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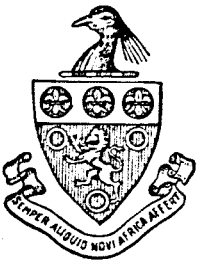

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5. *A New Dendrochirote Holothurian from South Africa, with some Remarks on the* Rhopalodinidae.—By S. G. HEDING, University Zoological Museum, Copenhagen.

(With Plates IV, V, and 3 Text-figures.)

I.

Rhopalodinopsis n.g.

Diagnosis.—Body composed of two parts, a lower spherical soft part containing the intestine, the gonads, and the respiratory trees; and an upper part, which is proboscis-shaped and hard, and contains the cloaca, the oesophagus, the ring-canal with the polian vesicle, and the stone-canal and the calcareous ring with the retractors. Mouth and anus are both placed at the end of the proboscis, but are clearly separated by the dorsal part of the dorsal interambulacrum. The tube-feet are confined to the radii of the sphere and the proximal part of the proboscis. Tentacles about twenty. Retractor muscles present and respiratory trees well developed. Tentacle-ampullae and rete mirabile lacking. Gonads in two tufts, opening on a conical papilla into the cloacal cavity, close to the anal opening. Anal opening supplied with five pairs of papillae, placed on a system of large perforate anal plates. Calcareous deposits of body-wall in two layers, an inner well-developed layer of perforate, rather solid plates, and an outer very sparse layer of rudimentary tables.

Genotype.—Rhopalodinopsis capensis n.sp.

Remarks.—The specimens at hand must without doubt be referred to the family *Rhopalodinidae* as characterised by Panning in 1932 and 1936, but they differ in several characters so definitely from the species described by Panning in his latter work that it seems most reasonable to establish a separate genus.

One of the features which I consider as being of generic value in the classification of these forms is the arrangement of mouth and anus. These two openings are well separated in *Rhopalodinopsis*, and thereby form a real "dorsal side" on the specimens, whereas in *Rhopalodina* they are set very close together and usually in such a way that the anal pore is placed on the tip of the trunk, and the mouth on the side of it, though quite close to the tip. Another

feature available for separating the genera is the presence of well-developed tube-feet on the ventral pole of the body-sphere. In the species of *Rhopalodina* such well-developed ventral tube-feet (pedicels) are lacking, which has occasioned Semper's statement that *R. lageniformis* has 10 ambulacra. In the present genus the well-developed tube-feet clearly show the shape of the ambulacra, and that they are only 5 in number, of which the two dorsal ones do not reach the pole of the body-sphere (Plate IV and fig. 1*a*). Also the shape of the calcareous plates from the inner layer of the body-wall, and especially the shape of those from the sphere, indicates a generic difference between the present species and those of *Rhopalodina*.

Rhopalodinopsis capensis n.sp.

Locality.—Kalk Bay, Cape Peninsula, low water (the specimens were found washed ashore after a storm, October 1931, and presented to the Museum by Mr. C. L. Biden).

External Features.—The specimens (Plate IV) measure about 10 cm. in length. They are shaped as *Bonellia* with the proboscis stretched out. The ventral part of the specimens, the sphere, measures about 3 cm. in diameter and is quite soft to the touch, due to the relatively few and small plates in the body-wall. Its colour in alcohol is pale yellowish, and the body-wall itself is semi-transparent, so that the gonads and the intestine can be seen through it. The trunk is hard and white, due to the numerous large imbricated plates. [The colour was the same when the specimens were first brought to the Museum.—Ed.]

The pedicels are placed in two rows in each ambulacrum, and reach from the ventral pole of the sphere to about 1 cm. on the base of the proboscis. They are largest on the ventral half of the sphere (Plate IV), and are rudimentary on the proboscis. Contrary to what is the case in *Rhopalodina* the pedicels are well developed on the ventral pole of the sphere (Plate IV, fig. 4 and fig. 1*a*), and it is easily seen that only the mid-ventral ambulacrum crosses the actual pole. The other ambulacra are only bent towards the pole, leaving narrow interambulacral spaces free.

