

THE SPECIES OF THE GENUS SACCOLINA (CRUSTACEA RHIZOCEPHALA)

by

H. BOSCHMA

With 96 textfigures

The genus *Sacculina* was founded by Thompson (1836), who described the species *Sacculina carcini*, the parasite of the shore crab. A second species, *Sacculina inflata*, was described by Leuckart (1859). Anderson (1862) gave a description of a third species, *Sacculina triangularis*, and published important notes on the anatomy of this and other species; afterwards it proved that *S. triangularis* morphologically is not distinct from *S. inflata*. Hesse (1867) gave names to two Sacculinidae on different crabs. Of these one (*Sacculinidia gibbsii*) is a synonym of *Sacculina carcini*; the characters of the other species, named by Hesse *Sacculinida Herbstia nodosa*, are unknown. Kossmann (1872) described a large number of species of the genus from the Philippine Islands; he based his descriptions chiefly on the anatomical characters and on the excrescences of the external cuticle of the mantle. Although Kossmann's material seems to be entirely lost a number of parasites can be identified as representatives of Kossmann's species. Some of Kossmann's species of *Sacculina* now must be referred to other genera of Rhizocephala. In 1877 Fraise described a European species, *Sacculina neglecta* (now included in the genus *Drepanorchis*). The names given by Hoek (1878) and Malm (1881) to Sacculinidae which they regarded as distinct species now are proven to be synonyms of previously described ones. Miers (1880) described *Sacculina rotundata*, a new species from the East Indies; Gissler (1884) described the first North American species, *Sacculina panopaei* (now included in the genus *Loxothylacus*). Giard (1886, 1887, 1888), Bonnier (1887) and Giard and Bonnier (1887, 1890) gave numerous names for parasites on crabs for which no previous records of infestation by Sacculinidae existed, in all probability all these names are synonyms of previously described species. Smith (1906) created the genus *Heterosaccus* for those species of the group in which the mesen-

tery is rudimentary or absent. He was convinced that all the described species of *Sacculina* which possess a more or less complete mesentery were representatives of the species *Sacculina carcini*. Notwithstanding this opinion he uses the name *Sacculina eriphiae* for the parasite of *Eriphia spinifrons*. Guérin-Ganivet (1911) gave strong evidence for the view that most of the forms regarded by Giard and Bonnier as distinct species must enter into the synonymy of *Sacculina carcini*. In the same paper Guérin-Ganivet described a number of new species, these descriptions were based on characters of the external form and the shape and situation of the genital organs. Krüger (1912) mentions a number of East Asian crabs as hosts of parasites of the group, and with the exception of *Heterosaccus hians* he identifies the specimens as *Sacculina carcini*. Pérez (1920) gives the name *Sacculina ostracotheris* to a parasite from the Persian Gulf, he regards it as a distinct species on account of its occurrence on the crab *Ostracotheres spondyli*. Van Kampen and Boschma (1925) studied the material of the "Siboga" Expedition and some specimens from other sources. In this paper the distinction of the species was based largely on the characters of the external and internal cuticle of the mantle. In a number of other papers Boschma (1925—1936) gave the results of his investigations on an extensive material of the group, gradually the peculiarities of the internal organs proved to be of importance for the description of the species. In 1929 Popov described *Sacculina pauli* (probably not specifically distinct from *S. carcini*). Okada and Miyashita (1935) gave an account of the peculiar parasite *Sacculina gregaria* which occurs in large numbers on its hosts.

In the course of time it proved necessary to erect a few other genera, based on anatomical characters distinct from those of *Sacculina* and *Heterosaccus*. Many of the previously described species of *Sacculina* now must be included in these genera, especially in *Drepanorchis* and *Loxothylacus*.

In the present paper descriptions are given of all the described species of *Sacculina* of which the anatomical characters and the peculiarities of the external and internal cuticle are known. An exception is made for those species which now are included in another genus; these species are listed only. These new descriptions are wanted because in many cases the previous diagnoses are far from complete. As gradually the number of species increased it became necessary to study the formerly known species in more detail to find the accurate characters of distinction. In the part of this paper dealing with the descriptions of the species a number of names are preceded by *; this means that the characters of these species are imperfectly known or that the species has been included in another genus.

The descriptions of the species in the present paper are based largely on the type specimens or on "typical" specimens. As those I regard specimens which correspond with the original diagnosis and which lived on the same species of host as the type specimen.

In some cases, however, this rule could not be upheld. In our report on the material of the "Siboga" Expedition (Van Kampen and Boschma, 1925) we tried to identify a number of specimens as representatives of Kossmann's species from the Philippines. In these cases our specimens showed characters which correspond closely with those of Kossmann's diagnoses, but in many cases the hosts of our specimens were different from those of Kossmann's species. In the course of further investigations on the group I have come to the conclusion that we may have made severe mistakes in this respect. For the present, however, I accept the identifications as provisionally correct, but future work undoubtedly will show that changes in the nomenclature are necessary. To settle these questions material of parasites on the same hosts as those from Kossmann's material must become available.

For the greater part of the species the characters of the external and internal cuticle are already given in sufficient detail in previous papers. In the present paper the anatomical characters (chiefly those of the genital organs) generally are given in more detail than previously.

Many erroneous statements in previous papers had to be corrected. In our first paper on the Rhizocephala of the "Siboga" Expedition (Van Kampen and Boschma, 1925) we mentioned for several species that the male genital organs showed a close resemblance to those of *Sacculina carcini*. In most of the cases this is entirely wrong, as I could show in my revision of the same material (Boschma, 1931 c).

A severe mistake was still to be corrected in the description of the "Siboga" specimen of *Sacculina margaritifera*. In the explanation of the figures of this specimen (Van Kampen and Boschma, 1925, Pl. III fig. 4 a, b) the sections were described as longitudinal; in reality these are transverse sections.

Another grave error is that in the explanation of the figures of *Sacculina granulosa* in the revision of the "Siboga" material (Boschma, 1931 c, p. 17). Fig. 8 a is described here as a section from the ventral part of the body; in reality it is from the dorsal region.

In another paper (Boschma, 1933 a, p. 507) the testes of *Sacculina exarcuata* are described as gradually passing into their vasa deferentia. This is erroneous, for the transition of the testes into the vasa deferentia occurs

in an abrupt manner; there is even a distinct layer of chitin on the inner walls of the dorsal parts of the vasa deferentia.

Of minor importance are the errors of regarding the right side of the parasites as the left. When the series of sections starts at the ventral side of the body and the sections are orientated with the posterior end at the upper side, the left half is found at the left side of the sections. Many of the series of sections begin at the ventral part, others at the dorsal part. This has not always been taken into account in previous descriptions, so that the right side has been taken for the left. A few examples are given here. In *Sacculina hirsuta* the left testis is somewhat larger than the right, in *S. pustulata* the right testis is rudimentary, the left well developed. In the descriptions and figures of these species (Boschma, 1925, Pl. II fig. 5, 6) the left testis is indicated with "rt". A similar mistake is made concerning *Sacculina muricata* (Boschma, 1931 a, p. 315), here the right testis erroneously is described as being smaller than the left. In *Sacculina hirta* too the right testis is larger than the left, and not the reverse as stated previously (Boschma, 1933 a, p. 511).

The peculiarities which may be used for the distinction of the species, as far as they pertain to the male genital organs and the colleteric glands, are briefly mentioned below.

The genus *Sacculina* can be divided into two parts on account of the situation of the male genital organs. In one group these organs occur in the visceral mass (fig. 74), in the other they are found in the posterior part of the body from which the stalk takes its origin, outside the visceral mass (fig. 1). As a rule the male genital organs have a more or less straight course, they are running in a ventro-dorsal direction at the posterior end of the visceral mass or in the region of the stalk. When the male genital organs are found in the visceral mass they generally remain in the vicinity of the mesentery for the whole of their extent (fig. 74). Sometimes, however, the dorsal part of one of the testes lies at some distance from the mesentery so that it is bent somewhat in an anterior direction (fig. 61). It may also occur that the two testes are slightly curved in an anterior direction (fig. 24). When this curvation is still stronger developed the testes in some respects remind of those of *Drepanorchis*, as, e.g., those of *Sacculina angulata* (fig. 3).

The male genital organs of *Sacculina anomala* (fig. 5) show a peculiarity of special interest: the extremities of the male genital organs are found at the posterior side of the rest of these organs. Generally when in Sacculinidae the testes are recurved this curvature occurs in an anterior direction; in *S. anomala* a bend is present in a posterior direction. Consequently in

longitudinal sections of the body the distal part of the testes is found behind the more proximal part (fig. 5 d-f, in these figures the posterior part is at the upper side). The recurved part of the male genital organs is rather small and narrow as compared to the more or less straight region which consists of comparatively wide sacs. Now in the region where the recurved part is connected to the more or less straight part the internal wall of the organs is covered by a thick layer of chitin (fig. 5 e, f), just like in other species of the genus at the region of transition of the vas deferens into the testis. If on account of this fact we have to regard the region where the layer of chitin occurs as the part of transition between vas deferens and testis, we must conclude that *Sacculina anomala* has well developed vasa deferentia, consisting of rather wide sacs, which in their dorsal part pass into the small narrow testes. Then the vasa deferentia are running in a ventro-dorsal direction, the testis in a dorso-ventral direction.

Fig. 22 represents transverse sections of the male genital organs of a specimen which I described as the type of *Sacculina levis*. The male genital organs of this specimen show a similarity to those of *S. anomala* in so far as the closed extremities of the testes are recurved in a dorso-ventral direction (fig. 22 e). Moreover the vasa deferentia are somewhat tortuous, so that in many sections the cavities of these organs occur twice or thrice (fig. 2 b-d). Although the shape of the male genital organs of *Sacculina levis* is somewhat less complicated, these organs correspond closely with those of *S. confragosa* (cf. Boschma 1933 a, fig. 17). The male genital organs of *S. confragosa* are found in the visceral mass, whereas those of *S. levis* were considered to occur in the posterior part of the body, outside the visceral mass (cf. Boschma, 1933 b, p. 231). This statement in all probability is erroneous. The type specimen of *Sacculina levis* is rather badly preserved, the series of longitudinal sections shows many deficiencies, so that the place of insertion of the mantle to the region of the stalk cannot be determined with accuracy. This means that we cannot decide whether in this specimen the male genital organs occurred in the visceral mass or in the posterior region of the body. In the type specimen of *S. confragosa* the male genital organs are more complicated than those of the type specimen of *S. levis*; the vasa deferentia, however, show the same shape and manner of bending, the closed part of the testes in both specimens is recurved in a postero-ventral direction. Moreover the colleteric glands of the two specimens, though differing in size, correspond closely (fig. 23), they have a similar arrangement of the canals and approximately the same number of canals. When we compare the structure of the external and internal cuticle of the mantle (cf. Boschma, 1933 a, fig. 18; 1933 b, fig. 14) we find a striking conformity. I do not hesitate, therefore, to conclude that

both specimens belong to the same species. A further argument for this opinion is the fact that both specimens were collected in Japan.

The peculiar curvature of the male genital organs in *Sacculina anomala* and in *S. confragosa* might be regarded of sufficient importance to remove these from the genus *Sacculina*. In this case a new genus should be erected, as they cannot be included into any other genus of the family.

The shape of the male genital organs may furnish still more specific characters. In many species of *Sacculina* the vasa deferentia very gradually pass into the testes so that it is difficult to determine at which level the transition of the vas deferens into the testis occurs (fig. 88). Sometimes in these male genital organs which gradually increase in size there is a region in which the inner wall is covered by a distinct layer of chitin of some thickness (fig. 7). As such a layer of chitin occurs in the extreme dorsal part of the vasa deferentia in nearly all species which have globular testes (so that there is a sharp limit between the two parts of the male genital organs) it is highly probable that the region in which the chitinous layer occurs here too is the dorsal end of the vas deferens. Fig. 91 represents transverse sections of globular testes with narrow vasa deferentia, fig. 90 shows longitudinal sections of male genital organs of a similar shape.

In species with more or less globular testes the vasa deferentia may be rather wide, but then between the two parts of the male genital organs there is a narrow canal connecting these two parts, usually with a chitinous inner wall (fig. 62). A similar case is represented in fig. 72; here the dorsal part of the vas deferens lies behind the ventral part of the testis.

Often the vasa deferentia are comparatively wide but contain narrow cavities as a result of ridges on their inner wall (fig. 26). When these ridges are extremely numerous the cavities obtain a strongly irregular shape (fig. 35).

The two male genital organs of the left and right side of the body may have approximately the same size and shape (fig. 10) or they may be different. In some species the difference is very conspicuous, then one of the male genital organs may be more or less rudimentary (fig. 60) or one of the two testes may be enormously enlarged so as to form a wide sac with a thin wall (fig. 40). In other species both testes may show this excessive development, then the one may be found at a more dorsal level than the other (fig. 47).

In many species the male genital organs of the left and right side of the body remain completely separated for the whole of their extent (fig. 57). In other species they are, at least partially, in close contact. Then their cavities may remain completely distinct or they may form a smaller

or larger part communicate. In *Sacculina calva* the male genital organs are rather strongly united (fig. 14); their cavities, however, remain separated, although at one level there is a thin septum only between the two (fig. 14 h). When the cavities of the two male genital organs are partially united the duplicity of the united part may remain evident (fig. 83), but often the two organs fuse partially into a single canal. This may occur in the ventral region (fig. 95) or in the median part (fig. 66). In extreme cases the dorsal parts of the two organs are completely united and constitute a wide sac (fig. 69); it then appears as if there is one testis only, with two vasa deferentia.

In *Sacculina lata* (fig. 55) there are two separate regions in which the cavities of the two male genital organs largely communicate.

Especially in species with more or less globular testes these organs are surrounded by a distinct muscular sheath. Then usually each testis has its own muscular layer, which surrounds it closely (fig. 39). Sometimes the muscular layers are found at some distance from the testes (fig. 64); the cavity between the muscles and the testes then may be filled with connective tissue or loose cells. In some cases the two testes have a common muscular sheath (fig. 54, 67).

In young animals (fig. 59) the cavities of the testes have not yet developed. Such specimens may differ in other respects too from the adult forms of the same species, and it is doubtful whether diagnoses based on immature specimens contain the exact characters which separate the species from others.

The colleteric glands too may furnish important characters for the description of the species. These glands are more or less variable in shape and size and in the number of their canals, but in general they possess sufficient characters of specific value. Generally in species of small size the colleteric glands are small and possess a few canals only whilst in larger species the reverse occurs. It depends upon the state of development of the eggs whether there is a distinct layer of chitin on the inner walls of the canals or not. When this layer of chitin is present it is drawn in the figures of the present paper as a double line (fig. 6), when there is no chitin the inner wall of the canals is drawn only, or the epithelium of the canals is drawn in black (fig. 65).

Many species of *Sacculina* possess colleteric glands of a more or less elliptical shape in which the canals form a somewhat compact system (fig. 96). Among these there are species with an enormous number of these branched canals (fig. 31). Sometimes in colleteric glands with numerous canals these are found at comparatively large distances from each other (fig. 13).

Other species have more or less flattened colleteric glands, then the canals may occur in a similar manner as those of the more or less elliptical ones (fig. 48). In some species, however, the canal system of the colleteric glands is neatly arranged in a single row along the surface of the visceral mass (fig. 91). This especially occurs in species of small size in which the colleteric glands contain few canals only (fig. 49).

Usually the colleteric glands do not project noticeably above the surface of the visceral mass. An exception to this rule forms *Sacculina hirsuta* (fig. 45) in which the colleteric glands protrude as distinct little pads on the sides of the visceral mass.

A striking irregularity occurs in *Sacculina caelata*. Here the visceral mass and the mesentery are attached to the mantle at a considerable distance from the place of insertion of the stalk (fig. 12). This character is peculiar for the genus *Loxothylacus*, but in this genus the male genital organs are distinctly curved. As the male genital organs of *Sacculina caelata* are more or less straight, a character of the genus *Sacculina*, it seems justified to keep the species in the latter genus.

The characters of the male genital organs and the colleteric glands generally are remarkably constant to a certain degree. There always remain insignificant individual variations, but the general structure of the organs is very little different when a number of specimens of the same species are compared to each other. An example is given by the two figures of the male genital organs of *Sacculina eriphiae* (fig. 29, 30), they show slight differences in the shape of the vasa deferentia and in the shape and size of the testes, but these differences are of minor importance. In both specimens the right testis is of very large size, the left testis is much smaller (in comparison to those represented in fig. 29 the sections after which the drawings of fig. 30 were made are mounted upside down: in one specimen the series of sections begins at the ventral part, in the other at the dorsal region of the body).

Some specimens of *Sacculina inflata* which were living on *Cancer pagurus* have testes of approximately the same size; in other specimens the right testis is many times larger than the left (cf. Boschma, 1931 b). In two of my series of sections of these animals the difference in size between the two testes is very striking (fig. 51); in a third the right testis is somewhat larger than the left, but this difference is very slight (fig. 52). Anderson (1862, p. 5) gives a fairly accurate description of the male genital organs in his *Sacculina triangularis* (now considered as a synonym of *S. inflata*), he describes the oval shape of the testes, the dorsal part of the vasa deferentia, and even mentions the chitin in the region of

transition of the vasa deferentia into the testes. In his description he does not mention anything which might point to the fact that the two testes are of appreciably different sizes, one of his figures (l.c., pl. I fig. 3) even seems to indicate that the two testes are strikingly similar. This case is very exceptional among the species of the genus, usually the structure of the male organs is remarkably similar in different specimens of the same species.

When we compare the only available specimen of *Sacculina inflata* on *Hyas coarctatus* to the material of the same species on *Cancer pagurus* we find that it has testes of strongly different sizes (fig. 50), just like some specimens of the parasites of *Cancer*. The colleteric glands of the parasite on *Hyas coarctatus* in some respects are different from those in the specimens on *Cancer pagurus* (fig. 53). In the latter specimens there are more chitinous canals than in the former. Moreover in the specimens on *Cancer* each chitinous tube is contained in its own canal with glandular epithelium, whilst in the specimen on *Hyas* a number of chitinous tubes are found in common canals. This last peculiarity is so exceptional in the species of *Sacculina* that it might constitute an individual abnormal case. Moreover the differences between the colleteric glands of the specimens on *Cancer* and those of the specimen on *Hyas* are not striking enough to prove that the two forms are specifically distinct. It is necessary to study new material of specimens on *Hyas* before a conclusion can be reached in this respect.

