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Papers from Dr. Th. Mortensen's Pacific Expedition 1914—16.

LV.

Rhizocephala.

By

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With 57 Figures.

The present paper contains the main results of a study of the Rhizocephala of the Copenhagen Zoological Museum, with the exception of those from European waters and from the North Atlantic region. Nearly half the number of specimens dealt with here have been collected by Dr. Th. Mortensen during his Pacific Expedition, a number of specimens are from the material of the Danish Expedition to the Kei Islands, a few from Dr. Mortensen's Expedition to Siam, and the remaining specimens have been collected by various persons in different localities.

Every larger collection of Rhizocephala contains a number of peculiar forms, and the material of the Copenhagen Zoological Museum in this respect also is very interesting. There are a number of forms which are new to science, these are described in the present paper. But the examination of the material revealed facts of more interest than new species only. In this respect two forms are of much importance: the specimens which in all probability belong to *Chlorogaster gracilis* (Kr)., and the specimen identified as *Lernaeodiscus porcellanae* Müll. These species have been described as early as 1855 and 1862; since then their anatomy has not been studied again. Moreover the material of the Copenhagen Museum contains a number of specimens belonging to the genus *Heterosaccus*, which enabled me to describe

the anatomy of this genus in more detail and to determine the differences of this genus from the other genera of Sacculinidae.

I wish to express my thanks to Dr. Th. Mortensen and Dr. K. Stephensen of the Copenhagen Museum for placing this collection at my disposal for identification. Further I am much indebted to the late Dr. J. G. de Man, who identified a large number of the hosts of the parasites dealt with here.

Family *Peltogastridae.*

In a previous paper (Boschma, 1928 *b*) I have given a diagnosis of this family. Afterwards two species have been described which belong to the Peltogastridae, but possess somewhat aberrant peculiarities as compared with the other genera of the family. Both of these, *Briarosaccus callosus* and *Galatheascus striatus* (cf. Boschma, 1930 *a*, *b*), are attached to their hosts with the long axis perpendicular to the long axis of the former[1]). The diagnosis of the family consequently has to be emended in so far that it contains the statement: long axis parallel to long axis of host, or perpendicular to the latter.

In the material dealt with in the present paper species of three genera of the family are represented, viz., *Peltogaster*, *Chlorogaster*, and *Septosaccus*. Structurally the two former genera are very little different and accordingly I did not treat these as different genera in previous papers (Boschma, 1927 *c*, 1928 *b*). The species of the genus *Chlorogaster* have a much more elongated body than those of the genus *Peltogaster*. The chief difference between the two genera, however, is the peculiarity that *Peltogaster* usually occurs as a single parasite (only exceptionally two or more are found on one host), whilst *Chlorogaster* as a rule lives gregariously on its host. Duboscq (1912), who founded the genus *Chlorogaster*, laid great stress upon this phenomenon. As these several parasites of one host in all probability are the outcome of the infection of the host by a single larva of the parasite, which forms a certain number of external sacs by a process of asexual propagation, the adult parasites of the two genera are sufficiently different to constitute two separate genera. Then in *Peltogaster* an individual consists of the root system and a single external sac, in *Chlorogaster* of the root system and several external sacs. As moreover the number of known species of the two forms gradually increases it is convenient to arrange them in two genera. One can decide at first sight to which of the two genera a certain species belongs.

[1]) The type specimen of *Briarosaccus callosus* was taken from its host, the exact position of host and parasite was unknown. In material of the "Discovery" Expedition, which has not yet been worked out, specimens of the genus are present, which are still fastened to the Lithodid crabs of which they are parasites.

Septosaccus is another well defined genus of the family. The specimens of the genus dealt with in the following pages differ from the hitherto known species by their bilaterally curved visceral mass. In this respect the new species of the present paper has some resemblance with *Dipterosaccus* (cf. van Kampen and Boschma, 1925).

Peltogaster rugosus nov. sp.

Danish Expedition to the Kei Islands, Station 59, 385 m, coral bottom, trawl, 12. V. 1922. 1 ex. on *Clibanarius* sp.

The parasite is remarkable among the Peltogastridae for its strongly folded shape: the lateral parts of the mantle form a number of irregular

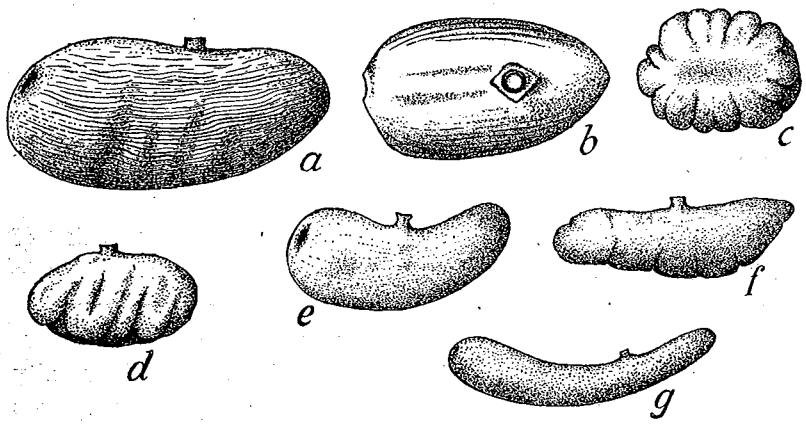

Fig. 1. Peltogastridae. *a*, *Septosaccus plicatus*, lateral surface of the larger specimen, × 6. *b*, *Septosaccus plicatus*, dorsal surface of the smaller specimen, × 6. *c*, *Peltogaster rugosus*, ventral surface, × 7.5. *d*, the same specimen, lateral surface, × 7.5. *e*, *Peltogaster* sp. from Nanaimo, lateral surface, × 10.5. *f*, *Peltogaster* sp. from Nanaimo (another specimen), lateral surface, × 14. *g*, *Chlorogaster gracilis*, lateral surface, × 3.75. In all figures the anterior part is found at the left side.

lobes, especially in the ventral half of the body (fig. 1 *c*, *d*). Its dimensions are: length nearly 3 mm, breadth 2 mm, and thickness approx-

imately 1.5 mm. It was attached to the ventral surface of the abdomen of the host, at a distance of about one third of the total length of the abdomen from the thorax of the host. The long axis of the parasite formed an angle of about 45 degrees with that of the hermit crab, the foremost part of the parasite (with the mantle opening) being found at the left side of the host.

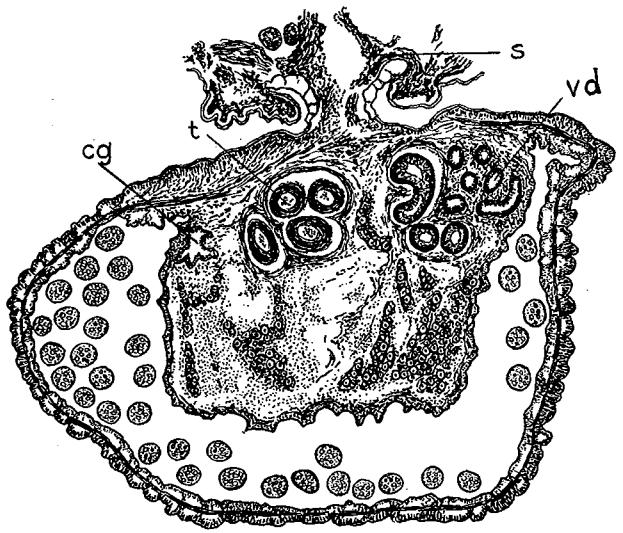

Fig. 2. *Peltogaster rugosus*, transversal section through the region of the stalk. *cg*, colleteric gland; *s*, stalk; *t*, testis; *vd*, vas deferens. × 36.

The internal structure of the specimen is very similar to that of *Peltogaster paguri*, the organs are found in corresponding places in both species.

The closed ends of the testes are lying at some distance before the stalk; the anterior part of the testes is straight, but in the vicinity of the stalk they have a twisted course. Here they gradually pass into the vasa deferentia, which also form a tortuous mass (fig. 2). Slightly behind the stalk the male genital openings are found, each of them at the dorsal part of one of the sides of the visceral mass.

The colleteric glands are small, they have an irregular shape with small parts of the cavity projecting in many directions (fig. 2). These glands are found in the vicinity of the stalk at the lateral surfaces of the visceral mass.

The musculature of the mantle is similar to that of *Peltogaster paguri*, the sphincter of the very narrow mantle opening is strongly developed.

In the mantle cavity a quantity of developing eggs are found.

The external cuticle of the mantle is thin (approximately 4 μ) with the exception of that of the region round the stalk, where it forms a small shield-like layer of thicker chitin. Its surface is smooth, here and there somewhat wrinkled.

Retinacula could not be detected on the extremely thin internal cuticle of the mantle.

Although the internal anatomy of this specimen corresponds in nearly every respect with that of *Peltogaster paguri*, it belongs undoubtedly to a new species which may receive the name *Peltogaster rugosus*. Externally the specimen differs strongly from *P. paguri*, in the first place by the lappets of the mantle which are separated from one another by comparatively deep grooves. Secondly, the specimen is very little elongated; this also forms a difference between *P. rugosus* and *P. paguri*. Moreover there is a considerable difference in size between the two species. The only specimen known of *P. rugosus* is adult (the mantle cavity contains eggs) whilst its greater diameter does not exceed 3 mm. Specimens of *P. paguri* of this size have never been found with ripe eggs, and, moreover, in such specimens there has not yet developed a mantle opening. The differences mentioned above give sufficient evidence to regard the specimen of the present collection as the type of a new species.

Peltogaster sp.

Dr. Th. Mortensen's Pacific Expedition, Pylades Channel, Nanaimo (British Columbia), 36 m, mud, stones. 6. VII. 1915. 4 ex. on Pagurids (too small and too much damaged for identification).

Two specimens were parasites of one Pagurid, the two remaining ones of another. The largest specimen has a length of 4 mm. The specimens have a well developed shield (the thick chitinous part surrounding the stalk). The shape of the animals is rather variable (fig. 1 *e, f*), one is comparatively slender, the others are thicker in comparison to their length. On the whole the shape reminds one of that of *Peltogaster paguri*, though the parasites are of much smaller size.

The stalk is found approximately in the middle of the long axis, the mantle opening at the anterior end.

Notwithstanding the fact that transversal sections have been made of all the specimens it is difficult to decide whether they belong to one of the known species of the genus or not. The anatomy of the animals corresponds in almost every detail with that of *Peltogaster paguri*.

The testes are found in the dorsal part of the body, in the vicinity

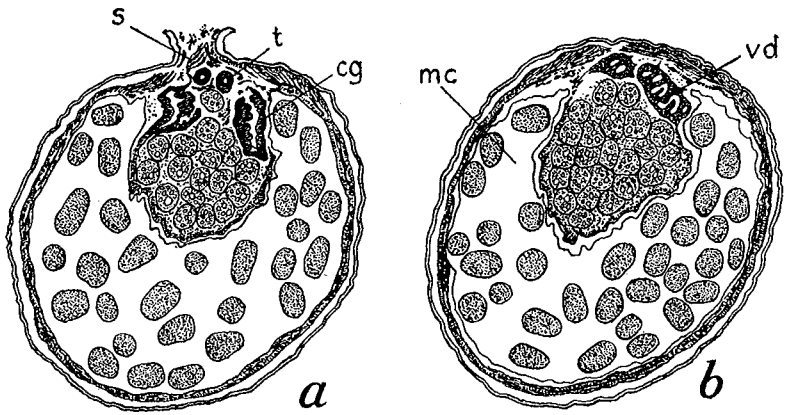

Fig. 3. *Peltogaster* sp. from Nanaimo. *a*, transversal section through the stalk. *cg*, colleteric gland; *s*, stalk; *t*, testis. *b*, transversal section containing the vasa deferentia (*vd*); *mc*, mantle cavity. Both figures × 36.

of the stalk (fig. 3 *a*), their posterior part passes into the vasa deferentia, which have a tortuous course (fig. 3 *b*).

The colleteric glands (fig. 3 *a*) have a simple structure: they consist of a small cavity with a distinct epithelium. Each of these glands is found at one of the lateral surfaces of the visceral mass, in the neighbourhood of the stalk.

The musculature of the mantle, including the sphincter of the mantle opening, is rather strong, just as in *P. paguri*. In the smaller specimens the mantle cavity is a narrow slit between the mantle and the visceral mass, in these specimens it does not contain eggs. The larger specimens have a much wider mantle cavity in which eggs or stages of larval development are found.

Two of the specimens are parasitized by other animals. In one of

them the parasite is enclosed in the mantle cavity, in the other it projects partially from this cavity through a hole in the mantle.

The external cuticle of the mantle is very thin (its thickness in the different specimens varies from 3 to 8 μ), only the shield-like portion around the stalk is somewhat thicker. The cuticle is quite smooth, in many places slightly wrinkled.

There is a considerable difference in size between the specimens from Nanaimo and those belonging to *Peltogaster paguri*. This may be due, however, to the differences in size between the hosts. The european specimens of *Peltogaster paguri* live on hosts of comparatively large sizes, whilst the material from Nanaimo was attached to small hermit crabs. It is well known that certain species of Rhizocephala which live on different hosts attain a much larger size on large hosts than on small ones.

These differences in size do not furnish sufficient evidence for regarding the specimens from Nanaimo as representatives of a species which differs from *Peltogaster paguri*. But on the other hand I do not feel justified to identify them as *P. paguri*. For the present it is better to wait till more material from the locality has been examined.

Septosaccus plicatus nov. sp.

Dipterosaccus sp. Van Kampen and Boschma 1925.

Danish Expedition to the Kei Islands, Banda, sandy shore, at low tide, 8. VI. 1922. 2 ex. on *Pagurus deformis* H. M.-E.

Each of the parasites is attached to the basal part of the abdomen of its host, at the left side, the anterior end of the parasite pointing to the thorax of the Pagurid. They have an oval shape, the anterior part is somewhat thicker and broader than the posterior part. The larger specimen (fig. 1 *a*) has a length of 7 mm, a breadth of 4, and a thickness of 3.5 mm; in the smaller specimen (fig. 1 *b*) these dimensions are 5.5, 3, and 2 mm respectively. The mantle opening is found at the anterior part of the body, the stalk at some distance behind the middle of the parasite. The smaller specimen has a rather smooth surface, that of the larger specimen shows a great number of longitudinal grooves.

In this species the visceral mass has a peculiar shape: its ventral region is divided into two lobes which are curved upwards towards

the dorsal region (fig. 4 *a*, *b*). These lateral lobes are strongly developed in the median part of the body, in the anterior and posterior region they gradually become smaller. Even in the smaller specimen, which

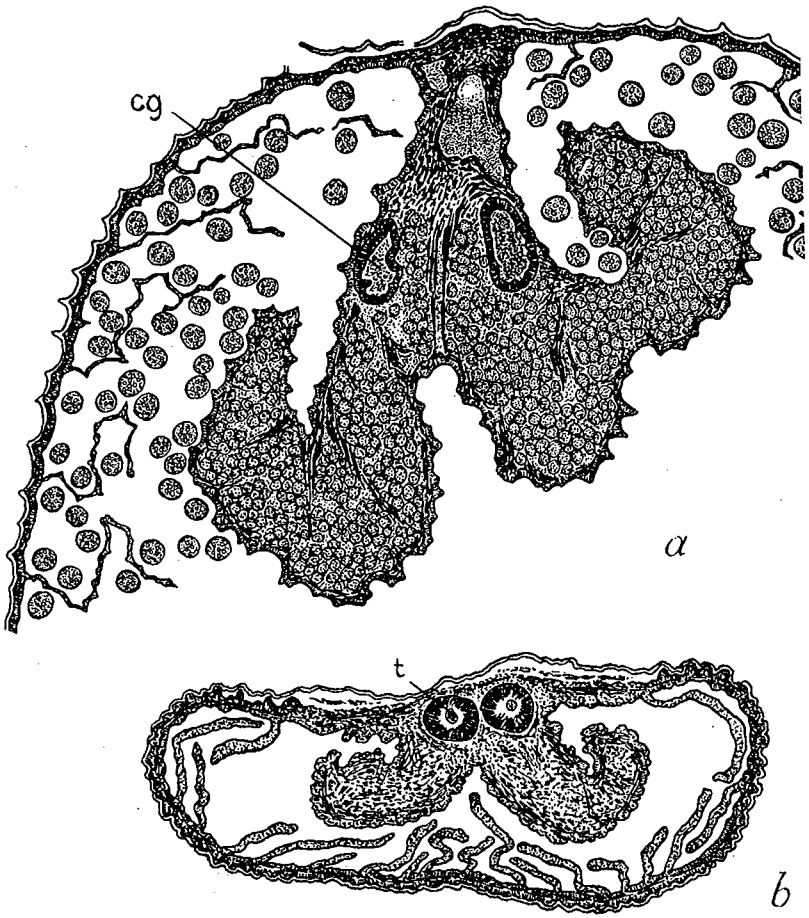

Fig. 4. *Septosaccus plicatus*. *a*, transversal section of the larger specimen, showing the colleteric glands (*cg*). × 36. *b*, transversal section of the smaller specimen, showing the testes (*t*). × 36.

obviously represents a juvenile stage, these lobes are distinctly pronounced.

The testes (fig. 4 *b*) form nearly straight tubes which stretch along the dorsal part of the visceral mass, in the neighbourhood of the stalk.

The vasa deferentia open backwards in the mantle cavity, they form straight tubes, not a twisted mass as in many species of *Peltogaster*.

The colleteric glands (fig. 4 *a*) have a similar shape as those of *Peltogaster paguri*: they consist of small cavities, one at each side of the visceral mass. They are found slightly before the stalk.

The mantle is muscular, the sphincter of the mantle opening is a comparatively strong muscle. In the larger specimen the mantle cavity contains eggs, in the smaller specimen it is empty. The inner surface of the mantle bears numerous septa, which divide the mantle cavity into a number of chambers. In the larger specimen the eggs are lying between the septa.

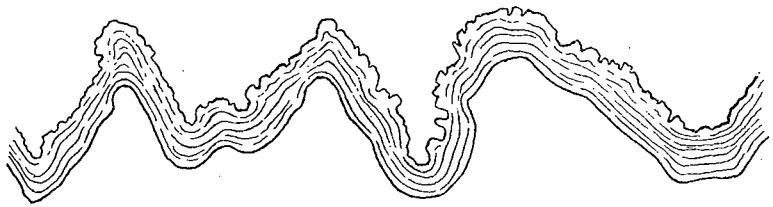

Fig. 5. *Septosaccus plicatus*, section of the external cuticle of the mantle. × 300.

The external cuticle of the mantle is rather thin (thickness in various parts of the larger specimen from 6 to 22 μ, in the smaller specimen circa 11 μ). Its surface is not altogether smooth (at least in the larger specimen): when examined with a high power it is seen to possess a great many irregular excrescences consisting of small ridges and papillae of various shape. Moreover this cuticle is somewhat folded and at the top of each of these folds the chitin is slightly thicker (fig. 5). The folds of the cuticle form small ridges, and, especially at the anterior and posterior ends of the body, the arrangement of the ridges is similar to that in *Septosaccus reticulatus* (cf. van Kampen and Boschma, 1925). They are, however, in the greater part of the body of much smaller size than in the figured part. In the smaller specimen the cuticle is almost completely smooth.

The differences of this species from other species of the genus are striking enough. The curved shape of the lateral parts of the visceral mass is not found in any other species of *Septosaccus*. *S. cuenoti*

(cf. Duboscq, 1912) and *S. reticulatus* v. K. & B. have a visceral mass of approximately the same shape as that of *Peltogaster*, the lateral parts of the visceral mass not being curved upwards.

In 1874 Kossmann gave some particulars of a Rhizocephalon from the Philippines, named by him *Peltogaster philippinensis*. From this author's figures results that this parasite also had a visceral mass with distinctly curved lateral parts. Moreover in one of his figures (l. c., Pl. 6, fig. 8 *c*) Kossmann draws small excrescences on the inner surface of the mantle, which might represent the septa. Kossmann mentions only that the parasite had a smooth cuticle, and from his figures one cannot draw sufficient conclusions to decide whether the specimen had well developed septa or not. It remains possible that *Septosaccus plicatus* is a synonym of *Peltogaster philippinensis*, but definite proof is lacking.

In the specimen of the Siboga Expedition which we have described as *Dipterosaccus* sp. (van Kampen and Boschma, 1925) the visceral mass possesses the typical curved lateral parts which are a characteristic of *Septosaccus plicatus*. In this specimen the septa have not yet developed, but the inner surface of the mantle shows some papillae separated by grooves and slits, which in the course of further development would have resulted into septa. The specimen undoubtedly belongs to the new species described here. Evidence for this opinion is also given by the fact that it was a parasite of *Pagurus deformis*, the host of the the specimens from Banda.

Dipterosaccus indicus, described in the paper cited above, is, at least specifically, different from *Septosaccus plicatus*. I do not place the species described above in the genus *Dipterosaccus*. The species shows more resemblance to *Septosaccus reticulatus* and *S. cuenoti* than to *Dipterosaccus indicus*. The latter is an aberrant form, the peculiarities of which I intend to describe in more detail in a later paper. *Septosaccus cuenoti* is an interesting species in so far as in many specimens the ventral region of the visceral mass is much broader than the median part; the ventral region of the visceral mass of each side often is laterally expanded in the mantle cavity, but not curved upwards as in *S. plicatus*. In this respect the visceral mass of *S. cuenoti* has a shape which is more or less intermediate between that of *Peltogaster paguri* and that of *Septosaccus plicatus*.

Chlorogaster gracilis (Kr.).

Peltogaster gracilis Krøyer 1855.
Peltogaster gracilis Boschma 1927 *a*, 1928 *b*.
Callao (coast of Peru), April 1841. 2 ex. from *Ligella gracilis* Kr.
Valparaiso (Chili), March 1841. 5 ex. from *Ligella gracilis* Kr.
Valparaiso. 2 ex. from *Ligella affinis* Kr.

The parasites, which are detached from their hosts, have a slender form, as the other species of the genus. With little variation in size and shape they are more or less curved cylindrical; usually the anterior part is somewhat thicker than the posterior region (fig. 1 *g*). The length varies from 8 to 12 mm, the thickness amounts to 1.5 or 2 mm. Probably they were living gregariously, the material of this species then may have been taken from three different hosts.

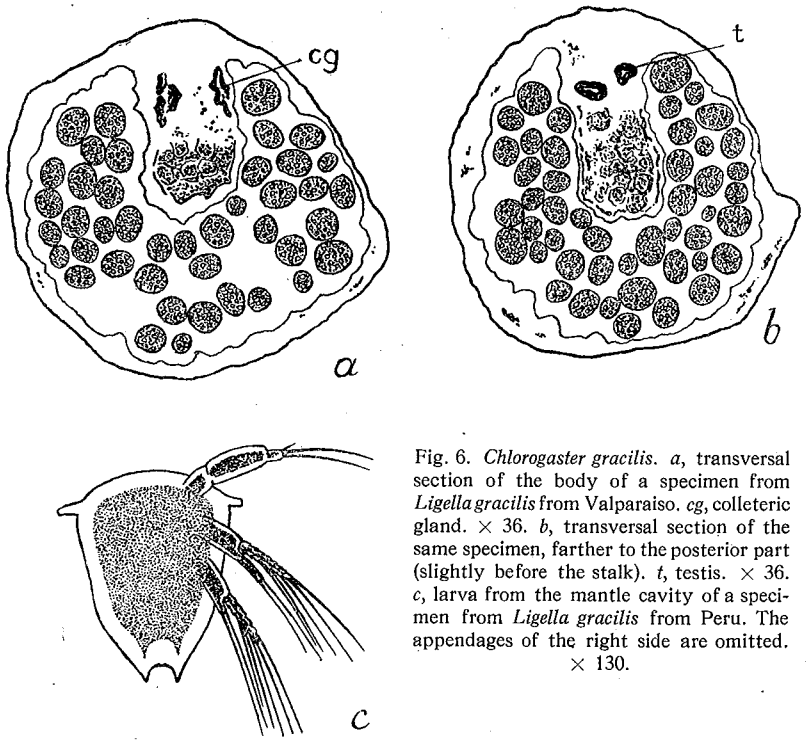

Fig. 6. *Chlorogaster gracilis*. *a*, transversal section of the body of a specimen from *Ligella gracilis* from Valparaiso. *cg*, colleteric gland. × 36. *b*, transversal section of the same specimen, farther to the posterior part (slightly before the stalk). *t*, testis. × 36. *c*, larva from the mantle cavity of a specimen from *Ligella gracilis* from Peru. The appendages of the right side are omitted. × 130.

As might be expected from material which has been in the museum for nearly a hundred years the preservation of the specimens is no

longer excellent. Still the chief points of the internal anatomy can be studied in sufficient detail. Transversal sections have been made of three specimens. In one of these the chief internal organs have remained approximately in their original place (fig. 6 *a*, *b*); the particulars given below are chiefly derived from the study of this specimen.

