mesotriaena n. sp., var. megana.

denfeld photographed.

PLATE 26.

PLATE 26.

Geodia agassizii LENDENFELD (adult).

Figures 1–21.

1–12.— Orthoplagiotriaenes and orthoplagiotriaene-derivates; magnified 20; phot. Zeiss, planar 20:

- 1, a mesorthotriaene orthoplagiotriaene-derivate with simple, terminally abruptly bent clades, of a specimen from Station 2978;
- 2, an amphiclade orthoplagiotriaene-derivate with three simple, very unequal clades and one opisthoclade a considerable distance from the cladomal end of the rhabdome, of a specimen from Station 3168;
- 3, an orthoplagiotriaene with oblique cladome and simple clades, of a specimen from Station 2886;
- 4, a regular orthoplagiotriaene with short, simple clades, of a specimen from Station 2978;
- 5, 6, 8, 12, orthoplagiotriaenes some or all the clades of which are terminally branched, of a specimen from Station 4199;
- 7, a regular orthoplagiotriaene with long simple clades, of a specimen from Station 2886;
- 9, 10, 11, orthoplagiotriaenes some or all the clades of which are terminally branched, of a specimen from Station 3168.

13.— Surface-view of a detached piece of the cortex of a specimen from Station 4199; magnified 7.5; phot. Zeiss, planar 50.

14, 15.— An efferent cortical canal in a detached piece of an efferent area of the cortex of a specimen from Station 4199; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6:

- 14, seen from within, the chonal sphincter, a, is in focus; an indistinct image of the dermal sieve, b, is seen behind;
- 15, seen from without, the dermal sieve, b, is in focus; an indistinct image of the chonal sphincter, a, is seen behind.

16–21.— Six specimens of the sponge; 16, 18–21, natural size, 17 reduced 1:0.67; phot. Zeiss, anastig. 480 / 412:

- 16, 19–21, from Station 2886;
- 17, from Station 4193;
- 18, from Station 2887.

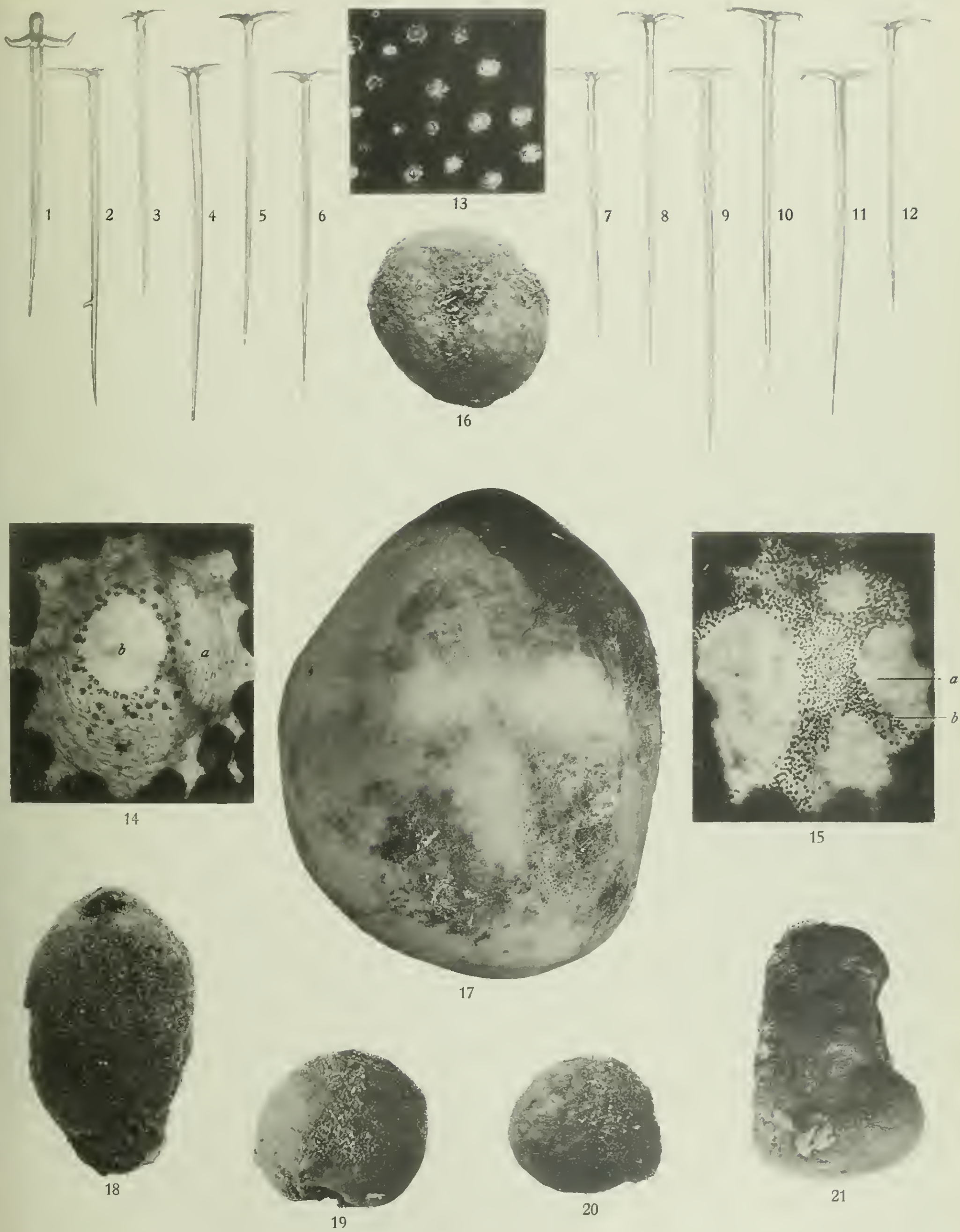

Fig. 1-21 Geodia agassizii n. sp. (adult).
1, 4 from station 2978; 2, 9-11 from station 3168; 3, 7, 16, 19-21 from station 2886; 5, 6, 8, 12-15 from station 4199; 17 from station 4193; 18 from station 2887.

PLATE 27.

PLATE 27.

Geodia agassizii Lendenfeld (adult).

Figures 1–19.

1.— Radial section through the region bearing efferent pores of a large specimen from Station 4193; magnified 7.5; phot. Zeiss, planar 50:

b, sterraster-armour of the cortex; d, large afferent canals; e, large efferent canal.

2.— Radial section through the region bearing afferent pores of a medium-sized specimen from Station 3168; magnified 7.5; phot. Zeiss, planar 50:

a, ectochrotal outer layer of the cortex, free from sterrasters, with small, radial dermal amphioxes; b, sterraster-armour of the cortex; c, subcortical cavities; d, large afferent canal.

3–13.— Groups of spicules from centrifugal spicule-preparations; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6:

3, 4, 9, of specimens from Station 2978;
5, of a specimen from Station 2887;
6, 11, of a specimen from Station 3168;
7, of a specimen from Station 4551;
8, of a specimen from Station 4193;
10, of a specimen from Station 2886;
12, of a specimen from Station 4199;
13, of a specimen from Station 3088;

a, small dermal amphioxes: b, large choanosomal oxyasters; c, large cortical oxysphaerasters; d, small strongylosphaerasters.

14.— Group of asters from a centrifugal spicule-preparation of a specimen from Station 4193; magnified 500; phot. Zeiss, hom. imm. apochr. 2, compens. oc. 6:

b, large oxyaster; c, large oxysphaeraster; d, small strongylosphaeraster.

15–19.— Groups of sterrasters from spicule-preparations; magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6:

15, of a specimen from Station 2978;
16, of a specimen from Station 4551;
17, of a specimen from Station 4193;
18, of a specimen from Station 3088;
19, of a specimen from Station 4199.

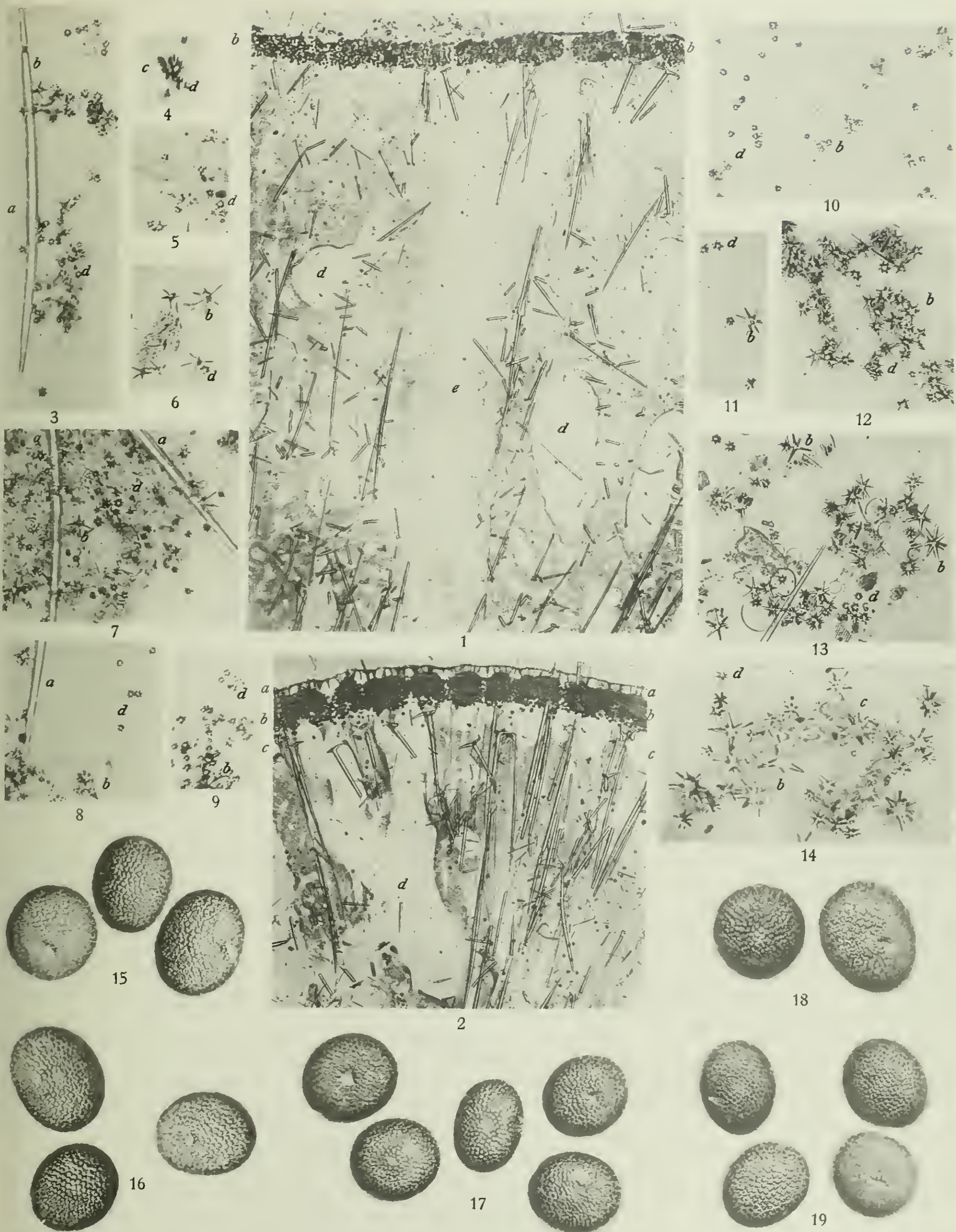

Fig. 1-19 Geodia agassizii n. sp. (adult).
, 8, 14, 17 from station 4193; 2, 6, 11 from station 3168; 3, 4, 9, 15 from station 2978; 5 from station 2887; 7, 16 from station 4551; 10 from station 2886; 12, 19 from station 4199; 13, 18 from station 3088.

PLATE 28.

PLATE 28.

Geodia agassizii Lendenfeld (adult).

Figures 1–28.

1–7.— Cladomes of mesoprotriaenes; magnified 75, phot. Zeiss, apochr. 16, compens. oc. 6:
- 1, with long and stout curved clades, one of which is terminally abruptly bent, and a rather long epirhabd, of a specimen from Station 4199;
- 2, with rather long and stout curved clades and long epirhabd, of a specimen from Station 4199;
- 3, with stout and short curved clades and short epirhabd, of a specimen from Station 4199;
- 4, with short, nearly straight clades and medium epirhabd, of a specimen from Station 4551;
- 5, with slender, slightly curved clades and rather long epirhabd, of a specimen from Station 2978;
- 6, with long and slender, curved clades and short epirhabd, of a specimen from Station 2978;
- 7, with rather stout, nearly straight clades and very long epirhabd, of a specimen from Station 4199.

8–11.— The branched ends of quite irregular telo- and mesoclade-like spicules; magnified 75; phot. Zeiss, apochr. 16, compens. oc. 6:
- 8, the branched end of a long rhabd with three conic branch-rays (clades) lying nearly in the same plane as the rhabd (rhabdome), of a specimen from Station 4199;
- 9, the branched end of a rhabd with two branch-rays lying in a straight line and together appearing as a small style attached obliquely to the end of the rhabd, of a specimen from Station 2887;
- 10, the branched end of an amphiox-like spicule with two very oblique, backwardly directed spines inserted a little below the end, of a specimen from Station 2887;
- 11, the branched end of an amphiox-like spicule, with a straight branch-ray arising nearly vertically a little distance below one end, of a specimen from Station 2887.

12–14.— Parts of stout, club-shaped styles; magnified 75; phot. Zeiss, apochr. 16, compens. oc. 6; of specimens from Station 4193:
- 12, 13, the thick blunt ends of two such styles;
- 14, the thin pointed end of the style, the other end of which is represented in Fig. 13.

15.— An end of a regular large choanosomal amphiox, of a specimen from Station 3168; magnified 75; phot. Zeiss, apochr. 16, compens. oc. 6.

16, 17.— Groups of spicules from spicule-preparations; magnified 20; phot. Zeiss, planar 20:
- 16, of a specimen from Station 2978;
- 17, of a specimen from Station 2886;
  - a, large choanosomal amphioxes; b, a club-shaped style; c, an anatriaene; d, a mesoprotriaene.

18–28.— Cladomes of anaclades; magnified 75; phot. Zeiss, apochr. 16, compens. oc. 6:
- 18, of an anatriaene with short, somewhat unequal clades, of a specimen from Station 2887;
- 19, of an anatriaene with short, rather stout, somewhat unequal clades, of a specimen from Station 4193;
- 20, 21, of anatriaenes with long and slender, equal clades, of a specimen from Station 2978;
- 22, of an anatriaene with rather long and fairly slender, equal clades, of a specimen from Station 2887;
- 23, of an anatriaene with short, stout, equal clades, of a specimen from Station 4199;
- 24, of an anatriaene with long and stout, equal clades, of a specimen from Station 4551;
- 25, of an anatriaene with long and stout, equal clades, of a specimen from Station 4193;
- 26, of an anatriaene with small, nearly straight, equal clades, of a specimen from Station 4199;
- 27, of an anatriaene with slender, very unequal clades, of a specimen from Station 3168;
- 28, of an anadiaene, of a specimen from Station 3168.

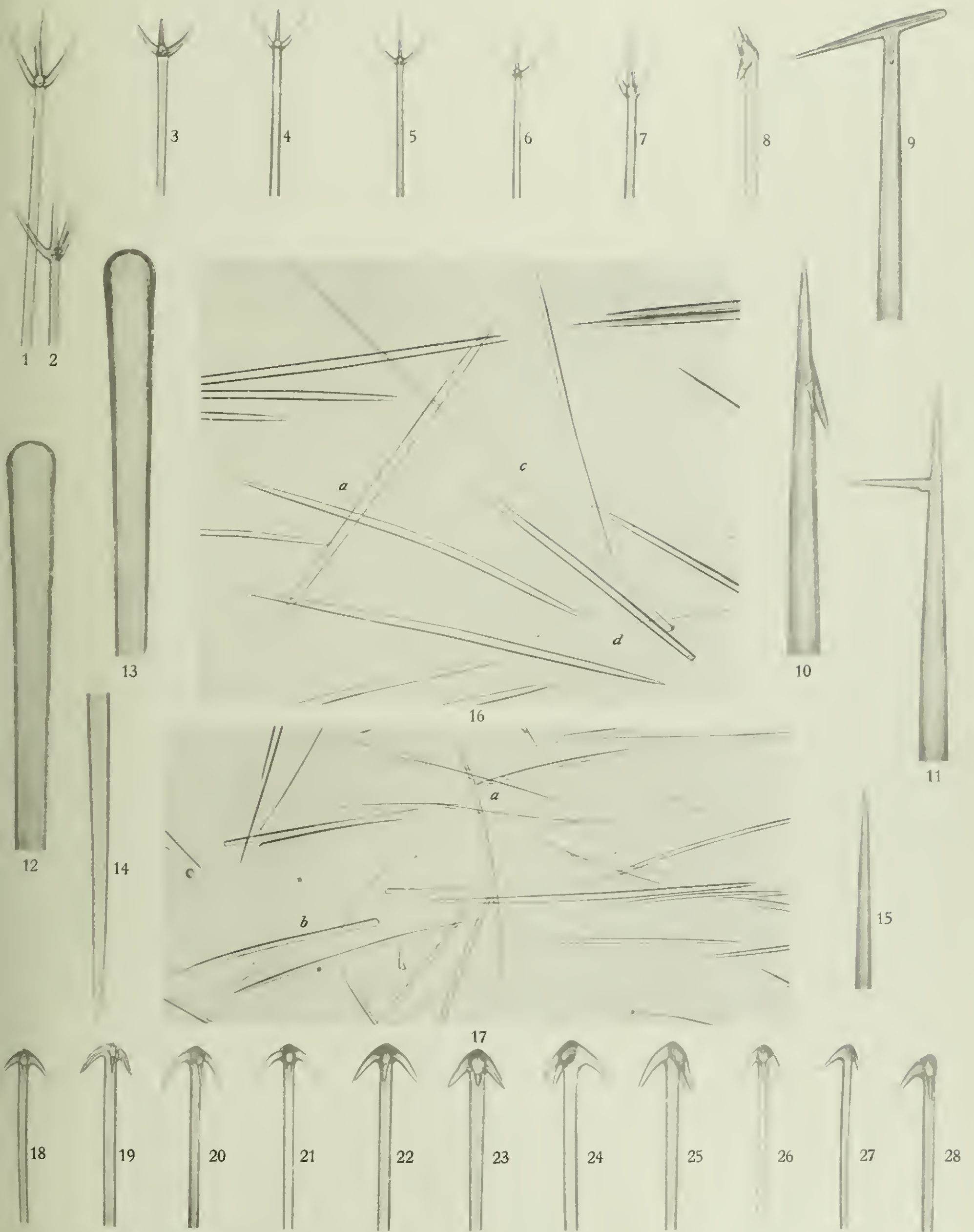

Fig. 1-28 Geodia agassizii n. sp. (adult).
1-3, 5, 7, 8, 23, 26 from station 4199; 4, 24 from station 4551; 6, 16, 20, 21; from station 2978; 9-11, 18, 22 from station 2887; 12-14, 19, 25 from station 4193; 15, 27, 28 from station 3168; 17 from station 2886.

PLATE 29.

PLATE 29.

Geodia agassizii LENDENFELD (adult).

Figures 1–17.

1–17.—Cladomes of orthoplagiotriaenes and orthoplagiotriaene-derivates; magnified 75; phot. Zeiss, apochr. 16, compens. oc. 6:

1, of an orthoplagiotriaene with medium rhabdome and simple, somewhat unequal clades, of a specimen from Station 2886;

2, of an orthoplagiotriaene with slender cladome and simple, equal clades, of a specimen from Station 4199;

3, of an orthoplagiotriaene with thick rhabdome and short, rather equal, simple clades, of a specimen from Station 2978;

4, of an orthoplagiotriaene with slender rhabdome, and irregularly extending, simple clades, of a specimen from Station 3088;

5, of an orthoplagiotriaene with thick rhabdome, and simple unequal clades, of a specimen from Station 2978;

6, of an ortboplagiotriaene, with slender rhabdome, and clades, partly abruptly recurved and partly branched terminally, of a specimen from Station 4199;

7, of a mesorthotriaene with thick rhabdome, and clades terminally abruptly bent, of a specimen from Station 2978;

8, of an orthoplagiotriaene with thick rhabdome, and simple, equal clades, of a specimen from Station 4551;

9, of an orthoplagiotriaene with slender rhabdome, and unequal clades, one of which is branched, of a specimen from Station 4199;

10, of an orthotriaene with slender rhabdome and unequal clades, one of which is branched, of a specimen from Station 4193;

11, of a plagiotriaene with medium rhabdome and simple, equal clades, of a specimen from Station 2887;

12, of an orthoplagiotriaene with slender rhabdome and unequal clades, one of which is branched, of a specimen from Station 4199;

13, of an amphiclade orthotriaene-derivate with slender rhabdome with a verticil of three unequal, terminally branched clades and one simple and knob-shaped opisthoclade, of a specimen from Station 4199;

14, of an orthoplagiotriaene with medium rhabdome and unequal clades, one of which is branched, of a specimen from Station 3088;

15, of an orthoplagiotriaene with medium rhabdome and very unequal, simple clades, of a specimen from Station 3168;

16, of an orthoplagiotriaene with medium rhabdome and unequal, branched clades, of a specimen from Station 3168;

17, of an orthoplagiotriaene with slender rhabdome and unequal clades, one of which is branched, of a specimen from Station 4199.

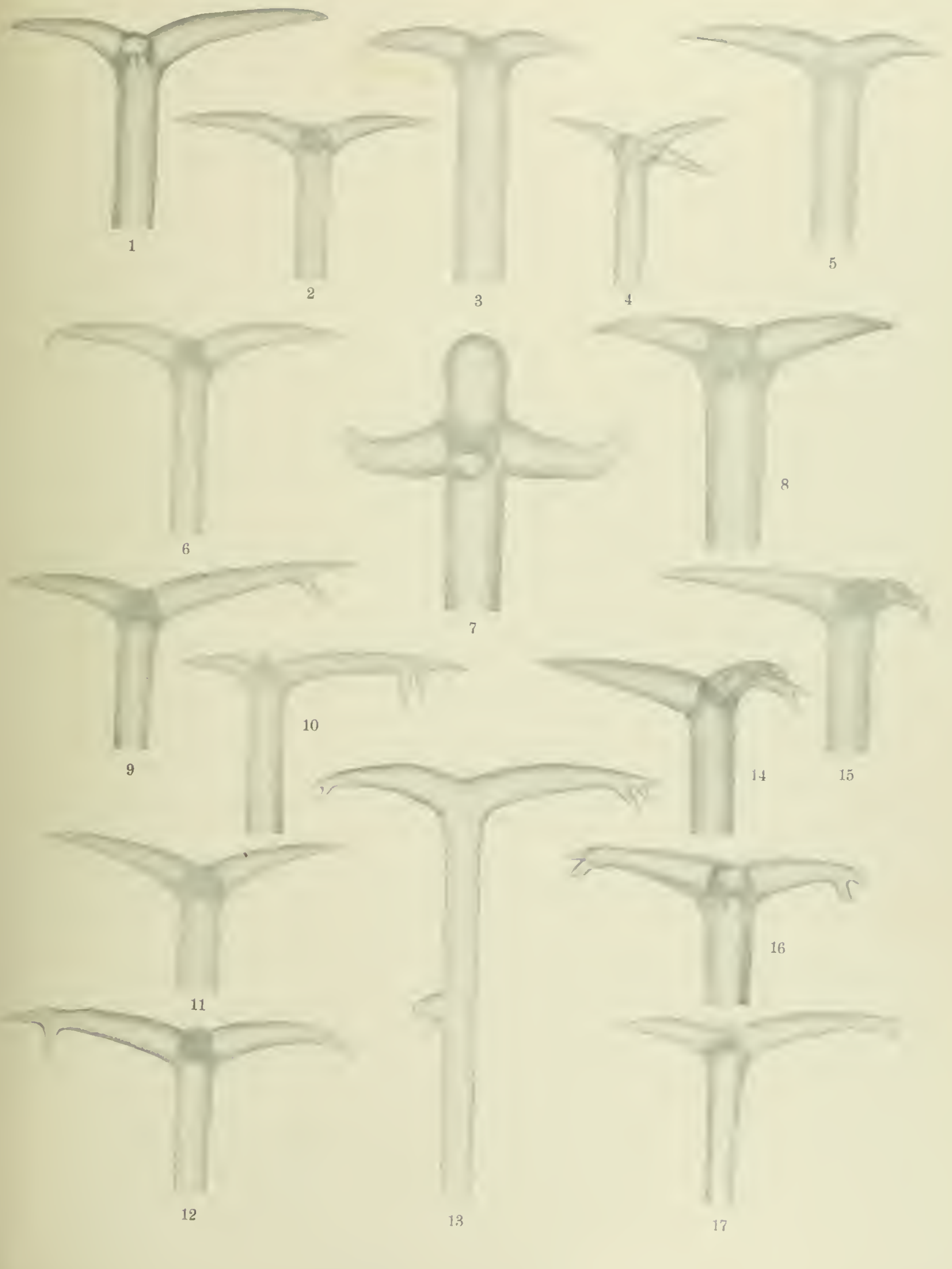

Fig. 1-17 Geodia agassizii n. sp. (adult).

rom station 2886; 2, 6, 9, 12, 13, 17 from station 4199; 3, 5, 7 from station 2978; 4, 14 from station 3088; 8 from station 4551, 10 from station 4193; 11 from station 2887; 15, 16 from station 3168.

PLATE 30.

PLATE 30.

Geodia agassizii LENDENFELD (adult).

Figures 1–17.

1, 2.— Group of asters from a centrifugal spicule-preparation, of a specimen from Station 2886; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
  1, focused higher; 2, focused lower;
    a, small strongylosphaerasters; b, large oxyaster.
3.— Large oxysphaeraster of a specimen from Station 2978; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.
4.— Large oxyaster of a specimen from Station 2978; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.
5.— Part of a large oxyaster of a specimen from Station 4193; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7., q. oc. 10.
6–9.— Small strongylosphaerasters: magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
  6, 8, of a specimen from Station 4193;
  7, 9, of a specimen from Station 3088.
10.— Group of asters from a centrifugal spicule-preparation of a specimen from Station 3168; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
    a, small strongylosphaerasters; b, large oxyasters.
11–17.— Parts of sterrasters in different stages of development (growth) of a specimen from Station 3088; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
  11, 12, part of the side opposite the umbilicus of a quite young sterraster with slender, distally sharp-pointed rays;
    11, focused lower; 12, focused higher;
  13, part of the umbilical side of a sterraster somewhat older than the one represented in Figs. 11 and 12, with stouter, but still simple, pointed rays;
  14, part of the umbilical side of a sterraster older than the one represented in Fig. 13, the rays of which are still simple but already stout and blunt;
  15, 16, part of the side opposite the umbilicus of two sterrasters still older, in which the spine verticils are beginning to appear on the summits of the rays;
  17, part of the side opposite the umbilicus of a young sterraster with rays already distally extended and crowned by verticils of slender spines.

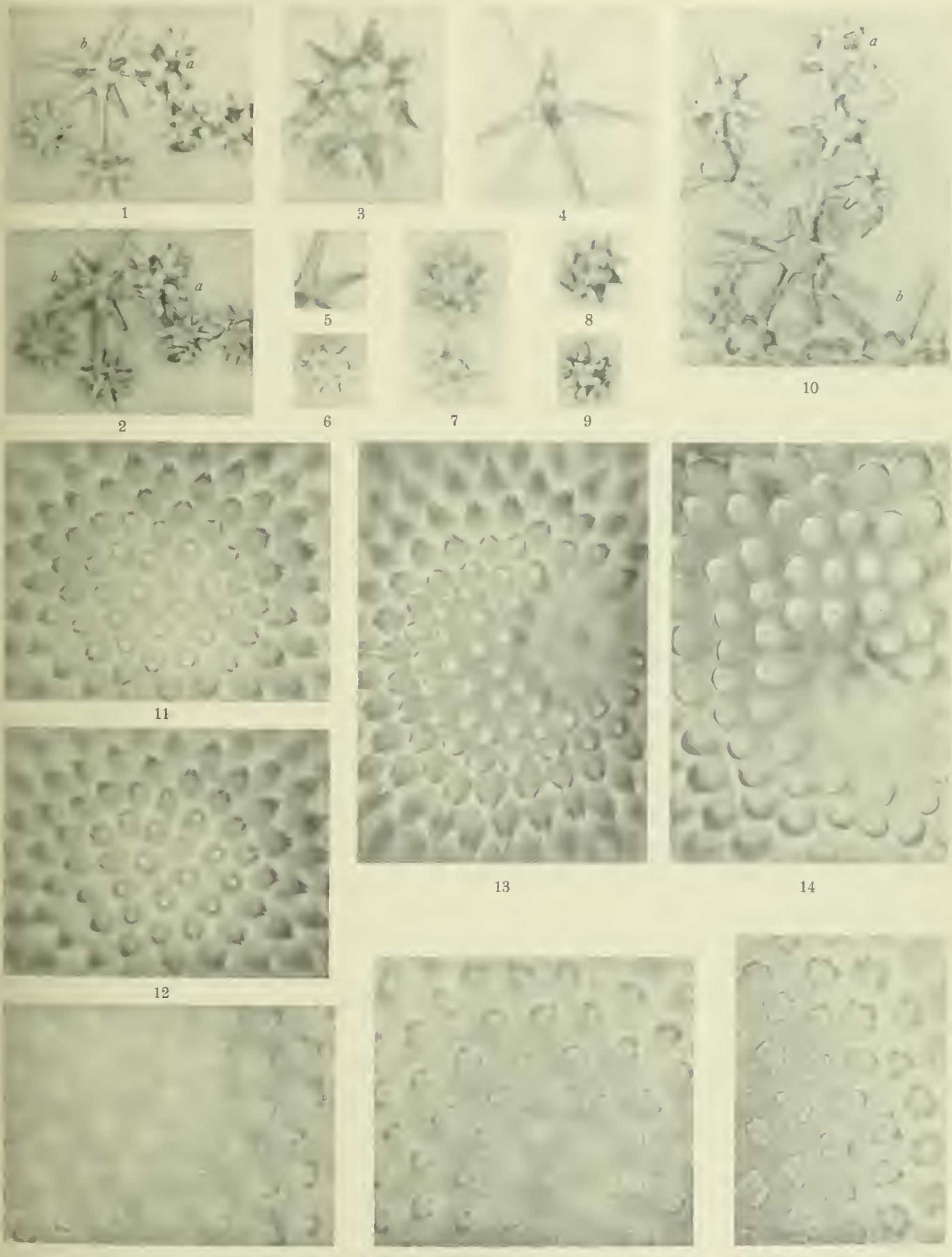

Fig. 1-17 Geodia agassizii n. sp. (adult).
1, 2 from station 2886; 3, 4 from station 2978; 5, 6, 8 from station 4193; 7, 9, 11-17 from station 3088; 10 from station 3168.

PLATE 31.

PLATE 31.

Geodia agassizii Lendenfeld (adult).

Figures 1–10.

1–10.— Parts of fully developed sterrasters; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:

1, 2, the umbilical side of a normal sterraster of a specimen from Station 3088;

1, focused higher;

2, focused lower;

3, 4, the umbilical side of a sterroid with large terminal extensions of the rays, of a specimen from Station 4193;

3, focused higher·

4, focused lower;

5, the umbilical side of a sterraster of a specimen from Station 4193, focused just above the bottom of the umbilical pit to show the roughness of its sides;

6, 7, the umbilical side of a normal sterraster of a specimen from Station 4193;

6, focused higher;

7, focused lower;

8–10, the umbilical side of a sterroid of a specimen from Station 3088, with few and large, rough spines on the ends of the rays, focused in three levels about 2 μ apart;

8, focused high; 9, focused intermediate; 10, focused low.

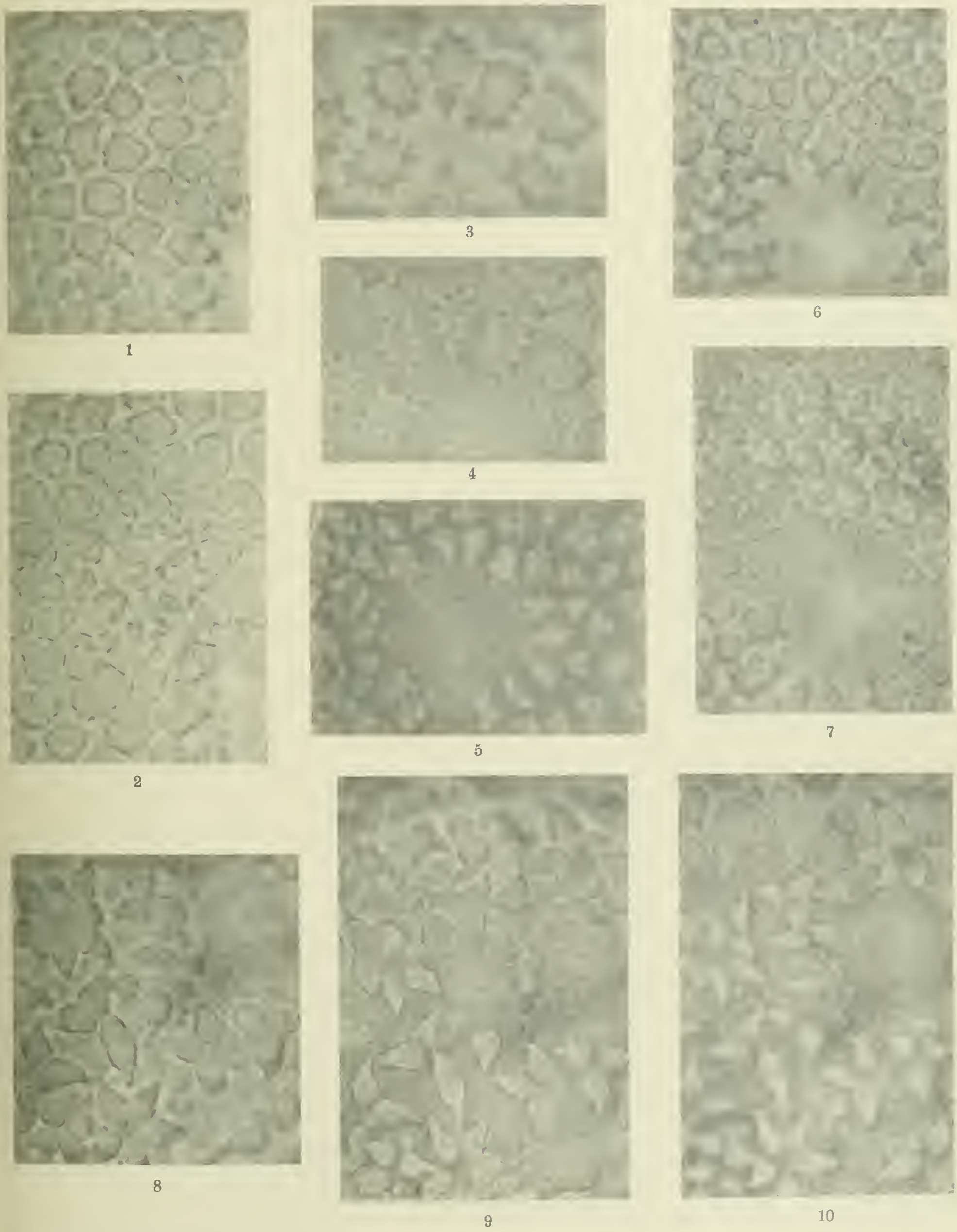

Fig. 1-10 Geodia agassizii n. sp. (adult).
1, 2, 8-10 from station 3088; 3-7 from station 4193;

PLATE 32

PLATE 32.

Geodia agassizii LENDENFELD (young) from Station 4425.

Figures 1–46.

1.— Part of a radial section through the choanosome; haematoxylin; magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6:
a, flagellate chambers.

2, 3.— Small sphaerasters; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
2, with conical, pointed rays;
3, with cylindrical, truncate rays.

4.— Group of euasters from a centrifugal spicule-preparation; magnified 300; u. v. phot. Zeiss, q. monochr. 1.7.

5.— Part of a radial section through the choanosome; haematoxylin; magnified 10; phot. Zeiss, planar 50:
a, an efferent canal with constrictions.

6, 7.— Large oxysphaerasters; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.

8.— Part of a radial section; magnified 10; phot. Zeiss, planar 50:
a, sterraster-armour.

9, 10.— Large choanosomal amphioxes; magnified 30; phot. Zeiss, planar 20.

11.— Part of a radial section; magnified 10; phot. Zeiss, planar 50:
a, sterraster-armour; b, protruding parts of spicules forming the spicule-fur.

12.— Part of a radial section; magnified 10; phot. Zeiss, planar 50:
a, sterraster-armour; b, rhabdome of an orthotriaene with rounded and thickened acladomal end.

13-39.— Sterroids and sterrasters; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6:
13, 15, 17, 19, 21, 23, 25, 27, and 29–39, the highest part of the upper surface in focus;
14, 16, 18, 20, 22, 24, 26, 28, the spicules represented above them in Figs. 13, 15, 17, 19, 21, 23, 25, 27, focused lower.

40–42.— Cladomes of mesoproclades; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6:
40, 41, of regular slender ones;
42, of a stout one with one rudimentary clade. (This spicule may be foreign).

43–46.— Cladomes of anaclades; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6:
43, 46, of regular anatriaenes with well-developed, pointed clades;
44, of an anadiaene with well-developed pointed clades;
45, of an irregular anatriaene with small clades, one of which is shortened and rounded at the end.

