VI. — THE RHIZOCEPHALA OF THE LEIDEN MUSEUM.

BY H. BOSCHMA.

In the paper on the Rhizocephala of the Siboga Expedition (VAN KAMPEN and BOSCHMA 1925) besides the material collected during this expedition a number of specimens from other collections have been described. Among these there were a few from the collection of the Leiden Museum ('s Rijks Museum van Natuurlijke Historie). The rich collection of Crustacea in this Museum, however, contains a much larger number of specimens infested with Rhizocephala than those described in the cited paper, as turned out after an inspection of the whole collection. Alltogether 35 specimens, including the 10 specimens described in the cited paper, could be found.

The taxonomy of the Rhizocephala is a rather difficult problem, which can be solved only after the study of a comparatively large material. The differences between the genera of this group of parasites are strikingly enough (cf. SMITH 1906), but within each genus the species usually differ in subordinate characteristics only, the internal anatomy of the species of each genus usually showing a close resemblance. The chief characteristics of the species, especially in *Sacculina* and allied genera, are those of the chitinous parts of the mantle: the excrescences of the external cuticle and the retinacula. KOSSMANN (1872) discovered the excrescences of the external cuticle in many Sacculinidae from the Philippine Islands and by means of these excrescences he was able to describe several species. Many of these species are well defined and we could identify a certain number of specimens from the East Indies with some of KOSSMANN's species (cf. VAN KAMPEN and BOSCHMA 1925). In the cited paper we moreover proved that in certain cases also the retinacula may furnish specific characteristics. KOSSMANN regarded the shape of the parasites also as a feature of specific value; this, however, is decidedly wrong, for the shape of these animals in many cases is, at least partially, determined by their surroundings: the room between the abdomen and the thorax of the host. So in many cases representatives of a certain species living on male crabs have quite another shape than those living on female crabs of the same species. Sometimes, however, the external form of a specimen of *Sacculina* may give a clue as to its identity, e. g., in the case of *S. hispida*. Both specimens of this species have almost exactly the same shape, caused especially by their noticeable ear-like lobes near the stalk (fig. 1 *f*, *g*).

Sacculina Thomps.

I have divided the old genus *Sacculina* into three parts, each of which represents a distinctly different group of generic value. These three genera are *Sacculina* (s. s.), *Drepanorchis*, and *Loxothylacus*. In

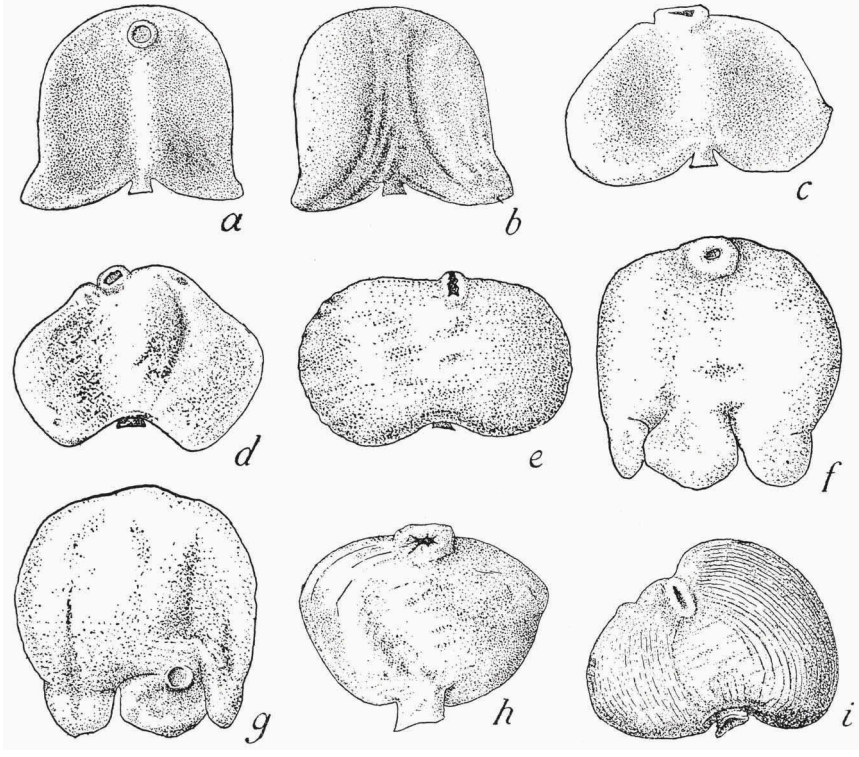

Fig. 1. *a. Sacculina aculeata*, specimen from *Carupa laeviuscula*, thoracal surface. 7,2 : 1. — *b.* the same specimen, abdominal surface. 7,2 : 1. — *c. Sacculina flexuosa*, specimen from *Varuna litterata*, thoracal surface. 3,2 : 1. — *d. Sacculina flexuosa*, specimen from *Macrophthalmus erato*, thoracal surface. 4 : 1. — *e. Sacculina flexuosa*, specimen from *Plagusia depressa*, thoracal surface. 2,8 : 1. — *f. Sacculina hispida*, specimen from *Zozymus aeneus*, Amboina, thoracal surface. 3,2 : 1. — *g.* the same specimen, abdominal surface. 3,2 : 1. — *h. Loxothylacus spinulosus*, specimen from *Heteropanope serratifrons*, thoracal surface. 8 : 1. — *i. Lernaeodiscus munidae*, specimen from *Munida bamffica*, thoracal surface. 2,8 : 1. — In all figures the mantle opening is found at the upper side, the stalk at the lower side.

both of the last named genera the testes have a curved shape; whereas for those species which have more or less straight testes I have retained the generic name *Sacculina*. The type species of this genus is *Sacculina carcini* Thomps. The species of the genus *Sacculina* again may be arranged

into two groups according to the different places where the testes are found. In many species, e. g., *S. carcini*, the testes are embedded in the visceral mass, whilst in other species they are situated in the region of the stalk, behind the place where the mantle is inserted to the stalk. The chief characteristics of each of the species of the two groups are those of the excrescences on the external cuticle and of the retinacula.

Sacculina carcini Thomps.

Sacculina carcini Thompson 1836.
Sacculina gibbsi Hesse 1867.
Sacculina benedeni Kossmann 1872.
Sacculina pisae Hoek 1878.
Sacculina andersoni Giard 1887.
Sacculina carcini Guérin-Ganivet 1911.
Sacculina carcini Boschma 1927 *b*.
(Probably *S. betencourti* Giard 1887, *S. priei* Giard 1887, *S. similis* Giard and Bonnier 1887, *S. gerbei* Bonnier 1887, *S. belli* Giard 1888, and *S. pirimelae* Guérin-Ganivet 1911 also are synonyms of this species).

Off Wangeroog, 1 ex. on *Carcinides maenas* (L.), 1 ex. on *Portunus holsatus* (Fabr.), Van Giffen leg.

Off Vlieland, 1 ex. on *Portunus holsatus* (Fabr.), R. Inst. Vissch. Onderz., 1893.

Barcelona, 4 ex. on *Brachynotus lucasi* H. M.-E., Pedro Antiga leg.

Without locality, 1 ex. on *Pachygrapsus marmoratus* (Fabr.).

The testes of *Sacculina carcini* are embedded in the visceral mass, they are surrounded by the developing eggs of the ovary. The colleteric glands contain a large quantity of branched tubes. In this species the external cuticle is provided with papilliform or conical excrescences which usually bear short lateral hairs and which may attain a length of 12 μ. The retinacula possess 4 to 10 spindles with small barbs. The length of these spindles is about 15 μ. For further particulars on the species *Sacculina carcini* cf. BOSCHMA 1927 *b*.

The material of the Leiden Museum consists of eight specimens on four different hosts.

The specimen on *Carcinides maenas* is a very small one, its dimensions are: breadth 3,5 mm, height 2.5 mm, and thickness 2 mm [1]). Its

1) The terms breadth, height and thickness are used here in another sense than the true morphological one. In the Rhizocephala the mesentery determines the dorsal surface, the mantle opening the anterior pole. For practical purposes the term "height" is used throughout this paper for the largest dimension in the

shape is rather irregular; apparently the specimen had but recently become external.

The specimens on *Portunus holsatus* are much larger, the dimensions of the specimen from Wangeroog are: breadth 11,5 mm, height 7 mm, and thickness 4 mm; the corresponding dimensions of the other specimen are: 14, 9, and 6 mm. They have a more or less rounded oval shape without pronounced angular excrescences of the mantle. The larger specimen has a rather wide mantle opening, in the other specimen this opening is comparatively small. Retinacula of the usual form are present in large numbers on the internal cuticle.

The four specimens on *Brachynotus lucasi* have the following dimensions: $7 \times 4 \times 3$ mm, $9 \times 6 \times 3$ mm, $9 \times 6 \times 3{,}5$ mm, and $8 \times 5 \times 3$ mm. Two of these were parasites of crabs with a narrow abdomen (probably males, the sex of the hosts, however, has not been determined); the other two were attached to the abdomen of crabs of female appearance. Now the latter two parasites were completely covered by the broad abdomen of their host. Probably in connection with this fact their shape is evenly rounded oval. On the other hand the two parasites on *Brachynotus* of male appearance have a more angular form, especially two of the angles are rather pronounced. This may be a result of the fact that the parasites were for a small part only covered by the narrow abdomen of the host, now they could develop their characteristic shape without being hindered by the abdomen. In some of the specimens the cuticular excrescences are somewhat longer than those of the other specimens, the shape of these papillae is like those described in a previous paper (cf. BOSCHMA 1927 *b*, fig. 4 *e*, *f*).