The mantle opening is found at the anterior end of the parasite, sometimes in the dorsal part of this region, sometimes farther to the ventral part. The colleteric glands (fig. 6 *a*) consist of simple cavities; these organs are visible in sections of the median part of the body. Between the colleteric glands and the stalk the testes are found (fig. 6 *b*), which in the living animal undoubtedly were lying nearer to the mantle than in the section. At a distance of about one third of the total length from the posterior end the short stalk is inserted to the broad mesentery. The visceral mass has been partially macerated, it still contains a few eggs and some remains of muscles. In the greater part of the body the muscles have vanished. One finds still some irregular masses of strongly decayed muscles between the external and internal cuticles of the mantle (fig. 6 *b*). The mantle cavity contains eggs or larvae (the latter is the case in two of the specimens).

In the larvae just as in the adults the soft parts have not been sufficiently preserved. The anterior part of the larvae (fig. 6 *c*) is comparatively broad, the body gradually becomes narrower and terminates with two broad spines. At the left and right sides of the anterior end a short frontal horn is present. The appendages of the body have approximately the same shape as in other larvae of Peltogastrids (cf. Nilsson-Cantell, 1921), they are provided with strong swimming hairs. The total length of the larvae is 210 μ approximately, they belong to the first nauplius stage.

In the adult state the specimens bear a strong likeness to *Chlorogaster sulcatus*. The larvae of *C. gracilis* also are quite similar to those of *C. sulcatus*, as I have already pointed out in a previous paper (Boschma, 1927 *a*). They differ slightly in size: those of *Chlorogaster sulcatus* have a length of about 250 μ, whilst the larvae of *C. gracilis* measure circa 210 μ. The internal anatomy of the adults of the two species does not present any striking differences, but this may be due to the imperfect state of preservation of the specimens of *C. gracilis*.

In my opinion it is advisable to regard *Chlorogaster gracilis* as a distinct species until fresh material of this form may be collected and

examined. If later it might be necessary to unite the two forms into one species, this species has to keep the name *Chlorogaster gracilis*. This species was named in 1855, whilst *C. sulcatus* was described by Lilljeborg in 1859. Consequently the name *C. gracilis* would have priority over *C. sulcatus* if one could prove that they are synonyms.

One may ask whether the specimens which I have examined are really the same as those to which Krøyer (1855) refers, but I think that I am sufficiently justified to say so. Krøyer states that he has found parasites of the group in the Pacific, on the coasts of Chili and Peru, which are the exact localities of the material dealt with here. Moreover the larvae of Krøyer's *Peltogaster gracilis* according to this author correspond approximately with those of *Sacculina*. In the material which I have studied also larvae are present (in a specimen from Peru and in another from Chili; the latter locality is mentioned by Krøyer as that of his larvae of *P. gracilis*). These larvae (fig. 6 *c*) differ in subordinate details only from the nauplius larvae of *Sacculina*, so also in this respect my observations closely correspond with those of Krøyer.

Probably the name *Peltogaster gracilis* was given to this species by Krøyer after one of its hosts (*Ligella gracilis*), as has been done with a great number of Rhizocephala by different authors. According to its form the species belongs to the genus *Chlorogaster*; it needs still to be proved whether the parasite lives gregariously on its host or not.

Family *Sacculinidae.*

The Sacculinidae of the collection dealt with here can be arranged into four genera: *Sacculina*, *Drepanorchis*, *Heterosaccus*, and *Loxothylacus*. Until now I had the opportunity to study one species of the genus *Heterosaccus* only (cf. van Kampen and Boschma, 1925); the material of the Copenhagen Museum contains some more, so that the anatomy of the genus could be studied in more detail. Both specimens of the Siboga Expedition ("*Heterosaccus hians*") have been cut into series of transverse sections, from which the internal anatomy cannot be as easily read as from longitudinal sections. One of the chief points, viz., the curved shape of the testes, is not obvious in the sections of the Siboga specimens, whilst it is visible at first sight in the longitudinal sections made from specimens of the genus from

the Copenhagen Museum. A later examination of the sections of the Siboga material showed that these specimens also have curved testes. A result of this fact is that the genus *Drepanorchis* is very little different from *Heterosaccus*: in the latter genus the mesentery is almost absent, whilst in *Drepanorchis* it is incomplete: it does not reach the mantle opening. In both genera the testes are curved. As long as I did not know the internal structure of *Heterosaccus* I placed the Sacculinidae with incomplete mesentery (or even without mesentery) in the genus *Drepanorchis*. After the study of the specimens of *Heterosaccus* in the present material I have to transfer the species *Drepanorchis occidentalis* to the genus *Heterosaccus*, as it does not possess a mesentery. These two genera consequently differ very little from one another, whilst on the other hand *Sacculina* and *Loxothylacus*, both with a complete mesentery, differ in many respects from each other and from the two other genera of the family. *Sacculina* has more or less straight testes, *Loxothylacus* has these organs in a curved shape, moreover, the latter genus is an aberrant form in so far as the visceral mass is attached to the mantle at some distance from the stalk.

In the genus *Sacculina* a large number of species can be distinguished, each with its own characteristics. In the following pages under each species the differences are given from other species of the genus which have excrescences of the cuticle of a similar appearance as those of the specimens described in the present paper. The differences from the european species of *Sacculina* have not been mentioned under the species of the present collection which have excrescences of a similar character as those of the european species (hairs or papillae which may be covered with minute lateral hairs, cf. Boschma, 1927 *b*). The differences of all the known species with excrescences of this type are given in the following short synopsis.

Testes in the visceral mass.
- Testes fused for a part of their length.
  - Excrescences of the external cuticle small (length not exceeding 18 μ). Retinacula consisting of a basal part and a number (4—10) of spindles ..... *S. carcini.*
  - Excrescences of the external cuticle varying between 20 and 35 μ.
    - Typical retinacula unknown ..... *S. nodosa.*
- Testes separated from each other ..... *S. muricata.*

Testes in the muscular region of the posterior part of the body.
- Testes gradually passing into the vasa deferentia.

  - Mantle opening surrounded by a more or less circular area with a thin cuticle ..... *S. atlantica.*
  - Not a distinct area with a thin cuticle around the mantle opening.
    - Testes not fused ..... *S. exarcuata.*
    - Testes fused for a part of their length ..... *S. brevispina.*

Testes more or less globular, rather abruptly passing into the thin vasa deferentia.
- One of the testes of much larger size than the other.
  - Internal cuticle without retinacula..... *S. inflata.*[1])
  - Internal cuticle with retinacula which have spindles of large size..... *S. eriphiae.*
- Both testes have approximately the same size.
  - Excrescences of the cuticle with stiff small lateral hairs .. *S. spinosa.*
  - Excrescences of the cuticle smooth or covered with weak minute lateral hairs.
    - Colleteric glands not distinctly protruding above the surface of the visceral mass ..... *S. gonoplaxae.*
    - Colleteric glands forming a definite excrescence on the sides of the visceral mass ..... *S. hirsuta.*

From this synopsis results that the specimens with hair-like excrescences described in the present paper belong to species which differ in constant characteristics from the european species of the genus *Sacculina*. The species with comparatively long hairs, as *S. setosa* v. K. & B. and *S. hispida* B., are distinguished sufficiently from the species dealt with above by this length of the excrescences.

Concerning the differences of the specimens dealt with in the present paper from the species of *Sacculina* described by Kossmann (1874), or the identity of the specimens of the Copenhagen Museum with Kossmann's species in a few cases only definite statements could be made. The greater part of the species described by Kossmann are too vaguely characterized to give any certainty for identifying other specimens with these species.

Sacculina nodosa nov. sp.

Danish Expedition to the Kei Islands, 1922, Station 53, 85 m, sand, coral, trawl. 1 ex. on *Lambrus* (*Rhinolambrus*) *cybelis* Alcock.

The specimen has a breadth of 7.5 mm, a height of 6 mm, and a thickness of nearly 3 mm. The surface which was directed towards the thorax of the host bears the mantle opening which lies in the

[1]) *Sacculina triangularis* Anderson is a synonym of *Sacculina inflata* Leuckart.

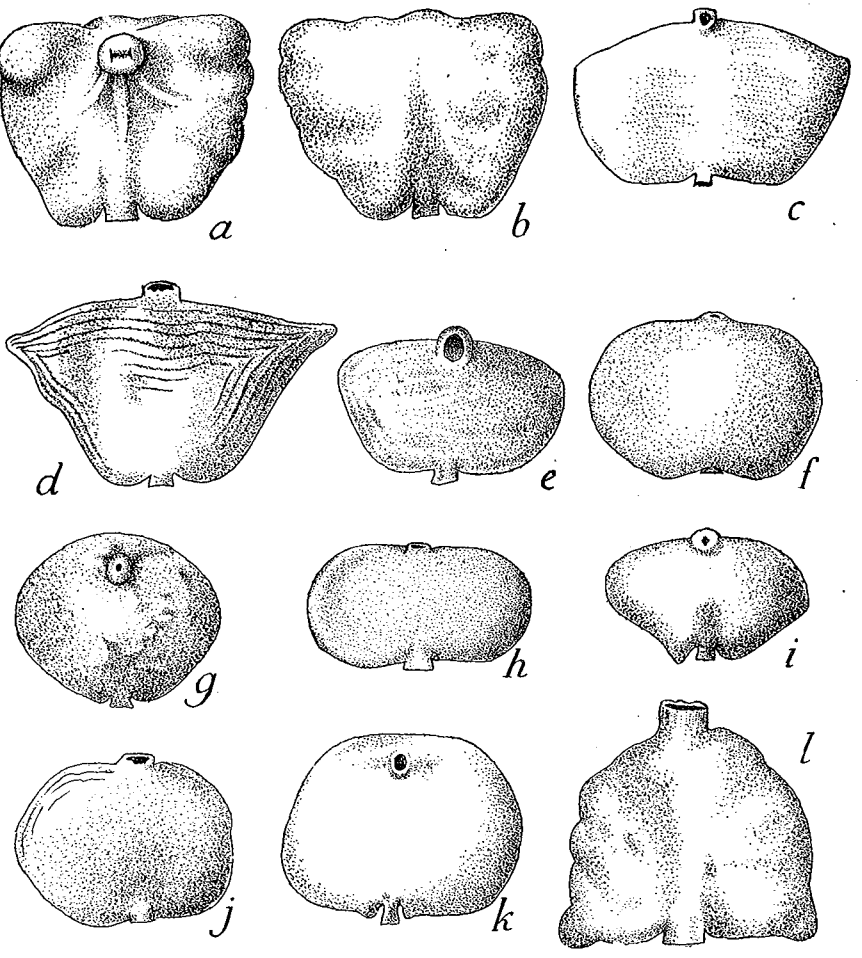

Fig. 7. Different species of *Sacculina*. *a*, *Sacculina nodosa*, thoracal surface, × 4.5. *b*, the same specimen, abdominal surface, × 4.5. *c*, *Sacculina angulata*, × 4.5. *d*, *Sacculina striata*, thoracal surface, × 5.25. *e*, *Sacculina caelata*, thoracal surface, × 12. *f*, *Sacculina muricata*, thoracal surface, × 4.5. *g*, *Sacculina phacelothrix*, thoracal surface, × 9. *h*, *Sacculina gracilis*, specimen from *Neptunus* sp., thoracal surface, × 6. *i*, *Sacculina spinosa*, specimen from *Pilumnus hilarulus*, thoracal surface, × 9. *j*, *Sacculina hirsuta*, × 5.25. *k*, *Sacculina spinosa*, specimen from *Pleistacantha sancti-johannis*, thoracal surface, × 3.75. *l*, *Sacculina bicuspidata*, thoracal surface, × 5.25.

Note. The terms "thoracal" and "abdominal" surface are used for the surfaces of the parasites touching the thorax and the abdomen of the hosts respectively.

centre of a muscular prominence. The angles of the anterior region are rather strongly pronounced (fig. 7, *a*, *b*). On the whole the surface of the parasite is rather smooth, with the exception of a few folds and grooves, especially the one caused by the pressure of the abdomen of the crab against the parasite.

The testes are lying in the posterior part of the visceral mass, along the mesentery (fig. 8). The median parts of the two testes have fused and form a single tube; their dorsal parts (the closed ends) are separated and also the ventral parts of the testes and the vasa deferentia form two separate tubes. In the figured section the two testes have almost fused, but each still has its own lumen.

The colleteric glands are comparatively large, they contain an extensive number of tubes. They are found near the free extremity of the visceral mass (the anterior part).

The internal surface of the mantle is somewhat irregular owing to a number of lacunae of different sizes. The mantle cavity does not contain eggs.

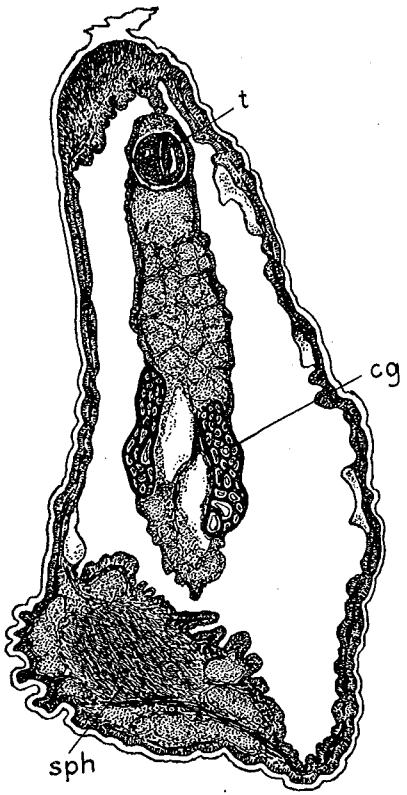

Fig. 8. *Sacculina nodosa*, longitudinal section (the excrescences of the external cuticle are omitted). *cg*, colleteric gland; *sph*, sphincter muscle of the mantle opening; *t*, testis. × 18.

An enormously developed sphincter surrounds the mantle opening.

The external cuticle of the mantle is comparatively thick (on an average 50 μ), it is covered with hairs, which attain a length of 20 to 35 μ (fig. 9). These hairs are evenly distributed on the surface of the cuticle and consist of the same material as the cuticle itself. The hairs are rather densely covered with small lateral hairs, the shape and length of these excrescences differs in different parts of the cuticle.

Retinacula could not be found on the thin internal cuticle. In some places the areas secreted by each cell of the epithelium of the inner surface of the mantle are arranged in circular rows around a somewhat larger area, which corresponds more or less with the arrangement of these areas around the retinacula in other species, but

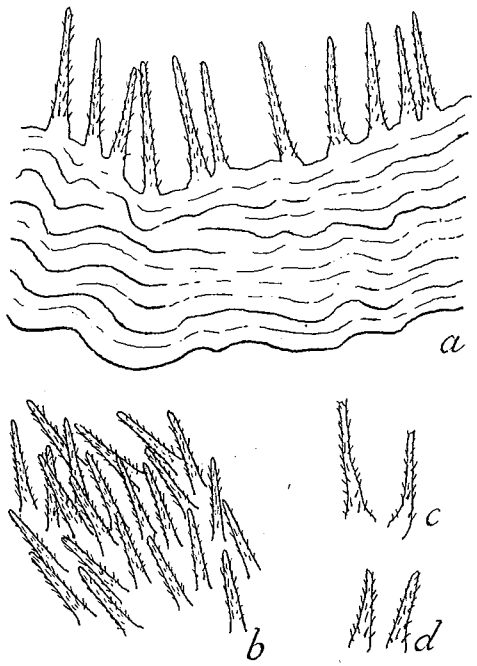

Fig. 9. *Sacculina nodosa*. *a*, section of the external cuticle. *b*, *c*, and *d*, excrescences from different parts of the external cuticle. All figures × 530.

true retinacula are not present in the slides examined in this respect. The structure of the internal cuticle reminds one in many respects of that of a specimen of *Sacculina pilosa* from the Siboga Expedition (cf. van Kampen and Boschma, 1925, fig. 3 D).

The excrescences of the external cuticle are similar to those of *Sacculina echinulata* v. K. & B., though in *S. nodosa* they do not possess a broadened basal part as in the former species. In *S. echinulata*, however, the retinacula are very peculiar: they are arranged in rows which consist of isolated spindles. As *S. nodosa* has an internal cuticle which recalls in some respects that of the specimen of

S. pilosa referred to above, it is highly improbable that the specimen described as *S. echinulata* and the type of the new species dealt with here belong to the same species.

From *Sacculina exarcuata* Kossm.[1]) the specimen differs by the place of its testes: in *S. nodosa* these are found in the visceral mass, whilst in *S. exarcuata* they are embedded in the muscular region in the neighbourhood of the stalk. In both species the excrescences of the cuticle have a similar structure. The excrescences of the cuticle of *Sacculina spinosa*, *S. hirsuta*, and *S. brevispina* also recall in some respects those of *S. nodosa*. These species can be easily distinguished from *S. nodosa* by the place of their testes, which are lying outside of the true visceral mass.

Sacculina muricata, described in the present paper, has excrescences of the cuticle which are in some respects similar to those of *S. nodosa*. In *S. nodosa*, however, they are much longer (20 to 35 μ) than in *S. muricata* (in this species they measure 8 to 12 μ only). Moreover in the former species the excrescences are densely covered with minute lateral hairs, whilst in *S. muricata* they are smooth. A further difference between the two species is found in the male genital organs: in *S. nodosa* the median part of the testes forms a single tube, whilst in *S. muricata* the two testes remain separated for the whole of their length.

Sacculina muricata nov. sp.

Dr. Th. Mortensen's Pacific Expedition, Sagami Sea (Japan), 720 m, tangles, 1.—7. VI. 1914. 1 ex. on *Oxypleurodon stimpsoni* Miers.

To the naked eye the animal has a smooth surface (fig. 7 *f*), it has a more or less oval shape. Its dimensions are: breadth 6.5, height 4.5, and thickness 4 mm approximately. The mantle opening lies at the anterior end, at the top of a small papilla. A rather deep groove is present at the surface which was covered by the abdomen of the crab.

The testes occupy the posterior part of the visceral mass (fig. 10 *a*); they form approximately straight tubes which run along the mesentery, and remain separated from each other for the whole of their length. For their greater part they are lying closely together, but they have not fused. The testis of the right side is somewhat smaller than that of the left side.

[1]) In a later paper I intend to give a full description of the characteristics of this species.

In the anterior part of the visceral mass the colleteric glands (fig. 10 *b*) are found. These glands are of fairly large size, they contain a great number of branched tubes.

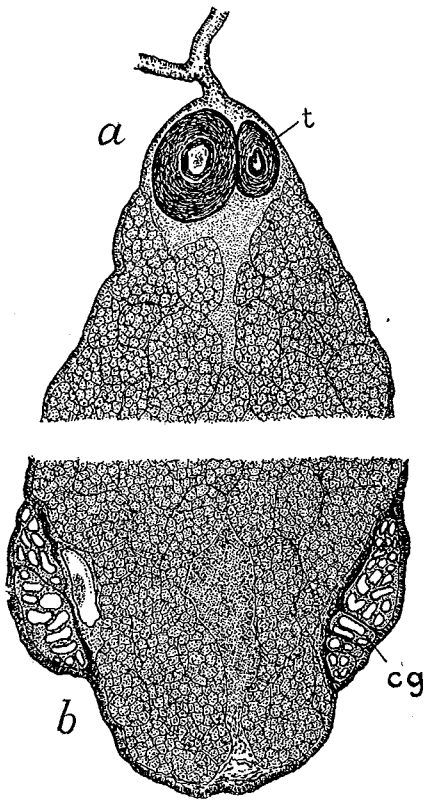

Fig. 10. *Sacculina muricata*. *a*, posterior part of a longitudinal section from the dorsal region of the body. *t*, testis. *b*, anterior part of a longitudinal section from the median region of the body. *cg*, colleteric gland. The mantle is omitted in these figures. Both figures × 26.

The mantle cavity is almost empty; only a small quantity of eggs is contained in the posterior part of this cavity. The mantle is not very strongly muscular, with the exception of the sphincter of the mantle opening.

The thin external cuticle (thickness about 14 μ) is rather densely covered with small, slender papillae or hairs, which attain a length of 8 to 12 μ. These excrescences are smooth, they do not possess lateral hairs (fig. 11 *a*, *b*).

Many retinacula are found on the thin internal cuticle. They are rather large and consist of a basal part and 5 to 8 or more spindle-like excrescences, which are fastened to the basal part (fig. 11 *c*, *d*). On these spindles no barbs could be found. The spindles vary in length from 10 to 14 μ.

The excrescences of the external cuticle of the mantle in *Sacculina muricata* recall strongly those of *S. brevispina* v. K. & B. and of *S. hirsuta* B. In *S. muricata* the excrescences are somewhat smaller than in the other species, but this might as well occur as a case of individual variation. Leaving alone the differences in the anatomy of the three species as far as concerns the situation of the testes, *S. muricata* differs already from the other species by its retinacula, which are rather regularly distributed over the surface of the internal cuticle and which consist of a basal part with a number of spindle-like excrescences. In *Sacculina brevispina* the retinacula are arranged in more or less straight rows, here each retinaculum has a variable number (1 to 4) of spindles. The retinacula of *Sacculina hirsuta* consist of

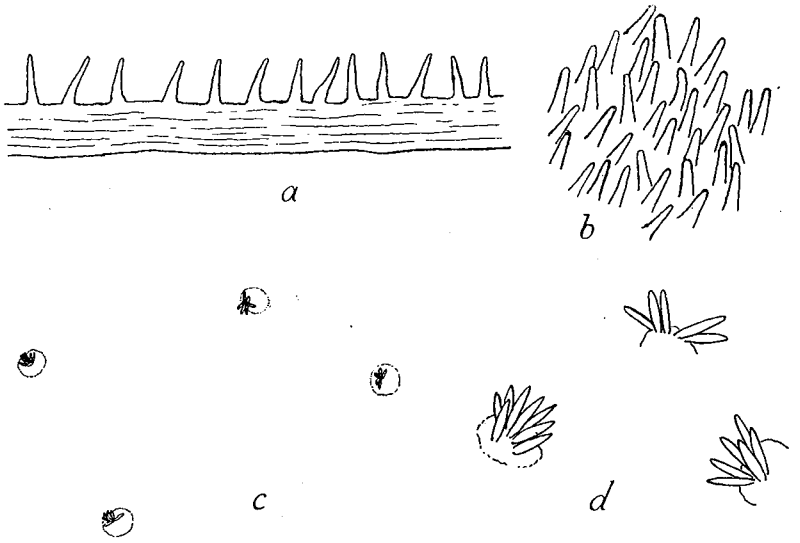

Fig. 11. *Sacculina muricata*. *a*, section of the external cuticle, × 530. *b*, excrescences of the external cuticle, × 530. *c*, retinacula, drawn in their mutual position on the internal cuticle, × 130. *d*, retinacula, × 530.

isolated spindles only, which are also distributed in rows over the surface of the internal cuticle. A similar arrangement of the retinacula is found in *Sacculina echinulata*, another species with hair-like excrescences of the external cuticle.

As concerns *Sacculina nodosa*, *S. exarcuata*, and *S. spinosa*, which are characterized by excrescences of a somewhat similar shape as those of *S. muricata*, only one of these (*S. nodosa*) has its testes situated in the same manner as *S. muricata*, viz., in the visceral mass. In the two other species the testes are found in the muscular region of the posterior part of the body. The differences between *S. muricata* and *S. nodosa* have been dealt with under the latter species.

Sacculina striata nov. sp.

Danish Expedition to the Kei Islands, Station 59, 385 m, coral, trawl, 12. V. 1922. 2 ex. on *Calocarcinus africanus* Calman.