The species *Sacculina carcini* occurs, besides on its "typical" host, *Carcinides maenas*, on other crabs too. Sections of the male genital organs of specimens on four of these hosts, viz., *Liocarcinus holsatus*, *Liocarcinus pusillus*, *Brachynotus lucasi*¹⁾, and *Pachygrapsus marmoratus*, are represented in fig. 16—19. They vary in some respects in size and shape, but on the whole they show a striking conformity. The differences found between the figured specimens are not larger than those present among specimens from the same species of host. The same applies to the colleteric glands of the specimens on the hosts mentioned above. In fig. 20 sections are drawn from the most strongly branched region of specimens of *Sacculina carcini* on five different hosts. The number of canals visible in these sections is rather variable; the diameter of the canals and the size of the

1) In all probability this name should be changed into *Brachynotus gemmellari* Rizza (cf. O. Duboscq and O. Tuzet, 1934. Sur un Crabe mal connu, *Brachynotus gemmellari* Rizza (*Heterograpsus lucasi* Milne-Edw.). C. R. Soc. Biol., vol. 117). In the material which I could examine the male crabs possess the vesicles mentioned in the cited paper.

glands as a whole varies to a considerable degree, but taken as a whole the glands of the five species show a strikingly similar aspect.

Finally mention may be made of the colleteric glands of two specimens of *Sacculina confragosa* (= *S. levis*), which are drawn on a different scale and now are as similar as possible (fig. 23).

The following pages contain the names of the species of the genus *Sacculina* and a key and descriptions of the species of which the characters are sufficiently known. The characters of the species which are imperfectly known are given as far as the data are available; those species which must be referred to another genus are listed only. These as well as the imperfectly known species are indicated with *.

The expressions "testes more or less cylindrical" or "testes more or less globular" must not be taken too literally, as they are used in a general sense. As a rule globular testes are connected by a narrow canal with a chitinous inner wall to their vasa deferentia whilst cylindrical testes gradually pass into the vasa deferentia so that the exact region of transition cannot be determined.

In some cases the larger testes of the two is globular, passing abruptly into its vas deferens, whilst the other testis is more or less cylindrical, sometimes rudimentary. In the key these species are included among those with globular testes.

In the figures of transverse sections of male genital organs the lettering starts with the most ventral part: each consecutive section is from a more dorsal region. The longitudinal sections of the colleteric glands are arranged from the central to the peripheral region or in the reverse order. The surface of the visceral mass is indicated by a single or sometimes a double line.

KEY TO THE SUFFICIENTLY KNOWN SPECIES OF THE GENUS SACCOLINA

- A 1. Male genital organs completely or for the greater part in the visceral mass.
- B 1. Cavities of the male genital organs of both sides of the body completely separated.
- C 1. Vasa deferentia rather abruptly passing into the testes.
- D 1. Excrescences of the external cuticle of the mantle consisting of a hyaline kind of chitin, different from that of the main layers of the cuticle.
- E 1. Lumen of the vasa deferentia divided by numerous ridges. Canal system of the colleteric glands strongly branched (more than 40 canals in longitudinal sections of the most strongly divided region) *duracina*.
- E 2. Lumen of the vasa deferentia very little divided by ridges. Canal system of the colleteric glands with a moderate number of branches (not more than 30 canals in a section) *pilosa*.
- D 2. Structure of the excrescences of the external cuticle of the mantle not different from that of the main layers of the cuticle.
- E 1. External cuticle with hairs.
- F 1. Male genital organs not strikingly differing in size and shape.
- G 1. Cuticle densely covered with small hairs which have a length of 3—8 μ *microthrix*.
- G 2. Cuticle rather sparsely covered with hairs which have a length of 10—30 μ *sinensis*.
- F 2. One of the testes globular, of fairly large size, the other rudimentary *longipila*.
- E 2. External cuticle with small papillae covered with minute hairs *teretiuscula*.
- C 2. Vasa deferentia more or less gradually passing into the testes.
- D 1. Vasa deferentia wide *confragosa*.
- D 2. Vasa deferentia comparatively narrow.
- E 1. External cuticle with well developed excrescences.
- F 1. External cuticle covered with hairs *muricata*.
- F 2. External cuticle covered with papillae or small globular excrescences *margaritifera*.
- E 2. External cuticle with insignificant excrescences or without excrescences.
- F 1. Colleteric glands with numerous canals (more than 40 in a longitudinal section of the most strongly divided region). Male genital organs completely separated *bucculenta*.
- F 2. Colleteric glands with a moderate number of canals (between 15 and 30 in a longitudinal or transverse section of the most strongly divided region). Male genital organs partially close together, their walls partially united.
- G 1. Dorsal extremities of the testes completely separated.
- H 1. Ventral region of the male genital organs with numerous ridges, so that the cavities are more or less irregular. External cuticle smooth, without excrescences *glabra*.
- H 2. Ventral region of the male genital organs without ridges. External cuticle with minute ridges (height 1 to 2 μ) *caelata*.

- G 2. Dorsal extremities of the testes close together *calva*.
- F 3. Colleteric glands with less than 10 canals in longitudinal sections of the most strongly divided region. Male genital organs completely separated *rathbuni*.
- B 2. Male genital organs of both sides of the body at least partially united, so that the cavities partially communicate.
- C 1. Dorsal extremities of the two testes united *pertenuis*.
- C 2. Dorsal extremities of the two testes separated.
- D 1. External cuticle of the mantle with distinct excrescences.
- E 1. Excrescences of the external cuticle consisting of a hyaline kind of chitin, differing in structure from that of the main layers *bipunctata*.
- E 2. Structure of the excrescences not different from that of the main layers of the external cuticle.
- F 1. Excrescences flat-topped *angulata*.
- F 2. Excrescences consisting of hairs or papillae, not with flat tops.
- G 1. The cavities of the two male genital organs communicating in one region only.
- H 1. Parts of the male genital organs with well developed ridges on their inner walls.
- I 1. Excrescences of the external cuticle with stiff minute spines.
- J 1. Excrescences about $18\ \mu$ long, pointed, with minute spines especially in their basal part *weberi*.
- J 2. Excrescences about 6 to $7\ \mu$ long, with minute spines on the whole of their surface *granulosa*.
- I 2. Excrescences of the external cuticle with soft minute lateral hairs or without these, length of the excrescences not exceeding $15\ \mu$ *carcini*.
- H 2. Male genital organs without distinct ridges on their inner walls.
- I 1. Colleteric glands with numerous canals. External cuticle with hairs (length 20 to $35\ \mu$), which are covered with minute lateral hairs *nodosa*.
- I 2. Colleteric glands with few canals. External cuticle with papillae (length 3 to $9\ \mu$), which are covered with minute spines *striata*.
- G 2. The cavities of the two male genital organs communicating in two different regions *lata*.
- D 2. Surface of the external cuticle of the mantle more or less rough and uneven, but without distinct excrescences *scabra*.
- A 2 Male genital organs in the posterior part of the body, outside the visceral mass.
- B 1. Cavities of the male genital organs of both sides of the body completely separated.
- C 1. Closed extremities of the male genital organs not recurved in a posterior and ventral direction.
- D 1. Vasa deferentia rather abruptly passing into the testes.
- E 1. Vasa deferentia comparatively wide.
- F 1. External cuticle of the mantle with excrescences, which consist of a hyaline kind of chitin, different from that of the main layers; excrescences composed of spines which are more or less united into groups.

- G 1. Excrescences divided into a few branches each, which at their extremities bear numerous minute spines.
- H 1. External cuticle of the mantle comparatively thick (50—75 μ); retinacula probably absent *compressa*.
- H 2. External cuticle of the mantle comparatively thin (10—15 μ); retinacula consisting of single spindles, arranged in groups on the internal cuticle *pilosella*.
- G 2. Spines of the excrescences directly attached to the basal part (at least no distinct branches), or spines in groups without common basal part.
- H 1. Spines of the excrescences short (as a rule not longer than 12 μ).
- I 1. Spines confined to the marginal parts of the upper surface of the excrescences *gracilis*.
- I 2. Spines occurring on the whole of the upper surface of the excrescences *formosa*.
- H 2. Spines of the excrescences longer (as a rule longer than 15 μ).
- I 1. Excrescences with well developed basal parts.
- J 1. Excrescences with numerous long spines; length of the excrescences 80—160 μ .
- K 1. Colleteric glands with numerous canals (longitudinal sections of the most strongly divided part with more than 40 canals) *rotundata*.
- K 2. Colleteric glands with few canals (longitudinal sections of the most strongly divided part with less than 20 canals) *carpilinae*.
- J 2. Excrescences with comparatively few spines; length of the excrescences as a rule less than 80 μ .
- K 1. Colleteric glands with comparatively few canals (less than 10 in longitudinal sections of the most strongly divided part) *vankampeni*.
- K 2. Colleteric glands with a greater number of canals (16—24 in longitudinal sections of the most strongly divided part) *leptodiae*.
- I 2. Basal parts of the excrescences absent or very little developed.
- J 1. Length of the spines 15—30 μ ; colleteric glands with few canals (not more than 8 in longitudinal sections of the most strongly divided part); retinacula present *phacelothrix*.
- J 2. Length of the spines 30—65 μ ; colleteric glands with more than 20 canals in longitudinal sections of the most strongly divided part; retinacula probably absent *yatsui*.
- F 2. External cuticle without excrescences or covered with excrescences which are not composed of groups of spines.
- G 1. External cuticle without distinct excrescences, with small columns of chitin differing in structure from that of the main layers *punctata*.
- G 2. External cuticle with distinct excrescences.

- H 1. External cuticle with minute spines. Inner walls of the vasa deferentia with a few ridges only *micracantha.*
- H 2. External cuticle with hairs. Inner walls of the vasa deferentia with numerous ridges *echinulata.*
- E 2. Vasa deferentia comparatively narrow.
- F 1. External cuticle with distinct excrescences.
 - G 1. Excrescences consisting of a hyaline kind of chitin, different from that of the main layers of the cuticle.
 - H 1. Excrescences with a great many small spines at the top *pulchella.*
 - H 2. Excrescences with one central blunt conical spine each *semistriata.*
 - G 2. Excrescences consisting of approximately the same kind of chitin as that of the main layers of the cuticle.
 - H 1. Excrescences consisting of hairs or spines.
 - I 1. Colleteric glands with numerous canals (more than 30 in longitudinal sections of the most strongly divided region).
 - J 1. Length of the excrescences not exceeding $40\ \mu$.
 - K 1. Testes of approximately equal size *exarcuata.*
 - K 2. Testes considerably differing in size.
 - L 1. Retinacula consisting of single spindles of $20\ \mu$ length *hirta.*
 - L 2. Retinacula composed of many spindles which are till $30\ \mu$ long *eriphiae.*
 - J 2. Length of the excrescences till $70\ \mu$ *hispida.*
 - I 2. Colleteric glands with comparatively few canals (less than 30 in sections of the most strongly divided region).
 - J 1. Canal system of the colleteric glands forming a more or less compact mass *inflata.*
 - J 2. Canal system of the colleteric glands more or less flattened.
 - K 1. Testes conspicuously differing in shape and size *gordonii.*
 - K 2. Testes not strongly differing in shape and size.
 - L 1. Basal part of the excrescences of the external cuticle noticeably swollen.
 - M 1. Excrescences with stiff minute spines, especially on their basal parts. Length of the excrescences 25 to $30\ \mu$ *spinosa.*
 - M 2. Excrescences sometimes with a few soft lateral hairs, not with spines. Length of the excrescences 12 to $24\ \mu$ *elongata.*
 - L 2. Basal part of the excrescences not conspicuously swollen.
 - M 1. Length of the excrescences till $70\ \mu$ *comosa.*
 - M 2. Length of the excrescences less than $40\ \mu$ but more than $10\ \mu$.
 - N 1. Colleteric glands with about 20 canals in sections of the most strongly divided region.

- O 1. Excrescences of the external cuticle with numerous minute lateral hairs, tops of the excrescences not swollen *gonoplaxae*.
- O 2. Excrescences of the external cuticle without minute lateral hairs, tops of the excrescences slightly swollen *leopoldi*.
- N 2. Colleteric glands with about 10 canals in sections of the most strongly divided region.
 - O 1. External cuticle of the mantle about 25 μ thick *hirsuta*.
 - O 2. External cuticle of the mantle about 50 μ thick *vieta*.
- M 3. Length of the excrescences from 2 to 10 μ *leptothrix*.
- H 2. Excrescences consisting of papillae.
 - I 1. Papillae with a smooth surface, without spines or hairs *flacca*.
 - I 2. Papillae covered with spines or hairs.
 - J 1. Papillae with a central cavity; spines small in comparison to the papillae *teres*.
 - J 2. Papillae without central cavity; spines long in comparison to the papillae *sentia*.
- F 2. External cuticle without distinct excrescences.
 - G 1. Colleteric glands strongly branched (more than 40 canals in longitudinal sections of the most strongly divided region); gregarious *gregaria*.
 - G 2. Colleteric glands less strongly branched (less than 30 canals in longitudinal sections of the most strongly divided region).
 - H 1. External cuticle of the mantle consisting of one kind of chitin only.
 - I 1. One of the testes rudimentary, the other well developed *pustulata*.
 - I 2. Both testes well developed.
 - J 1. One testis much farther extending towards the dorsal region than the other *gibba*.
 - J 2. Dorsal ends of the two testes in approximately the same region *rugosa*.
 - H 2. External cuticle of the mantle consisting of two different kinds of chitin.
 - I 1. Hyaline parts of the cuticle in its upper half only *irrorata*.
 - I 2. Hyaline parts of the cuticle extending through the cuticle from basis to upper layers *sulcata*.
- D 2. Vasa deferentia gradually passing into the testes.
 - E 1. Vasa deferentia comparatively wide *flexuosa*.
 - E 2. Vasa deferentia comparatively narrow.
 - F 1. External cuticle of the mantle with distinct excrescences.
 - G 1. External cuticle with small hairs or elongate papillae *atlantica*.
 - G 2. External cuticle with short papillae covered with minute spines *verrucosa*.

- F 2. External cuticle without distinct excrescences.
 - G 1. Extreme dorsal part of the testes curved in a postero-anterior direction *curvata.*
 - G 2. Testes more or less straight.
 - H 1. Vasa deferentia straight, testes with a comparatively thin wall *anceps.*
 - H 2. Vasa deferentia slightly tortuous, testes with a comparatively thick wall *bicuspidata.*
- C 2. Closed extremities of the male genital organs recurved in a posterior and ventral direction. Testes very small in comparison to the wide vasa deferentia *anomala.*
- B 2. Male genital organs of both sides of the body at least partially united, so that their cavities communicate.
 - C 1. Vasa deferentia rather abruptly passing into the testes.
 - D 1. External cuticle of the mantle with excrescences.
 - E 1. Excrescences consisting of comparatively short spines (about 15 μ long) *brevispina.*
 - E 2. Excrescences consisting of long hairs (about 70 μ long) *setosa.*
 - D 2. External cuticle without distinct excrescences.
 - E 1. Colleteric glands with a large number of canals *plana.*
 - E 2. Colleteric glands with a very small number of canals *schmitti.*
 - C 2. Vasa deferentia gradually passing into the testes.
 - D 1. External cuticle of the mantle covered with more or less flat topped papillae (length about 22 μ), which at their upper surface bear numerous little spines *papposa.*
 - D 2. External cuticle of the mantle covered with small papillae, without lateral spines or hairs, varying in length from 3 to 9 μ *reniformis.*

* **Sacculina abyssicola** Guérin-Ganivet 1911.

Type specimen on *Ethusa (Ethusina) abyssicola* S. I. Smith.

Type-locality: Cape Verde Islands, 3655 m (a second specimen from the Azores, 3975 m).

Guérin-Ganivet (1911, p. 64) gives the following account of the anatomical characters:

“La masse viscérale est exactement de même forme que son enveloppe; le mésentère est normal; les testicules sont faiblement ellipsoïdaux et situés dans le voisinage du pédoncule; ils sont insérés entre les replis du mésentère et n'ont avec l'ovaire que de très vagues rapports de contiguïté; les glandes collétériques sont volumineuses chez l'adulte; elles ont de très nombreux tubes bien visibles par transparence; l'orifice est en forme de fente; elles sont beaucoup plus étendues dans le sens de la largeur que dans le sens de la longueur; enfin elles sont situées de chaque côté au milieu de la masse viscérale;...”

The characters of the external and internal cuticle of the mantle are unknown.

* **Sacculina (?) actaeae** Guérin-Ganivet 1911.

Type specimen on *Actaea rufopunctata* (M.-Edw.)

Type-locality: Canary Islands, 30 m.

Guérin-Ganivet (1911, p. 60) remarks concerning this species:

“Je ne puis donner de ce Rhizocéphale qu'une diagnose incomplète et qu'il sera nécessaire de considérer comme provisoire: elle me paraît en effet très déformée et n'être pas arrivée à son complet développement par suite de la présence de trois Liriopsidés sur lesquels je me propose de revenir dans un prochain travail et qui ont dû exercer sur elle une influence analogue à celle que les Rhizocéphales exercent eux-mêmes sur les Crustacés qui les hébergent; je n'ai en effet pu trouver les testicules et la masse viscérale était réduite à une lame très aplatie et reliée au manteau par un mésentère large ou paraissant du moins tel, peut-être par suite de l'insuffisance de développement de l'ovaire; je n'ai d'ailleurs pu préciser à la surface de celui-ci la situation des glandes collétériques, probablement atrophiées du fait de l'influence des Liriopsidés.”

The characters of the external and internal cuticle of the mantle are unknown.

* **Sacculina aculeata** Boschma 1928.

Type specimen on *Carupa laeviuscula* Heller.

Type-locality: Jiddah, Red Sea.

The specimen can be described as follows (cf. Boschma, 1928, p. 157—158): Male genital organs in the posterior part of the body, outside the visceral mass, completely separated. Testes more or less globular, rather abruptly passing into the vasa deferentia; one of the testes in a more dorsal region than the other. Colleteric glands rather strongly flattened, with a comparatively small number of canals. External cuticle of the mantle consisting of two layers; the external layer has a smooth surface, whilst the internal layer, which is in immediate contact with the epithelium of the mantle, bears excrescences consisting of groups of spines. The distal half of the spines consists of hard chitin, the proximal part is much weaker.

Evidently the specimen is immature, the excrescences of the external cuticle have not yet reached their full development. Therefore the specific characters of the excrescences are unknown and the decision whether the parasite of *Carupa laeviuscula* is a distinct species or not can be made only after more material becomes available.

* **Sacculina ales** Kossmann 1872.

Type specimen on *Macrophthalmus* spec.

Type-locality: Cavite, near Manila, Philippine Islands.

Kossmann (1872, p. 31; 1874, p. 127) remarks:

“Über die anatomischen Verhältnisse kann ich keine Angaben machen.”

As even the exact name of the host is unknown it is highly improbable that the characters of *Sacculina ales* will become known.

Sacculina anceps Boschma 1931 a.

Type specimen on *Albunea symnista* (L.).

Type-locality: Java (?).

The material of this species is not as well preserved as necessary for an accurate description. Three specimens have been sectioned, two in longitudinal sections, one in transverse. These three specimens show some differences, which, however, may be due to their somewhat damaged state. The best preserved of the two specimens of which longitudinal sections have been made is selected now as the type of the species, the description of the species is chiefly based on this type specimen.