The single specimen in the collection which was attached to the abdomen of *Pachygrapsus marmoratus* has a strongly flattened form; its dimensions are: breadth 15, height 8, and thickness 3 mm. It possesses a distinct median groove at the abdominal surface at the place where the region of the gut of the host was lying against the parasite. In this specimen the mantle opening lies exactly opposite the stalk: it is found

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plane passing through the mantle opening and the stalk, parallel to the dorsal surface (morphologically the length of the parasite); the term "thickness" is used for the distance between the two flattened surfaces of the parasite (morphologically the breadth); the term "breadth" is used for the largest direction perpendicular to both of the other two (morphologically the distance between the dorsal and the ventral surfaces).

To avoid too extensive descriptions further the terms "thoracal surface" and "abdominal surface" are used for the surfaces lying against the thorax and the abdomen of the hosts. Although these terms are morphologically wrong they will not give rise to confusions.

at the marginal part of the parasite, between the abdominal and the thoracal surfaces. The structure of the external cuticle of the mantle is rather indistinct, probably the specimen has been preserved for a very long time.

Sacculina pilosa Kossm.

Sacculina pilosa Kossmann 1872.
Sacculina dentata Kossmann 1872.
Sacculina crucifera Kossmann 1872.
Sacculina rotundata Miers 1880.
Sacculina pilosa Van Kampen and Boschma 1925.

Moluccas, 1 ex. on *Eriphia laevimana* Latr., Forsten leg.
Sula Sanana (= Sula Besi), 1 ex. on *Eriphia laevimana* Latr.
Halmaheira, 1 ex. on *Tiarinia gracilis* Dana, Bernstein leg.
Djeddah, 2 ex. on *Actaea hirsutissima* (Rüpp.), Kruyt leg. 1881.
Nossi Faly (near Madagascar), 1 ex. on *Eurycarcinus grandidieri* A. M.-E. (= *Galene natalensis* Krauss), Pollen and Van Dam leg.

Among the material of the Siboga Expedition there are thirteen specimens of *Sacculina* with cuticular excrescences of approximately the same shape as those of KOSSMANN'S *Sacculina pilosa* and which consequently have been identified as that species (cf. VAN KAMPEN and BOSCHMA 1925). Now the specimens of the Siboga Expedition do not agree exactly in every detail. As for the internal anatomy, all the specimens examined have the same arrangement of the internal organs: the testes are found in the posterior part of the visceral mass as in *Sacculina carcini*, and the colleteric glands are well developed and contain a large number of branched tubes. The structure of the external cuticle, however, is rather variable. Some of the specimens of the Siboga Expedition may be regarded as typical specimens, for their cuticular excrescences have approximately the same shape and size as those of the specimen described by KOSSMANN (1872) as the type of *Sacculina pilosa*. In KOSSMANN's specimen the groups of hairs with the compact basal part from which they arise had a length of about 85 μ (in the text this author states erroneously 0,85 mm, but his figure of the excrescences is enlarged 200 times, from which results a length of about 85 μ). Approximately the same length have the excrescences of the specimens of the Siboga Expedition from Stat. 131 on *Eriphia laevimana* and on *Atergatis floridus*, that from Stat. 164, and the specimens on *Actaea hirsutissima* which are dealt with again in the present paper. Besides these the specimen of Stat. 240 has cuticular appendages of about the same size, although they are not yet in a full state of development.

Another group of specimens have cuticular excrescences of smaller size whilst their spines are spreading more or less in a lateral direction. This group is formed by the specimens of the Siboga Expedition from Stat. 282, from Stat. 169, and from Celebes. In each of these the excrescences have a length of 30—50 μ, whilst the shape of these complexes of spines is quite similar in all of these specimens. The specimen of Stat. 260 differs from the above mentioned by the thickness of the basal part of its cuticular excrescences, whilst these parts in the specimen from the Kajobay again have a more or less peculiar shape: here they are somewhat digitiform with blunt extremities.

The basal part of the cuticular excrescences may be different in the various specimens; in some of them, e. g., in those from Stat. 164 and from Stat. 260, this part is very strongly developed, whilst in other specimens, especially in those on *Actaea hirsutissima* and in the type specimen of „*Sacculina rotundata*" (cf. Miers 1880) it may be almost wanting.

It is very difficult to decide whether all the specimens referred to *Sacculina pilosa* in the cited paper in reality belong to this species or to two or more species which have a very similar structure. This difficulty still is enlarged by the fact that the retinacula of *Sacculina pilosa* hardly ever have been found. In the specimens which undoubtedly are typical representatives of *Sacculina pilosa* no real retinacula could be detected. Instead of these the corresponding spots of the internal cuticle show small ring-shaped walls (cf. Van Kampen and Boschma 1925, fig. 3 D). Here a retinaculum might have loosened from the internal cuticle, leaving a kind of scar, or it might be possible that in this species the retinacula are organs of a strongly reduced form, consisting of a ring-shaped wall only. These retinacula (?) have been found in two specimens of the Siboga Expedition, viz. that from Stat. 131 on *Eriphia laevimana* and that from Stat. 240. On the other hand true retinacula are present on the internal cuticle of the specimen from Celebes (cf. Van Kampen and Boschma 1925, fig. 6 B). In this specimen these organs have a similar shape as those of *Sacculina carcini*: they bear a number of barbed spindles.

The retinacula of *Sacculina pilosella* differ strongly from those of *S. pilosa*, in the former species they consist of spindles on which no barbs could be found and which are scattered more or less irregularly on certain spots of the internal cuticle. The presence of these highly different retinacula indeed was the chief reason why the species *S. pilosella* was to be separated from *S. pilosa*, from which it may be distinguished otherwise only by the slight differences in the shape of the excrescences of the external cuticle.

Among the material of the Leiden Museum *Sacculina pilosa* is represented with six specimens, three of which (those on *Eriphia laevimana* and on

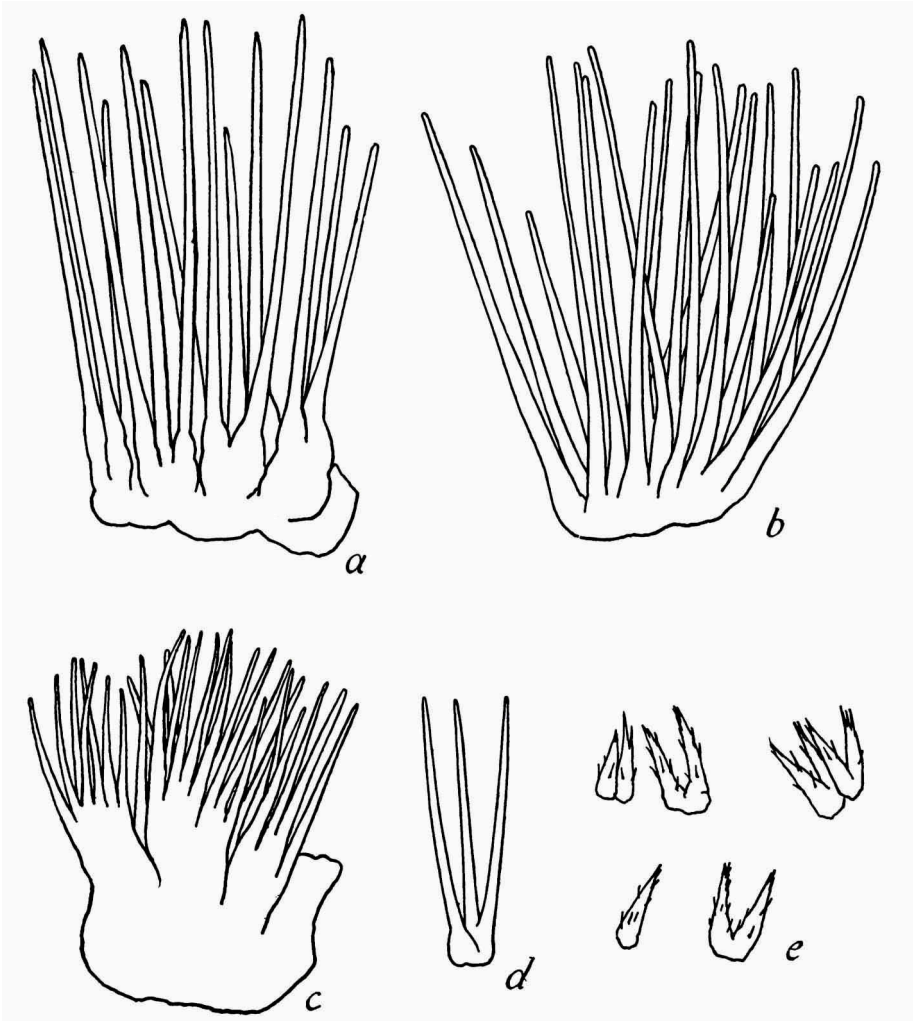

Fig. 2. Excrescences of the external cuticle of the mantle of various specimens of *Sacculina pilosa*. 530 : 1. *a*. specimen from *Eriphia laevimana*, Moluccas. *b*. specimen from *Eriphia laevimana*, Sula Sanana. *c*. specimen from *Tiarinia gracilis*. *d*. specimen from *Actaea hirsutissima* (cf. VAN KAMPEN and BOSCHMA 1925, fig. 12 B). *e*. specimen from *Eurycarcinus grandidieri*.