The two specimens have rather strongly pronounced anterolateral lobes (fig. 7 *d*), moreover both possess a number of small grooves

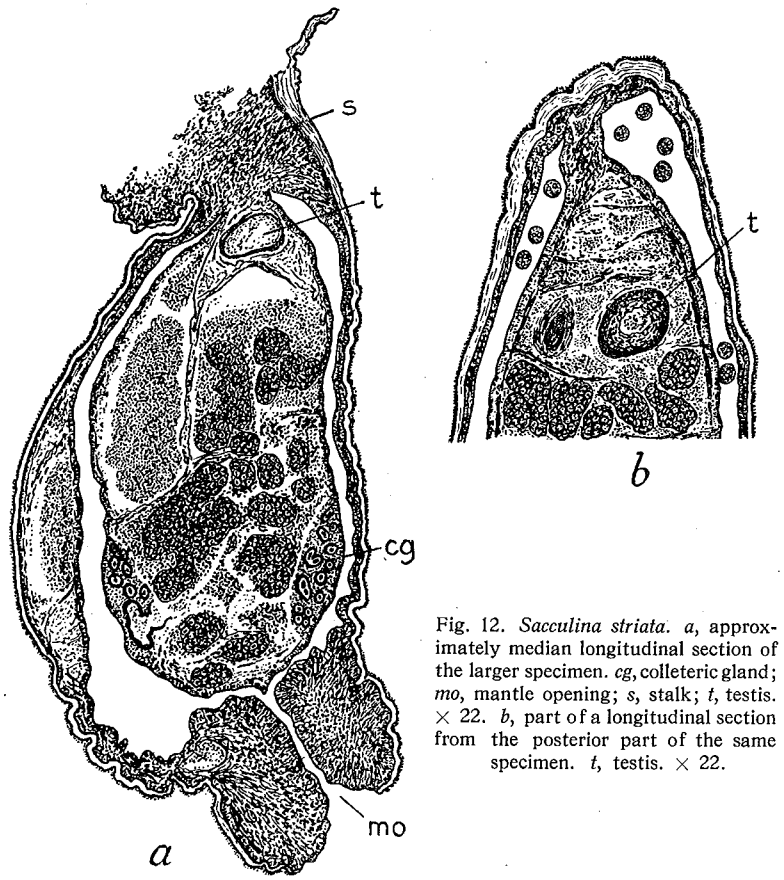

Fig. 12. *Sacculina striata*. *a*, approximately median longitudinal section of the larger specimen. *cg*, colleteric gland; *mo*, mantle opening; *s*, stalk; *t*, testis. × 22. *b*, part of a longitudinal section from the posterior part of the same specimen. *t*, testis. × 22.

which run parallel to the anterior and dorsal and ventral surfaces. These grooves are somewhat more pronounced in the smaller specimen than in the larger one. Their dimensions are: breadth 9, height 5.5, thickness 2.5 mm (the larger specimen), and 8, 4.5, and 2.5 mm in the smaller specimen. The mantle opening lies at the top of a small papilla at the anterior margin of the parasite.

The testes are found in the visceral mass, they are more or less straight. The closed ends of the testes (in the dorsal region of the body) are distinctly separate. Fig. 12 *b* shows the ends of the testes, one still has a distinct lumen, whilst in the other the cavity begins farther to the ventral region than in the figured section. In the dorsal region the testes are lying farther from the margin of the visceral mass than usually in species of *Sacculina*. Towards the median part the testes fuse into a single tube (fig. 12 *a*), which in the ventral half

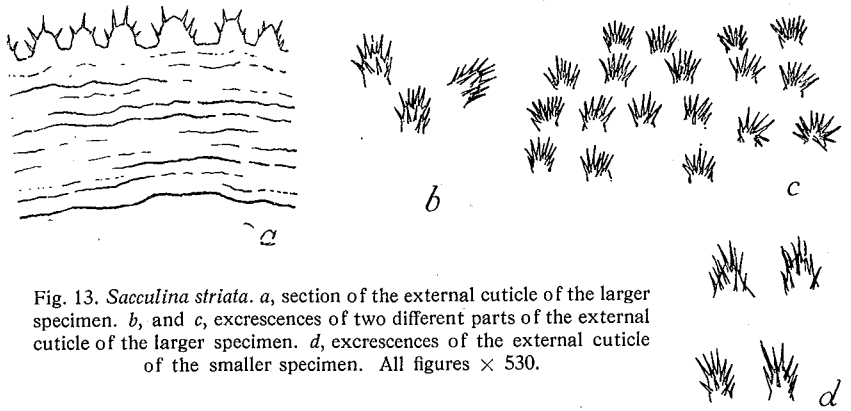

Fig. 13. *Sacculina striata*. *a*, section of the external cuticle of the larger specimen. *b*, and *c*, excrescences of two different parts of the external cuticle of the larger specimen. *d*, excrescences of the external cuticle of the smaller specimen. All figures × 530.

of the body again splits into two canals, the vasa deferentia, which remain separate.

The colleteric glands are present in the anterior part of the visceral mass; they are fairly large, but do not contain a great number of tubes (fig. 12 *a*).

The visceral mass contains, besides groups of egg-cells, many lacunae; also in the mantle some of these cavities occur. In the mantle cavity a small number of eggs are found. The narrow mantle opening is surrounded by strong muscles.

The external cuticle of the mantle has a thickness of 40 μ approximately. It is covered with small papillae which bear a variable number of minute spines (fig. 13). The height of these papillae varies from 3 to 9 μ, the spines have a length of 3 to 8 μ approximately. The size of the papillae varies slightly in different parts of the external cuticle. In both specimens the shape of the excrescences of the external cuticle is fairly uniform.

On the thin internal cuticle no retinacula could be found.

The excrescences of the external cuticle of *Sacculina striata* bear some resemblance to those of *S. hystrix* v. K. & B. In the latter species the spines are more neatly arranged around a central cone, but the size of the excrescences does not show any important differences. The two species, however, are strongly different in their internal structure: in *S. hystrix* the testes are found near the stalk, whilst in *S. striata* they are embedded in the visceral mass.

For *Sacculina calappae* v. K. & B. and *S. verrucosa* v. K. & B. the same holds good: here also the testes are lying outside the true visceral mass. Moreover, these species have smaller excrescences on the external cuticle than those of *S. striata*.

In *Sacculina teretiuscula* of the present collection the excrescences of the cuticle are somewhat smaller than those of *S. striata*, but besides they are much weaker and are covered with very minute lateral hairs only.

Sacculina angulata v. K. & B.

Sacculina angulata van Kampen and Boschma 1925.

Koh Kam (Siam), 15 m., broken shells, 16. II. 1900, Dr. Th. Mortensen. 1 ex. on *Thalamita sima* H. M.-E.

The parasite has an irregular pentagonal shape (fig. 7 *c*), its breadth is 8 mm (at the anterior part), its height nearly 5 mm, and its thickness nearly 3 mm. The surface of the mantle does not possess any grooves or wrinkles. The mantle opening, which is comparatively small, is situated at the anterior margin. The parasite was detached from its host, so that no statement can be made as to which surface was lying against the thorax of the crab. On the whole both surfaces are very little different in appearance.

The testes are lying in the visceral mass, as more or less straight tubes along the mesentery (fig. 14). Their median parts have grown together, but the cavities remain distinct.

The colleteric glands, which are present at each side of the visceral mass, are situated near the anterior region; they consist of a large mass of tubes.

The visceral mass consists chiefly of groups of young egg cells, between which lacunae are found. The latter contain a coagulated mass which has a great affinity for stains.

The musculature of the mantle is well developed, the sphincter

of the mantle opening is comparatively large. The mantle cavity does not contain eggs.

In this specimen the external cuticle of the mantle consists of two layers: the old cast-off cuticle which has a very little differentiated surface and the inner one, which is still in contact with the epithelium. The latter cuticle bears small, but characteristic excrescences. The outer layer of the external cuticle (fig. 15 *a*, *d*) has a thickness of 6 μ. On its surface a number of areas, separated from each other, are indistinctly visible. Each of these has a diameter of 8 to 12 μ, they project more or less above the other parts of this cuticle. On the inner layer of the external cuticle (the cuticle which undoubtedly is characteristic for the species) a great number of small papillae are found. They have the appearance of small pillars which have very irregular sides, with lateral excrescences, leaving only narrow grooves between each other. The upper surface of these papillae is more or less flat, in some sections they appear to have small spines on the top (fig. 15 *a*). When seen from above (fig. 15 *b*, *c*) these spines are not distinctly visible. The diameter of the papillae varies from 4 to 17 μ, their height is approximately 6 μ.

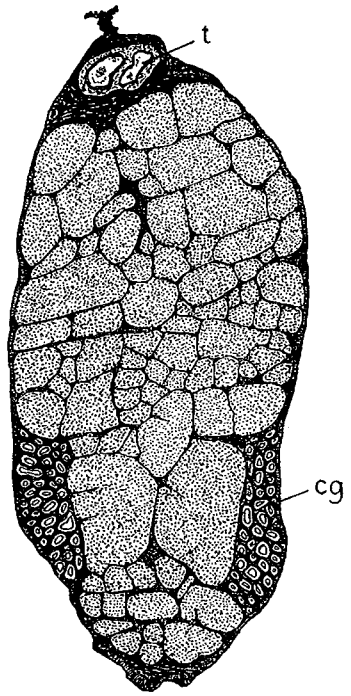

Fig. 14. *Sacculina angulata*, longitudinal section of the visceral mass. *cg*, colleteric gland; *t*, testes. × 26.

The internal cuticle of the mantle is densely covered with retinacula of comparatively large size (fig. 15 *e*, *f*). These excrescences consist of a more or less circular basal part and a variable number (4 to 10) spindle-like parts. The latter have a length of 8 to 12 μ and possess clearly visible barbs.

Undoubtedly the specimen dealt with here belongs to the species *Sacculina angulata* v. K. & B. The external form (fig. 7 *c*) bears a great likeness to that of the type specimen (van Kampen and

Boschma, 1925, Pl. I, fig. 17), but this peculiarity is of little importance. The internal anatomy of the two specimens corresponds in

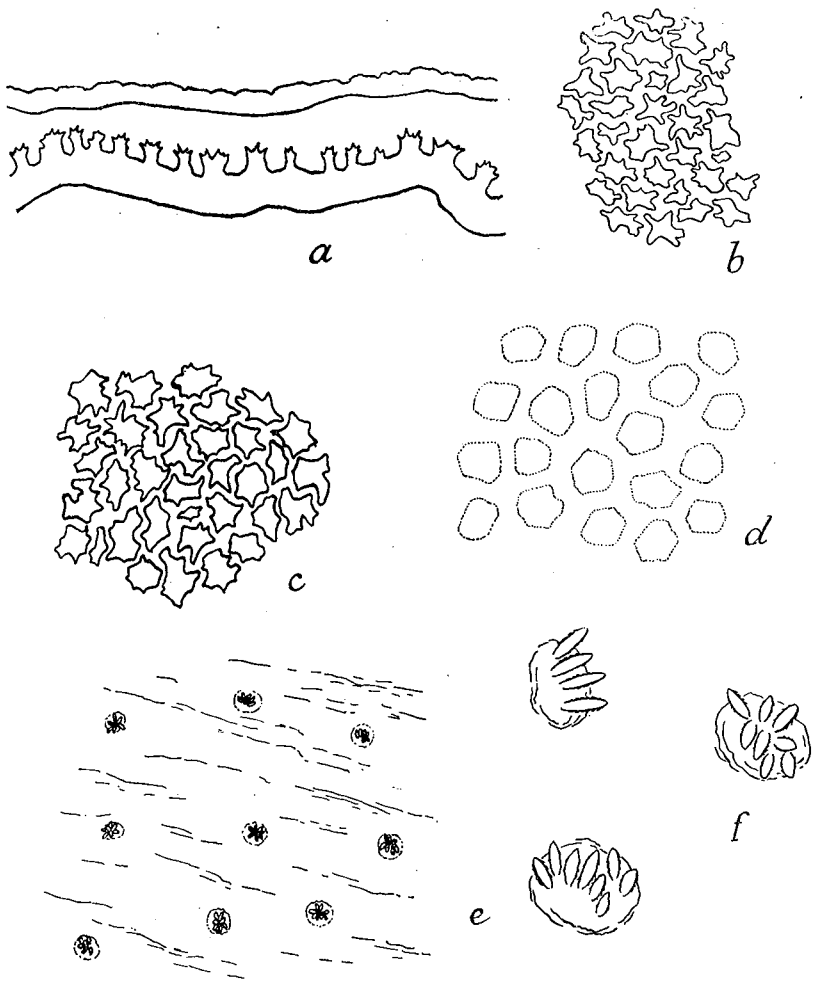

Fig. 15. *Sacculina angulata*. *a*, section of the two layers of external cuticle. × 530. *b*, and *c*, excrescences of the innermost external cuticle, seen from above. × 530. *d*, areas of the outer layer of external cuticle, seen from above. × 530. *e*, internal cuticle with retinacula. × 130. *f*, retinacula. × 530.

every detail. In both specimens the testes are found in the posterior part of the visceral mass, and in the same manner in both specimens

the testes are fused for a part of their length to form a single tube. Moreover the excrescences of the external cuticle are highly similar in both specimens, and the size of these parts does not differ to any extent.

In both specimens the colleteric glands consist of a great number of tubes, which again confirms the evidence for the identity of the two specimens.

Sacculina teretiuscula nov. sp.

18 miles west of Koh Chang (Siam), ca. 36 m, mud, 30. I. 1900, Dr. Th. Mortensen. 1 ex. on *Scalopidia spinosipes* Stimps.

The almost globular parasite was attached to the distal part of the abdomen of its host (fig. 16), its breadth is somewhat more than 2 mm, its height 2 mm, and its thickness 1.5 mm approximately. The mantle opening is slightly prominent, it is found at the extreme anterior end of the parasite. The surface of the mantle exhibits no wrinkles or furrows of any importance.

Although the specimen has been slightly macerated, so that the muscles of the mantle have become rather indistinct, the chief organs remain in a sufficient state of preservation for the study of its anatomy.

The animal has testes of fairly large size (in comparison with the size of the body), which for the greater part are lying in the visceral mass, only slightly protruding into the muscular region of the posterior part (fig. 17). The testes form more or less straight tubes.

The colleteric glands are found in the anterior half of the visceral mass.

The mantle cavity does not contain eggs.

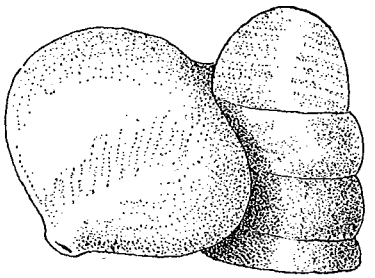

Fig. 16. *Sacculina teretiuscula*, attached to the abdomen of its host. The dorsal surface of the abdomen of the crab is represented. × 15.

In this specimen there are two layers of external cuticle of the mantle, the one loosely covering the other (fig. 18 *a*). Undoubtedly this is a case of moulting as is known also from many other species of Sacculinidae. Probably then the outer chitinous layer is the first one, formed soon after the parasite has become external; then afterwards a new cuticle is formed, which possesses

the characteristic excrescences of the species, and afterwards the first cuticle is cast off. In the specimen dealt with here the outer external cuticle has a smooth surface, it is very thin (about 4.5 μ). The inner cuticle bears small excrescences: little papillae which are covered with minute hairs (fig. 18 *a*, *b*). This cuticle itself has a thickness of about 6 μ, the papillae have a length of 4 to 8 μ. They have a rather narrow base, the tip may be blunt or somewhat pointed.

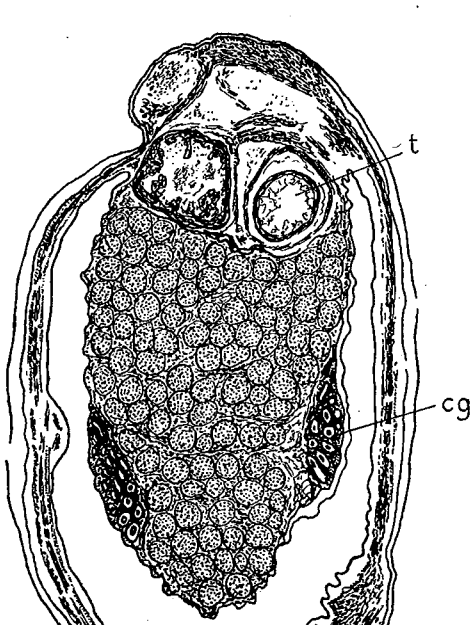

Fig. 17. *Sacculina teretiuscula*, longitudinal section. *cg*, colleteric gland; *t*, testis. × 36.

On the thin internal cuticle of the mantle no retinacula could be found.

The differences of *Sacculina teretiuscula* with *S. striata* have already been mentioned under the latter species. In two species of the East Indian region, *Sacculina calappae* v. K.. & B. and *S. verrucosa* v. K. & B., the external cuticle of the mantle is covered with excrescences of about the same shape and size as those of *S. teretiuscula*. Both of

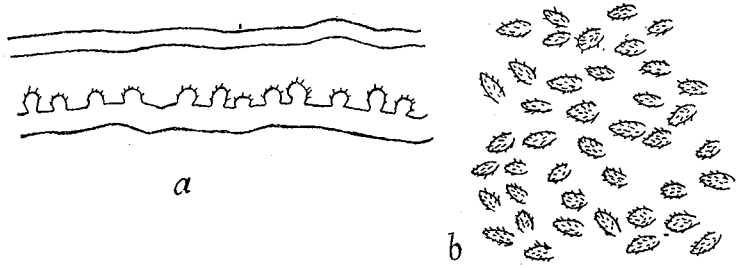

Fig. 18. *Sacculina teretiuscula*. *a*, section of the external cuticle with the outer layer. *b*, excrescences of the external cuticle, seen from above. Both figures × 530.

these species, however, have the testes lying in the region of the stalk, not in the visceral mass as in *S. teretiuscula*. The combination of these peculiarities characterizes the specimen sufficiently as the type of a new species.

Sacculina caelata nov. sp.

South of Koh Bidang (Siam), 16 m, mud, shells, 18. I. 1900, Dr. Th. Mortensen. 1 ex. on *Typhlocarcinus nudus* Stimps.

The small parasite has a breadth of 2.5, a height of 1.5, and a thickness of 0.75 mm approximately. The surface which was lying against the thorax of the crab is more or less flat, the surface which was covered by the abdomen of the host is more or less convex. The comparatively wide mantle opening was turned towards the thorax of the host, it is surrounded by a muscular wall (fig. 7 *e*).

In this specimen the mesentery does not form, as usually in species of *Sacculina*, a direct continuation of the stalk, but it has shifted slightly to one side (fig. 19). On the other hand the ventral part of the mesentery has moved to the other side. The visceral mass therefore has a somewhat slanting position in the mantle cavity.

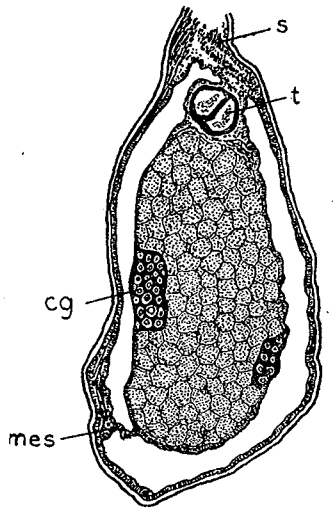

Fig. 19. *Sacculina caelata*, longitudinal section. *cg*, colleteric gland; *mes*, mesentery; *s*, stalk; *t*, testis. × 36.

The testes form for the greater part of their length separate tubes, their median portion has fused, but the cavity of each testis remains separated from that of the other. They are lying in the visceral mass.

The colleteric glands, which are present approximately in the central part of the lateral surfaces of the visceral mass (somewhat nearer to the anterior region than to the posterior part), consist of a comparatively large number of tubes.

The mantle cavity does not contain eggs.

The external cuticle of the mantle has a thickness of about 15 μ. Its surface is covered with an irregular system of minute ridges separ-

ated by shallow grooves (fig. 20). The ridges have a height of 1 to 2 μ only. In many places these ridges are rather short and separated from each other; sometimes they have united to form somewhat stronger developed ridges, as the one of fig. 20 *b*.

The internal cuticle bears retinacula of the usual form: they consist of a basal part with a few spindles (fig. 20 *c*). The latter have a length of 8 μ approximately, they do not possess barbs.

The specimen described here as *Sacculina caelata* bears a strong resemblance to *S. glabra* v. K. & B. In both species the testes are

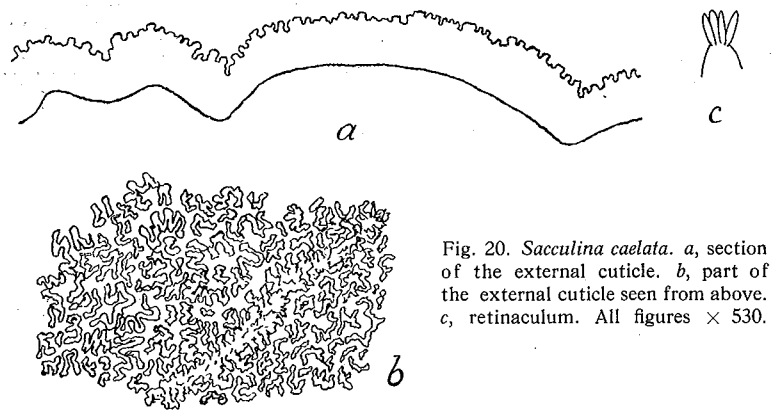

Fig. 20. *Sacculina caelata*. *a*, section of the external cuticle. *b*, part of the external cuticle seen from above. *c*, retinaculum. All figures × 530.

found in the visceral mass, whilst also in both species these organs have partially fused. The external cuticle of the mantle is different in the two species, which is the chief reason why I do not regard them as representatives of the same species. In *S. caelata* this cuticle is about twice as thick as in *S. glabra*, but this fact is of very little importance. If the specimen of the present collection had a smooth cuticle it should be united with the Siboga specimen, but the insignificant ridges and grooves, which constitute a somewhat sculptured surface of the cuticle in *S. caelata*, give sufficient evidence to regard this form as a distinct species.

Some specimens of *Sacculina flexuosa* also have an external cuticle which shows a great number of small grooves (cf. Boschma 1928 *c*), but then no definite small ridges have been formed as in *S. caelata*. Moreover *S. flexuosa* is characterized by the position of its testes in the region of the stalk, outside the true visceral mass.

There are a number of other species of *Sacculina* with a smooth

cuticle or with very insignificant excrescences on the cuticle. In one of these, *Sacculina margaritifera* v. K. & B., one of the testes has a peculiar position: its dorsal part is situated at some distance of the mesentery, by which characteristic it is easily distinguished from *S. caelata*. The other species with a smooth or almost smooth external cuticle (besides those mentioned above), viz., *S. rugosa* v. K. & B., *S. sulcata* v. K. & B., *S. pustulata* B., *S. bicuspidata* and *S. anceps* (both described in the present paper) have testes which are lying in the muscular region of the posterior part of the body, not in the visceral mass as in *S. caelata*.

Sacculina phacelothrix nov. sp.

Trincomalee, Ceylon, 4 m, III. 1889, K. Fristedt leg. 1 ex. on *Chlorodius niger* (Forsk.).

The parasite is more or less circular (fig. 7 *g*), its breadth is about 3 mm, its height 2.5, and its thickness 1.5 mm approximately. The small mantle opening, surrounded by a somewhat prominent muscular wall, is found at the surface which was directed toward the thorax of the host. Both surfaces are almost smooth, only slightly wrinkled in some places.

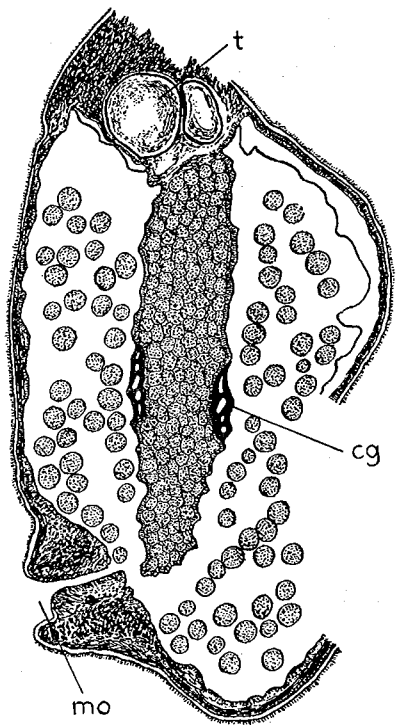

Fig. 21. *Sacculina phacelothrix*, longitudinal section. *cg*, colleteric gland; *mo*, mantle opening; *t*, testis. × 36.

The testes are found for the greater part of their length in the muscular mass of the posterior part of the body (the region from which the stalk takes its origin), they are not lying in the visceral mass, as in many other species of *Sacculina*. They are of fairly large size (fig. 21). In some parts of the body the mantle cavity extends somewhat farther to the posterior region than in the figured section, and then on longitudinal sections it appears as if they are embedded in the visceral mass itself.

The colleteric glands are comparatively small and consist of few tubes only. These glands are found somewhat nearer to the anterior part of the visceral mass than to the posterior region.

The mantle cavity, which is of fairly large size, contains a great number of eggs. The small mantle opening possesses a well developed sphincter.

The external cuticle of the mantle has a thickness of about 20 μ; it is covered with groups of hairs or bristles, which may be densely arranged on the cuticle or each of these groups may be found at some

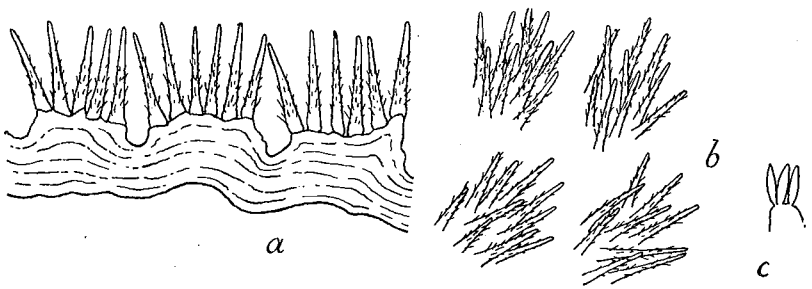

Fig. 22. *Sacculina phacelothrix*. *a*, section of the external cuticle. *b*, excrescences of the external cuticle, seen from above. *c*, retinaculum. All figures × 530.

distance from the others (fig. 22 *a*, *b*). As results from cross sections of the cuticle, the bristles do not form part of the cuticle itself. Their structure differs from that of the cuticle, the hairs being more transparent than the layer to which they are attached. Each group consists of about ten of these bristles. The latter are covered with small lateral hairs, which often are not found at the free extremity of the bristles; also the basal parts usually are devoid of these small hairs. The groups of bristles are standing on slightly elevated parts of the cuticle, consequently the groups are separated by shallow grooves. The bristles vary in size from 18 to 26 μ.