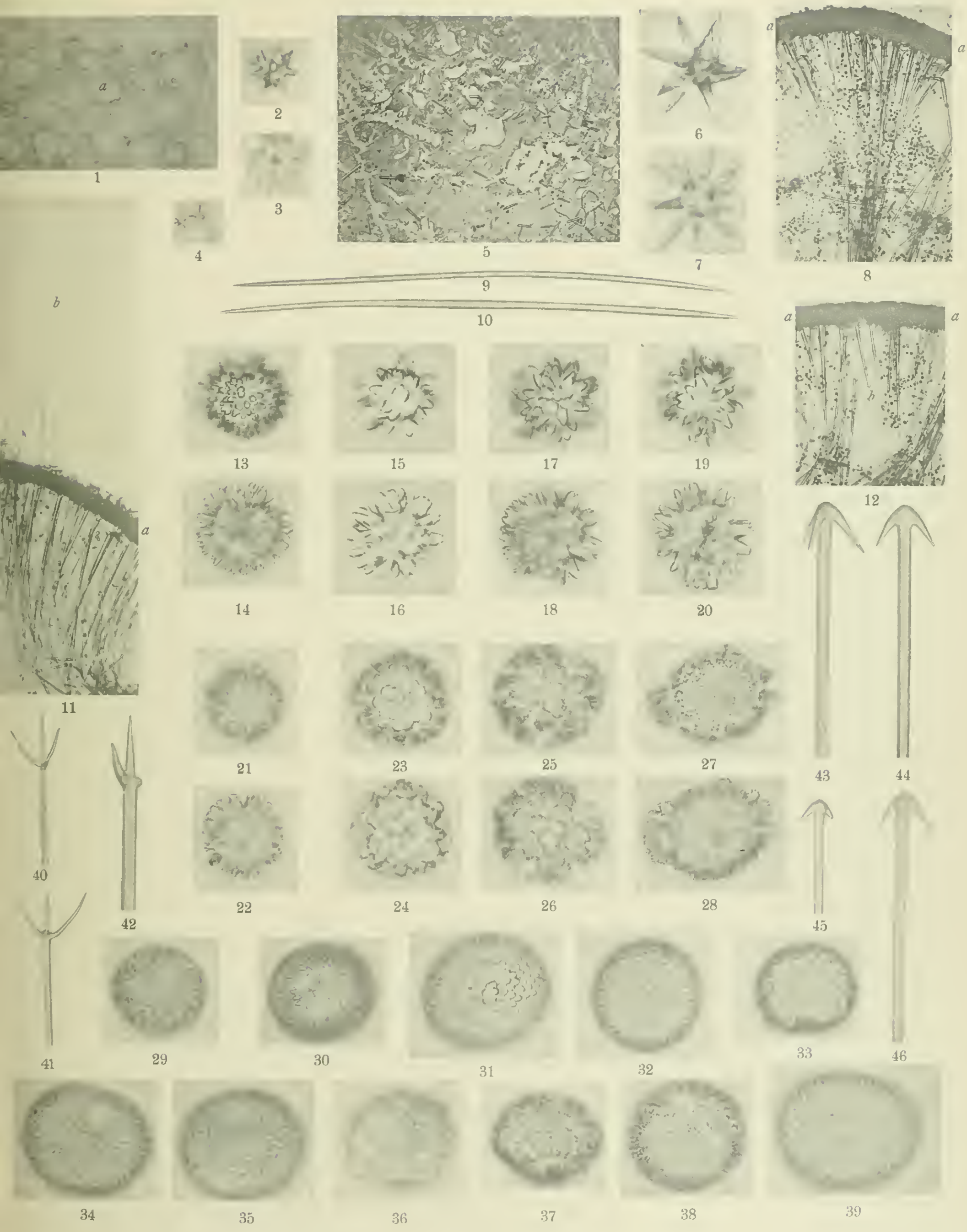

Fig. 1-46 Geodia agassizii n. sp. (young specimen from station 4228).

PLATE 33.

Geodia agassizii Lendenfeld, (young) from Station 4228.

Figures 1–14.

1–8.— Four stages of development of the sterraster; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:

1, 3, 5, 7, the highest part of the upper surface in focus;

2, 4, 6, 8, the sterrasters (parts of sterrasters) represented to the left of them in Figs. 1, 3, 5, 7, focused lower;

1, 2, young sterraster 17 μ in diameter;

3, 4, young sterraster 23 μ in diameter;

5, 6, young sterraster 50 μ in diameter;

7, 8, young sterraster 70 μ in diameter.

9–14.— Parts of the surface of adult sterrasters and sterroids; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:

9, 14, part of the surface opposite the umbilicus of sterroids with distant protruding rays the spines of which are rough, apparently covered with secondary spinelets;

10, umbilical part of the surface of a sterraster with extremely thick rays the spines of which are numerous and smooth;

11, part of the lateral surface of a sterroid;

12, 13, part of the surface, some distance from the umbilicus, of a sterraster with thin protruding rays standing very close together;

12, focused lower; 13, focused higher.

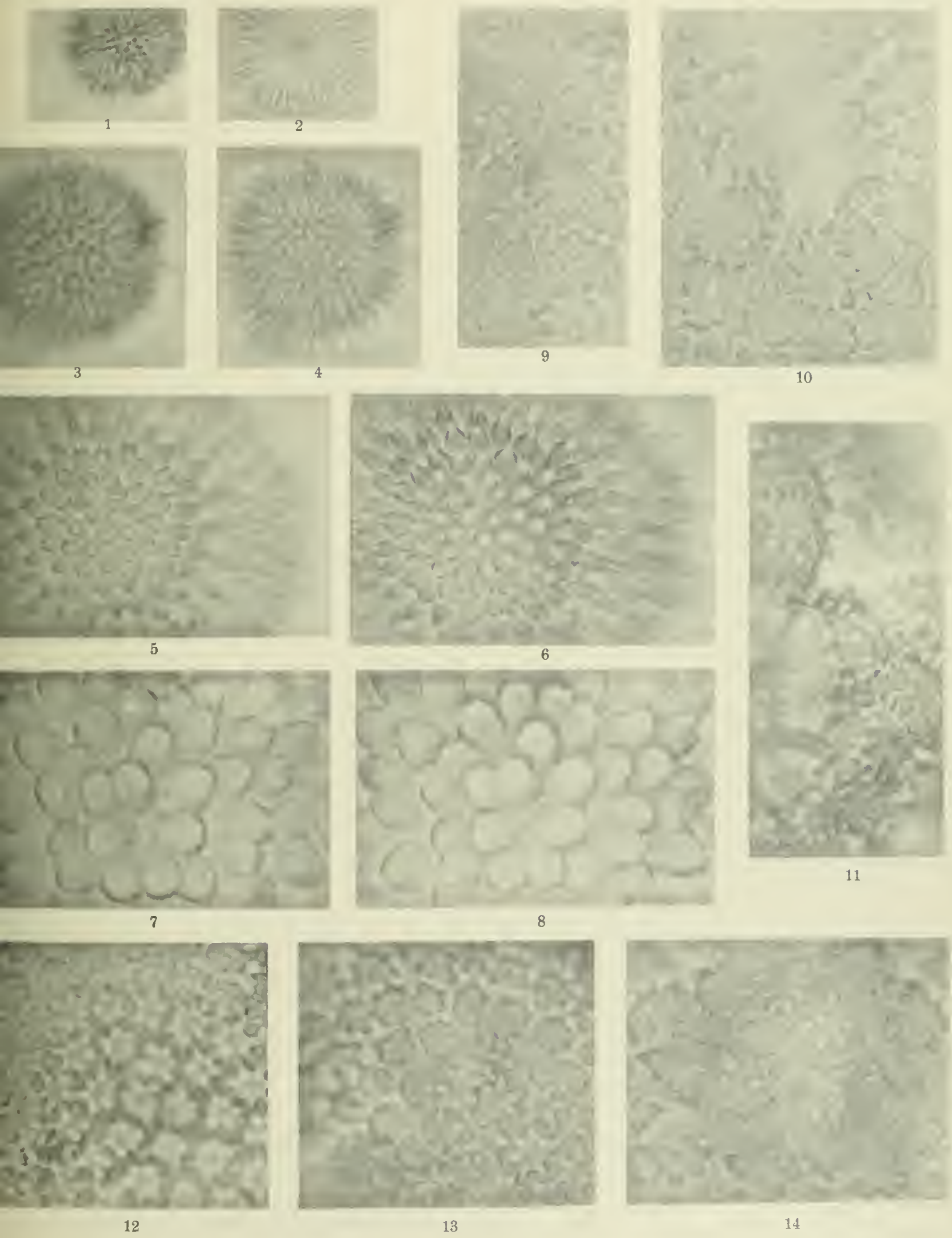

Fig. 1-14 Geodia agassizii n. sp. (young specimen from station 4228).

PLATE 34.

PLATE 31.

Geodia agassizii LENDENFELD (young) from Station 4228.

Figures 1–17.

1–16.— Orthoplagiotriaenes and orthoplagiotriaene-derivates; magnified 30; phot. Zeiss, planar 20:
1–7, orthoplagiotriaenes with the rhabdome pointed at the acladomal end;
8, 10–12, 14, orthoplagiotriaenes with the rhabdome slightly shortened and rounded and more or less thickened at the acladomal end;
9, orthoplagiotriaene with the rhabdome slightly shortened and simply rounded at the acladomal end;
13, amphiclade orthoplagiotriaene-derivate with the rhabdome shortened, rounded, thickened, and provided with a spine-like opisthoclade at the acladomal end;
15, orthoplagiotriaene-derivate with one clade bifurcate and the rhabdome much shortened, and rounded and thickened at the acladomal end;
16, mesoclade orthoplagiotriaene-derivate.

17.— Transverse section of the specimen; magnified 1.6; phot. Zeiss, planar 100.

Geodia mesotriaenella LENDENFELD.

Figures 18–26.

18.— Group of asters from a centrifugal spicule-preparation; magnified 300; u. v. phot. Zeiss, q. monochr. 1.7:
a, large oxyasters; b, small strongylosphaerasters.

19.— View of the sponge; natural size; phot. Zeiss, anastig. 480 / 112.

20.— Portion of the surface bearing afferent pores, a superficial paratangential section viewed with transmitted light; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6.

21, 22. Large oxyaster; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
21, focused higher; 22, focused lower.

23.— A sterraster; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6.

24.— A large oxyaster; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.

25.— Portion of the surface bearing efferent pores, a superficial paratangential section viewed with transmitted light; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6.

26.— Group of small strongylosphaerasters from a centrifugal spicule-preparation; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
a, with longer rays attenuated towards the end; b. with shorter cylindrical rays.

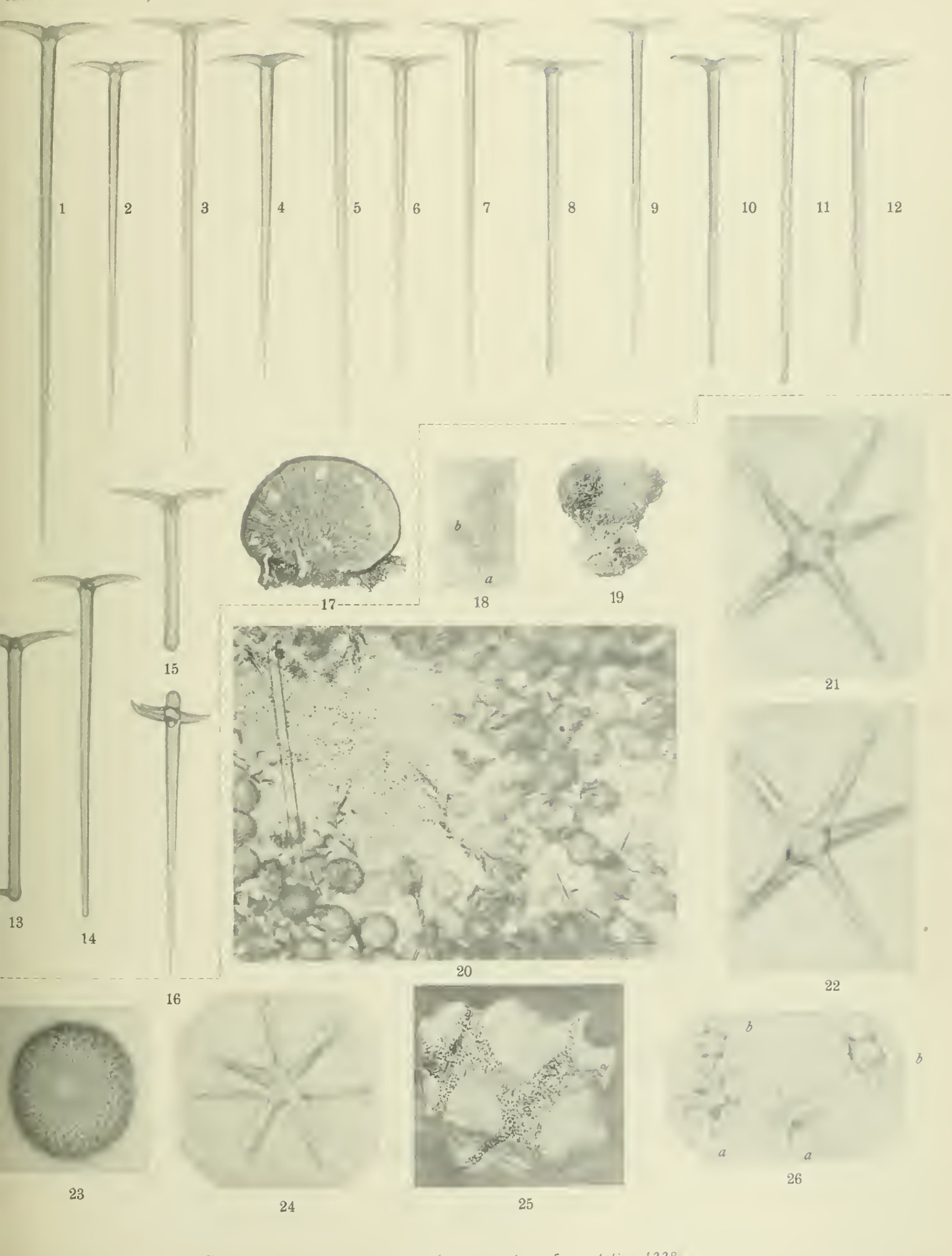

Fig. 1-17 Geodia agassizii n. sp. (young specimen from station 4228).
Fig. 18-26 Geodia mesotriaenella n. sp.

PLATE 35.

PLATE 35.

Geodia breviana Lendenfeld.

Figures 1–27.

1–4.— Large choanosomal amphioxes; magnified 30; phot. Zeiss, planar 20.
5–7.— Cladomes of anatriaenes; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6.
8–13.— Small strongylosphaerasters; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
 8, 9, group of two strongylosphaerasters from a centrifugal spicule-preparation;
  8, focused higher; 9, focused lower;
 10, group of two strongylosphaerasters from a centrifugal spicule-preparation;
 11, 12, a strongylosphaeraster;
  11, focused higher; 12, focused lower;
 13, a strongylosphaeraster.
14.— Cladome of a mesoprotriaene; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6.
15–17.— Ortho- and plagiotriaenes; magnified 30; phot. Zeiss, planar 20.
18–22.— Groups of asters from centrifugal spicule-preparations; magnified 300.
 18, 20–22, u. v. phot. Zeiss, q. monochr. 1.7;
 19, phot. Zeiss, apochr. 4, compens. oc. 6;
  a, large oxyasters; b, small strongylosphaerasters; c, large oxysphaeraster.
23.— A sterraster; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6.
24–27.— Large oxyasters and oxysphaerasters; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
 24, 27, two large oxyasters;
 25, 26, a large oxysphaeraster;
  25, focused higher; 26, focused lower.

Geodia mesotriaenella Lendenfeld.

Figures 28–35.

28–30.— Mesoprotriaenes; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6.
31.— Group of megascleres from a spicule-preparation; magnified 30; phot. Zeiss, planar 20:
  a, orthotriaenes; b, mesoprotriaenes; c, large choanosomal amphioxes.
32–35. Cladomes of anatriaenes; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6.

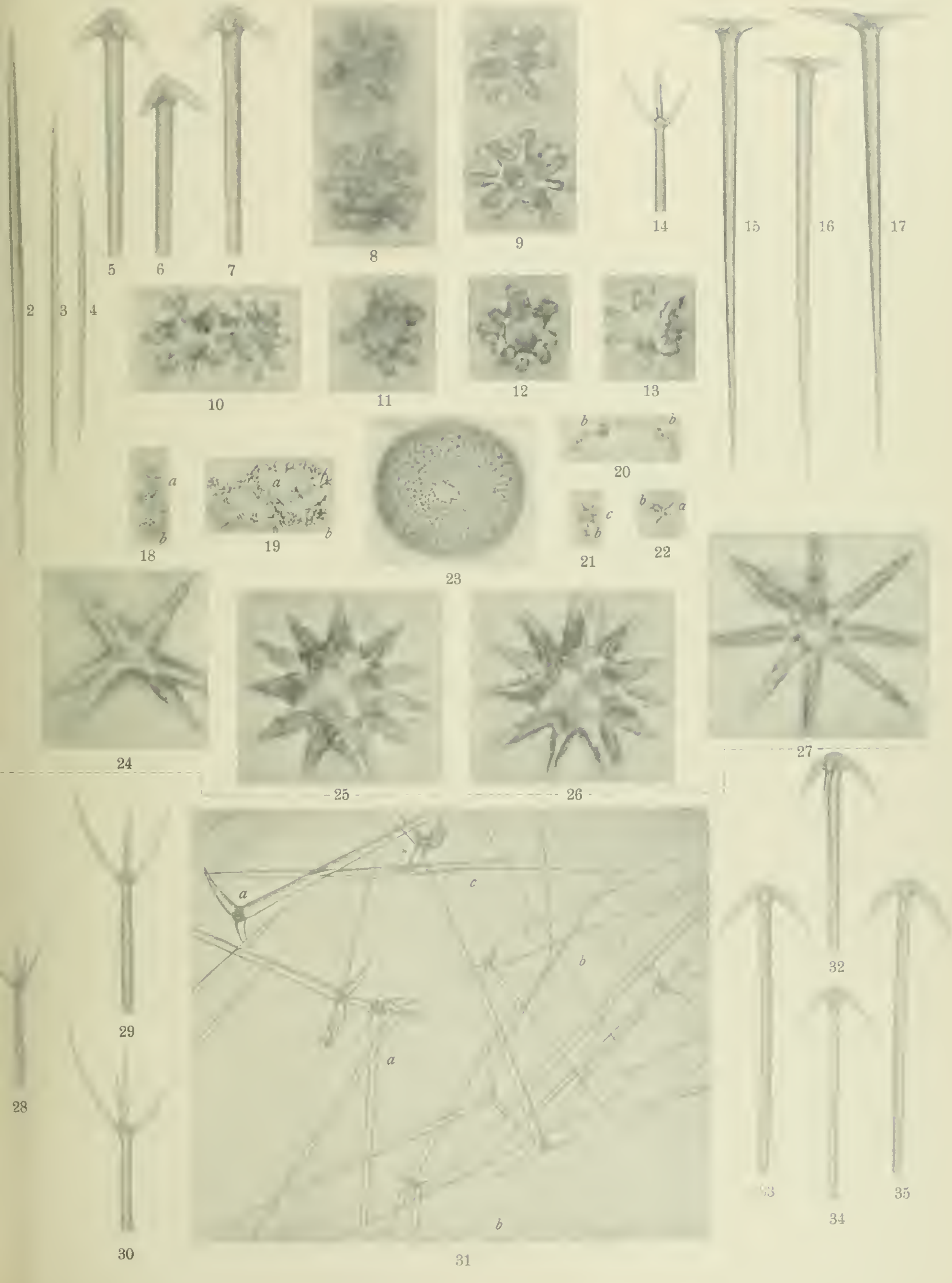

Fig. 1-27 Geodia breviana n. sp.
Fig. 28-35 Geodia mesotriaenella n. sp.

PLATE 36

PLATE 36.

Geodia breviana Lendenfeld.

Figures 1–12.

1.— Two minute dermal anaclades *in situ* protruding from the surface; magnified 300; phot. Zeiss, apochr. 8, compens. oc. 6.

2–9.— Minute dermal anaclades:

- 2, 4, 6, 8, entire dermal anaclades; magnified 150; phot. Zeiss, apochr. 8, compens. oc. 6;
- 3, 5, 7, 9, the cladomes of the dermal anaclades represented to the left of them in Figs. 2, 4, 6, and 8; magnified 400; phot. Zeiss, apochr. 4, compens. oc. 6;
  - 2–5, triaenes;
  - 6, 7, a diaene;
  - 8, 9, a monaene.

10–12.— Minute dermal amphioxes; magnified 150; phot. Zeiss, apochr. 8, compens. oc. 6:

- 10, a slightly curved one;
- 11, 12, two angularly bent ones.

Geodia micropora Lendenfeld.

Figures 13–36.

13–17.— Cladomes of mesoproclades; magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6:

- 13, 15, of mesoprotriaenes;
- 14, of an irregular mesoclade;
- 16, of a mesoprodiaene;
- 17, of a mesopromonaene.

18, 19.— Group of asters from a centrifugal spicule-preparation; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:

- 18, focused higher; 19, focused lower.
  - a, small strongylosphaerasters; b, large oxysphaeraster.

20.— Two small strongylosphaerasters; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7. q. oc. 10.

21–23.— Sterrasters; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6:

- 21, a young sterraster;
- 22, 23, full-grown sterrasters.

24–27.— Spicules and groups of such from centrifugal spicule-preparations; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6:

- a, dermal rhabds; b, small strongylosphaerasters; c, large oxysphaerasters; d, large oxyasters.

28.— Group of small strongylosphaerasters; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.

29.— Part of the surface of the sponge; magnified 3; phot. Zeiss, anastig. 167.

30, 31.— Umbilical part of the surface of a full-grown terraster; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:

- 30, focused higher; 31, focused lower.

32.— View of the sponge; reduced 1 : 095; phot. Zeiss, anastig. 480 / 412 mm.

33.— Group of asters from a centrifugal spicule-preparation; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:

- a, small strongylosphaeraster; b, large oxysphaeraster.

34.— Group of asters from a centrifugal spicule-preparation; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:

- a, small strongylosphaerasters; b, large oxyaster.

35, 36.— Umbilical part of the surface of a not quite fully developed sterraster; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:

- 35, focused higher; 36, focused lower.

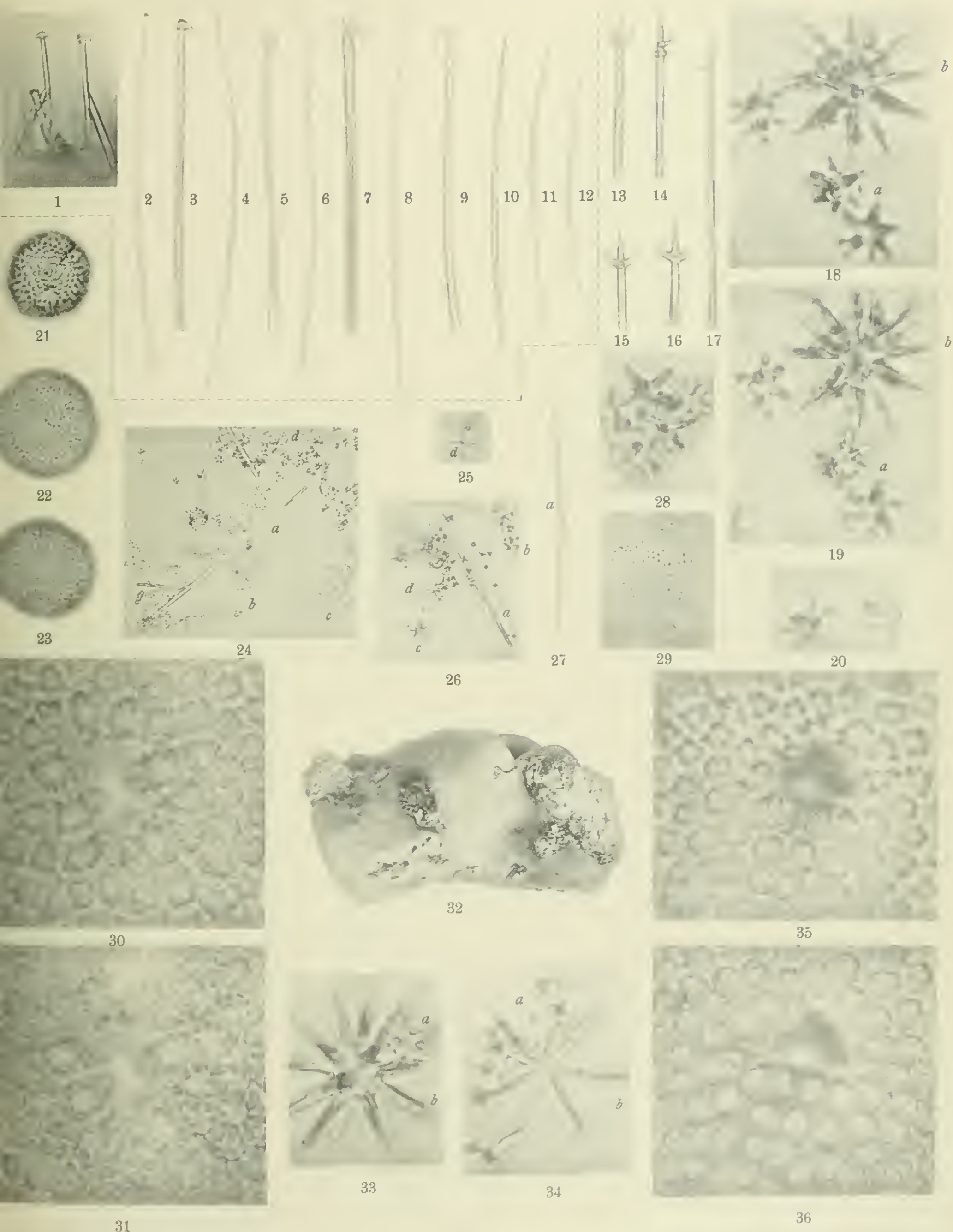

Fig. 1-12 Geodia breviana n. sp.
Fig. 13-36 Geodia micropora n. sp.

PLATE 37.

PLATE 37.

Geodia micropora Lendenfeld.

Figures 1–14.

1.— Portion of a radial section through the superficial part of the sponge; magnified 20; phot. Zeiss, planar 20:
  a, cortex.
2.— Portion of a radial section through the superficial part of the sponge; magnified 7.5; phot. Zeiss, planar 50:
  a, cortex; b, large efferent canal-stem.
3.— Portion of a radial section through the superficial part of the sponge; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6:
  a, dermal membrane; b, tufts of small dermal rhabds in position in the dermal layer; c, sterraster-armour; d, subcortical cavity; e, small dermal rhabds still situated subcortically; f, large subcortical triaenes.
4–7.— Orthoplagiotriaenes; magnified 50; phot. Zeiss, apochr. 16, compens. oc. 4.
8, 9.— Surface views of thin superficial, paratangential sections in transmitted light; magnified 10; phot. Zeiss, planar 50:
  8, part of an afferent area;
  9, part of an efferent area.
10, 11.— Chelotrops; magnified 50; phot. Zeiss, apochr. 16, compens. oc. 4.
12.— A pore-sieve from an afferent area; magnified 50; phot. Zeiss, apochr. 16, compens. oc. 4.
13.— A group of pore-sieves from an efferent area; magnified 50; phot. Zeiss, apochr. 16, compens. oc. 4.
14.— Part of a radial section through the choanosome; congo-red; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6.

Geodia japonica (Sollas).

Figures 15–30.

15–17.— Cladomes of orthotriaenes; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6:
  15, side-view of an orthotriaene-cladome with terminally irregular clades;
  16, side-view of an orthotriaene with regular clades;
  17, an orthotriaene-cladome (with the rhabdome broken off) seen from below.
18–21.— Large choanosomal amphioxes; magnified 20; phot. Zeiss, planar 20.
22.— Group of megascleres from a spicule-preparation; magnified 20; phot. Zeiss, planar 20.
  a, ordinary, large choanosomal amphioxes; b, orthotriaene with regular clades; c, orthotriaene with an irregular clade; d, smaller, slender curved amphiox; e, large anatriaene.
23–28.— Orthotriaenes; magnified 20; phot. Zeiss, planar 20:
  23–27, with fairly straight rhabdome;
  28, with curved rhabdome.
29, 30.— Large anatriaenes; magnified 20; phot. Zeiss, planar 20.

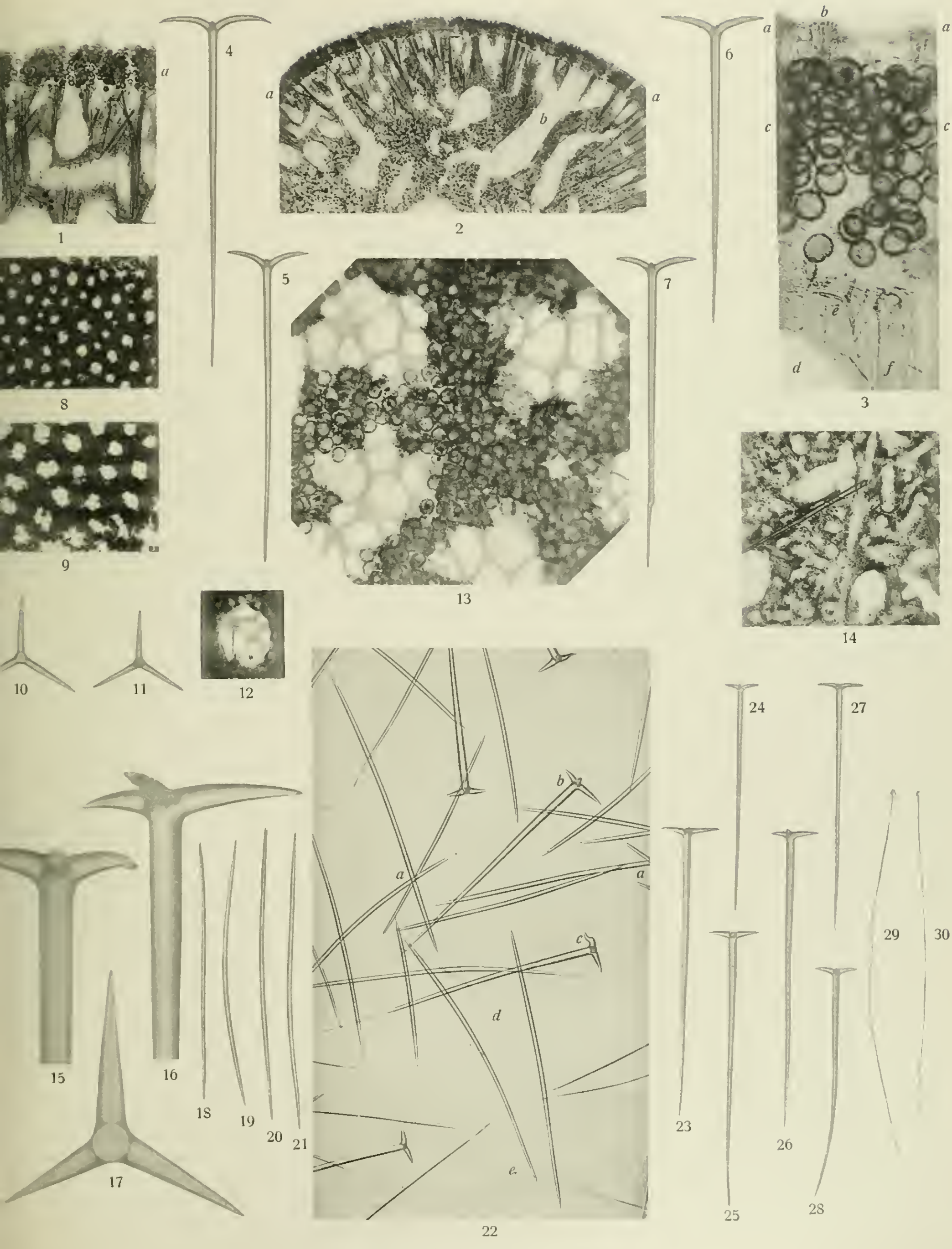

Fig. 1—14 Geodia micropora n. sp.
Fig. 15—30 Geodia japonica (Sollas).

[...]denfeld photographed.

PLATE 38.

PLATE 38.

Geodia japonica (SOLLAS).

Figures 1–29.

1–7.— Cladomes of orthotriaenes; magnified 50; phot. Zeiss, apochr. 16, compens. oc. 2.
8.— Side-view of the specimen; reduced 1 : 0.58; phot. Zeiss, anastig. 480 / 412.
9–17.— Cladomes of mesoproclades; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6:
- 9, 14, of regular mesoprotriaenes;
- 10, 12, of regular mesoprodiaenes;
- 11, of a regular mesoprodiaene with a rudiment of a third clade;
- 13, of a mesoclade with all three clades reduced;
- 15, 16, of mesopromonaenes with rudiments of the two other clades;
- 17, of a mesoprodiaene with one shortened, truncate clade.

18–29.— Cladomes of large anatriaenes; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6:
- 18, 19, of young, large anatriaenes with not fully developed clades;
- 20–22, of full-grown, large anatriaenes, the distal parts of the clades of which are straight;
- 23–29, of full-grown, large anatriaenes, the distal parts of the clades of which are more or less curved outwards (sigmaclade).

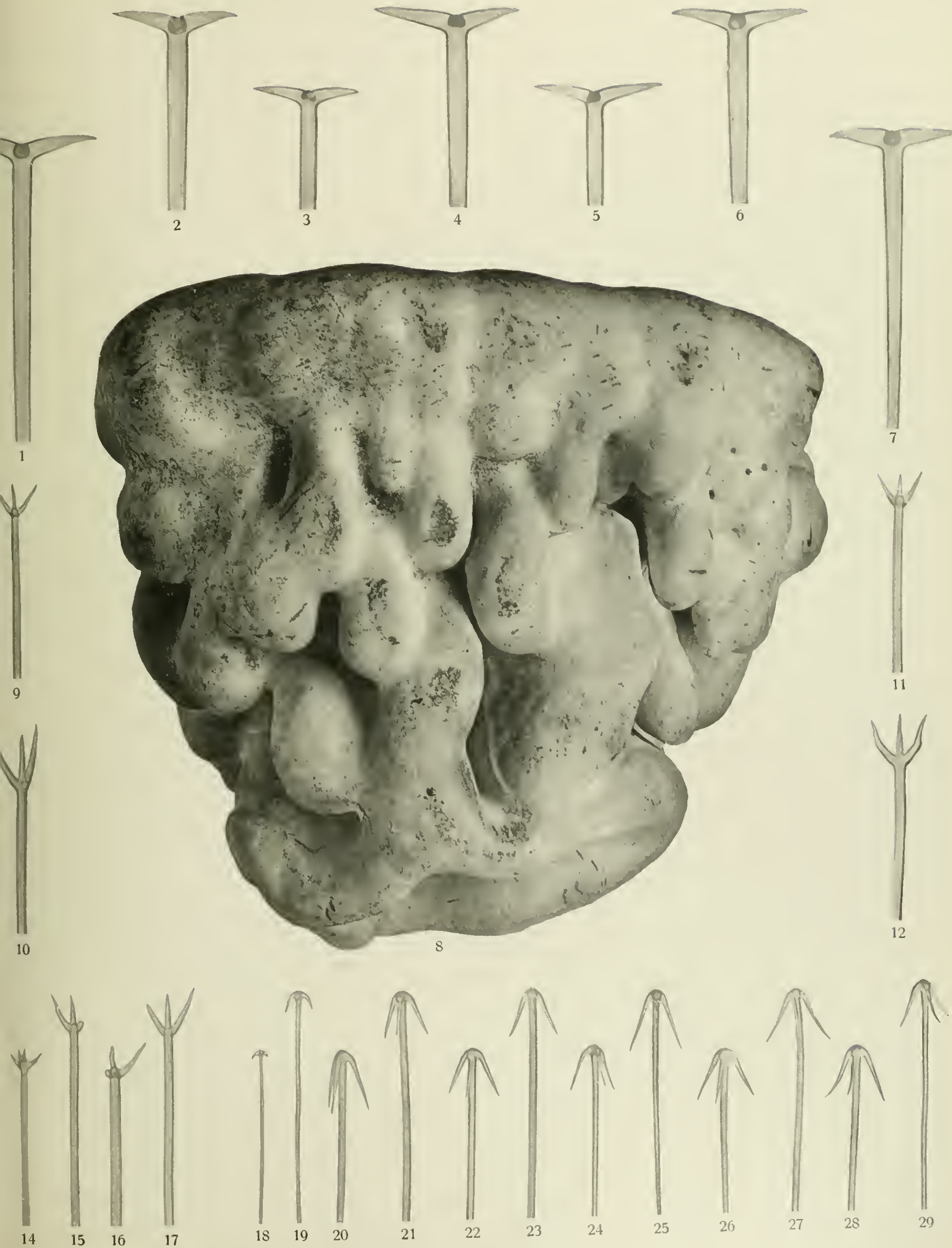

Fig. 1—29 Geodia japanica (Sollas).

eld photographed.

PLATE 39.

PLATE 39.

Geodia japonica (SOLLAS).

Figures 1–41.

1–9.— Small dermal rhabds (amphioxes); magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6.

10–12.— Groups of small strongylosphaerasters and a single one from a centrifugal spicule-preparation; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.

13.— Group of spicules from a centrifugal spicule-preparation; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6:

a, large oxyasters; b, small strongylosphaerasters; c, a minute dermal anaclade.

14–17.— Minute dermal anaclades; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6:

14, 15, with well-developed cladomes;

16, 17, with reduced cladomes.

18–24.— Large oxyasters; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6.

25, 26.— Parts of large oxyasters; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.

27.— Group of asters from a centrifugal spicule-preparation; magnified 540; u. v. phot. Zeiss, q. monochr. 6, q. oc. 10:

a, large oxyaster; b, small strongylosphaerasters.

28–32.— Sterrasters; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6:

28, 29, *en face* views with the umbilicus near the centre of the upper side;

30–32, profile views with the umbilicus at or near the margin.

33.— A large oxysphaeraster; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.

34, 35.— The umbilical part of the surface of a sterraster; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:

34, focused higher; 35, focused lower.

36, 37.— Two strongylosphaerasters from a centrifugal spicule-preparation; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:

36, focused lower; 37, focused higher.

38, 39.— Cladomes of minute dermal anaclades; magnified 1000; phot. Zeiss, hom. imm. apochr. 2, compens. oc. 6.