Tiarinia gracilis, fig. 2*a*—*c*) may be regarded as typical ones. Two of the other specimens (those on *Actaea hirsutissima*, fig. 2*d*) have spines which are very loosely connected at their basal part. One specimen

(that on *Eurycarcinus grandidieri*, fig. 2*e*) has much shorter spines which bear distinctly visible lateral hairs. The cuticular excrescences of this specimen bear a strong likeness to those of the parasite on *Ozius rugulosus* from the Kajobay (cf. VAN KAMPEN and BOSCHMA 1925, fig. 8). Notwithstanding these differences, however, I refer all these specimens to the species *Sacculina pilosa*. In the following pages each of the specimens of the Leiden Museum is described at some length; in each case in which a specimen is rather different from the "typical form" these differences are given.

a. The specimen on *Eriphia laevimana* from the Moluccas.

The animal has an oval shape; its dimensions are $12{,}5 \times 9 \times 6{,}5$ mm. The mantle opening, which lies at the anterior margin of the thoracal surface, is small and surrounded by a slight thickening of the mantle, as in the specimen from Stat. 169 of the Siboga Expedition (cf. VAN KAMPEN and BOSCHMA 1925, Pl. I, fig. 5). The surface of the mantle is very little wrinkled.

From this specimen sections have been made. The testes are approximately straight, the vasa deferentia are slightly tortuous. As in the other specimens of *Sacculina pilosa* of which sections have been made the whole of the male genital organs is found in the visceral mass before the stalk. The colleteric glands are large and contain numerous branched tubes.

The external cuticle of the mantle has a thickness of about 60 μ. Its excrescences, clusters of bristles which are united at the base in a compact chitinous mass (fig. 2*a*) have the typical shape; these excrescences have a length of about 130 μ, sometimes they are somewhat longer (till 140 μ).

The internal cuticle of this specimen shows a number of small grooves surrounded by a circular or oval wall, just as in two of the specimens of the Siboga Expedition (cf. VAN KAMPEN and BOSCHMA 1925, fig. 3 D). These grooves have a diameter of 15 to 20 μ; they are found at the same places where in other species the retinacula occur.

b. The specimen on *Eriphia laevimana* from Sula Sanana.

The form of the parasite is very similar to that from the Moluccas, it has an oval shape and the mantle opening is small. This opening lies at the thoracal surface naar the margin of the animal. The breadth of this specimen is 16 mm, the height 11 mm, and the thickness 6 mm. The surface of the mantle shows a great number of wrinkles and more

or less deep grooves. At the place where the abdomen of the crab touched the parasite there is a shallow median groove.

The external cuticle of the mantle bears excrescences of approximately the same shape as those of the specimen described above (fig. 2*b*). These groups of bristles have a size of about 120 μ. The cuticle without the excrescences has a thickness of 130 to 150 μ. It consists of layers which are parallel to the mantle, in sections (fig. 3) these layers are clearly visible. Perpendicular to the layers the cuticle contains a system of pores which occur in groups. The extremities of the pores of each group converge towards the upper and the lower surface of the cuticle. In tangential sections of the cuticle these pores have exactly the same

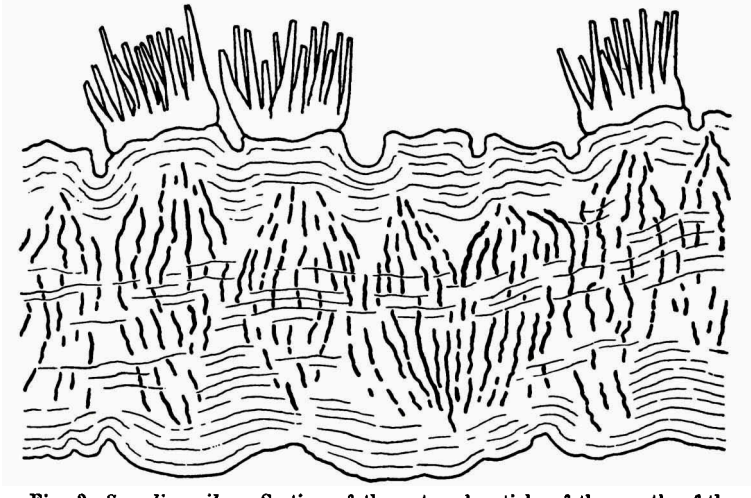

Fig. 3. *Sacculina pilosa*. Section of the external cuticle of the mantle of the specimen from *Eriphia laevimana* from Sula Sanana. The heavy black lines indicate the canal system in the cuticle. The extremities of the cuticular excrescences are broken. 300 : 1.

structure as those described in a previous paper (VAN KAMPEN and BOSCHMA 1925, fig. 3 C): each of the larger pores is surrounded by a number of smaller ones. The number of pores is very large, larger than in other specimens of the same species. Moreover the course of the pores through the cuticle is different from that in the two other specimens in which similar pores have been found: in one specimen (cf. VAN KAMPEN and BOSCHMA 1925, fig. 3 A) they are found especially in the upper part of the cuticle, in the other specimen (l. c., fig. 5 A) they are about straight and terminate at the lower part of the cuticle. Especially in sections stained with hematoxylin these pores are distinctly visible; their contents then take a dark color. The function of these pores is completely unknown.

c. The specimen on *Tiarinia gracilis.*

The animal has a flattened roundish shape, its breadth is 6 mm, its height 5 mm, and its thickness 3 mm. Probably it is a young specimen for although the excrescences of the external cuticle are about as large as those of the two other specimens this cuticle itself is much thinner than that of the two previously described specimens. The surface of the mantle is rather smooth, there is only a shallow median groove at the abdominal surface. The mantle opening, which lies at the thoracal surface near the margin, is small and is surrounded by an inconspicuous thickening of the mantle.

The external cuticle of the mantle is rather thin (on a average 20 μ). It bears excrescences which have approximately the same shape as those of the typical form; the basal part of these groups of hairs, however, is very strongly developed (fig. 2*c*). Each of the excrescences is divided into a number of thick branches which again bear a quantity of bristles. The length of these excrescences from the basal part to the extremity of the bristles varies from 75 to 95 μ.

d. The specimens on *Actaea hirsutissima.*

In a previous paper (VAN KAMPEN and BOSCHMA 1925, p. 21, fig. 12) these two specimens have been described. The excrescences of the external cuticle (fig. 2 *d*) have a length of 60 to 80 μ. The groups of bristles consist of a much smaller number than usually in *Sacculina pilosa.*

e. The specimen on *Eurycarcinus grandidieri.*

This specimen has an oval shape, its breadth, height, and thickness amount to 8,5, 5, and 3,5 mm respectively. The mantle opening lies near the margin on the anterior part of the thoracal surface of the parasite. The mantle is comparatively smooth, it only has a few shallow grooves caused by the pressure of the pleopods and the abdomen of the crab.

Longitudinal sections have been made of this specimen. Its anatomy is in accordance with that of other specimens of *Sacculina pilosa* which could be studied in this way. The testes have a fairly large size, they are found in the posterior part of the visceral mass. The colleterie glands are comparatively large and are flatter than in other specimens of *Sacculina pilosa*; these organs contain a large number of tubes.

The external cuticle of the mantle has a thickness of about 40 μ, it bears excrescences which strongly remind of those of the specimen from

the Kajobay (cf. VAN KAMPEN and BOSCHMA 1925, fig. 8). These excrescences (fig. 2*e*) are rather small, but stout; they are very little branched. The length of the cuticular appendages is 15 to 25 μ, the branches may have a thickness of 6 μ at the base. The branches are provided with short lateral hairs.

This specimen is rather different from the typical form of *Sacculina pilosa*. It bears, however, in its cuticular excrescences a strong likeness to the specimen of the Kajobay, on account of which I have identified it with this species. If it might be necessary to divide the species *Sacculina pilosa* into two or more species, it remains at least a certain fact that the specimen from Nossi Faly belongs to the same species as that from the Kajobay.

Sacculina villosa V. K. and B.

Sacculina villosa Van Kampen and Boschma 1925.

Djeddah, 7 ex. on *Chlorodius niger* (Forsk.), Kruyt leg. 1881.

Sacculina villosa is characterized especially by the shape of the chitinous parts of the mantle; the excrescences of the external cuticle are long, slender papillae with a length of 10 to 15 μ which, especially at their extremities, bear a number of lateral hairs. Moreover the retinacula of this species have a peculiar shape, they are furnished with a comparatively large number (till 14) of spindles which are rather thin (slightly thicker than 2 μ).

The description of the species was based on the material of the Leiden Museum; for further particulars on the shape and the size of the parasites I refer to this description (VAN KAMPEN and BOSCHMA 1925, p. 28). In this species the testes are very wide, they occupy the posterior part of the visceral mass (l. c., Pl. II, fig. 4); rather abruptly these organs pass into the much narrower vasa deferentia.

The excrescences of the external cuticle of *Sacculina villosa* have approximately the same shape as those of *Sacculina hirsuta* (cf. BOSCHMA 1925). In the latter species, however, the testes are situated in the region of the stalk and not in the visceral mass.

Sacculina eriphiae Smith.

Sacculina carcini Smith 1906.
Sacculina eriphiae Boschma 1927 *b*.

Positano, Gulf of Salerno, 1 ex. on *Eriphia spinifrons* (Herbst), Dr. G. Stiasny leg.

The name *Sacculina eriphiae* was used by SMITH (1906, in the explanation of Plate I); this author, however, was convinced that the parasite of *Eriphia spinifrons* was a form of the species *Sacculina carcini.* In a previous paper (BOSCHMA 1927 *b*) I have described the retinacula of *Sacculina eriphiae* which consist of extremely large spindles (till 30 μ long). By this peculiarity only the species already is distinguished from all other hitherto known species of the genus.

The internal anatomy of this species also differs from that of *S. carcini.* In *S. eriphiae* the testes are situated in the region of the stalk, at a considerable distance from the visceral mass. For further particulars I refer to the above cited paper.