The internal cuticle bears retinacula, only a few of these, however, could be found in the slides made for this purpose. They consist of a basal part and a few spindle-like excrescences (fig. 22 *c*), which have a length of 9 μ approximately. On the spindles no barbs could be found.

Sacculina phacelothrix bears a strong resemblance to *S. pilosa*. The spines of the external cuticle arise in groups from basal parts which

protrude slightly above the cuticle itself, more or less as in *S. pilosa*. In the latter species, however, the spines are united on hyaline basal parts which form a sharp limit against the cuticle. The basal parts on which the spines of *S. phacelothrix* are placed are parts of the cuticle itself and they stain as easily as this layer. Here the spines only consist of chitin with a hyaline structure, whilst in *S. pilosa* the whole of the excrescences, the spines with their common basal parts, are hyaline. The retinacula are much smaller than those of the only specimen of *S. pilosa* from which retinacula are known (cf. van Kampen and Boschma, 1925, fig. 6 B), the spindles of the retinacula of *S. phacelothrix* are approximately half as long as those of the specimen from the Siboga Expedition. These differences, though not very striking, give sufficient evidence that the specimen from Ceylon does not belong to *S. pilosa*. Moreover the anatomy of the specimens which we united in the cited paper as *Sacculina pilosa* is still imperfectly known. In a later paper I intend to show that the group of specimens described in this paper under *S. pilosa* in reality consists of representatives of different species.

The anatomy of *Sacculina phacelothrix* is similar to that of *S. aculeata* (cf. Boschma, 1928 *c*). The type specimen of *S. aculeata* has excrescences which might develop in the same manner as those of *S. phacelothrix*, but in all probability they would have changed into excrescences as those of *S. pilosa*, if the mould of the specimen had become complete. In my opinion the type of *S. aculeata* belongs to the same species as a number of specimens of the Siboga Expedition, described under *S. pilosa*, in which the testes are found in the muscular region of the posterior part of the body.

The specimens of "*Sacculina pilosa*" on *Actaea hirsutissima* (cf. van Kampen and Boschma, 1925, fig. 12) have excrescences which remind one in some respects of those of *Sacculina phacelothrix*. The anatomy of these specimens is not known, and, moreover, the excrescences of these specimens are very irregularly arranged on the surface of the external cuticle in comparison with those of *S. phacelothrix*.

Sacculina gracilis nov. sp.

Koh Kahdat (Siam), 7—9 m, sand, stones, coral, 15.—18. II. 1900, Dr. Th. Mortensen. 1 ex. on *Neptunus* sp. (probably *Neptunus* (*Xiphonectes*) *longispinosus* (Dana) var. *obtusidentatus* Miers).

Koh Kam (Siam), 15 m, broken shells, 6. II. 1900, Dr. Th. Mortensen. 1 ex. on *Thalamita sima* H. M.-E.

The specimen on *Neptunus* (fig. 7 *h*) has an oval shape (dimensions: breadth 5, height 2.5, thickness 1.5 mm approximately); to the naked eye the surface seems quite smooth. The mantle opening lies

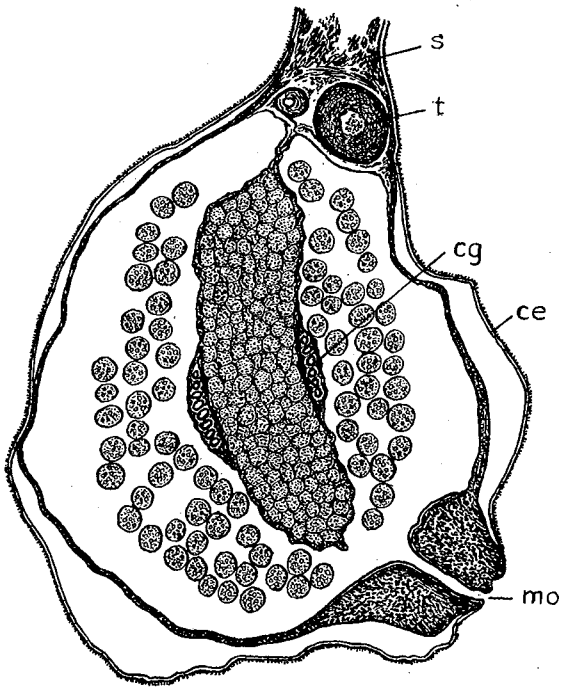

Fig. 23. *Sacculina gracilis* from *Neptunus* sp., longitudinal section. *ce*, external cuticle of the mantle; *cg*, colleteric gland; *mo*, mantle opening; *s*, stalk; *t*, testis. × 36.

at the top of a small tube which was directed towards the thorax of the crab.

The specimen on *Thalamita* also has a more or less smooth surface. Its dimensions are: breadth 4, height 2.5, and thickness nearly 1.5 mm. The side of the parasite which was touching the abdomen of the crab has a deep median groove and shows a number of irregular furrows or wrinkles at the anterior region. The parts surrounding the mantle opening do not project above the surface of the mantle. This opening

lies near the anterior margin, at the side of the animal which was lying against the thorax of the crab.

From both specimens series of longitudinal sections have been made.

In the specimen on *Neptunus* the testes are not contained in the visceral mass, but they are found in the muscular region in the neighbourhood of the stalk (fig. 23). The testes have approximately the same thickness, one is a little shorter than the other.

Each of the colleteric glands is lying in the central region of the lateral surfaces of the visceral mass, these glands consist of a rather small number of tubes.

The mantle cavity is large, it contains several eggs. The mantle itself is comparatively little muscular, with the exception of the strong sphincter, which surrounds the mantle opening.

The anatomy of the specimen on *Thalamita* does not differ in any important detail from that of the other specimen. The testes and colleteric glands occupy corresponding places. One of the testes (that of the right side) is longer than the other and has a larger size. These organs form more or less straight tubes which are lying the one beside the other in the muscular region of the posterior part of the body, they remain separated for the whole of their length.

Also in this specimen the colleteric glands contain a few tubes only.

The musculature of the mantle is in any respect similar to that of the other specimen. The mantle cavity contains a small quantity of eggs.

The mantle of the specimen on *Neptunus* has an external cuticle with a thickness of about 10 μ. This cuticle bears numerous small excrescences which consist of a thick basal part and a number of small bristles or spines which are inserted especially at the margin of the basal part (fig. 24 *a—e*). The height of these excrescences (with the spines included) varies from 15 to 20 μ, the diameter of the basal part usually amounts to 6 to 9 μ; sometimes larger excrescences are found between the smaller ones, these may attain a diameter of 16 μ (fig. 24 *c*). The excrescences of the cuticle have a structure which is different from that of the cuticle itself. The latter consists of parallel layers of chitin, which stain easily with borax carmine. On the other hand the excrescences do not take this stain, they are more or less hyaline and consist of a much harder kind of chitin. They are separated from the main layers of chitin by a sharp line.

The external cuticle of the specimen on *Thalamita* has a thickness of 8 μ approximately (not including the excrescences). The excrescences of the cuticle of this specimen do not differ in any important detail from those of the other specimen (fig. 24 *f—h*).

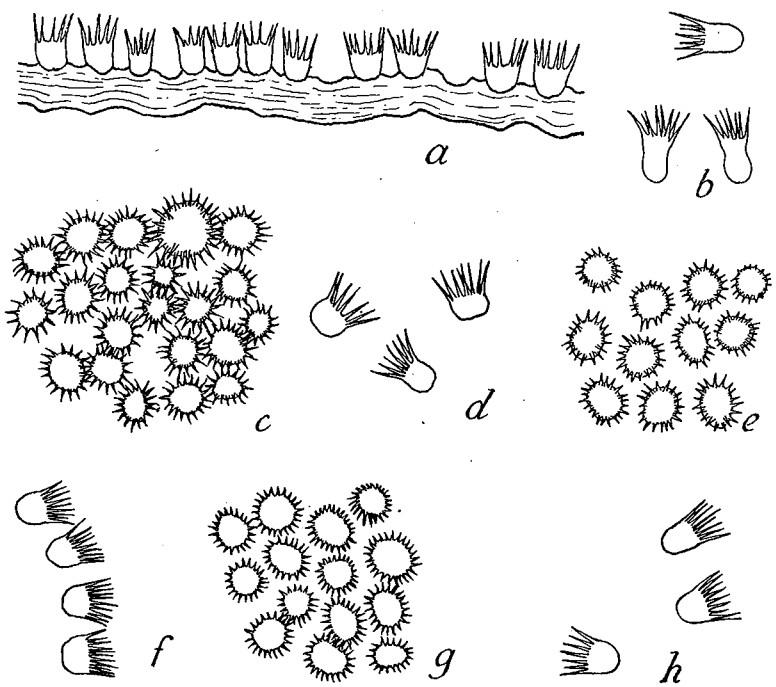

Fig. 24. *Sacculina gracilis*. *a*, section of the external cuticle of the specimen from *Neptunus* sp. *b*, and *d*, excrescences from other parts of the external cuticle of the same specimen. *c*, and *e*, excrescences from different parts of the external cuticle of the same specimen, seen from above. *f*, and *h*, excrescences from different parts of the external cuticle of the specimen from *Thalamita sima*. *g*, excrescences of the external cuticle of the same specimen, seen from above. All figures × 530.

On the internal cuticle of the mantle in none of the specimens retinacula could be found.

The excrescences of the cuticle bear some resemblance to those of *Sacculina dentata*, they are, however, much smaller than in the latter species (cf. Kossmann, 1874). Especially the spines are thinner: in *S. dentata* they have a thickness of 5 μ at the basal parts, whilst in *S. gracilis* they are not thicker than 1.5 μ. Moreover the excrescences as a whole are smaller: the diameter of these chitinous parts of *S. dentata* is 28 μ, in *S. gracilis* they measure usually 6 to 9 μ, only exceptionally they may attain a thickness of 16 μ.

In *Sacculina bipunctata* the excrescences of the cuticle possess a much smaller number of spines than those of *S. gracilis*. The two species are, moreover, different in their anatomical characteristics: *S. bipunctata* has the testes embedded in the visceral mass, whilst in *S. gracilis* they are found in the muscular posterior part of the body.

Sacculina spinosa v. K. & B.

Sacculina spinosa van Kampen and Boschma 1925.

Dr. Th. Mortensen's Pacific Expedition:

Misaki (Japan), 140—180 m, hard bottom, tangles, 19. VI. 1914. 2 ex.

Off Misaki, 140—220 m, sand, tangles, 10. VI. 1914. 5 ex. (2 of these on one crab).

Sagami Sea (Japan), 140—220 m, sand, 6.—19. VI. 1914. 4 ex. (2 of these on one crab).

Sagami Sea, 540 m, hard bottom, tangles, 29. VI. 1914. 4 ex.

All these japanese specimens on *Pleistacantha sancti-johannis* Miers.

Danish Expedition to the Kei Islands, Station 5, 290—90 m, sand, stones, trawl, 4. IV. 1922. 1 ex. on *Pilumnus hilarulus* de Man.

The parasites on *Pleistacantha* (fig. 7 *k*) have a more or less irregular circular shape, the dimensions (breadth, height, and thickness) of three of them are: 7, 6.5, and 4; 6, 6.5, and 2.5; 8, 6.5, and 4.5 mm respectively. The mantle opening, which is found at the anterior part of the surface which was turned against the thorax of the host, is small and very little prominent. The surface which is lying against the abdomen of the crab usually possesses a distinct longitudinal groove caused by the pressure of the median ridge of the abdomen against the parasite.

Longitudinal sections have been made of four specimens. The anatomy of these differs in unimportant details only, so that a short general description may be sufficient.

The testes are lying in the muscular posterior region from which the stalk takes its origin (fig. 25). They have a more or less globular shape, the vasa deferentia form short tubes which are slightly tortuous (fig. 26).

The colleteric glands contain a variable number of tubes, in one of the specimens more than in the one a section of which is represented in fig. 25, in the other ones a slightly smaller quantity. In one of the

specimens these glands protrude somewhat over the surface of the visceral mass. The colleteric glands are always found in the anterior part of the visceral mass, sometimes somewhat nearer to the anterior part than in the specimen of fig. 25.

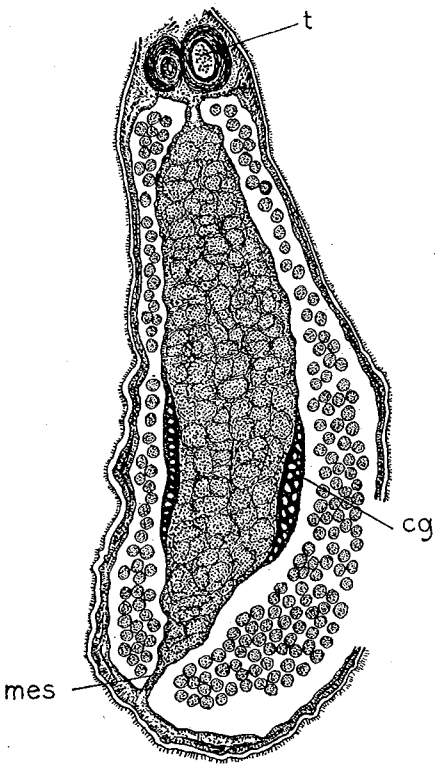

Fig. 25. *Sacculina spinosa*, specimen from *Pleistacantha*, longitudinal section. *cg*, colleteric gland; *mes*, mesentery; *t*, testis. × 18.

In three of the specimens from which sections have been made the mantle cavity contains eggs. The sphincter of the mantle opening is well developed.

In the different specimens from *Pleistacantha* the thickness of the external cuticle of the mantle is rather variable, on the average this thickness is about 30 μ. It is covered with rather strong hairs, which have a length of 8 to 36 μ. Some specimens have very short hairs, in others these are much longer (fig. 27). They may be very short and thick (fig. 27 *b*), or long and slender (fig. 27 *k*). The hairs are covered with small lateral hairs, which look like minute spines. Especially at the top of the hairs these small spines often are strongly developed (fig. 27 *c*, *l*, *n*, *p*). The surface of the external cuticle is divided into small areas with a diameter of 8—10 μ. Usually these areas are rather indistinct. Their size corresponds with that of the upper surface of the cells of the epithelium of the mantle: each area must have been secreted by one of these cells. Of these areas only a small number bear hairs (fig. 27 *b*) The hairs form a part of the cuticle itself: there is no sharp limit between the excrescences and the cuticle (fig. 27 *a*).

Retinacula in all probability do not occur in this species: they could not be found in any of the slides made for this purpose.

The parasite on *Pilumnus hilarulus* (fig. 7 *i*) differs in some respects from those dealt with above, especially as concerns its shape. In Sacculinidae the shape of the animal is highly dependent upon the space between the thorax and the abdomen of their hosts, so that these differences are of little value. The specimens living on *Pleistacantha*

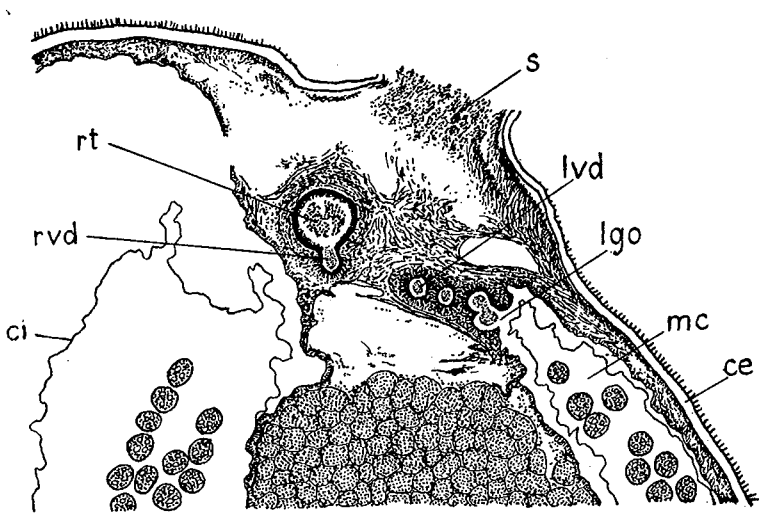

Fig. 26. *Sacculina spinosa*, other specimen from *Pleistacantha*, part of a longitudinal section through the ventral part of the male organs. *ce*, external cuticle; *ci*, internal cuticle; *lgo*, left male genital opening; *lvd*, left vas deferens; *mc*, mantle cavity; *rt*, right testis; *rvd*, right vas deferens. × 36.

are enclosed in the large cavity between the thorax and the abdomen of the host, wholly shut off from the outside, whilst the specimen on *Pilumnus* is covered in its median part only by the abdomen of the crab, the dorsal and ventral region projecting freely at each side of this abdomen.

The specimen on *Pilumnus hilarulus* has the following dimensions: breadth 3 mm, height nearly 2 mm, and thickness about 1 mm. The mantle forms a kind of lobe at each side of the stalk (fig. 7 *i*), the surface is not wrinkled or grooved to any extent. The mantle opening lies at the anterior margin, it was directed towards the thorax of the

host. The parts surrounding the mantle opening are comparatively muscular.

The testes (fig. 28 *b*) are approximately globular, they have short,

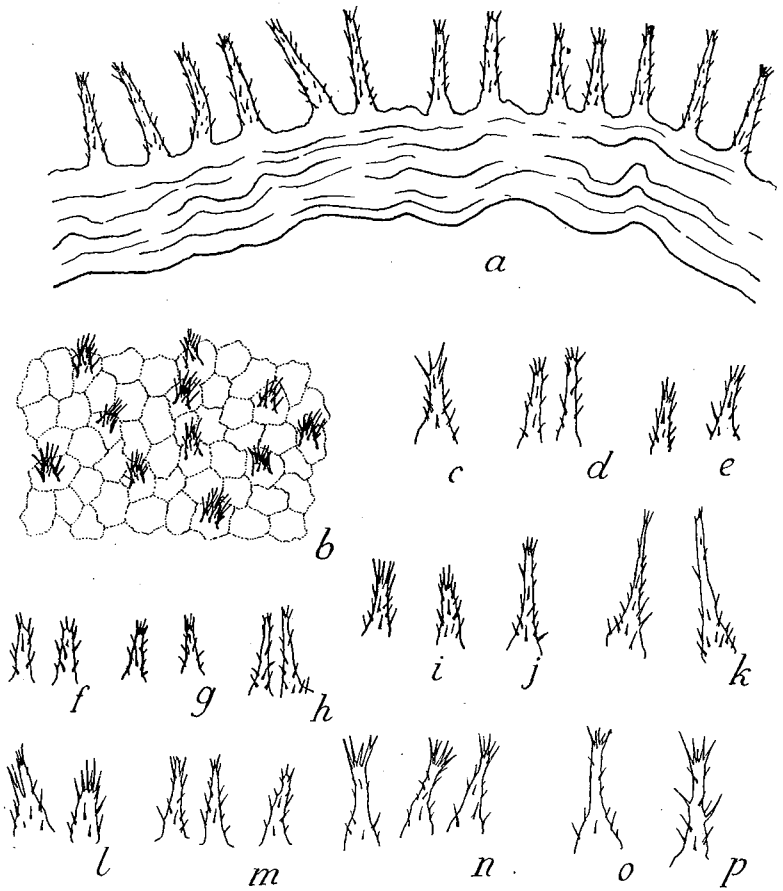

Fig. 27. *Sacculina spinosa*, specimens from *Pleistacantha*. *a*, section of the external cuticle. *b*, external cuticle of another specimen, with rather short excrescences. *c*—*p*, excrescences of the external cuticle of different specimens (*e*, *h*, and *i*, from different parts of the cuticle of one specimen; *n*, and *p*, from different parts of another specimen). All figures × 530.

almost straight vasa deferentia. The testes are not embedded in the visceral mass, but are lying in the muscular region in the vicinity of the stalk.

The colleteric glands are partially lying in the visceral mass, for

another part they protrude above its surface (fig. 28 *a*). These glands consist of a small number of tubes.

In the mantle cavity developing eggs are found. The mantle opening has a sphincter of good size, the other muscles of the mantle are insignificant.

The external cuticle of the mantle is comparatively thin (on an

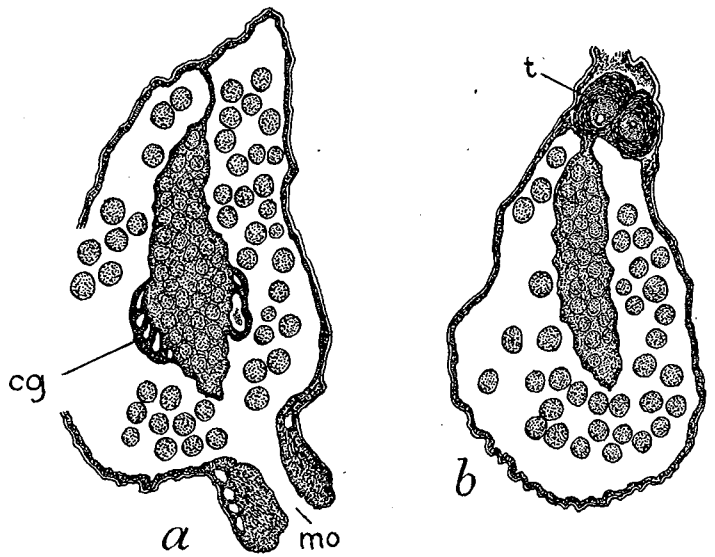

Fig. 28. *Sacculina spinosa* from *Pilumnus hilarulus*. *a*, longitudinal section through the mantle opening (*mo*); *cg*, colleteric gland. × 36. *b*, longitudinal section through the stalk; *t*, testis. × 36. (The sections are not strictly longitudinal, they are somewhat oblique.)

average about 12 μ). It is covered with hairs which form part of the cuticle itself: they can be stained in the same manner and are not separated from the cuticle. The length of these excrescences is extremely variable (fig. 29), in some parts of the mantle they are rather short (9 μ), whilst in other parts of the mantle they may attain a length of nearly 40 μ. The excrescences are covered with minute lateral hairs especially in their basal part. Their extremity is divided into a number of minute spines.

On the thin internal cuticle of the mantle no retinacula could be found.

It is probable that the two specimens of the Siboga Expedition,

described as *Sacculina spinosa* (van Kampen and Boschma, 1925) in reality belong to two different species. I consider the specimen of Station 274 (Aru Islands) as the type, as the anatomy of this specimen is known. This specimen is characterized by approximately globular testes which rather abruptly pass into the short vasa deferentia with a slightly tortuous course. The position of these organs is in the muscular region of the body, outside the true visceral mass.

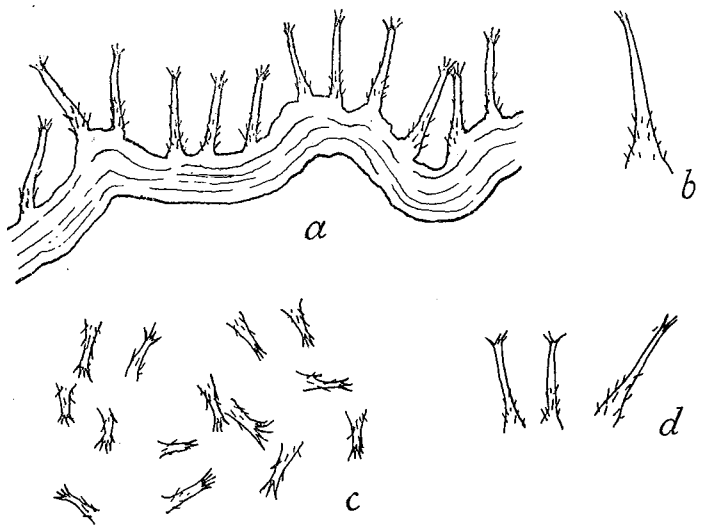

Fig. 29. *Sacculina spinosa* from *Pilumnus hilarulus*. *a*, section of the external cuticle. *b*, and *d*, excrescences of the external cuticle. *c*, excrescences of the external cuticle, as seen from above. All figures × 530.