Mouth and anus are both placed on the dorsal side (*i.e.* the tip of the proboscis) (fig. 1*b*). There is a distinct interambulacral dorsal space developed, and here the large calcareous plates of the trunk are lacking and replaced by a few small perforated plates. The oral opening is surrounded by some rather large scales, which, when the

tentacles are totally retracted, may close the opening. Around the anal opening there are ten surprisingly well-developed anal papillae, two in each ambulacrum. Anal teeth are lacking, but the anal papillae are at their base supplied with some large perforated plates, one for each papilla; these plates further lie in pairs on five other deeper-lying radial plates. Superficially we may thus speak about an anal calcareous ring, as did Semper. Further, care must be taken

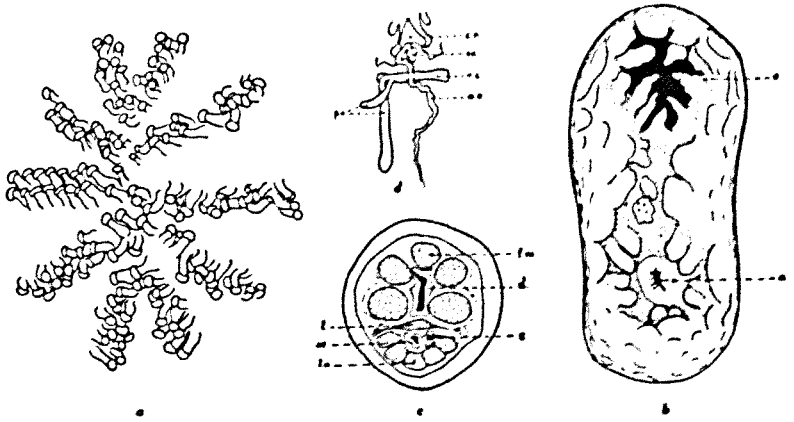


FIG. 1.—*Rhopalodinopsis capensis* n.g., n.sp. (*a*) Ventral pole of body-sphere, showing arrangement of radii and tube-feet. (*b*) End of proboscis with oral (o.) and anal (a.) openings, showing the peculiar medio-dorsal part of the dorsal interambulacrum. (*c*) Transverse section of proboscis about 1 cm. from end, showing longitudinal muscles (l.m.), cloaca (cl.) gonoduct (g.) oesophagus (oe.) and cavity (l.) between anterior and posterior part of the folded inner layer of the medio-dorsal interambulacrum. (*d*) Medio-dorsal part of calcareous ring (c.r.), with ring-canal (r.c.), polian vesicles (p.v.), stone-canal (s.c.), and axial organ (a.o.).

that the highly developed anal papillae with their fenestrated plates are not confounded with the tentacles and the calcareous ring.

Anatomy.—The specimens were all washed ashore, so they are scarcely well enough preserved to allow a very detailed examination of their anatomy; in any case, not of that of the body-sphere. In the sphere the intestine, the respiratory trees, and the gonads are found, and in the proboscis the cloaca and the anterior body-end with calcareous ring, ring-canal, oesophagus, gonoduct, and retracted muscles.

A transverse section of the proboscis about 1 cm. from its distal end shows the arrangement of some of these organs (fig. 1*c*). On the one side (*i.e.* that which represents the posterior end of the animal) there is a rather voluminous cloaca (*cl*) surrounded by five strong

longitudinal muscles. On the other side (*i.e.* the anterior end) there are the oesophagus (*oe*) and the gonoduct (*g*), also surrounded by five longitudinal muscles. In the section here figured the oesophagus and the gonoduct are placed side by side, but farther towards the end of the proboscis the gonoduct bends behind the oesophagus and then runs through the two laminae seen in the figure, and opens on a large papilla into the cloaca. This is quite a unique place for the genital opening in Holothurians.

Further, it appears from the section that the oesophageal part of the proboscis is separated from the cloacal part by a narrow cavity, a cavity the origin of which is at first sight difficult to ascertain. A closer examination, however, shows that the two laminae which separate the oesophageal and cloacal parts of the body-cavity are the muscular part of the dorsal interambulacrum which, forming a large fold, divides the coelomic cavity of the proboscis into two channels. Thus the cavity separating these two laminae is seen to be, not of coelomic origin, but merely a secondary cavity formed when the saddle-shaped external layer of the dorsal interambulacrum parted from the muscular inner layer and was drawn into the interior of the proboscis.