The specimen of the Leiden Museum is rather large, its dimensions are: breadth 22, height 17, and thickness 10 mm. Its surface is somewhat wrinkled; at the abdominal surface there is a short median groove near the stalk. The mantle opening lies at the extremity of a tubiform excrescence of the mantle. The external cuticle of the mantle has a thickness of about 120 μ, it bears excrescences of the usual shape: long papillae with a great number of small lateral hairs. In this specimen the papillae may attain a length of 33 μ, their thickness at the base is 4 to 6 μ. The retinacula consist of the large spindles which are typical for the species.

Sacculina aculeata n. sp.

Djeddah, 1 ex. on *Carupa laeviuscula* Heller, Kruyt leg. 1882.

The excrescences of the cuticle of this new species remind strongly of those of *Sacculina pilosa* Kossm., the species differs from the latter by the different situation of the testes: in *Sacculina aculeata* these organs are lying in the posterior part of the body, and not in the visceral mass as in *S. pilosa.*

The strongly flattened specimen has a more or less circular shape with the exception of the two angles at each side of the stalk, which are strongly protruding (fig. 1 *a*, *b*). Its abdominal surface has a median groove where the region of the gut of the host pressed against it. The specimen was attached to the basal part of the abdomen of its host; its dimensions are: $4 \times 4 \times 1$ mm.

From this specimen longitudinal sections have been made, which prove that it is specifically distinct from *Sacculina pilosa.* The testes are not, as in the latter species, embedded in the visceral mass, but are found in the posterior part of the body, in the region of the stalk (fig. 4 *a*). The testes have a straight course; one of them projects somewhat farther into the ventral part of the body than the other, accordingly in

the figure only one of the testes is visible. They are of fairly large size. About in the central part of each side of the visceral mass the colleteric glands are found, which constitute rather strongly flattened organs with a comparatively small number of tubes. The small size of these glands, however, may be due to the fact that the specimen is rather young.

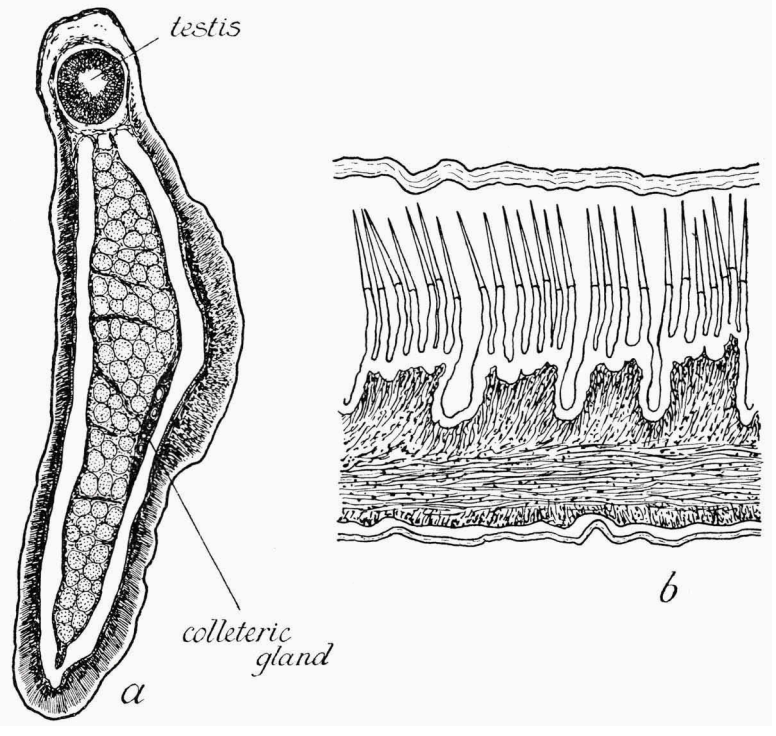

Fig. 4. *Sacculina aculeata*. *a*. longitudinal section. 30 : 1. *b*. section of the mantle. The loose external cuticle is visible above the excrescences in the upper part of the figure; the internal cuticle at the lower part. 530 : 1.

The external cuticle of the mantle has a very interesting structure (fig. 4 *b*). It consists of two layers; the external layer has a smooth surface, whilst the internal layer, which is in immediate contact with the epithelium of the mantle, bears excrescences consisting of groups of bristles. In the distal half of the bristles the chitin has a hard structure, the proximal part is much weaker. In this specimen the real external cuticle of the mantle still was in a late stage of development, later the whole of the cuticular excrescences undoubtedly would have changed to hard chitin and then the thin external cuticle would be thrown off.

The external cuticle of this specimen bears a strong likeness to that of the specimen of *S. pilosa* from Stat. 240 of the Siboga Expedition (cf. VAN KAMPEN and BOSCHMA 1925, fig. 4). The specimen of *S. aculeata*, however, has the excrescences in a later stage of development than those of the specimen of *S. pilosa*; they also are more regularly united into groups.

Probably both of the specimens were preserved a short time before their first moult of the external cuticle. Then the typical external cuticle with the peculiar excrescences develops for the first time after the first moult. In both of the specimens with such a double cuticle the external cuticle is very thin and bears no excrescences; that of the specimen of *S. pilosa* is somewhat granulated, whilst that of the specimen of *S. aculeata* has a smooth surface. In *Sacculina crucifera* (cf. KOSSMANN 1872, Pl. I, fig. 22) this external thin layer of cuticle also had a smooth surface. In a previous paper (VAN KAMPEN and BOSCHMA 1925) we have proved that this name is a synonym of *Sacculina pilosa*.

The excrescences of the cuticle are of somewhat smaller size than those of the specimen of *S. pilosa* from the Siboga Expedition; in the specimen of *S. aculeata* the bristles have a length of about 36 μ; their distal part of more compact structure may attain a length of 20 μ.

Specimens with moulting external cuticle are by no means rare in many species of *Sacculina*. Such specimens may be found among several of the european species of Sacculinidae (cf. BOSCHMA 1927 *b*). In many cases the moulting external cuticle bears the same kind of appendages as the new cuticle which lies against the epithelium of the mantle.

Sacculina flexuosa Kossm.

Sacculina flexuosa Kossmann 1872.
Sacculina flexuosa Van Kampen and Boschma 1925.

Indian Ocean, 1 ex. on *Grapsus strigosus* (Herbst), Reinwardt leg.

Haruku (near Amboina), 1 ex. on *Grapsus strigosus* (Herbst), Hoedt leg. 1865.

Without locality, 1 ex. on *Grapsus strigosus* (Herbst), Ludeking leg. 1863.

Alkmaar (Bay of Batavia), 1 ex. on *Varuna litterata* (Fabr.), Dr. P. Buitendijk leg.

South coast of Madura, 2 ex. on *Macrophthalmus erato* de Man, Dr. P. Buitendijk leg. 1915.

Without locality, 1 ex. on *Plagusia depressa immaculata* Lam. (from the Museum Godeffroy).

It is not quite sure whether the seven specimens from the above named hosts and localities all belong to the species *Sacculina flexuosa* or

not. Concerning the three specimens on *Grapsus strigosus* there is no

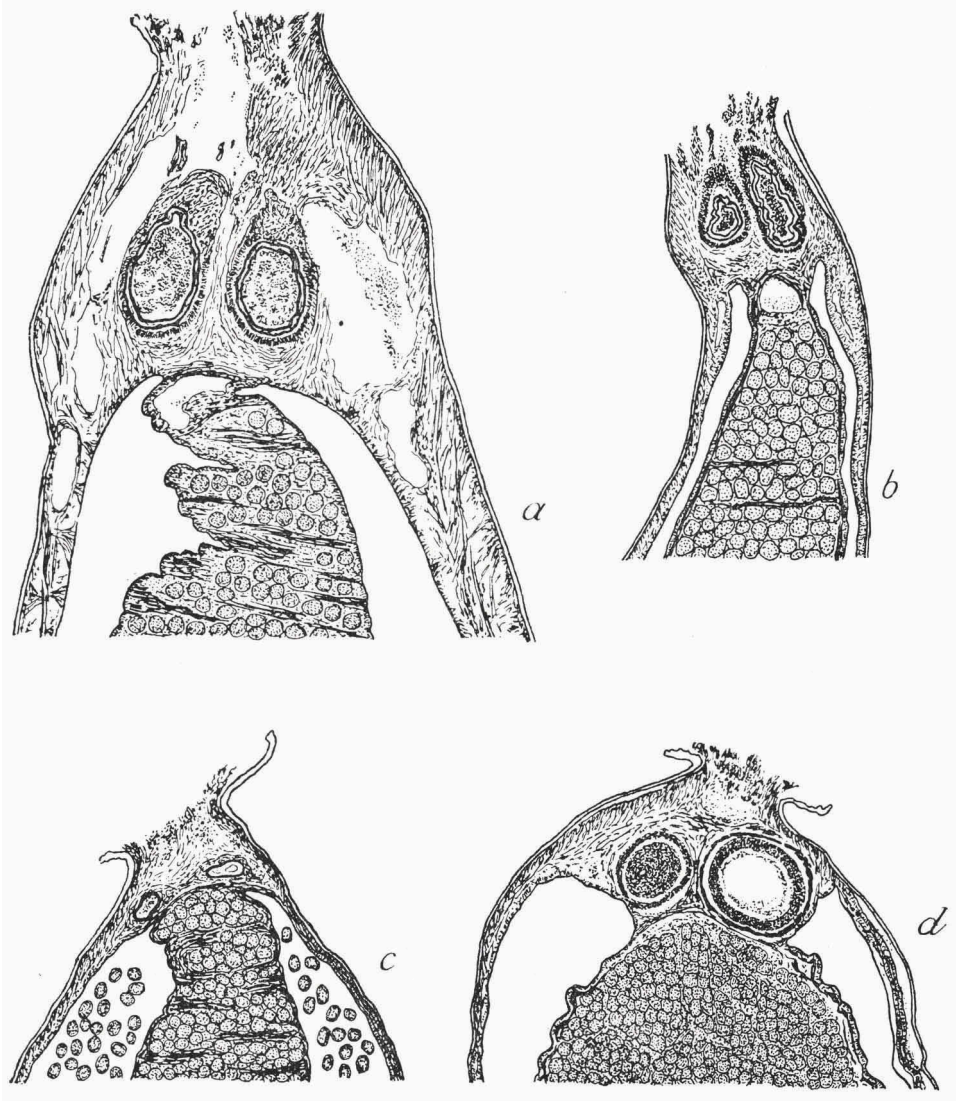

Fig. 5. *Sacculina flexuosa*. The posterior part of longitudinal sections parallel to the dorsal surface of various specimens, showing the situation of the testes (in *c* the vasa deferentia). *a*. specimen from *Varuna litterata*. 36 : 1. *b*. specimen from *Macrophthalmus erato*. 36 : 1. *c*. specimen from *Grapsus strigosus*. 18 : 1. *d*. specimen from *Plagusia depressa*. 18 : 1.