Description: Antero-posterior axis of the body noticeably longer than dorso-ventral axis. Attachment of the visceral mass and the mesentery not completely corresponding with the attachment of the stalk and its surroundings to the mantle. Male genital organs in the posterior part of the body, outside the visceral mass, completely separated. Testes with a rather thin

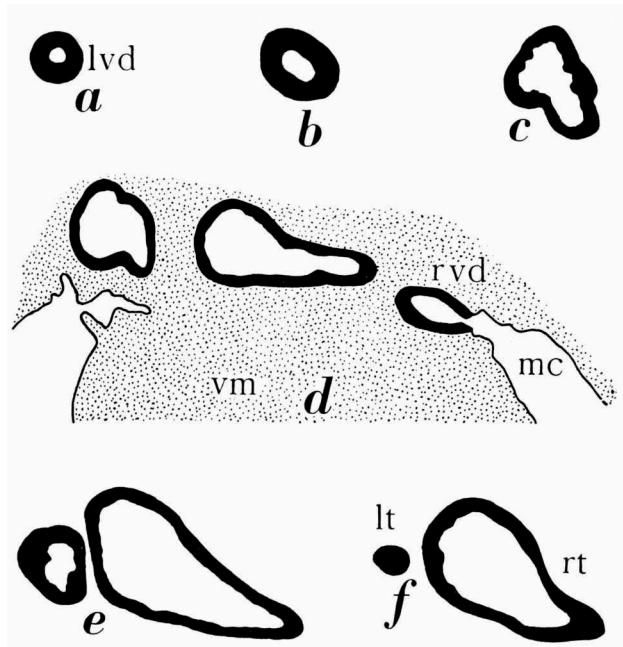


Fig. 1. *Sacculina anceps*. Transverse sections of the male genital organs (in d with the surrounding region of the body). Posterior end at the upper side of the figures. lt, left testis; lvd, left vas deferens; mc, mantle cavity; rt, right testis; rvd, right vas deferens; vm, visceral mass. $\times 45$.

wall, comparatively straight, more or less cylindrical, gradually passing into the vasa deferentia, which are rather straight and comparatively narrow. Colleteric glands rather compact, with a moderate number of canals. Surface of the external cuticle of the mantle somewhat irregular and ragged, but without distinct excrescences. Retinacula unknown.

In the type specimen one of the male genital organs is nearer to the dorsal region than the other, in sections of the ventral part the vas deferens and the testis of the latter is visible only (fig. 1 a—c). In a more dorsal section the other male genital organ

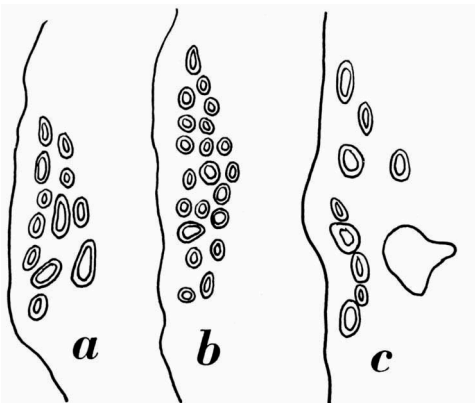


Fig. 2. *Sacculina anceps*. Longitudinal sections of one of the colleteric glands; posterior end at the upper side of the figures. $\times 60$.

appears (fig. 1 d); here in the left part of the figure the most ventral testis is visible, in the central part of the figure the most dorsal testis and in the right part of the figure the genital opening of the latter. Towards the dorsal region the ventral testis diminishes in size, the dorsal testis increases (fig. 1 e). At the region where the ventral testis terminates the dorsal testis still is of large size (fig. 1 f). Fig. 1 d of the present paper is from approximately the same region as a previous figure (Boschma, 1931 a, fig. 38 a). In the same paper (l.c., fig. 38 b) a section of a second specimen is figured, in which the two testes are united; this may be an incorrect interpretation as the specimen is rather badly preserved.

The colleteric glands of the type specimen (fig. 2) correspond closely with those of another specimen of the same species (cf. Boschma, 1931 a, fig. 38 c), as far as concerns the number and arrangement of their canals.

* ***Sacculina andersoni*** Giard 1887.

Type specimen on *Liocarcinus holsatus* (Fabr.).

Type-locality: Wimereux, Atlantic coast of France.

This parasite was considered by Giard as a distinct species on account of his theory of specificity of the parasites. Guérin-Ganivet (1911) and Boschma (1927) proved that its characters correspond in every detail with those of *Sacculina carcini*.

In the year after the parasite of *Liocarcinus holsatus* was designated as a new species Giard (1888, p. 503) wrote:

“Quoique très voisine de *S. carcini*, la *Sacculina Andersoni* s'en distingue spécifiquement. Elle présente même un caractère d'ordre éthologique très net. L'époque de la ponte a lieu beaucoup plus tard dans la saison que chez le parasite de *Maenas*. Les très nombreuses *S. Andersoni* que nous avons recueillis en août et septembre venaient à peine de s'évaginer et ne renfermaient que des œufs ovariens très jeunes.”

These remarks by Giard might indicate that in the species *Sacculina carcini* there occur distinct biological races. As long as no further data on the phenomenon are available this question must remain unsettled.

Sacculina angulata Van Kampen and Boschma 1925.

Type specimen on *Portunus (Hellenus) longispinosus* (Dana).

Type-locality: Waigeu, East Indies, 32 m.

Description: Male genital organs in the visceral mass, the cavities partially united in their ventral part. Vasa deferentia comparatively narrow, gradually passing into the more or less cylindrical testes. Dorsal parts of the testes separated, somewhat curved in an anterior direction. Colleteric glands with a fairly large number of branched tubes. External cuticle

of the mantle with excrescences which do not differ in structure from that of the main layers. The excrescences consist of flat-topped papillae with an irregular contour as they possess more or less sharp edged lateral ridges. The diameter of these excrescences varies from 4 to 17 μ ; their height is approximately 6 μ . Internal cuticle with numerous retinacula, consisting of basal parts with 4 to 10 spindles. The latter have a length of 8 to 12 μ and are barbed.

The above description is largely based on the type specimen; in the latter, however, no retinacula were found. These occur in large numbers on the internal cuticle of a specimen on *Thalamita sima* H. M.-Edw. from Koh Kam (Siam), which was identified as *Sacculina angulata* (cf. Boschma, 1931 a, p. 320).

In the type specimen the ventral parts of the male genital organs are

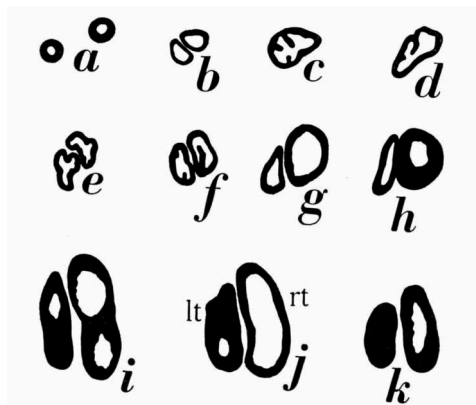


Fig. 3. *Sacculina angulata*. Transverse sections of the male genital organs; posterior end at the upper side of the figures. lt, left testis; rt, right testis. $\times 53$.

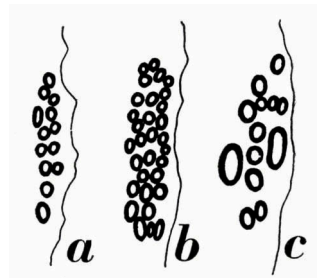


Fig. 4. *Sacculina angulata*. Longitudinal sections of one of the colleteric glands; posterior end at the upper side of the figures. $\times 80$.

completely separated (fig. 3 a). Towards the dorsal region the two male organs gradually unite, so that their cavities are largely communicating (fig. 3 c, d). At a still more dorsal level the two organs become separated again (fig. 3 e), so that at least their cavities remain distinct for the whole of their dorsal part. The most dorsal part of the testes is bent in an anterior direction. The curvature is as strong as to show in some sections, at least in one of the testes, the cavity twice (fig. 3 i). This means that this testis is so strongly curved that its closed extremely even points slightly in a ventral direction.

One section of the type specimen is figured in a previous paper (Van

Kampen and Boschma, 1925, pl. III, fig. 5). Here it looks as if the visceral mass is attached to the mantle at some distance from the region of attachment of the stalk. The specimen, however, is not in an excellent state of preservation, so that the visceral mass may be shifted from its original place of attachment. If, however, really the situation of the organs was like in the cited figure, this fact together with the slightly curved testes would indicate that the species belongs to the genus *Loxothylacus*.

The colleteric glands of the type specimen (fig. 4) contain a fairly large number of branched canals. They do not show an inner layer of chitin, so that the epithelium of the canals is represented in the figure.

Sacculina anomala Boschma 1933 b.

Type specimen on *Thalamita cooperi* Borrada.

Type-locality: Amirante, Western Indian Ocean, 54 m.

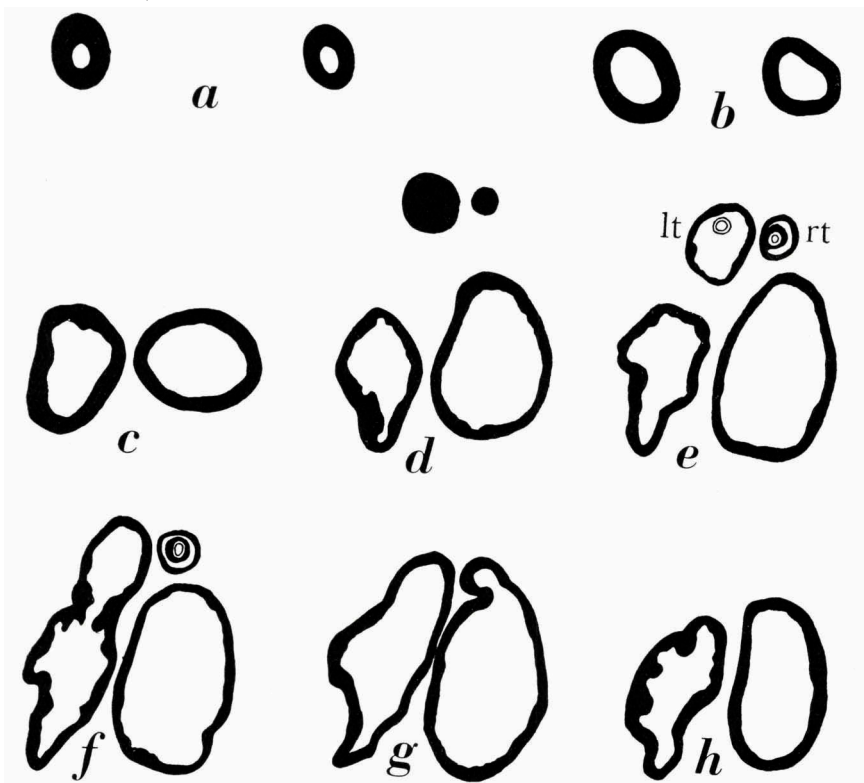


Fig. 5. *Sacculina anomala*. Transverse sections of the male genital organs; posterior end at the upper side of the figures. lt, left testis; rt, right testis. $\times 30$.

Description: Male genital organs in the posterior part of the body,

outside the visceral mass, completely separated. Testes rather small, more or less globular, rather abruptly passing into the much larger vasa deferentia, which from their ventral to their dorsal part increase from narrow canals to wide sacs. Closed extremities of the male genital organs recurved in a posterior and ventral direction. Male genital organs of both sides of the body of approximately equal size. Colleteric glands with a fairly large number of branched canals. External cuticle of the mantle with short thick hairs, which vary in length between 10 and 16 μ , and which possess numerous minute lateral hairs. Internal cuticle of the mantle with numerous

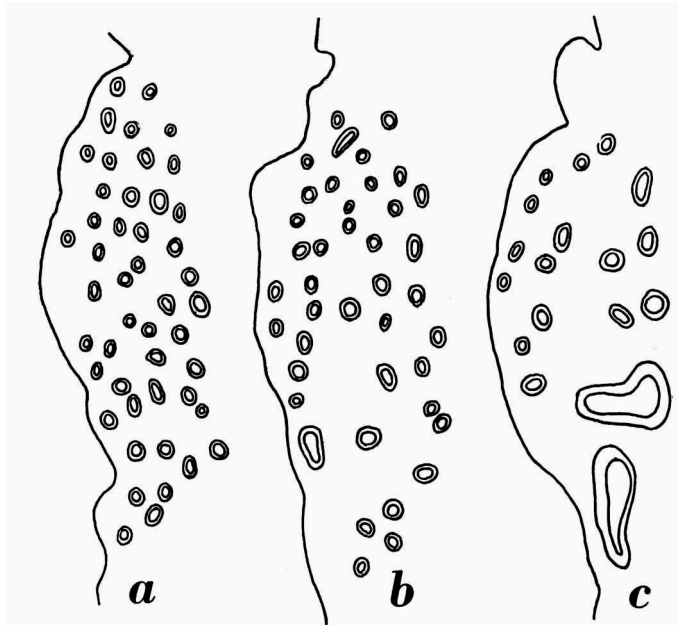


Fig. 6. *Sacculina anomala*. Longitudinal sections of one of the colleteric glands; posterior end at the upper side of the figures $\times 107$.

retinacula, each of which consists of a single barbed spindle with a length of 12 μ approximately.

The male genital organs (fig. 5) each consist of a part running in a ventro-dorsal direction, gradually increasing in size towards the dorsal region (here they form comparatively wide sacs), and a shorter, narrow part, running in a dorso-ventral direction. This narrow part (fig. 5 d—f) which lies in a slightly more posterior region than the wider part, in all probability is the testis, as it is connected to the wider part (which then is the vas deferens) by a narrow canal with a distinctly chitinous inner wall.

This means, in other words: testes very small, more or less globular, rather abruptly passing into the vasa deferentia, which in their dorsal part are strongly increasing in size and width.

The colleteric glands (fig. 6) possess a fairly large number of branched canals, from the three figured sections that from the most peripheral region (fig. 6 a) contains 47 sections of canals.

Sacculina atlantica Boschma 1927.

Type specimen on *Achaeopsis thomsoni* (Norman).

Type-locality: "Thor", Stat. 93 (south-west of Ireland), 1275—1180 m.

Description: Male genital organs in the posterior part of the body,

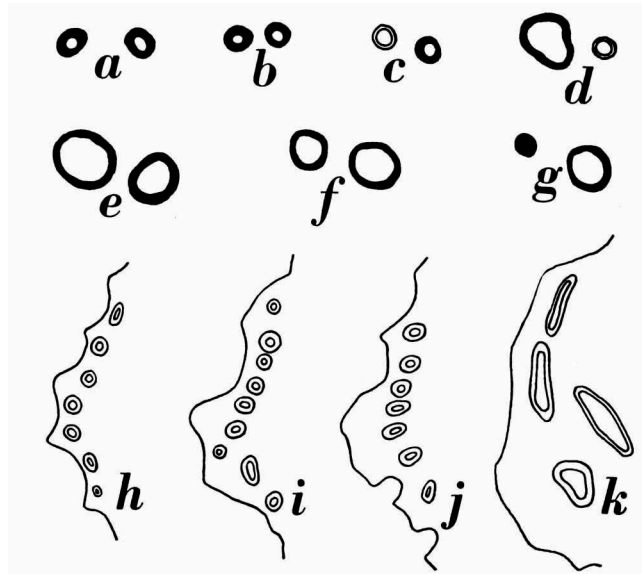


Fig. 7. *Sacculina atlantica*. a—g, transverse sections of the male genital organs. h—k, longitudinal sections of one of the colleteric glands. Posterior end at the upper side of the figures. a—g, $\times 45$; h—k, $\times 80$.

outside the visceral mass, completely separated. Testes more or less cylindrical, gradually passing into the vasa deferentia, which form narrow canals. At the region of transition of the testes into the vasa deferentia there is a well developed layer of chitin. Colleteric glands with a small number of canals which are arranged more or less parallel to the surface of the visceral mass. External cuticle in the vicinity of the mantle opening much thinner than that of the rest of the mantle. The external cuticle bears excrescences of approximately 7μ length, these are rather densely distri-

buted on its surface and consist of hairs or elongate papillae with several minute lateral hairs. Retinacula unknown.

From the ventral to the dorsal region the male genital organs (fig. 7 a—g) gradually increase in size. At a certain region the inner wall of the cavity is covered with a well developed layer of chitin (fig. 7 c, left side, 7 d, right side); this region therefore is the region of transition of the vasa deferentia into the testes. The two male organs have approximately the same size and shape.

The number of canals in the colleteric glands (fig. 7 h—k) is very small. The greater number of canals in these sections is 9 (fig. 7 i). Fig. 7 h is drawn after a section from the peripheral part, fig. 7 k is from the vicinity of the atrium, the two other sections are from intermediate regions.

* **Sacculina belli** Giard 1888.

Type specimen on *Liocarcinus marmoreus* (Leach).

Type-locality: Wimereux, Atlantic coast of France.

This form was considered by Giard as a distinct species on account of his theory of specificity of the parasites. According to Guérin-Ganivet (1911) the parasite does not differ in any respect from *Sacculina carcini*.

* **Grapsisaccus benedeni** (Kossmann).

= *Sacculina carcini* Thomps.

I do not know where the diagnosis of the genus *Grapsisaccus* was published. Giard and Bonnier (1890, p. 391) mention the name "*Grapsisaccus benedeni* Kossmann". Stebbing (1893, p. 403) also uses this name for the parasite of *Pachygrapsus marmoratus*.

* **Sacculina benedeni** Kossmann 1872.

Type specimen on *Pachygrapsus marmoratus* (Oliv.).

Type-locality: Palma, Baleares.

According to Kossmann (1872, p. 35; 1874, p. 131) the anatomical characters of this parasite are:

"Die Cuticula ist glatt. Der Zusammenhang zwischen Körper und Mantel geht hinten bis zur Mantelöffnung, vorn wenig über dieselbe hinaus. Der Körper ist seitlich zusammengedrückt und durchaus symmetrisch. Die Ovarialmündungen liegen in der Mitte der kreisrunden Eikittdrüsen, nahe am hintern Rande des Körpers. Die männlichen Sexualorgane sind paarig, und liegen dicht hinter dem Rüssel. Die Hoden sind cylindrisch, sein Ausführungsgang anfangs sehr dick, in der Nähe der Mündung weit dünner."

In a previous paper (Boschma, 1927) I showed that *Sacculina benedeni* is a synonym of *S. carcini*.

Kossmann (1873) found a parasite on *Xantho floridus* (Mont.), which he identifies as *Sacculina benedeni*.

Gruvel (1920) mentions the occurrence of a parasite on *Geryon affinis* M.-Edw. & Bouvier from Stat. 230 of the cruises of the Prince of Monaco, 1236 m; he names this specimen *Sacculina benedeni*.