40, 41.— Large oxysphaeraster; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:

40, focused higher; 41, focused lower.

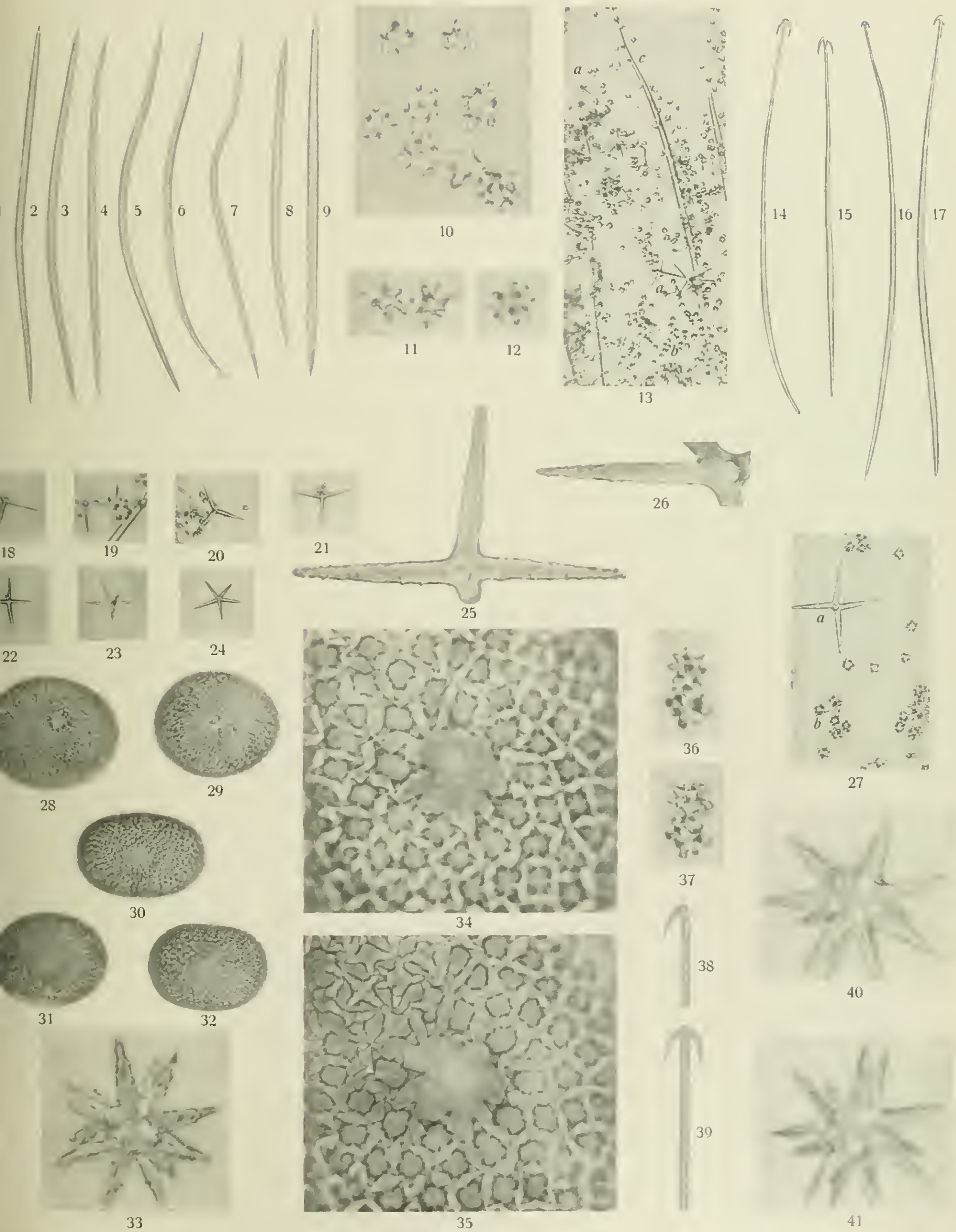

Fig. 1—41 Geodia japonica (Sollas).

nfeld photographed,

PLATE 40.

PLATE 40.

Geodia ovis LENDENFELD.

Figures 1–30.

1–4.— Orthotriaenes; magnified 10; phot. Zeiss, planar 50.

5.— View of a thick radial slice of the sponge; magnified 1.5; phot. Zeiss, anastig. 480 / 412:
a, spicule-fur; b, cortex; c, choanosome.

6–13.— Large amphioxes; magnified 10; phot. Zeiss, planar 50.

14–16.— Sterrasters; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6:
14, a side-view;
15, 16, front-views of the umbilical side.

17, 18.— The umbilical part of the surface of a sterraster: magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
17, focused lower; 18, focused higher.

19–23.— Cladomes of orthotriaenes; magnified 50; phot. Zeiss, apochr. 16, compens. oc. 2.

24.— Part of the surface of a sterraster opposite the umbilicus; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.

25.— Part of an afferent pore-sieve; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6.

26.— Tip of an abnormal spicule with numerous branch-rays; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6.

27.— Tip of a normal, large amphiox; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6.

28.— The cut face of the halved specimen; reduced 1 : 0.76; phot. Zeiss, anastig. 480 / 412.

29.— Sterroid; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6.

30.— The tip of an orthotriaene-clade with abnormally branched axial thread; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6.

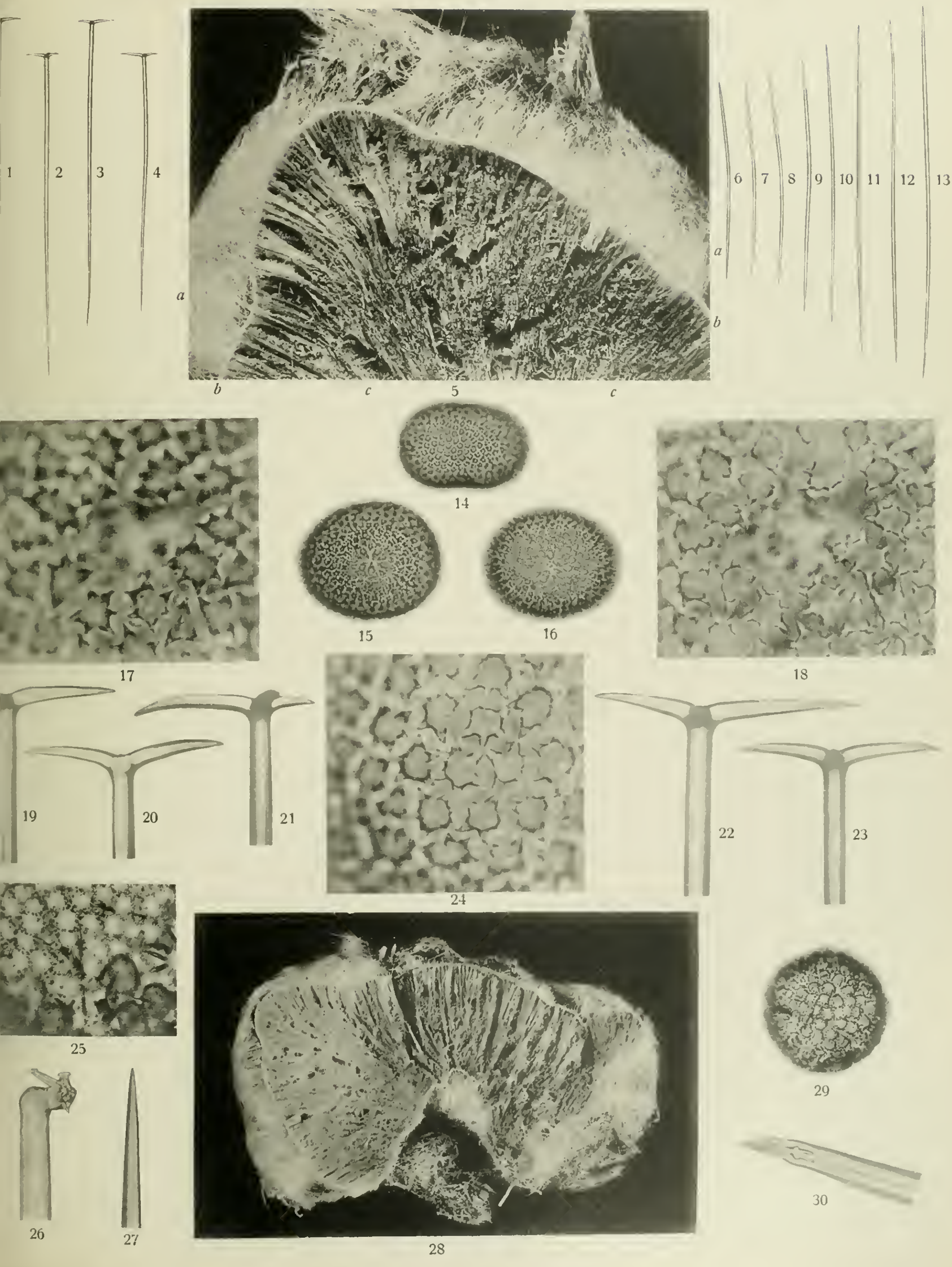

Fig. 1—30 Geodia ovis n. sp.;

nfeld photographed.

PLATE 41.

PLATE 41.

Geodia ovis LENDENFELD.

Figures 1–20.

1–20.— Asters and parts of such; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, compens. oc. 10:

1, 2, small strongylosphaerasters;

3, thin-rayed oxyaster;

4, strongylosphaeraster;

5–8, medium strongylasters;

9, group of asters from a centrifugal spicule-preparation;

a, small, thick-rayed aster; b, oxyaster with thin, more cylindrical rays;

10, 11, group of asters from a centrifugal spicule-preparation;

10, focused higher; 11, focused lower;

a, small thick-rayed aster; b, large thick-rayed oxyaster with one ray bifurcate;

12, oxyaster with rays intermediate in thickness;

13, 14, large strongylaster;

13, focused higher; 14, focused lower;

15, large oxyaster with slender rays;

16, large oxyaster with thick rays;

17, part of a large oxyaster with thick rays;

18, a ray of a large thick-rayed oxyaster;

19, a ray (the left below) of the large thin-rayed oxyaster represented in Fig. 15, focused lower;

20, a ray of a large thick-rayed oxyaster.

Fig. 1—20 Geodia ovis n. sp.

PLATE 42.

PLATE 42.

Geodia ovis Lendenfeld.

Figures 1–40.

1.— Radial section through the superficial part of the sponge; magnified 30; phot. Zeiss, planar 20:
a, dermal membrane; b, sterraster-armour; c, choanosome; d, a chone.

2.— Radial section through the superficial part of the basal part of the sponge and the spicule-fur; magnified 10; phot. Zeiss, planar 50:
a, surface of the sponge; b, c, d, freely protruding spicules of the spicule-fur: b, large amphioxes; c, small anaclades; d, orthotriaenes.

3.— Group of spicules from a centrifugal spicule-preparation; magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6:
a, minute dermal amphioxes; b, minute dermal anaclade; c, asters.

4–7.— Minute dermal amphioxes; magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6.

8.— Radial section through the superficial part of the sponge; magnified 20; phot. Zeiss, planar 20:
a, dermal membrane; b, sterraster-armour; c, choanosome.

9.— Radial section through the dermal layer of the cortex; magnified 100; phot. Zeiss, apochr. 16; compens. oc. 6:
a, dermal membrane; b, sterraster-armour; c, tufts of minute dermal rhabds.

10, 11.— Cladomes of minute dermal anaclades; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.

12–17.— Asters and groups of such from centrifugal spicule-preparations; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6:
a, large thick-rayed oxyasters; b, large thin-rayed oxyasters; c, small strongylasters.

18, 19.— Groups of oxyasters with medium rays from a centrifugal spicule-preparation; magnified 330; phot. Zeiss, apochr. 4, compens. oc. 6.

20–22.— Groups of asters from a centrifugal spicule-preparation; magnified 540; u. v. phot. Zeiss, q. monochr. 6, q. oc. 10:
a, large thick-rayed oxyasters; b, large thin-rayed oxyasters; c, small strongylasters.

23, 24.— Groups of spicules from a centrifugal spicule-preparation; magnified 330; phot. Zeiss, apochr. 4, compens. oc. 6:
a, minute dermal rhabd; b, minute dermal anaclades; c, asters.

25.— Small anatriaene; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6.

26–40.— Cladomes of anatriaenes; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6.

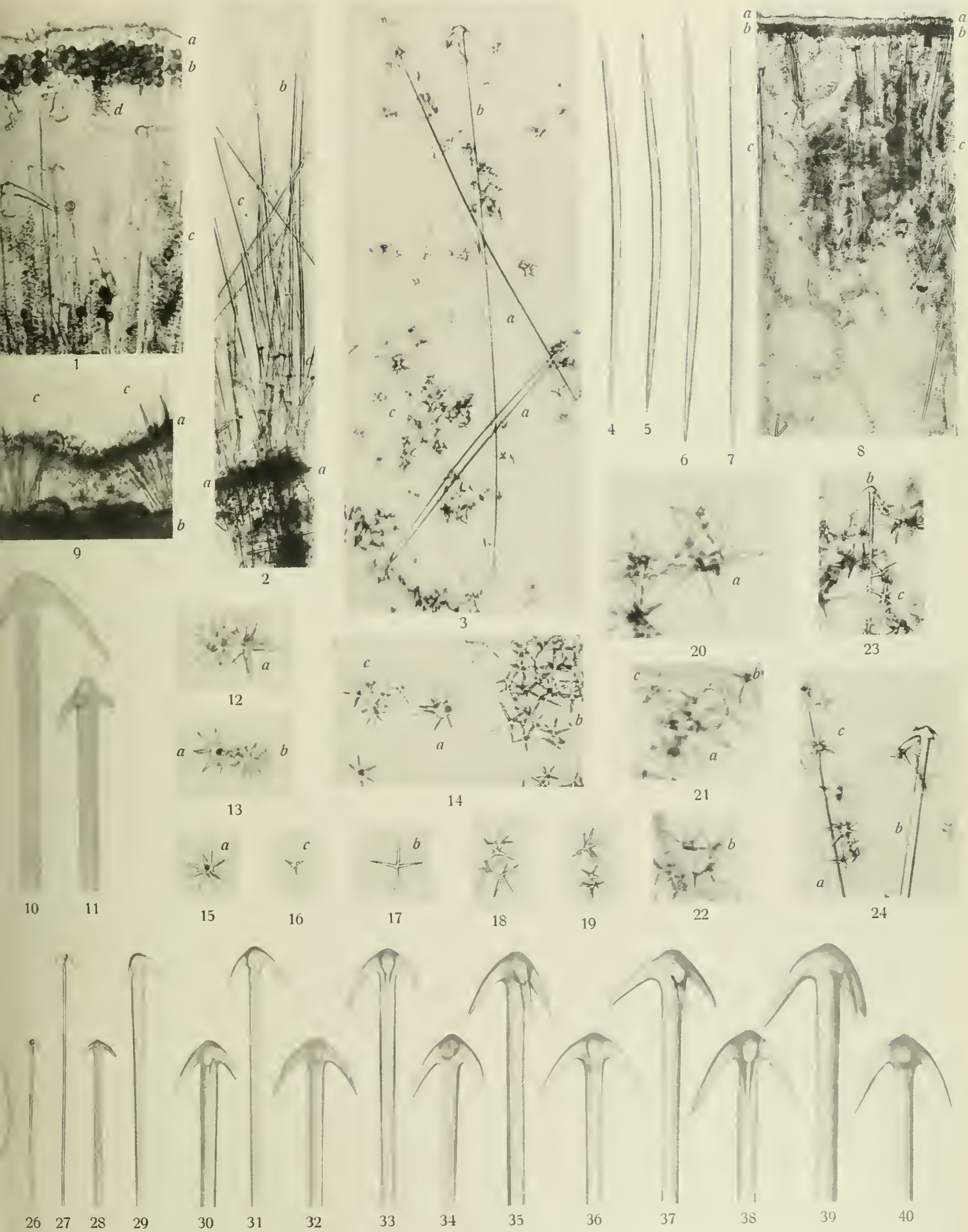

Fig. 1—40 Geodia ovis n. sp.

PLATE 43.

PLATE 43.

Geodia ovis Lendenfeld.

Figures 1–8.

1–8.— Cladomes of mesoproclades and teloclades; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6:
- 1, of an irregular mesoprodiaene;
- 2, of an irregular plagiotriaene with clades convex towards the rhabdome;
- 3, 4, of quite regular mesoprotriaenes;
- 5, of a quite regular mesopromonaene;
- 6, of an irregular mesoprotriaene, with one elongated clade;
- 7, of a prodiaene;
- 8, of an irregular mesoprotriaene with one clade reduced to a rounded knob, and another much elongated.

Geodia ataxastra Lendenfeld.

Figs. 9–25, 28–38.— var. **angustana** Lendenfeld.
Figs. 26, 27. — var. **latana** Lendenfeld.

9–14.— Cladomes of orthotriaenes (plagiotriaenes) of var. *angustana*; magnified 50; phot. Zeiss, apochr. 16, compens. oc. 2:
- 9, of a young one;
- 10, of an adult, somewhat irregular one;
- 11–14, of adult regular ones.

15–22.— Orthotriaenes of var. *angustana*; magnified 20; phot. Zeiss, planar 20.

23, 24.— Groups of megascleres from spicule-preparations of var. *angustana*; magnified 20; phot. Zeiss, planar 20:
a, orthotriaene; b, mesoprotriaene; c, anatriaenes; d, large amphioxes.

25.— Part of a radial section of var. *angustana*; magnified 10; phot. Zeiss, planar 50:
a, cortex; b, choanosome.

26.— An afferent pore-sieve of var. *latana*; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6.

27.— Group of megascleres from a spicule-preparation of var. *latana*; magnified 20; phot. Zeiss, planar 20:
a, orthotriaenes; d, large amphioxes.

28.— A group of efferent pore-sieves of var. *angustana*; magnified 30; phot. Zeiss, planar 20.

29–32.— Large oxysphaeraster of var. *angustana*; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
29, focused higher; 30, focused lower; 31, focused still lower; 32, focused lowest.

33, 34.— Groups of small strongylosphaerasters from a centrifugal spicule-preparation of var. *angustana*; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.

35.— Part of a large slender-rayed oxyaster of var. *angustana*; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.

36.— Part of a large thick-rayed oxyaster of var. *angustana*; magnified 1800; u. v phot. Zeiss, q. monochr. 1.7, q. oc. 10.

37.— Group of spicules from a centrifugal spicule-preparation of var. *angustana*; magnified 1800: u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
a, part of a large thick-rayed oxyaster; b, small strongylosphaeraster.

38.— Part of a large thin-rayed aster of var. *angustana*; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.

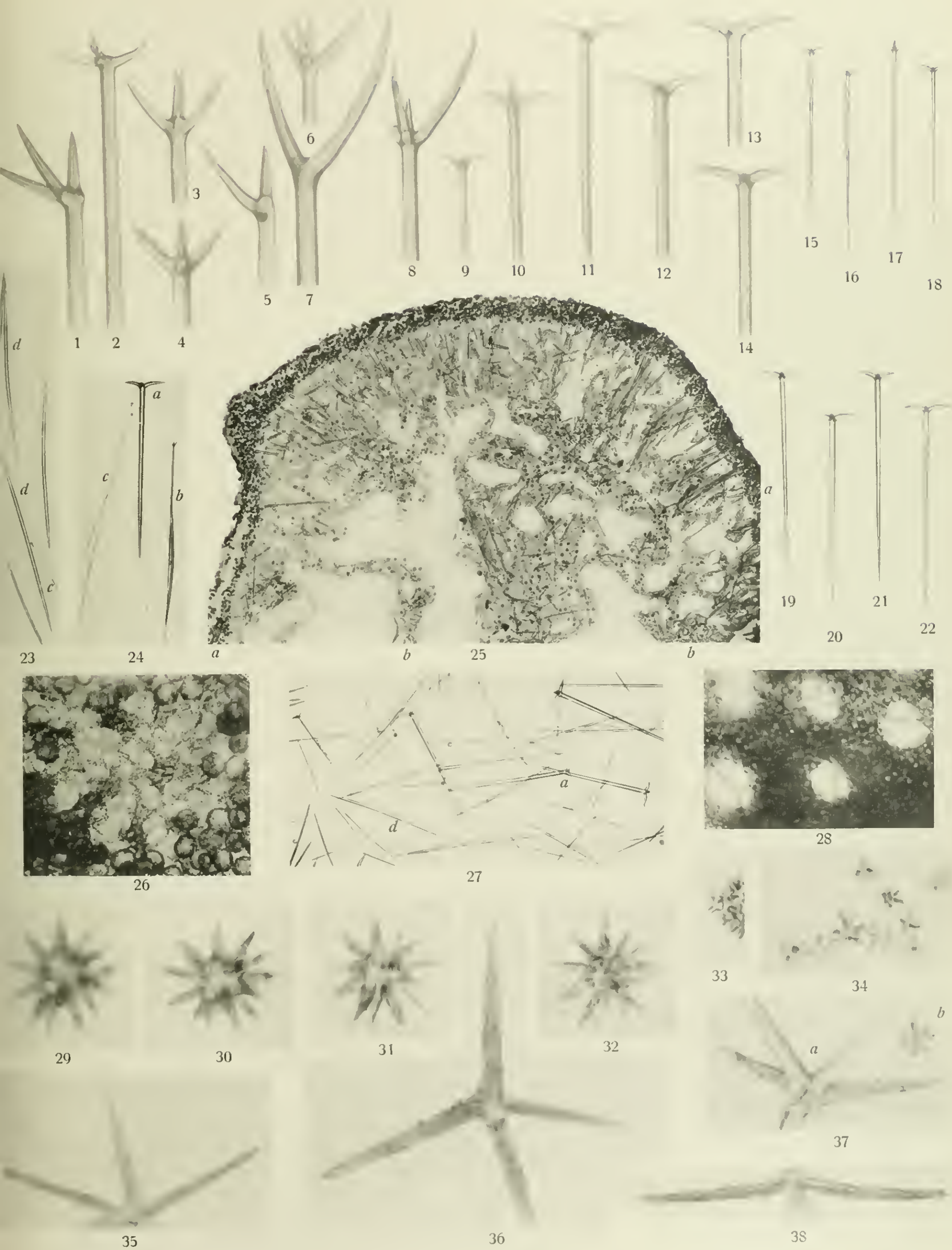

Fig. 1—8 Geodia ovis n. sp.;
Fig. 9—38 Geodia ataxastra n. sp.
9—25, 28—38 G. a. var. angustana; 26, 27 G. a. var. latana.

endenfeld photographed.

Phototype by Charles Bellmann, Prague.

PLATE 44.

Geodia ataxastra Lendenfeld.

Figs. 1–12, 14–49.— var. **angustana** Lendenfeld.
Fig. 13. — var. **latana** Lendenfeld.

1–14.— Cladomes of mesoproclades; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6:
1–12, 14, of var. *angustana*;
13, of var. *latana*;
1, 2, of mesoprotetraenes;
3–11, of fairly regular mesoprotriaenes;
12, of a mesoprodiaene;
13, 14, of irregular mesoprotriaenes with one or more clades reduced in length and terminally rounded.

15–22.— Cladomes of large anatriaenes of var. *angustana*; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6.

23.— Cladome of an anatriaene-derivate with clades reduced to small knobs of var. *angustana*; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6.

24.— Part of a section through the choanosome of var. *angustana*; haematoxylin; magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6.

25.— View of a cluster of specimens of var. *angustana* growing together on a stone; natural size; phot. Zeiss, anastig. 480 / 412.

26.— Radial section through the superficial part of var. *angustana*; magnified 30; phot. Zeiss, planar 20:
a, sterraster-armour; b, radial cortical canal; c, choanosome.

27.— Thick radial section through the superficial part of var. *angustana*; magnified 20; phot. Zeiss, planar 20:
a, surface of the sponge; b, protruding mesoproclades.

28.— Group of spicules from a centrifugal spicule-preparation of var. *angustana*; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6:
b, small strongylosphaerasters; c, large oxyaster; d, minute dermal anaclades.

29, 30.— Groups of asters from a centrifugal spicule-preparation of var. *angustana*; magnified 540; u. v. phot. Zeiss, q. monochr. 6, q. oc. 10:
b, small strongylosphaerasters; c, large thick-rayed oxyasters; e, large thin-rayed oxyaster.

31.— Group of spicules from a centrifugal spicule-preparation of var. *angustana*; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6:
a, minute dermal amphioxes; b, small strongylosphaerasters.

32.— A minute dermal amphiox of var. *angustana*; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6.

33.— Group of spicules from a centrifugal spicule-preparation of var. *angustana*; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6:
a, minute dermal amphioxes; b, small strongylosphaerasters; c, large thick-rayed oxyasters.

34, 35.— Groups of asters from a centrifugal spicule-preparation of var. *angustana*; magnified 540; u. v. phot. Zeiss, q. monochr. 6, q. oc. 10:
b, small strongylosphaerasters; c, large thick-rayed oxyasters; e, large thin-rayed oxyasters.

36–38.— Sterrasters of var. *angustana*; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6:
36, side-view.
37, 38, views of the umbilical face.

39.— Large oxyaster with medium rays; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6.

40.— Group of spicules from a centrifugal spicule-preparation of var. *angustana*; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6:
a, minute dermal rhabds; b, small strongylosphaerasters; c, large thick-rayed oxyasters; d, minute dermal anatriaene.

41, 42.— Cladomes of anatriaenes of var. *angustana*; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6.

43–45.— The umbilicus of a sterraster and the adjacent parts of its surface of var. *angustana*; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
43, focused high; 44, focused intermediate; 45, focused low.

46–49.— Minute dermal anaclades of var. *angustana*; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6.

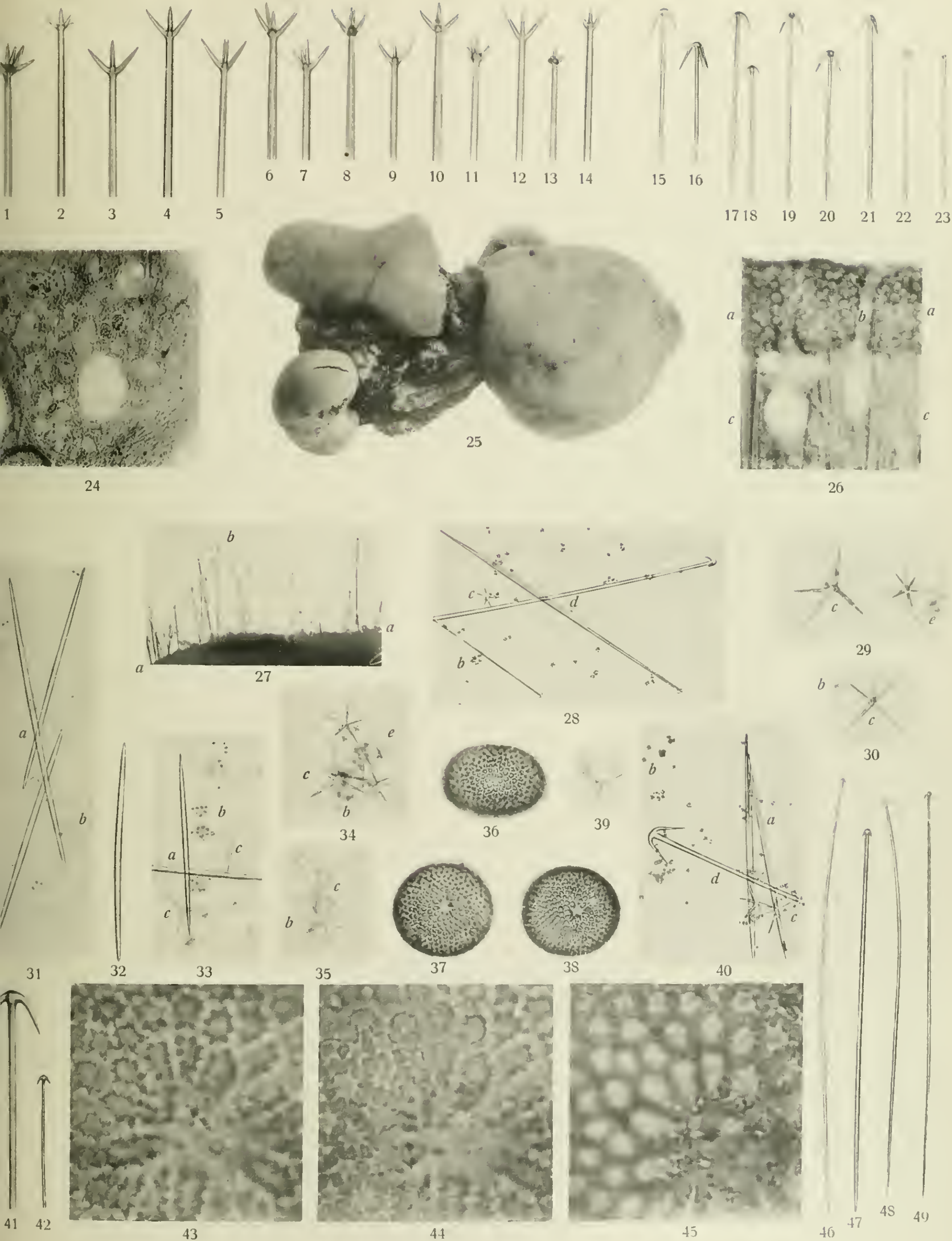

Fig. 1—49 Geodia ataxastra n. sp.
1—12, 14—49 G. a. var. angustana, 13 G. a. var. latana.

denfeld photographed.

Phototype by Charles Bellmann, Prague.

PLATE 45.

PLATE 45.

Geodia acanthylastra Lendenfeld.

Figures 1–39.

1–7.— Cladomes of mesoprotriaenes; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6.
8–15.— Cladomes of anatriaenes; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6.
16.— The cut face of a halved specimen; magnified 3; phot. Zeiss, anastig. 167.
17–19.— Groups of spicules from spicule-preparations; magnified 20; phot. Zeiss, planar 20:
  a, large amphioxes; b, plagiotriaenes; c, anatriaenes.
20–22.— Dermal amphioxes:
  20–21, magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6;
  22, magnified 300; phot. Zeiss, apochr, 4, compens. oc. 6.
23–25.— Groups of asters from centrifugal spicule-preparations; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6:
  a, large acanthtylasters; b, small strongylosphaerasters.
26, 27.— Groups of asters from a centrifugal spicule-preparation; magnified 540; u. v. phot. Zeiss, q. monochr. 6, q. oc. 10:
  a, large acanthtylasters; b, small strongylosphaerasters.
28.— Part of a section through the choanosome; aniline-blue; magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6:
  a, young sterraster; b, flagellate chambers.
29.— View of the sponge; magnified 1.5; phot. Zeiss, anastig. 167.
30–38.— Plagiotriaenes, dichotriaenes, and cladomes of these spicules; magnified 50; phot. Zeiss, apochr. 16, compens. oc. 2:
  30, 35, cladomes of somewhat irregular plagiotriaenes with one lengthened clade;
  31, 32, regular plagiotriaenes;
  33, a plagiotriaene with one bifurcate clade;
  34, cladome of a regular plagiotriaene;
  36,37, dichotriaenes (possibly foreign);
  38, a plagiotriaene with a shortened, terminally rounded rhabdome.
39.— Radial section through the superficial part of the sponge, magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6:
  a, dermal membrane; b, sterraster-armour; c, tufts of dermal rhabds; d, dermal cavities.

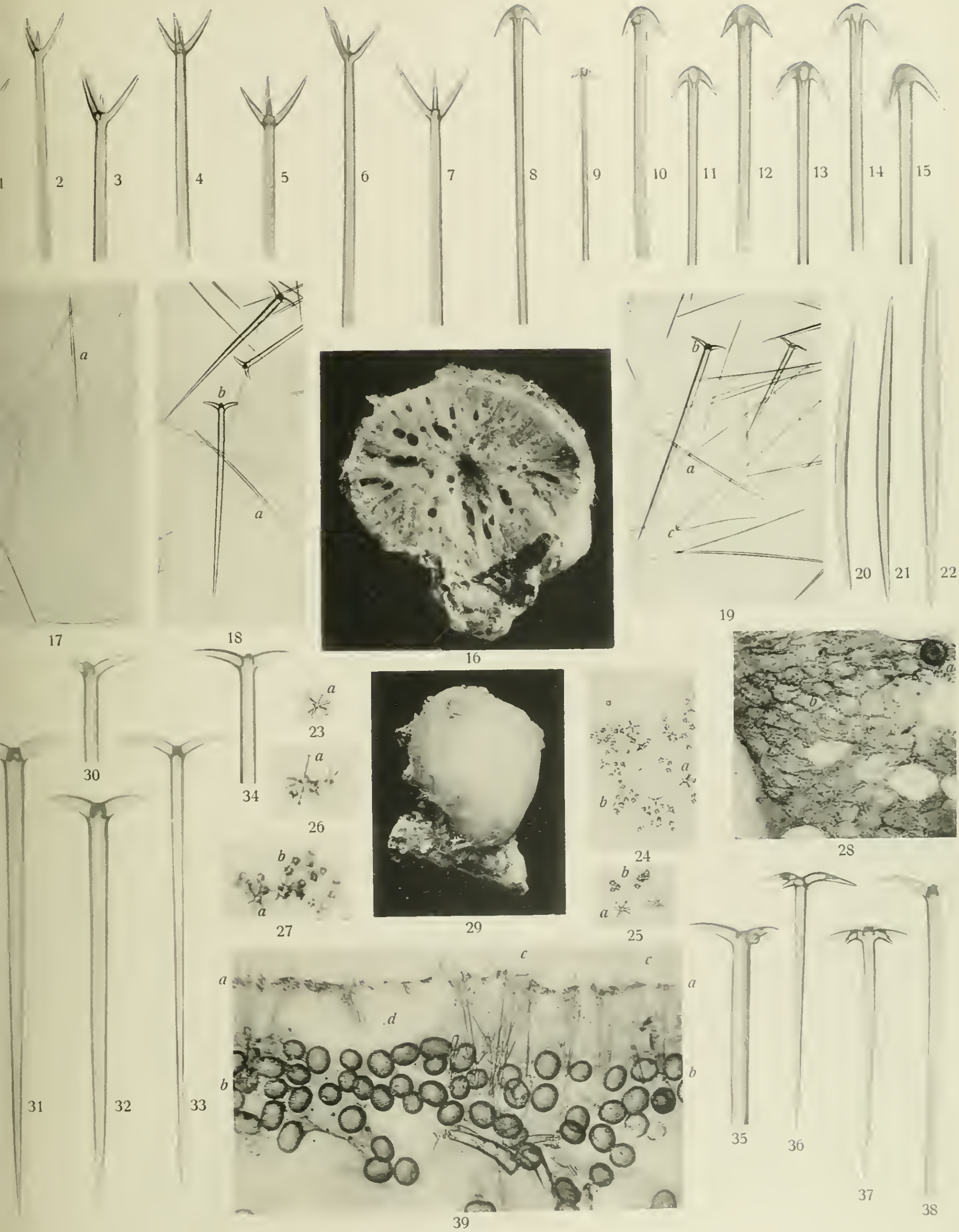

Fig. 1—39 Geodia acanthtylastra n. sp.

nfeld photographed.

Printed by Charles Bellmann, Prague

PLATE 46.

PLATE 46.

Geodia acanthylastra Lendenfeld.

Figures 1–21.

1, 2.— Group of small strongylosphaerasters; magnified 1800, u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
1, focused higher; 2, focused lower.

3–7.— Small strongylosphaerasters and groups of such from centrifugal spicule-preparations; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.

8, 9.— Sterrasters; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6.

10, 11.— Large oxysphaerasters; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
10, focused lower; 11, focused higher.

12, 13.— Large oxysphaeraster; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
12, focused lower; 13, focused higher.

14–16.— The umbilicus of a sterraster and the adjacent parts of its surface; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
14, focused high; 15, focused intermediate; 16, focused low.

17–19.— The umbilicus of a sterraster and the adjacent parts of its surface; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
17, focused high; 18, focused intermediate; 19, focused low.

20.— Radial section through the superficial part of the sponge; magnified 30; phot. Zeiss, planar 20:
a, protruding minute dermal rhabds; b, dermal membrane; c, sterraster-armour; d, protruding mesoproclades; e, choanosome.

21.— A pore-sieve; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6.