doubt as to their identity with the specimens described by KOSSMANN (1872) and by VAN KAMPEN and BOSCHMA (1925). The testes of *Sacculina*

flexuosa are situated in the region of the stalk, not in the visceral mass (fig. 5). This holds true for the specimens on *Grapsus, Varuna,* and *Macrophthalmus*, and partially also for the specimen on *Plagusia* (cf. the description of this specimen in the following pages). Now the species *Sacculina flexuosa* possesses no definite excrescences on the external cuticle of the mantle, the surface is somewhat rough and granulated only. In specimens from the same species of host there may be some variation in the structure of the external cuticle (cf. VAN KAMPEN and BOSCHMA 1925, fig. 37 A, and fig. 6 *a—c* in the present paper). As in other Sacculinidae the thickness of the external cuticle is variable, in the specimens of *Sacculina flexuosa* of the Leiden Museum the cuticle is much thinner than that of the specimens described by KOSSMANN and by VAN KAMPEN and BOSCHMA.

The retinacula have a characteristic shape, they bear a small number of very stout spindles (fig. 6 *d*). Unfortunately the retinacula of the specimens on *Varuna, Macrophthalmus*, and *Plagusia* could not be detected; consequently they are known only from the specimens on *Grapsus strigosus* which constitute the typical form of the species.

As in *Sacculina pilosa* some specimens referred here to *S. flexuosa* in reality may belong to another species, but this can be proved only as soon as more material is available.

Another East Indian species, *Sacculina rugosa* V. K. and B., has an external cuticle with approximately the same structure. In this species also the testes are situated behind the visceral mass, in the region of the stalk. It differs from *S. flexuosa* by its much smaller retinacula which consist of a single spindle. As the retinacula of the specimens on *Varuna*, *Macrophthalmus*, and *Plagusia* dealt with in the present paper are unknown, these specimens might as well belong to *S. rugosa* as to *S. flexuosa*. Preliminarily I classify them with the latter species; each of the specimens in the following pages is described in detail and the differences with the typical form are especially mentioned.

a. The specimen on *Grapsus strigosus* from the Indian Ocean.

The animal has an oval shape, its dimensions are: breadth 15,5 mm, height 7,5 mm, and thickness 5 mm. The mantle opening, which is surrounded by a short tube-like projecting part of the mantle, is situated at the anterior margin. The surface of the mantle is comparatively smooth and does not show any marked grooves or wrinkles.

A series of longitudinal sections has been made of this specimen. The state of preservation, however, was rather bad and the chief details

only could be studied. The testes are found outside of the visceral mass, in the region of the stalk. The greater part of the male organs could

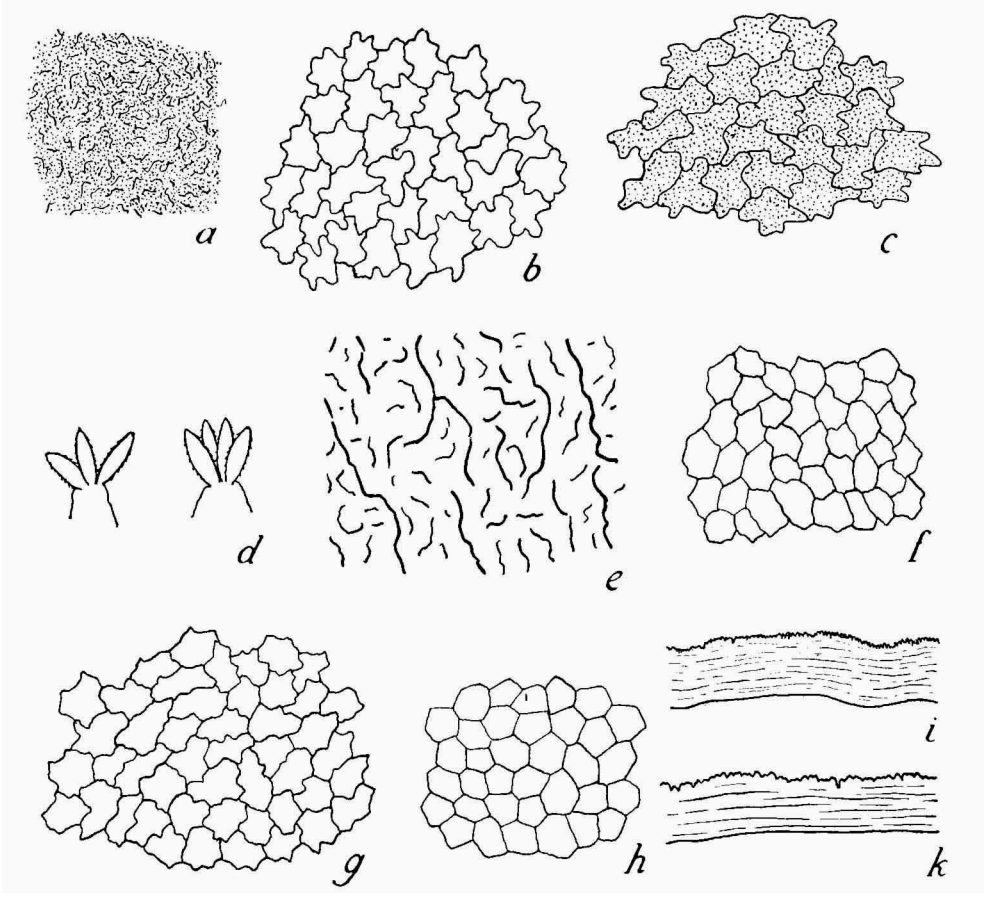

Fig. 6. *Sacculina flexuosa*. Structure of various parts of the cuticle of the mantle of different specimens. 530 : 1. *a*. specimen from *Grapsus strigosus*, Indian Ocean; upper surface of the external cuticle. *b*. specimen from *Grapsus strigosus*, Haruku; upper surface of the external cuticle. *c*. specimen from *Grapsus strigosus*, locality unknown; upper surface of the external cuticle. *d*. retinacula of the specimen from *Grapsus strigosus* from Haruku. *e*. one of the specimens from *Macrophthalmus erato*; upper surface of the external cuticle. *f*. the other specimen from *Macrophthalmus erato*; upper surface of the external cuticle. *g*. specimen from *Varuna litterata*; upper surface of the external cuticle. *h*. specimen from *Plagusia depressa*; upper surface of the external cuticle. *i*. specimen from *Varuna litterata*; transverse section of the external cuticle. *k*. one of the specimens from *Macrophthalmus erato*; transverse section of the external cuticle.

not be found in the sections, but the vasa deferentia are distinctly visible (fig. 5 *c*). The colleteric glands are rather large and contain a considerable

number of tubes. They are situated in the anterior part of the visceral mass (nearer to the mantle opening than to the stalk).

The external cuticle of the mantle is very thin, its thickness is about 26 μ. When examined with a high power the surface of the cuticle appears minutely wrinkled and granulated (fig. 6 *a*); small areas separated by distinct lines as often occur on the cuticle of other specimens of *Sacculina flexuosa* do not occur here. The internal cuticle of the mantle bears no retinacula. Probably this is in connection with the fact that the mantle cavity contains numerous larvae, the retinacula may be lost after having performed their function.

The larvae are in a rather bad state of preservation, accordingly only the chief peculiarities can be observed. Their shape and size is approximately the same as that of the nauplii of *Sacculina carcini* from *Pachygrapsus marmoratus* (cf. BOSCHMA 1927 *a*). From the arched anterior region till the extremities of the abdominal appendages they measure about 195 μ. The frontal horns are rather short and are directed laterally and slightly toward the posterior part of the body, as in the other known nauplii of *Sacculina*. In the eye no traces of pigment could be found. Now the material is rather old and it is not quite sure whether the eye of these larvae originally was devoid of pigment or not. If really the nauplius of *Sacculina flexuosa* does not contain eye-pigment, this peculiarity is a specific characteristic.

b. The specimen on *Grapsus strigosus* from Haruku.

The parasite has an irregularly oval shape, its breadth is 21 mm, its height (in the median plane) 12 mm, and its greatest thickness 4,5 mm. The surface of mantle is somewhat wrinkled and shows a number of smaller and lesser grooves; the more conspicuous of these are caused by the pressure of the pleopods and the abdomen of the host against the parasite. The mantle opening is situated at the extremity of a rather flattened tube-like expansion of the mantle which is found at the thoracal surface near the anterior region.