Popov (1929) identifies a part of his material of parasites on *Pachygrapsus marmoratus* as *Sacculina carcini*, another part as *Sacculina benedeni*.

* ***Sacculina betencourti*** Giard 1887.

Type specimen on *Portumnus latipes* (Penn.).

Type-locality: Wimereux, Atlantic coast of France.

This parasite was considered by Giard as a distinct species on account of his theory of specificity of the parasites. Guérin-Ganivet (1911) remarks that this form in all probability is identical with *Sacculina carcini*.

* ***Sacculina biangularis*** Kossmann 1872.

Kossmann (1872, p. 25; 1874, p. 121) erroneously used the name *biangularis* instead of *triangularis* for the parasite of *Cancer pagurus*. Weltner (1897, p. 233) includes the name *Sacculina biangularis* in his list and adds: "Mir ist der Autor dieser Art nicht bekannt".

Maitland (1897) includes "*Sacculina biangularis* Hoek" in his list of species.

Sacculina bicuspidata Boschma 1931 a.

Type specimen on *Microphrys bicornutus* (Latr.).

Type-locality: Tobago, British West Indies.

Description: Male genital organs in the posterior part of the body, outside the visceral mass, completely separated. Testes rather thick-walled, with a straight course, more or less cylindrical, gradually passing into the vasa deferentia, which are comparatively narrow, somewhat tortuous in their extreme ventral part. Colleteric glands with a comparatively small number of canals which form one or two rows parallel to the surface of the visceral mass. External cuticle of the mantle without distinct excrescences; in many parts almost smooth or with a slightly ragged surface, in other parts with small irregular papillae, which are till 6 μ long but do not show characteristic peculiarities. Retinacula unknown.

One of the vasa deferentia extends somewhat farther ventrally than the other (fig. 8 a); this ventral part is somewhat toruous. There is a gradual transition of the vasa deferentia into the testes so that the limit between

the two cannot be determined with certainty (fig. 8 a—g). The dorsal part of the male genital organs has a thick wall and a narrow cavity.

The colleteric glands of the type specimen (fig. 8 h—j) do not possess the

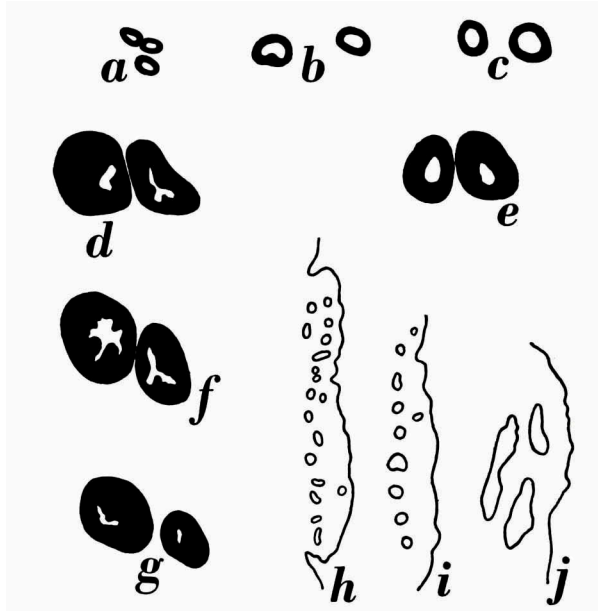


Fig. 8. *Sacculina bicuspadata*. a—g, transverse sections of the male genital organs. h—j, longitudinal sections of one of the colleteric glands. Posterior end at the upper side of the figures. a—g, $\times 30$; h—j, $\times 53$.

usual layers of chitin; this indicates that the eggs but recently had left the ovary.

The sections represented in a previous paper (Boschma, 1931 a, fig. 31) correspond approximately with fig. 8 d and with a region between fig. 8 i and j in the present paper.

***Sacculina bipunctata* Kossmann 1872.**

Type specimen on *Portunus* spec. (*Lupea* spec.).

Type-locality: Kreiangel, Palao, Philippine Islands.

Kossmann's (1872, p. 33; 1874, p. 129) description runs as follows (characters of shape and size omitted):

“Die Cuticula des Mantels besitzt Verdickungen, welche denen der *S. pilosa* ähneln. Doch sind sie weit kleiner und die darauf stehenden Stacheln kurz und vereinzelt. Der Durchmesser der Verdickungen ist 0,01 mm., die

Länge ihrer Stacheln bis zu 0,006 mm. (S. Fig. 24 auf Taf. I.) Die Verwachsung des Mantels geht vorn weit über den Mund hinaus, hinten bis zur Mantelöffnung. Der Körper ist stark seitlich zusammengedrückt und symmetrisch. Die Ovarialmündungen und Eikittdrüsen liegen genau in der Mitte der Seitenflächen. Ein unpaarer Hoden mit doppeltem Ausführungsgange, der wie gewöhnlich ventral vom Munde in die Bruthöhle mündet."

Van Kampen and Boschma (1925, p. 38) identified a specimen on *Pilumnus* spec. from "Siboga" Expedition, Stat. 260 (Kei Islands) as *Sacculina bipunctata* Kossm. This specimen has the following characters.

Description: Male genital organs in the visceral mass, for the greater part united. Testes gradually passing into the vasa deferentia, the ventral parts of which form completely separated narrow canals. The testes are largely united to form a more or less globular body with one wide cavity which in the extreme dorsal part is divided into two cavities. Colleteric glands in the anterior region of the visceral mass, containing a small number of canals, more or less arranged in one row parallel to the surface of the visceral mass. Surface of the external cuticle of the mantle with excrescences which have a different structure from that of the main layers. They consist of small more or less prismatical columns which at their extremities bear a number of small spines arranged in a circular row. The excrescences may reach a length of 18 μ . Retinacula unknown.

In all essential points the specimen of the "Siboga" Expedition corresponds with Kossman's description. As, however, the hosts of the two specimens belong to different genera it is not absolutely certain that the parasites are identical.

Sacculina brevispina Van Kampen and Boschma 1925.

Type specimen on *Actaea hirsutissima* (Rüpp.).

Type-locality: Sanguisiapo, Sulu Archipelago.

Description: Male genital organs in the posterior part of the body, outside the visceral mass, in their dorsal part largely united, forming a common wide sac. Testes abruptly passing into the vasa deferentia, which, especially in their ventral part, are rather narrow. Colleteric glands with comparatively few canals, arranged in a single row parallel to the surface of the visceral mass. External cuticle of the mantle rather sparsely covered with small blunt spines of approximately 15 μ length, which may possess a few minute hairs. Internal cuticle of the mantle with rows of retinacula, each consisting of a basal part and a variable number (1 tot 4) of spindles. The latter are of variable size; they may reach a length of 20 μ .

Fig. 9 a—h represent transverse sections of the male genital organs. In

fig. 9 c one of the vasa deferentia is seen passing into the common testis, in fig. 9 e the same is represented for the other vas deferens. Fig. 9 f—h are drawn after sections of the united part of the male organs. In the sections of fig. 9 c and e no chitinous layer is visible on the inner wall of the canals which penetrate into the common testis; it is, therefore, not

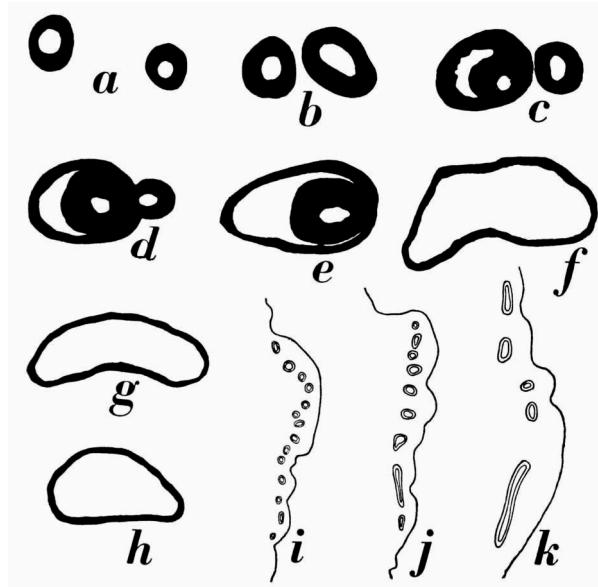


Fig. 9. *Sacculina brevispina*. a—h, transverse sections of the male genital organs. i—k, longitudinal sections of one of the colleteric glands. Posterior end at the upper side of the figures. a—h, $\times 30$; j—k, $\times 53$.

absolutely certain that this region represents the part of transition of the vasa deferentia into the testis.

Sections of the canal system in the colleteric glands are drawn in fig. 9 i (from the peripheral part), fig. 9 k (from the median part) and fig. 9 j (intermediate between the two others). Towards the periphery of the glands the division of the canal system increases, but the number of canals remains rather low.

Sacculina bucculenta Boschma 1933 a.

Type specimen on *Micippe philyra* (Herbst).

Type-locality: Martaban (Lower Burmah).

Description: Male genital organs in the visceral mass, completely separated. Testes more or less cylindrical, gradually passing into the vasa defe-

rentia, which, at least in their ventral part, consist of narrow canals. Canal system of the colleteric glands strongly branched (more than 40 canals in longitudinal sections of the most strongly divided part). External cuticle of the mantle without excrescences, its surface divided into small areas with

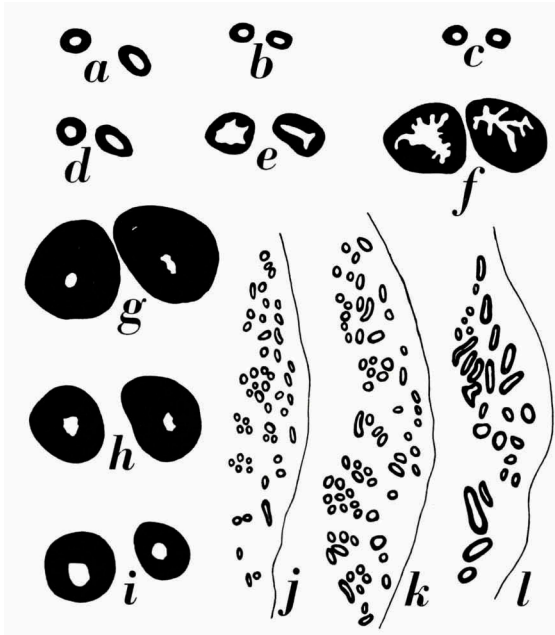


Fig. 10. *Sacculina bucculenta*. a—i, transverse sections of the male genital organs. j—l, longitudinal sections of one of the colleteric glands. Posterior end at the upper side of the figures. a—i, $\times 30$; j—l, $\times 53$.

an irregular contour, which have a diameter of 8 to 18 μ . Internal cuticle of the mantle with evenly distributed retinacula consisting of a basal part and 4 to 5 spindles, which have a length of 7.5 μ approximately.

In the male genital organs there is not a chitinous structure which might give an indication for the region of transition of the vasa deferentia into the testes. The vasa deferentia in their ventral part are narrow canals (fig. 10 a—d); towards the dorsal region gradually the cavities of the male genital organs become somewhat wider (fig. 10 e, f), whilst still

farther dorsally the size of the cavities diminishes again (fig. 10 g—i). In their dorsal part the testes have a very thick wall.

The colleteric glands of the type specimen do not contain chitin, therefore in the figures (fig. 10 j—l) the epithelium of the glandular tubes is drawn. The canal system of the glands in longitudinal sections has a more or less flattened aspect; the canals themselves are distributed in an irregular manner.

The visceral mass of the type specimen shows a very uncommon peculiarity: it contains numerous muscles which are arranged in groups; the muscles of each group are radiating from a common centre (cf. Boschma, 1933 a, fig. 21, 22).

* **Sacculina bursa pastoris** Kossmann 1872.

Type specimen on *Rhinolambrus turriger* Ad. & Wh.

Type-locality: Philippine Islands, 11—63 m.

Kossmann (1872, p. 28; 1874, p. 124) gives the following description (characters of shape and size omitted):

“Die Cuticula ist mit stumpfen Wärzchen bedeckt. Der Körper ist sehr wenig seitlich comprimirt. Da der Erhaltungszustand der mir zu Gebote stehenden Exemplare nicht tadellos war, so kann ich über die Lage der Ovarialöffnungen und das Vorhandensein von Eikittdrüsen nichts erwähnen. Die Hoden gleichen an Gestalt und Lage denen von *S. carcini*; nur liegen sie nicht so dicht neben einander.”

Sacculina caelata Boschma 1931 a.

Type specimen on *Typhlocarcinus nudus* Stimp.

Type-locality: South of Koh Bidang (Siam), 16 m.

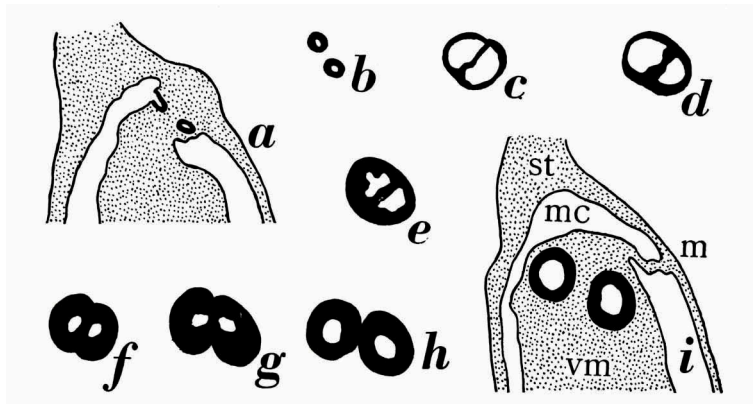


Fig. 11. *Sacculina caelata*. Transverse sections of the male genital organs (in a and i with the surrounding region of the body). Posterior end at the upper side of the figures. m, attachment of mesentery to the mantle; mc, mantle cavity; st, stalk; vm, visceral mass. $\times 45$.

Description: Visceral mass and mesentery attached to the mantle at some distance from the region of attachment of the stalk. Male genital organs in the visceral mass, partially in close contact, but the cavities completely separated. Dorsal extremities of the testes widely separated. Testes more or less cylindrical, gradually passing into the vasa deferentia, which consist of narrow canals. Colleteric glands with a moderately branched canal system (more than 15 and less than 30 branches in longitudinal sections of the most strongly divided part). External cuticle without distinct excrescences,

but its surface covered with minute ridges of 1 to 2 μ height, which have an irregular shape. Internal cuticle of the mantle with evenly distributed retinacula consisting of a basal part and a small number of spindles; the latter have a length of 8 μ approximately.

The uncommon manner of attachment of the visceral mass and the

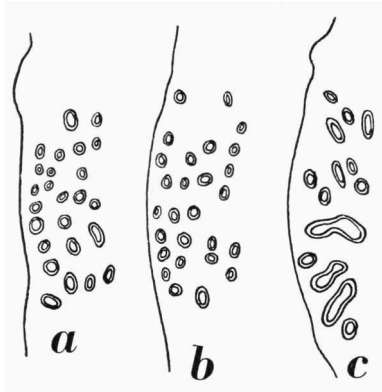


Fig. 12. *Sacculina caelata*. Longitudinal sections of one of the colleteric glands; posterior end at the upper side of the figures. $\times 107$.

mesentery to the mantle is represented in fig. 11 a and i (cf. also Boschma, 1931 a, fig. 19). In this respect *Sacculina caelata* shows a character which is peculiar to the genus *Loxothylacus*; the male genital organs, however, are not curved as in the latter genus. The ventral parts of the vasa deferentia are narrow (fig. 11 a, b). Towards the dorsal region the two male genital organs come into close contact (fig. 11 c-g), their cavities, however, remain completely separated. In their dorsal part the two testes diverge again (fig. 11 h, i).

Three sections of one of the colleteric glands, from the periphery (a) to the median part (c), are represented in fig. 12. These glands are very small, but contain a fairly large quantity of canals.

* ***Sacculina calappae*** Van Kampen and Boschma 1925.

Type specimen on *Calappa pustulosa* Alc.

Type-locality: "Siboga" Expedition, Stat. 320 (Java Sea).

Description: Male genital organs in the posterior part of the body, outside the visceral mass. Colleteric glands with numerous canals, which are rather loosely distributed. External cuticle of the mantle with small blunt papillae which are till 15 μ long and possess numerous small hairs. Internal cuticle of the mantle with retinacula consisting of one spindle (rarely two), which have a length of 22 μ approximately.

A complete diagnosis of the species can not be given as the type (the only available specimen) is severely damaged: when the specimen was taken off from its host the greater part of the male genital organs was lost. The ventral part of the vasa deferentia only could be examined, these are found outside the visceral mass, in the posterior region of the body (cf. Boschma, 1931 c, fig. 28) as comparatively narrow canals.

The colleteric glands are well developed; they contain numerous canals,

which, especially in the median region (fig. 13 b) are rather sparsely distributed. Towards the peripheral parts of the glands the branches of



Fig. 13. *Sacculina calappae*. Longitudinal sections of one of the colleteric glands; posterior end at the upper side of the figures. $\times 45$.

the canal system become much narrower and somewhat more crowded (fig. 13 a).

Sacculina calva Boschma 1933 b.

Type specimen on *Menaethius monoceros* Latr.

Type-locality: Saya de Malha, Western Indian Ocean, 52 m.

Description: Male genital organs in the visceral mass. Testes close together for the whole of their extent, in one region their cavities separated

by a thin septum only. Dorsal extremities of the two testes close together. Testes more or less cylindrical, gradually passing into the vasa deferentia, which, at least in their ventral parts, form narrow tubes. Colleteric glands with a moderate number of canals (more than 15 and less than 30 canals in longitudinal sections of the most strongly divided part). External cuticle of the mantle without excrescences; its surface divided into small irregularly polygonal areas with a diameter of 6 to 14 μ . Retinacula unknown.

In the male genital organs there is not a region in which the inner wall of the cavities is covered with chitin, so that the exact place of transition of the vasa deferentia into the testes cannot be determined. The ventral parts of the vasa deferentia are narrow (fig. 14 a-c); in a more dorsal

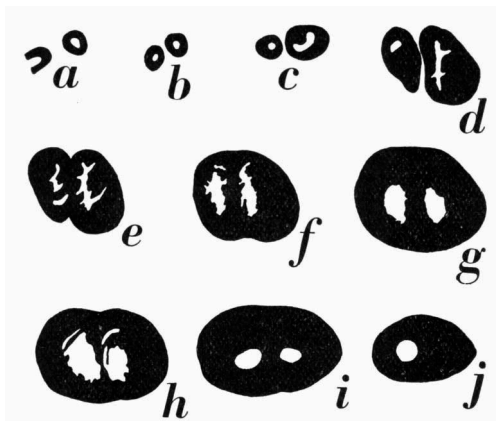


Fig. 14. *Sacculina calva*. Transverse sections of the male genital organs; posterior end at the upper side of the figures. $\times 30$.