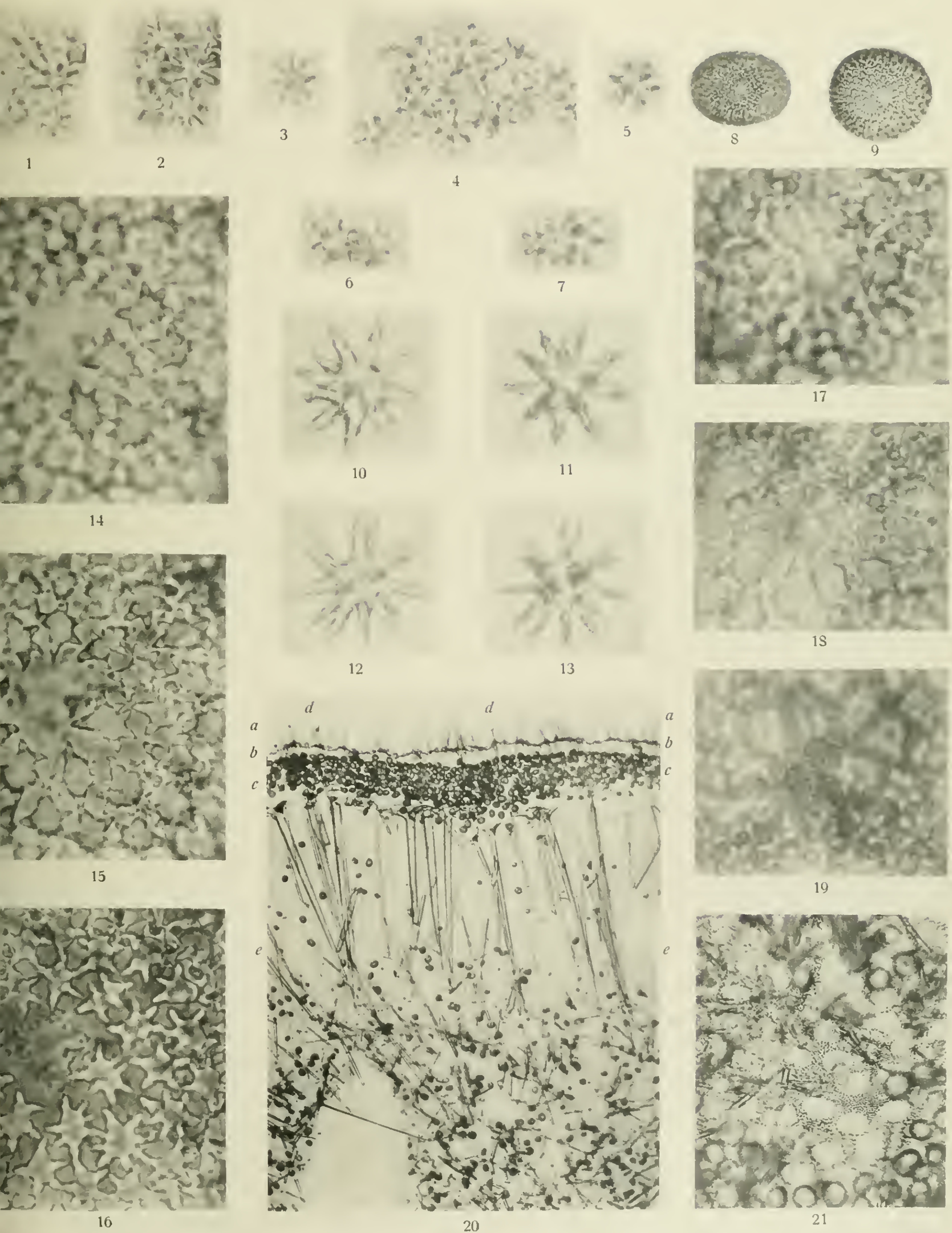

Fig. 1—21 Geodia acanthtylastra n. sp.

enfeld photographed.

PLATE 47.

PLATE 47.

Geodia acanthtylastra LENDENFELD.

Figures 1–8.

1, 2.— Large acanthtylaster; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
1, focused higher; 2, focused lower.

3.— Group of asters from a centrifugal spicule-preparation; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
a, small strongylosphaeraster; b, large acanthtylasters.

4–6.— Acanthtylasters; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.

7.— Group of asters from a centrifugal spicule-preparation: magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
a, small strongylosphaeraster; b, large acanthtylaster.

8.— Large acanthtylaster; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q oc. 10.

Geodia lophotriaena LENDENFELD.

Figures 9–36.

9–21.— Side views of lophotriaenes and plagiotriaenes; magnified 50; phot. Zeiss, apochr. 16, compens. oc. 2:
9–12, 14, 19, lophotriaenes with more or less irregular cladomes and long simple, pointed rhabdomes;
13, 15, 16, 18, dichotriaenes with regular cladomes and long pointed rhabdomes:
17, plagiotriaene;
20, lophotriaene with bifurcate rhabdome;
21, plagiotriaene with shortened and terminally rounded rhabdome.

22.— The sponge seen from above; magnified 3.5; phot. Zeiss, anastig. 167.

23.— Radial section through the superficial part of the sponge; magnified 100; phot. Zeiss. apochr. 16, compens. oc. 6:
a, dermal membrane; b, sterraster-armour; c, choanosome.

24.— Radial section through the superficial part of the sponge; magnified 10: phot. Zeiss, planar 50:
a, cortex; b, choanosome.

25–33.— Cladomes of dicho- and other lophotriaenes seen from below (the rhabdome is directed vertically upwards); magnified 50; phot. Zeiss, apochr. 16, compens. oc. 2:
25–29, cladomes of dichotriaenes;
30, 33, cladomes of lophotriaenes with one trifurcate and two bifurcate clades;
31, cladomes of a lophotriaene with one bifurcate, one trifurcate and one quaterfurcate clade;
32, cladome of a lophotriaene with one quaterfurcate and two trifurcate clades.

34.— Mesoprotriaene; magnified 50; phot. Zeiss, apochr. 16, compens. oc. 2.

35, 36.— Cladomes of anatriaenes; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6.

Fig. 1—8 Geodia acanthylastra n. sp.
Fig. 9—36 Geodia lophotriaena n. sp.

Lendenfeld photographed

Phototype by Charles Bellmann, Prague.

PLATE 48.

PLATE 48.

Geodia lophotriaena Lendenfeld.

Figures 1–34.

1, 2.— Large oxyaster; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
1, focused higher; 2, focused lower.

3–7.— Large amphioxes; magnified 50; phot. Zeiss, apochr. 16, compens. oc. 2.

8, 9.— Minute dermal amphioxes; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6.

10.— Group of spicules from a centrifugal spicule-preparation; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6:
a, minute dermal amphiox; b, sphaerasters.

11.— Large oxyaster; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6.

12.— Group of asters from a spicule-preparation; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6:
a, sphaeraster; b, large oxyasters.

13–15.— Strongylosphaerasters; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6.

16–18.— Large oxyaster; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
16, focused high; 17, focused intermediate; 18, focused low.

19.— Oxysphaeraster; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.

20.— Strongylosphaeraster; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.

21.— A ray of a large oxyaster; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.

22, 23.— Strongylosphaerasters; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.

24–26.— Strongylosphaeraster; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
24, focused high; 25, focused intermediate; 26, focused low.

27–29.— Sterrasters; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6.

30, 31.— The umbilicus and adjacent parts of the surface of a sterraster; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
30, focused lower; 31, focused higher.

32.— Group of asters from a centrifugal spicule-preparation; magnified 540; u. v. phot. Zeiss, q. monochr. 6, q. oc. 10:
a, sphaerasters; b, large oxyasters.

33, 34.— Part of the surface of a sterraster opposite the umbilicus; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.
33, focused lower; 34, focused higher.

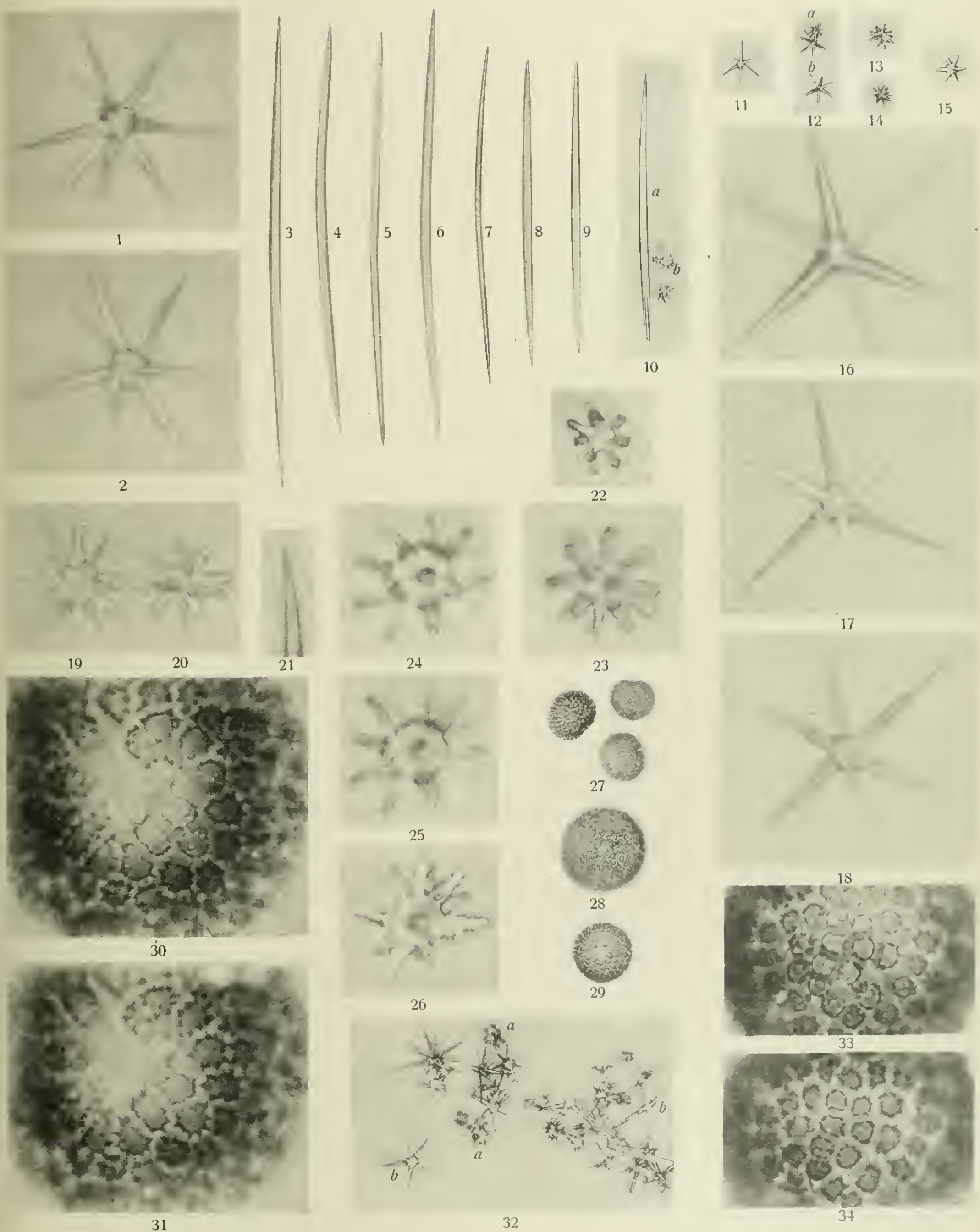

Fig. 1—34 Geodia lophotriaena n. sp.

Lendenfeld photographed.

Memoirs of the Museum of Comparative Zoölogy
AT HARVARD COLLEGE.
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REPORTS ON THE SCIENTIFIC RESULTS OF THE EXPEDITION TO THE EASTERN TROPICAL PACIFIC, IN CHARGE OF ALEXANDER AGASSIZ, BY THE U. S. FISH COMMISSION STEAMER "ALBATROSS," FROM OCTOBER, 1904, TO MARCH, 1905, LIEUT. COMMANDER L. M. GARRETT, U. S. N., COMMANDING, AND OF OTHER EXPEDITIONS OF THE "ALBATROSS," 1888–1904.

XXI.

THE SPONGES.

2. THE ERYLIDAE.

BY ROBERT VON LENDENFELD.

WITH EIGHT PLATES.

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I. DESCRIPTION OF THE SPECIES COLLECTED BY THE "ALBATROSS."

Erylidae.

Tetraxonia with rhabd and teloclade megascleres, and a superficial armour composed of aspidasters [1] and microrhabds. Euasters are always present in the choanosome.

Sollas [2] divided the family Geodidae (Geodiadae) of Gray [3] into the two subfamilies Erylina and Geodina, and placed the geodid genera Erylus, Caminus, and Pachymatisma in the former. Later authors, I [4] among others, have not retained these subfamilies and have placed the three genera named, together with the typical genus Geodia and its allies, in the family Geodidae. The genera Caminus and Pachymatisma are not represented in the collections of the "Albatross," so that I have not been able to give any new data concerning their systematic position during this work. The genus Erylus on the other hand is well represented, and the examination of the "Albatross" material has shown that, as I have already stated in the first part of this monograph (*ante* p. 17), Erylus differs very considerably from Geodia the typical genus of the Geodidae. I therefore now not only revert to Sollas's (*loc. cit.*) original proposition of dividing the family Geodidae into two subfamilies but propose to go even farther and to place Erylus in a separate family: the Erylidae.

The question whether other genera (Pachymatisma, Caminus) should also be placed in this new family I shall not, for the reason given above, discuss here, and I leave them, for the present at least, in the Geodidae; the description of

[1] The aspidasters are those spicules of the Erylidae which were previously termed sterrasters. They are distinguished from the sterrasters of the true Geodidae by passing, during their development, through a stage with perfectly smooth surface which does not occur in the development of the sterrasters of Geodia and its allies, and also by their flattened, disc-like shape.

[2] *W. J. Sollas.* Tetractinellida. Rept. voy. "Challenger," 1888, **25**, p. cxlvii.

[3] *J. E. Gray.* Notes on the arrangement of sponges.... Proc. Zool. soc. London, 1867, p. 492.

[4] *R. v. Lendenfeld.* Tetraxonia. Tierreich, 1903, **19**, p. 84.

the Pacific species, not in the "Albatross" collection, will be found in the first part of this monograph.

The family Erylidae thus comprises the single genus Erylus.

ERYLUS Gray.

With uniporal afferents and uniporal efferents or larger oscules. Without ana- or protriaenes.

There are in the "Albatross" collection twenty-two specimens which belong to four species, one of which is divided into three varieties. All the species and varieties are new.

Erylus oxyaster, sp. nov.

Plate 3, figs. 29–35; Plate 4, figs. 1–43.

I establish this species for a specimen obtained in the Galapagos Islands. Its asters are oxyasters and to this the name refers.

The single, somewhat fragmentary specimen (Plate **4**, fig. 24) is 30 mm. in maximum diameter and consists of two rounded lobose parts, one of which is broad cushion shaped, the other slender, digitate. The surface is smooth and bears numerous small afferent pores. These are quite uniformly distributed and 0.7–1 mm. apart. On the summit of the broader of the two lobes an irregularly circular oscule, 1.8 mm. in diameter, is situated.

The *colour* of the surface of the sponge (in spirit) is brown. A small part of it, which was probably sheltered from the light, is much lighter than the rest. The interior is light greenish yellow.

The superficial part of the body is differentiated to form a *cortex* 450–650 μ thick. This is composed of two layers, an outer layer, 75–120 μ thick, occupied by microrhabds, and an inner layer 360–560 μ thick, occupied by aspidasters.

Canal-system. Many of the afferent pores appear to be quite closed. The open ones (Plate **4**, fig. 25) are circular and surrounded by fine sphincter-membranes in which numerous more or less radially disposed microrhabds are situated. These pores are 30–60 μ wide. They lead into radial canals which traverse the cortex and open out into subcortical cavities the radial diameters of which are usually greater than the paratangential.

The *skeleton* consists of regular rhabd megascleres, irregular derivates of these, microrhabds, teloclades, aspidasters, and oxyasters. The rhabd megascleres are for the most part amphioxes, but a few styles have also been observed. These rhabds and their irregular derivates form bundles which extend radially from the base of the sponge to the cortex and abut vertically on the latter. The microrhabds occupy in dense masses the outer layer of the cortex. The superficial ones are situated paratangentially, the deeper ones mostly obliquely or radially. The teloclades are mostly regular dichotriaenes, but some irregular dichotriaene-derivates and simple plagiotriaenes have also been observed. The cladomes of these teloclades extend paratangentially; just below the cortex their rhabdomes are directed radially inward. The oxyasters form a series from small many-rayed to large few-rayed ones. As, however, the asters of medium diameter and ray-number are not nearly so numerous as the large few-rayed and small many-rayed ones, this series does not appear uniform and large few-rayed and small many-rayed oxyasters can readily be distinguished. The large few-rayed oxyasters are quite uniformly scattered throughout the choanosome; the small many-rayed ones on the other hand, although also present in all parts of the choanosome, are much more numerous in the subcortical region, particularly in the roofs of the subcortical cavities and the walls of the cortical canals, than elsewhere. The aspidasters, which occupy the inner layer of the cortex, are rather irregularly arranged. They exhibit hardly a trace of a paratangential orientation.

The *regular amphioxes* (Plate **4**, figs. 6–9) are isoactine, gradually attenuated towards the ends, and usually rather sharply pointed (Plate **4**, figs. 6–8), more rarely blunt (Plate **4**, fig. 9). They are straight (Plate **4**, fig. 6) or slightly and uniformly curved (Plate **4**, figs. 7, 9), exceptionally abruptly bent in the middle (Plate **4**, fig. 8). The amphioxes are 1.8–2.9 mm. long and 60–85 μ thick.

The rare *styles* (Plate **4**, figs. 10, 11) are slightly curved, simply rounded off at one end and gradually attenuated towards the other, which is usually very blunt. They are 1.9–2.3 mm. long and 60–105 μ thick.

The *irregular derivates of the rhabd megascleres* (Plate **4**, figs. 12–19) have similar dimensions to the regular rhabds. They appear as more or less curved amphioxes, either strongly angularly bent near one end, or provided with one or more branches. The angle in the angularly bent forms (Plate **4**, figs. 12–13) is 15–95°. The branched forms bear one (Plate **4**, fig. 15) or, more frequently, two (Plate **4**, figs. 16, 19) or three branches (Plate **4**, figs. 17, 18), which arise either from the same part (Plate **4**, figs. 16, 19) or from different parts of the shaft (Plate **4**, figs. 17, 18). The branches are always very much shorter than the shaft, rarely over 400 μ long, straight, conical, and terminally either pointed (Plate **4**, figs. 16, 17, 18 the upper right one, 19) or rounded (Plate **4**, figs. 15, 18 the upper left and the lower one). The angle at which they arise is very variable. Sometimes two similar branches lie opposite each other in a straight line (Plate 4, fig. 17 the two lower ones, 19). The axial threads of the shaft and the branches are either joined in a regular manner, or slight irregularities occur at their junction. The most remarkable of these were observed in the two spicules represented on Plate 4, figs. 15 and 18. The axial thread of the single branch of the former and that of the lowest one of the latter do not reach down to the axial thread of the shaft, which passes the junction unaltered, but terminate with a bulbous thickening at a distance of about 3 μ from it.

The *microrhabds* (Plate 3, figs. 29–31, 32a, 35a; Plate 4, figs. 28–33a) are more or less curved, centrotyle amphistrongyles, and generally isoactine. The curvature is either uniform or one or both ends are also abruptly bent in the direction of the curvature. The isoactine microrhabds are usually 31–47 μ long, but occasionally very much larger ones, up to 93 μ in length, are observed (Plate 4, fig. 31). The ordinary microrhabds are, near the centre (tyle), 3.5–4.5 μ thick; the tyle measures 4.5–5.5 μ, usually about 1 μ more than the adjacent parts of the spicule, in diameter. Towards the rounded ends the actines taper gradually to about 2 μ. The rare giant microrhabds are thicker in proportion to their greater length. The centre of the spherical tyle usually lies in the axis of the spicule; sometimes, however, it is eccentric and then the tyle bulges much more on one side than on the others. In some microrhabds one actine is reduced in length; these appear as anisoactines. In a few one of the actines is completely suppressed; these appear as blunt tylostyles. The anisoactine microrhabds are shorter and also somewhat thicker than the ordinary isoactine ones.

The rare *plagiotriaenes* (Plate 4, fig. 20) have a straight, conical rhabdome, about 0.9 mm. long and, at the cladomal end, 75–90 μ thick. The clades are nearly straight, about 0.7 mm. long, and enclose angles of 109–112° with the rhabdome. The breadth of the cladome is 1.3–1.4 mm.

The *regular dichotriaenes* (Plate 4, figs. 1–5, 21–23) have a fairly straight, conical rhabdome, 0.6–1.6 mm. long and, at the cladomal end, 70–105 μ thick. The main clades are straight, 250–400 μ long and enclose angles of 109–120° with the rhabdome. The end clades are conical, pointed, and straight or, more rarely, slightly curved inwards (Plate 4, fig. 5, below), and 50–450 μ long. The cladome is 0.9–1.5 mm. broad.

In the rare *irregular dichotriaene-derivates* either the clades are reduced in number or the rhabdome reduced in length, or both. Forms with two and with only one clade (dichodiaenes and dichomonaenes) have been observed. The reduced rhabdomes are cylindrical, rounded at the acladomal end, 200–

600 μ long, and about as thick as the rhabdome of the regular dichotriaenes. In such rhabdomes the axial thread terminates some distance from the acladomal end, in the centre of its hemispherical surface. In the dichotriaene-derivates with reduced clade number, the central parts of the axial threads of both the rhabdome and the clades usually exhibit considerable irregularities.

The *oxyasters* (Plate **3**, figs. 32c, d, 33d, 34c, 35b, d; Plate **4**, figs. 26d, 27b, 28c, 29f, 30d, f, 32–34e, 38–40) usually have a slight central thickening. This is most clearly discernible in the monactine (Plate **4**, fig. 27b) and diactine forms (Plate **3**, fig. 35b; Plate **4**, fig. 28c). The rays are from one to twenty or more in number, concentric, regularly distributed, and usually equal in size. They are perfectly smooth (Plate **4**, figs. 38–40), conical, and pointed. Very rarely one or two rays are reduced in length, much shorter than the others, and terminally rounded (Plate **3**, fig. 34c). The properly developed rays of the small oxyasters (Plate **4**, figs. 39–40) are uniformly attenuated towards the pointed end, those of the large ones (Plate **4**, fig. 38) attenuated more rapidly in their distal than in their proximal part. The rays are 6–55 μ long and, at the base, 0.8–4.5 μ thick. The whole aster measures 10–90 μ in diameter. The ray-number is, as the following table shows, in inverse proportion to the size of the rays and, apart of course from the monactines, of the whole aster.

Number of rays	1	2–3	4–5	6–9	10–13	14–20 or more
Total diameter of aster, μ	57	48–90	45–75	32–58	15–23	10–17
Length of rays measured from centrum, μ	55	29–50	27–40	19–38	9–14	6–10
Basal thickness of rays, μ	4.5	3–1.5	3–4.5	1.7–1.5	2–3.5	0.8–1.5

As mentioned above there is a kind of gap in the series of these oxyasters, produced by the scarcity of forms 20–35 μ in diameter with from nine to eleven rays.

Most of the *aspidasters* (Plate **4**, figs. 35–37, 41–43) are stout oval discs. Very rarely roundish (Plate **4**, fig. 41) or irregular aspidasters have been observed. The ordinary oval aspidasters are 208–243 μ long, 125–150 μ broad and in the middle 30–40 μ thick. Towards the margin they thin out gradually. The average proportion of length to breadth to (central) thickness is 100 : 63.3 : 15.7.

The umbilical pit is more or less circular in outline, 30–50 μ broad, and about 15 μ deep. Its walls are usually quite smooth. The rest of the surface of the adult aspidaster is covered with protruding rays, often somewhat irregularly distributed, and 1.4–1.7 μ thick. These rays bear terminal verticils of usually six to eight lateral spines (Plate 4, figs. 36, 37). The youngest aspidasters observed were about 55 μ long and appeared as oval, radially striated discs with deeply serrated margins. In a more advanced stage these spicules are smooth discs with slightly undulating margins. On the faces and the margin of such, small protuberances then make their appearance and these grow out to form the protruding rays of the adult aspidasters above described. The centre of the aspidaster is occupied by a rosette-shaped granule about 1.7 μ in diameter. Viewed in profile the adult aspidasters show a distinct stratification. The limits of the layers are smooth and nearly parallel to the two faces. Viewed *en face* they show fine straight striae radiating from the central granule.

This sponge was trawled in the Galapagos Islands, Station 2809, on April 4, 1888; 0° 50′ S., 89° 36′ W.; depth 82 m. (45 f.); it grew on a bottom of gray sand; the bottom temperature was 23.4° (74.1° F.).

The only known species which appears to be allied to the sponge described above is *E. polyaster* Lendenfeld from the Agulhas bank, South Africa. From this it differs, apart from minor peculiarities, by the aspidasters, which are, absolutely and relatively more than three times as thick in *E. polyaster* as in *E. oxyaster*, a difference, of course, quite sufficient for specific distinction.

Erylus sollasii, sp. nov.

Plate 1, figs. 1–48; Plate 2, figs. 1–26; Plate 3, figs. 1–28.

I establish this species for seven specimens obtained at five stations among the Hawaiian Islands. Among the known species of Erylus the one named after me by Sollas appears to be its nearest ally. I therefore return my distinguished friend's compliment by naming this new species after him.

The two specimens from Station 3847 are both small; one is partly light, partly dark in colour; in the other the whole of the surface is dark. Both the specimens from Station 3848 are large and whitish. The specimens from Stations 3849 and 4055 are large and dark. The specimen from Station 4062 is middle sized and light coloured.

The two specimens from Station 3848 are in every way identical; all the others differ to some extent from these and from each other. We have to deal therefore with six different forms. As is shown below, these six forms fall into three groups, which I consider as three distinct races. These I denominate I, II, and III. Race I contains four forms; the races II and III one each. The four forms of race I are designated A, B, C, and D. To race I, form A, belongs the partly light and partly dark specimen from South Molokai (Station 3847); to race I, form B, the small, entirely dark specimen from South Molokai (Station 3847); to race I, form C, the two large whitish specimens from South Molokai (Station 3848); to race I, form D, the middle-sized, light-coloured specimen from northeast Hawaii (Station 4062); to race II the large dark specimen from South Molokai (Station 3849); and to race III the large dark specimen from northeast Hawaii (Station 4055).

Shape and size. The smallest specimen is the entirely dark one from Station 3847 (race I, form B). It is massive, lobose, covered with small but relatively high gyriform ridges, and measures 18 by 9 mm. It has one oscule, about 1 mm. wide, which lies on the summit of a slight elevation. The partly light, partly dark specimen also from Station 3847 (race I, form A) is an irregular mass, with still higher gyriform ridges and measures 24 by 17 by 13 mm. It has two oscules, the larger 1.8 mm. in diameter, and numerous small pores, which are scattered over its surface. The specimen from Station 4062 (race I, form D) is meandric, has small, but relatively quite high, gyriform ridges and measures 36 by 27 by 18 mm. Here and there small apertures are observed on its surface. Of the two specimens from Station 3848 (race I, form C) one (Plate 1, fig. 27) is meandric, while the other appears as a mass with lobose, somewhat digitate processes 7–12 mm. thick. The former measures 60 by 35 by 20 mm., the latter is only 51 mm. long. A few oscules, up to 1.5 mm. wide, are situated on the elevations, and groups of small pores are scattered over the other parts of the surface. The specimen from Station 3849 (race II) (Plate 1, fig. 28) appears as an aggregate of vertical digitate parts about 15 mm. thick, which are joined for the greater part of their length. It is 73 mm. high, 64 mm. long, and 42 mm. broad. From the surface ridges protrude which are about 1 mm. high and 2.5 mm. apart. These ridges are somewhat curved and most of them extend longitudinally, parallel to the vertical axis of the sponge. On or near the summit of each digitate protuberance an oscule is situated. The largest of these oscules is oval and measures 3.2 by 2 mm.; the other oscules are 1–2.5 mm. wide and more or less circular. On the sides of the digitate parts groups of small pores are met with. At one place there is a group of six much larger apertures about 1 mm. wide; here the sponge seems to have been injured some time before its capture. The specimen from Station 4055 (race III) (Plate 3, fig. 27) is an irregular lobose mass with small gyriform ridges on parts of its surface and measures 78 by 62 by 40 mm. On or near the summits of some of the lobes oscules are observed. The largest are oval and measure 4 by 2 mm. The other parts of the surface are occupied by groups of small pores.

In regard to their *colour* the (spirit) specimens differ to a considerable extent. The two specimens from Station 3848 (race I, form C) are for the most part yellowish white, only some of the protruding parts having a purplish brown tinge. The specimen from Station 4062 (race I, form D) is dirty light brownish gray. The lower, basal portion of the partly dark, partly light-coloured specimen from Station 3847 (race I, form A) is light gray, the upper portion dark chestnut-brown. In the entirely dark specimen from the same Station (race I, form B), the surface is dark chestnut-brown throughout. The specimen from Station 3849 (race II) is dirty brownish purple, some parts of its surface being considerably darker than others. The specimen from Station 4055 (race III) is rather dark purple-brown.

The superficial part of the body is differentiated to form a *cortex* (Plate 1, fig. 1a). This is 100–250 μ thick and composed of an outer, middle, and inner layer. The outer, dermal layer is generally quite insignificant and on parts of the surface of most of the specimens absent altogether, probably rubbed off. In those parts of the cortex of race II where it is most highly developed, it attains a thickness of 30 μ. This layer is rich in microrhabds, but contains no fibres and no aspidasters. The middle layer is from 83 μ (in parts of the cortex of race II) to 210 μ (in parts of the cortex of race III) thick and occupied by dense masses of aspidasters. The inner layer is often insignificant and hardly to be made out in the sections. In race I, form C, it attains in places a thickness of 20–30 μ. It is composed of paratangential fibres and contains a few granular cells and groups of granules.

Granular cells, oval to spherical in shape and 12–18 μ long, are abundant in most of the specimens. These cells are most numerous just below the cortex and here often quite densely packed (Plate 1, fig. 3). They also occur scattered in the interior of the choanosome. These cells are filled with granules of fairly equal size. In the granular cells of pale parts of the sponge, particularly in the region overgrown with symbionts, the granules are colourless. In the subcortical and cortical granular cells of the dark and exposed parts the granules are brown. Both the colourless and the brown granules stain deeply with aniline-blue. As mentioned above a few granular cells and groups of granules also occur in the inner layer of the cortex. These groups of granules are massive, flattened, or drawn out so as to appear like strings of beads. Some of the granules forming these groups are similar to the granules in the granular cells, others are larger. They seem to be remnants of disintegrated granular cells.

Canal-system. The afferent apertures, which, as mentioned above, generally form groups on the surface, are uniporal. They are always circular but they differ very considerably in size, their diameter varying between 70 and 520 μ. The largest pores were observed in race I, form C, and in race III. From each pore a canal leads vertically downwards. This canal penetrates the cortex and opens out into one of the subcortical cavities which underlie the poral areas of the cortex. Its proximal opening into the subcortical cavity is surrounded by a chonal sphincter usually more or less contracted, but only rarely completely closed. The canals leading down from small pores are distended, those leading down from large pores constricted below the entrance. I am inclined to ascribe these differences and also, to a great extent, the differences in the width of the pores themselves, to differences in the degree of contraction. The afferent canals, which arise from the subcortical cavities and lead down into the choanosome, are not particularly wide and divide into numerous narrow branch-canals which supply the flagellate chambers. The latter (Plate 1, fig. 4) are spherical or somewhat compressed in the direction of their axis, and measure about 20 μ in diameter. The efferent canals join to form lacunose cavities, which sometimes attain a very considerable width (Plate 1, fig. 1). They open out on the surface with the oscules described above.

Skeleton. Loose strands of rhabd megascleres traverse the choanosome. Their distal portions extend more or less radially and they terminate just below the cortex. Triaenes with radial, centripetally directed rhabdomes are quite abundant in the subcortical layer. In some of the sections a few spicules of this kind have also been found in the interior of the choanosome. I do not consider that as their natural position, however, and believe that these triaenes were brought there from the subcortical layer in cutting the section. No megascleres protrude beyond the surface, and this is entirely destitute of a spicule-fur. Microrhabds occupy in large numbers the outer layer of the cortex and are found in smaller numbers also in the choanosome, chiefly in its distal parts. In the outer, cortical layer of the cortex these microrhabds are not regularly arranged; some are situated paratangentially, others obliquely, and others radially. The middle layer of the cortex is occupied by dense masses of aspidasters, most of which are arranged paratangentially, with their broad faces parallel to the outer surface. Only around the pores some of them are differently situated; these turn one broad side towards the pore-canal and the edge towards the outer surface of the sponge. Young and adult aspidasters also occur scattered in the choanosome. In some specimens aspidasters are rather numerous in the choanosome. In all parts of the choanosome acanthtylasters are met with. These asters, particularly the small many-rayed ones, are more numerous in the subcortical region than in the interior. In the spicule-preparations of race I, form C, large smooth-rayed oxyasters up to 56 μ in diameter, and in those of race III small smooth-rayed oxysphaerasters (Plate 3, fig. 26b) have been observed. I consider these asters, which were not found *in situ* in the sections, as foreign spicules. About the foreign nature of the small oxysphaerasters in the spicule-preparations of race III there can indeed be no doubt, as a Donatia-like sponge-crust, containing such oxysphaerasters in large numbers, covers parts of its surface.

The *rhabd megascleres* (Plate 1, figs. 29–35, 42–48; Plate 3, figs. 19–22) are for the most part blunt amphioxes (Plate 1, figs. 29–31, 33, 44–46; Plate 3, figs. 19, 20, 22). Besides these also sharp-pointed amphioxes (Plate 1, figs. 34, 35, 42, 43, 47, 48), amphistrongyles (Plate 1, fig. 32), and styles (Plate 3, fig. 21) occur. Generally these rhabds are rather uniformly curved (Plate 1, figs. 29–31, 33–35, 42, 43, 46–48; Plate 3, figs. 19–22), rarely straight (Plate 1, figs. 32, 45), or abruptly bent near one end (Plate 1, fig. 44; Plate 3, fig. 18). The styles and particularly the amphistrongyles are curved much less than the amphioxes. The rhabds are 425–980 μ long and 8–24 μ thick. The longest are found among the amphioxes, the thickest among the amphistrongyles and styles. The small specimens, race I, forms A and B, have smaller rhabds than the larger ones. Among the latter race I, form D, and race III have larger rhabds than race I, form C, and race II. Besides these simple rhabds, spicules similar in shape and size, possessing however a short branch-ray, are met with, chiefly in race III. In these mesomonaene-like rhabd-derivates the branch-ray (clade) is pointed or blunt, up to 50 μ long, and situated near one end, in styles thus branched near the pointed end. The branch-ray is either turned upwards proclade-, or downward anaclade-fashion. (See table, p. 277.)

Most of the adult *microrhabds* (Plate 1, figs. 37–41a, 39b, 41b; Plate 2, figs. 16–18; Plate 3, figs. 13–15, 26a) are quite stout, slightly and uniformly curved, centrotyle, isoactine amphioxes. Most of them are blunt, some sharp pointed. Sharp-pointed microrhabds are particularly frequent in race III. The blunt amphiox microrhabds are often somewhat constricted just below their ends, so that the ends themselves appear as terminal knobs (Plate 2, fig. 18).

DIMENSIONS OF RHABD MEGASCLERES.

		Race						all forms	
		I				II	III		
		Form							
		A	B	C	D			limits	general average of the largest three
Length	of all the spicules measured, μ	425–650	530–730	470–760	530–880	450–760	720–980	425–980	
	average of the three longest, μ	630	710	747	853	743	913		766
Thickness	of all the spicules measured, μ	8–13	8–11	10–24	10–22	9–20	12–22	8–24	
	average of the three thickest, μ	12	13	22	20	19	21		18

Besides these greatly preponderating isoactine forms, some anisoactine ones, with one actine shortened and rounded at the end (Plate 1, figs. 39b, 41b), are met with. In some of the microrhabds of race I, form A, and race II this reduction has gone so far that one actine is absent altogether. Such spicules appear as styles (tylostyles). Also branched microrhabds, composed of more than two actines, have occasionally been met with. These are most frequent in race I, form B. Most of them are tetractine and appear to have been produced by an early concrescence of two simple microrhabds lying crosswise. Two opposite rays of such spicules usually form a microrhabd of similar dimensions to the ordinary ones. The microrhabd represented by the two other rays is usually considerably shorter. Rarely the two microrhabds presumably composing these spicules are equal in length. Their axis generally encloses small angles, 30° or less; rarely these angles are greater; forms with axis crossing at right angles are exceedingly rare. Sometimes the one microrhabd is attached to the other by its end; such spicules appear as triactines. The tyle is usually a simple spherical thickening. In the isoactine forms it occupies the centre, in the anisoactine forms it lies nearer to one end than to the other, and in the microrhabds with one actine quite suppressed, it is situated terminally. In a few of the microrhabds of race I, form D, the tyle is irregular and appears as a cluster of rounded protuberances.

No correlation between the size of the sponge and the dimensions of its microrhabds is discernible. The thickness of these spicules is about the same in all the forms; their length however varies, those of race III being considerably shorter than those of the races I and II, although the specimens of some of these (race I, A and B) are very much smaller. The microrhabds are 30–78 μ long and 2.5–5 μ thick. The tyle is 0.3–1.5 μ thicker than the adjacent parts of the spicule and measures 3.5–6.5 μ in diameter.

DIMENSIONS OF MICRORHABDS.

		Race						all forms	
		I				II	III		
		Form							
		A	B	C	D			limits	general average of the largest three
Length	of all the spicules measured, μ	46–76	39–56	30–57	38–78	39–61	30–44	39–78	
	average of the three longest, μ	65	54	56	62	58	44		56.5
Thickness	of all the spicules measured, μ	2.5–5	2–4	3.5–5	3.5–5	3.1–4.3	3–4.5	2.5–5	
	average of the three thickest, μ	4.7	3.8	4.8	4.8	4.1	4.3		4.4
Diameter of tyle	of all the spicules measured, μ	4–6.5	3–5	3.8–6	4–6	3.5–5.5	3.5–5.5	3.5–6.5	
	average of the three largest, μ	5.8	4.8	5.7	5.7	5.2	5.4		5.4

The *triaenes* (Plate 1, figs. 5–26; Plate 3, figs. 1–6, 12, 23, 24) are ortho- or, more frequently, plagio-triaenes with simple or branched clades. The rhabdome is always straight. Usually it is simple and conical. Its acladomal end is sharp pointed (Plate 1, figs. 17, 19, 20; Plate 3, figs. 12, 23, 24) or blunt (Plate 1, figs. 15, 16, 24, 26). Sometimes slight knob-like protuberances are observed near the acladomal end. Rarely the rhabdome is reduced in length, cylindrical, and terminally rounded and slightly thickened (Plate 1, fig. 18; Plate 3, fig. 1). The properly developed, conical rhabdomes are 210–520 μ, the reduced, cylindrical ones 140–220 μ long. Their thickness at the acladomal end is 8–22 μ. Cylindrical rhabdomes are always thick; all the slender triaene-rhabdomes observed were conical. The triaenes of the small specimens (race I, forms A and B) have somewhat shorter and very much thinner rhabdomes than those of the larger ones. The averages of three thickest of the former being 10–13, those of the latter 18–21 μ. Among the large specimens the one of race III has far larger triaene-rhabdomes than those of the races I and II.