The external cuticle of the mantle has a thickness of about 33 μ, it is not quite smooth but minutely granulated. When seen from above with a high power the cuticle appears to be composed of small areas divided by distinct lines of a strongly meandering course (fig. 6 *b*). The diameter of these areas is 9 to 14 μ.

In the mantle a few lime corpuscles are found. It is difficult to decide whether these corpuscles are contained in the external cuticle itself or are situated beneath this cuticle. It appears as if these lime corpuscles

are lying between the cuticle and the epithelium of the mantle [1]). In this specimen of *Sacculina flexuosa* the lime corpuscles may attain a fairly large size (diameter till about 100 μ).

The retinacula of this specimen (fig. 6 *d*) have approximately the same size and shape as those of the specimen from Stat. 234 of the Siboga Expedition. The spindle-shaped excrescences of the retinacula have a size of 12 to 15 μ, they are provided with distinct small barbs.

c. The specimen on *Grapsus strigosus* from unknown locality.

This specimen has almost quite the same shape as that of the Siboga Expedition (cf. VAN KAMPEN and BOSCHMA 1925, Pl. I, fig. 22); moreover it has approximately the same size (its dimensions are $22 \times 12{,}5 \times 7$ mm). The body of this parasite is about oval, with the exception of the angles at each side of the stalk which are protruded into somewhat conical excrescences (in the specimen of the Siboga Expedition only at one side such an excrescence of the mantle is found). The mantle opening lies at the extremity of a flattened tube at the thoracal surface not very far from the margin. The surface of the mantle is strongly wrinkled, especially near the margin. At the abdominal surface there are a few deeper grooves caused by the pressure of the pleopods and the median ridge of the abdomen of the host.

The external cuticle of the mantle has a thickness of about 23 μ, it is therefore much thinner than that of the specimen of the Siboga Expedition in which this cuticle measures about 100 μ. Its upper surface consists of small irregular areas as in the specimen from Haruku; these areas have a diameter of 10 to 18 μ (fig. 6 *c*). The granulation of the upper surface of the external cuticle is somewhat more strongly pronounced than in the preceding specimen, but, as in all other specimens of *Sacculina flexuosa*, no real excrescences of the external cuticle exist.

On the internal cuticle of the mantle retinacula of the typical form occur; they are slightly smaller than those of the specimen from Haruku: their spindles have a length of about 12 μ.

d. The specimen on *Varuna litterata*.

The animal is triangular-oval (fig. 1 *c*), the surface of the mantle is smooth without wrinkles or furrows. The abdominal surface has a median concavity caused by the pressure of the abdomen of the crab. The rather

1) In *Sacculina eriphiae*, however, I could prove that they are embedded in the external cuticle of the mantle (cf. BOSCHMA 1927 *b*, fig. 6).

wide mantle opening lies at the anterior margin at the extremity of a short tube with a comparatively thick wall. Breadth, height, and thickness are 11, 6,5, and 2 mm respectively.

From this specimen a complete series of longitudinal sections has been made. The testes (fig. 5 *a*) are found in the region of the stalk, not in the visceral mass. They have a more or less straight course. The colleteric glands are well developed and contain a considerable quantity of tubes. Worthy of mention is further that at least a part of the visceral mass has a flexuous shape quite similar to that in the type specimen (cf. KOSSMANN 1872, Pl. II, fig. 1 *b*). Probably this is due to an excessive development of the visceral mass in the longitudinal direction.

The external cuticle of the mantle is rather thin (its thickness is 11 to 15 μ). When examined with a high power it appears to be slightly granular (fig. 6 *i*). In many parts its surface shows small irregular areas separated by distinct lines with a more or less meandering course (fig. 6 *g*). The diameter of these areas varies from 8 to 15 μ.

The mantle contains a few lime corpuscles which may reach a diameter of about 100 μ. Whether these corpuscles lie beneath the external cuticle or in this chitinous sheath remains uncertain.

Retinacula could not be found in the preparations of the internal cuticle made for this purpose.

This specimen is structurally very much alike to the typical specimens of *Sacculina flexuosa*; its identity with this species, however, is not quite certain. It does not possess any characteristics which prove that it belongs to a different species and consequently at least preliminarily it may be regarded as a representative of *Sacculina flexuosa*.

e. The specimens on *Macrophthalmus erato*.

Each of the two specimens is attached to the base of the abdomen of its host. The shape of the two specimens is rather different. The larger has the following dimensions: breadth 8 mm, height 5 mm, and thickness 1,5 mm; for the smaller specimen these dimensions are 3,5, 3, and 2,5 mm respectively. The larger specimen is strongly flattened, its shape is more or less pentagonal with a concave side where the stalk takes its origin (fig. 1 *d*). In this specimen the mantle opening is surrounded by a small tubiform, rather thick-walled expansion of the mantle. A shallow groove is found on the thoracal surface near the median plane. The smaller specimen is almost globular, though different parts of the mantle are somewhat irregularly protruded. Here the mantle opening lies at the thoracal surface near the anterior margin, its surroundings do no protrude

above the remaining part of the mantle. In both of the specimens the abdominal surface possesses a shallow median groove, elsewhere the mantle is rather smooth.

Longitudinal sections have been made of both of the specimens. The series of sections of the smaller specimen is practically spoiled and does not give any clue to the situation and the shape of the internal organs; that of the larger specimen is much better. The shape of the testes (fig. 5 *b*) is quite similar to that in the specimen on *Varuna litterata*; these organs occupy a corresponding place in the region of the stalk. The colleteric glands are of fairly good size; they contain a very large quantity of tubes.

The external cuticle of the mantle in the specimens on *Macrophthalmus erato* is rather thin, in both of them the thickness does not exceed 15 μ (fig. 6 *k*). The surface of the cuticle has a somewhat variable structure, in the larger specimen (fig. 6 *e*) this cuticle is slightly wrinkled, but definitely arranged small areas cannot be found. In the smaller specimen there are neatly arranged small areas on the surface of the cuticle (fig. 6 *f*), which have a diameter of 8 to 11 μ. This proves again that in a certain species of *Sacculina* the different specimens may show slight differences in the structure of their chitinous parts.

Retinacula could not be found on the preparations of the internal cuticle.

As for the presumed identity of these specimens with *Sacculina flexuosa* there is no definite proof that they belong to this species. On the other hand they do not possess any distinct characteristics on account of which they have to be regarded as reprentatives of another species.

f. The specimen on *Plagusia depressa.*

In its general appearance this specimen bears a strong likeness to the specimen on *Grapsus strigosus* from the Indian Ocean. As this specimen it has an oval shape (fig. 1 *d*), its breadth is 12,5 mm, its height 8 mm, and its thickness 4 mm. The surface of the mantle is somewhat coarse and shows a number of shallow grooves, especially in the marginal part and in the median region of the abdominal surface. The mantle opening lies in the marginal region, it is directed towards the thoracal surface. It is surrounded by a thick border.

From this specimen a series of longitudinal sections has been made, from which results that its anatomy is slightly different from that of the other specimens of the Leiden Museum identified as *Sacculina flexuosa*. Especially the testes are situated in a somewhat different place. The

greater part of these organs lies in the region of stalk, outside of the visceral mass (fig. 5 *d*). The ventral part of the male organs, including the vasa deferentia, however, penetrates into the visceral mass. Sections of this part of the body show a situation of the male organs quite similar to that in *Sacculina carcini*. The testes are rather wide and have a more or less cylindrical shape. The colleteric glands are present at the same place as in the other specimens referred to *S. flexuosa*, they are rather large and contain an extensive quantity of tubes.

The structure of the external cuticle of the mantle does not show any important differences with that found in the other specimens. The cuticle has a thickness of about 50 μ; its upper surface consists of small areas separated by distinct lines (fig. 6 *h*). These areas on an average have a diameter of 8 μ.

On the internal cuticle of this specimen no retinacula could be found.

The specimen on *Plagusia depressa* may not with absolute certainty be identified with *Sacculina flexuosa*: there is a difference in the course of the testes which may be an important characteristic. The greater part of the testes, however, lies in the stalk and this is the chief reason why I unite the specimen with *S. flexuosa*. The cuticular structure is very similar to that of the specimens on *Grapsus strigosus*. Unfortunately the retinacula are unknown, otherwise the question might be settled by the comparison of these organs in the different specimens.

The seven specimens described above are united as one species chiefly on account of the lack of distinct characteristics. The external cuticle being almost smooth, possessing at least no definite excrescences, it is very difficult to decide whether they all belong to *Sacculina flexuosa* or not. The study of a more abundant material of *Sacculina* from the same species of hosts probably would result in a better knowledge of the forms described above and would yield a more accurate result as to the specificity of the specimens dealt with here.

Sacculina hispida n. sp.

Amboina, 1 ex. on *Zozymus aeneus* (L.), Hoedt leg.
Sula Sanana (= Sula Besi), 1 ex. on *Zozymus aeneus* (L.).

This new species has the following characteristics: the testes are situated in the region of the stalk; the external cuticle of the mantle is covered with long hairs (length of these excrescences 50 to 70 μ) which bear numerous lateral hairs.

To this diagnosis might perhaps be added that in the posterior part

of the body two pronounced lobes are found, one at each side of the stalk. The two specimens, however, both were parasites of hosts belonging to the same species (*Zozymus aeneus*), and it may be quite possible that on other hosts, if the species does live also on other species of crabs, the shape of the parasites is quite different. As only two retinacula have been found it is not altogether sure whether these have the typical form.

Among the material of the Leiden Museum there are two specimens of *Sacculina hispida*, which differ from each other in very subordinate peculiarities only.

a. The specimen from Amboina.