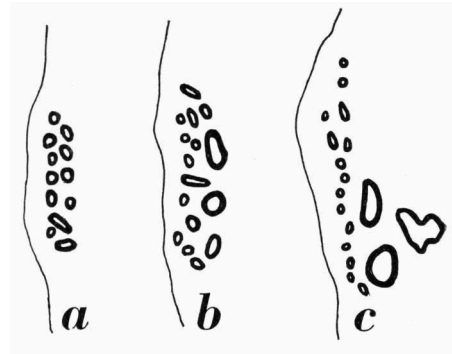


Fig. 15. *Sacculina calva*. Longitudinal sections of one of the colleteric glands; posterior end at the upper side of the figures. $\times 80$.

region the male genital organs gradually increase in size (fig. 14 d) and their walls unite (fig. 14 e-g). The cavities of the left and right male genital organ remain completely separated although the common wall in one region is reduced to a narrow septum only (fig. 14 h). In the extreme dorsal part the two cavities again are at some distance from each other (fig. 14 i, j, the latter figure is from a region in which the cavity of one of the testes already has vanished).

The colleteric glands of the type specimen do not contain chitin, in the drawings (fig. 15) the epithelium of the canals is represented in black.

* *Sacculina captiva* Kossmann 1872.

Type specimen on *Myra fugax* (Fabr.).

Type-locality: Bohol, Philippine Islands.

Kossmann (1872, p. 32; 1874, p. 128) gives the following description (characters of shape and size omitted):

“Die Cuticula des Mantels ist sehr dünn und ganz glatt, was sich wohl daraus erklärt, dass das Thier unter dem Abdomen seines Wirththieres, der *Myra fugax*, in einem ganz dichten, sehr festen, dosenartigen Verschlusse liegt. Der Körper ist mässig seitlich comprimirt und symmetrisch. Die Ovarialöffnungen und Eikittdrüsen liegen ganz an seinem hinteren Rande. Die paarigen Hoden sind langgestreckt cylindrisch.”

* ***Pachybdella carcini*** Lilljeborg 1859.

= *Sacculina carcini* Thomps.

* ***Peltogaster carcini*** Rathke 1843.

= *Sacculina carcini* Thomps.

Sacculina carcini Thompson 1836.

Type specimen on *Carcinides maenas* (L.).

Type-locality: coast of England.

The following description differs from that in a previous paper (Boschma, 1936 c) in unimportant details only.

Description: Male genital organs in the visceral mass, partially united, dorsal parts completely separated. Testes more or less cylindrical, gradually passing into the vasa deferentia, which, at least in their ventral part, are narrow tubes. Dorsal parts of the testes with a comparatively thick wall. Parts of the male genital organs with ridges on their inner walls. Colleteric glands with numerous canals (as a rule more than 30 of these canals in longitudinal sections of the most strongly divided part). External cuticle of the mantle with small hairs or papillae which as a rule are not longer than $12\ \mu$ (generally shorter), and possess minute lateral hairs. The chitin of the excrescences is of the same kind as that of the main layers of the cuticle. Internal cuticle of the mantle with numerous retinacula, which are more or less evenly distributed on its surface. Each retinaculum consists of a basal part and 4 to 10 barbed spindles, which have a length of about $15\ \mu$.

In his paper on *Sacculina carcini* Delage (1884) gives an elaborate description of the genital organs of the parasite of *Carcinides maenas*. In the present paper sections of the male organs of representatives of the same species, but taken from different hosts, are represented (fig. 16—19), moreover sections of the colleteric glands of specimens on five different hosts (fig. 20).

The male genital organs of the parasite of *Liocarcinus holsatus* (fig. 16) closely correspond with those of "typical" specimens (the parasites of

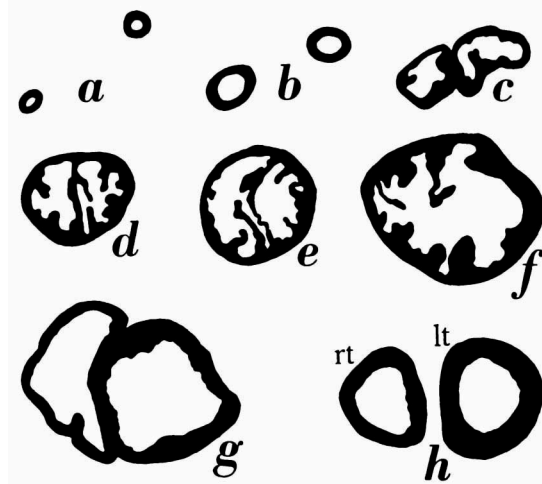


Fig. 16. *Sacculina carcini*, specimen on *Liocarcinus holsatus*. Transverse sections of the male genital organs; posterior end at the upper side of the figures. lt, left testis; rt, right testis. $\times 30$.

Carcinides maenas). The two vasa deferentia are narrow canals (fig. 16 a, b); in their dorsal ends they unite (fig. 16 c) and gradually the contour of the two united male genital organs becomes more or less circular (fig. 16 d, e). The two cavities remain separate for some distance, although the septum formed by the fused median parts of the walls of the organs becomes more and more irregular. At last the septum is pierced by a large opening (fig. 16 f).

Towards the dorsal region the opening through which the two cavities communicate gradually closes, and the two testes regain more and more their individuality (fig. 16 g).

In their extreme dorsal part the testes are completely separated (fig. 16 h); the wall of this part of the male organs is rather thick. Fig. 16 f of the present paper corresponds approximately with Delage's figure 74; fig. 16 h with Delage's figure 72 (l.c., pl. 29).

Sections of the male genital organs of a parasite of *Liocarcinus pusillus* are drawn in fig. 17. The differences with those represented in the previous figure are very slight and are of the

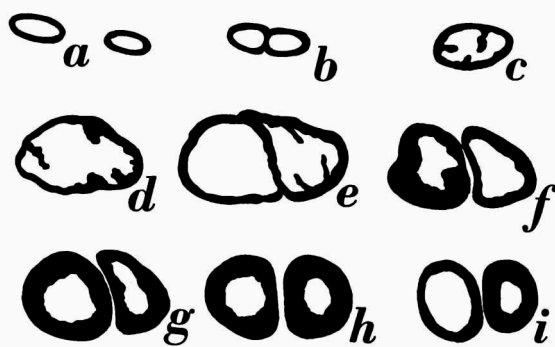


Fig. 17. *Sacculina carcini*, specimen on *Liocarcinus pusillus*. Transverse sections of the male genital organs; posterior end at the upper side of the figures. $\times 30$.

same order as those found among specimens from the same species of host. Here we find a smaller number of irregular ridges on the inner wall (fig. 17 d, e) than in the other animal (fig. 16 d-f).

The sections of the male organs of a specimen on *Brachynotus lucasi*¹⁾ again are slightly different from those of the two other animals. The fusion of the cavities (fig. 18 d) occurs here in a corresponding region. In the last figured section (fig. 18 g) the two testes are still close together, the extreme dorsal parts of these organs, which are not drawn here, are somewhat more separated.

The male organs of a specimen on *Pachygrapsus marmoratus* do not differ appreciably from those of representatives of *Sacculina carcini* on other hosts. The region in which the two male genital organs are united

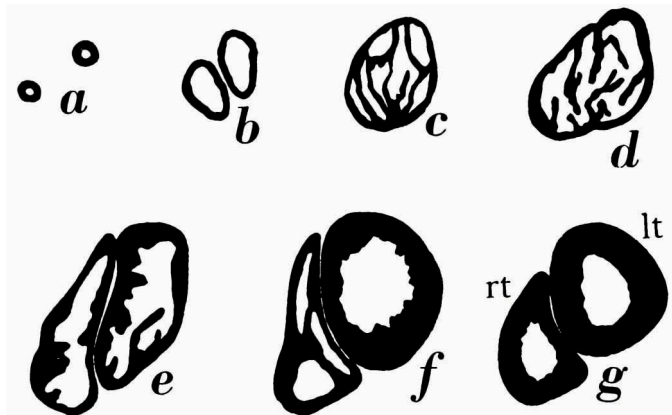


Fig. 18. *Sacculina carcini*, specimen on *Brachynotus lucasi*. Transverse sections of the male genital organs; posterior end at the upper side of the figures. lt, left testis; rt, right testis. $\times 45$.

shows a rather strong compression of these organs in an antero-posterior manner (fig. 19 c-g). In general, however, there are no conspicuous differences with the corresponding organs of the animals dealt with above.

Fig. 20 represents longitudinal sections of the most strongly divided region of the canal system in the colleteric glands of five specimens of *Sacculina carcini* from different hosts, viz., *Brachynotus lucasi* (fig. 20 a), *Liocarcinus arcuatus* (fig. 20 b), *Pachygrapsus marmoratus* (fig. 20 c), *Liocarcinus holsatus* (fig. 20 d), and *Carcinides maenas* (fig. 20 e), drawn on the same scale. In some of these (fig. 20 a, e) the canals do not contain chitin, the epithelium of the canals is represented in black. In the other specimens distinct chitinous tubes are present. The arrangement of the

1) cf. footnote on p. 195.

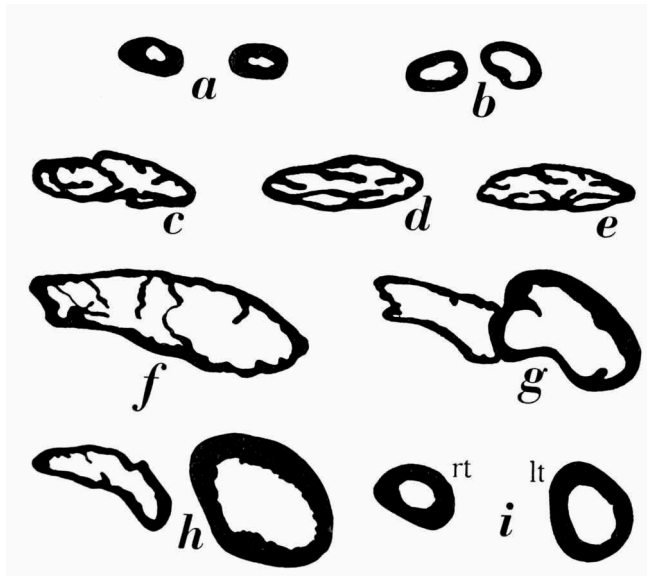


Fig. 19. *Sacculina carcini*, specimen on *Pachygrapsus marmoratus*. Transverse sections of the male genital organs; posterior end at the upper side of the figures. lt, left testis; rt, right testis. $\times 30$.

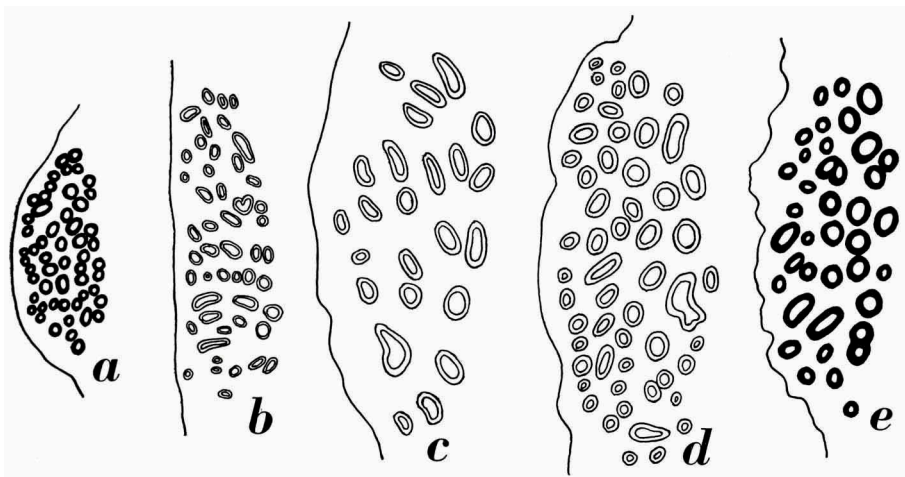


Fig. 20. *Sacculina carcini*. Longitudinal sections of the most strongly divided parts of the colleteric glands of five specimens. a, on *Brachynotus lucasi*; b, on *Liocarcinus arcuatus*; c, on *Pachygrapsus marmoratus*; d, on *Liocarcinus holsatus*; e, on *Carcinides maenas*. Posterior end at the upper side of the figures. $\times 45$.

canal system in the five specimens is very similar, but the number of canals in the sections and their density in distribution differs in some respects. The number of canals in each section is 54 (a), 49 (b), 24 (c), 55 (d), and 39 (e). These differences are rather striking, but they are too insignificant to use these as specific characters, for the number of canals in the colleteric glands is subject to rather extensive individual variation.

The excrescences of the external cuticle of the mantle too are rather variable in different specimens of *Sacculina carcini*, even in those which are parasites of the same species of host. The excrescences may be strongly reduced so that some parts of the external cuticle may appear to have a smooth surface. Moreover the length of these excrescences is variable to a certain extent.

The name *Sacculina carcini* has been used by many authors for the parasites of various species of crabs.

* ***Sacculina carinata*** Kossmann 1872.

= *Loxothylacus carinatus* (Kossm.).

Sacculina carpiliae Guérin-Ganivet 1911.

Type specimen on *Carpilius convexus* (Forsk.).

Type-locality: Red Sea.

Guérin-Ganivet (1911, p. 56) describes the anatomical characters as follows:

“Le manteau est épais, sa surface intérieure est blanche et est en continuité avec la masse viscérale par le mésentère qui est normalement disposé; cette masse viscérale est également brúnatre et présente dans son tiers inférieur, de chaque côté, une glande collétérique assez étendue dont les ramifications se voient par transparence et qui est pourvue d'un orifice vulvaire en forme de fente très nette et parallèle au bord de la masse viscérale située en face de l'orifice cloacal, ce qui est très différent de ce qu'on trouve chez *Sacculina carcini*. Les testicules s'aperçoivent par transparence dans la partie supérieure de la masse viscérale avoisinant le pédoncule et paraissent déboucher tout auprès de ce dernier; ils sont blanchâtres et paraissent être courtement claviformes et allongés perpendiculairement au pédoncule, du côté de l'insertion mésentérique;...”

Professor Ch. Gravier of the Muséum National d'Histoire Naturelle kindly allowed me to study the characters of the external cuticle of the type specimen. As a result I gave the following diagnosis of the species, which is partially based on other specimens from the same species of crab (Boschma, 1936 b, p. 344):

“Organes génitaux mâles dans la partie postérieure du corps, en dehors de la masse viscérale. Testicules complètement indépendants, plus ou moins globuleux. Glandes collatérales avec un assez petit nombre de tubes. Appendices de la cuticule externe du manteau composé d'un assez grand nombre d'épines. Les dimensions des appendices varient de 100 à 160 μ .”

This does not yet suffice to distinguish the species from all others which have more or less similar excrescences of the external cuticle. The following is an attempt to do this.

Description: Male genital organs in the posterior part of the body, outside the visceral mass, completely separated. Testes more or less globular, abruptly passing into the vasa deferentia which for their greater part are comparatively wide (although their cavities may be reduced by ridges on the inner wall). Colleteric glands with few canals (less than 20 in longitudinal sections of the most strongly divided region); the canals more or less in a single row parallel to the surface of the visceral mass. External cuticle covered with groups of hyaline spines, consisting of a kind of chitin different from that of the main layers of this cuticle. Excrescences consisting of well developed basal parts and numerous spines, at their basal region the spines often are united into groups of two or three, but the excrescences are not divided into distinct branches. The spines have a length of 60 to 100 μ , the length of the excrescences as a whole varies from 80 to 160 μ .

The region of transition of the testes into the vasa deferentia can be accurately determined as there is a narrow canal with a distinct layer of chitin uniting the two parts of the male genital organs.

* **Sacculina cartieri** Kossmann 1872.

Type specimen on *Pilumnus vespertilio* Fabr.

Type-locality: Bohol, Philippine Islands.

Kossmann's (1872, p. 32/33; 1874, p. 128/129) description is as follows (characters of shape and size omitted):

“Die Cuticula des Mantels trägt steinflasterartige durch tiefe Furchen von einander getrennte Verdickungen. Die sonstigen anatomischen Verhältnisse gleichen denen der *S. carinata* und *dentata*. Die männlichen Sexualorgane jedoch entsprechen denen einer weiter unten zu beschreibenden Art, *Sacculina benedeni* (Taf. II, Fig. 3). Die paarigen Hoden nämlich sind cylindrisch, die Ausführungsgänge in ihrem grössten Verlaufe sehr dick und mit spiraligem Lumen versehen.”

Sacculina benedeni is the name given by Kossmann to the parasite of *Pachygrapsus marmoratus*, which parasite now is regarded as a represen-

tative of the species *Sacculina carcini*. In my material of the specimens on *Pachygrapsus marmoratus* the vasa deferentia have a more or less straight course; their cavities do not present any particulars which might justify to describe them as spirally.

* **Sacculina cavolinii** Kossmann 1872.

Type specimen on *Aulacolambrus hoplonotus* Ad. & Wh.

Type-locality: Philippine Islands (?).

Kossmann (1872, p. 35; 1874, p. 131) gives the following description (characters of shape and size omitted):

“Auch die anatomischen Verhältnisse waren nicht mit Sicherheit zu ermitteln. Dennoch erwähne ich die Art, weil das Wohnthier, Lambrus hoplonotus, bekannt und die Cuticula des Mantels durch ähnliche Bildungen ausgezeichnet ist, wie sich bei *S. exarcuata* fanden.”

For the present it remains unsettled whether *Sacculina cavolinii* is distinct from *S. exarcuata* or not. Moreover it remains questionable whether the specimen on *Parthenope valida* which I identified as *S. exarcuata* belongs to this species or to *S. cavolinii* or to none of the two.

Sacculina comosa Boschma 1931 c.

Type specimen on *Eurycarcinus maculatus* (A. M.-Edw.).

Type-locality: Madura, East Indies.

Description: Male genital organs in the posterior part of the body, outside the visceral mass, completely separated. Testes not strongly differing in size and shape, more or less globular, rather abruptly passing into the vasa deferentia, which are narrow and somewhat tortuous. Colleteric glands small, with very few canals (less than 10 in longitudinal sections of the most strongly divided region). External cuticle with long slender hairs which do not possess small lateral hairs and which may reach a length of 70 μ . The hairs form a rather dense mass on the surface of the cuticle, their structure does not differ from that of the main layers. Retinacula unknown.

In the type specimen one of the testes is found in a more ventral region than the other; the former (fig. 21 c) is slightly smaller than the latter (fig. 21 g). Fig. 21 b shows the ventral part of the smaller testis (at the right side below), fig. 21 e (at the right side) the dorsal extremity of the same. Parts of the vasa deferentia are rather strongly tortuous (fig. 21 b, d). In fig. 21 c the narrow tube with its chitinous inner wall which connects the vas deferens with the testis is seen penetrating the smaller testis; in fig. 21 e the corresponding canal of the other side has just traversed the muscular sheath of the larger testis, in fig. 21 f it has penetrated through the wall of this testis itself. Fig. 21 h shows the dorsal extremity of the larger testis, surrounded by its muscular sheath.