The ring-canal (fig. 1*d*) is supplied with 2–3 polian vesicles, a short stone-canal with a rather large madreporite, and a long and well-developed "axial organ." The calcareous ring (fig. 2) consists of ten pieces, of which the radials have more or less rudimentary posterior prolongations. The interradials are all rather simple, triangular, thick pieces, usually with a deep incision in their posterior margin. The radials are of different shape, not only in different specimens, but even in the same specimen, and the mid-ventral radial is always less well-developed than the lateral ones. Anteriorly all the radials have more or less deep incisions, and in every case the larger part of these incisions form insertions for tentacles or incisions for the passage of the water-vascular system and the radial nerves. In spite of the fact that the pieces of the calcareous ring are rather thick, so thick that we should not call them incisions, but rather bowl-shaped depressions for the musculi retractor tentaculi, the limits between the calcified part of the ring and the surrounding connective tissue are often indistinct; for which reason it is impossible to ascertain the real number of tentacles when studying the shape of the calcareous ring.

From the shape of the calcareous ring one would expect between 20 and 30 tentacles, and a careful dissection of the retracted muscles

showed that there were 22, but of these 2 may perhaps be merely torn-off pieces or folds of the introvert. In any case, this species has about 20 tentacles, and of these it seems (it is not *quite* certain) that 5 are placed in an inner circle. The tentacles themselves are all unbranched and supplied with numerous calcareous deposits.

Calcareous Deposits.—Similar to the species of *Rhopalodina* (as shown by Panning), the present species of *Rhopalodinopsis* has two

FIG. 2.—*Rhopalodinopsis capensis* n. g., n. sp. (*a–c*) Calcareous ring of specimen I. (*a*) Right ventral radial with additional interradials. (*b*) Mid-ventral radial with additional interradials. (*c*) Mid-dorsal interradial with additional radials. (*d*) Mid-ventral radial with additional interradials of specimen II. (*e, f*) Pieces of calcareous ring of specimen II cleared in xylol and mounted in balsam: (*e*) Mid-ventral radial with left ventral radial and additional interradials. (*f*) Mid-dorsal interradial and left dorsal interradial with left dorsal radial and fragments of right dorsal radial and left ventral radial.

layers of calcareous deposits in the body-wall, a deeper layer of perforated plates and a superficial layer of tables, but here the outer layer is so reduced that it has not been possible to find more than two rudimentary tables.

The deposits of the inner layer are very different in the two main parts of the body. In the proboscis they are large circular plates with round holes (Plate V, fig. 1). They are imbricated, and in their free parts have a number of large knobs on their external side. These knobs are smallest in the plates from the proximal part of the proboscis, and close to the free end of the proboscis they may be as high as is shown in the figure (Plate V, fig. 1*a*). The deposits from the wall of the sphere (Plate V, figs. 2–5) are not imbricated,

being small thick bodies which are fairly uniformly dispersed. None of these plates, either from the proboscis or from the sphere, consists of more than one layer, which is often the case in the genus *Rhopalodina*.

As stated above, the deposits of the superficial layer are nearly lacking. There are, however, two small spiny button-like deposits lying superficially above the large "fat" bodies in the wall of the sphere, deposits which do not leave much doubt that they are rudimentary tables (Plate V, figs. 6, 7).

The tube-feet are without end-plates, but have small spiny rods (Plate V, figs. 14–18) in their walls. In the tentacles there are two different sorts of rods: relatively large perforated plates (Plate V, figs. 8–10) and rather characteristic small oval plates or bodies (Plate V, figs. 11–13).

II.

Remarks on the *Rhopalodinidae*.

The fact that the new species described above has about 20 tentacles appeared to be quite contrary to what is the case in the other species belonging to the *Rhopalodinidae*; Semper, as well as Panning, stating the normal number of tentacles in *Rhopalodina* to be 10. A comparison of the calcareous ring of *Rhopalodinopsis capensis* with Semper's figure of that of *R. lageniformis* showed, however, that there were reasons for supposing that Semper's statement was not quite correct. I therefore wrote to Dr. Panning in Hamburg asking him to undertake a renewed examination of the tentacles of his specimens. As Dr. Panning had long ago finished his beautiful work on the genus *Rhopalodina*, and for the present had no time to work on these specimens, he kindly sent me some specimens and fragments of the two species *R. lageniformis* and *gracilis*, and suggested that I undertake the examination myself.