The animal has a more or less circular shape but for the posterior part which is protruded into three lobes, two of which are projecting at

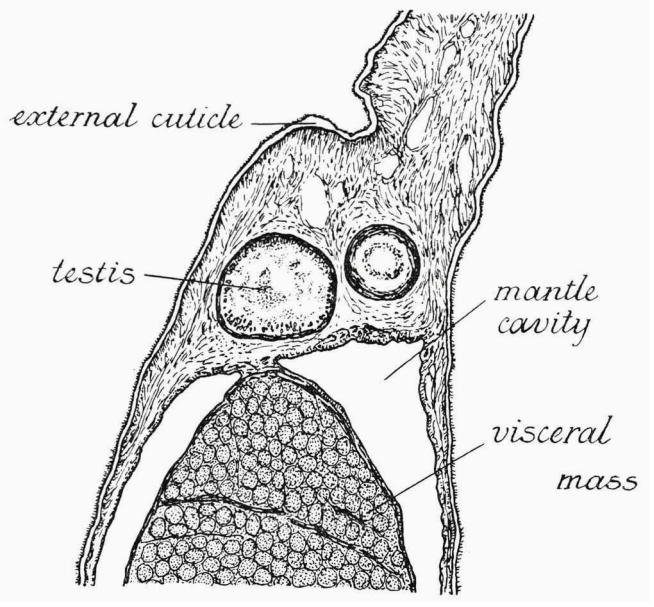

Fig. 7. *Sacculina hispida*, specimen from Amboina. Longitudinal section through the median part of the body. 18 : 1.

each side of the median lobe from which the stalk takes its origin (fig. 1 *f*, *g*). The mantle opening is found at the anterior region, it is directed towards the thoracal surface. This opening is surrounded by a broadened part of the mantle containing the sphincter. With the exception of a few shallow grooves the surface of the mantle is comparatively smooth. The breadth of the specimen is 13 mm, its height 13,5 mm, and its thickness 4 mm.

From this specimen a complete series of sections has been made. The testes are of rather large size and are situated in the region of the stalk, quite separated from the visceral mass (fig. 7). These organs have a more or less straight course, towards the ventral part of the body they gradually become narrower, passing into the vasa deferentia. The colleteric glands are found at the usual places, somewhat nearer to the mantle opening than to the stalk. They are not so very large but contain rather numerous branched tubes.

The external cuticle of the mantle is rather thick (about 90 μ). Its surface is covered with long, rather soft hairs, which have a blunt ex-

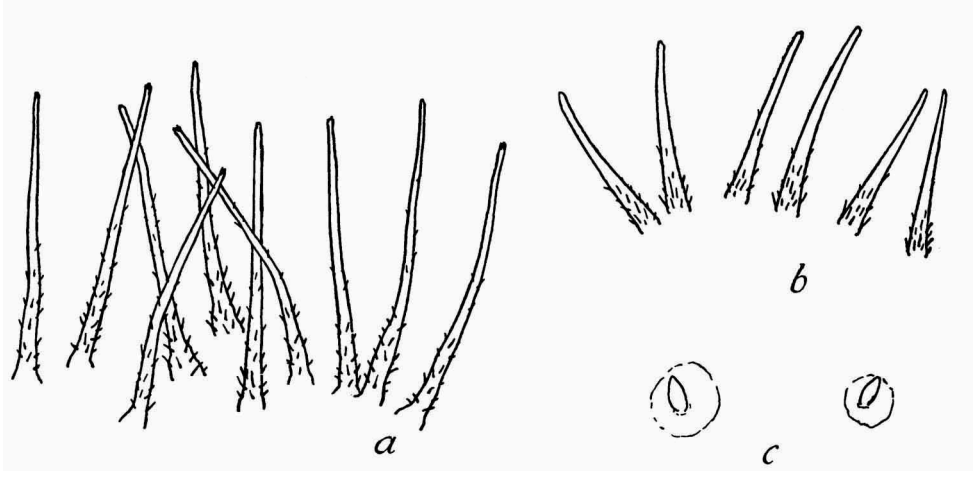

Fig. 8. *Sacculina hispida*, different parts of the cuticle of the mantle. 530 : 1. *a*. specimen from Amboina, excrescences of the external cuticle. *b*. specimen from Sula Sanana, excrescences of the external cuticle. *c*. specimen from Amboina, retinacula.

tremity. The length of these excrescences on an average is 70 μ, at the base they have a thickness of about 5 μ. Especially in the basal part they bear a number of small lateral hairs (fig. 8 *a*).

On the internal cuticle of the mantle only two retinacula could be found (fig. 8 *c*). These retinacula are provided with one spindle-shaped excrescence only, which is not barbed. It remains uncertain whether the retinacula represented in fig. 8 *c* have the typical form; usually when in a specimen of *Sacculina* retinacula can be observed they occur in large quantities. Moreover the exact shape of these organs could not be determined with complete certainty.

b. The specimen from Sula Sanana.

The animal has approximately the same shape as the other specimen of *Sacculina hispida*, at each side of the stalk here also a distinct lobe of the mantle protrudes. The breadth is 19 mm, the height (in the median plane) 15 mm, and the thickness 5 mm. In the region of the posterior lobes the height is 17,5 mm. The surface of the mantle is rather strongly winkled and shows a number of furrows, especially near the margin. At the abdominal surface there is a deep median groove which has been caused by the pressure of the longitudinal ridge of the abdomen of the host against the parasite.

The external cuticle of the mantle is about half as thick as that of the other specimen, though the animal from Sula Sanana has a larger size than that from Amboina. In the specimen dealt with here the thickness of the external cuticle is 40 to 50 μ. The surface is covered with long hairs of the same type as the excrescences of the other specimen (fig. 8 *b*). They are, however, somewhat shorter, their length varies between 40 and 60 μ. At the base they have the same thickness (5 μ) as those of the other specimen. Small lateral hairs are present here also, especially on the basal part of the excrescences.

I have not found any retinacula in the preparations of the internal cuticle of the mantle. In all probability they are wanting in this specimen.

As in the new species described above in *Sacculina setosa* V. K. and B. the external cuticle of the mantle is covered with long slender hairs (cf. VAN KAMPEN and BOSCHMA 1925, fig. 21, 22). In *S. setosa* these excrescences have approximately the same length as those of *S. hispida* (about 70 μ), they occur, however, in larger quantities on an area of a given size. Moreover in *S. setosa* the excrescences do not bear lateral hairs. The retinacula of *Sacculina setosa* are well developed and contain a comparatively large number of spindles, consequently also in this respect the species differs from *S. hispida*. The internal anatomy of *S. setosa* is unknown.

Drepanorchis Boschma.

A number of species of Sacculinidae have testes of a curved shape; in longitudinal sections of the dorsal part of the body then twice the testis of each side is to be seen. For the group of species which have such curved testes and which moreover have an incomplete mesentery (i. e., a mesentery which terminates at some distance from the mantle opening) in a previous paper (BOSCHMA 1927 *b*) I have founded the generic

name *Drepanorchis*. A further peculiarity of this genus is that, as in *Sacculina*, the visceral mass is in immediate contact with the region of the stalk. The typical species of this genus is *Drepanorchis neglecta* (Fraisse), a species occurring in the european seas on crabs of the genera *Inachus* and *Macropodia*.

After the paper on the Rhizocephala of the Siboga Expedition (VAN KAMPEN and BOSCHMA 1925) had appeared a series of longitudinal sections has been made of the specimen of the Leiden Museum described in the cited paper under the name *Sacculina carinata*. From these sections results that the specimen is a representative of the genus *Drepanorchis*. The chief peculiarities which have not yet been described in the cited paper are mentioned below.

Drepanorchis carinata (Kossm.).

Sacculina carinata Kossmann 1872.
Sacculina carinata Van Kampen and Boschma 1925.

Banda, 1 ex. on *Thalamita prymna* (Herbst), Semmelink leg. 1881.

The structure of the excrescences of the external cuticle of this specimen and the retinacula have been described in our paper on the Rhizocephala of the Siboga Expedition (VAN KAMPEN and BOSCHMA 1925, p. 37, fig. 25). The most important peculiarities of its internal anatomy are the following. The testes are of fairly good size; the anterior part of these organs (the closed extremity) lies quite near to the posterior part which ventrally passes into the vas deferens. Consequently the whole of the strongly curved male genital organs is situated in the posterior part of the visceral mass. In other species of *Drepanorchis* usually these two parts of the testes are further separated from each other, as, e. g., in *Drepanorchis neglecta* (cf. BOSCHMA 1927 *b*, fig. 11). The colleteric glands are found at each side of the visceral mass, somewhat nearer to the mantle opening than to the stalk. The quantity of secretive tubes in these organs is not so very large, but they contain more tubes than the corresponding organs of *D. neglecta*.

The specimen of the Leiden Museum belongs to the genus *Drepanorchis*. In the paper on the Rhizocephala of the Siboga Expedition cited above we have identified this specimen with *Sacculina carinata* Kossm. on account of the structure of its cuticular excrescences. According to KOSSMANN (1872) the anatomy of *S. carinata* is exactly similar to that of the species described by him under the name *S. dentata*. In the latter species the testes had a globular form and were situated in the vicinity of the stalk. Now in the specimen of the Leiden Museum the testes have

a curved shape, more or less like a horse-shoe with a very narrow opening. It is quite possible that KOSSMANN in studying the anatomy of his small specimen of *Sacculina carinata* by dissection of the animal became convinced that the testes had a circular shape. In this way his statement "the testes are globular" might perhaps be explained.

As a matter of fact there is no definite proof that the specimen described above really belongs to KOSSMANN's *Sacculina carinata,* but the cuticular excrescences are so similar to those described by KOSSMANN that the identification of this specimen as *Drepanorchis carinata* at least very probably is correct.