The cladomes of these triaenes are very polymorphic. Triaenes with simple clades occur in all the specimens. In race I, form A, no other triaenes were observed. In race I, forms B, C, and in race II a few triaenes with one, more rarely two or three branched (bifurcate) clades occur besides the ones with simple clades. The ramification of the triaene-clades is still greater in race I, form D, and in race III: in these the triaenes with branched clades are more numerous than the ones with simple clades.

In the triaenes with three simple clades (Plate 1, figs. 7, 11, 12, 15–20, 24–26) the clades are usually conical and blunt pointed, rarely reduced in length, cylindrical, and rounded at the end (Plate 1, figs. 16, 18). Such a reduction of the clades is usually associated with a reduction or other abnormity of the rhabdome. The simple triaene-clades are slightly and uniformly curved, concave to the rhabdome (Plate 1, figs. 17, 19), or nearly straight (Plate 1, figs. 22, 25), or, more rarely, abruptly bent down at the end (Plate 1, figs. 18, 20, 24). Their chords are 120–300 μ long.

As stated above, one, two, or all three clades of the triaenes may be branched. This branching is most frequently a simple and regular bifurcation, the two branches (end clades) being simple, and fairly equal in length and angular position (Plate 1, figs. 6, 9, the lower ones in fig. 10; Plate 3, the lower left ones in figs. 2, 3, 5, 6). Irregularities due to a difference in the length or the position of the two branches or to secondary ramifications of the branches are frequently met with. The difference in the length of two end clades forming a pair is caused by the reduction of one of them. This reduction sometimes becomes so great as to lead to a complete suppression of one of the end clades, in which case a single end clade arises from the, in such spicules usually somewhat thickened end of the main clade (Plate 1, fig. 8). The differences of position are frequently so great that one end clade appears as a continuation of the main clade (Plate 1, the upper one in fig. 5; Plate 3, the upper one in fig. 3). Some of these spicule-rays might indeed be considered as simple clades from which a branch-ray arises laterally. A secondary ramification of the end clades has been observed only in race I, form D, and in race III. It affects either both end clades of a pair in a similar manner (Plate **3**, the left ones in fig. 4) or one of them only (Plate **1**, the upper one in fig. 10; Plate **3**, the upper in fig. 2 and the right ones in figs. 2–5). The proportion of the length of the main clade to the length of the end clades is, as a comparison of figs. 6 and 9 on Plate **1** shows, subject to very considerable variation. The main clades are 70–270, the end clades 10–160 μ long. The cladomes are 160–550 μ broad. The triaenes of the small specimens of race I, form A, have the narrowest cladomes (average of the three largest 373 μ), those of the large specimen of race III, the broadest (average of the three largest 530 μ). The angle enclosed by the axis of the rhabdome and the chords of the simple clades and the stems (main clades) of the branched ones, is 86–116° (general average 103.4°). It is smallest in the triaenes of race I, form A (average 97°), and largest in those of races II and III (average 107 and 107.5°). Thus most of these spicules are plagioclades, some orthoclades. (See table, p. 281.)

In race II some spicules, 310–330 μ in diameter, composed of two simple (Plate **1**, fig. 13) or branched (Plate **1**, the right one in fig. 14) clade-like, and two short, conical, blunt rudimentary rays, have been observed. These spicules appear to be derivates of the triaenes described above.

The *acanthtylasters* (Plate **1**, figs. 36–40c; Plate **2**, figs. 1–4, 8–11; Plate **3**, figs. 7, 8, 25, 26c) are destitute of a central thickening and have from two to fourteen, a few perhaps more than fourteen, rays. The rays are concentric and nearly always uniformly distributed, simple, and equal in size. Acanthtylasters with rays unequally long or branched (bifurcate) have been only very rarely observed. The rays of the larger acanthtylasters (Plate **2**, figs. 1, 2, 8, 9; Plate **3**, figs. 7, 8) are cylindroconical and at the base 1–3 usually 1.5–2.3 μ thick. They taper distinctly towards the end, and are, at their thinnest point a short distance below the end, 0.7–1.5 μ thick. The rays of the smaller ones (Plate **2**, figs. 10, 11) are somewhat more cylindrical and only 0.4–1.5 μ thick. The rays invariably bear spines, some of which always congregate at the end of the ray and here form a terminal, acanthtyl cluster 1.3–3.5 μ in diameter. The size of the spines is on the whole proportional to the size of the aster. Apart from this they are subject to considerable variation. Sometimes numerous small and insignificant (Plate **3**, fig. 7), sometimes numerous medium sized (Plate **2**, figs. 8, 9), and sometimes only one or a few very large spines, 1–1.6 μ in length (Plate **2**, figs. 1, 2; Plate **3**, fig. 8), arise from the sides of the rays. In the two-rayed acanthtylasters a cluster of spines arises from the centre of the spicule.

DIMENSIONS OF TRIAENES.

			Race								
			I				II	III	all forms		
			Forms								
			A	B	C	D			limits	general average of the largest three	general average
Rhabdome	length	of all the spicules measured, μ	210–400	140–360	220–470	200–420	240–400	180–520	140–520		
		average of the three largest, μ	373	290	397	380	380	490		385	
	thickness	of all the spicules measured, μ	10–15	8–10	10–22	10–22	12–20	13–22	8–22		
		average of the three thickest, μ	13	10	18	21	19	21		17	
Simple clades	length	of all the spicules measured, μ	120–215	170–280	120–270	175–270	120–240	225–300	120–300		
Branched clades	length of main clades	of all the spicules measured, μ		150–230	100–200	80–140	120–185	70–270	70–270		
	length of end clades	of all the spicules measured, μ		30–50	20–40	60–160	10–60	10–130	10–160		
Cladome	breadth	of all the spicules measured, μ	160–380	370–460	215–490	290–470	170–450	280–550	160–550		
		average of the three largest, μ	373	413	457	450	417	530		410	
Clade- (main clade) angle		of all the spicules measured	89–107	100–107	89–115	86–112	95–116	98–115	86–116		
		average of all	97	103	105	101	107.5	107			103.4

This appears as a rudiment of a third ray. Most of the spines are conical, straight, and vertical, some conical and recurved (Plate 2, fig. 1), some irregular, cylindrical, terminally rounded or even thickened, and occasionally lobose at the end.

The acanthtylasters measure 10–38 μ in diameter. Their size is in inverse proportion to the number of their rays. To obtain a clearer insight into this correlation I measured (and counted the rays of) 207 of them and took the means of the diameters of those with the same ray-numbers. There is no difficulty in counting the rays of the large few-rayed acanthtylasters, but it is impossible to ascertain the ray-numbers of the small many-rayed ones with sufficient exactitude. I therefore calculated the means of the two- to nine-rayed acanthtylasters by themselves, but combined the ten- to fourteen-rayed ones in one group of which I took the mean. This mean can be taken as the mean diameter of the asters with a ray-number equivalent to the mean of 10, 11, 12, 13, and 14, that is twelve. In this way I found that the average diameter

of the acanthtylasters with two	rays	is	38 μ,
of those with three	"		29 ",
" " " four	"		28 ",
" " " five	"		27 ",
" " " six	"		25 ",
" " " seven	"		23 ",
" " " eight	"		21 ",
" " " nine	"		19 ", and
" " " ten to fourteen (mean twelve) rays 14 μ.			

Apart from the two-rayed asters, which are so few that I was unable to measure a number sufficient for attaining a reliable mean, the mean given above shows that there is a very regular decrease in size with increasing ray-number, amounting in the asters with from three to five rays to 1 μ and the asters with six or more rays to about 2 μ per unit of difference of ray-number.

In all the forms four- to ten-rayed acanthtylasters have been observed. The four- to six-rayed appearing to be the most frequent ones. In the forms A, C, and D of race I and in race II also three-rayed and in race II also a few two-rayed acanthtylasters were found. Acanthtylasters with more than ten rays have been found in all the forms except race I, form C. In the small specimens the acanthtylasters are not smaller than in the large ones. The largest acanthtylasters occur in the form A of race I and in the races II and III. (See table, p. 283.)

The *aspidasters*. The disc-shaped spicules of the cortical armour of the species of Erylus have hitherto been designated, like the ovoid spicules of the armour of Geodia, as sterrasters. Closer examination of these spicules in the species of Erylus of the "Albatross" collection has shown, however, that they differ from the sterrasters found in the species of Geodia and allied genera not only in their shape, but also in their mode of development, to such an extent that it is advisable to give them another name. Aspidaster, the name selected for them, has reference to their shield (ἀσπίς)- like shape.

DIMENSIONS OF ACANTHTYLASTERS.

		Race I, Forms A	Race I, Forms B	Race I, Forms C	Race I, Forms D	Race II	Race III	all forms: limits	all forms: general average of the largest three
Number of rays		4–12	3–13	3–10	3–14	2–14	4–12	2–14	
Diameter	of all asters measured with six rays or fewer, μ	20–36	21–32	21–32	22–30	22–38	25–36	15–38	
	of all asters measured with seven or more rays, μ	10–27	6–20	17–22	12–27	12–24	13–24	10–27	
	average of the three largest, μ	33	29	31	29	35	33		31.7

The adult aspidasters of *Erylus sollasii* (Plate **1**, fig. 36d; Plate **2**, figs. 5–7, 12–15, 19–26; Plate **3**, figs. 9–11, 16, 17, 25d, 28) are 95–156 μ long, 55–82 μ broad, and 74–14 μ thick. The general average proportion of their length to their breadth to their thickness is 100:55.8:8.8. Optical transverse sections show that these disc-shaped spicules are gradually attenuated towards the margin, which is usually quite sharp. The shape of their outline is variable; some of them (Plate **2**, figs. 13, 23, 26; Plate **3**, fig. 9) are quite regularly oval, some rounded rhomboidal (Plate **2**, fig. 22; Plate **3**, figs. 10, 17), and some irregular (Plate **2**, figs. 12, 24, 25) with lobose marginal protuberances of which one or a few broad ones, or a larger number of narrow ones may be present. On one face of the disc there is a very shallow, more or less circular depression 20–30 μ in diameter. In this depression, which is obviously homologous to the umbilicus of the sterrasters of Geodia, the surface is either quite smooth, or bears only a few small rays or spines. From all the other parts of the surface (Plate **2**, figs. 5, 6; Plate **3**, fig. 28) and also from the margin, rays usually about 1–2 μ thick protrude. Those on the margin are about 1.5 μ long, those on the faces appear to be shorter. These rays are scattered rather irregularly and (measured from centre to centre) 2–6 μ apart. Each ray bears a terminal verticil of four to ten lateral spines. The centre of the aspidaster is occupied by a small group of granules, from which very numerous and perfectly straight radial lines extend towards the margin. In some adult aspidasters this radial structure is well defined (Plate **2**, fig. 7), in others it can hardly be made out.

There appears to be a certain degree of correlation between the size of the sponge and the size of its aspidasters, the latter being smaller in the small specimens of race I, forms A and B (average length of the three largest of these forms 118 and 120 μ respectively), larger in the middle-sized specimen, race I, form D (that average 124 μ), and still larger in the large specimens of race I, form C, and races II and III. Among the latter those of races II and III (that average 150 and 152 μ) are very considerably larger than those of race I, form C (that average 128 μ), and the other smaller forms of race I. Also in their shape the aspidasters of the different forms differ to a certain extent, those of race II being much more slender and those of race I, form C (Plate **2**, fig. 25) much more irregular than those of the others. Also in the number of the ray-spines differences are observed, the rays of the aspidasters of race II bearing up to ten, those of the aspidasters of the races I and III only from four to six lateral spines.

DIMENSIONS OF THE ASPIDASTERS.

		Race						all forms		
		I				II	III			
		Forms								
		A	B	C	D			limits	general average of the three largest	general average
Length	of all measured, μ	102–121	95–120	105–130	107–126	120–156	128–153	95–156		
	average of the three longest, μ	120	118	128	124	152	150		132	
Breadth	of all measured, μ	57–68	55–70	59–73	60–75	60–76	71–82	55–82		
	average of the three broadest, μ	67	69	73	73	75	82		73	
Thickness	of all measured, μ	7.4–12.2	8.2–10.4	10	11.2–12	9.2–11.4	12–14	7.4–14		
	average of the three thickest, μ	11.6	10	10	11.6	11	14		11.6	
Average of proportion of length to breadth to thickness, μ		100: 55.3: 8.2	100: 59.1: 9	100: 57: 8.4	100: 56: 9.8	100: 49.8: 7.6	100: 57.7: 10			100: 55.8: 8.8

Young aspidasters were found in considerable numbers scattered throughout the choanosome in several specimens. They are imbedded in the ground substance. A special membrane or plasmatic sheath enclosing them could not be made out even in sections strongly stained with aniline-blue.

The youngest (smallest) aspidasters observed (Plate 2, fig. 14) were oval discs, about 25 μ long and 10 μ broad, and composed of numerous exceedingly slender and perfectly straight rays which radiated from a granular centrum about 3 μ in diameter. These rays are, at first, quite isolated. They grow in length and in thickness and so the whole aspidaster increases in size (Plate 1, fig. 36d; Plate 3, fig. 25d) and the basal parts of the rays become united. The solid, central mass of silica thus produced forms a disc from the margin of which the still isolated, distal parts of the rays protrude (Plate 2, fig. 19; Plate 3, fig. 16). When this stage is reached the longitudinal growth of the rays slows down or ceases altogether, while the transverse growth of the rays, that is their increase in thickness, continues. In consequence the marginal spines become joined more and more (Plate 2, figs. 20, 21) until they entirely lose their individuality, the margin of the aspidaster becoming quite smooth. In young forms of regular aspidasters this smooth, non-serrated margin is continuous (Plate 3, fig. 11), in young forms of irregular ones lobose (Plate 2, fig. 15). Not only the margin but also the two broad faces of such young aspidasters are smooth. Their smoothness in this stage constitutes the chief difference between them and the sterrasters of Geodia, which do not pass through a smooth stage during their development. Later small, spine-like protuberances make their appearance on the surface of the smooth young aspidaster. These develop into the protruding rays with terminal verticils of lateral spines, which have been described above.

LOCALITIES AND NATURE OF ENVIRONMENT.

No. of Station	Locality	Date	Depth	Bottom temperature	Bottom	No. of specimens
3847	S. coast of Molokai, Lae-o Ka Laau Light. N. 61° 30′, W. 23°	April 8, 1902	42–44 m. (23–24 f.)	—	Sand and stones	2 Forms A, B (Race I)
3848	S. coast of Molokai, Lae-o Ka Laau Light. N. 68°15′, W. 22.4′	April 8, 1902	80–133 m. (44–73 f.)	21.7° (71.1° F.)	Sand and gravel	2 Form C (Race I)

LOCALITIES AND NATURE OF ENVIRONMENT (*continued*).

No. of Station	Locality	Date	Depth	Bottom temperature	Bottom	No. of specimens
3819	S. coast of Molokai, Lae-o Ka Laau Light. N. 71°, W. 21.9′	April 8, 1902	133–78 m. (73–43 f.)	19.8° (67.6° F.)	Coarse sand, broken shells, and corals	1 Race II
4055	N. E. coast of Hawaii, Alia Point Light, Hilo Bay. N. 20°, W. 3.5′	July 16, 1902	91–121 m. (50–62 f.)	—	Fine gray sand and Foraminifera	1 Race III
1062	N. E. coast of Hawaii, Kauhola Light. S. 69°15′, E. 6.9′	July 18, 1902	152–207 m. (83–113 f.)	—	Coral, volcanic sand, shells, and Foraminifera.	1 Form D (Race I)

There can be no doubt that the seven sponges described above are very closely allied, still they differ to a certain extent in size, shape, colour, and spiculation. As to the size it is to be noted that the forms A and B of race I are very much smaller than the others. Since, however, the spiculation of these small specimens exhibits immature characters, there can be no doubt that they are young forms, that their small size is merely due to their age and of no systematic importance whatever. Neither can any importance be attached to the differences in shape, since they lie well within the limits of individual variation usual in sponges of this kind. The differences in colour, which ranges from dirty white to dark chestnut-brown, are indeed great. If, beginning with the lightest coloured one, we arrange the forms in the order of the degree of their pigmentation, we get, 1) race I, form C, 2) race I, form D, 3) race II, 4) race III, 5) race I, form A, and 6) race I, form B. If, beginning with the deepest, we arrange them in the order of the depth of the water at the place where they were found, we get, 1) race I, form D, 152–207 m.; 2) race I, form C, race II and III, 78–133 m.; and 3) race I, forms A and B, 42–44 m. Although it is unknown which of the specimens of race I, form C, race II, and race III grew in deeper, and which in shallower water, we see that the depth of the locality is, on the whole, roughly in inverse proportion to the degree of pigmentation. The darkest forms, the partly or wholly dark chestnut-brown, race I, forms A and B, grew in the shallowest water, at a depth of 42–44 m., to which, in clear tropical sea water, considerable day light penetrates. This and the fact that in some of the specimens the upper protruding parts are darker than the basal, lead me to suppose that these differences of colour are merely due to differences in the amount of light to which the different specimens were exposed during life. I am therefore inclined to consider these differences as direct individual adaptations of the simplest kind to which no systematic importance whatever can be attached.

The chief differences in the spiculation of the six forms is shown in the following tabular view of the averages of the three largest observed of the most important spicule dimensions and of the character of the triaene-cladomes and aspidasters.

Race			I				II	III
Form			A	B	C	D		
Rhabd megascleres		length, μ	630	710	747	853	743	913
		thickness, μ	12	13	23	20	19	21
Microrhabds		length, μ	65	54	56	62	58	44
		thickness of tyle, μ	5.8	4.8	5.7	5.7	5.2	5.4
Triaenes	rhabdome	length, μ	373	290	397	380	380	490
		thickness, μ	13	10	18	21	19	21
	cladome	breadth, μ	373	413	457	450	417	530
	character		all clades simple	most clades simple, some branched		most clades branched	most clades simple, some branched	most clades branched
Acanthtylasters		diameter, μ	33	29	31	29	35	33
Aspidasters		length, μ	120	118	128	124	152	150
		proportion of length to breadth to thickness	100: 55.3: 8.2	100: 59.1: 9	100: 57: 8.4	100: 56: 9.8	100: 49.8: 7.6	100: 57.7: 10
		character	few irregular, four to six ray-spines		many irregular, four to six ray-spines	few irregular, four to six ray-spines	few irregular up to ten ray-spines	few irregular, four to six ray-spines

This table shows that in race I, form A, all the triaene-clades are simple; and the rhabd megascleres shorter and thinner, the microrhabds longer and thicker, and the triaene-cladomes smaller than in any of the others. In race I, form B, most of the triaene-clades are simple; and the microrhabds thinner and shorter, and the aspidasters absolutely shorter and relatively broader than in any of the others. In race I, form C, most of the triaene-clades are simple; and the rhabd megascleres thicker and the aspidasters more irregular than in any of the others. In race I, form D, most of the triaene-clades are branched; and the triaene-rhabdomes relatively thicker than in any of the others. In race II most of the triaene-clades are simple; and the acanthtylasters larger, the aspidasters absolutely longer and relatively considerably narrower and thinner and their rays provided with a larger number of lateral spines than in any of the others. In race III most of the triaene-clades are branched; and the rhabd megascleres longer, the microrhabds very considerably shorter, the triaene-rhabdomes much longer, the triaene-cladomes much broader, and the aspidasters relatively thicker than in any of the others.

That the megascleres of race I, form A, are smaller in size and more simple in character than those of the other forms and that there are other differences of this kind, appears to be due to differences in the age (size) of the specimens. Some peculiarities, as for instance the irregularity of the aspidasters of race I, form C, may be pathological. Some are, no doubt, to be accounted for by differences in the external forces which acted on the different specimens. All these can be considered as mere somatic non-germinal characters, destitute of systematic significance. There remain however some, the nature of which is more doubtful and which might well be germinal. These peculiarities are the exceptional narrowness and thinness of the aspidasters and the richness of their rays in spines in race II, and the exceptional shortness of the microrhabds and the exceptionally large size of the triaene-cladomes in race III. If these peculiarities are considered germinal three systematic groups must be distinguished, one for the forms A, B, C, and D of race I, one for race II, and one for race III.

There can, I think, be no doubt that these three groups must be united in one and the same species; it is another question, however, whether or not varieties should be established for them. After a careful consideration I have decided that these differences are probably germinal and systematically important, but sufficient only for racial distinction, and I distinguish three races, designated I, II, and III, in this species accordingly.

Race I.

Rhabd megascleres 425–880 by 8–23 μ; centrotyle microrhabds 30–78 by 2–5 μ and a tyle 3–6 μ; triaenes with simple clades only, or with simple and branched clades, either the former or the latter predominating; rhabdome 104–470 by 8–22 μ, cladome 160–490 μ broad; acanthtylasters with from three to fourteen rays, 20–36 μ in diameter; aspidasters, regular or irregular, with from four to six ray-spines, 95–130 by 55–75 by 7.4–12.2 μ, average proportion of length to breadth to thickness 100 : 56.8 : 8.8. This race comprises four forms, designated, A, B, C, and D.

South Molokai, northeast Hawaii.

Race II.

Rhabd megascleres 450–760 by 9–20 μ; centrotyle microrhabds 39–61 by 3.4–4.3 μ, tyle 3.5–5.5 μ; triaenes with simple and with branched clades, the former predominating; rhabdome 240–400 by 12–20 μ, cladome 170–450 μ broad; acanthtylasters with from two to fourteen rays, 22–38 μ in diameter; aspidasters mostly regular, with up to ten ray-spines, 120–156 by 60–76 by 9.2–11.4 μ, average proportion of length to breadth to thickness 100 : 49.8 : 7.6.

South Molokai.

Race III.

Rhabd megascleres 720–980 by 12–22 μ; centrotyle microrhabds 30–44 by 3–4.5 μ, tyle 3.5–5.5 μ; triaenes with simple and branched clades, the latter predominating; rhabdome 180–520 by 13–22 μ, cladome 280–550 μ broad; acanthtylasters with from four to twelve rays, 25–36 μ in diameter; aspidasters, mostly regular, with from four to six ray-spines, 128–153 by 71–82 by 12–14 μ, average proportion of length to breadth to thickness 100 : 57.7 : 10.

Northeast coast of Hawaii.

The character of the canal-system and the spiculation show that these sponges belong to the genus Erylus. From all the species of this genus, with the exception of the one from Freemantle, S. W. Australia, which Carter[1] erroneously identified as *Erylus* (*Stelletta*) *euastrum* O. Schmidt and for which Sollas[2] established *Erylus lendenfeldi*, they differ very considerably. Sollas's description indicated, and a reexamination of the type, kindly placed at my disposal by

[1] *H. J. Carter.* Report on specimens dredged up from the Gulf of Manaar. Ann. mag. nat. hist., 1880, ser. 5, **6**, p. 136.

[2] *W. J. Sollas.* Tetractinellida. Rept. voy. "Challenger," 1888, **25**, p. 239.

Mr. Kirkpatrick, clearly shows, that this species also differs from *Erylus sollasii*. The chief differences between the two are the presence of asters 100 μ in diameter and exceedingly irregular aspidasters in *E. lendenfeldi*, and their absence in *E. sollasii*. These differences are quite sufficient for specific distinction.

Erylus rotundus, sp. nov.

megarhabda, var. nov.

Plate 5, figs. 18–23, 32; Plate 6, figs. 14, 18, 24, 33–35; Plate 7, figs. 22–30, 57–73; Plate 8, fig. 13.

typica, var. nov.

Plate 5, figs. 1–4, 11–17, 30; Plate 6, figs. 15–17, 25, 27, 30–32; Plate 7, figs. 16–21, 46–56.

cidaris, var. nov.

Plate 5, figs. 5, 26–28, 31; Plate 7, figs. 1–10, 42–45, 75, 76, 79; Plate 8, fig. 14.

I establish this species for thirteen specimens obtained at five different stations among the Hawaiian Islands. The aspidasters of these sponges are nearly circular in outline and to this the name refers.

The thirteen specimens represent seven distinct forms which fall into three groups. The latter I consider as varieties. One of these varieties possesses remarkable rhabd-clusters resembling certain Cidaridae in appearance, hence the varietal name *cidaris*. The other two varieties, which are destitute of these spicules, differ in respect to their microrhabds, these being very much larger in one of them than in the other. The former I name *megarhabda*; for the latter, which is the most frequent of the three, I have selected the name *typica*.

Two forms belong to the var. *megarhabda*, four to var. *typica*, and one to var. *cidaris*. The number of specimens and the habitat of each form are tabulated below:—

Erylus rotundus
- var. *megarhabda*
  - form A: 2 specimens from the south coast of Molokai (Station 3849);
  - " B: 1 specimen from the coast of Kauai (Station 3982);
- var. *typica*
  - form A: 4 specimens from the south coast of Molokai (Station 3849),
  - " B: 3 dark-coloured specimens from the coast of Kauai (Station 4024);

form C: 1 light-coloured specimen from the coast of Kauai (Station 4128);

" D: 1 specimen from the northeast coast of Hawaii (Station 4061);

var. *cidaris*

1 specimen from the south coast of Molokai (Station 3849).

Shape and size. The larger of the two specimens of var. *megarhabda*, form A (Plate 5, fig. 32), is upright, somewhat flattened, ellipsoid, 45 mm. high. Its largest and smallest horizontal diameters are 38 and 27 mm. respectively. The surface is rugose. The protruding ridges are high and irregular on the apex, lower and arranged in a more regular manner longitudinally, at the sides of the sponge. On the apex and the upper parts of the sides numerous circular or oval apertures, 0.1–0.7 mm. in diameter, are observed. The smaller specimen of this form is irregular, massive, 32 mm. long, and in part covered with foreign bodies, attached to the partly undulating, partly rugose surface. There are a few groups of apertures up to 0.8 mm. in diameter. The single specimen of var. *megarhabda*, form B, is irregular, massive, and 23 mm. long. To its rugose surface foreign bodies are attached. There is one group of six conspicuous apertures 0.7–1.4 mm. wide on the surface.

The largest of the four specimens of var. *typica*, form A (Plate 5, fig. 30), appears as an upright bunch of thick lobose parts, joined for the greater part of their length to form a continuous mass, from the upper side of which their free lobes protrude. The whole sponge is 67 mm. high; its largest and smallest horizontal diameters measure 69 and 72 mm. respectively. The lobose parts are 16–36 mm. thick and distally rounded. The surface is slightly rugose. On and near the summits of the lobes a few larger apertures, 1–2 mm. wide, are observed; the sides are occupied by numerous small pores. Considerable parts of the surface are covered by an incrusting composite ascidian (Plate 5, fig. 30). The other three specimens of this form are similar, but smaller, the smallest only 33 mm. high. To the surface of one of them numerous foreign bodies, fragments of shells, etc., are attached. The largest of the three specimens of var. *typica*, form B, is an irregular lobose mass, measuring 55 by 51 by 46 mm. It appears to be composed of more or less coalesced gyriform parts up to 10 mm. in thickness. Some of these terminate in slightly protruding digitate excrescences. The surface is penetrated by numerous small apertures and partly covered with symbiotic sponge-crusts and foreign bodies (fragments of shells, etc.). The other two specimens are similar and only slightly smaller. The smallest is 52 mm. long. One of them possesses, besides numerous small pores, two larger apertures (oscules) 1.5 and 2 mm. in diameter. The single specimen of var. *typica,* form C, is irregular, massive, and 34 mm. long. Several short, lobose protuberances arise from it. The surface is perforated by numerous small pores and foreign bodies are attached to parts of it. The single specimen of var. *typica,* form D, is an elongate mass, attenuated at one end to a digitate process, 5 mm. thick. The total length of the sponge is 44 mm. Small pores are scattered over its surface.

The single specimen of var. *cidaris* (Plate 5, fig. 31) is an upright, lobose mass, 67 mm. high. Its largest and smallest horizontal diameters measure 57 and 45 mm. respectively. Small irregular grooves are observed on its otherwise smooth, undulating surface. Here and there two adjacent grooves extend for some distance in parallel directions, enclosing a gyriform fold. The surface is perforated by numerous small pores, and a few crusts of symbiotic organisms, but no dead foreign bodies, are attached to it.

The *colour* of the interior of these spirit specimens varies from dirty white to light brown, that of the surface is subject to considerable variations. The upper part and the sides of the large specimen of var. *megarhabda,* form A, are dark purplish brown, the base and the interior being light dirty brown. Where the dark colour of the sides gradually merges into the light colour of the base, numerous whitish spots, marking the position of the — mostly closed — pores, are observed on the surface. The smaller specimen of this form is coloured in the same way, but the light-coloured part of the surface is here relatively more extensive. The single specimen of var. *megarhabda,* form B, is rather dark purplish gray.

Three of the specimens of var. *typica,* form A, are purplish brown above and light dirty brown below; one is bluish gray. The three specimens of var. *typica,* form B, are dark purplish black above and much lighter purplish brown below. The single specimen of var. *typica,* form C, is light purple with a small, considerably darker patch. The single specimen of var. *typica,* form D, is dirty white. The single specimen of var. *cidaris* is whitish with a large brown patch, in which numerous whitish spots, marking the position of the mostly closed pores, are observed.

The differences in the degree of pigmentation of these sponges are probably due to differences in the amount of light that fell on their surface during growth. I think that in the specimens not uniform in colour, the upper parts, which were more exposed to the light, became more strongly pigmented than the lower parts, which were more or less in the shade, and am inclined to ascribe the differences in the degree of pigmentation of the darkest parts of different specimens to differences in the amount of light due to differences in the depth at which they grew. Unfortunately the information about the depths given is not sufficiently exact to allow of a definite conclusion on this point.

The superficial part of the body is differentiated to form a *cortex*, composed of an outer and an inner layer. The outer layer is occupied by dense masses of spicules and appears as an armour. Under the outer exposed parts of the surface this armour usually is 65–90 μ, in the walls of sheltered cavities, extending farther into the interior, only 35 μ thick, or even thinner. Pigment cells occur in the armour between the spicules on the dark parts of the surface. The inner layer of the cortex is usually 55–75 μ thick and contains hardly any spicules. It is composed of paratangential fibres, pigment cells, and usually contains also granule cells.

The *pigment cells*, the number of which is in proportion to the degree of darkness of the surface, are nearly always elongate and usually extend paratangentially. They have one or, more frequently, several lobose or filiform processes, appear irregularly amoeboid, and are very variable in size, 6–29 μ long. The transparent plasm of these cells contains numerous apparently spherical granules, dark brown in transmitted light, which measure 0.3–0.8 μ in diameter. These granules are usually rather uniformly distributed throughout the body of the cell and its processes, but sometimes parts of the cell are free from them. Occasionally rows of single pigment granules, appearing like strings of beads, have been observed in the sections. These probably lie in (invisible) filiform processes of pigment cells.

In the distal part of the choanosome and in the lower layer of the cortex of forms A and B of var. *typica*, and also in some of the others, remarkable *granule cells* have been observed in large numbers. These cells appear to be situated in spherical, oval, or irregular cavities of the ground substance, 15–20 μ in diameter, which in some places lie very close together. The granule cells themselves are more or less spherical, measure 8–12 μ in diameter, appear hyaline, and stain slightly with haematoxylin and aniline-blue. They are either simple and structureless, or composed of a number, from ten to twenty or so, of polyedric parts 2–4 μ in diameter. The spaces between these parts appear to be empty. Rarely a more strongly stained, superficial layer and a body, which may be a nucleus, have been observed in the simple, undivided cells; and occasionally minute pigment granules are attached to, or contained in, the ones composed of polyedric parts. It is possible that the spaces between these cells and the walls of the cavities, within which they lie, and which appear to be empty, are in reality thick, hyaline, cell walls. But as these spaces are not stainable with any of the stains (eosin, malachite-green, magenta, aniline-blue, methyl-violet, azure, haematoxylin, aurantia, Bismarck-brown), I think this improbable. The cells composed of parts are much more numerous than the simple, undivided ones. The latter are scattered quite irregularly between the former and do not increase in number either towards the surface or towards the interior. Although convinced that the undivided ones and the ones composed of polyedric parts are merely different stages in the development of the same kind of cell, I am unable to say whether the simple ones arise from the composed ones or *vice versa*.

In the sections of var. *typica*, form B, groups of broad, irregularly oval cells, 28–32 μ long, were observed in the distal part of the choanosome. The plasm of these cells is granular and each one contains a large nucleus, about 8 μ in diameter. These cells appear to be ova.

In the sections of var. *cidaris* young larvae were observed. Some of these lay free on the canals, others appeared to be just on the point of emerging from the cavities of the ground substance in which they were bred. These larvae are spherical, measure 50–60 μ in diameter, and appear to consist of a central granular mass, surrounded by a single layer of roundish, not elongate cells about 8 μ in diameter.

In the choanosome of var. *typica*, form D, large numbers of monocellular symbiotic Algae were observed. These are spherical or oval, measure 15–20 μ in maximum diameter, and have a stout cell wall about 4 μ thick.

Canal-system. The uniporal entrances to the canal-system are usually circular, and, when quite open, 100–250 μ wide. Dilated pores of this width are however not frequent, most of the pores being more or less contracted and smaller, or closed altogether. The flagellate chambers are more or less spherical and measure 14–23 μ in diameter. Those of var. *cidaris* are smaller (diameter 14–17 μ) than those of the others. The collar cells clothing them are not numerous, distant, rather slender, and 4–6 μ long. The larger canals are surrounded by stout mantles of tissue free from megascleres and flagellate chambers. Some of them are traversed by sphincter-membranes. Such have been particularly observed in var. *typica*, form B. In the forms C and D of var. *typica* and in var. *cidaris* no apertures much larger than the pores described above, were observed on the surface. In these sponges the efferent openings (oscules) do not seem to be of much greater width than the afferents. In both forms of var. *megarhabda* and in some specimens of the forms A and B of var. *typica* on the other hand, larger oscules, up to 1.4 mm. wide in the former, and up to 2 mm. wide in the latter variety, have been observed. These larger oscules usually lie on or near the summit of protruding parts of the sponge. In some cases, as for instance in *megarhabda,* form B, large oscular tubes, up to 2.4 mm. in diameter, lead up to the oscules. In other cases, as for instance in var. *cidaris,* a tract of transparent tissue, about 1.7 mm. broad, free from megascleres and flagellate chambers, extends from each of the here strongly contracted or evenly closed oscules, down into the interior of the sponge. In the axis of this tract a row of small cavities is observed. These cavities, which in the radial sections appear to be isolated, are 100–150 μ broad, up to 350 μ long, and situated close together. Distally, towards the contracted oscule, they become smaller and scarcer. I consider these rows of cavities as the remnants of the lumen of the strongly contracted oscular tubes.

The *skeleton* consists of rhabd megascleres, microrhabds, triaenes, large acanthtylasters with not very numerous rays, small oxyasters with numerous rays, and aspidasters. In several forms also asters, resembling the acanthtylasters in size and ray-number, but with conical rays, which become very slender distally, have been observed. These spicules, which are particularly numerous in var. *megarhabda,* form A, are in all probability merely young stages of the ordinary acanthtylasters. I shall not therefore deal with them as a special spicule form. In var. *cidaris* aster-like rhabd-clusters have been observed.

Some of the rhabd megascleres are isolated, others form more or less undulating bundles (Plate **6**, fig. 25a), which traverse the internal parts of the choanosome in a radial or, in the digitate and lobose processes, longitudinal direction, and, on nearing the cortex, tend to assume a position vertical to the surface. These bundles are in var. *megarhabda,* form A, up to 100 μ broad. In the other forms most of the bundles are 10–40 μ thick. The broad bundles of var. *megarhabda,* form A, appear to be flattened, band shaped; the narrow ones are cylindrical. The isolated rhabds are, in the interior, quite irregularly scattered; near the surface, just below the cortex, most of them usually assume a position more or less vertical to the surface. This radial arrangement of the subcortical rhabds is particularly well marked in var. *megarhabda,* form A.

The asterose rhabd-clusters of var. *cidaris* are scattered in the choanosome.

In var. *megarhabda* the armour is composed chiefly of obliquely or radially situated microrhabds, aspidasters being relatively scarce and confined to its superficial part. In this variety numerous microrhabds also occur scattered in the choanosome. In vars. *typica* and *cidaris*, on the other hand, the armour is chiefly composed of aspidasters, and here the microrhabds are confined to its superficial part, except in the vicinity of the pores, around which they form mantles, extending right through the whole armour. Sometimes the superficial microrhabd-bearing part of the armour-layer is stout and well developed, and then it consists of an outer zone composed of paratangial microrhabds and an inner zone of oblique and vertical (radial) microrhabds, lying above and between the outermost aspidasters. Often, however, this microrhabd-bearing outer armour-layer is insignificant, and then composed only of relatively few, mostly oblique microrhabds. It is possible that the superficial parts of the sponges presenting this appearance have been rubbed off. The majority of the microrhabds in the pore-canal mantles are situated so that one of their ends points obliquely upward towards the centre of the pore. In some forms of var. *typica*, particularly in form B, a fair number of microrhabds were also found scattered in the choanosome.

The cladomes of the triaenes extend paratangentially just below the cortex or within its lower, fibrous layer; their rhabdomes are directed radially inward. The triaenes occupy the interporal spaces and in some forms, as for instance in var. *typica*, form A (Plate 6, fig. 27a), form well-defined groups, in which a number of triaenes lie close together at the points of intersection of the interporal zones.

The acanthtylasters and their oxyaster-like young are scattered throughout the choanosome. They are most abundant in one of the specimens of var. *megarhabda*, form A. In some forms, as for instance in var. *typica*, form B, they are very much scarcer in the subcortical region than in the interior of the choanosome. A great many acanthtylasters lie in the walls of the choanosomal canals. Some of the rays of these usually protrude into the canal-lumen. In the walls of the remnants of the contracted oscular tubes of var. *cidaris*, above referred to, the acanthtylasters stand particularly close together and here form a veritable pavement. This local acanthtylaster-density is doubtless due to the contraction of the surface on which, when normally extended, they are probably distributed in the ordinary, not particularly dense manner.

The small oxyasters with numerous rays are confined to the roofs of the subcortical cavities and the walls of the pore-canals. In the choanosome they appear to be entirely absent. In the walls of the pore-canals, where they are most numerous and sometimes form quite a dense layer, they extend right up to within a short distance of the outer surface. In one of the specimens of var. *megarhabda*, form A, I failed to find any of these asters *in situ* in the sections.