This examination gave the following results: in the specimens of *R. lageniformis* (Nos. 4477 and 4479) the calcareous ring consists of ten pieces, of which all the radials have a distinct posterior bifurcating prolongation (fig. 3, *a–d*). The real shape of the pieces is very difficult to ascertain, as they are not only small, but also placed in such a way that quite different results are obtained when the piece under observation is turned a little to one side or the other. Figures *a–l* in fig. 3 are all drawn, as far as possible, in such a position that the central piece in the figure is lying parallel to the surface of the alcohol in the dissecting dish. Only figures *b* and *c* are drawn in a slightly

oblique position—in *b* turned slightly to the right, in *c* slightly to the left. It is evident that if all the incisions in the anterior side of the calcareous ring, apart from the five radial incisions for the radial nerves and canals, are insertions for tentacles, which is normal in

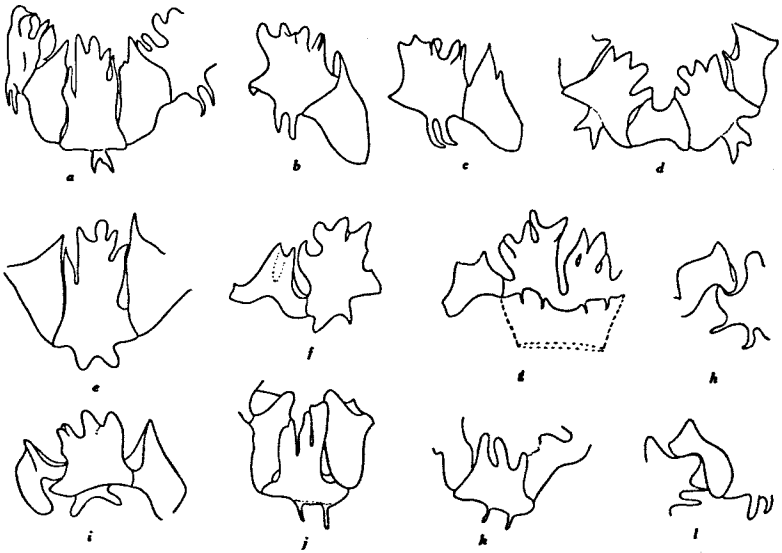


FIG. 3.—*Rhopalodina lageniformis* Gray. (*a–d*) (Panning, No. 4477). (*a*) Mid-ventral radial with the two ventral interradials and parts of the two lateral radials. (*b, c*) Right ventral radial and interradial drawn in two slightly different positions, showing how the contours of the pieces may vary in accordance with the position of the piece under examination. (*d*) Mid-dorsal interradial with the two dorsal radials and lateral interradials.

(*e, f*) (Panning, No. 4479). Mid-ventral radial with ventral interradials and mid-dorsal interradial with right dorsal radial, showing the variation of the shape of the calcareous ring in this species.

Rhopalodina gracilis Panning. (*g–l*) (Panning, No. 4484). (*g*) Mid-dorsal inter-radial with the abnormal double right radial; the stippled line is the outline of the abnormally wide right retractor. (*h*) Right lateral interradial with a part of the right ventral radial. (*i*) Right ventral radial with additional interradials. (*j*) Mid-ventral radial with ventral interradials. (*k*) Left dorsal radial with mid-dorsal interradial. (*l*) Left lateral interradial with additional radials.

most other Holothurians, we should expect about 20 tentacles, and dissection of specimen No. 4479 showed 18 tentacles, of which 5 were placed in an inner circle. After having done this as carefully as possible, I cleared the whole introvert in xylol and mounted it on a slide. Further examination showed that I had overlooked two small ventral, apparently regenerating, tentacles. The number of tentacles is thus in this specimen (i.e. *R. lageniformis* sens. str.) 20,

and they are arranged with 15 in an outer and 5 in an inner circle. The other specimen of *R. lageniformis*, No. 4477, was unfortunately so badly preserved that I was unable to count the tentacles.

The two other specimens at hand, Nos. 4484 and 5863, represent the species *R. gracilis* Panning. One of them, No. 5863, had the calcareous ring destroyed, and could not throw any light on either the shape of the ring itself or the number of tentacles. The other, No. 4484, showed a slight but apparently distinct difference from the calcareous ring of *R. lageniformis*. This may be a systematic character, but as the ring is evidently abnormal, having two right dorsal radials, we should not lay too much stress on the shape of it. The examination of the tentacles in the opened introvert, as well as in cleared preparation, showed that they were 18 in number. As far as it was possible for me to ascertain there were not more than 18 tentacles, and if the calcareous ring were not abnormal we should have here a valid character for separating the two species *lageniformis* and *gracilis*. As, however, the calcareous ring *is* abnormal, it is possible that the normal number of tentacles is 20 in *gracilis* also.