Loxothylacus Boschma.

In some species belonging to the Sacculinidae the stalk is attached to the mantle at a spot which lies at some distance from the place where the visceral mass is connected with the mantle. In these species the mesentery is complete (i. e., it reaches the mantle opening), and, besides, the testes have a curved shape. For these species in a recent paper (BOSCHMA 1928*a*) I have proposed the name *Loxothylacus* on account of the fact that the visceral mass has an oblique position in the mantle. The type species of this genus is *Sacculina corculum* Kossm. One specimen of this species was among the material of the Siboga Expedition; in our paper on this material we have already made mention of the fact that the stalk is inserted to the mantle in this unusual manner (VAN KAMPEN and BOSCHMA 1925). Another representative of the genus *Loxothylacus* is the species *Sacculina panopaei* Gissl.; the characteristics of the latter species are dealt with in the paper cited above, in which the genus is established.

Among the material of the Leiden Museum there is a specimen which distinctly shows all the above mentioned characteristics of the genus *Loxothylacus*; the accompanying figures (fig. 9 *a*, *b*) furnish sufficient evidence for this statement. The stalk and the mesentery are inserted at different places of the mantle (fig. 9 *a*); the mesentery is complete (fig. 9 *b* is a section close to the mantle opening; here the anterior part of the mesentery, in the lower part of the figure, still connects the visceral mass with the stalk), and the testes have a curved shape: in fig. 9 *a* the anterior extremity of one of the testes is visible besides the two vasa deferentia.

Loxothylacus spinulosus n. sp.

Pacific Ocean, 1 ex. on *Heteropanope serratifrons* Kinah. (from the Museum Godeffroy).

The diagnosis of this new species may run as follows: a *Loxothylacus* whose external cuticle of the mantle bears small papillae which have a length of about 4,5 μ. These papillae are situated in the central region

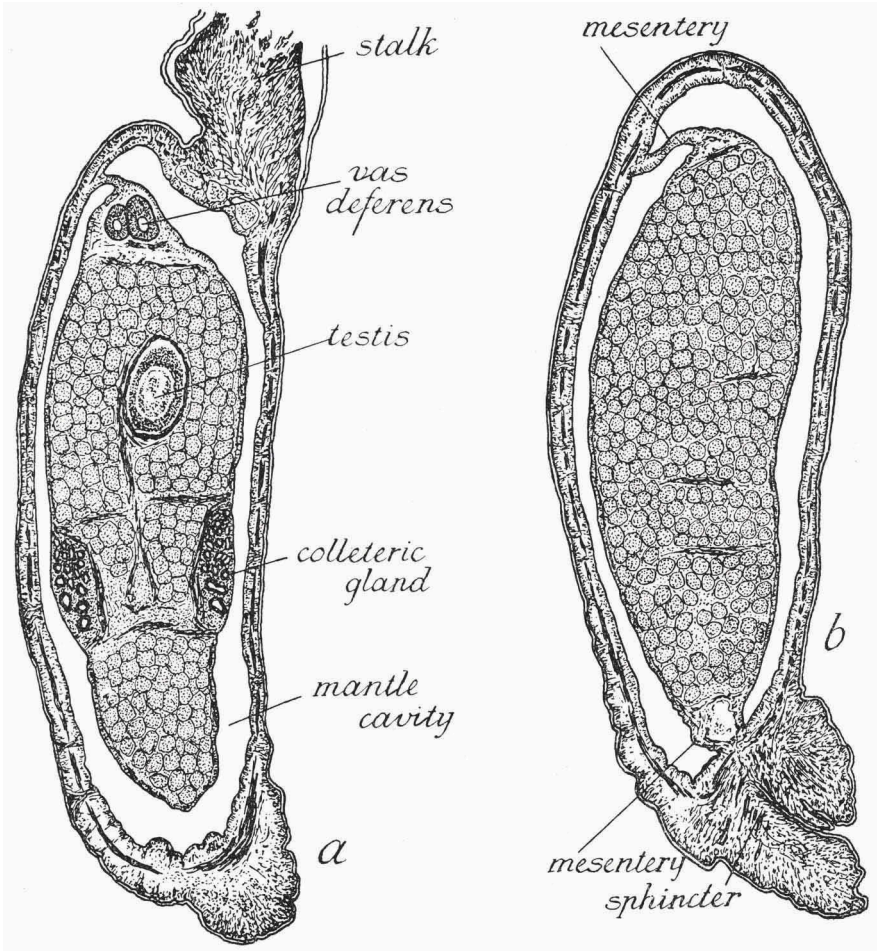

Fig. 9. *Loxothylacus spinulosus*, longitudinal sections. 36 : 1. *a*. section through the stalk and the colleteric glands. *b*. section in the immediate vicinity of the mantle opening, showing the complete mesentery.

of small areas (diameter 7—11 μ), which are separated by irregularly meandering lines.

The specimen has a breadth of 4 mm, a height of 3 mm, and a thickness of 1 mm. Its shape is oval with slightly protruded angles (fig. 1 *h*). The surface of the mantle is smooth except for a few furrows near the margin. The mantle opening is surrounded by a rather thick sphincter;

this region protrudes somewhat above its surrounding parts. The mantle opening lies at the thoracal surface quite near the anterior margin.

A series of longitudinal sections has been made of this specimen. The testes are of fairly good size, one is somewhat larger than the other. They are contained in the posterior part of the visceral mass, nearly completely in the ventral half of the body. Consequently in sections quite near the median plane, but slightly to the dorsal side of this plane, as that of fig. 9 *b*, no traces of the testes are to be seen. The colleteric glands (fig. 9 *a*) contain rather numerous tubes; the distance of these organs to the stalk is somewhat larger than that to the mantle opening.

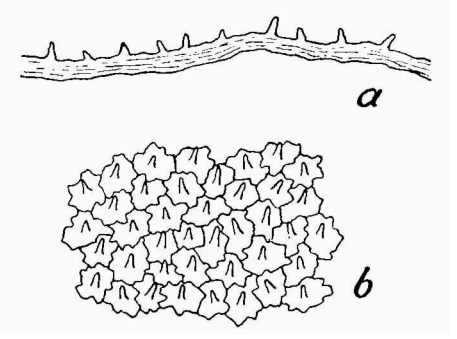

Fig. 10. *Loxothylacus spinulosus*. *a*. section of the external cuticle of the mantle. 530 : 1. *b*. upper surface of the external cuticle of the mantle. 530 : 1.

The external cuticle of the mantle is very thin (about 5 μ). It consists of layers of chitin which have been secreted parallel to the surface of the mantle. At the surface the cuticle bears small papillae which are like minute spines; these excrescences (fig. 10) have a length of approximately 4,5 μ. When seen from above with a high power it appears that each of the papillae is situated in the central part of a small area with an irregular outline. The diameter of these areas varies from 7 to 11 μ.

I have not found the retinacula of this species.

The three species of *Loxothylacus* which are hitherto known can be easily distinguished by the great differences in the size of their cuticular excrescences. In *L. corculum* (Kossm.) these parts of the cuticle are of comparatively gigantic size (till 500 μ or more!), in *L. panopaei* (Gissl.) they are much smaller (about 20 μ, cf. BOSCHMA 1928*a*), whilst in *L. spinulosus* they have a very minute size.

Lernaeodiscus Müll.

In my opinion in all Rhizocephala the dorsal surface is determined by the place of the mesentery which may be thin, as in the Sacculinidae, or broader, as, e. g., in *Lernaeodiscus*. The species belonging to this genus are flattened dorso-ventrally. As in other Rhizocephala the mantle opening determines the anterior pole of the body. The orientation of *Lernaeodiscus* defined in this way differs from that proposed by SMITH

(1906, 1915), but it corresponds better with that of the other genera of the group (cf. also BOSCHMA 1928*b*).

In the material of the Leiden Museum the genus *Lernaeodiscus* is represented by one specimen, the chief particularities of which are described here.

Lernaeodiscus munidae (Smith).

Triangulus munidae Smith 1906.
Triangulus munidae Guérin-Ganivet 1910, 1911.
Lernaeodiscus munidae Smith 1915.
Lernaeodiscus munidae Boschma 1928 *b*.

North Atlantic Ocean, 1 ex. on *Munida bamffica* (Penn.) (= *Galathea rugosa* Leach), Frank leg. 1897.

The specimen was attached to the ventral surface of the third abdominal segment of its host. The dorsal surface (the surface represented in fig. 1 *i*) was directed towards the thorax of the host, consequently the mantle opening was situated nearer to the left side than to the right side of the host. The parasite is strongly asymmetrical (fig. 1 *i*), its dimensions are: breadth 12, height 9, and thickness 7 mm. The mantle opening, which is situated at the anterior region of the dorsal surface of the parasite, has an elongated shape. The lobes of the mantle, which in many specimens of *Lernaeodiscus* project at the marginal part, are almost wanting in the specimen of the Leiden Museum. On the whole the surface of the mantle has a smooth appearance; especially in the marginal part, however, a large quantity of minute concentrical grooves are visible.

A series of transversal sections has been made of this specimen. The testes are very wide sacks with a spacious lumen; they gradually pass into the short vasa deferentia which open into the mantle cavity in the vicinity of the stalk (i. e., in the posterior part of the body). The direction of the testes is more or less parallel to the median plane. The right colleteric gland is nearer to the anterior part of the body than the left one; these organs are comparatively large, their epithelium is slightly folded so as to form a few marginal divisions.

The mantle is muscular, the external cuticle is rather thin (about 20 μ) and does not show any excrescences of definite shape. In some spots the surface of this cuticle is somewhat rough or provided with minute granulations.

The mantle cavity contains a large quantity of developing eggs.

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