The aspidasters take part in the formation of the cortical armour and are also found scattered in the choanosome. In vars. *typica* and *cidaris* the greater part of the armour is composed of these spicules, which are here absent only in the mantles surrounding the pore-canals. Apart from these mantles, the proximal (internal) part of the armour in these varieties consists entirely of aspidasters. In the distal (external) part of the armour microrhabds are usually added to the aspidasters, and sometimes the outermost part of the armour consists entirely of microrhabds. Most of the aspidasters of the armour are situated paratangentially. Under exposed tracts of the surface they form many layers, under the sheltered parts of it which limit the cavities, extending into the interior, only few layers or only a single layer. In var. *megarhabda* the aspidasters form only a small part of the armour and are here confined to its distal (external) part. Young and also adult aspidasters are usually found scattered in the choanosome. Here they generally lie in cavities of the ground-substance, as long and broad but much wider (thicker) than the aspidasters, so that the margins of the aspidasters are in contact with the ground-substance, while their faces are separated from it by apparently empty spaces. Seen *en face* the aspidasters consequently appear to fill these cavities completely, seen in profile they appear as narrow bars occupying the long axis of the oval cavities. The empty spaces at their sides may of course have been produced by the shrinkage of the tissue, during the preservation of the sponges in alcohol, but they may also be natural, and in this case occupied possibly by some liquid, rich in silica secreted from the surrounding tissue, from which the cell or cells building the aspidaster draw their supply.

The *rhabd megascleres* (Plate 5, figs. 11–23, 26–28a) are for the most part simple amphioxes or amphistrongyles, curved uniformly, or in the middle more strongly than near the ends. Occasionally style (Plate 5, fig. 17c) and angularly bent or branched derivates of these rhabds have been observed. The ordinary amphioxes and amphistrongyles are 310–650 μ long, and 6–15 μ thick. Of the amphioxes and amphistrongyles occurring together in the same specimen, the former are on the whole longer than the latter. In the vars. *megarhabda* and *cidaris* nearly all the rhabds are sharp-pointed amphioxes (Plate 5, figs. 19–23, 26–28a), blunt amphioxes and amphistrongyles (Plate 5, fig. 18) being rare. In the forms B and C of var. *typica*, sharp-pointed amphioxes (Plate 5, figs. 14, 15, 17a) also preponderate; in the forms A and D of this variety, on the other hand, the blunt rhabds (amphistrongyles) (Plate 5, figs.

11–13, 16b) are more numerous than the sharp-pointed amphioxes. Some of the amphioxes, this was particularly observed in form B of var. *typica*, appear as amphistrongyles, the blunt ends of which are surmounted by small conical tips. These tips may be simple or terraced, telescope-like. Angularly bent or branched rhabd-derivates have chiefly been observed in form A of var. *megarhabda* and in var. *cidaris*. The spicules of this kind in the last-named variety appear as transitional forms connecting its aster-like rhabd-clusters with the ordinary rhabds.

The dimensions of the rhabd megascleres and the relative frequency of the sharp-pointed and blunt amphioxes and amphistrongyles in the different forms and varieties are tabulated below.

Rhabd megascleres		Erylus rotundus									
		var. megarhabda			var. typica					var. cidaris	
		A	B		A	B	C	D			
		South Molokai	Kauai	limits and means of averages of all the forms of the variety	South Molokai	Kauai, dark specimen	Kauai, light specimen	Northeast Hawaii	limits and means of averages of all the forms of the variety		limits and means of averages of all the forms of the species
Length	limits, μ	330–650	350–550	330–650	320–570	330–560	350–520	310–490	310–570	440–650	310–650
	average of the longest three, μ	603	543	573	556	533	507	477	518.3	617	518
Thickness	limits, μ	6–13	6–12	6–13	6–11	6–12	6–11	7–15	6–15	8–12	6–15
	average of the thickest three, μ	13	11	12	11	11	11	14	11.3	12	11.9
Shape		mostly sharp-pointed amphioxes; blunt forms rare.	mostly sharp-pointed amphioxes; blunt forms rare.	mostly sharp-pointed amphioxes; blunt forms rare.	mostly amphistrongyles or blunt amphioxes; sharp forms rare.	sharp-pointed and blunt amphioxes and amphistrongyles; the first named most numerous.	mostly sharp-pointed amphioxes; blunt forms rare.	mostly amphistrongyles or blunt amphioxes; sharp forms rare.	amphistrongyles, blunt and sharp-pointed amphioxes; in some the blunt in others the sharp forms preponderate.	mostly sharp-pointed amphioxes; blunt forms rare.	sharp-pointed amphioxes; blunt amphioxes; amphistrongyles; variously combined.

The *aster-like rhabd-clusters* (Plate 7, figs. 4–10), which have been found only in var. *cidaris,* are, in my opinion, to be considered as derivates of ordinary rhabds. They appear as smooth oxyasters, composed of from about fifteen to thirty concentric, straight rays fairly uniform in thickness, but differing exceedingly in length, and distributed very irregularly. From four to ten of the rays appear properly developed; these are conical, more rapidly attenuated distally than proximally, and pointed. The other rays are rudimentary, very short, cylindrical, and terminally rounded. These rudimentary rays together form a kind of lobose centrum, from which the longer, pointed rays arise. The rhabd-clusters are 125–180 μ in total diameter. Their rays are 5–8 μ thick and the longest one of the whole cluster is 70–100 μ long.

The *branched amphioxes* (Plate 7, figs. 1–3) also occurring in this variety, which I consider as transitions between the clusters and the ordinary rhabds, are 410–520 μ long and 9–13 μ thick. They bear from one to four straight branch-rays.

The *microrhabds* (Plate 5, fig. 27c; Plate 6, figs. 30–35; Plate 7, figs. 46–51, 53a, 54a, 55, 56a, 57a, 60a, 61–73, 75a, 79) are for the most part simple, isoactine, gradually or rather abruptly pointed or, more rarely blunt, uniformly curved, and usually slightly centrotyle amphioxes. The tyle, never large, is often so insignificant as to be hardly visible, and many of these spicules seem to have no central thickening at all. In the forms A, B, and C of var. *typica* (Plate 6, figs. 30–32; Plate 7, figs. 46, 48–51, 53a, 54a, 55, 56a) nearly all the microrhabds have a distinct central tyle. In the microrhabds of var. *cidaris* (Plate 7, figs. 75a, 79) the tyle is not so well developed, and in most of the microrhabds of var. *megarhabda* (Plate 6, figs. 33–35, Plate 7, figs. 57a, 66–73) and var. *typica,* form D (Plate 7, fig. 47), the tyle is hardly perceptible or absent altogether. Besides these regular, simple, and isoactine microrhabds a few anisoactine ones, with one actine reduced in length and rounded at the end, and a few with small branch-rays near one end, have been observed in var. *cidaris,* in both forms of var. *megarhabda,* and in form C of var. *typica.* The microrhabds are 30–98 μ long and 1.5–7.5 μ thick. Those of var. *megarhabda* are considerably larger (maximum averages of three 82.3–95.7 by 5.3–6.7 μ) than those of the other two varieties (maximum averages of three 54–61.7 by 3–3.8 and 66.1 by 4.2 μ respectively).

DIMENSIONS AND SHAPES OF MICRORHABDS.

Microrhabds		*Erylus rotundus*										
		var. megarhabda			var. typica					var. cidaris	limits and means of averages of all the forms of the species
		A	B	limits and means of averages of all the forms of the variety	A	B	C	D	limits and means of averages of all the forms of the variety		
		South Molokai	Kauai		South Molokai	Kauai, dark specimen	Kauai, light specimen	Northeast Hawaii			
Length	limits, μ	45–98	43–86	43–98	35–60	30–55	31–58	46–66	30–66	32–55	30–98
	average of the longest three, μ	95.7	82.3	89	57.7	54	57	61.7	57.6	51	66.1
Thickness	limits, μ	3–7.5	3–5.5	3–7.5	1.5–3.3	1.5–3	2.5–4	2–3.5	1.5–4	2–4.5	1.5–7.5
	average of the thickest three, μ	6.7	5.3	6	3.1	3	3.8	3.3	3.3	4	4.2
Shape		gradually and sharply pointed; central tyle small or absent.	gradually and sharply pointed; usually without central tyle; this when present, small.	gradually and sharply pointed; central tyle small or, more frequently, absent.	rather abruptly and bluntly pointed; centrotyle.	sharply pointed; centrotyle.	abruptly sharply pointed; centrotyle.	gradually and sharply pointed; usually without central tyle.	variously pointed or blunt; central tyle in most, but not in all specimens well developed.	gradually and sharply pointed; more or less centrotyle.	variously pointed, with or without central tyle.

Most of the *triaenes* (Plate 5, figs. 1–5; Plate 6, fig. 27a) are orthotriaenes, some plagiotriaenes. The rhabdome is conical and generally slightly and irregularly curved in an undulating manner. It is 170–370 μ long and, at the cladomal end, 6–12 μ thick. The clades of the same cladome are fairly equal in length. They are usually slightly curved and 80–270 μ long. The breadth of the cladome is 155–440 μ. The triaenes of var. *cidaris* have the broadest, those of var. *megarhabda* the narrowest cladomes. The angle enclosed between the clades and the rhabdome is 90–107°. In form A of var. *megarhabda* I have found a few triaenes with clades either bearing a small branch-ray or abruptly bent down near the end.

DIMENSIONS OF TRIAENES.

Triaenes		Erylus rotundus									
		var. megarhabda			var. typica					var. cidaris	limits and means of averages of all the forms of the species
		A	B	limits and means of averages of all the forms of the variety	A	B	C	D	limits and means of averages of all the forms of the variety		
		South Molokai	Kauai		South Molokai	Kauai, dark specimen	Kauai, light specimen	Northeast Hawaii			
Rhabdome	length (limits), μ	170–180	350–370	170–370	200–220		200		200–220	180–190	170–370
	thickness (limits), μ	6–11		6–11	8–12	8	8–9	8	8–12	7–8	6–12
Clade-length (limits), μ		85–180	150–200	85–200	140–225	80–210	150–220	210–250	80–250	80–270	80–270
Cladome breadth	limits, μ	160–290	250–350	160–350	300–360	150–400	250–350	350–390	150–400	300–440	150–440
	average of the broadest three, μ	231	333	282	347	357	310	370	346	397	335
Clade-angle	limits °	92–102		92–102	92–107		90	90	90–107	97–101	90–107
	average °	96.5		96.5	99.5		90	90	93.2	100.5	95.3

The *acanthtylasters* (Plate 6, figs. 14b, 15, 16; Plate 7, figs. 52–54b, 56b, 57b, 58, 59, 75b, 76b) have from two to fourteen concentric, regularly distributed rays. Two-rayed acanthtylasters are rare and have been observed only in var. *cidaris*. Also the three-rayed, which have been found in var. *typica*, form B, var. *megarhabda*, form A, and in var. *cidaris*, are not frequent. Four- to eight-rayed acanthtylasters are abundant in all the forms. Acanthtylasters with more than eight rays appear to be most frequent in var. *typica*, form B, and in var. *megarhabda*, form A. The acanthtylasters measure 12–31 μ in total diameter. Those of var. *cidaris* are somewhat smaller than those of the other two varieties. The size of the acanthtylasters is on the whole in inverse proportion to the number of their rays, those with from two to six rays being 16–31, those with from seven to nine rays 14–24, and those with from ten to fourteen rays 12–19 μ in diameter. The rays are, at the base, 0.5–2.4 μ thick and taper distally. At their ends they are usually thickened to an acanthtyle, rarely simply rounded off. The transverse diameter of the acanthtyle (rounded end) is, inclusive of its spines, 0.5–4 μ. The basal part of the rays is always quite smooth. This smooth part may be quite short, or it may extend right up to the acanthtyle (the rounded, spiny end). Acanthtylasters with rays smooth right up to the acanthtyle have been observed chiefly in var. *typica,* form A. Usually the proximal one to two thirds of the rays are spineless, the remaining distal part being either rough or provided with smaller or larger spines. The larger the spines, the fewer their number. Frequently an increase in the size of the spines towards the end of the ray is noticeable. The acanthtyle is covered with numerous, fairly large spines. Most of the spines appear to be conical and pointed, but in var. *megarhabda*, form A, acanthtylasters with cylindrical spines, rounded at the end, have also been observed. The spines of the acanthtyle are usually somewhat recurved. The proximal spines are usually directed more or less obliquely backward, the distal obliquely upward and outward. On the whole the acanthtyle-spines have the appearance of short hair combed down in all directions from the apex. The spines on the other parts of the rays are vertical or, more rarely, directed obliquely outward.

DIMENSIONS OF ACANTHTYLASTERS.

Acanthtylasters		Erylus rotundus										
		var. megarhabda			var. typica					var. cidaris	all varieties
		A	B		A	B	C	D			
		South Molokai	Kauai	all forms	South Molokai	Kauai, dark specimen	Kauai, light specimen	Northeast Hawaii	all forms		
with two rays	total diameter, μ									24	24
	basal thickness of rays, μ									1.5	1.5
	diameter of acanthtyle (rounded end), μ									3.3	3.3

DIMENSIONS OF ACANTHTYLASTERS (*continued*).

Acanthtylasters		Erylus rotundus									
		var. megarhabda			var. typica					var. cidaris	
		A	B		A	B	C	D			
		South Molokai	Kauai	all forms	South Molokai	Kauai, dark specimen	Kauai, light specimen	Northeast Hawaii	all forms		all varieties
with three rays	total diameter, μ	23		23		23–29			23–29	25–28	23–29
	basal thickness of rays, μ	1.4		1.4		1.2–1.4			1.2–1.4	1.4–1.9	1.2–1.9
	diameter of acanthtyle (rounded end), μ	2.7		2.7		2–2.1			2–2.1	1.6–2.7	1.6–2.7
with four to six rays	total diameter, μ	16–27	16–26	16–27	19–30	17–31	17–23	18–26	17–31	16–26	16–31
	basal thickness of rays, μ	0.8–2	0.8–1	0.8–2	0.7–2	0.8–1.7	0.5–2	1.2–1.5	0.5–2	1–2.4	0.5–2.4
	diameter of acanthtyle (rounded end), μ	1.3–3.5	1.3–1.8	1.3–3.5	1.5–3.5	1.2–2.4	1–4	1.5–2.2	1–4	2–3	1–4
with seven to nine rays	total diameter, μ	16–21	14–23	14–23	15–19	16–24	15–24	17–18	15–24	16–21	14–24
	basal thickness of rays, μ	0.8–1.4	0.7–1.5	0.7–1.5	1.2	0.9–1.3	0.6–1.2	1.2	0.6–1.3	1–1.7	0.6–1.7
	diameter of acanthtyle (rounded end), μ	1–2.3	1.3–2	1–2.3	1.5	1.3–2	0.5–2	1.5	0.5–2	1.5–2.2	0.5–2.3
with ten to fourteen rays	total diameter, μ	13–19	12–17	12–19	12–17	15–19	13–16	16	15–19	13	12–19
	basal thickness of rays, μ	0.6–1.5	0.5–1.2	0.5–1.5	0.6–1.1	0.5–1.3	0.8–1.2	0.7	0.5–1.3	1	0.5–1.5
	diameter of acanthtyle (rounded end), μ	1.2–2.1	1–1.8	1–2.1	1–1.6	0.7–2	1.2–1.8	1.2	0.2–2	1.2	0.7–2.1

It has been stated above, that oxyaster-like spicules similar in size and ray-number to the acanthtylasters, which I consider a young form of the latter, also occur in these sponges. These spicules are rather numerous in var. *megarhabda*, form A, and met with in smaller numbers in var. *megarhabda*, form B, and in the forms A and C of var. *typica*. The distal parts of the rays of these asters are exceedingly slender. Proximally the rays thicken considerably and abruptly, so that their basal part appears bulbous. Besides these spicules, which I consider as the earliest known stages, others similar to them, but with thicker and distally rough rays, representing a later developmental stage, are observed. Finally various asters of this kind occur, in which a more or less pronounced spiny thickening crowns the end of each ray. These asters connect the slender-rayed oxyasters with the true acanthtylasters.

The *small many-rayed oxyasters* (Plate **6**, fig. 14c; Plate **7**, figs. 52c, 60c, 76c) are without centrum or have a slight central thickening, in var. *typica*, form A, up to 4 μ in diameter. There are from eight to twenty-two, or more, usually from fourteen to twenty, equal, concentric, and regularly distributed rays. The rays are, at the base, 0.4–0.9 μ thick and conical, either throughout or only at the end, and then nearly cylindrical in their basal part. They are always sharp pointed and more or less spiny. Sometimes the spines are too small to be discerned as such and their presence is indicated only by a certain roughness of the rays. More often, however, particularly in the larger oxyasters, the spines are large enough to be clearly made out. The larger the spines, the fewer their number. Some of the spines frequently form a verticil some distance below the end of the ray. Oxyasters of this kind were chiefly observed in var. *typica*, form A. The total diameter of the oxyasters is 7–17 μ. Those of var. *typica* are a little smaller than those of the other two varieties. A few asters were observed which appeared as transitions between these oxyasters and the acanthtylasters.

DIAMETERS OF SMALL OXYASTERS.

	Erylus rotundus									
	var. megarhabda			var. typica					var. cidaris	
	A	B		A	B	C	D			
Small oxyasters (oxysphaerasters) with numerous rays	South Molokai	Kauai	all forms	South Molokai	Kauai, dark specimen	Kauai, light specimen	Northeast Hawaii	all forms		all varieties
Total diameter, μ	7.5–11	8–17	7.5–17	10–13	8–14	8–16	7–12	7–16	8–14	7–17

The *aspidasters* (Plate **5**, figs. 27f, 28f; Plate **6**, figs. 17, 18; Plate **7**, figs. 16–30, 42–45; Plate **8**, figs. 13, 14) are broad-oval or circular discs, often with a somewhat irregular outline. This irregularity of outline generally does not exceed that of the aspidasters represented in figs. 18, 19, and 25 on Plate **7**; occasionally, however, quite irregular aspidasters, with one or more deep incisions reaching far into the interior, have been observed in all varieties. The aspidasters are 50–77 μ long, 46–70 μ broad, and 4.4–8.8 μ thick. Those of var. *megarhabda* (50–66 by 46–59 by 4.6–8.8 μ) are smaller than those of the other two varieties. The general average proportion of length to breadth to thickness of the aspidasters of all the forms (varieties) is 100: 93.3: 10.2. The aspidaster-disc is either of uniform thickness throughout, or slightly thickened in the middle. Its margin is simply rounded off. An umbilicus could not be detected. All parts of the surface, the margin as well as the two faces, are covered with protuberances. The largest protuberances are 0.7–2 μ thick and about as high. Most of them bear a terminal verticil of usually from three to seven exceedingly small lateral spines. The large protuberances are usually scattered rather irregularly over the surface. Occasionally some of the protuberances of the central part of the aspidaster lie in straight lines, radiating from the centre of the disc. Between the larger protuberances small ones, just perceptible with the strongest lenses, lie singly or in small groups on the otherwise smooth surface of the disc.

DIMENSIONS OF ADULT ASPIDASTERS.

Aspidasters		Erylus rotundus									
		var. megarhabda			var. typica					var. cidaris	
		A	B		A	B	C	D			
		from South Molokai	from Kauai	limits and means of averages of all the forms of the variety	from South Molokai	from Kauai, dark specimen	from Kauai, light specimen	from northeast Hawaii	limits and means of averages of all the forms of the variety		limits and means of averages of all the forms of the species
Length	limits, μ	50–62	53–66	50–66	65–77	50–67	60–72	64–70	50–77	65–75	50–77
	average of the three largest, μ	60	64	62	72	63	71	69	68.8	73	67.4
Breadth, limits, μ		46–56	49–59	46–59	54–68	48–61	57–70	61–69	48–70	62–69	46–70
Thickness, limits, μ		6.2–8.8	4.6–5	4.6–8.8	5–7.8	5–6.4	6–6.8	4.4–7.6	4.4–7.8	5–7	4.4–8.8
Average proportion of length to breadth to thickness		100: 91: 12.3	100: 90: 8.2	100: 90.5: 10.3	100: 91: 9.7	100: 94: 11.2	100: 96: 9.8	100: 95: 11.2	100: 94: 10.5	100: 96: 9.2	100: 93.3 10.2
Thickness of protruding rays, μ		0.7–1.6	0.7–1.7	0.7–1.7	1–2	0.8–1	0.7–2	1–1.9	0.7–2	0.7–1	0.7–2

The youngest aspidasters observed were oval or circular discs, about half the size of the adult, and composed of numerous, long, exceedingly slender, perfectly straight rays, lying nearly in the same plane, and radiating from an irregular, lobose structure 2–4 μ in diameter. This lobose centrum is apparently composed of short, terminally rounded concentric rays, arising obliquely to the plane occupied by the long rays. The rays, which in this young stage appear to be isolated throughout, grow in length and in thickness. Their longitudinal growth leads to an increase in the size of the aspidaster, their transverse growth (thickening) to a coalescence of the rays themselves, which, as the growth continues, progresses from the centre towards the margin of the disc. Thus the aggregations of isolated, radial rays become larger, solid discs with serrated margins. This goes on until the spicule has attained nearly its full size. Then the longitudinal growth of the rays ceases, while their lateral growth continues. This leads to a filling up of the serrations and to the formation of smooth discs with more or less continuous margin (Plate **7**, figs. 22, 23). On the whole of the surface, the margin as well as the faces, of the disc, small excrescences then make their appearance, and these grow out to form the protuberances above described.

LOCALITIES AND NATURE OF ENVIRONMENT.

VAR. MEGARHABDA LENDENFELD.

No. of Station	Locality	Date	Depth	Bottom temperature	Bottom	No. of specimens
3849	S. coast of Molokai, Lae-o Ka Laau Light. N. 71°, W. 21.9′.	April 8, 1902	133–78 m. (73–43 f.)	19.8° (67.6° F.)	Coarse sand, broken shells, and corals	2 Form A
3982	Vicinity of Kauai Island, Nawiliwili Light. N. 68°, W. 1.6′.	June 10, 1902	426–73 m. (233–40 f.)	9.2° (48.5° F.)	Coarse brown corals, sand, shells.	1 Form B

VAR. TYPICA LENDENFELD.

No. of Station	Locality	Date	Depth	Bottom temperature	Bottom	No. of specimens
3849	S. coast of Molokai, Lae-o Ka Laau Light. N. 71°, W. 21.9′.	April 8, 1902	133–78 m. (73–43 f.)	19.8° (67.6° F.)	Coarse sand, broken shells, corals	4 Form A
4024	Vicinity of Kauai Island, Mokuaeae Islet. S. 83°, E. 7.6′.	June 23, 1902	44–79 m. (24–43 f.)	23.2° (73.7° F.)	Coarse coral, sand, and Foraminifera	3 Form B
4061	N. E. coast of Hawaii, Kauhola Light. S. 79°, E. 6.7′.	July 18, 1902	44–152 m. (24–83 f.)	—	Corals, sand, coralline nodules, and Foraminifera	1 Form D
4128	Vicinity of Kauai Island, Hanamaulu Warehouse. N. 14° 30′, W. 2.6′.	August 1, 1902	165–327 m. (253–68–90 179 f.)	8.8° (47.8° F.)	Coarse brown coral, sand, and Foraminifera.	1 Form C

VAR. CIDARIS LENDENFELD.

No. of Station	Locality	Date	Depth	Bottom temperature	Bottom	No. of specimens
3849	S. coast of Molokai, Lae-o Ka Laau Light. N. 71°, W. 21.9′.	April 8, 1902	133–78 m (73–43 f.)	19.8° (67.6° F.)	Coarse sand, broken shells, and corals.	1

The thirteen sponges described above obviously form a systematic, though far from a homogeneous, group, the specimens comprising it differing not inconsiderably from each other in several respects. In three specimens the cortical armour is chiefly composed of microrhabds, the aspidasters in it being but few and confined to its external part. In the other ten the cortical armour is composed chiefly of aspidasters, and the microrhabds which take part in its formation are confined to the external part. In the three specimens the microrhabds are considerably larger and the acanthtylasters and aspidasters smaller than in the ten. Among these ten there is one which has smaller oxyasters and relatively thinner aspidasters than the others, and which possesses aster-like rhabd-clusters, a kind of spicule not observed in any of the others. Thus three secondary groups, *megarhabda* (armour chiefly composed of microrhabds, microrhabds large, aspidasters small), *typica* (armour chiefly composed of aspidasters, microrhabds small, aspidasters large, without rhabd-clusters), and *cidaris* (armour chiefly composed of aspidasters, microrhabds small, aspidasters large, with rhabd-clusters) can be distinguished.

Two of the specimens of group *megarhabda*, which come from the south coast of Molokai, are fairly identical, while the third, which comes from the coast of Kauai, has a more grayish colour, smaller rhabd megascleres and microrhabds, considerably larger triaenes, larger oxyasters, and thinner aspidasters. Thus two somewhat different forms (A and B) are contained in the group *megarhabda*.

In five of the nine specimens of group *typica* most of the rhabd megascleres are amphistrongyles or very blunt amphioxes; in the other four most of these spicules are sharp-pointed amphioxes. Four of the five specimens with chiefly amphistrongyle rhabd megascleres, which come from the south coast of Molokai, are fairly identical with each other; the fifth, which comes from the northeast coast of Hawaii, is not like these, massive, lobose, but elongate, digitate in shape, having a much lighter colour, thicker rhabd megascleres, less centrotyle, for the most part simple amphiox microrhabds, somewhat larger euasters and relatively thinner aspidasters. Of the four specimens with chiefly sharp-pointed rhabd megascleres, which all come from the coast of Kauai, three (from Station 4024) are fairly identical, while the fourth (from Station 4128) has a lighter colour, slightly larger microrhabds, much smaller acanthtylasters and longer, considerably broader and thinner aspidasters. Thus four forms (A, B, C, and D) are contained in the group *typica*.

The surroundings of all the different forms of the same group must have been different to a certain extent, since they were found at different stations. For this reason, and because the differences between them are not great and their peculiarities more in the character of individual (somatic) adaptations than of germinal qualities, I think that no greater systematic value than that of local forms, two, A and B, in the group *megarhabda*, and four, A, B, C, and D, in the group *typica*, can be attached to them.

The differences between the groups are much greater, and can hardly be directly due to differences in the surroundings, since specimens belonging to different groups were repeatedly captured together, at one and the same station. This and their general nature lead me to consider the peculiarities, by which these groups differ, not as mere somatic adaptations but as germinal characters. Although most probably germinal in nature and certainly not inconsiderable, these differences are, in my opinion, nevertheless insufficient for more than varietal distinction.

The characters of the three varieties are the following:—

Var. megarhabda.

Cortical armour composed chiefly of microrhabds. Rhabd megascleres mostly sharp pointed, blunt forms rare; 330–650 by 6–13 μ. Rhabd-clusters absent. Microrhabds gradually and sharply pointed, central tyle small or absent; 43–98 by 3–7.5 μ. Triaenes; rhabdome 170 370 μ long; cladome 160–350 μ broad. Acanthtylasters with three or more rays; 12–27 μ in diameter. Oxyasters 7.5–17 μ in diameter. Aspidasters 55–66 by 46–59 by 4.6–8.8 μ; average proportion of length to breadth to thickness 100:90.5:10.3.

South coast of Molokai; coast of Kauai.

Var. typica.

Cortical armour composed chiefly of aspidasters. Rhabd megascleres sharp pointed or blunt amphioxes, or amphistrongyles; 310–570 by 6–15 μ. Rhabd-clusters absent. Microrhabds variously pointed or blunt, with or without central tyle; 30–66 by 1.5–4 μ. Triaenes; rhabdome 200–220 μ long; cladome 150–400 μ broad. Acanthtylasters with three or more rays; 15–31 μ in diameter. Oxyasters 7–16 μ in diameter. Aspidasters 50–77 by 48–70 by 4.4–7.8 μ; average proportion of length to breadth to thickness 100:94:10.5.

South coast of Molokai; coast of Kauai; northeast coast of Hawaii.

Var. **cidaris.**

Cortical armour composed chiefly of aspidasters. Rhabd megascleres chiefly sharp-pointed amphioxes; 440–650 by 8–12 μ. Rhabd-clusters 125–180 μ long. Microrhabds gradually and sharply pointed, more or less centrotyle; 32–50 by 2–4.5 μ. Triaenes; rhabdome 180–190 μ long; cladome 300–440 μ broad. Acanthtylasters with two or more rays; 12–31 μ in diameter. Oxyasters 8–14 μ in diameter. Aspidasters 65–75 by 62–69 by 5–7 μ; average proportion of length to breadth to thickness 100:96:9.2.

South coast of Molokai.

The structure of the canal-system and spiculation of these sponges clearly show that they belong to Erylus. They differ considerably from all the species of this genus previously described, by the nearly circular shape and the small size of their aspidasters and other characters. Their nearest ally is the species here described as *Erylus caliculatus*. By its shape being caliculate, by its microrhabds being amphistrongyle instead of amphiox, by its aspidasters being larger, relatively much thicker, and partly reniform in shape, and by its spicules generally being larger and much stouter, this sponge differs from *E. rotundus* to such an extent, that it must be considered specifically distinct from it.

Erylus caliculatus, sp. nov.

Plate 5, figs. 6–10, 24, 25–29; Plate 6, figs. 1–13, 19–23, 26, 28, 29; Plate 7, figs. 11–15, 31–41, 74, 77, 78, 80; Plate 8, figs. 1–12, 15–20.

I establish this species for a specimen obtained on the northeast coast of Hawaii (Station 4062). The name refers to its caliculate shape.

Shape and size. The sponge (Plate 5, fig. 29) appears as a broad, low, truncate, inverted cone. It is 33 mm. high. The base of the cone, which forms the upper side of the sponge, is irregularly oval in outline, depressed in the middle, 47 mm. long, and 36 mm. broad. Its elevated margin is rounded, about 6 mm. thick, and partly divided into lobes. The base of attachment, which corresponds to the truncate summit of the cone, measures 30 by 18 mm. The surface is uneven and covered with shallow grooves, 0.5–1 mm. broad. These grooves are particularly well marked on the protruding marginal lobes. Numerous small circular pores, up to 0.3 mm. in diameter, are scattered over the sides of the sponge. Apertures occur also on its depressed upper face, but these are not so numerous and less uniform in size than those on the sides. The largest of these apical apertures, which I am inclined to consider as oscules, measure 1 mm. in diameter. The margin is free from pores.

The *colour* of the sponge (in spirit) is dirty white.

The superficial part of the body is differentiated to form a *cortex* which contains an aspidaster-armour and is about 65 μ thick.

Canal-system. The, probably efferent, apertures on the depressed, terminal face of the sponge are surrounded by sphincter-membranes. The flagellate chambers (Plate 6, figs. 28, 29) are more or less spherical and 15–22 μ in diameter.

The *skeleton* consists of rhabd megascleres, microrhabds, triaenes, acanthtylasters, slender-rayed oxyasters, small oxysphaerasters, and aspidasters. Some of the rhabd megascleres form bundles (Plate 6, fig. 26a), others are isolated and scattered. The bundles extend from the base upward and outward; on nearing the surface they curve, where necessary, so as to abut steeply or vertically on the cortex. The cladomes of the triaenes extend paratangentially just below the cortical armour, their rhabdomes being directed radially inwards. The triaenes occupy the interporal spaces (Plate 6, fig. 23) and often form well-defined groups at the intersections of the interporal zones. The microrhabds form a thin superficial layer overlying the aspidaster-armour and occupy the mantles surrounding the cortical canals, chiefly their outer parts farthest from the lumen. A few microrhabds are also found scattered in the choanosome. The acanthtylasters and the slender-rayed oxyasters, which latter I consider as young acanthtylasters, are numerous in all parts of the choanosome and extend right up to the cortex and even into the mantles of the cortical canals. The small oxysphaerasters are confined to the subcortical region and the mantles of the cortical canals, on the inner surface of which they are often quite numerous. The aspidasters occupy the proximal and middle parts of the cortical armour in dense masses, leaving only the mantles of the cortical canals free. Some aspidasters also occur scattered in the choanosome. The aspidasters in the armour are mostly situated paratangentially. Next the mantles of the cortical canals, however, they often assume other positions.

Most of the *rhabd megascleres* (Plate 5, figs. 24, 25) are very blunt amphioxes (Plate 5, figs. 24a, 25a), many indeed so blunt that they can be considered as amphistrongyles. A few blunt styles (Plate 5, fig. 24c) and branched rhabd, derivates have also been observed. Most of the rhabds are more or less curved, usually more strongly in their central part than at their ends. The rhabds are 410–850 μ long and 10–19 μ thick, the average measurements of the three longest and thickest being 723 by 18 μ.

The *microrhabds* (Plate 6, figs. 1, 2, 4a, 5a; Plate 7, figs. 74a, 77a, 78, 80) are centrotyle amphistrongyles, usually more or less attenuated towards the rounded ends. They are generally slightly curved, the curvature being uniform or, rarely, greater near the ends than in the middle. Most of these spicules are isoactine, anisoactine forms with one actine reduced in length being met with only exceptionally. The microrhabds are 39–52 μ long and, near the middle, close to the tyle, 3–5 μ thick, the average measurements of the three longest and thickest being 51 by 4.8 μ. The tyle is 0.3–1 μ more in transverse diameter than the adjacent parts of the spicule.

Besides these regular microrhabds, branched microrhabd-derivates have been observed in small numbers. In these spicules two or, rarely, more, short, terminally rounded or, exceptionally, pointed branch-rays arise from a point a little below one end of the spicule. In one of these spicules such branch-rays were observed at both ends. When there are two branch-rays they usually stand opposite each other in a straight line which intersects the axis of the spicule at an angle of 40 to 60°.

The *triaenes* (Plate **5**, figs. 6–10; Plate **6**, fig. 23) are orthotriaenes. Their rhabdome is straight, conical, 200–300 μ long, and, at the cladomal end, 13–20 μ thick. The clades are 125–220 μ long, usually simple, and slightly and irregularly curved. Rarely one clade bears a short branch-ray. The clades enclose angles of 87–98° with the rhabdome. The breadth of the cladome is 210–380 μ.

The *acanthtylasters* (Plate **6**, figs. 4b, 5b, 6–13, 29; Plate **7**, figs. 74, 77b; Plate **8**, figs. 2–12) usually have from four to eight, rarely only two or three, concentric and regularly or, more rarely, irregularly distributed rays. The rays are equal or one or more of them reduced in length. The properly developed rays are, at the base, 1.5–4.5 μ thick and taper towards the distal end, which is usually crowned by an acanthtyle, rarely simply rounded off. The acanthtyle or rounded end is 1–5 μ in transverse diameter. The basal part of the rays is either quite smooth or bears a few spines; from their central and distal parts a good many spines arise. The acanthtyle (rounded end) is densely covered with spines. The spines are usually conical, sharp pointed, and of considerable size. The largest one observed was 1.5 μ long. The spines arising from the acanthtyle (rounded end) are generally very markedly recurved and in their position resemble short flexible hair combed down in all directions from the apex of the acanthtyle (rounded end). Those arising from the rays farther down are either vertical or directed obliquely outward or inward. The total diameter of the acanthtylasters is 17–50 μ. This dimension and also the size of the rays and acanthtyles are, on the whole, in inverse proportion to the ray-number. This proportional correlation is, however, not a uniformly regular one, for while the three- to five-rayed acanthtylasters and their parts are nearly equal in size, and the same applies to the seven- and eight-rayed ones, there are considerable dimensional differences between the two- and three-rayed, the five- and six-rayed, and six- and seven-rayed ones. In a curve representing this correlation two steep, step-like falls would interrupt the general descent. The dimensions of the two-rayed, three- to five-rayed, six-rayed, and seven- to eight-rayed acanthtylasters are tabulated below.

ACANTHTYLASTERS.

Ray-number	2	3–5	6	7–8
Total diameter, μ	50	23–39	19–34	17–23
Basal thickness of rays, μ	3	2–4.5	1.5–3.5	1.5–2.5
Transverse diameter of acanthtyle (rounded end), μ	4.5	2–5	1–1.3	1–2.5

Many oxyasters, similar in diameter and ray-number to the acanthtylasters, occur in the choanosome. The rays of these spicules are quite slender in their distal part but usually thickened in a very marked manner at their base. Similar spicules with slightly thicker, rough rays, and others with still thicker and rougher rays and a slight terminal thickening, connect the oxyasters with the acanthtylasters. I consider the former as young stages of the latter.

The *small oxysphaerasters* (Plate 6, fig. 3; Plate 7, figs. 11–15, 74c) have a spherical centrum, 4–5.5 μ in diameter, from which from ten to twenty or more equal, concentric, regularly distributed, conical, blunt or sharp-pointed rays arise. The rays are, at the base, 0.7–1.4 μ thick, and smooth. Their middle and distal parts are covered with small spines. Occasionally a few spines, larger than the rest, form a loose verticil some distance from the end of the ray. The whole aster is 9–18 μ in diameter. A correlation (inverse proportion) between size and ray-number is not discernible.

The *aspidasters* (Plate 6, figs. 19–22; Plate 7, figs. 31–41; Plate 8, figs. 1, 15–20) are discs varying from broad-oval to circular or reniform. Very rarely aspidasters quite irregular in outline, with several deep incisions, have been observed. The broad-oval to circular aspidasters (Plate 6, figs. 19, 20; Plate 7, figs. 31–37), which are much more numerous than the reniform ones, are fairly regular in outline, 72–88 μ long, 67–77 μ broad, and 10.6–12.8 μ thick. The average proportion of length to breadth to thickness is 100:95:15. In the reniform aspidasters (Plate 6, figs. 21, 22; Plate 7, figs. 38–41), which are otherwise similar to the broad-oval to circular ones, the margin is incised at a point usually lying on one of the broader sides. This incision may be quite insignificant (Plate 7, fig. 39) or it may extend far into the interior of the spicule (Plate 6, fig. 21). The reniform aspidasters have similar dimensions to the broad-oval or circular ones, but are somewhat narrower, some not more than 63 μ broad. The surface of the adult aspidaster is covered with short, truncate, protruding rays, 1.8–4 μ thick. These rays bear terminal verticils of lateral spines, and usually also some spines arise from their apical faces. The number of protruding rays is very variable. On some aspidasters (Plate 6, fig. 20; Plate 7, figs. 32–35, 38–40; Plate 8, figs. 15, 16) they are few and far between, in others (Plate 6, fig. 19; Plate 7, figs. 36, 37, 41; Plate 8, figs. 17–20) very numerous and, although usually distributed rather irregularly, nowhere very far apart.