The fact that the species of *Rhopalodina* and *Rhopalodinopsis*, *i.e.* all the members of the family *Rhopalodinidae*, have not 10 (as previously assumed) but about 20 tentacles, arranged in two circles with 5 in the inner and 12–15 in the outer circle, appears to be of the greatest value for the classification of the Dendrochirote Holothurians. Owing to the large number of tentacles it is now quite evident that *Rhopalodina* (and *Rhopalodinopsis*) cannot be placed close to *Echinocucumis* and *Sphaerothuria* with *Ypsilothuria* (see Perrier, 1902), but that it is closely related to the *Phyllophorinae*. If all the characters are taken into consideration, there is no reason to maintain a separate family for these two genera, since they may be placed, without serious difficulty, close to or within the subfamily *Phyllophorinae*. However, so long as our knowledge of the classification of the *Phyllophorinae*, and indeed of the whole order *Dendrochirota*, is as unsatisfactory as it is at present, it is of no practical use to try to find the true natural place for these odd forms. I prefer for the moment to maintain a separate taxonomic group for the two genera here under discussion, but I suppose it must be regarded as a subfamily, the *Rhopalodinae*, closely related to the *Phyllophorinae*. In reality the only important difference between the *Rhopalodinae* and the *Phyllophorinae* is the presence of large plates in the former, as I do not think that the peculiar body-shape is of any higher taxonomic value.

I wish to express my sincerest thanks to the Director of the South

African Museum, who has given me the opportunity of studying these very interesting specimens, and to Dr. Panning, Hamburg, who has supplied me with material of *Rhopalodina* for examination of the calcareous ring and tentacles in that genus, and to Dr. Mortensen of Copenhagen, whose good advice and never-failing interest in my studies have been of invaluable help to me.

LITERATURE.

GRAY, J. E., 1853. Description of *Rhopalodina*, a new genus of *Echinodermata*, Ann. Mag. Nat. Hist., Ser. 2, vol. ix.

SEMPER, C., 1868. Reisen im Archipel der Philippinen, 2 Theil, Wiss. Res., Bd. 1, Holothurien.

LUDWIG, H., 1877. "Ueber *Rhopalodina lageniformis* Gray und die darauf gegründete Klasse *Diplostomidea* Semper," Zeitschr. Wiss. Zool., Bd. 29.

PERRIER, E., 1886. Les Explorations sous-marines, Paris.

THÉEL, HY., 1886. Holothurioidea II, in "Challenger" Report, vol. XIV, 2.

LUDWIG, H., 1889. "Nochmals über *Rhopalodina lageniformis*," Zeitschr. wiss. Zool., Bd. 48.

STUDER, TH., 1889. Die Forschungsreise S.M.S. "Gazelle" in den Jahren 1874–76, 2 Theil, Zoologie und Geologie.

LUDWIG, H., 1892. Die Seewalzen, in Bronn's Klassen und Ordnungen, Bd. II, 3 Abtlg., Echinodermen 1 Buch.

GOODRICH, E. S., 1900. Holothurioidea; in Lankaster: Treatise on Zoology, part 3; Bather, F. A., Echinoderma.

PERRIER, R., 1902. Holothuries, in Expéditions scientifiques du "Travailleur" et du "Talisman."

VANEY, M. C., 1911. Holothuries, in Mission Gruvel sur la côte occidentale d'Afrique (1909–10); in Ann. Inst. Oceanogr., T. 2.

MORTENSEN, TH., 1927. Echinoderma; in Monod, Th., Contribution à l'étude de la Faune du Cameroun, Première Partie; in Faune des Colonies Françaises, Bd. I.

MORTENSEN, TH., 1927. Handbook of the Echinoderms of the British Isles, footnote, p. 395.

PANNING, A., 1932. Echinoderma III. Holothurioidea 3 (Fam. *Rhopalodinidae*); in Michaelsen, W., Beiträge zur Kenntniss der Meeresfauna Westafrikas, Bd. III.