The specimens from *Pleistacantha sancti-johannis* as well as the specimen on *Pilumnus hilarulus* dealt with above agree closely with the type specimen of *Sacculina spinosa*: all of these have testes of the same shape and position, whilst the excrescences of the external cuticle have a similar shape. Moreover in the specimens dealt with here no retinacula could be found, which was also the case in the type specimen. This negative peculiarity, however, is of little importance, but as in all the specimens on *Pleistacantha* examined in this respect no retinacula could be found, it is probable that they do not occur in *Sacculina spinosa*.

There are a number of species of *Sacculina* which have excrescences of a more or less similar shape as those of *S. spinosa*. Each of these

can be distinguished from this species by special characteristics. *Sacculina echinulata* has hairs which are covered with minute hairs over their whole surface, and, moreover, the retinacula of this species are very typical. *S. nodosa* and *S. muricata* differ from *S. spinosa* by their position of the testes in the visceral mass. In *S. exarcuata* the testes occupy approximately the same part of the body as in *S. spinosa*, but in the former species there is a gradual transition of the testes into the vasa deferentia. Moreover *S. exarcuata* is characterized by typical retinacula of a very simple form. *Sacculina brevispina* has testes which differ from those of *S. spinosa* by their longer shape and gradual transition into the vasa deferentia, and, moreover, by its retinacula.

It is difficult to describe the differences between *Sacculina spinosa* and *S. hirsuta*, though undoubtedly the two forms constitute distinct species. The excrescences of the external cuticle of the mantle of all the specimens of *S. spinosa* possess a thickened basal part, which does not occur in the excrescences of *S. hirsuta*. The testes are very similar in both species, also the colleteric glands. In all specimens of *Sacculina hirsuta* the latter protrude above the surface of the visceral mass, with a rounded margin. This peculiarity is also found in the specimen of *S. spinosa* on *Pilumnus hilarulus* (fig. 28 *a*), whilst in the specimens on *Pleistacantha sancti-johannis* the glands are not so sharply limited against the visceral mass. The only differences between the two species, therefore, are those of the excrescences of the mantle.

Sacculina spinosa is known from the East Indies and from Japan, *Sacculina hirsuta* has been found in the West Indies only. This also makes it probable that the two forms are specifically distinct.

Sacculina hirsuta Boschma.

Sacculina hirsuta Boschma 1925.
S. Thomas (West Indies). 1 ex. on *Pilumnus dasypodus* Kingsley.

The specimen has a more or less oval shape: its breadth (5.5 mm) is slightly more than its height (4 mm); the thickness is 2.5 mm approximately. The surface of the mantle is comparatively smooth with the exception of a few furrows at the anterior margin (fig. 7 *j*). The mantle opening lies at the top of a small tube, in the middle of the anterior region. As the parasite was detached from the crab, it is not known which surface was directed towards the thorax of the crab. Probably this was the figured surface, as the other side has a short

median groove, which may have been formed by pressure of the abdomen of the crab against the parasite.

From the series of longitudinal sections, which has been made of this specimen, little can be learned of the internal anatomy, as the specimen is in a rather badly preserved state. There are, however, sufficient details left to show that the testes are lying in the muscular

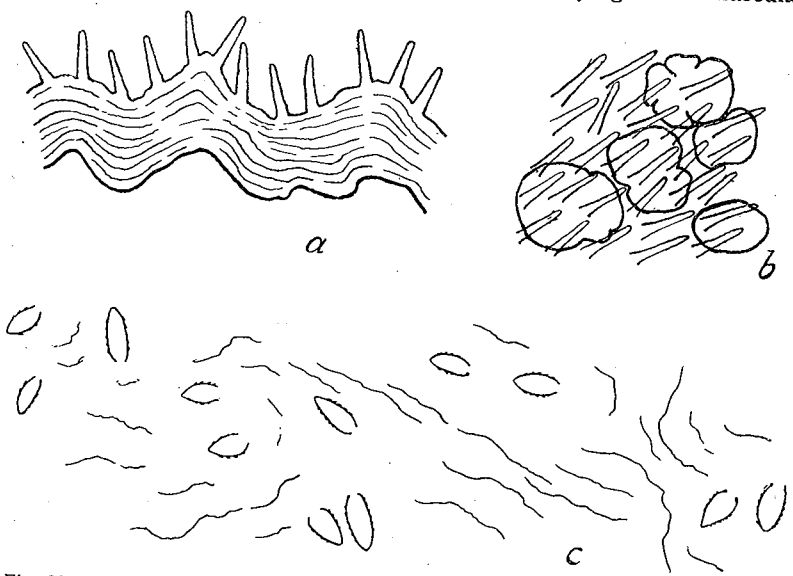

Fig. 30. *Sacculina hirsuta*. *a*, section of the external cuticle. *b*, excrescences of the external cuticle, seen from above, and calcareous corpuscles in the cuticle. *c*, internal cuticle with a row of retinacula. All figures × 530.

mass of the posterior region, they are not contained in the visceral mass itself.

The colleteric glands of this specimen could not be studied.

The external cuticle of the mantle has a thickness of approximately 25 μ, it is covered with small hairs, which usually have a smooth surface, but sometimes possess a few minute lateral hairs (fig. 30 *a*, *b*). These excrescences of the cuticle have a length which varies from 12 to 18 μ. In some places the external cuticle contains a large number of calcareous corpuscles (fig. 30 *b*), which may fuse to irregular compounds. These corpuscles usually have a diameter of about 30 μ.

On the thin internal cuticle numerous retinacula are present. These excrescences do not possess a basal part: they consist of isolated

spindles, which have a length of 9 to 16 μ and a thickness of about 6 μ. They are distinctly barbed. The retinacula are found in more or less straight lines on the internal cuticle, in the areas between these lines they do not occur. A part of one of these lines is represented in fig. 30 *c*.

The excrescences of the external cuticle are rather different from those of the type specimen of *Sacculina hirsuta* (cf. Boschma, 1925). In the specimen from S. Thomas they consist of smooth, rather stiff hairs, whilst in the type specimen (from Curaçao) the hairs have a weaker appearance, and, moreover, they are covered with numerous small lateral hairs.

In the collection of Rhizocephala of the United States National Museum, which I have studied for a part till now, there is a specimen on *Pilumnus dasypodus* from S. Thomas, which undoubtedly is a representative of the same species as the specimen dealt with here. It has excrescences of the same shape and size, a number of which bear a few lateral hairs. Moreover from this specimen the internal anatomy is known in detail and this leaves no doubt as to the identity of this specimen with *Sacculina hirsuta*. The testes are fairly large, situated in the muscular region outside the visceral mass, they are more or less globular with a short vas deferens, whilst the colleteric glands protrude above the surface of the visceral mass in quite a similar way. Even the attachment of the visceral mass to the muscular region of the posterior part of the body shows a corresponding peculiarity: this place of attachment in both specimens has shifted slightly to one side of the muscular region.

The anatomy of the specimen of the present material is imperfectly known: only a part of the male organs is visible. But as this part occupies a corresponding place to that of the testes in the specimen of the United States National Museum and as, moreover, the excrescences of the cuticle correspond closely, I do not hesitate to unite the two specimens as one species. Notwithstanding the differences of the excrescences of the cuticle of these two specimens from those of the type specimen there is sufficient evidence to identify them as *Sacculina hirsuta*.

The differences of this species from *S. spinosa* have been mentioned under the latter species. In *Sacculina exarcuata* and *S. brevispina*, species in which the testes are found in the muscular region of the posterior part of the body, these organs form tubes which

gradually pass into the vasa deferentia; by this peculiarity they are easily to be distinguished from *S. hirsuta*. It is a remarkable fact that in these three species the retinacula consist of more or less scattered spindles.

In the two other species with excrescences which are similar to those of *S. spinosa*, viz., *S. nodosa* and *S. muricata*, described in the present paper, the testes are embedded in the visceral mass, by which characteristic they differ sufficiently from *S. spinosa*.

Sacculina bicuspidata nov. sp.

Dr. Th. Mortensen's Pacific Expedition, Tobago (B. W. I.), coral reef, IV. 1916. 1 ex. on *Microphrys bicornutus* Latr.

The parasite has a more or less triangular shape, the posterior part forms an approximately straight line, whilst the sides of the triangle are more or less curved. The mantle opening lies at the extremity of a rather long tube (fig. 7 *l*). The dimensions of the specimen are: breadth 6, height 5.5, and thickness 2.5 mm approximately. The surface of the mantle is rather smooth, somewhat uneven at the sides of the triangle, whilst a deep median groove is found at the surface which was lying against the abdomen of the crab; this groove has developed as a result of the pressure of this part of the host on the parasite.

The testes (fig. 31 *a*) are lying in the muscular mass at the posterior part of the body, they terminate with somewhat tortuous, narrow vasa deferentia.

The colleteric glands (fig. 31 *b*) consist of a small number of comparatively wide tubes, they are found in the anterior half of the visceral mass.

Besides a very small quantity of ripe eggs the visceral mass contains only groups of extremely young egg cells. The whole organ is more or less shriveled, probably the eggs in the mantle cavity had just left the ovary when the specimen was preserved. With the exception of the sphincter of the mantle opening the mantle is not strongly muscular.

The external cuticle of the mantle, which has a thickness of about 25 μ, is in many parts almost smooth (fig. 32 *a*), its surface being only slightly ragged, without forming excrescences of definite shape. In other parts of the cuticle (fig. 32 *b*) this chitinous layer possesses

small excrescences of irregular shape, which may attain a length of 6 μ. There is only a gradual difference between the two types.

No retinacula have been found on the internal cuticle of this specimen.

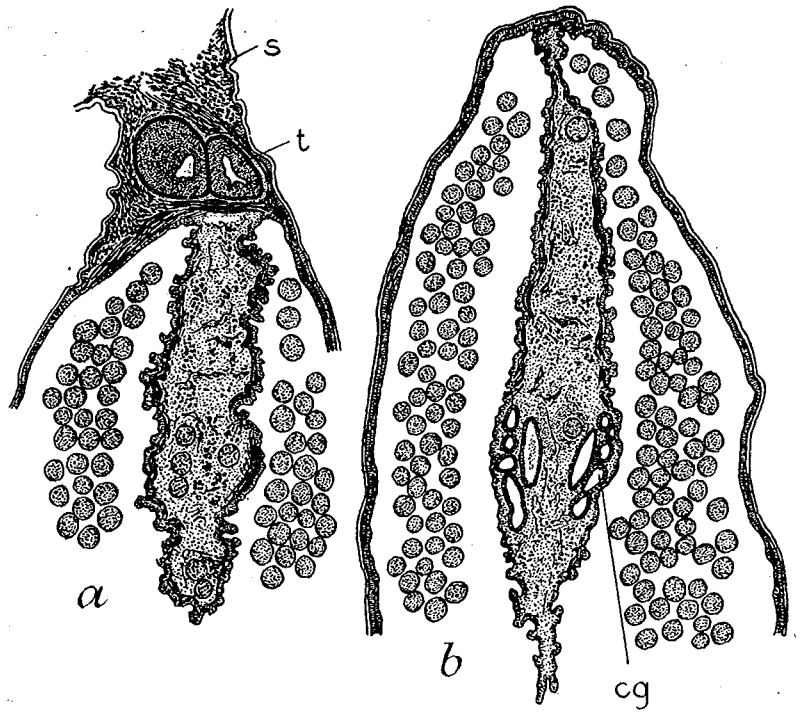

Fig. 31. *Sacculina bicuspidata*. *a*, part of a longitudinal section through the stalk (*s*); *t*, testis. × 26. *b*, part of another longitudinal section of the same specimen, showing the colleteric glands (*cg*). × 26.

As the external cuticle of the mantle does not possess characteristic excrescences, it is in some cases difficult to describe the differences of *Sacculina bicuspidata* from other species which have a smooth or almost smooth cuticle. In the following lines these species are dealt with.

Sacculina flexuosa is a species in which the testes are very similar to those of *S. bicuspidata*: they are found in the same part of the body and pass gradually into the vasa deferentia. In *S. flexuosa* these organs remain more widely apart than in *S. bicuspidata*; in the latter species they are lying closely together for a part of their length. More-

over the colleteric glands are different in the two species: in *S. flexuosa* they consist of an enormous number of tubes, whilst in those of *S. bicuspidata* there are a few tubes only.

Sacculina pustulata differs from *S. bicuspidata* by the structure of its cuticle (cf. Boschma, 1925), and, besides, in the former species one of the testes is rudimentary. In *S. rugosa* v. K. & B. and *S. sulcata* v. K. & B. the globular testes pass rather abruptly into the vasa deferentia.

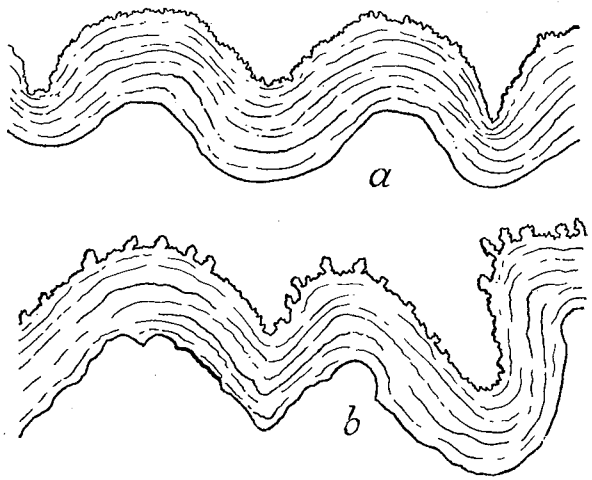

Fig. 32. *Sacculina bicuspidata*. *a*, and *b*, sections of the external cuticle from different parts of the mantle. × 530.

It is difficult to state the differences of *S. bicuspidata* from *S. anceps*, the variable species described in the present paper, but already its aberrant shape distinguishes this species from the other species of the genus.

In *Sacculina glabra* v. K. & B., *S. margaritifera* v. K. & B., and *S. caelata* of the present paper the testes are found in the true visceral mass, which distinguishes these species from *S. bicuspidata*.

Sacculina flexuosa Kossm.

Sacculina flexuosa Kossmann 1874.
Sacculina flexuosa van Kampen and Boschma 1925.
Sacculina flexuosa Boschma 1928 *c*.
Jap (Caroline Islands), Hartmann, 1880. 1 ex. on *Plagusia depressa* (Fabr.).
Locality unknown. 1 ex. on *Plagusia depressa* (Fabr.).

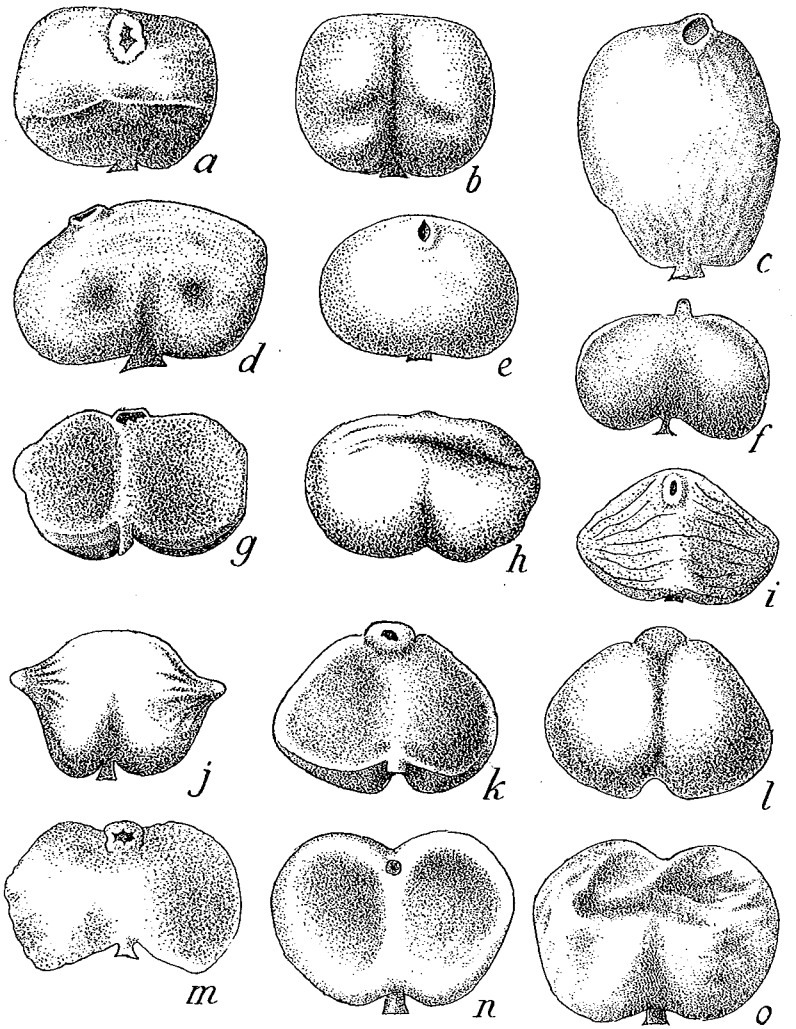

Fig. 33. Sacculinidae. *a*, *Heterosaccus ruginosus*, specimen from *Lissocarcinus*, thoracal surface, × 4.5. *b*, the same specimen, abdominal surface, × 4.5. *c*, *Sacculina anceps*, thoracal surface, × 3.75. *d*, *Sacculina flexuosa*, specimen from the Carolines, abdominal surface, × 3. *e*, *Drepanorchis fabacea*, specimen from *Achaeopsis superciliaris*, thoracal surface, × 7.5. *f*, *Sacculina flacca*, abdominal surface, × 7.5. *g*, *Heterosaccus ruginosus*, specimen from *Thalamita*, thoracal surface, × 3.5. *h*, the same specimen, abdominal surface, × 3.5. *i*, *Loxothylacus panopaei*, specimen from *Tetraplax quadridentata*, thoracal surface, × 7.5. *j*, *Loxothylacus panopaei*, specimen from *Panopeus occidentalis*, thoracal surface, × 7. *k*, *Loxothylacus carinatus*, specimen from *Lissocarcinus polybioides*, thoracal surface, × 5.25. *l*, the same specimen, abdominal surface, × 5.25. *m*, *Loxothylacus carinatus*, specimen from *Neptunus* (*Hellenus*) *hastatoides*, thoracal surface, × 3.75. *n*, *Loxothylacus desmothrix*, thoracal surface, × 7. *o*, the same specimen, abdominal surface, × 7. Cf. fig. 7, note.

The specimen from the Carolines has a breadth of 12 mm, a height of 8 mm, and a thickness of 3 mm. Its surface is more or less wrinkled, especially at the anterior margin. The posterior part of the surface which was lying against the abdomen of the crab has a median groove. The mantle opening lies at some distance from the middle of the anterior region, at the top of a small papilla with rather thick walls.

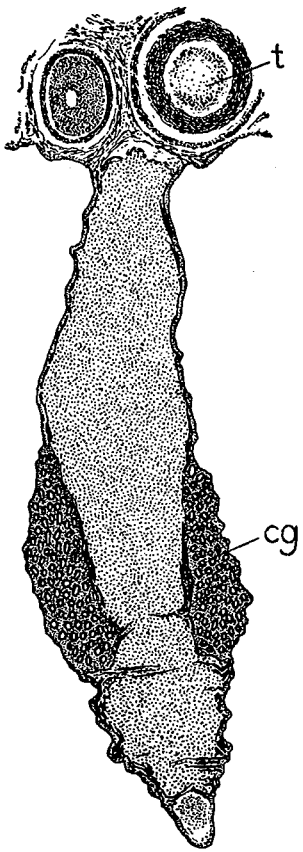

Fig. 34. *Sacculina flexuosa*, longitudinal section. *cg*, colleteric gland; *t*, testis. × 26.

In the specimen from unknown locality the mantle opening lies comparatively far from the middle of the anterior region (fig. 33 *d*). The surface of the mantle is smooth with the exception of shallow grooves and pits where the parasite was in narrow contact with its host. The dimensions of this specimen are: breadth 11 mm, height 6.5 mm, and thickness 3 mm.

Longitudinal sections have been made from the specimen from the Carolines. The visceral mass is rather badly preserved, but the colleteric glands are still present in their original position. Many of the muscles surrounding the testes are lost, but these organs are still connected with the muscular layer which covers their anterior surface and unites them with the visceral mass.

The testes, which are situated in the muscular region near the stalk, are of fairly large size (fig. 34). The vasa deferentia are wide, they consist of tubes of slightly smaller sizes than the testes. The cavity of the vasa deferentia is strongly tortuous, especially in the ventral part. This part is lying against the dorsal region of the visceral mass, so that the male genital openings are found at some distance from the muscular region of the body.

The colleteric glands are found in the anterior half of the lateral

surfaces of the visceral mass, they consist of an extensive number of small tubes (fig. 34).

The mantle cavity contains a large quantity of eggs. The mantle is rather muscular, the sphincter of the mantle opening is not very strongly developed.

The external cuticle of the mantle of the specimen from the Carolines

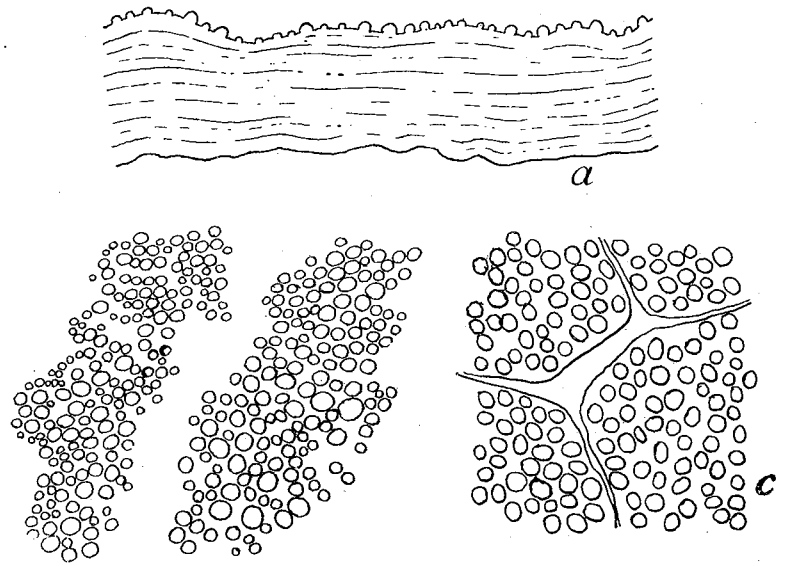

Fig. 35. *Sacculina flexuosa*. *a*, section of the external cuticle of the specimen from the Carolines. *b*, external cuticle of the same specimen, seen from above. *c*, external cuticle of the specimen from unknown locality, seen from above. All figures × 530.

has a thickness of about 40 μ. Its surface is covered with small circular wart-like excrescences, which may attain a diameter of 6 μ, but usually are much smaller (fig. 35 *a*, *b*). As a rule these excrescences are found in small patches (size of these patches from 40 to 100 μ), which are separated by areas in which the cuticle is quite smooth (fig. 35 *b*).

On the whole the external cuticle of the specimen from unknown locality has the same structure as that of the other specimen. Here the areas which are covered with the small excrexcences may be separated from each other by grooves or small fissures of the upper layers of the cuticle (fig. 35 *c*).

In none of the specimens retinacula could be found on the thin internal cuticle of the mantle.

With the exception of the excrescences of the external cuticle (which are too insignificant to be regarded as characteristics of great value) the structure of the two specimens agrees closely with that of another specimen from *Plagusia depressa*, described in a previous paper (Boschma, 1928 *c*). This specimen also is much broader than long, but the mantle opening has a more median position (l. c., fig. 1 *e*). More important is the fact that the internal anatomy corresponds almost in every detail. In the specimen of the present collection from which sections have been made a larger part of the testes is contained in the muscular region of the posterior part of the body than in the specimen from the Leiden Museum. In this respect the specimen of the Copenhagen Museum resembles the typical specimens of *S. flexuosa* (those on *Grapsus strigosus*) more closely. A special characteristic of *S. flexuosa* is also the abundance of tubes in the colleteric glands, a feature which is distinctly present also in the specimen from the Carolines.

The structure of *Sacculina flexuosa* is strongly alike to that of *S. bicuspidata*; it can be distinguished from the latter species by its colleteric glands which have such a large number of tubes. As concerns the differences from other species with a smooth or almost smooth cuticle, these are the same for *S. flexuosa* and *S. bicuspidata*, and are dealt with under the latter species.

Sacculina flacca nov. sp.

Danish Expedition to the Kei Islands, off Kombir, Banda, ca. 70—90 m, sand, dredge, 6. VI. 1922. 1 ex. on *Galathea* sp. (species unidentified, as the legs are failing).

The specimen belongs to the genus *Sacculina*, although it was living as a parasite on *Galathea*. It is a rather flat and delicately built specimen. Its dimensions are: breadth 3, height 2.5, and thickness 1 mm approximately. The mantle is almost transparent, it shows no definite grooves or wrinkles. The mantle opening lies at the top of a rather prominent papilla at the anterior end (fig. 33 *f*), the stalk is very thin.