The youngest stages of the aspidasters (Plate 7, fig. 31; Plate 8, fig. 1) appear as discs composed of slender rays radiating from a common centre. The great majority of these rays are as long as the radius of the disc, lie nearly in one plane, and extend from the centre to the margin of the disc. A few are much shorter, and these are situated obliquely to the plane of the disc occupied by the long rays (Plate 8, fig. 1). These ray-aggregations grow in the same way as in *Erylus rotundus*, described in detail, p. 306, and become smooth discs (Plate 6, fig. 22), on the surface of which protruding rays later make their appearance. It seems, *a priori*, probable that the aspidasters with few protuberances (Plate 6, fig. 20; Plate 7, figs. 32–35, 38–40; Plate 8, figs. 15, 16) are young forms which later, by the accession of further protuberances, are converted into the aspidasters with numerous protruding rays (Plate 6, fig. 19; Plate 7, figs. 36, 37, 41; Plate 8, figs. 17–20). Since, however, the protruding rays of the aspidasters with but few of them seem to be on the whole larger than those of the aspidasters with many of them, this is somewhat doubtful.

This sponge was caught with the tangles on the northeast coast of Hawaii, Station 4062, Kauhola Light, S. 69° 15′, E. 6.9′ on July 18, 1902; depth 152–206 m. (83–113 f.); it grew on a bottom of coral, volcanic sand, shells, and Foraminifera.

The structure of the canal-system and the spiculation of this sponge clearly show that it belongs to Erylus. From all the species of this genus previously described it differs considerably by the partly broad-oval to circular, partly reniform shape, and the small size of its aspidasters. It is nearest allied to *Erylus rotundus*. From this *E. caliculatus* is distinguished by the shape, which is massive lobose to digitate in *E. rotundus* and caliculate in *E. caliculatus;* by the microrhabds, which are amphiox in the former and amphistrongyle in the latter; by the aspidasters which are absolutely smaller, relatively thinner, and oval or circular in *E. rotundus* and absolutely larger, relatively thicker, and in part also reniform in *E. caliculatus;* and by the spicules generally which are smaller and much less robust in *E. rotundus* than in *E. caliculatus*.

II. GENERAL SYSTEMATIC ACCOUNT OF THE GENERA, SPECIES, AND VARIETIES FROM THE PACIFIC OCEAN.

Erylidae.

Tetraxonida with rhabd and teloclade megascleres, and a superficial armour composed of aspidasters and microrhabds. Euasters are always present in the choanosome.

For the present I place only one genus, Erylus, in this family.

ERYLUS Gray.

With uniporal afferents and uniporal efferents or larger oscules. Without ana- or protriaenes.

Twenty-two species are known. Eight of these occur in the Pacific Ocean.

SUMMARY OF THE SPECIES FOUND IN THE PACIFIC OCEAN.

A_1 The large choanosomal euasters are oxyasters.

A_2 The teloclades are orthoplagiotriaenes.

A_3 The microrhabds have pointed ends.

E. placenta Thiele. E. monticularis Kirkpatrick.

B_3 The microrhabds are amphistrongyle centrotyles.

E. decumbens Lindgren.

B_2 The teloclades are chiefly dichotriaenes.

E. oxyaster Lendenfeld.

B_1 The large choanosomal euasters are acanthtylasters.

A_2 The aspidasters are about twice as long as broad.

E. nobilis Thiele. E. sollasii Lendenfeld.

B_2 The aspidasters are nearly as broad as long.

E. rotundus Lendenfeld, var. megarhabda Lendenfeld, var. typica Lendenfeld, var. cidaris Lendenfeld. E. caliculatus Lendenfeld.

Erylus placenta Thiele.

Zoologica, 1898, **24**, p. 5, plate 1, fig. 1; plate 6, fig. 1 a–h. Lendenfeld, Tierreich, 1903, **19**, p. 87.

Incrusting, 2–3 mm. thick. In spirit: reddish gray.

Amphioxes: mostly 700–800 by about 15 μ; sometimes much shorter, only half as long. *Orthotriaenes*: rhabdome 500, clades 270 μ long.

Microrhabds: slightly curved, abruptly pointed centrotyle amphioxes; 25–50 μ long. *Oxyasters*: three to six, most frequently four rays; each ray 20–30 μ long. *Oxysphaerasters*: centrum about 5, whole aster 10 μ in diameter. *Aspidasters*: oval, very frequently with incised margin, irregular; 170–200 by 80–90 by 18 μ.

Northwestern Pacific. Japan: Kagoshima Bay.

Erylus monticularis Kirkpatrick.

Ann. mag. nat. hist., 1900, ser. 7, **6**, p. 351, plate 14, fig. 3 a–h.

Thin, incrusting. Pale brown.

Amphioxes: 210 by 10 μ. *Orthotriaenes*, rhabdome 6 μ thick; clades 186 μ long.

Microrhabds: amphiox; 40–80 by 1–3 μ. *Oxyasters*: about 6 rays; total diameter 18–30 μ. *Small tylasters* (chiasters, Kirkpatrick): with small centrum; about 12 rays; total diameter 10 μ. *Aspidasters*: 150 μ long, 114 μ broad.

Central Pacific. Funafuti Islet.

Erylus decumbens Lindgren.

Zool. anz. 1897, **20**, p. 485. Zool. jahrb. Syst., 1898, **11**, p. 338, plate 20, fig. 1.
Erylus euastrum (Schmidt) Lendenfeld, Tierreich, 1903, **19**. p. 86.

Incrusting, 3 mm. high. Surface black, interior gray.

Amphioxes: one end often blunt, 0.8 mm. by 24 μ. *Orthoplagiotriaenes*: rhabdome 420 by 28 μ; clades curved, concave to rhabdome, 280 μ long; clade-angles nearly 90° (according to text), 104° (according to figure).

Microrhabds: curved, centrotyle amphistrongyles, 60 by 6 μ. *Oxyasters*: two to five smooth rays; each ray 24 μ long. *Sphaerasters*: numerous rays; total diameter 10 μ. *Aspidasters*: oval, some with incisions; 182 by 120 by 28 μ.

Formerly I was inclined (*loc. cit.*) to consider this species as identical with *Stelletta euastrum* Schmidt (1868) and *Erylus cylindrigerus* Ridley (1884), but the reexamination has made me doubtful on this point, so that I now revert to Lindgren's name.

Western Pacific: Java.

Erylus oxyaster Lendenfeld.

Ante, p. 268.

Massive with lobose or digitate protuberances. In spirit: brown, part of the surface lighter than the rest.

Amphioxes: pointed, rarely blunt: 1.8–2.9 mm. by 60–85 μ. *Styles*: rare; 1.9–2.3 mm. by 60–105 μ. *Angularly bent and branched rhabd-derivates*: in dimensions similar to the amphioxes, rare. *Plagiotriaenes*: rare; rhabdome 0.9 mm. by 75–90 μ; clades 0.7 mm. long; clade-angles 109–112°. *Dichotriaenes*: rhabdome 0.6–1.6 mm. by 70–105 μ; main clades 250–400, end clades 40–450 μ long; clade-angles 109–120°. *Irregular dichotriaene-derivates*: with the clades reduced in number or the rhabdome reduced in length; rare.

Microrhabds: more or less curved, centrotyle, generally isoactine amphistrongyles; 31–47, rarely up to 93 μ long, 3.5–4.5 μ thick. *Oxyasters*: usually with a slight central thickening; one to twenty or more perfectly smooth, conical rays; total diameter 10–90 μ. *Aspidasters*: oval, rarely roundish or irregular; the ordinary oval ones 208–243 by 125–150 by 30–40 μ.

Eastern Pacific. Galapagos Islands: 0° 50′ S., 89° 36′ W. "Albatross" Station 2809.

Erylus nobilis Thiele.

Abhandl. Senckenb. gesellsch., 1900, **25**, p. 48, plate 2, fig. 17. Lendenfeld, Tierreich, 1903, **19**, p. 85.

Irregularly cylindrical. White; in the interior brownish.

Amphioxes: rather abruptly pointed; nearly 1 mm. by 30 μ. *Orthotriaenes*: rhabdome 600 by 40 μ; clades 250 μ long, slightly curved.

Microrhabds: centrotyle amphistrongyles; about 48 by 6 μ. *Acanthtylasters*: most frequently seven rays; each ray 20 μ long. *Aspidasters*: oval, outline sometimes irregular; 190 by 90–100 by 40 μ.

Western Pacific. Ternate.

Erylus sollasii Lendenfeld.

Ante, p. 272.

Irregularly massive, with lobose, gyriform, or short digitate processes. In spirit: whitish to chestnut-brown or purplish brown; one part of the surface sometimes darker than the rest.

Blunt amphioxes: 425–980 by 8–24 μ. *Sharp-pointed amphioxes, amphistrongyles, and styles* of similar dimension; rare. *Orthoplagiotriaenes*: rhabdome

140–520 by 8–22 μ, rarely reduced in length and thickened; cladomes very polymorphic; clades simple or bifurcate; simple clades 120–300 μ long; bifurcate clades, main clades 70–270, end clades 10–160 μ long; clade-angles 86–116°; in some specimens all the triaene-clades are simple, in some the majority are simple, the minority bifurcate, in some the majority are bifurcate.

Microrhabds: curved, centrotyle, pointed; 30–78 by 2.5–5 μ. *Anisoactine and branched microrhabd-derivates*: of similar dimensions; rare. *Acanthtylasters*: two to fourteen or more rays; total diameter 10–38 μ. *Aspidasters*: oval, rounded rhomboidal, or irregular with lobose marginal protuberances; 95–156 by 55–82 by 7.4–14 μ.

Central Pacific. Hawaiian Islands: south coast of Molokai. "Albatross" Stations 3847, 3848, 3849; northeast coast of Hawaii. "Albatross" Stations 4055, 4062.

Erylus rotundus Lendenfeld.

Ante, p. 290.

Massive, oval or somewhat irregular, with lobose, gyriform, or digitate protuberances. Surface usually more or less rugose. In spirit: dirty white to light brown in the interior; surface dirty white to purplish brown or purplish gray or purplish black, one part of the surface often much darker than the rest. Sometimes with whitish spots, marking the position of the pores, on the darker parts of the surface.

Rhabd megascleres: sharp-pointed amphioxes, blunt amphioxes, or amphistrongyles, variously combined, 310–650 by 6–15 μ. *Styles, angularly bent and branch-bearing rhabd-derivates*: of similar dimensions; rare. *Aster-like rhabd-clusters*: four to ten conical, irregularly distributed, longer, and a number of very short rudimentary, cylindrical, terminally rounded rays; total diameter 125–180 μ; only in variety *cidaris*. *Orthoplagiotriaenes*: rhabdome 170–370 by 6–12 μ; clades often slightly, irregularly curved; 80–270 μ long; clade-angles 90–107°.

Microrhabds: slightly curved, variously but generally sharply pointed; 30–98 by 1.5–7.5 μ; with or without central tyle, the latter when present small. *Acanthtylasters*: two to fourteen rays; total diameter 12–31 μ. *Small oxyasters*: eight to twenty-two or more, conical, spined rays; total diameter 7–17 μ. *Aspidasters*: broad oval to circular; 50–77 by 46–70 by 4.4–8.8 μ.

Central Pacific. Hawaiian Islands: south coast of Molokai. "Albatross" Station 3849; coast of Kauai. "Albatross" Stations 3982, 4024, 4128; northeast coast of Hawaii. "Albatross" Station 4061.

Erylus rotundus var. megarhabda Lendenfeld.

Ante, p. 309.

Cortical armour composed chiefly of microrhabds. *Rhabd megascleres*: mostly sharp pointed; blunt forms rare; 330–650 by 6–13 μ. *Rhabd-clusters* absent. *Orthoplagiotriaenes*: rhabdome 170–370 μ long; cladome 160–350 μ broad. *Microrhabds*: gradually and sharply pointed; 43–98 by 3–7.5 μ; central tyle small or absent. *Acanthtylasters* with three or more rays; 12–27 μ in diameter. *Small oxyasters*: 7.5–17 μ in diameter. *Aspidasters*: 55–66 by 46–59 by 4.6–8.8 μ.

Central Pacific. Hawaiian Islands: south coast of Molokai. "Albatross" Station 3849; coast of Kauai. "Albatross" Station 3982.

Erylus rotundus var. typica Lendenfeld.

Ante, p. 309.

Cortical armour composed chiefly of aspidasters. *Rhabd megascleres*: sharp pointed or blunt amphioxes, or amphistrongyles; 310–570 by 6–15 μ. *Rhabd-clusters*: absent. *Triaenes*: rhabdome 200–220 μ long, cladome 150–400 μ broad. *Microrhabds*: variously pointed or blunt, with or without central tyle; 30–66 by 1.5–4 μ. *Acanthtylasters*: with three or more rays; 15–31 μ in diameter. *Oxyasters*: 7–16 μ in diameter. *Aspidasters*: 50–77 by 48–70 by 4.4–7.8 μ.

Central Pacific. Hawaiian Islands: south coast of Molokai. "Albatross" Station 3849; coast of Kauai. "Albatross" Stations 4024, 4128; northeast coast of Hawaii. "Albatross" Station 4061.

Erylus rotundus var. cidaris Lendenfeld.

Ante, p. 310.

Cortical armour composed chiefly of aspidasters. *Rhabd megascleres*: chiefly sharp-pointed amphioxes; 440–650 by 8–12 μ. *Rhabd-clusters*: 125–180 μ long. *Triaenes*: rhabdome 180–190 μ long, cladome 300–440 μ broad. *Microrhabds*: gradually and sharply pointed, more or less centrotyle; 32–50 by 2–4.5 μ. *Acanthtylasters*: with two or more rays; 12–31 μ in diameter. *Small oxyasters*: 8–14 μ in diameter. *Aspidasters*: 65–75 by 62–69 by 5–7 μ.

Central Pacific. Hawaiian Islands: south coast of Molokai. "Albatross" Station 3849.

Erylus caliculatus Lendenfeld.

Ante, p. 310.

Inverted conical, caliculate. In spirit: dirty white.

Blunt amphioxes and amphistrongyles: 410–850 by 10–19 μ. *Orthotriaenes*: rhabdome 200-300 by 13–20 μ; clades 125–220 μ long; clade-angles 87–98°.

Microrhabds: centrotyle amphistrongyles, usually attenuated towards the ends; 39–52 by 3–5 μ. *Acanthtylasters*: usually four to eight, rarely only two or three rays; total diameter 17–50 μ. *Small oxysphaerasters*: ten to twenty or more rays; centrum 4–5.5, whole aster 9-18 μ in diameter. *Aspidasters*: broad-oval to circular, or, not so frequently, reniform; the broad-oval to circular ones 72–88 by 67–77 by 10.6–12.8 μ; the reniform ones often narrower.

Central Pacific. Hawaiian Islands: northeast coast of Hawaii. "Albatross" Station 4062.

III. DISTRIBUTION.

If the fauna of the Pacific so far as it relates to the Erylidae is compared with that of other regions, it is seen that its single genus Erylus occurs in both. Some of the Pacific species are similar to species found outside the Pacific, but not a single one appears to be really identical with any ultra-Pacific one.

Eight of the twenty-two known species, that is 36 %, occur in the Pacific.

The range of the Pacific species is, so far as at present known, not great. With the exception of *Erylus rotundus* and *E. sollasii*, which have been obtained at various points on the coasts of the Hawaiian Islands, all the Pacific species are recorded from one locality only.

The majority of species, the Pacific as well as those of other regions, are tropical or subtropical. It is remarkable that no specimen of Erylus has hitherto been found on the west coast of the American continent.

The horizontal distribution of the Pacific species is:—

Eastern Pacific Islands.

Erylus oxyaster.	Galapagos.

Central Pacific Islands.

Erylus monticularis.	Funafuti.
" sollasii.	Hawaiian Islands.
" rotundus.	" "
" caliculatus.	" "

Southeastern Asiatic Islands.

Erylus decumbens.	Java.
" nobilis.	Ternate.

Northeastern Asiatic Islands.

Erylus placenta.	Japan.

All the Pacific species have been found in rather shallow water.

IV. LIST OF STATIONS.

Station	Locality	Lat.	Long.	Date	Depth in fathoms	Surface temperature, Fahr.	Bottom temperature, Fahr.	Bottom	Instruments used
		° ′ ″	° ′ ″						
2809	Galapagos Islands	S. 00 50 00	W. 89 36 00	April 4, 1888	45	79°	74.1°	Gray sand	Small beam trawl
3847	S. coast of Molokai, Lae-o Ka Laau Light	N.64 30 00	W. 23 00 00	April 8, 1902	23–24	76		Sand and stones	Hand lead, 6 foot hemp tangles
3848	S. coast of Molokai, Lae-o Ka Laau Light	N.68 15 00	W. 22 4 00	" " "	44–73	76	71.1	Sand and gravel	Sigsbee sounding machine, surface tow net, 5½ foot Blake beam trawl, etc.
3849	S. coast of Molokai, Lae-o Ka Laau Light	N.71 00 00	W. 21 09 00	" " "	73–43	76	67.6	Coarse sand, broken shells, and corals	Tanner sounding machine, 10 foot Blake beam trawl, surface tow net
3982	Vicinity of Kauai Island, Nawiliwili Light	N.68 00 00	W. 01 06 00	June 10, 1902	233–40	78	48.5	Coarse brown corals, sand, shells	Sigsbee sounding machine, 9 foot hemp tangles
4024	Vicinity of Kauai Island, Mokuaeae Islet	S.83 00 00	E. 07 06 00	June 23, 1902	24–43	75	73.7	Coarse coral, sand, and Foraminifera	Sigsbee sounding machine, 9 foot hemp tangles
4055	N. E. coast of Hawaii, Alia Point Light, Hilo Bay	N.20 00 00	W. 03 05 00	July 16, 1902	50–62	76		Fine gray sand, and Foraminifera	Tanner sounding machine, 8 foot hemp tangles
4061	N. E. coast of Hawaii, Kauhola Light	S. 79 00 00	E. 06 07 00	July 18, 1902	24–83	77		Corals, sand, coralline nodules, and Foraminifera	Tanner sounding machine, 8 foot hemp tangles
4062	N. E. coast of Hawaii, Kauhola Light	S. 69 15 00	E. 06 09 00	" " "	83–113	77		Coral, volcanic sand, shells, and Foraminifera	Tanner sounding machine, 8 foot hemp tangles
4128	Vicinity of Kauai Island, Hanamaulu Warehouse	N.44 30 00	W. 02 06 00	Aug. 1, 1902	253–68–90–179	77	47.8	Coarse brown coral, sand, and Foraminifera	Sigsbee sounding machine, 8 foot Albatross pattern Blake beam trawl

EXPLANATION OF THE PLATES.

PLATE 1.

Erylus sollasii Lendenfeld.

Figures 1–48.

1.— Transverse section of a lamellar part of a large dark specimen from South Molokai (race II); magnified 7.5; phot. Zeiss, planar 50 mm.:
a, cortex; b, choanosome; c, monaxonid symbiont attached to one side of the Erylus.

2.— Part of the surface of a large whitish specimen from South Molokai (race I, form C); magnified 7.5; phot. Zeiss, planar 50 mm.

3.— Subcortical portion of a radial section occupied by numerous large spherical granular cells, of a large dark specimen from South Molokai (race II); haematoxylin; magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6.

4.— Part of a radial section through the choanosome of a large dark specimen from South Molokai (race II); haematoxylin; magnified 200; phot. Zeiss. apochr. 8, compens. oc. 6.

5-12.— Apical views of cladomes of triaenes; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6:
5, of a triaene with one simple and two bifurcate clades of a large dark specimen from South Molokai (race II);
6, of a regular dichotriaene with very short end clades of a large dark specimen from South Molokai (race II);
7, of a regular plagiotriaene of a large dark specimen from South Molokai (race II);
8, of an irregular dichotriaene-derivate in which one end clade of each of the three pairs is reduced, of a middle-sized light-coloured specimen from northeast Hawaii (race I, form D);
9, of a regular dichotriaene with long end clades of a middle-sized light-coloured specimen from northeast Hawaii (race I, form D);
10, of a triaene with one trifurcate and two bifurcate clades of a middle-sized light-coloured specimen from northeast Hawaii (race I, form D);
11, of a regular plagiotriaene of a large whitish specimen from South Molokai (race I, form C);
12, of a regular plagiotriaene of a middle-sized light-coloured specimen from northeast Hawaii (race I, form D).

13–26.— Side views of triaenes; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6:
13, of a regular plagiotriaene with a rhabdome reduced to a short, conical protuberance, of a large dark specimen from South Molokai (race II);
14, of a triaene with one bifurcate and two simple clades, and a rhabdome reduced to a short, conical protuberance, of a large dark specimen from South Molokai (race II);
15, of a plagiotriaene with simple, unequal, stout, blunt clades and a regular blunt rhabdome, of a large whitish specimen from South Molokai (race I, form C);
16, of a plagiotriaene with equal, cylindrical, terminally rounded clades and a rhabdome bearing small rounded protuberances near the end, of a large whitish specimen from South Molokai (race I, form C);
17, of a plagiotriaene with slightly unequal, slender, blunt clades and a regular pointed rhabdome, of a large whitish specimen from South Molokai (race I, form C);
18, of an irregular orthotriaene with unequal stout clades partly rounded at the end, and a reduced cylindrical, terminally rounded rhabdome, of a middle-sized light-coloured specimen from northeast Hawaii (race I, form D);
19, of a plagiotriaene with fairly equal, slender, pointed, regular clades and a fairly pointed rhabdome, of a middle-sized light-coloured specimen from northeast Hawaii (race I, form D);
20, of a plagiotriaene with slender, regular clades, one of which is strongly curved at the end, of a middle-sized light-coloured specimen from northeast Hawaii (race I, form D);
21, of a fairly regular plagiotriaene with short pointed clades, of a large dark specimen from South Molokai (race II);
22, of a triaene with one bifurcate clade, of a large dark specimen from South Molokai (race II);
23, of a protriaene with unequal, cylindrical clades, reduced in length and terminally rounded, of a large dark specimen from South Molokai (race II);
24, of a plagiotriaene with one clade terminally recurved and a rhabdome bearing slight protuberances near the end, of a large dark specimen from South Molokai (race II);
25, of a rather stout plagiotriaene with relatively long clades, of a large dark specimen from South Molokai (race II);

26, of a slender plagiotriaene with relatively long clades of a large dark specimen from South Molokai (race II).

27.— A large whitish specimen from South Molokai (race I, form C); natural size; phot. Zeiss, anastig. 480/412 mm.

28.— A large dark specimen from South Molokai (race II); natural size; phot. Zeiss, anastig. 480/421 mm.

29–35.— Rhabd megascleres; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6:

29–31, more or less amphiox-rhabds tapering towards both ends, of a large whitish specimen from South Molokai (race I, form C);

32, stout and short, somewhat irregularly cylindrical amphistrongyle, of a large whitish specimen from South Molokai (race I, form C);

33, 34, sharp-pointed amphioxes, of a small dark specimen from South Molokai (race I, form B);

35, pointed amphiox of a large dark specimen from South Molokai (race II).

36–41.— Groups of microscleres from centrifuge-spicule preparations; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6:

a, isoactine centrotyle microrhabds; b, anisoactine microrhabds; c, acanthtylasters; d, young aspidaster;

36, 39, 41, of a large whitish specimen from South Molokai (race I, form C);

37, of a small dark specimen from South Molokai (race I, form B);

38, of a large dark specimen from South Molokai (race II);

40, of a middle-sized light-coloured specimen from northeast Hawaii (race I, form D).

42–48.— Rhabd megascleres; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6:

42, 43, large, more or less pointed amphioxes, of a middle-sized light-coloured specimen from northeast Hawaii (race I, form D);

44, style, abruptly bent close to the blunt end, of a middle-sized light-coloured specimen from northeast Hawaii (race I, form D);

45, amphistrongyle, of a middle-sized light-coloured specimen from northeast Hawaii (race I, form D);

46, small blunt amphiox, of a middle-sized light-coloured specimen from northeast Hawaii (race I, form D);

47, 48, small, sharp-pointed amphiox, of a small, partly light, partly dark, specimen from South Molokai (race I, form A).

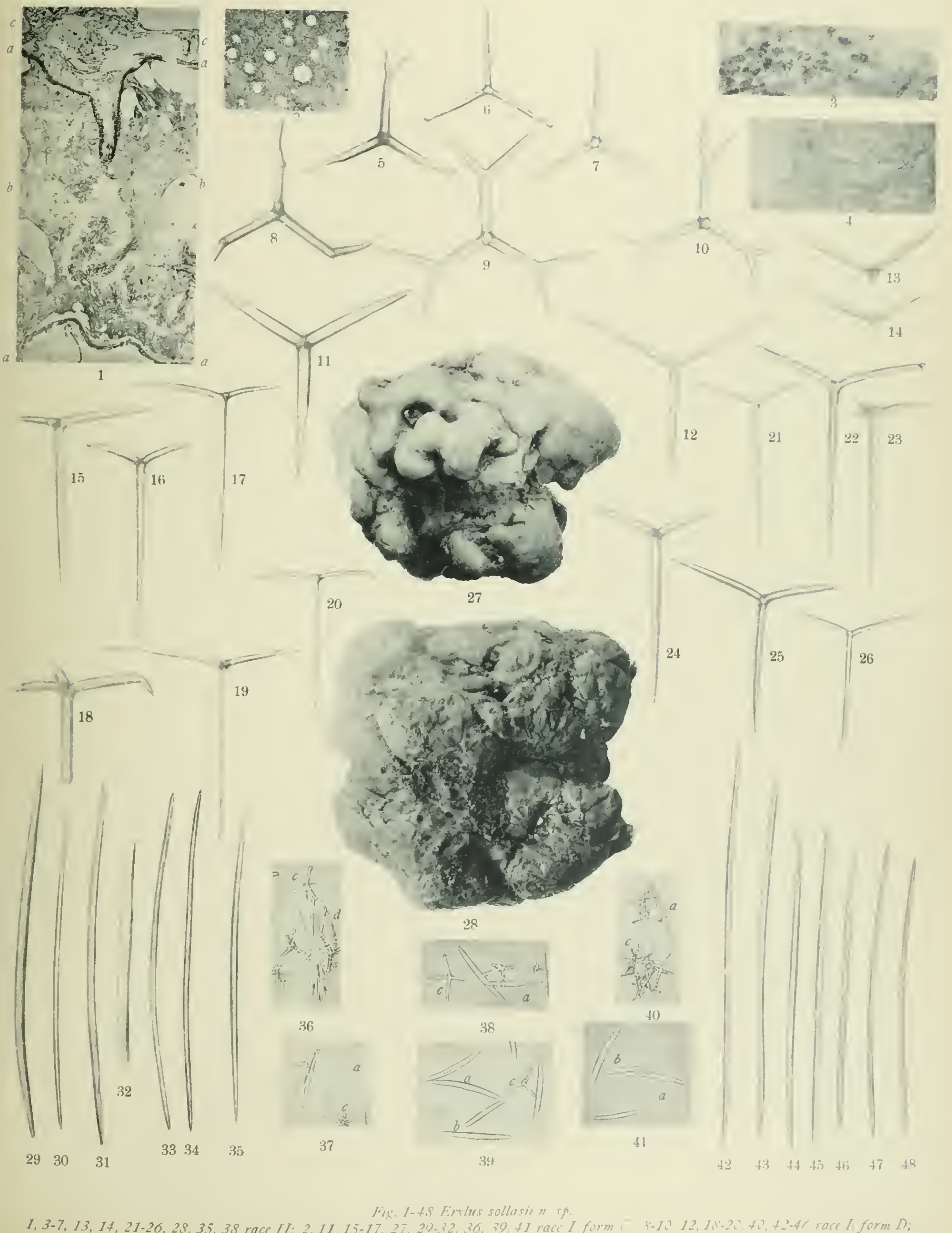

Fig. 1-48 Erylus sollasii n. sp.
1, 3-7, 13, 14, 21-26, 28, 35, 38 race II; 2, 11, 15-17, 27, 29-32, 36, 39, 41 race I form C; 8-10, 12, 18-20, 40, 42-46 race I, form D; 33, 34, 37 race I, form B; 47, 48 race I, form A.

PLATE 2.

PLATE 2.

Erylus sollasii LENDENFELD.

Figures 1–26.

1, 2.— A large acanthtylaster of a large dark specimen from South Molokai (race II); magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:

1, focused higher; 2, focused lower.

3, 4.— Group of acanthtylasters from a centrifuge-spicule preparation; magnified 540; u. v. phot. Zeiss, q. monochr. 6, q. oc. 10:

3, of a large whitish specimen from South Molokai (race I, form C);

4, of a large dark specimen from South Molokai (race II).

5-7.— The central part of an aspidaster of a large dark specimen from South Molokai (race II); magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:

5, focused high (on the upper surface); 6, focused intermediate; 7, focused low (on the centrum).

8, 9.— A large acanthtylaster of a large dark specimen from South Molokai (race II); magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:

8, focused higher; 9, focused lower.

10, 11.— A small acanthtylaster of a large dark specimen from South Molokai (race II); magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:

10, focused lower; 11, focused higher.

12–15.— Aspidasters; magnified 540; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:

12, somewhat irregular adult aspidaster, of a large whitish specimen from South Molokai (race I, form C);

13, regular, oval adult aspidaster, of a large dark specimen from South Molokai (race II);

14, very young aspidaster composed of radiating rays, of a large dark specimen from South Molokai (race II);

15, elongate, young, perfectly smooth aspidaster, of a large dark specimen from South Molokai (race II).

16.— Group of isoactine microrhabds, of a large dark specimen from South Molokai (race II); magnified 540; u. v. phot. Zeiss, q. monochr. 6, q. oc. 10.

17.— Isoactine microrhabd, of a large whitish specimen from South Molokai (race I, form C); magnified 540; u. v. phot. Zeiss, q. monochr. 6, q. oc. 10.

18.— Isoactine microrhabd, of a large dark specimen from South Molokai (race II); magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.

19–26.— Aspidasters; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6:

19, young aspidaster, of a small, partly light, partly dark, specimen from South Molokai (race I, form A);

20, young aspidaster, of a large whitish specimen from South Molokai (race I, form C);

21, young aspidaster, of a middle-sized light-coloured specimen from northeast Hawaii (race I, form D);

22, adult, lozenge-shaped aspidaster, of a small, partly light, partly dark, specimen from South Molokai (race I, form A);

23, adult, oval aspidaster, of a middle-sized light-coloured specimen from northeast Hawaii (race I, form D);

24, adult, irregular aspidaster, of a small, partly light, partly dark, specimen from South Molokai (race I, form A);

25, adult, irregular aspidaster, of a large whitish specimen from South Molokai (race I, form C);

26, adult, broad oval aspidaster, of a middle-sized light-coloured specimen from northeast Hawaii (race I, form D).

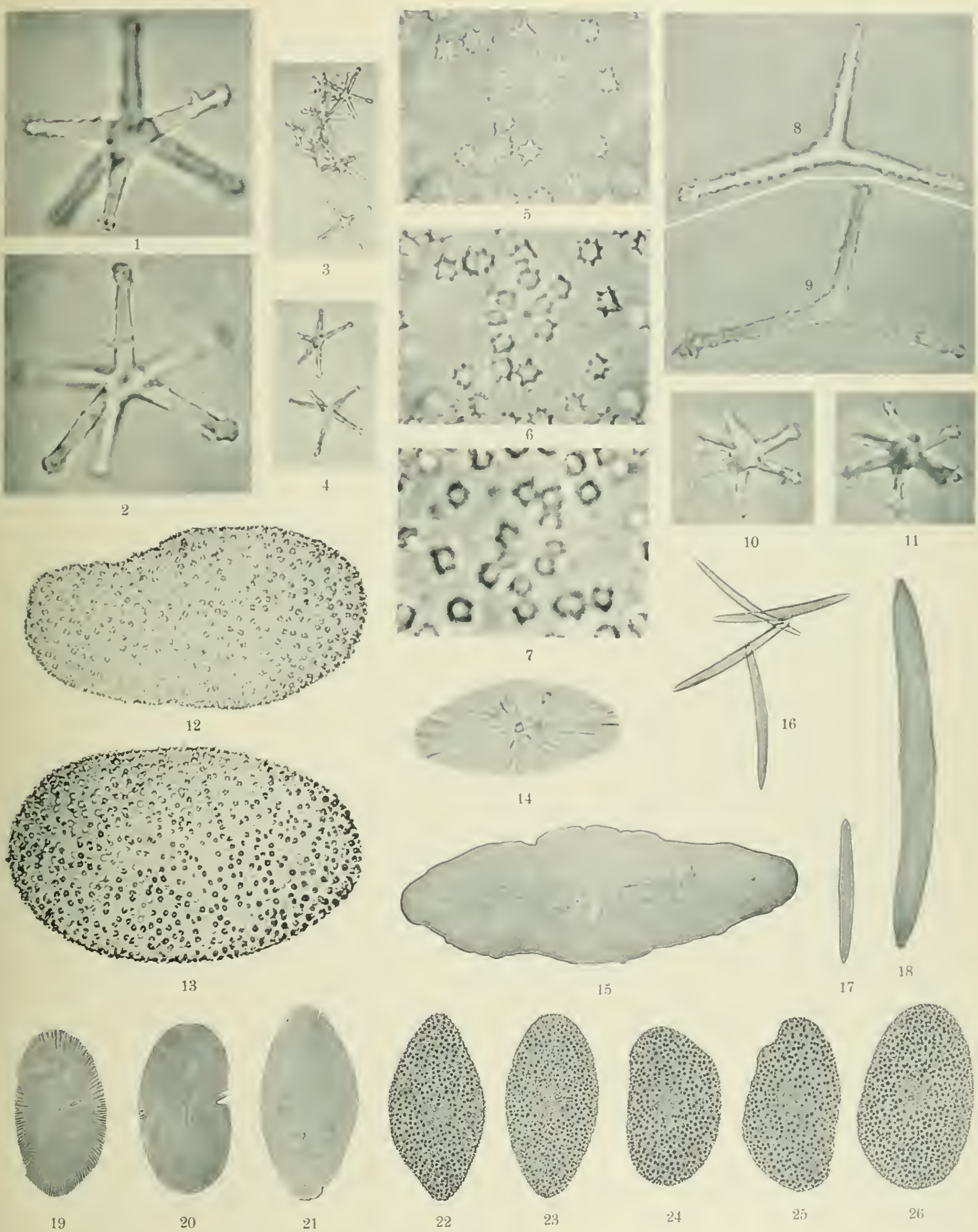

Fig. 1-26 Erylus sollasii n. sp.
1, 2, 4-11, 13-16, 18 race II; 3, 12, 17, 20, 25 race I form C; 19, 22, 24 race I, form A. 21, 23, 26 race I. form D.

PLATE 3.

PLATE 3.

Erylus sollasii Lendenfeld.

Figures 1–28. Race III. Large dark specimen from northeast Hawaii.

1.— Side view of a triaene with branched clades, and a reduced, cylindrical, terminally rounded rhabdome; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6.

2–6.— Apical views of cladomes of triaenes; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6:
 2–4, with all clades branched dichotomously or in a more complicated manner;
 5, 6, with only two clades thus branched and the third simple.

7, 8.— Parts of large acanthtylasters; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.

9–11.— Aspidasters; magnified 350; phot. Zeiss, apochr. 4, compens. oc. 6:
 9, a perfectly adult one;
 10, a nearly adult one;
 11, a young, still smooth one.

12.— Side view of a triaene with branched clades; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6.

13.— Two isoactine microrhabds; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6.

14, 15.— Two isoactine microrhabds; magnified 540; u. v. phot. Zeiss, q. monochr. 6, q. oc. 10.

16, 17.— Aspidasters; magnified 540; u. v. phot. Zeiss, q. monochr. 6, q. oc. 10:
 16, a young one;
 17, an adult one.

18.— Promonaene-like style, abruptly bent near the pointed end; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6.

19–22.— Rhabd megascleres; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6:
 19, 20, large amphioxes;
 21, style;
 22, small amphiox.

23, 24.— Side views of triaenes; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6:
 23, with three-branched clades;
 24, with simple and two-branched clades.

25, 26.— Groups of microscleres from centrifuge-spicule preparations; magnified 540; u. v. phot. Zeiss, q. monochr. 6, q. oc. 10:
 a, microrhabd; b, small, most probably foreign, sphaeraster; c, large acanthtylasters; d, very young aspidasters.

27.— View of the largest specimen; natural size; phot. Zeiss, anastig. 480/412 mm.

28.— Part of the surface of an adult aspidaster; magnified 1800; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.

Erylus oxyaster Lendenfeld.

Figures 29–35.

29–35.— Microscleres and groups of such from centrifuge-spicule preparations; magnified 600; u. v. phot. Zeiss, q. monochr. 6, q. oc. 10:
 a, (Figs. 29–32, 35) microrhabds;
 b, (Fig. 35) large diactine oxyaster;
 c, (Fig. 34) large triactine oxyaster with one ray reduced;
 d, (Figs. 32, 33, 35) large oxyasters with three or more fully developed rays;
 e, (Fig. 32) small oxyaster with numerous rays.