Fig. 21 i is drawn after a peripheral section of one of the colleteric glands, fig. 21 k after an approximately median section, and fig. 21 j after a section from an intermediate region.

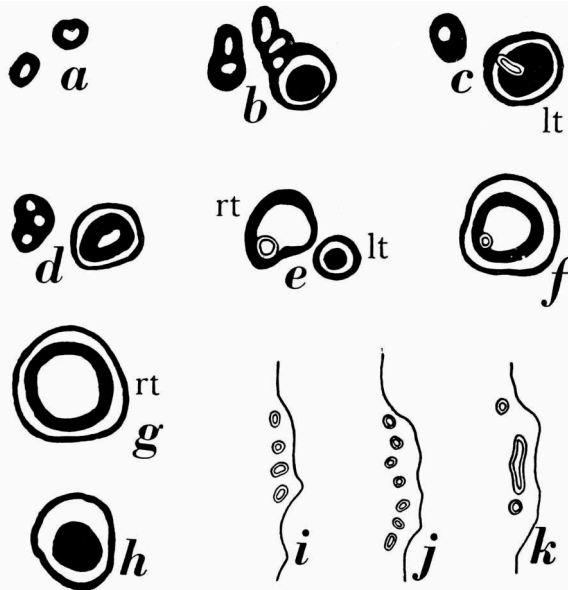


Fig. 21. *Sacculina comosa*. a-h, transverse sections of the male genital organs. i-k, longitudinal sections of one of the colleteric glands. Posterior end at the upper side of the figures. lt, left testis; rt, right testis. a-h, $\times 45$; i-k, $\times 80$.

***Sacculina compressa* Boschma 1931 c.**

Type specimen on *Ozius tuberculatus* H. M.-Edw.

Type-locality: Merak, West Java.

Description: Male genital organs in the posterior part of the body, outside the visceral mass, completely separated. Testes more or less globular, rather abruptly passing into the comparatively wide vasa deferentia. Colleteric glands with a rather small number of canals (less than 20 in longitudinal sections of the most strongly divided region). External cuticle of the mantle comparatively thick (50 to 75 μ), its surface covered with hyaline excrescences, consisting of a kind of chitin differing from that of the main layers. The excrescences consist of a small number of comparatively thick branches, united in their basal part. Each of the branches at its top is divided into numerous sharp little spines. The total length of the excrescences is 18 to 27 μ . Retinacula unknown.

This description is based on the characters of the type specimen only. The specimen on *Eriphia laevimana* cf. Boschma, 1931 c) corresponds closely with the type specimen, but differs from the latter in some details.

Sacculina confragosa Boschma 1933 a.

Type specimen on *Pachygrapsus crassipes* Randall.

Type-locality: Misaki, Japan.

Description: Male genital organs in the visceral mass, partially close together, but their cavities completely separated. Testes more or less cylindrical, gradually passing into the comparatively wide vasa deferentia, which are distinctly tortuous. Dorsal extremities of the testes recurved in a posterior and ventral direction. Colleteric glands with numerous canals (as a rule more than 40 in longitudinal sections of the most strongly divided part). External cuticle of the mantle without excrescences, its surface smooth, divided into small irregular areas with a diameter of 6 to 18 μ .

Internal cuticle of the mantle with numerous retinacula, which are evenly distributed on its surface. Each retinaculum consists of a basal part and 3 to 4 barbed spindles varying in length from 9 to 12 μ .

In the type specimen (cf. Boschma, 1933 a, fig. 17) one of the testes is laterally enlarged into a wide pouch; in the other specimens from which sections are available the two testes are of approximately equal size and shape.

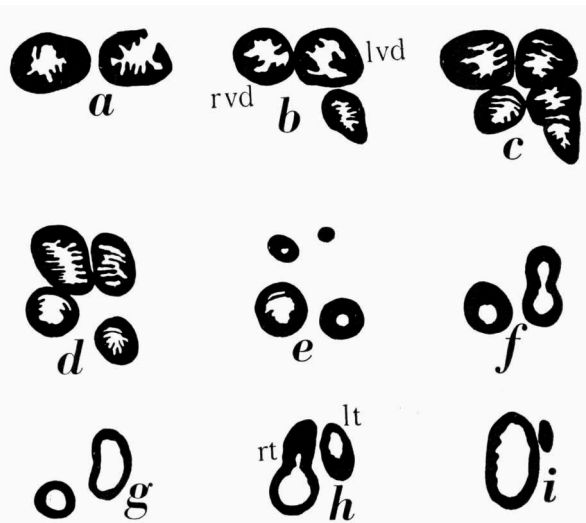


Fig. 22. *Sacculina confragosa* (type specimen of *Sacculina levis*). Transverse sections of the male genital organs; posterior end at the upper side of the figures. lt, left testis, lvd, left vas deferens; rt, right testis; rvd, right vas deferens. $\times 30$.

Fig. 22 represents transverse sections of the male genital organs of the specimen of *Sacculina confragosa* which was described as the type of the new species *Sacculina levis*. As the vasa deferentia gradually pass into the testes the limit between these two parts cannot be indicated with certainty,

but this limit probably lies between fig. 22 d and e. Then fig. 22 a—d are after sections of the vasa deferentia. fig. 22 e—i after sections of the testes. The male opening of one side is visible in fig. 22 a; the vasa deferentia are rather wide and strongly curved in a postero-anterior plane. The wall of the vasa deferentia possesses numerous ridges so that the cavities of these organs have become rather small and irregular. The small dots in the upper

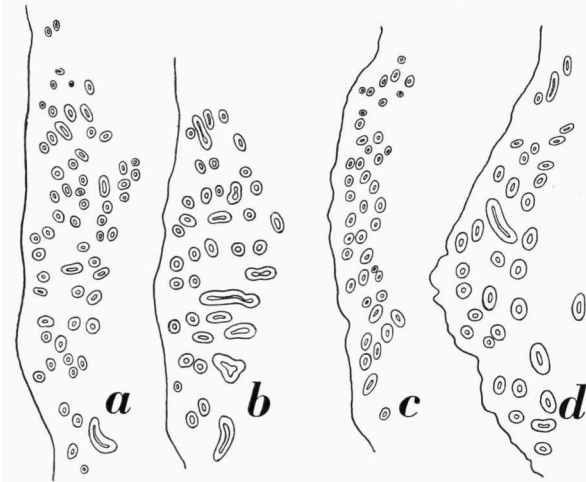


Fig. 23. *Sacculina confragosa*. Longitudinal sections of the colleteric glands of two specimens. a, b, type of *S. confragosa*; c, d, type of *S. levis*. Posterior end at the upper side of the figures. a, b, $\times 30$; c, d, $\times 53$.

part of fig. 22 e represent the most dorsal parts of the posterior region of the vasa deferentia. In fig. 22 f one of the testes (at the right side of the figure) is bent in a posterior direction, in fig. 22 h this occurs in the other testis. In this specimen the curvature of the testes therefore is much less distinct than in the type: in the latter the closed end of at least one of the testes is pronouncedly pointing in a ventral

direction, whilst in the specimen of fig. 22 the closed end of both testes is pointing in a posterior direction.

In the second specimen of the British Museum (Natural History) the closed extremities of the testes are distinctly recurved in a ventral direction.

Longitudinal sections of the colleteric glands of two specimens, representing the chitin of the canal system, are given in fig. 23. From each animal a more or less peripheral section (a, c) and one from the more median region is represented. The colleteric glands of the one specimen (fig. 23 c, d) are much smaller than those of the other (fig. 23 a, b); the figures, which are drawn on different scales, show a close correspondence. The number of canals in one of the specimens is somewhat larger than that in the other, but the arrangement of the canals is very similar.

* ***Sacculina corculum*** Kossmann 1872.

= *Loxothylacus corculum* (Kossm.).

* **Portunascus corrugatus** Giard.

Type specimen on *Liocarcinus corrugatus* (Penn.).

Type-locality: Gulf of Naples (?).

This parasite was considered by Giard as a distinct species on account of his theory of specificity of the parasites. I do not know when Giard used the specific name of this parasite for the first time, nor where the diagnosis of the genus *Portunascus* was published. Giard and Bonnier (1890, p. 391) mention the parasite as *Portunascus corrugatus* Gd., which name also is mentioned by Stebbing (1893, p. 403).

The anatomical characters of this parasite are unknown, it is probable, however, that the name *Portunascus corrugatus* is a synonym of *Sacculina carcini*.

* **Sacculina crucifera** Kossmann 1872.

Type specimen on *Actaea savignyi* (M.-Edw.).

Type-locality: Lapinig Canal, Bohol, Philippine Islands.

Kossmann (1872, p. 29; 1874, p. 125) gives the following description (characters of shape and size omitted):

“Die Cuticula (s. Taf. I. Fig. 22) ist, wo sie den Rüssel, seine nächste Umgebung und den kreisförmigen Wulst der Mantelöffnung umgibt, glatt und einfach. An der ganzen übrigen Manteloberfläche aber hebt sich diese glatte Cuticula frei von den darunter liegenden Schichten ab, und macht so Raum für ein dichtes, sammtartiges Polster starrer und spitziger Cuticularstacheln deren jeder als die Ausscheidung einer Epidermoidalzelle zu betrachten ist. Die Entwicklung dieser Stacheln geht am besten aus demjenigen Bilde hervor, welches man erhält, wenn man Schnitte durch die Grenzen der oben bezeichneten stachellosen Stellen legt. Hier sitzen nämlich ganz kurze stumpfconische Stacheln wie Mützen auf den Epidermoidalzellen. Dass das ganze Bild nicht das eines vorübergehenden Häutungsstadiums sei, muss ich annehmen, weil es sich bei beiden von mir untersuchten Exemplaren in gleicher Weise darbot. Der Körper ist mässig seitlich comprimirt, doch immer noch stark im Vergleich mit der Kugelform, die das Thier sammt dem Mantel zeigt. Die Ovarialöffnungen mit den Eikittdrüsen liegen etwas hinter der Mitte der Seitenflächen. Die Hoden haben Form und Lage wie bei *Sacculina carcini*, mit stark gewundenem Lumen des Ausführungsganges.”

Van Kampen and Boschma (1925) placed *Sacculina crucifera* in the synonymy of *Sacculina pilosa*. From Kossmann's description it is evident that his specimens were immature; it remains, therefore, uncertain whether they represent a distinct species or not.

Sacculina curvata Boschma 1933 b.

Type specimen on *Sesarma* (*Sesarma*) *edwardsii philippinense* Rathbun.

Type-locality: Pangauran River, Port Caltom, Busuanga Islands, Philippine Islands.

Description: Male genital organs in the posterior part of the body, outside

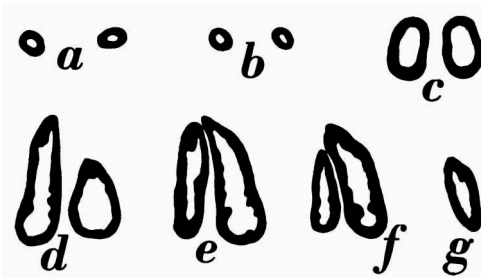


Fig. 24. *Sacculina curvata*. Transverse sections of the male genital organs; posterior end at the upper side of the figures. $\times 30$.

the visceral mass, completely separated. Testes more or less cylindrical, distinctly curved in an anterior direction, gradually passing into the narrow vasa deferentia. Colleteric glands with a fairly large number of canals. External cuticle of the mantle without excrescences, its surface divided into small areas with irregular sinuous contours, which have a diameter

of 6 to 14 μ Retinacula unknown.

The ventral part of the male genital organs is narrow (fig. 24 a, b);

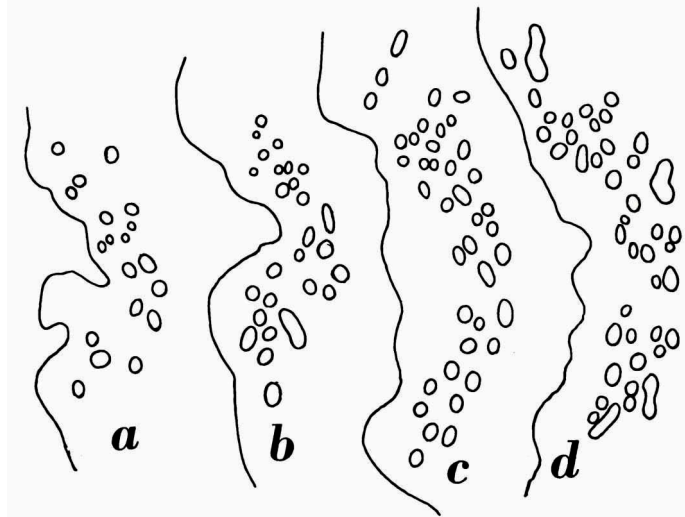


Fig. 25. *Sacculina curvata*. Longitudinal sections of one of the colleteric glands; posterior end at the upper side of the figures. $\times 80$.

these parts are straight and run in a dorsal direction. In their dorsal region the male genital organs extend in an anterior direction (fig. 24 d—g), here

the organs are slightly wider. The exact place of transition of the vasa deferentia into the testes cannot be determined with certainty, but probably this corresponds with fig. 24 c approximately.

The colleteric glands of the type specimen do not contain chitin. In the drawings (fig. 25) the inner walls of the canals are represented; the section of fig. 25 a is from a peripheral part, each following section from a slightly more median level.

* **Sacculina dentata** Kossmann 1872.

Type specimen on *Portunus* spec.

Type-locality: Lapinig Canal, Bohol, Philippine Islands.

Kossmann (1872, p. 27/28; 1874, p. 123/124) gives the following description (characters of shape and size omitted):

“Die Cuticula des Mantels ist von mässiger Dicke (c. 0,07 mm.) und trägt warzenförmige Verdickungen von etwa 0,028 mm. im Durchmesser; diese Warzen ihrerseits besitzen Fortsätze, wie dies etwa Taf. I. Fig. 24 darstellt: doch stehen hier deren weit zahlreichere (c. 25) dicht aneinandergedrängt auf einer Warze. Der Durchmesser der Fortsätze ist am Grunde etwa 0,005 mm. Der Körper ist seitlich comprimirt und symmetrisch; seine Verwachsung mit dem Mantel geht vorn etwas über den Mund hinaus, hinten bis zur Mantelöffnung. Die Oeffnungen der Ovarien liegen in der Mitte der Seitenflächen des Körpers und zugleich mitten in der kreisförmigen Eikittdrüse. Die paarigen kugelförmigen Hoden liegen dicht am Rüssel und haben einen kurzen, gegen seine Mündung hin stark anschwellenden Ausführungsgang. (S. Taf. II. Fig. 6.)”

Van Kampen and Boschma (1925) regarded *Sacculina dentata* as possibly synonymous with *S. pilosa*; from Kossmann's descriptions, however, sufficiently results that the two forms are different.

Sacculina duracina Boschma 1933 a.

Type specimen on *Parthenope longimana* (L.).

Type-locality: Port Molle, Queensland, 25 m.

Description: Male genital organs in the visceral mass, completely separated. Testes more or less globular, one in a much farther dorsal region than the other, rather abruptly passing into the vasa deferentia, which for their greater part are comparatively wide; there are numerous ridges on the inner walls of the vasa deferentia so that their cavities are very irregular. Colleteric glands large, with a great number of canals. External cuticle of the mantle thick (approximately 130 μ), its surface covered with excrescences consisting of a kind of hyaline chitin, differing from that of the

main layers. Each excrescence is composed of a small number of rather sharply pointed spines united on a common basal part. The length of the excrescences is $30\ \mu$ approximately. Retinacula unknown.

Longitudinal sections of the type specimen showing the situation of the male genital organs in different parts of the body and (in one of the figures) the colleteric glands are represented in a previous paper (Boschma, 1933 a, fig. 8—10). As these figures show the testes are rather voluminous. In fact they occupy so much space that locally the mantle cavity at the sides of the testes is reduced to a mere slit or altogether obliterated. In some regions therefore the male genital organs seem to occur outside the visceral mass.

The canal system of the colleteric glands is very strongly branched: in longitudinal sections of the most strongly divided region even more than a hundred of these canals may be counted.

Sacculina echinulata Van Kampen and Boschma 1925.

Type specimen on *Actumnus tomentosus* Dana.

Type-locality: "Siboga" Expedition, Stat. 164 (south of Salawati), 32 m.

Description: Male genital organs in the posterior part of the body, outside the visceral mass, completely separated. Testes more or less globular, rather abruptly passing into the vasa deferentia. One of the testes in a farther dorsal region than the other. Vasa deferentia comparatively wide, their cavities narrow and irregular as a result of numerous ridges on the inner walls of the canals. Colleteric glands with few canals, the latter arranged in a more or less single row parallel to the surface of the visceral mass. Surface of the external cuticle of the mantle covered with hairs which consist of approximately the same kind of chitin as that of the main layers. The hairs have a length of 20 to $25\ \mu$ and possess numerous minute lateral hairs. Internal cuticle with rows of retinacula, each of which consists of a single spindle with a length of about $20\ \mu$.

One of the vasa deferentia (fig. 26 a, b) extends somewhat farther towards the ventral region than the other. In fig. 26 c this vas deferens is seen beside the testis of the same half of the body with its muscular sheath. Fig. 26 d shows the same vas deferens connected with its testis (at the right of the figure), a narrow tube with a chitinous wall is seen penetrating through the wall of the testis. At the left side of the same figure the ventral part of the other vas deferens is drawn. In fig. 26 e the dorsal part of the second vas deferens is visible as a narrow canal (in the lower part of the figure to the left). Above this narrow canal the corresponding testis is

visible; the figure shows the extreme ventral part of this testis which here not yet possesses a cavity; it is surrounded by a muscular sheath. At the right of fig. 26 e the extreme dorsal part of the most ventral testis is to be seen. Fig. 26 f shows the narrow canal (which forms the transition of the

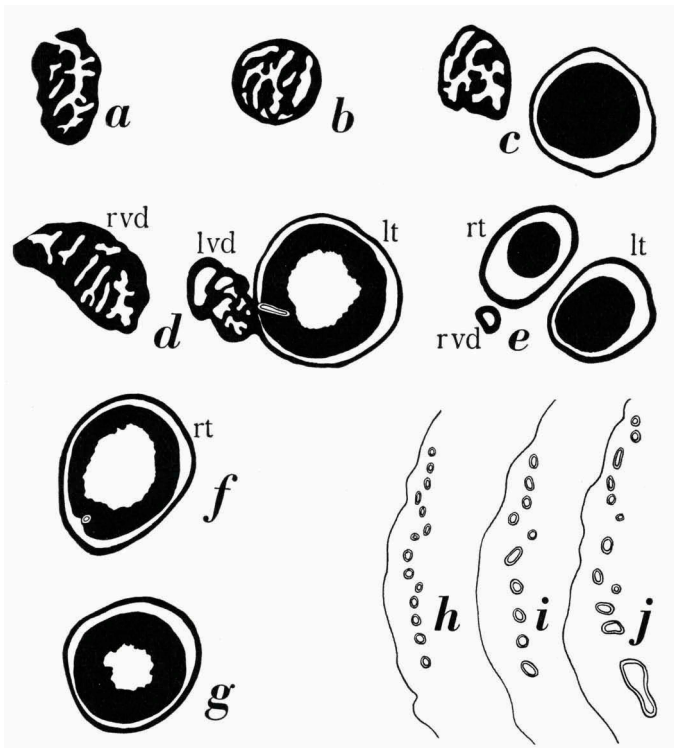


Fig. 26. *Sacculina echinulata*. a-g, transverse sections of the male genital organs. h-j, longitudinal sections of one of the colleteric glands. Posterior end at the upper side of the figures. lt, left testis; lvd, left vas deferens; rt, right testis; rvd, right vas deferens. a-g, $\times 30$; h-j, $\times 53$.

vas deferens into the testis) penetrating the wall of the most dorsal testis; fig. 26 g represents a section of the dorsal part of the latter.