The testes are found in the region of the stalk, outside the visceral

mass itself (fig. 36 *a*). The specimen has been cut into a series of transverse sections, but these show clearly enough that the mantle cavity does not exist at the sides of the muscular region in which the testes are embedded. The testes are more or less globular, short and thick. The short vasa deferentia open into the mantle cavity.

The colleteric glands (fig. 36 *b*) are found in the anterior half of

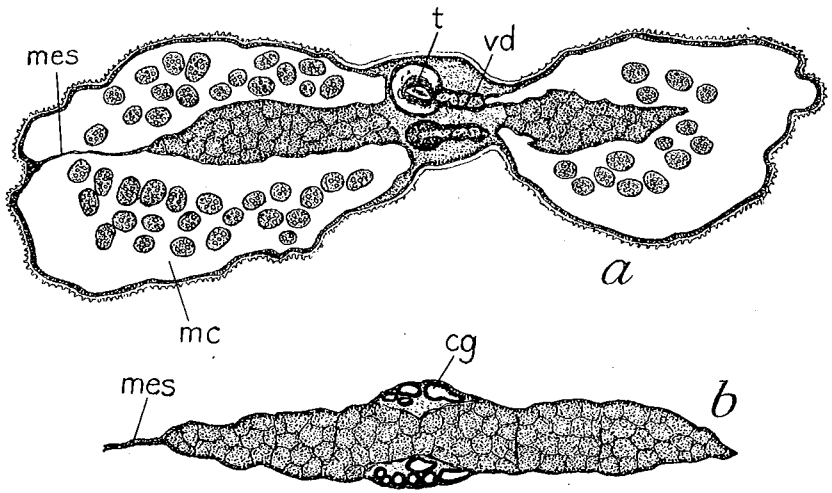

Fig. 36. *Sacculina flacca*. *a*, transversal section from the posterior region. *mc*, mantle cavity; *mes*, mesentery; *t*, testis; *vd*, vas deferens. × 36. *b*, transversal section through the colleteric glands (*cg*). *mes*, mesentery. In this figure the mantle has been omitted. × 36.

the visceral mass; they contain a comparatively small number of tubes.

In the mantle cavity a number of eggs are found. The mantle opening is surrounded by a strong sphincter, the muscles of the mantle itself are very poorly developed.

The external cuticle of the mantle, which is very thin (3 to 6 μ) bears numerous papillae of an irregular appearance. In different parts of the cuticle the height of these excrescences varies from 6 to 14 μ (fig. 37). In some parts of the cuticle the papillae are broad and blunt, in other parts they are slenderer and possess a more or less pointed extremity. The surface of these papillae is quite smooth, they do not possess lateral hairs or spines.

On the thin internal cuticle no retinacula have been found.

Sacculina flacca is the first parasite of a Galatheid which beyond any doubt belongs to the genus *Sacculina*. The specimen of the Siboga Expedition (*Sacculina* sp. on *Munida curvirostris*) is badly preserved, and consequently its anatomy is unknown. The specimen of *S. flacca*, however, is excellently preserved and the sections show clearly that the specimen belongs to the Sacculinidae. Especially the colleteric

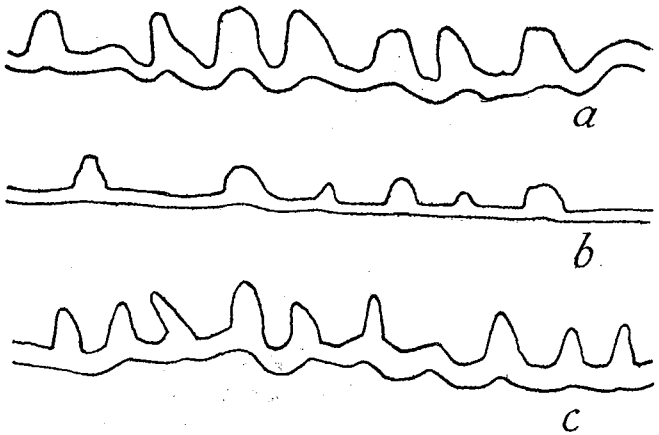

Fig. 37. *Sacculina flacca*. Sections of three different parts of the external cuticle. × 530.

glands with the branched tubes prove that it is a representative of this family, the straight testes and the complete mesentery are characteristics which place the specimen in the genus *Sacculina*.

In other species of the genus in which the cuticle is covered with papillae of approximately the same size as those of *S. flacca* these are covered with lateral hairs, whilst in *S. flacca* they are quite smooth.

In *Sacculina angulata* the papillae of the external cuticle have approximately the same size as in *S. flacca*. In the former species, however, the papillae are placed closely together and have a flat surface, whilst in *S. flacca* they are sparsely distributed on the surface of the cuticle and have a more or less rounded extremity.

Sacculina anceps nov. sp.

Coast of Java(?)[1]), VI. 1906, Hjalmar Jensen. 6 ex. on *Albunea symnista* (L.).

The parasites have an oblong shape (fig. 33 *c*), the greater diameter is that from the stalk (the posterior extremity) to the mantle opening

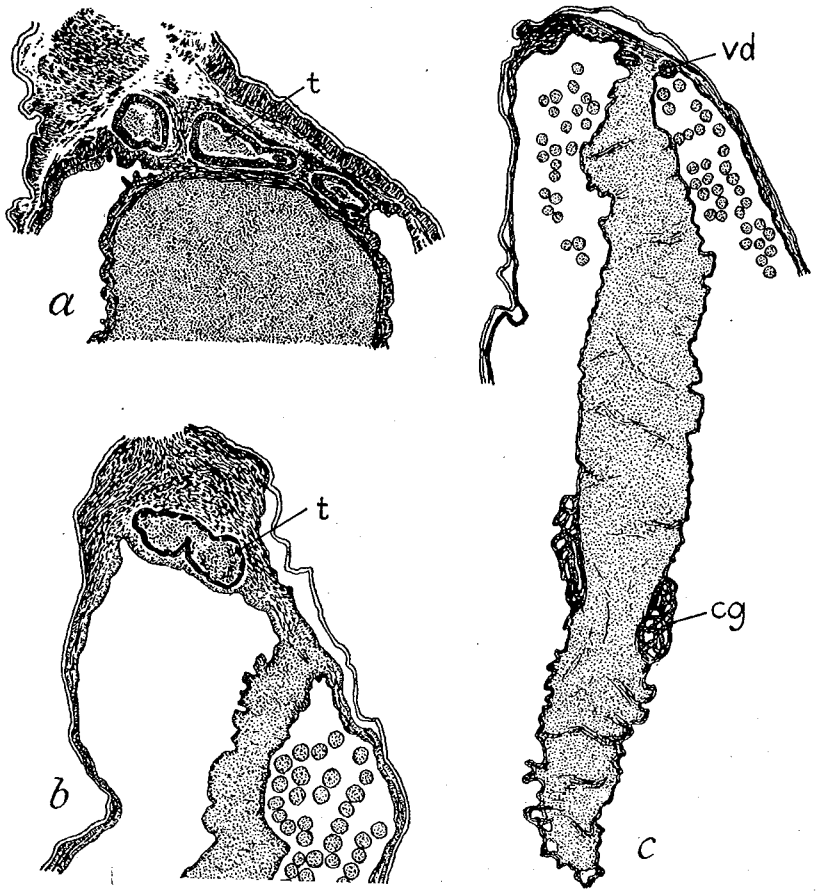

Fig. 38. *Sacculina anceps*. *a*, part of a longitudinal section. *t*, testis. × 26. *b*, part of a longitudinal section of another specimen. *t*, testis. × 26. *c*, longitudinal section of the visceral mass of the same specimen. *cg*, colleteric gland; *vd*, vas deferens. × 18.

(the anterior part of the body). Breadth, height, and thickness of three of the specimens are: 5.5, 7, and 3.5; 7, 8.5, and 4; and 5.5, 9, and

[1]) The label gives as locality "Buitenzorg", which obviously is incorrect.

4 mm respectively. The surface of the mantle is smooth with the exception of some irregular furrows or wrinkles. The parts surrounding the mantle opening are very little prominent, the opening itself usually is comparatively wide.

Longitudinal sections have been made of two specimens; a third has been cut into a series of transversal sections.

The stalk is not a direct continuation of the visceral mass: it is fastened to the mantle at some distance from the insertion of the visceral mass to the mantle. In different specimens there is a slight variability in this respect, as a comparison of fig. 38 *a* and *b* shows.

The testes are found in the muscular region from which the stalk takes its origin (fig. 38 *a*, *b*). In one of the specimens the two testes form separate tubes for the whole of their extent, in the other one the median portion of the testes is united so as to form a tube which has a single cavity. Consequently in this respect also the specimens are rather variable.

The colleteric glands (fig. 38 *c*) are found in the anterior half of the visceral mass, not far from the central part of the lateral surfaces of the visceral mass. The number of tubes in these glands is variable in the different specimens, but it is always a moderate number: not uncommonly few and not an exceedingly large quantity.

In one of the three specimens from which sections have been made the mantle is more strongly muscular than in the other two. The same holds true for the sphincter of the mantle opening.

The surface of the external cuticle of the mantle is comparatively smooth, only with a high power one sees that it has a somewhat ragged appearance (fig. 39). In one specimen an outer layer is present above the layer of chitin which is in contact with the epithelium of the mantle, this outer layer is very thin (6 μ) and nearly smooth.

The thickness of the external cuticle is different in different specimens and varies also in different parts of the same specimen. This thickness varies from 14 to about 26 μ. The irregular surface of the uppermost layer of the external cuticle is caused by numerous small cracks and grooves. Cross sections of different parts of this cuticle vary in appearance as a result of the different number of these grooves in a certain area.

Retinacula could not be found on the slides of parts of the internal cuticle of different specimens.

Sacculina anceps differs from the other species of the genus already by its external form: in contradistinction to other species its greater diameter is found in the longitudinal axis of the body.

From most of the other species of the genus which like *S. anceps* have a smooth or an almost smooth cuticle the species can be easily distinguished by internal characteristics. *Sacculina margaritifera* Kossm., *S. glabra* v. K. & B., and *S. caelata* differ from *S. anceps* by

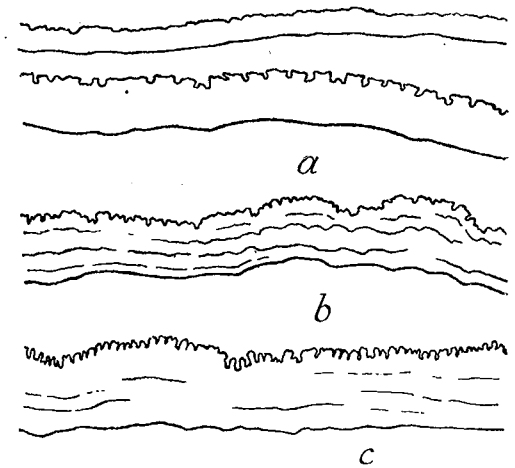

Fig. 39. *Sacculina anceps*. *a*, section of the external cuticle of a specimen in which two layers of this cuticle are present. *b*, section of the external cuticle of another specimen. *c*, section of the external cuticle of a third specimen. All figures × 530.

having their testes embedded in the visceral mass. In *S. rugosa* B. and *S. sulcata* v. K. & B., in which the testes have a position which corresponds with that in *S. anceps*, these organs are globular and pass rather abruptly into the vasa deferentia. *Sacculina pustulata* B. is characterized by the fact that one of the testes is rudimentary, at least a great deal smaller than the other, whilst in *S. anceps* the testes have approximately the same size.

The anatomy of *S. anceps* is very similar to that of *S. flexuosa* Kossm. and *S. bicuspidata*, described in the present paper. In these two species, however, the colleteric glands differ in structure from those of *S. anceps*. In the latter species they consist of a moderate quantity of tubes, whilst *S. bicuspidata* has colleteric glands with a very small number of tubes and in *S. flexuosa* these glands contain an extraordinarily large quantity.

It is an interesting fact that *Sacculina anceps* is a parasite of *Albunea symnista*, an animal which belongs to the Anomura. This is the second case of the occurrence of a *Sacculina* on a host of this group: *Sacculina flacca* also lives on one of the Anomura (*Galathea* sp.). In the case of the specimen mentioned in the report on the material of the Siboga Expedition (*Sacculina* sp. on *Munida curvirostris*, cf. van Kampen and Boschma, 1925) the sections of the parasite do not furnish any direct evidence to which genus this specimen belongs, so that the identification as *Sacculina* sp. even remains uncertain.

Drepanorchis fabacea nov. sp.

Dr. Th. Mortensen's Pacific Expedition:

Misaki (Japan), near the Biological Station, ca. 45 m, sand, 9. VI. 1914. 1 ex. on *Achaeus japonicus* (de Haan)(?).

Off Misaki, 140—220 m, sand, tangles, 10. VI. 1914. 1 ex. on *Achaeopsis pugnax* de Man.

Sagami Sea (Japan), 140—220 m, sand, 6.—19. VI. 1914. 2 ex. on one specimen of *Achaeopsis pugnax* de Man.

Sagami Sea, 540 m, hard bottom, tangles, 29. VI. 1914. 9 ex. on *Achaeopsis superciliaris* Ortm. (one crab with two parasites).

Okinose, Sagami Sea, 180 m, hard bottom, tangles, 23. VI. 1914. 3 ex. on *Achaeopsis superciliaris* Ortm., and 3 ex. on one specimen of *Achaeopsis pugnax* de Man.

The parasites have the shape of little beans (fig. 33 *e*), as a rule they have an evenly rounded surface with a concavity at the posterior part. All of them are of small size, the measurements (breadth, height, and thickness) of three specimens are: 4, 3, and 1.5 mm; 3.5, 2.5, and 1.5 mm; and 2.5, 1.5, and nearly 1 mm respectively. The greater part of the specimens has a smooth surface, with the exception of a median furrow at the abdominal surface, which is caused by pressure of the abdomen of the crab against the parasite. In a few specimens the mantle is slightly wrinkled, especially at the anterior margin. The mantle opening is comparatively small, its wall does not project noticeably above its surroundings. This opening lies at the anterior margin of the surface which is directed towards the thorax of the host.

Longitudinal sections have been made from a specimen from *Achaeopsis pugnax* and one from *Achaeopsis superciliaris*. In both specimens one of the testes has a very large size (fig. 40 *b*), the other is but little shorter but does not attain such an enormous size. Both

testes have a curved shape, they terminate in the anterior half of the visceral mass. The vasa deferentia are found in the close vicinity of the mantle.

The colleteric glands consist of a small number of tubes. These glands do not occupy the central part of the lateral surfaces of the

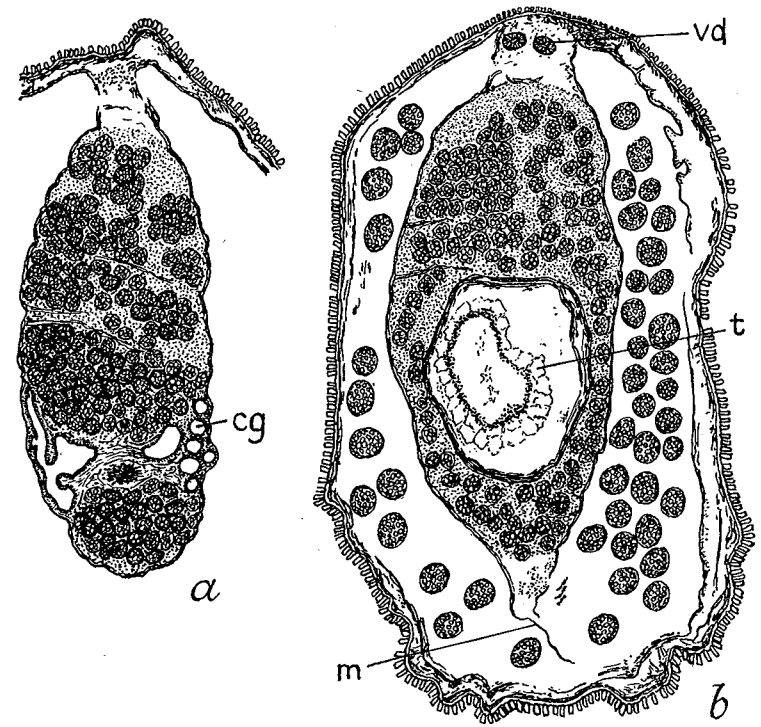

Fig. 40. *Drepanorchis fabacea*. *a*, longitudinal section of the visceral mass, showing the colleteric glands (*cg*). × 46. *b*, longitudinal section. *m*, mesentery; *t*, testis; *vd*, vas deferens. × 46.

visceral mass, but are lying at a short distance from the anterior extremity (fig. 40 *a*).

In both specimens from which sections have been made the mantle cavity contains a quantity of eggs. The musculature of the mantle, including the sphincter of the mantle opening, is less strongly developed than usually in Sacculinidae.

The external cuticle of the mantle is very thin (8 to 16 μ), it is densely covered with excrescences of a peculiar form (fig. 41). Their

structure is different from that of the cuticle itself: the latter can be easily stained, whilst the excrescences do not take the stain but keep their hyaline appearance. The central part of the excrescences is hollow and often contains some organic material. The cavity communicates with the outside by one or more canals (these are not visible in the

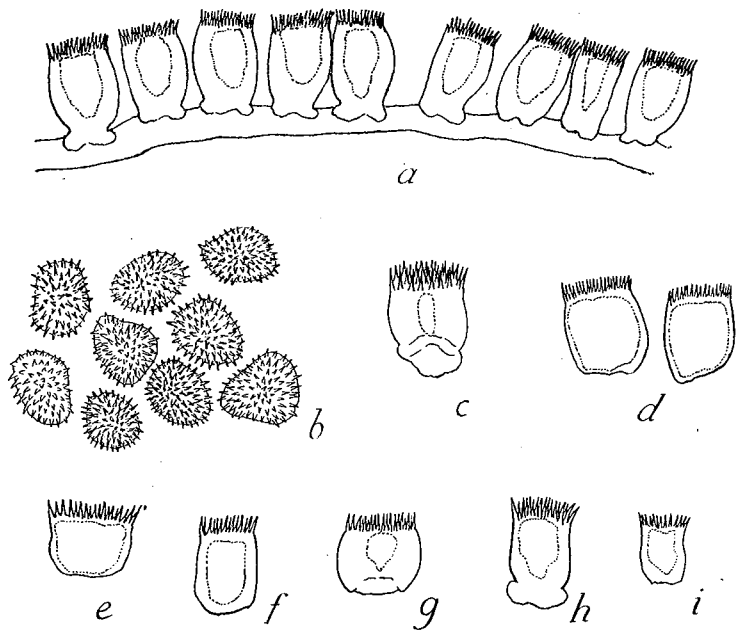

Fig. 41. *Drepanorchis fabacea*. *a*, section of the external cuticle of a specimen from *Achaeopsis superciliaris*. *b*, excrescences of the external cuticle of another specimen from *Achaeopsis superciliaris*, seen from above. *c*, *g*, *h*, and *i*, isolated excrescences from different specimens from *Achaeopsis superciliaris*. *d*, and *f*, isolated excrescences from different specimens from *Achaeopsis pugnax*. *e*, excrescence of the external cuticle of the specimen from *Achaeus japonicus*. All figures × 530.

preparations examined, but after staining the sections the contents of the cavity take the stain also). The excrescences are more or less cylindrical and are embedded with their basal part in the cuticle. This basal part may be evenly rounded or may be provided with lateral extensions. The upper surface of the excrescences is covered with a great number of minute spines. In some specimens the excrescences have a rather thick wall and a small central cavity (fig. 41 *c*, *g*), in others the chitinous matter of the excrescences is very thin (fig. 41 *d*, *e*).

The length of the excrescences varies from 18 to 30 μ, their diameter from 13 to 20 μ.

Retinacula have not been found in this species.

The mantle cavity of one of the specimens on *Achaeopsis pugnax* contains larvae (fig. 42). Some particulars of these larvae have been mentioned already in a previous paper (Boschma, 1927 *a*, with fig. 1 *a*). They are of smaller size than those of other species of Sacculinidae, their greater diameter is 165 μ approximately. In all probability the larvae of *Drepanorchis fabacea* do not possess an eye, at least no trace of pigment is present. The state of preservation of the larvae is not so excellent that one can decide with certainty that even an unpigmented eye does not occur. The shape of the body of these larvae (the first nauplius stage) does not differ in any respect from that of the larvae which are known from different species of *Sacculina*.

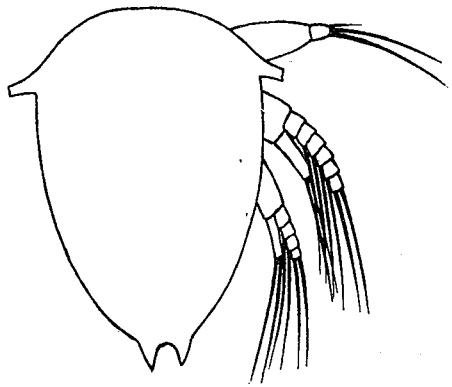

Fig. 42. *Drepanorchis fabacea*. Larva from a specimen on *Achaeopsis pugnax*. Dorsal surface. × 285.

The excrescences of the external cuticle of *Drepanorchis fabacea* are in some respects similar to those of *Loxothylacus carinatus*, specimens of which also occur among the material of the Copenhagen Museum. In the latter species, however, the excrescences have a compact pointed basal part which is fastened into a deep pit of the cuticle itself. In *D. fabacea* the basal part of the excrescences is very small and more or less flat. The distal parts of the excrescences is very similar in both species: they have a central cavity and their upper surface possesses little spines.

The anatomy of the two species is strongly different: *Drepanorchis fabacea* has an incomplete mesentery and the visceral mass is directly united with the stalk, whilst in *Loxothylacus carinatus* the visceral mass has an oblique position in the mantle cavity and the mesentery is complete. Moreover the testes are different in the two species: in

D. fabacea one is much larger and thicker than the other, and in *L. carinatus* they have approximately the same size.

The other species of the genus *Drepanorchis*, viz., *D. neglecta* (Fraisse) and *D. villosa* (v. K. & B.) are characterized by excrescences of a quite different shape: both of these species have a cuticle covered with small hairs or papillae which are provided with minute lateral hairs.

Genus ***Heterosaccus*** Smith.

Smith (1906) gave the following diagnosis of the genus: "Similar to *Sacculina*, save that the mesentery is confined to the surface of the visceral mass immediately round the ring of attachment, and does not stretch to the mantle opening. Mantle opening, in consequence, widely gaping." To this diagnosis must be added: "Testes of curved shape." The statement of a wide mantle opening does not hold true for all the species of the genus, it was a peculiarity of Smith's specimens. Krüger (1914) mentions also this characteristic for the specimen identified by him as *Heterosaccus hians*. The wide mantle opening may occur often in specimens of the genus, but it is by no means a constant peculiarity, consequently this statement cannot remain in the diagnosis of the genus. In one specimen of the Copenhagen Museum (*Heterosaccus ruginosus*, cf. fig. 33 *a*) the mantle opening is not wider than in many specimens of *Sacculina*.

In Sacculinidae with a mesentery there is a comparatively wide lacuna at the place of attachment of the mesentery to the mantle. This lacuna stretches along the whole dorsal surface, from the visceral mass to the mantle opening. In the species of the genus *Heterosaccus* this lacuna has remained, the tissue covering the lacuna then forms a kind of ridge along the inner surface of the dorsal region of the mantle.

Two species of the genus are among the material of the Copenhagen Zoological Museum. They are not easily to be distinguished from one another by specific characteristics, and the differences of the species dealt with here from the type of the genus, *Heterosaccus hians*, are unknown. Consequently it remains possible that one of the species of the present paper belongs to *H. hians*, but it is not probable. From Kossmann's (1874) statements results that in his *Sacculina hians* the colleteric glands are found in the anterior part of the visceral

mass, which does not hold true for the specimens of the present material. The material dealt with here corresponds with Kossmann's species in having testes of a curved shape. In the type species the cuticle of the mantle was wrinkled, a peculiarity which is, however, of too little value for a distinctive characteristic of the species.

Specimens of *Heterosaccus* from the Red Sea have been identified by Smith (1906) as *H. hians*. The anatomy of these specimens is imperfectly known (Smith mentions only that the mesentery is confined to the surface of the visceral mass immediately round the ring of attachment), the structure of the cuticle is unknown. The same holds true for the specimen from Japan referred by Krüger (1914) to *Heterosaccus hians*. From the specimens of the Siboga Expedition identified as *H. hians* (van Kampen and Boschma, 1925) the anatomy and the structure of the cuticle are known, but it is by no means certain that the identification of these specimens is correct. It is at least certain that the species dealt with in the following pages are distinct from the specimens of the Siboga Expedition.

Heterosaccus occidentalis (B.).

Drepanorchis occidentalis Boschma 1928 *a*.

Christianssted (S. Croix, West Indies), I. 1896, Chr. Levinsen. 2 ex. on one specimen of *Microphrys bicornutus* (Latr.).