PANNING, A., 1936. Die Gattung *Rhopalodina*. Verhandl. des Naturwiss. Vereins in Hamburg, Vierte Folge, Bd. V, Heft 1–4.

EXPLANATION OF PLATES.

PLATE IV.

Rhopalodinopsis capensis n. g., n. sp.

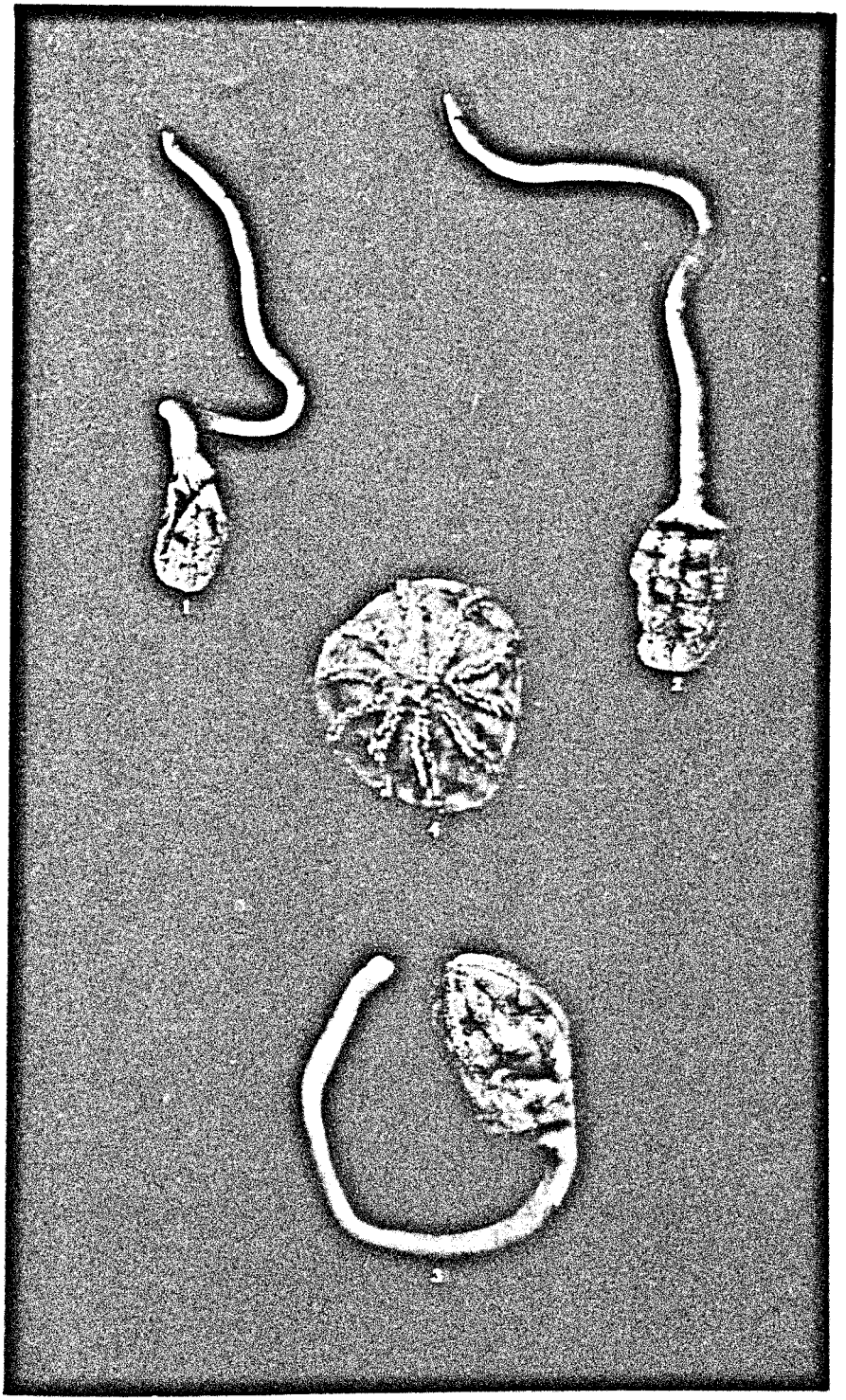
FIGS. 1–3. Three specimens, natural size.

FIG. 4. The pole of specimen 3 slightly enlarged.

Plate V.