The longitudinal sections given in a previous paper (Boschma, 1931 c, fig. 23 a, b) are from regions corresponding with those of fig. 26 d and g of the present paper.

A longitudinal section from approximately the median region of one of the colleteric glands (fig. 26 j) shows a small number of canals. Towards the peripheral part (fig. 26 i and h) the number of canals increases to a

certain degree, but the maximum number is 14 only. The canals seem to have a tendency to an arrangement parallel to the surface of the visceral mass.

Sacculina elongata Boschma 1933 a.

Type specimen on *Ethusa (Ethusina) gracilipes* var. *robusta* Miers.

Type-locality: "Challenger" Expedition, Stat. 191 (East Indies), 1440 m.

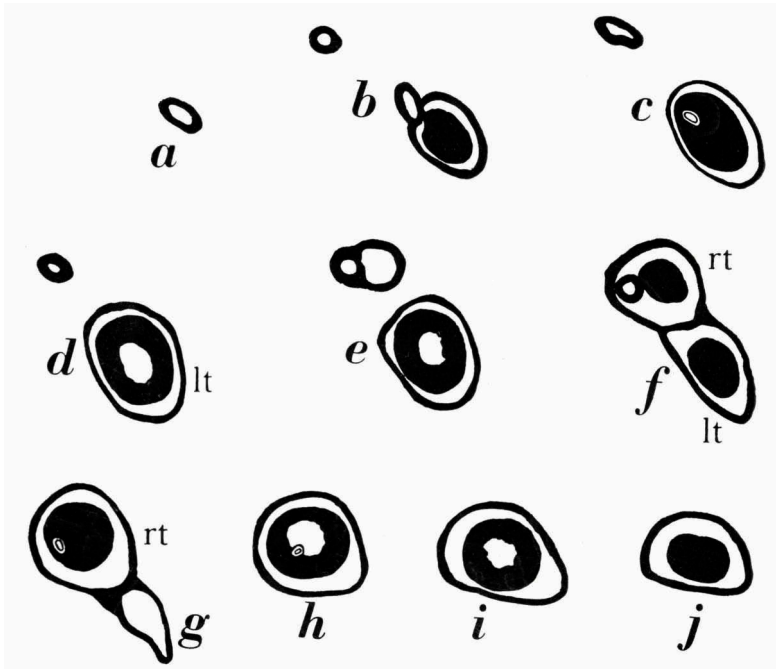


Fig. 27. *Sacculina elongata*. Transverse sections of the male genital organs; posterior end at the upper side of the figures. lt, left testis; rt, right testis. $\times 45$.

Description: Male genital organs in the posterior part of the body, outside the visceral mass, completely separated. Testes not strongly differing in size, more or less globular, rather abruptly passing into the narrow vasa deferentia. Colleteric glands with few canals (about 10 in longitudinal sections of the most strongly divided part); the canals arranged in one row parallel to the surface of the visceral mass. External cuticle of the mantle covered with small hairs which consist of the same kind of chitin as that of the main layers. The hairs are composed of a broad basal part and a slender pointed sharp extremity; they may possess a few minute lateral

hairs. Length of the excrescences varying from 12 to 24 μ . Retinacula unknown.

In the type specimen one of the male genital organs extends somewhat farther dorsally than the other, moreover the one occupies a somewhat more posterior position than the other (fig. 27). In fig. 27 b and c one of the vasa deferentia is seen penetrating first the muscular sheath of its testis (b), then the wall of the testis itself (c). In the upper part of fig. 27 e the vas deferens of the other male organ is visible next to the muscular sheath of the testis; in fig. 27 f the dorsal part of the vas deferens is found between the ventral (closed) end of the testis and its muscular layer; in fig. 27 g and h the narrow canal with its chitinous wall which connects the vas deferens to the testis is traversing the wall of the testis.

In the flattened colleteric glands the size of the canals diminishes and the number of canals increases from the median part (fig. 28 d) to the peripheral region (fig. 28 a).

***Sacculina eriphiae* Smith 1906.**

Type specimen on *Eriphia spinifrons* (Fabr.).

Type-locality: Gulf of Naples.

The name *Sacculina eriphiae* was used by Smith (1906) in the explanation of his Plate I. I have not found this name in the text of Smith's monograph. This author did not consider the parasite of *Eriphia spinifrons* as different from other parasites of the genus, for he remarks on p. 107: "I have examined the microscopic characters of the mantle, both externally and internally, and of the retinacula in the Neapolitan forms of *Sacculina*, without being able to find constant differences of specific value." On p. 77 of his monograph Smith, however, states: "The Rhizocephalous parasite of *Eriphia spinifrons* is very similar to the parasite of *Pachygrapsus marmoratus* which KOSSMANN calls *Sacculina benedeni*."

Description: Male genital organs in the posterior part of the body, outside the visceral mass, partially close together, but their cavities completely

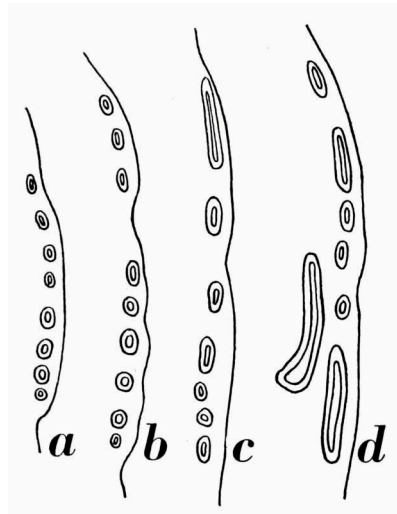


Fig. 28. *Sacculina elongata*. Longitudinal sections of one of the colleteric glands; posterior end at the upper side of the figures. $\times 80$.

separated. Testes more or less globular, rather abruptly passing into the vasa deferentia, which, at least in their ventral part, are comparatively

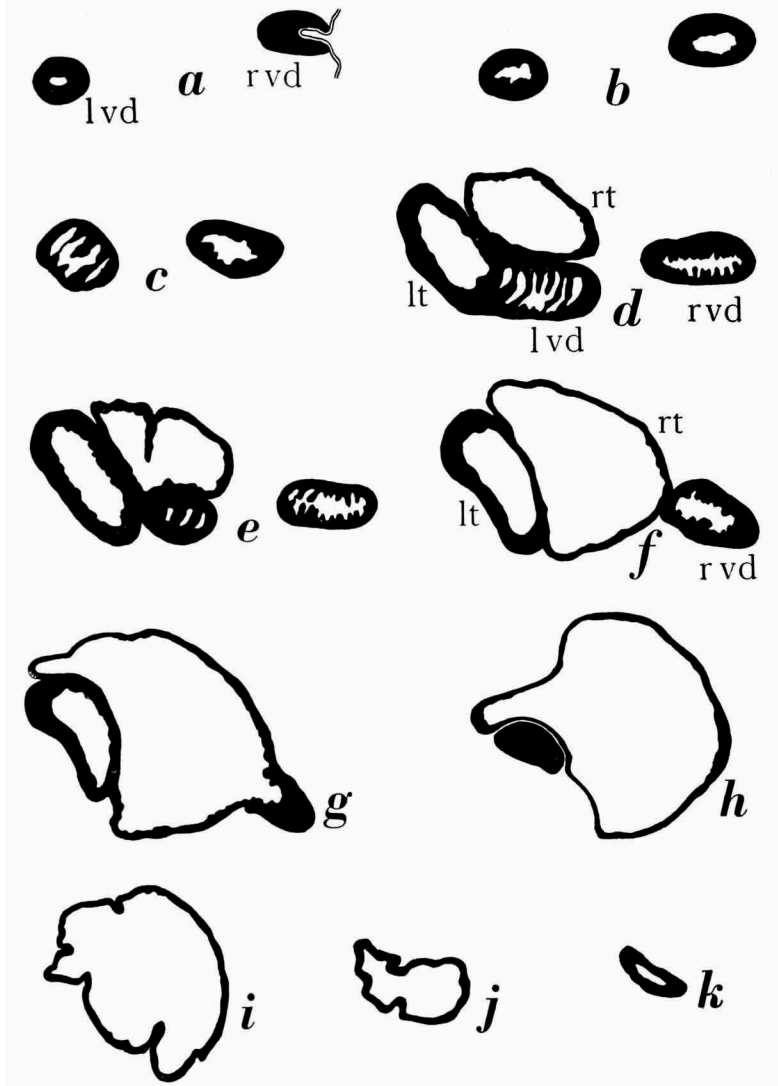


Fig. 29. *Sacculina eriphiae*. Transverse sections of the male genital organs; posterior end at the upper side of the figures. lt, left testis; lvd, left vas deferens; rt, right testis; rvd, right vas deferens. $\times 23$.

narrow. One of the testes much larger than the other, enlarged into a wide sac with a rather thin wall. Colleteric glands of large size, with an enormous number of canals. External cuticle of the mantle with excrescences

which consist of approximately the same kind of chitin as that of the main layers. These excrescences are hairs or elongate papillae which have a length of 17 to 28 μ and possess numerous minute lateral hairs. Internal cuticle with numerous retinacula which are evenly distributed on its surface. The retinacula vary appreciably in size and number of spindles, the latter are very large, their length may amount to 30 μ .

Fig. 29 and 30 illustrate the peculiarities of the male genital organs of two specimens of *Sacculina eriphiae*. In the specimen of fig. 29 the series of sections starts at the ventral region, in the specimen of fig. 30 at the dorsal region, the sections of the latter series therefore are mounted upside down on the slides in comparison to those of the former. Right and left side are as indicated in the figures with "lvd", "rvd", etc.

Fig. 29 a shows the right male genital opening (rvd) closed by the chitinous covering of the visceral mass (indicated with a double line), and the ventral part of the left vas deferens. Towards

their dorsal part the vasa deferentia gradually increase in size, then the inner wall shows a great number of ridges (fig. 29 c—f). Fig. 29 d is from the region of transition of the left vas deferens into its testis, in comparison to that in the other male genital organ this transition is comparatively gradual. In fig. 29 f and g the passing of the right vas deferens into its testis is represented, this canal ends abruptly into the wide testis. The two testes are close together for the whole of their extent (fig. 29 d—h), the left is much smaller than the right and does not continue as far dorsally as the latter. The extreme dorsal part of the larger testis has a more or less irregularly folded wall (fig. 29 i—k).

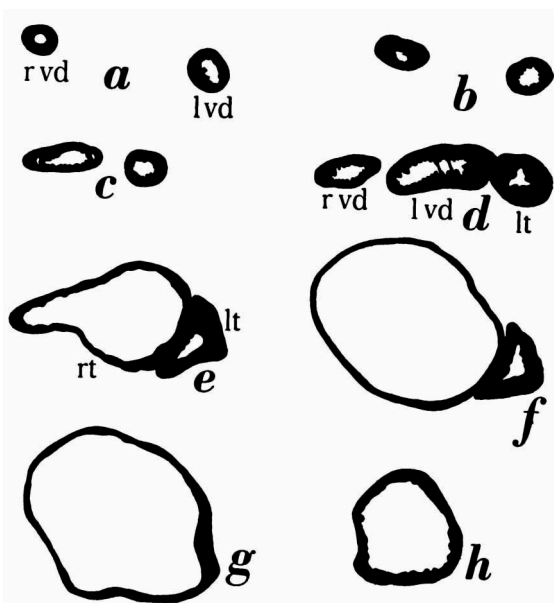


Fig. 30. *Sacculina eriphiae*. Transverse sections of the male genital organs; posterior end at the upper side of the figures. lt, left testis; lvd, left vas deferens; rt, right testis; rvd, right vas deferens. $\times 15$.

The male genital organs of the other specimen (fig. 30) do not present important differences from those of the former. From their ventral to their dorsal region the vasa deferentia gradually increase in size (fig. 30 a—d). The two testes are of a strongly different size (fig. 30 f); they are in close contact for the greater part of their length. Here, as in the other specimen, the larger testis extends much farther dorsally than the smaller (fig. 30 g, h).

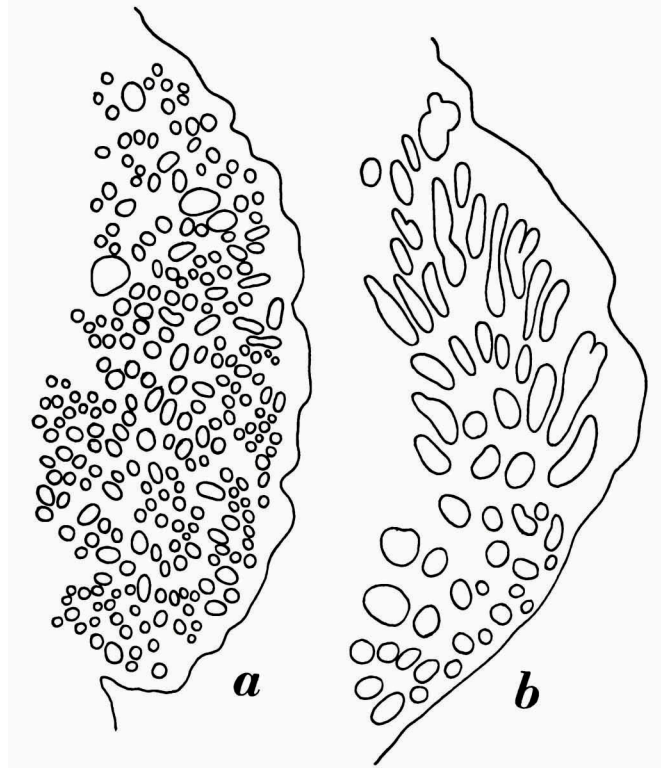


Fig. 31. *Sacculina eriphiae*. Longitudinal sections of one of the colleteric glands; posterior end at the upper side of the figures. $\times 45$.

The canal system in two longitudinal sections of one of the colleteric glands of a specimen of *Sacculina eriphiae* is drawn in fig. 31; one of the sections (b) is from the median region, the other (a) more or less intermediate between the centre and the periphery of the gland. The number of branches of the canal system is exceptionally large, in the section of fig. 31 a there are more than 200 canals visible. In the figured specimen the canals did not contain chitin, therefore the inner wall of the epithelium is drawn only.

Sacculina exarcuata Kossmann 1872.

Type specimen on *Cancer* spec.

Type-locality: Lapinig Canal, Bohol, Philippine Islands.

Kossmann (1872, p. 33/34; 1874, p. 129/130) gives the following description (characters of shape and size omitted):

“Die Cuticula des Mantels ist bedeckt von fadenartigen Gebilden, welche, wenn man von ihrer Grösse absieht, den Ambulacralfüsschen der Echinodermen ähnlich sind. Freilich beträgt ihre Länge nur 0,02 mm., ihre Dicke

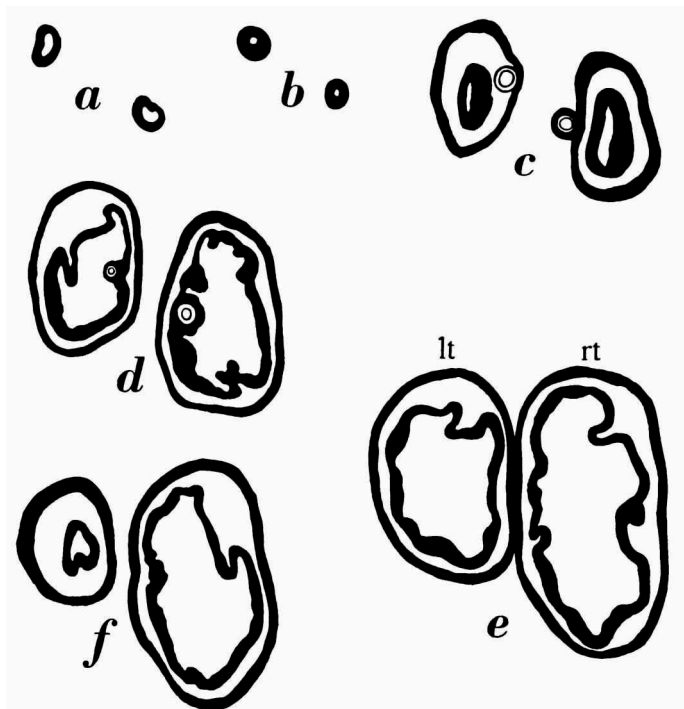


Fig. 32. *Sacculina exarcuata*. Transverse sections of the male genital organs; posterior end at the upper side of the figures. lt, left testis; rt, right testis. $\times 30$.

an der Wurzel 0,002 mm. Der Körper des von mir untersuchten Exemplar's war verhältnissmässig sehr klein, und zeigte eine schwache Andeutung jener Faltungen, die sich weit ausgeprägter bei *S. flexuosa* fanden. Ovarialmündung und Eikittdrüse etwa in der Mitte jeder Seitenfläche. Der Hoden glich in Lage und Gestalt dem der *S. dentata*.”

Boschma (1933 a) identified a specimen on *Parthenope valida* (de Haan) from Shanghai as *Sacculina exarcuata*. Taking into account the peculiarities of this specimen the species can be characterized as follows:

Description: Male genital organs in the posterior part of the body, outside the visceral mass, completely separated. Testes more or less globular, rather abruptly passing into the vasa deferentia. Testes of approximately equal size. Vasa deferentia comparatively narrow. Colleteric glands with a fairly large number of canals (more than 30 in longitudinal sections of the most strongly divided part). External cuticle of the mantle with excrescences consisting of a kind of chitin of apparently the same structure as that of the main layers of this cuticle. These excrescences are hairs or elongate papillae varying in length between 22 and 28 μ , and possess numerous minute lateral hairs. Internal cuticle of the mantle with retinacula which are more or less evenly distributed on its surface, usually they possess one spindle only, sometimes two or three. The length of the spindles, which do not seem to bear barbs, varies from 13 to 23 μ .

Taking into account the measurements of the excrescences of other specimens (cf. Boschma, 1933 a, p. 509, 510) the size of the hairs should be given as varying from 12 to 35 μ .