The two specimens have approximately the same size (greater diameter 5.5 mm), they are more or less circular. One of the two possesses a deep median groove, caused by the pressure of one of the sides of the abdomen of the host. Such abnormal features are not uncommon when two or more parasites are living on the same host. The mantle is smooth, the mantle opening, which is slightly prominent, is rather wide. This opening lies at the anterior end of the parasites.

From one of the specimens longitudinal sections have been made.

The testes are found in the posterior part of the visceral mass, the closed extremity (the curved portion) lies at a short distance from the part that passes into the vas deferens.

The colleteric glands are present approximately in the central part of the lateral surfaces of the visceral mass.

The mantle cavity contains eggs.

The external cuticle of the mantle (fig. 43 *a*) has a smooth surface, which is divided into small areas of the size of the cells of the epi-

thelium which have secreted the layers of chitin (diameter of these areas 8 to 16 μ).

The internal cuticle of the mantle bears numerous retinacula which consist of a basal part and 4 to 7 spindles (fig. 43 *b*). The latter have a length of 8 μ approximately. Barbs could not be detected on these spindles.

The specimens do not differ in any important detail from those described in a previous paper (Boschma, 1928 *a*). The specimens described previously have retinacula with clearly visible barbs. That these barbs have not been found in the specimens from the Copen-

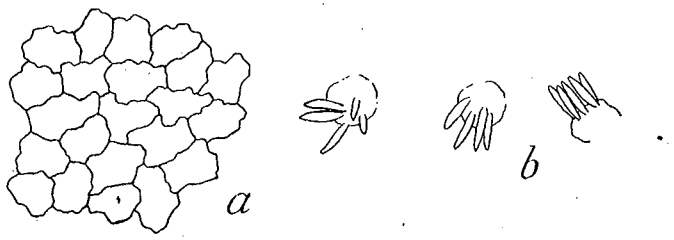

Fig. 43. *Heterosaccus orientalis*. *a*, external cuticle, seen from above. *b*, retinacula. Both figures × 530.

hagen Museum does not prove that they do not exist: these minute barbs cannot always be detected in specimens belonging to species from which barbed retinacula are known.

It is difficult to describe the differences between *Heterosaccus occidentalis* and *H. ruginosus*, described in the present paper. In fact, it is not altogether certain whether the two forms are specifically distinct or not, but they do not correspond closely enough to unite them as yet as one species. The shape and the position of the testes and the colleteric glands is approximately alike in both species. The unusual position of the colleteric glands in one of the specimens of *H. ruginosus* may be due to individual variation. The number of tubes in the colleteric glands is fairly uniform in the specimens of both species examined in this respect. The retinacula have approximately the same shape, and, moreover, in *H. ruginosus* they are found in large numbers, just as in *H. occidentalis*. The only difference is that of the structure of the external cuticle. In *H. occidentalis* always distinct areas are visible, whilst in *H. ruginosus* these have been found in one specimen only, and not in many parts of the cuticle.

In the specimen of *H. ruginosus* from *Thalamita* the visceral mass is united with the mantle at some distance of the stalk (fig. 46 *c*), a peculiarity recalling that found in the genus *Loxothylacus*. It is not certain that this manner of attachment of the visceral mass to the mantle is found also in the specimen of *H. ruginosus* from *Lissocarcinus*: in the latter specimen the mantle is too badly preserved.

In *Heterosaccus occidentalis* the muscular mass from which the stalk takes its origin is in distinct contact with the visceral mass. It is possible that the two species may be distinguished from each other by this characteristic.

In none of the species of *Heterosaccus* dealt with in the present paper there are "canals" in the external cuticle, as those of the specimens of the genus described by van Kampen and Boschma (1925) and identified as *Heterosaccus hians* (Kossm.).

Heterosaccus ruginosus nov. sp.

Singapore, coral reef, 5. XII. 1899, Dr. Th. Mortensen. 1 ex. on *Thalamita prymna* (Herbst).

Danish Expedition to the Kei Islands, Amboina, ca. 2 m, 10. II. 1922. 1 ex. on *Lissocarcinus pulchellus* Müller.

The specimen on *Lissocarcinus* is slightly oval in shape, its dimensions are: breadth 6, height 4.5, and thickness 3 mm. The mantle opening is found at the anterior part of the surface which was lying against the thorax of the crab, it is surrounded by a strongly muscular wall. The surface of the mantle is smooth with the exception of a ridge and a few grooves at the "thoracal" surface, whilst the surface which was covered by the abdomen of the crab possesses a deep median furrow (fig. 33 *a*, *b*).

The testes, which are of fairly large size, are contained in the posterior part of the visceral mass (fig. 44 *b*).

The colleteric glands are found in the central part of the lateral surfaces of the visceral mass, they protrude slightly above their surroundings (fig. 44 *a*). Each colleteric gland consists of a moderate number of tubes, which are wide in the proximal part and divide into many small ones in the distal region of the glands.

The mantle cavity contains eggs.

The specimen is rather badly preserved, especially the mantle. The internal cuticle of the mantle is distinctly visible, this layer does

not form a connection between the visceral mass and the mantle, so that it is certain that a mesentery does not occur. Of the musculature of the mantle only small parts are left.

The external cuticle of the mantle is very thin (thickness about

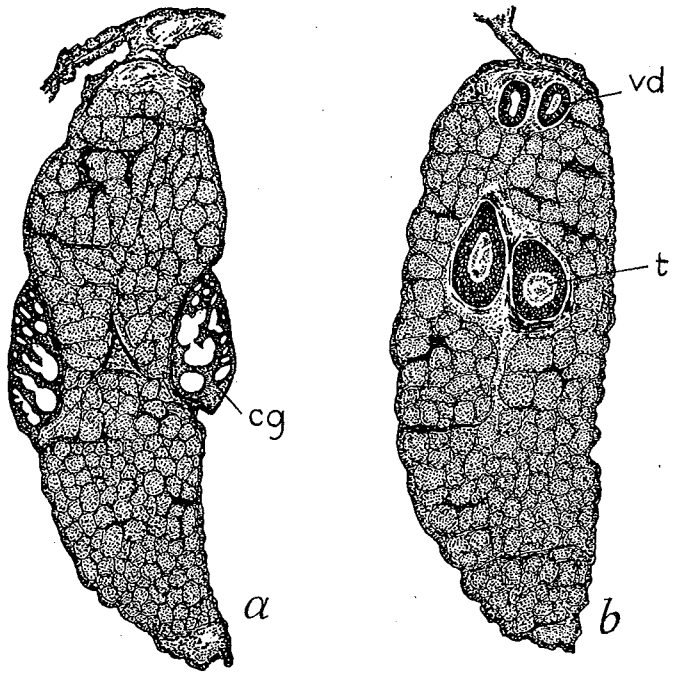

Fig. 44. *Heterosaccus ruginosus*, longitudinal sections of the visceral mass of the specimen from *Lissocarcinus*. *a*, approximately median section, showing the colleteric glands (*cg*). *b*, section of the dorsal part, showing the testes (*t*) and the vasa deferentia (*vd*). × 36.

5 μ), it does not possess excrescences. Its surface is almost smooth, only a little wrinkled in some parts (fig. 45 *a*).

The internal cuticle is densely covered with retinacula, which consist of a basal part and 3 to 5 spindles (fig. 45 *b*, *c*); the latter have a length of about 14 μ and possess distinctly visible barbs.

The parasite of *Thalamita* has the following dimensions: breadth 9, height 5, and thickness about 2 mm. The mantle opening is comparatively large, it is situated at the anterior margin, opening towards the thorax of the crab. This surface is rather flattened, the other

surface shows a few deep grooves (fig. 33 *g*, *h*), one in the anterior part, the other in the vicinity of the stalk.

Fig. 46 *a* represents a section of the ventral part, showing that there is no mesentery. There is a lacuna at the margin of the ventral surface as in other species of the genus.

The visceral mass is not inserted at the mantle in the region of the stalk, but in a somewhat oblique manner (fig. 46 *c*).

The testes are fairly large, they are found in the posterior part of the visceral mass. In fig. 46 *b* the curved part of one of the testes

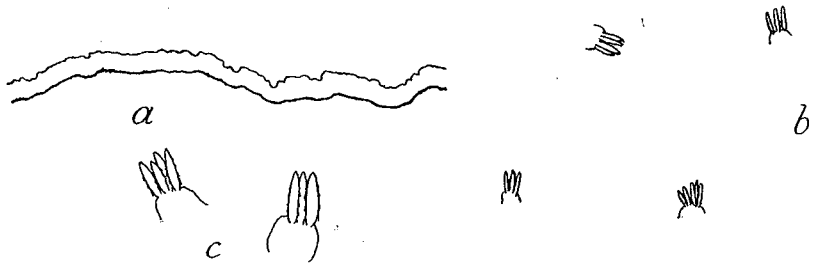

Fig. 45. *Heterosaccus ruginosus*, specimen from *Lissocarcinus*. *a*, section of the external cuticle of the mantle. × 530. *b*, retinacula, as these are distributed on the internal cuticle. × 300. *c*, retinacula. × 530.

(the left) is visible, at the other side the testis and the vas deferens of the right side.

The colleteric glands (fig. 46 *c*) are found in the posterior half of the visceral mass, which is a very exceptional case among the Sacculinidae. They consist of a moderate number of branched tubes.

The large mantle cavity contains a great quantity of eggs. The musculature of the mantle as a whole is rather thin, but the sphincter of the mantle opening is well developed.

The external cuticle of the mantle is very thin (thickness varying between 6 and 16 μ in different parts of the mantle). The surface of the cuticle also shows different aspects when different parts of this chitinous layer are examined. In some places (fig. 47 *d*) distinct small areas are to be seen, corresponding in size with that of the epithelium cells of the mantle (diameter 6 to 12 μ). In other parts of the cuticle the surface is slightly wrinkled (fig. 47 *c*). In such wrinkled parts as well as in quite smooth parts of the cuticle only exceptionally the small areas of fig. 47 *d* are visible. Sections of wrinkled parts of the

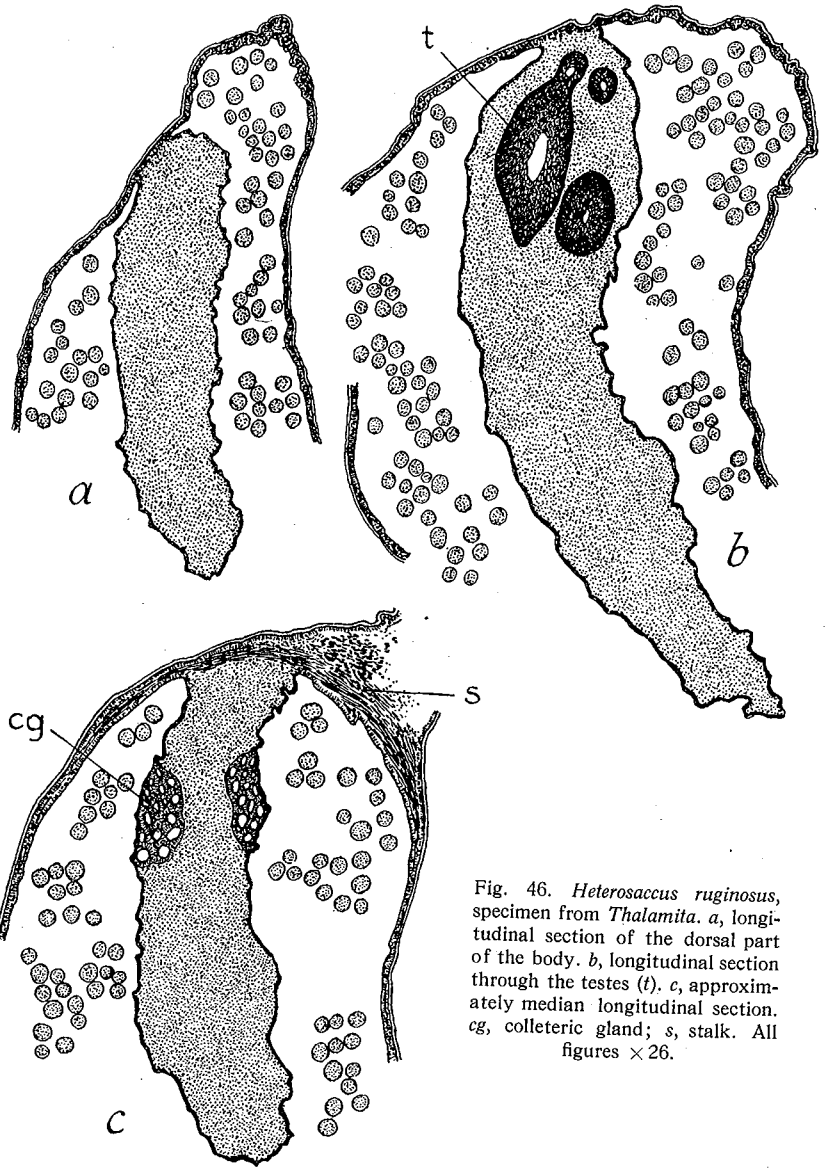

Fig. 46. *Heterosaccus ruginosus*, specimen from *Thalamita*. *a*, longitudinal section of the dorsal part of the body. *b*, longitudinal section through the testes (*t*). *c*, approximately median longitudinal section. *cg*, colleteric gland; *s*, stalk. All figures × 26.

cuticle show a number of grooves (fig. 47 *a*), which may have a different depth. When these grooves are rather strongly developed the surface may obtain a more or less ragged appearance (fig. 47 *b*), but excrescences of definite shape are nowhere present.

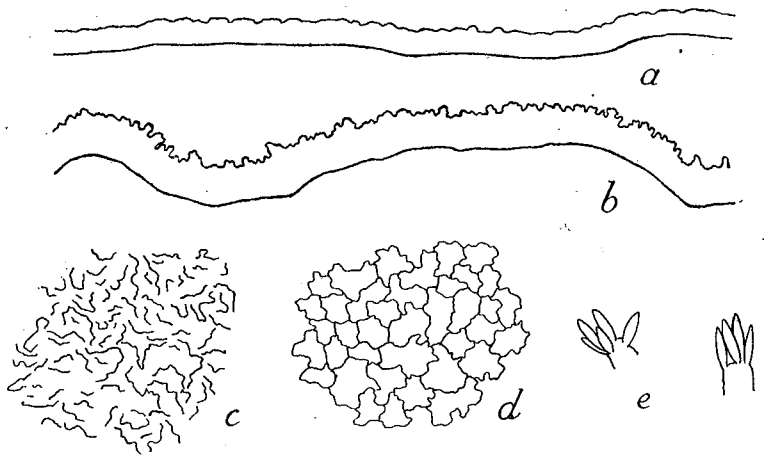

Fig. 47. *Heterosaccus ruginosus*, specimen from *Thalamita*. *a*, and *b*, sections of different parts of the external cuticle. *c*, and *d*, different parts of the external cuticle, as seen from above. *e*, retinacula. All figures × 530.

The internal cuticle of the mantle bears retinacula which consist of a basal part and 3 to 5 spindles (fig. 47 *e*). On the latter no barbs could be seen, they have a length of about 12 μ.

For the slight differences of *Heterosaccus ruginosus* from *H. occidentalis* I refer to the preceding pages.

Loxothylacus panopaei (Gissl.).

Sacculina panopaei Gissler 1884.

Loxothylacus panopaei Boschma 1928 *a*.

Off Puerto Cabello (Venezuela), mud, 10. XII. 1897, H. Kiær. 1 ex. on *Tetraplax quadridentata* (Rathb.).

Christianssted (S. Croix, West Indies), lagoon, 1898, H. Kiær. 1 ex. on *Panopeus occidentalis* Sauss.

Christianssted, lagoon, I. 1896, Chr. Levinsen. 7 ex. on *Panopeus occidentalis* Sauss. (one crab with 3 parasites).

Christianssted, depth ca. 0.5 m, 10. I. 1906, Dr. Th. Mortensen. 1 ex. on *Panopeus occidentalis* Sauss.

Dr. Th. Mortensen's Pacific Expedition, Dodds Narrows, Nanaimo (British Columbia), coast, low tide, 28. VI. 1915. 3 ex. on *Lophopanopeus bellus* (Stimps.) (two parasites on one crab).

The shape of the specimens is very variable: some are more or less globular (cf. Boschma, 1928 *a*, fig. 4 *c*, *d*), others have strongly pronounced excrescences at each side of the body (fig. 33 *j*), or are intermediate between those two forms (fig. 33 *i*).

The mantle may be smooth to the naked eye or show a number of irregular grooves (fig. 33 *i*). In some specimens the mantle opening lies at the extremity of a small tube-like excrescence of the mantle, in other specimens it is surrounded by a muscular mass which does not project above its vicinity. The dimensions of one specimen are: breadth 5.5, height 4.5, and thickness 2 mm, the corresponding dimensions of two other specimens are: 4, 2.5, and 1.5 mm; and 3.5, slightly more than 2, and nearly 1 mm respectively.

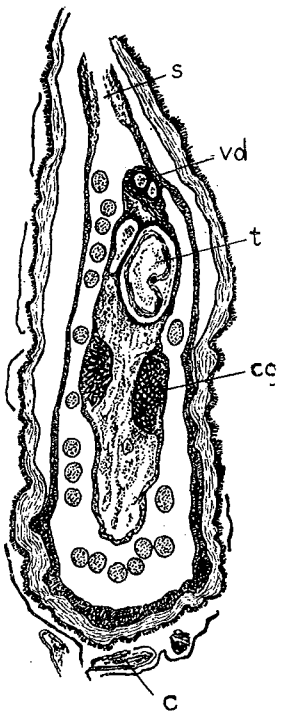

Fig. 48. *Loxothylacus panopaei*, specimen from *Tetraplax quadridentata*, approximately median longitudinal section. *c*, cypris larva; *cg*, colleteric gland; *s*, stalk; *t*, testis; *vd*, vas deferens. × 36.

From four specimens longitudinal sections have been made: from the specimen on *Tetraplax*, that on *Lophopanopeus* and two on *Panopeus*. The anatomy of these specimens in general shows exactly the same particulars. Usually one of the testes is somewhat larger than the other (fig. 48), these organs are found in the posterior part of the visceral mass, the vasa deferentia in the close vicinity of the mantle.

The colleteric glands lie approximately in the central part of the lateral surfaces of the visceral mass, they contain a fairly large number of tubes.

In the four specimens from which sections have been made the mantle cavity contains eggs. The musculature of the mantle is comparatively strongly developed, the sphincter of the mantle opening is a muscle of good size.

At the anterior part of the body of the specimen from *Tetraplax* a number of cypris larvae are found. They are partially covered by the thin sheet of chitin which originally covered the whole body, including the mantle opening. Smith (1906) has given sufficient evidence for the opinion that these so-called complimental males are cypris larvae which have entered the cavity between the external cuticle and the thin layer of chitin which covers this cuticle at a young stage of the parasite, instead of fixing themselves to a young crab. It is interesting that these cypris larvae are still present at a stage of the parasite in which already eggs are found in the mantle cavity. Parts of the thin external layer of chitin have remained on different parts of the cuticle (fig. 48), and beneath these parts the larvae are found.

The thickness of the external cuticle of the mantle is rather variable, not only in different specimens, but also in different parts of the mantle of one specimen. In one of the specimens on *Panopeus occidentalis* the thickness of the cuticle varies from 15 to 45 μ, in the other of the same species of crab from 25 to 55 μ. The specimen on *Lophopanopeus bellus* has a cuticle with a thickness varying between 15 and 30 μ, in that on *Tetraplax quadridentata* the thickness of the cuticle is 30 μ in some parts, in other parts till 65 μ. The latter specimen is the smallest of the three from which dimensions are given above.

In some specimens the surface of the external cuticle shows clearly the different small areas, each secreted by one cell of the epithelium (fig. 49 *a*). Each of these areas may possess a hair-like excrescence, but often the hairs are more loosely distributed. The length of the hairs is variable in the different specimens. In the parasites of *Panopeus occidentalis* these hairs have a length of 9 to 20 μ, in the specimens from *Lophopanopeus bellus* they measure about 23 μ (fig. 49 *d*), whilst in the specimen from *Tetraplax quadridentata* they are comparatively long (till 35 μ, fig. 49 *b*). Usually the hairs are quite smooth; in the specimens on *Lophopanopeus bellus* they are covered with a number of minute lateral hairs (fig. 49 *d*).

The internal cuticle of the mantle bears numerous retinacula (fig. 49 *e*—*g*), which consist of a basal part and a variable number (3 to 9) of spindles. The latter have a length of 6 to 12 μ, they are barbed. In different specimens the size of the retinacula may be different, e. g., in the specimens on *Lophopanopeus bellus*. In one of these (fig. 49 *f*) the retinacula are of larger size than in the other (fig. 49 *g*).

The barbs of the retinacula could not be found with certainty in all the specimens of the present collection.

It is not necessary to mention here at length the differences of *Loxothylacus panopaei* from the other species of the genus. The differences from the species of *Loxothylacus* dealt with in the present paper

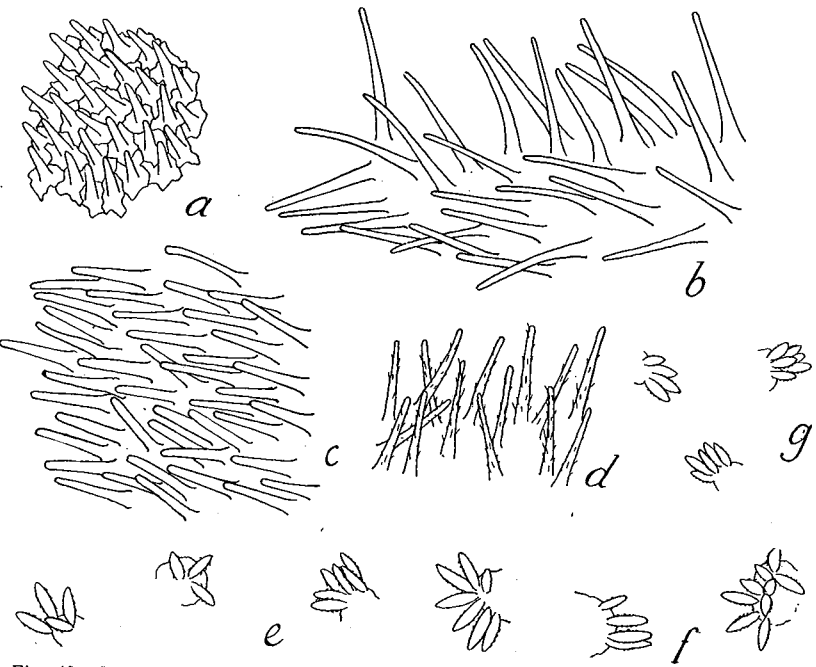

Fig. 49. *Loxothylacus panopaei*. *a*, and *c*, excrescences of the external cuticle of two different specimens from *Panopeus occidentalis*. *b*, excrescences of the external cuticle of the specimen on *Tetraplax quadridentata*. *d*, excrescences of the external cuticle of a specimen on *Lophopanopeus bellus*. *e*, retinacula of a specimen from *Panopeus occidentalis*. *f*, and *g*, retinacula of two different specimens from *Lophopanopeus bellus*. All figures × 530.

are striking enough, the same holds true for *L. corculum* Kossm. and *L. strigulosus* B., one of which is characterized by spines of an enormous size (at least for a Rhizocephalon), whilst those of the other have a length of 4 to 5 μ only.

Loxothylacus carinatus (Kossm.).

Sacculina carinata Kossmann 1874.
Sacculina carinata van Kampen and Boschma 1925.
Drepanorchis carinata Boschma 1928 *c*.

East Asia, Capt. Suenson leg., Miss Anthon ded., 19. IV. 1911. 1 ex. on *Neptunus* (*Hellenus*) *hastatoides* (Fabr.) A. M.-E.

Dr. Th. Mortensen's Pacific Expedition, off Jolo (Sulu Islands), 35—55 m, sand, coral, dredge, 19. III. 1914. 1 ex. on *Lissocarcinus polybioides* Ad. & White.

The specimen on *Neptunus* has a breadth of 8 mm, a height of 5 mm, and a thickness of 2.5 mm; in the specimen on *Lissocarcinus* these dimensions are 5.5, 4, and 2.5 mm respectively. One of the specimens (that on *Lissocarcinus*, fig. 33 *k*) possesses the carina from which the species derives its name. This ridge is not present in the specimen on *Thalamita* (fig. 33 *m*). In the latter specimen the surface of the mantle is slightly wrinkled, the specimen on *Lissocarcinus* has a more or less smooth surface. Both specimens have a median groove at the surface which was lying against the abdomen of the host (fig. 33 *l*). The mantle opening is surrounded by a rather thick wall, which projects slightly above the mantle, it is found at the anterior part of the surface which was touching the thorax of the host.