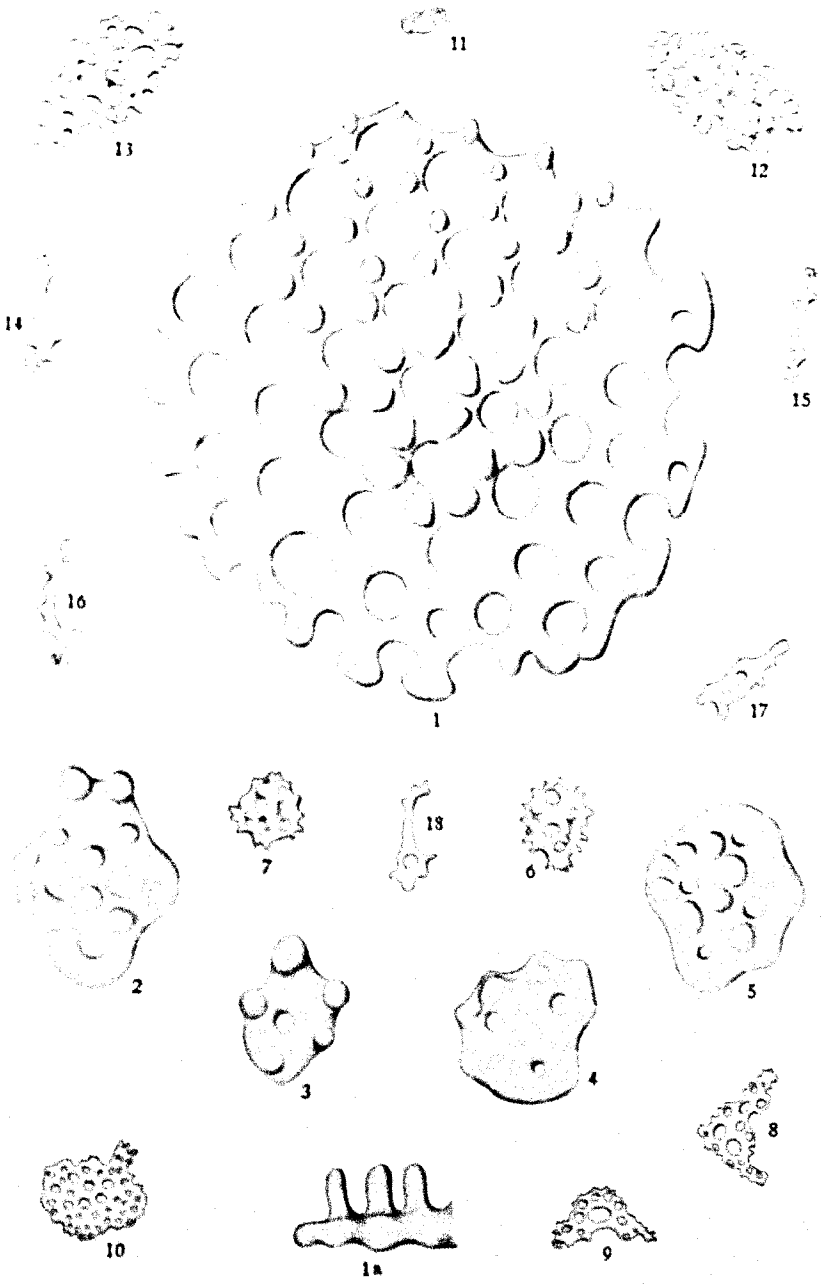
Calcareous deposits of *Rhopalodinopsis capensis* n. g., n. sp.

Fig. 1. Circular fenestrated plate from the proboscis.
„ 1*a*. Part of circular plate from the end of proboscis, seen from the side, showing high spine-like tubercles.
„ 2–5. Small perforate plates from the wall of the sphere.
„ 6–7. Rudimentary tables from the outer layer of the wall of the sphere.
„ 8–10. Perforated plates from tentacles (inner layer).
„ 11–13. Oval minute bodies from tentacles (superficial layer). Fig. 11 with the same magnification as the other figures.
„ 14–18. Rods from the tube-feet.



RHOPALODINOPSIS CAPENSIS, n.g., n.sp.

S. G. Heding, photo. *Neill & Co., Ltd.*



RHOPALODINOPSIS CAPENSIS, n.g., n.sp.

S. G. Heding, del. *Neill & Co., Ltd.*