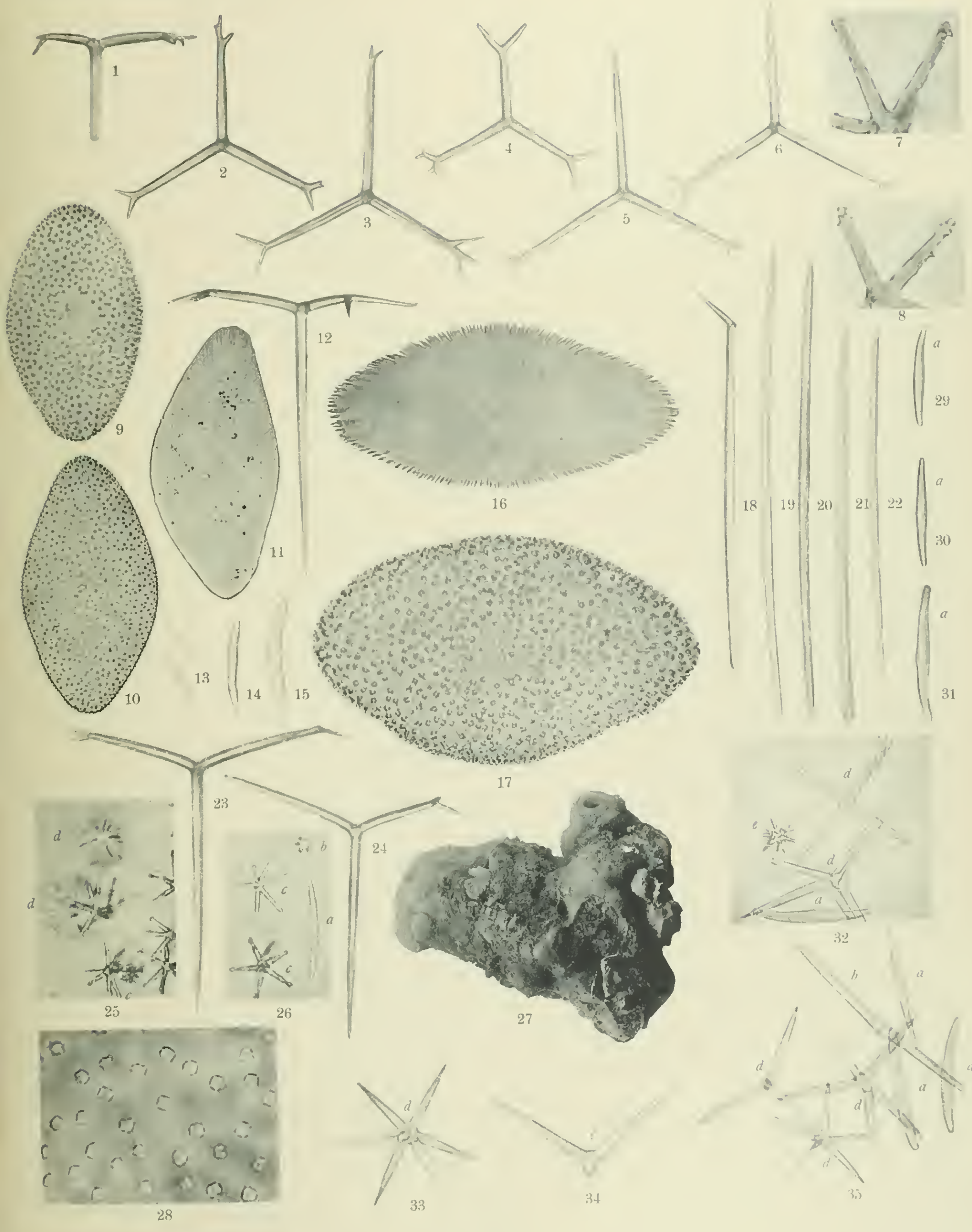

Fig. 1-28 Erylus [illegible]lasii n. sp. (race III),
Fig. 29-35 Erylus oxyaster n. sp.

PLATE 4.

PLATE 4.

Erylus oxyaster Lendenfeld.

Figures 1–43.

1–23.— Megascleres; magnified 30; phot. Zeiss, planar 20 mm.:
 1, apical view of the cladome of a dichotetraene;
 2–5, apical views of cladomes of dichotriaenes;
 6, 7, pointed, straight, or slightly curved amphioxes;
 8, pointed, angularly bent amphiox;
 9, blunt, slightly curved amphiox (amphistrongyle);
 10, 11, styles;
 12–14, amphiox-derivates, strongly angularly bent near one end, like monaenes;
 15, 16, amphiox-derivate with a vertically arising branch-ray, like mesomonaenes;
 17–19, amphiox-derivates with two or three branch-rays, like meso- or amphiclades;
 20, side view of a plagiotriaene;
 21, side view of a triaene with one simple and two bifurcate clades;
 22, 23, side views of dichotriaenes.

24.— View of the sponge; natural size; phot. Zeiss, anastig. 480/412 mm.

25.— Part of a superficial, paratangential section showing a pore; magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6.

26–34.— Microscleres and groups of such from centrifuge-spicule preparations; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6.:
 a, (Figs. 26, 28–33) microrhabds;
 b, (Fig. 27) large monactine oxyaster;
 c, (Fig. 28) large diactine oxyaster;
 d, (Figs. 26, 30) large triactine oxyasters;
 e, (Figs. 30, 32–34) large oxyasters with four or more rays;
 f, (Figs. 29, 30) small oxyasters with numerous rays.

35.— The umbilical face of an aspidaster; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6.

36, 37. — Part of the surface of the umbilical face of an aspidaster; magnified 2000; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
 36, focused lower; 37, focused higher.

38.— A ray of a large oxyaster; magnified 2000; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.

39, 40.— A small oxyaster with numerous rays; magnified 2000; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
 39, focused lower; 40, focused higher.

41–43.— Aspidasters; magnified 150; phot. Zeiss, apochr. 8; compens. oc. 6:
 41, rare, nearly circular aspidaster;
 42, 43, ordinary, elongate aspidasters.

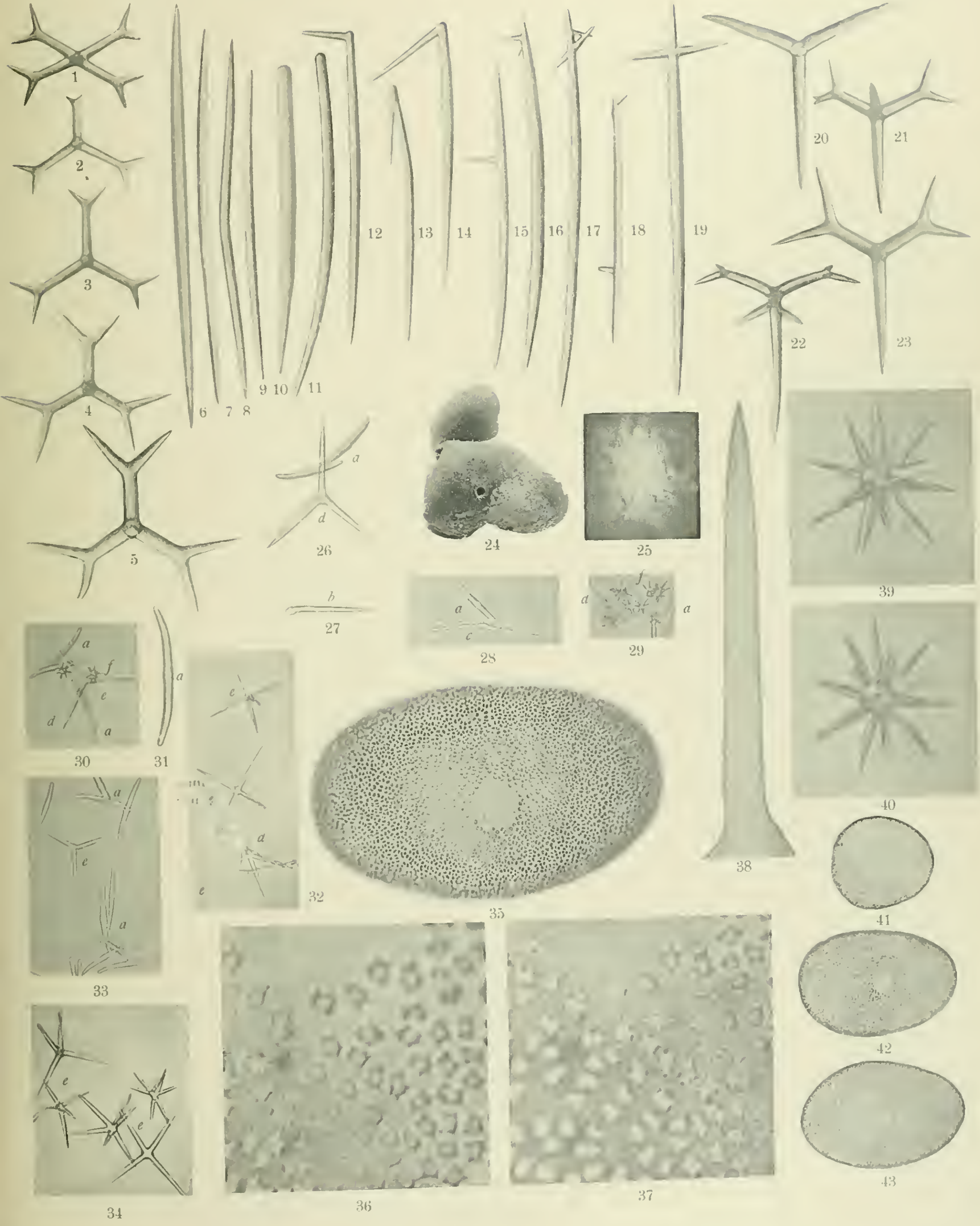

Fig. 1-43 Erylus oxyaster n. sp

PLATE 5.

PLATE 5.

Erylus rotundus Lendenfeld.

Figs. 1, 3, 11–13.	— var. typica Lendenfeld. Form D. Northeast Hawaii.
Figs. 2, 4, 17.	— var. typica Lendenfeld. Form B. Kauai.
Figs. 5, 26–28, 31.	— var. cidaris Lendenfeld.
Figs. 14, 15.	— var. typica Lendenfeld. Form C. Kauai.
Figs. 16, 30.	— var. typica Lendenfeld. Form A. South Molokai.
Figs. 18–22, 32.	— var. megarhabda Lendenfeld. Form A. South Molokai.
Fig. 23.	— var. megarhabda Lendenfeld. Form B. Kauai.

Erylus caliculatus Lendenfeld.

Figures 6–10, 24, 25, 29.

1–7.— Apical views of triaene-cladomes; magnified 100; phot. Zeiss, apochr. 16, compens oc. 6:
- 1, 3, of *Erylus rotundus* var. *typica* from northeast Hawaii (form D);
- 2, 4, of a dark specimen of *Erylus rotundus* var. *typica* from Kauai (form B);
- 5, of *Erylus rotundus* var. *cidaris*;
- 6, 7, of *Erylus caliculatus*.

8–10.— Side views of triaenes of *Erylus caliculatus*; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6.

11–15.— Amphioxes of *Erylus rotundus* var. *typica*; magnified 100; photo. Zeiss, apochr. 16, compens. oc. 6:
- 11–13, of a specimen from northeast Hawaii (form D);
- 14, 15, of a light specimen from Kauai (form C).

16, 17.— Groups of megascleres from spicule-preparations of *Erylus rotundus* var. *typica*; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6:
- 16, of a specimen from South Molokai (form A);
- 17, of a dark specimen from Kauai (form B);
  - a, sharp-pointed amphioxes; b, blunt amphiox (amphistrongyle); c, style.

18–23.— Rhabd megascleres of *Erylus rotundus* var. *megarhabda*; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6:
- 18, an amphistrongyle of a specimen from South Molokai (form A);
- 19–22, amphioxes of a specimen from South Molokai (form A);
- 23, an amphiox of a specimen from Kauai (form B).

24–28.— Groups of spicules from spicule-preparations; magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6:
- 24, 25, of *Erylus caliculatus*;
- 26–28, of *Erylus rotundus* var. *cidaris*;
  - a, (Figs. 24–28) amphioxes;
  - c, (Fig. 24) style;
  - d, (Fig. 26) triaene;
  - e, (Fig. 27) microrhabd;
  - f, (Figs. 24, 27, 28) aspidasters;
  - g, (Figs. 24, 27) acanthtylasters.

29–32.— Views of whole specimens; phot. Zeiss, anastig. 480/412 mm.:
- 29, *Erylus caliculatus*; natural size;
- 30, *Erylus rotundus* var. *typica* from South Molokai (form A); magnified 1: 1.08.
- 31, *Erylus rotundus* var. *cidaris*; magnified 1: 1.13;
- 32, *Erylus rotundus* var. *megarhabda* from South Molokai (form A); magnified 1: 1.08.

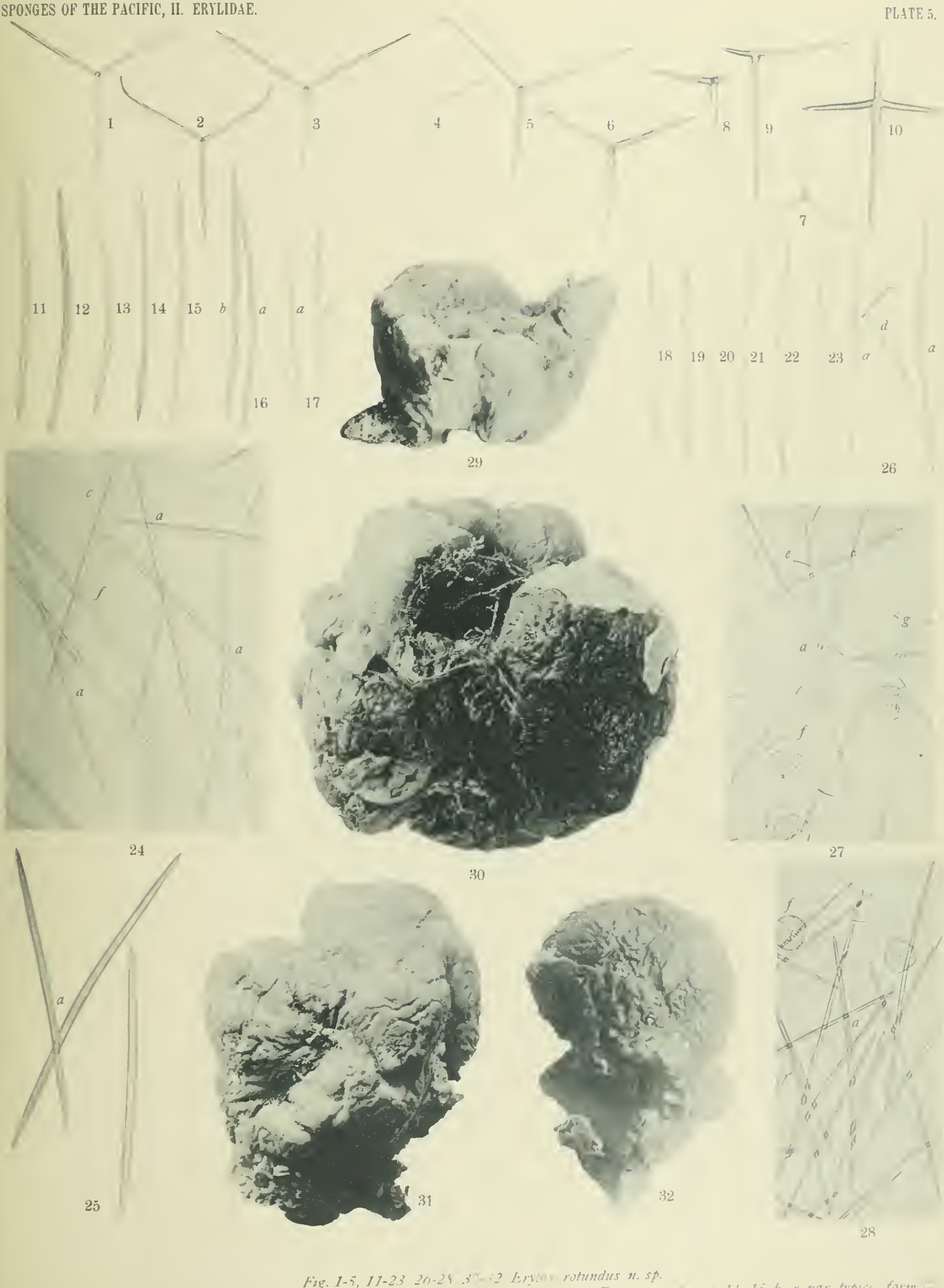

Fig. 1-5, 11-23 26-28, 30-32 Erylus rotundus n. sp.
1, 3, 11-13 E. r. var. typica, form D; 2, 4, 17 E. r. var. typica form B; 5, 26-28, 31 E. r. var. ciliaris; 14, 15 E. r. var typica form C;
16, 30 E. r. var. typica, form A; 18-22, 32 E. r. var. megarhabda, form A; 23 E. r. var. megarhabda form B
Fig. 6-10, 24, 25, 29 Erylus caliculatus n. sp.

PLATE 6.

PLATE 6.

Erylus caliculatus LENDENFELD.

Figures 1–13, 19–23, 26, 28, 29.

Erylus rotundus LENDENFELD.

Figs. 14, 18, 24, 33–35. — var. megarhabda LENDENFELD. From A. South Molokai.
Figs. 15–17, 25, 30–32. — var. typica LENDENFELD. Form B. Kauai.
Fig. 27. — var. typica LENDENFELD. Form A. South Molokai.

1, 2.— Microrhabds of *Erylus caliculatus*: magnified 600; u. v. phot. Zeiss, q. monochr. 6, q. oc. 10.

3.— Small oxysphaeraster of *Erylus caliculatus*; magnified 600; u. v. phot. Zeiss, q. monochr. 6, q. oc. 10.

4, 5.— Groups of microscleres from a centrifuge-spicule preparation of *Erylus caliculatus*; magnified 600; u. v. phot. Zeiss, q. monochr. 6, q. oc. 10:
a, microrhabds; b, acanthtylasters.

6–13.— Acanthtylasters of *Erylus caliculatus*; magnified 600; u. v. phot. Zeiss, q. monochr. 6, q. oc. 10.

14.— Group of microscleres from a centrifuge-spicule preparation of *Erylus rotundus* var. *megarhabda* from South Molokai (form A); magnified 600; u. v. phot. Zeiss, q. monochr. 6, q. oc. 10:
b, acanthtylasters; c, small oxysphaeraster.

15, 16.— Acanthtylasters of a dark specimen of *Erylus rotundus* var. *typica* from Kauai (form B); magnified 600; u. v. phot. Zeiss, q. monochr. 6, q. oc. 10.

17–22.— Aspidasters; magnified 600; u. v. phot. Zeiss, q. monochr. 6, q. oc. 10:
17, nearly adult aspidaster of a dark specimen of *Erylus rotundus* var. *typica* from Kauai (form B);
18, adult aspidaster of a specimen of *Erylus rotundus* var. *megarhabda* from South Molokai (form A);
19, adult, circular aspidaster with numerous protruding rays of *Erylus caliculatus*;
20, young, circular aspidaster with few protruding rays of *Erylus caliculatus*;
21, adult, reniform aspidaster with numerous protruding rays of *Erylus caliculatus*;
22, young, smooth, reniform aspidaster of *Erylus caliculatus*.

23.— Superficial, paratangential section of *Erylus caliculatus*; magnified 30; phot. Zeiss, planar 20 mm.

24.— Radial section through the superficial part of *Erylus rotundus* var. *megarhabda* from South Molokai (form A); magnified 10; phot. Zeiss, planar 50 mm.

25.— Radial section through the choanosome of a dark specimen of *Erylus rotundus* var. *typica* from Kauai (form B); magnified 20; phot. Zeiss, planar 20 mm.:
a, radial bundle of rhabd megascleres.

26.— Radial section through the superficial part of *Erylus caliculatus*; magnified 30; phot. Zeiss, planar 20 mm.:
a, radial bundle of rhabd megascleres.

27.— Paratangential section, a small distance below the surface, of *Erylus rotundus* var. *typica* from South Molokai (form A); magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6:
a, group of triaene-cladomes.

28, 29.— Radial sections through the choanosome of *Erylus caliculatus*; aniline-blue:
28, magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6;
29, magnified 100; phot. Zeiss, apochr. 16, compens. oc. 6.

30–35.— Microrhabds of *Erylus rotundus*; magnified 600; u. v. phot. Zeiss, q. monochr. 6, q. oc. 10:
30–32, of a dark specimen of var. *typica* from Kauai (form B);
33–35, of a specimen of var. *megarhabda* from South Molokai (form A).

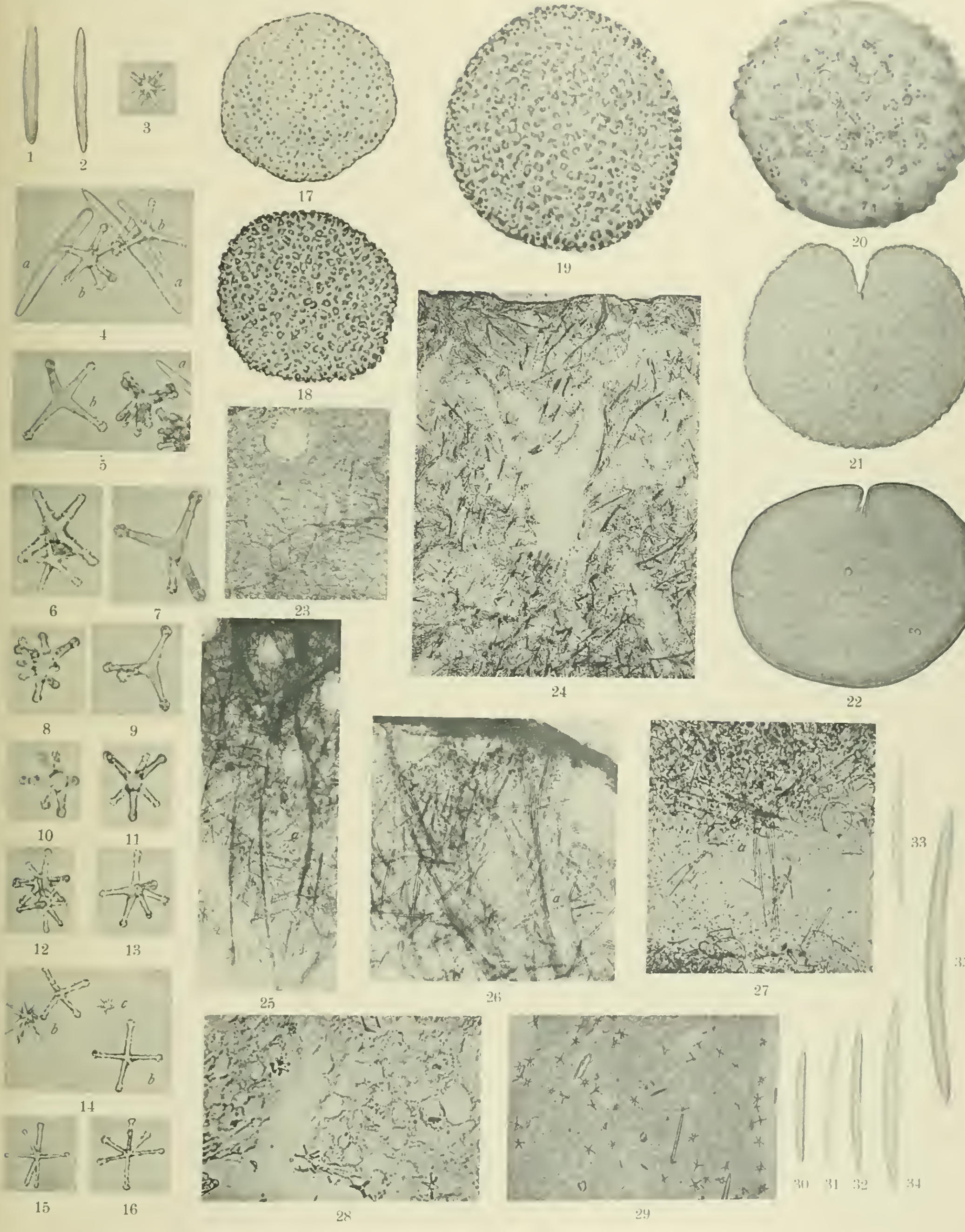

Fig. 1-13, 19-2[illegible] 2[illegible] 28 29 Erylus [illegible]aliculatus n. sp.
Fig. 14-18, 24, 25, 27, 3[illegible]-35 Erylus rotundus n. sp.
14, 18, 24, 33-35 E. r. var. megarhabda, form A; 15-17, 25, 30-32 E. r. var. typica form B. [illegible] E. [illegible] var. typica. form A

PLATE 7.

PLATE 7.

Erylus rotundus LENDENFELD.

Figs. 1–10, 12–45, 75, 76, 79.	— var. cidaris LENDENFED.
Figs. 16, 16, 48, 54.	— var. typica LENDENFELD. Form B. Dark specimen. Kauai.
Figs. 17, 18, 49–51, 53.	— var. typica LENDENFELD. Form A. South Molokai.
Figs. 19–21, 55, 56.	— var. typica LENDENFELD. Form C. Light specimen. Kauai.
Figs. 22–24, 26, 27, 30; 57–59, 66–73.	— var. megarhabda LENDENFELD. Form A. South Molokai.
Figs. 25, 28, 29, 60–65.	— var. megarhabda LENDENFELD. Form B. Kauai.
Figs. 17, 52.	— var. typica LENDENFELD. Form D. Northeast Hawaii.

Erylus caliculatus LENDENFELD.

Figures 11–15, 31–41, 74, 77, 78, 80.

1–10.— Branched amphiox-derivates and oxyastrose rhabd-clusters of *Erylus rotundus* var. *cidaris*; magnified 200; phot. Zeiss, apochr. 8, compens. oc. 6:

1–3, long amphioxes with two or three shorter branches;

4–10, oxyastrose rhabd-clusters.

11–15.— Oxysphaerasters of *Erylus caliculatus*; magnified 2000; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:

11, an oxysphaeraster with thicker rays, focused higher;

12, the same, focused lower;

13, an oxysphaeraster with thinner rays, focused high;

14, the same, focused intermediate;

15, the same, focused low.

16–21.— Aspidasters of *Erylus rotundus* var. *typica*; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6:

16, of a dark specimen from Kauai (form B);

17, 18, of a specimen from South Molokai (form A);

19–21, of a light specimen from Kauai (form C).

22–30.— Aspidasters of *Erylus rotundus* var. *megarhabda*; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6:

22, 23, young aspidasters without protruding rays, of a specimen from South Molokai (form A);

24, 26, 27, 30, adult aspidasters of a specimen from South Molokai (form A);

25, 28, 29, adult aspidasters of a specimen from Kauai (form B).

31–41.— Aspidasters of *Erylus caliculatus*; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6:

31, a very young, circular aspidaster showing the fine radial rays forming the disc;

32–35, young, circular aspidasters with few protruding rays;

36, 37, adult, circular aspidasters with numerous protruding rays;

38–40, young, reniform aspidasters with few protruding rays;

41, adult, reniform aspidaster with numerous protruding rays.

42–45.— Aspidasters of *Erylus rotundus* var. *cidaris*; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6:

46–80.— Microscleres and groups of such from centrifuge-spicule preparations; magnified 300; phot. Zeiss, apochr. 4, compens. oc. 6:

46, 48, 54, of a dark specimen of *Erylus rotundus* var. *typica* from Kauai (form B);

47, 52, of *Erylus rotundus* var. *typica* from northeast Hawaii (form D);

49–51, 53, of *Erylus rotundus* var. *typica* from South Molokai (form A);

55, 56, of a light specimen of *Erylus rotundus* var. *typica* from Kauai (form C);

57–59, 66–73, of *Erylus rotundus* var. *megarhabda* from South Molokai (form A);

60–65, of *Erylus rotundus* var. *megarhabda* from Kauai (form B);

74, 77, 78, 80, of *Erylus caliculatus*;

75, 76, 79, of *Erylus rotundus* var. *cidaris*;

a, (Figs. 46–51, 53–57, 60–75, 77–80) microrhabds; b, (Figs. 52–54, 56–60, 75–77) acanthtylasters; c, (Figs. 52, 60, 74, 76) small oxysphaerasters; d, (Figs. 56, 60) very young aspidasters; e, (Fig. 56) adult aspidasters.

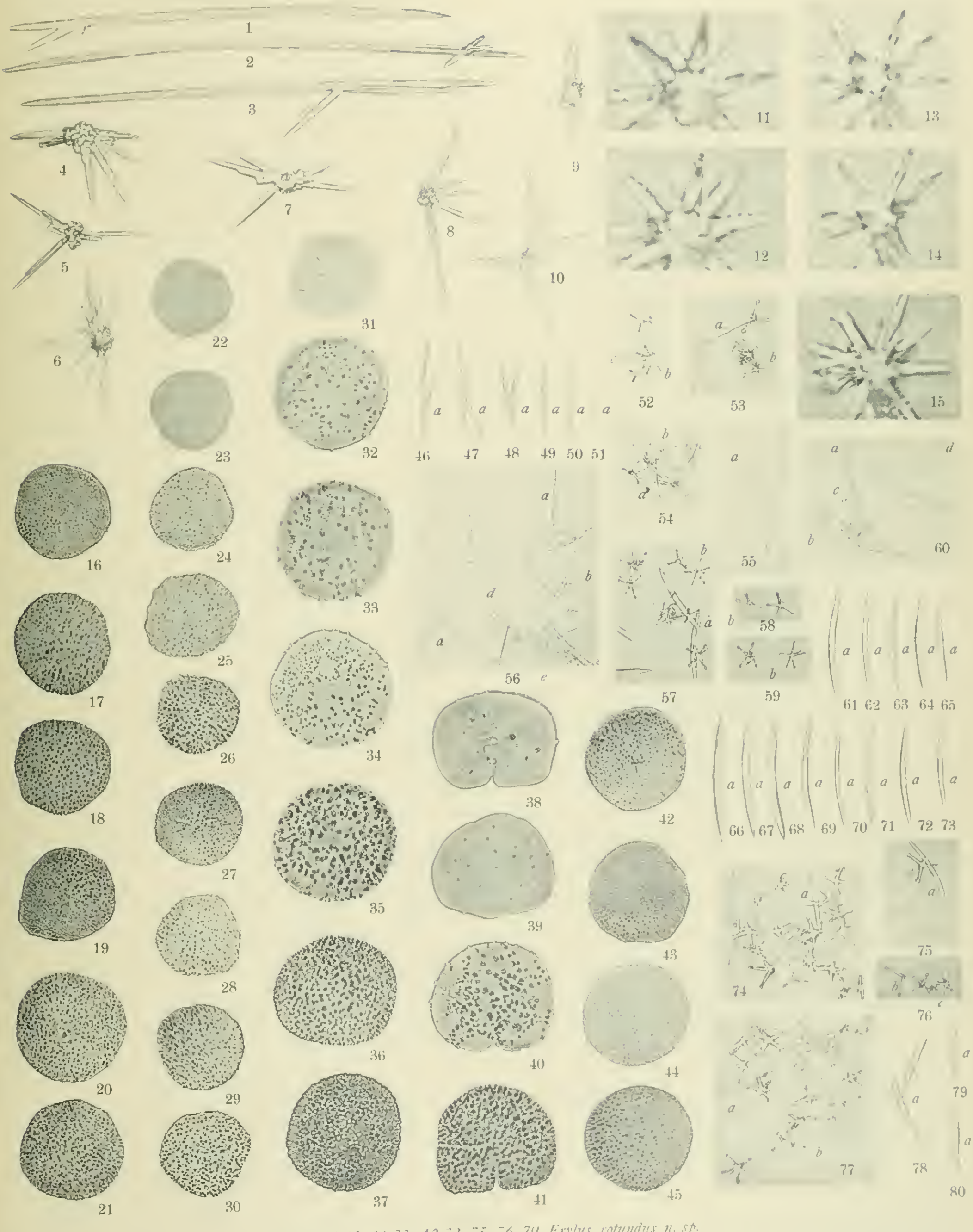

Fig. 1-10, 16-30, 42-73, 75, 76, 79 Erylus rotundus n. sp.
1-10, 42-45, 75, 76, 79 E. r. var. cidaris; 16, 46, 48, 54 F. r. var. typica, form B; 17, 18, 49-51, 53 E. r. var. typica, form A; 19-21, 55, 56 E. r. var. typica, form C; 22-24, 26, 27, 3[illegible], 57-59, 66-73 E. r. megarhabda, form A; 25, 28, 29, 60-65 E. r. var. megarhabda, form B; 47, 52 E. r. var. typica. form D.
Fig. 11-15, 31-41, 74, 77, 78, 80 Erylus caliculatus n. sp.

PLATE 8.

PLATE 8.

Erylus caliculatus Lendenfeld.

Figures 1–12, 15–20.

Erylus rotundus Lendenfeld.

Fig. 13.— var. megarhabda Lendenfeld. Form A. South Molokai.
Fig. 14.— var. cidaris Lendenfeld.

1.— Central part of a young aspidaster of *Erylus caliculatus*, showing the rays which form the disc; magnified 2000; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10.

2–12.— Acanthtylasters and parts (rays) of such of *Erylus caliculatus*; magnified 2000; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
- 2, a ray of a very large acanthtylaster;
- 3, a small, rather regular acanthtylaster, focused high; 4, the same, focused low;
- 5, a large regular acanthtylaster, focused high; 6, the same, focused low;
- 7, a small acanthtylaster, some of the rays of which are considerably shortened, focused high; 8, the same, focused low;
- 9, 10, single rays of small acanthtylasters;
- 11, part of a small, particularly thin-rayed acanthtylaster;
- 12, part of a small, particularly thick-rayed acanthtylaster.

13–17.— Marginal parts of aspidasters; magnified 2000; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
- 13, of an adult aspidaster of *Erylus rotundus* var. *megarhabda* (form A) from South Molokai;
- 14, of an adult aspidaster of *Erylus rotundus* var. *cidaris*;
- 15a, of a young, still quite smooth aspidaster of *Erylus caliculatus*;
- 15b, 16 of young aspidasters with only few protruding rays, of *Erylus caliculatus*;
- 17, of an adult aspidaster with numerous protruding rays, of *Erylus caliculatus*.

18–20.— Portions of the surface of the central parts of aspidasters of *Erylus caliculatus*; magnified 2000; u. v. phot. Zeiss, q. monochr. 1.7, q. oc. 10:
- 18, of an aspidaster not quite fully developed;
- 19, of a fully developed aspidaster, focused high;
- 20, the same, focused low.

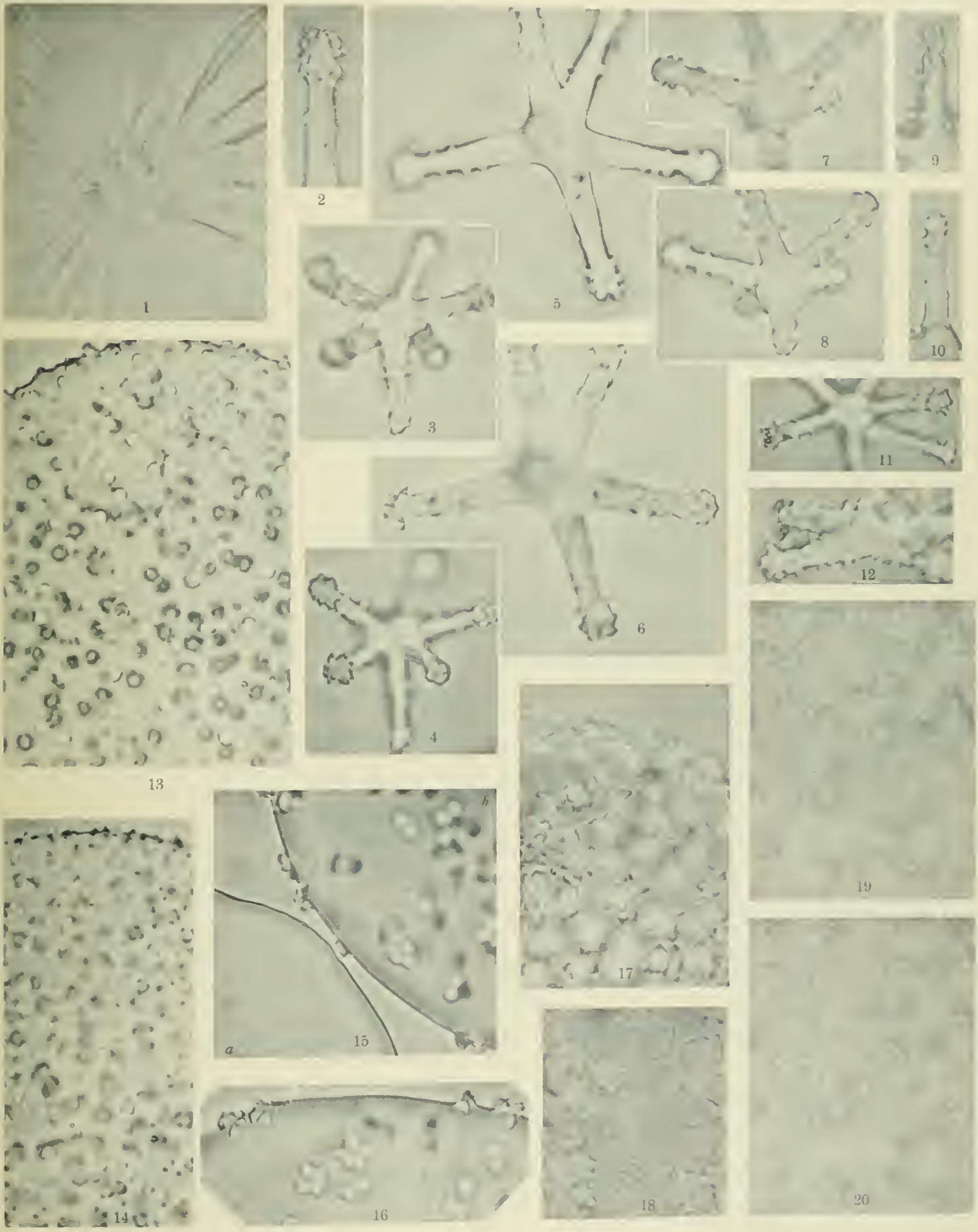

Fig. 1-12, 15-20 Erylus [illegible] n. sp.
Fig. 13, 14 Erylus rotundus n. sp.
13 E. r. var. megarhabda, form A; 14 E. r. var. [illegible]

(34)
1-4