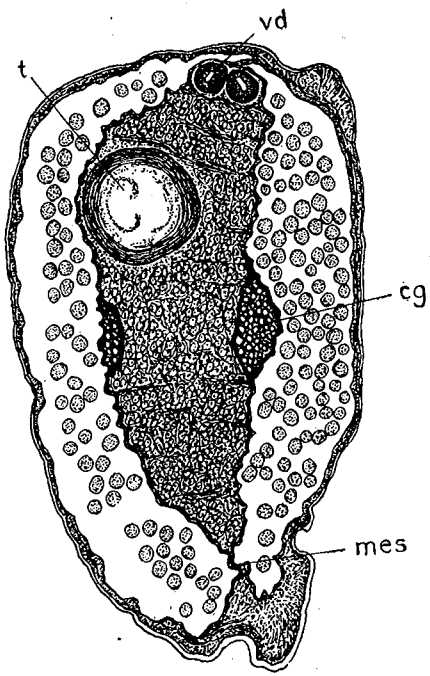

Fig. 50. *Loxothylacus carinatus*, longitudinal section of the specimen from *Lissocarcinus*. *cg*, colleteric gland; *mes*, mesentery; *t*, testis; *vd*, vas deferens. × 23.

From both specimens longitudinal sections have been made, from which results that they do not differ in any important detail. The characteristics of the genus are evident: the visceral mass is connected with the mantle at some distance of the stalk and the mesentery is complete (fig. 50).

The testes are present in the posterior part of the visceral mass. In both specimens one of the testes is larger than the other. In fig. 50 only one (the larger) of the testes is visible. They pass gradually into the vasa deferentia, which are found near the posterior part of the mesentery.

The colleteric glands consist of a large number of tubes.

The mantle cavity of both specimens is filled with eggs. The muscles of the mantle, with the exception of the strong sphincter of the mantle opening, are rather feeble.

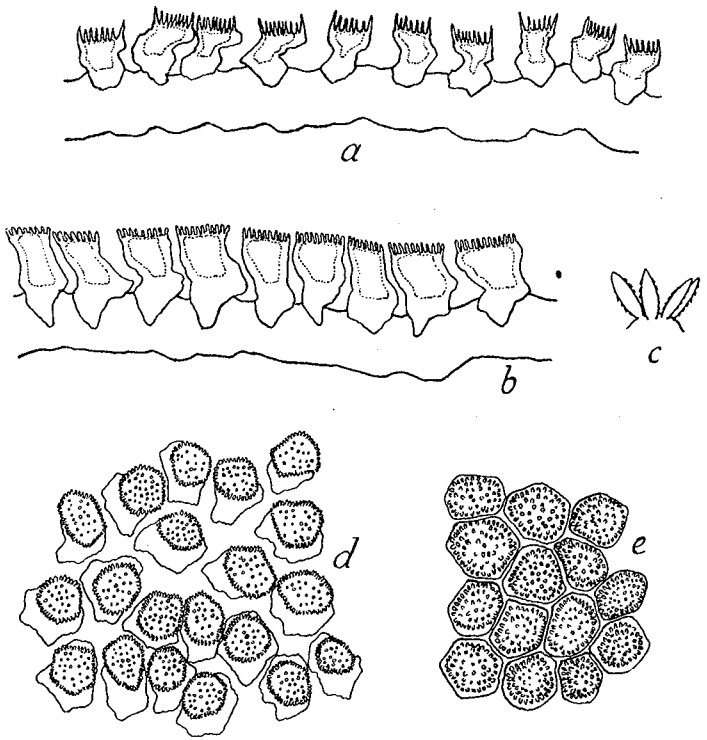

Fig. 51. *Loxothylacus carinatus*. *a*, section of the external cuticle of the specimen from *Lissocarcinus*. *b*, section of the external cuticle of the specimen from *Neptunus*. *c*, retinaculum of the same specimen. *d*, excrescences of the external cuticle of the specimen from *Lissocarcinus*, seen from above. *e*, excrescences of the external cuticle of the specimen on *Neptunus*. All figures × 530.

In the two specimens the external cuticle of the mantle has approximately the same thickness (15—20 μ). The excrescences of the cuticle (fig. 51) also are very much alike when those of the one specimen are compared with those of the other. The excrescences of the cuticle are embedded in the latter as a tooth in its alveole, they consist of rather hyaline chitin, which does not take stain, whilst the cuticle itself stains easily. The basal parts of the excrescences are solid,

the upper parts are hollow. The cavity undoubtedly communicates with the outside, as some matter in the cavity absorbs the stain. At their extremity the excrescences possess a great many small, short spines, which are most numerous on the margin.

In the specimen from *Lissocarcinus* (fig. 51 *a*, *d*) the excrescences are comparatively loosely distributed over the surface of the cuticle. They have a total length of about 20 μ and a diameter of 12 to 16 μ. The excrescences of the specimen from *Neptunus* (fig. 51 *b*, *e*) are more densely placed on the cuticle; they are somewhat larger than those of the other specimen (length 20 to 26 μ, diameter 16 μ approximately).

Retinacula could be found on the internal cuticle of the specimen from *Neptunus*. They consist of a small basal part and 4 to 6 spindle-like excrescences with barbs (fig. 51 *c*). The length of these spindles is approximately 14 μ.

The specimens described above belong to the same species as the animals of the Siboga Expedition which we identified as *Sacculina carinata* Kossm. (van Kampen and Boschma, 1925). In the cited paper we expressed our doubts as to Kossmann's (1874) statements about the cuticular excrescences in so far as he mentions that the cavities of his specimen were filled with foreign matter. After a reexamination of the material I think Kossmann was correct in this respect, for the organic remains in the cavities of the excrescences can be easily stained.

In another paper (Boschma, 1928 *c*) I placed the species in the genus *Drepanorchis*, but a new examination of the specimens of the Siboga Expedition and from the Leiden Museum proved that in reality they have all the characteristics of the genus *Loxothylacus*.

Loxothylacus desmothrix nov. sp.

Danish Expedition to the Kei Islands, Banda Neira, ca. 15 m, sand, 9. VI. 1922. 1 ex. on *Pilumnus normani* Miers.

The parasite is more or less bilobate (fig. 33 *n*, *o*), its dimensions are: breadth 4.5, height 3.5, and thickness 2 mm. The surface which was lying against the thorax of the crab bears the small mantle opening, which does not project above its surroundings. This surface has two slight concavities caused by the pressure of the body of the host against the parasite. The surface which was in contact with the abdomen of

the crab is somewhat wrinkled at its anterior part, moreover a median groove is present where the abdomen of the crab was lying against the parasite.

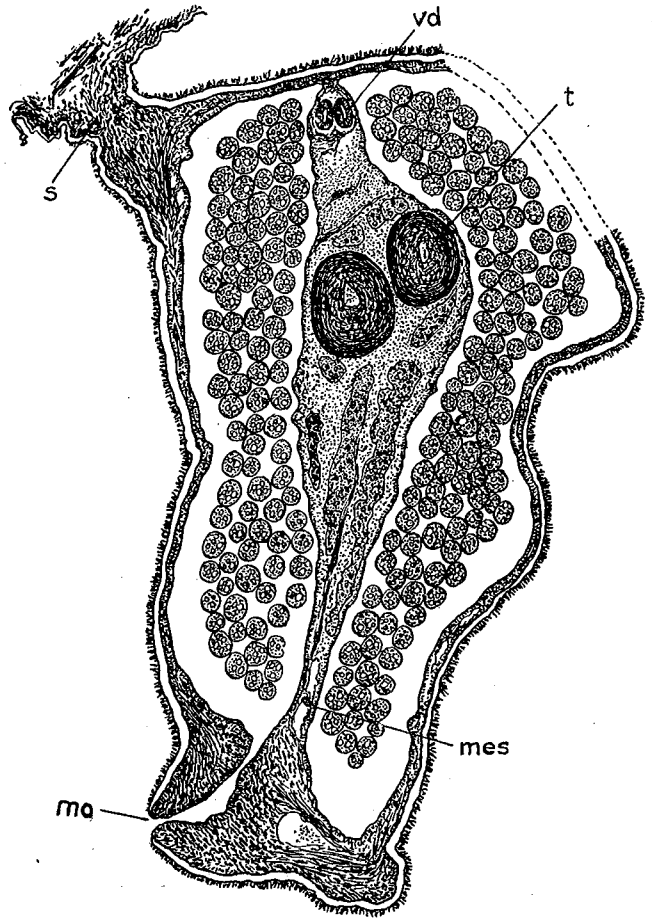

Fig. 52. *Loxothylacus desmothrix*, approximately median longitudinal section. *mes*, mesentery; *mo*, mantle opening; *s*, stalk; *t*, testis; *vd*, vas deferens. × 36.

The visceral mass is united with the mantle at a fairly large distance from the stalk, the mesentery is complete: it extends till the muscular mass surrounding the mantle opening (fig. 52).

The testes are found in the posterior half of the visceral mass, they consist of thick tubes which in the dorsal region of the visceral mass gradually pass into the narrow vasa deferentia.

The colleteric glands are embedded in the central part of the lateral surfaces of the visceral mass, they contain a fairly large number of tubes.

Besides the organs mentioned above the visceral mass contains a few groups of very young egg cells. The mantle cavity is filled with a large amount of eggs.

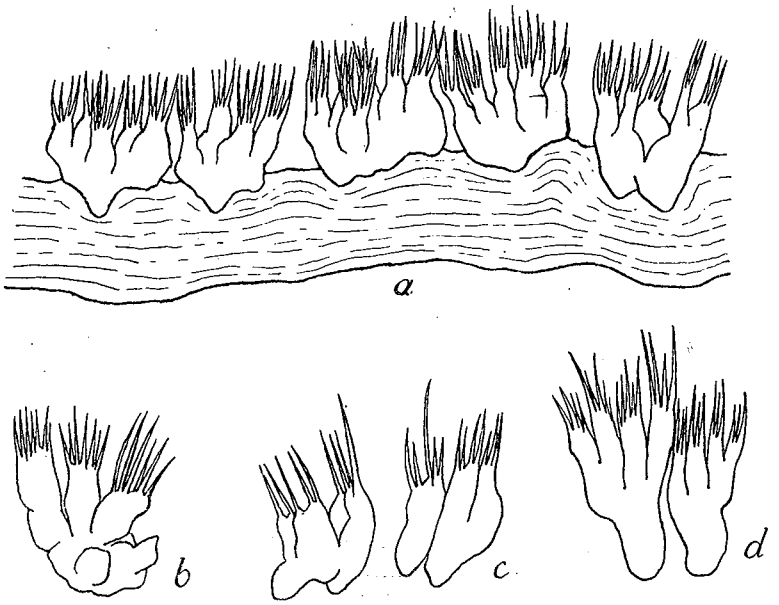

Fig. 53. *Loxothylacus desmothrix*. *a*, section of the external cuticle. *b*, *c*, and *d*, excrescences of different parts of the external cuticle. All figures × 530.

The external cuticle of the mantle has a thickness of 30 μ approximately. It contains a great number of excrescences of a peculiar form (fig. 53). These consist of material which differs from that of the main cuticle by its resistance against stains: the cuticle itself, which is built of parallel layers, stains easily, whilst the excrescences do not take the stain. The chitinous matter of which the excrescences consist is strongly hyaline. The excrescences are composed of a basal part (which may be rather narrow or comparatively broad) and a number of thick branches. At their extremity the latter are divided into a mass of sharp spines. From the basal part to the tips of these spines the excrescences have a length varying between 20 and 70 μ, their diameter lies between 15 and 45 μ.

On the internal cuticle of the mantle no retinacula could be found.

The excrescences of the cuticle of *Loxothylacus desmothrix* are similar to those of some of the specimens which we described in a previous paper (van Kampen and Boschma, 1925) as *Sacculina pilosa* and *S. pilosella*. The anatomy of these specimens is imperfectly known, but a new examination of the material will prove that they belong to more than two species. For the present *Loxothylacus desmothrix* is sufficiently characterized by the peculiarities of the genus and its cuticular excrescences. The differences between this species and the specimens of "*Sacculina pilosa*" and "*S. pilosella*" will be dealt with in a later paper.

Family *Lernaeodiscidae.*

The chief points of the diagnosis of this family, as I have given them in a previous paper (Boschma, 1928 *b*), are the following: "Body compressed dorso-ventrally. Stalk at the posterior extremity. Mesentery very broad, composed of a dorsal part extending from the stalk to the mantle opening, and a much smaller ventral part. Colleteric glands and testes paired. Male genital openings in the posterior part of the mantle cavity." This manner of orientation of the Lernaeodiscidae remained somewhat unsatisfactory, as the testes in all species of *Lernaeodiscus*, the anatomy of which was known, have a course which is more or less perpendicular to the chief plane of symmetry of the parasites, or at least somewhat irregular in respect to this plane. The specimen dealt with in the following pages, which probably belongs to the type species of the genus, has testes which are arranged in an exactly symmetrical way at each side of the plane dividing the animal in two congruent halves. This fact gives a strong support for the opinion that the orientation of the parasite as given above is correct.

Lernaeodiscus porcellanae Müll.

Lernaeodiscus Porcellanae F. Müller 1862.

Dr. Th. Mortensen's Pacific Expedition, Tobago (B. W. I.), coral reef, IV. 1916. 1 ex. on *Petrolisthes marginatus* Stimps.

The dimensions of the parasite are: breadth 10.5 mm, height 6.5 mm, and thickness about 4 mm. The stalk is small, it is found in the centre of the posterior region. Surrounding the stalk there is

a part of the mantle with thicker chitinous covering than is found at the other parts of the mantle. The mantle is united with the visceral mass in a large portion of the surface which was lying against the thorax of the host (fig. 54 *a*), forming a very broad mesentery. This surface is the dorsal region of the parasite (cf. Boschma, 1928 *b*). At the ventral surface (the part of the body which was lying against

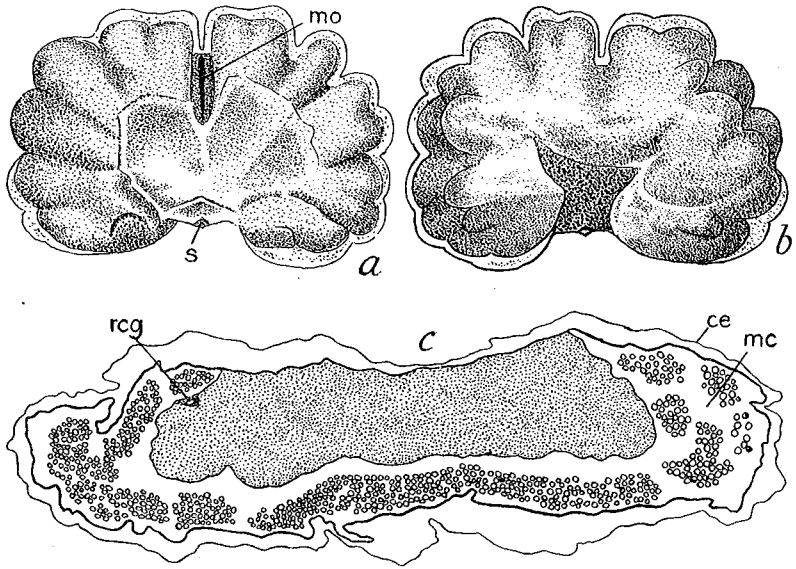

Fig. 54. *Lernaeodiscus porcellanae*. *a*, dorsal surface. *mo*, mantle opening; *s*, stalk. × 6. *b*, ventral surface. × 6. *c*, transversal section of the body. *ce*, external cuticle of the mantle; *mc*, mantle cavity; *rcg*, colleteric gland of right side. × 13.

the abdomen of the host) the mesentery is much smaller (fig. 54 *b*). The mantle opening forms a narrow slit in the middle of the anterior part of the body, it was directed towards the thorax of the host. The mantle possesses a great number of lappets, which are more or less symmetrically arranged at the left and right sides.

This bilateral symmetry manifests itself also in the internal anatomy, which is a very exceptional case among the species of the genus. The testes (figs. 56 and 55 *a*) are lying in the posterior part of the body, in the dorsal part of the visceral mass. Beginning with the closed extremity they continue their course along the margin of the visceral mass towards the posterior region, where they are curved

towards the ventral surface of the visceral mass. Gradually they pass into the vasa deferentia which run along the margin of the ventral mesentery. The male genital openings are found at the left and right side of the end of this short mesentery, they are in communication

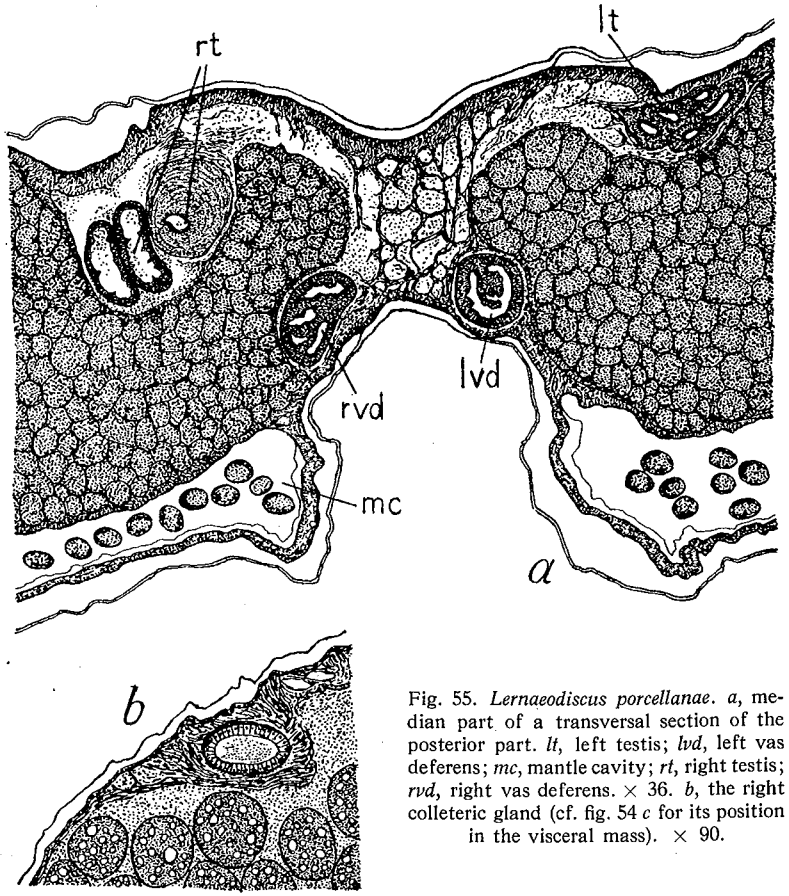

Fig. 55. *Lernaeodiscus porcellanae*. *a*, median part of a transversal section of the posterior part. *lt*, left testis; *lvd*, left vas deferens; *mc*, mantle cavity; *rt*, right testis; *rvd*, right vas deferens. × 36. *b*, the right colleteric gland (cf. fig. 54 *c* for its position in the visceral mass). × 90.

with the ventral part of the mantle cavity. In fig. 56 the male organs are somewhat diagrammatically represented, they have a more sinuous course than indicated in the figure. The latter is evident in sections (fig. 55 *a*). In the vasa deferentia also the cavity is somewhat tortuous.

The colleteric glands, which are found at the dorsal surface of the visceral mass (figs. 56 and 54 *c*), are extremely small and very simply

built. They consist of a minute globular cavity, the cells of which form a distinct epithelium (fig. 55 *b*).

From the sections it results still more clearly that at the dorsal surface a very broad portion of the visceral mass is attached to the mantle; this part forms the main mesentery, which is about as broad as long. The ventral mesentery is much shorter and narrower. In the

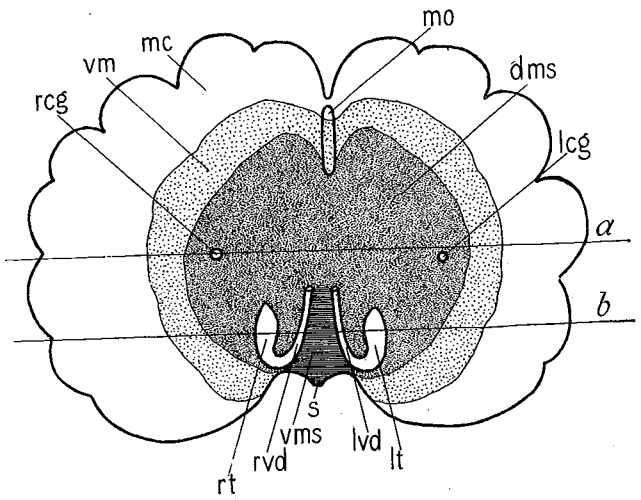

Fig. 56. *Lernaeodiscus porcellanae*, diagrammatic drawing, indicating the position of the chief organs, seen from the ventral surface. The line *a* corresponds with the section of fig. 54 *c* and fig. 55 *b*, the line *b* with that of fig. 55 *a*. *dms*, dorsal mesentery; *lcg*, left colleteric gland; *lt*, left testis; *lvd*, left vas deferens; *mc*, mantle cavity; *mo*, mantle opening; *rcg*, right colleteric gland; *rt*, right testis; *rvd*, right vas deferens; *s*, stalk; *vm*, visceral mass; *vms*, ventral mesentery.

posterior part of the body there is a muscular mass which is in connection with the stalk. Between the testes these muscles continue towards the anterior region; they connect the ventral and dorsal region between the two parts of the mesentery.

The spacious mantle cavity contains an enormous mass of eggs. The mantle opening has a well developed sphincter, in other parts of the mantle the musculature is not so prominent.

The external cuticle of the mantle, which has a thickness of 8 μ approximately, has a smooth surface.

From the description given above one sees that the anatomy of the specimen is completely similar to that of the Sacculinidae, the

only difference is that the Sacculinidae are compressed laterally, *Lernaeodiscus porcellanae* in a dorso-ventral manner.

In all probability the specimen dealt with here belongs to the type species of the genus: *Lernaeodiscus porcellanae* Müll. The external form of the parasite strongly agrees with that of Müller's specimens. The symmetrical arrangement of the testes in the posterior part of the body, each at one side of the small ventral mesentery, which is a characteristic of Müller's specimens, is also present in the specimen from Tobago. The mantle opening occupies approximately the same place. A further evidence for the identity of the specimen dealt with here with those described by Müller is the locality (Tobago), which is not far from the coast of Brazil, where Müller collected his specimens.

The nauplius larvae of *Lernaeodiscus porcellanae* have been described by Müller (1862), they have approximately the same shape and size as those of *Sacculina carcini*. Only the frontal horns seem to have a more curved form than in the latter species. The cypris larvae of *L. porcellanae* are described in another paper by the same author (Müller, 1863).

Lernaeodiscus porcellanae is the only hitherto known species of the genus with a true bilaterally symmetrical structure. In nearly all other specimens of the genus of which the anatomy is known one male genital opening is found at the dorsal surface of the visceral mass, the other at the ventral surface[1]).

Family *Sylonidae.*

The only specimen of this family in the collection does not present any differences from the hitherto known representatives of the family, so that it must receive the name *Sylon hippolytes*.

Sylon hippolytes M. Sars.

Sylon hippolytes M. Sars 1870.

Sylon hippolytes Boschma 1928 *b* (here also other synonyms).

Dr. Th. Mortensen's Pacific Expedition, Strait of Georgia (British Columbia), 70—120 m, mud, 16. VI. 1915. 1 ex. on *Spirontocaris bispinosa* Holmes.

The dimensions of the parasite are: length 8 mm, breadth 5 mm, and thickness 5 mm. The shape of the animal (fig. 57) does not differ

[1]) The only exception is one of the specimens of *Lernaeodiscus ingolfi* (cf. Boschma, 1928 *b*, fig. 11 *d*).

to any extent from that of the specimens of *Sylon* described in a previous paper (Boschma, 1928 *b*). The external cuticle has a similar structure and from the transverse sections of the animal nothing can be concluded which might give evidence for differences from *Sylon hippolytes*. Consequently the specimen has to be regarded as a representative of the only species of the family. Hitherto the species had not yet been recorded as a parasite of *Spirontocaris bispinosa*. The locality is not new for the species, for specimens of *Sylon* have been found at Friday Harbor (Potts, 1912). Probably *Sylon hippolytes* is found in the whole arctic region, in the Atlantic as well as in the Pacific.

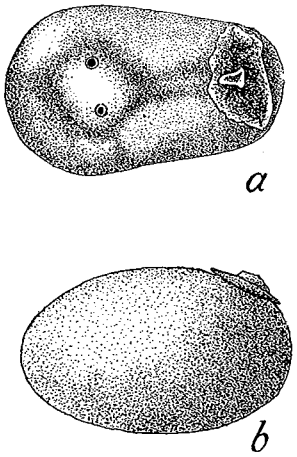

Fig. 57. *Sylon hippolytes* from *Spirontocaris bispinosa*. *a*, dorsal surface, × 4.5. *b*, lateral surface, × 4.5.

The specimens of the genus *Sylon* which have been examined anatomically do not furnish any evidence that the genus contains different species. This is a negative result: it does not prove that in reality the specimens do not belong to different species. But as long as no specific characteristics can be found it is better to regard all the specimens as representatives of one species.

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