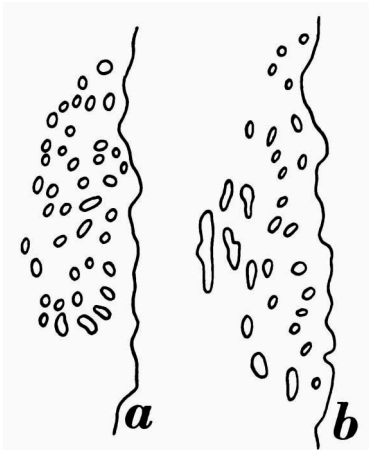


Fig. 33. *Sacculina exarcuata*. Longitudinal sections of one of the colleteric glands; posterior end at the upper side of the figures. $\times 45$.

In a previous paper (l.c., p. 507) a diagnosis of *Sacculina exarcuata* was given, largely based on the specimen which was a parasite of *Parthenope valida*. This diagnosis contains a grave error, as the testes are described as passing gradually into the vasa deferentia. The dorsal region of the vasa deferentia contains a distinct layer of chitin (fig. 32 c). This part of each vas deferens penetrates the muscular sheath of the testis, at a slightly more dorsal level it passes through the wall of the testis itself (fig. 32 d). The testes have a more or less globular shape, although in the figured specimen their wall shows a number of irregular grooves

and folds (fig. 32 d, e). The two testes do not differ appreciably in size, in the region of fig. 32 e they have reached their largest size, towards the dorsal region they soon decrease in size. The vasa deferentia (fig. 32 a, b) form more or less straight, comparatively narrow tubes.

The colleteric glands possess a fairly large quantity of canals (more than 30 canals in longitudinal sections of the most strongly divided part). In the figured specimen the canals do not contain chitin, the drawings (fig. 33) show the inner walls of the glandular epithelium of the colleteric glands.

Sacculina flacca Boschma 1931 a.

Type specimen on *Galathea* spec.

Type-locality: Banda, East Indies, 70—90 m.

Description: Male genital organs in the posterior part of the body, outside the visceral mass, completely separated. Testes more or less globular, rather abruptly passing into the straight, narrow vasa deferentia, the inner wall of which shows some feebly developed ridges. Colleteric glands with very few canals, which for the greater part are arranged in a single row parallel to the surface of the visceral mass. External cuticle of the mantle very thin (3 to 6 μ), with numerous papillae of a somewhat irregular

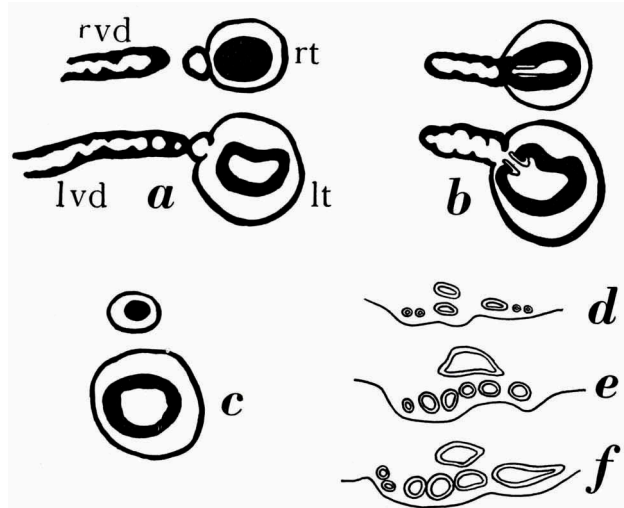


Fig. 34. *Sacculina flacca*. a-c, longitudinal sections of the male genital organs (a, from the posterior region; c, from the anterior region); ventral part at the left side of the figures. d-f, transverse sections of one of the colleteric glands. lt, left testis; lvd, left vas deferens; rt, right testis; rvd, right vas deferens. $\times 80$.

appearance. In different parts of the cuticle the height of these excrescences varies from 6 to 14 μ . 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. Retinacula unknown.

Fig. 34 a corresponds approximately with a part of a previous figure of the same specimen (Boschma, 1931 a, fig. 36 a). It represents the two male openings, longitudinal sections of the greater part of the two vasa deferentia and of the testes, each enveloped by its muscular sheath. The

chitinous covering of the inner wall of the dorsal end of each vas deferens, penetrating into the testes, is visible in fig. 34 b, which is from a more anterior level than the previous figure. The anterior region of the two testes is seen in fig. 34 c.

Transverse sections of one of the colleteric glands are represented in fig. 34 d—f, the first from a peripheral region, the last from a more central part. The latter corresponds approximately with fig. 36 b of the paper cited above.

Sacculina flacca is a well defined species of the genus *Sacculina*, although it is known only as a parasite of a species of the genus *Galathea*. Especially the narrow mesentery (Boschma 1931 a, fig. 36) and the colleteric glands with their system of branched tubes prove that the specimen belongs to the Sacculinidae and not to *Lernaeodiscus* or *Galatheascus*.

***Sacculina flexuosa* Kossmann 1872.**

Type specimen on *Grapsus strigosus* (Herbst).

Type-locality: Digollorin, Luzon, Philippine Islands.

Kossmann's (1872, p. 31; 1874, p. 127) description runs as follows (characters of shape and size omitted):

“Die Cuticula des Mantels ist von einer gleichmässigen, nicht erheblichen Dicke (0,05—0,07 mm.); sie zeigt eine feine Runzelung, welche (wenn Mund und Mantelöffnung als Pole betrachtet werden) in äquatorialer Richtung verläuft. Die Verwachsung des Mantels mit dem Körper geht vorn weit über den Mund hinaus (Taf. II. Fig. 1 a und b). Der Körper ist stark seitlich zusammengedrückt, zeigt aber statt der gewöhnlich stattfindenden seitlichen Symmetrie starke Faltungen, welche an die ganz ähnlichen bei *Peltogaster* im hohen Grade erinnern. Die Öffnungen der Ovarien liegen beiderseits ziemlich in der Mitte, umgeben von den flachscheibenförmigen Eikitttdrüsen. Die Hoden sind paarig retortenförmig, die Ausführungsgänge hufeisenförmig gebogen, so dass die Öffnung des Bogens nach vorne sieht. Sie liegen dicht hinter dem Munde, und zwar der Ausführungsgang dorsal von der Drüse.”

The following description is based especially on the anatomical characters of a specimen on *Grapsus grapsus* (L.) (*Grapsus maculatus* (Catesby)) from Amboina (cf. Boschma, 1933 a), moreover on the characters of the external and internal cuticle of this and several other East Indian specimens on *Grapsus strigosus* (Herbst) (cf. Van Kampen and Boschma, 1925; Boschma, 1928, 1931 b).

Description: Male genital organs in the posterior part of the body, outside the visceral mass, partially close together, but their cavities completely

separated. Testes more or less cylindrical, gradually passing into the vasa deferentia. The latter are comparatively wide, but their lumen in some parts is extremely narrow and irregular as a result of numerous ridges

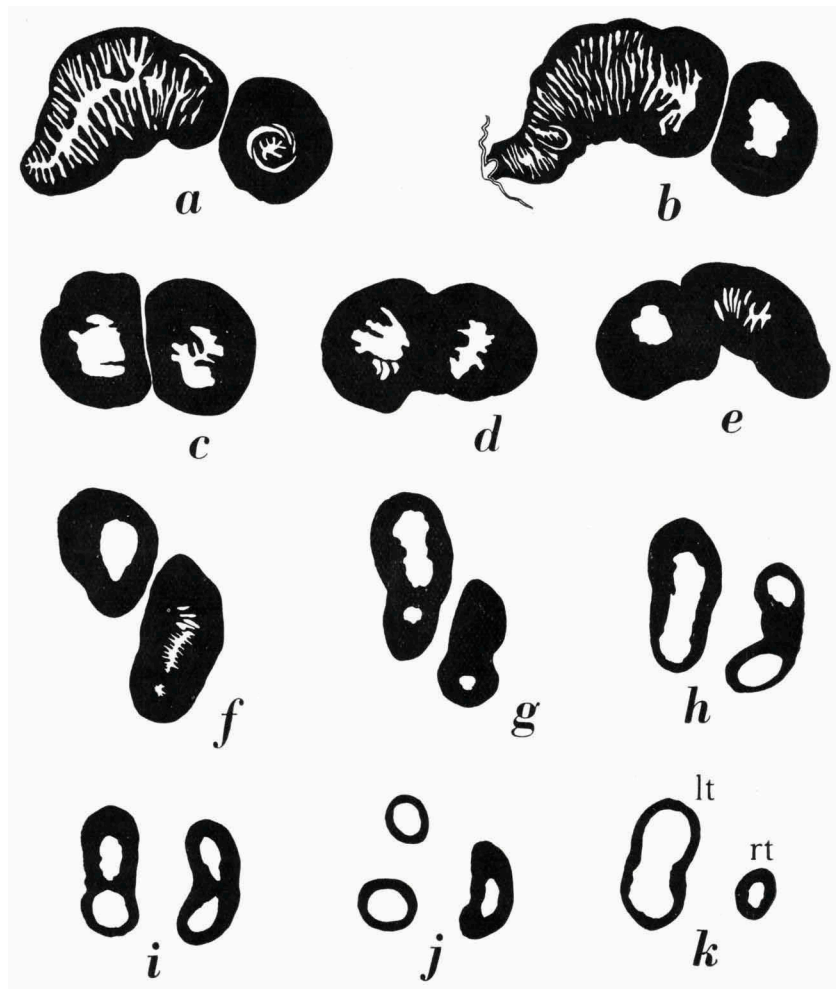


Fig. 35. *Saccolina flexuosa*. Transverse sections of the male genital organs; posterior end at the upper side of the figures. lt, left testis; rt, right testis. $\times 18$.

on their inner wall. Dorsal region of the testes recurved in an anterior and slightly ventral direction. Colleteric glands with a great number of branched canals. External cuticle of the mantle without excrescences, its surface smooth or somewhat rough; in some specimens the surface divided

into small areas with an irregular contour, the diameter of these areas is 9 to 18 μ . Internal cuticle of the mantle with numerous retinacula which

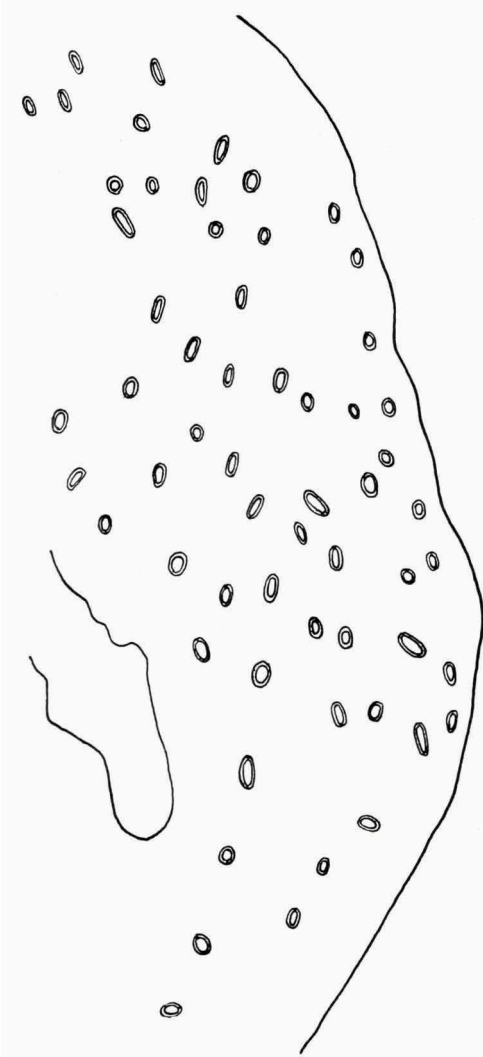


Fig. 36. *Sacculina flexuosa*. Longitudinal section of one of the colleteric glands. $\times 60$.

are more or less evenly distributed on its surface. Each retinaculum consists of a basal part and 3 to 5 barbed spindles, which vary in length from 12 to 15 μ .

A section of the specimen on *Grapsus grapsus* is figured in a previous paper (Boschma, 1933 a, fig. 41); this figure shows how the visceral mass is distinctly bent in a lateral direction, a peculiarity which according to Kossmann's description occurred in his specimens too. Fig. 35 a of the present paper shows sections of the ventral part of the vasa deferentia, that of the left side (left part of the figure) is from a more ventral region than where the male genital opening of this side occurs; the cavities of the vasa deferentia are strongly reduced by ridges on the inner walls of the canals. Fig. 35 b shows the left male genital opening, closed by a plug of chitin which is in connection with the chitinous covering of the visceral mass. The ridges which cause a reduction of the cavities occur at a more dorsal level too (fig. 35 c, d); they may even become rather

pronounced again (fig. 35 e, f). The dorsal extremities of the male genital organs are rather strongly curved, so that in many transverse sections the cavities of one or both testes are divided into two parts (fig. 35 g—k). The limit between the vasa deferentia and the testes cannot be

indicated as there is not a narrow canal with a chitinous inner wall to determine this limit.

The colleteric glands (fig. 36) are of rather large size; they contain numerous canals, which are rather sparsely arranged in the glands. At the left side of the figure a part of the atrium is indicated with a single line.

Sacculina formosa Boschma 1931 c.

Type specimen on *Lithocheira setosa* (A. M.-Edw.).

Type-locality: Banda, East Indies.

Description: Male genital organs in the posterior part of the body, outside the visceral mass, completely separated. Testes more or less globular, rather abruptly passing into the vasa deferentia, which are comparatively wide. Colleteric glands with few canals, arranged more or less parallel to the surface of the visceral mass. External cuticle with excrescences consisting of a hyaline kind of chitin, differing in structure from that of the main layers. The excrescences consist of a fairly large number of small spines which are united in their basal part on a thin or a rather well developed, sometimes more or less globular basal part. The spines are found on the whole of the upper surface of the basal parts, they are not united into branches, but each spine arises independently from the basal part. The spines may reach a length of $12\ \mu$; the excrescences as a whole vary in length from 7 to $20\ \mu$. Retinacula unknown.

* **Sacculina fraissei** Giard 1886.

= *Drepanorchis neglecta* (Fraisse).

* **Sacculina fraissei** var. **aegyptia** Giard 1887.

In all probability = *Drepanorchis neglecta* (Fraisse).

The following statement by Giard (1887, p. 3, footnote) is interesting as it shows that the author not in all cases adhered strictly to his theory of specificity of the parasite:

“Mon excellent ami M. le professeur Marion m’a envoyé il y a quelques années une Sacculine parasite du *Stenorhynchus Aegyptius* Milne-Edwards, qui est évidemment très voisine de *S. Fraissei*. Je la désigne sous le nom de *S. Fraissei* var. *Aegyptia*. Le *Stenorhynchus* qui la portait provenait des fonds vaseux à l’est du port d’Alger, entre l’usine à gaz et les bains de l’Agha.”

According to his theory Giard should have regarded the specimen as a representative of a separate species.

* **Sacculina galatheae** Norman and Scott 1906.

= *Triangulus galatheae* (Norman and Scott).

* **Sacculina gerbei** Bonnier 1887.

Type specimen on *Xantho floridus* (Mont.).

Type-locality: unknown.

This parasite was considered as a distinct species on account of Giard's theory of specificity of the parasites. Guérin-Ganivet (1911) remarks that probably this form belongs to *Sacculina carcini*.

Sacculina gibba Boschma 1933 b.

Type specimen on *Eriocheir rectus* Stimp.

Type-locality: Nuiwha, near Foochow, China.

Description: Male genital organs in the posterior part of the body, outside the visceral mass, completely separated. The two testes well developed, more or less globular, rather abruptly passing into the narrow vasa deferentia. One of the testes in a more dorsal region than the other. Colleteric glands with a comparatively small number of canals (less than 20 in longitudinal sections of the most strongly divided part); the canals not arranged in rows. External cuticle of the mantle consisting of one kind of chitin only, its surface smooth or somewhat rough or covered with irregular minute spines which may reach a length of 4μ , the latter cannot be regarded as typical excrescences. In many regions the surface of the external cuticle is divided into small areas with an irregular contour, and which have a diameter varying between 6 and 18μ . Retinacula unknown.

The vasa deferentia are narrow canals (fig. 37 a); one of these passes into its testis at a more ventral region than the other (fig. 37 b, c). In fig. 37 c inside the testis the dorsal extremity of the vas deferens is visible, it is not covered with chitin as in other species of *Sacculina* with globular testes. The closed end of the most ventral testis is seen in fig. 37 d, e; in fig. 37 e the vas deferens of the other side is seen passing into its testis (at the right side of the figure); here the inner wall of the canal is lined with a thin layer of chitin. In fig. 37 f—h sections of the most dorsal testis are represented, each from a more dorsal region than its predecessor. This testis is of slightly larger size than the other.

Longitudinal sections of one of the colleteric glands are given in fig. 37 i—k. The first section is from the peripheral region, the second from an intermediate region between the two others, the third is a median one. In the drawings the chitinous covering of the visceral mass is represented

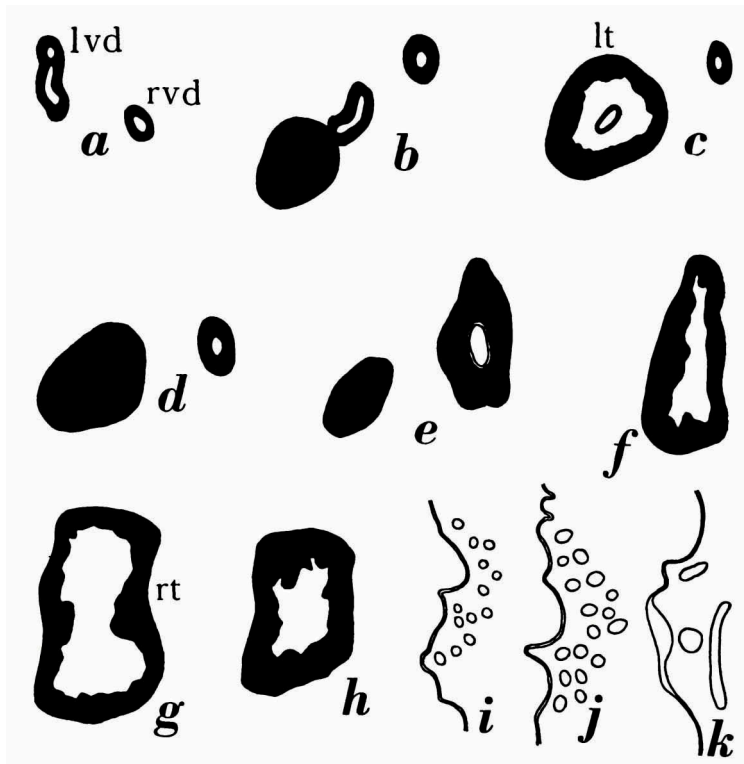


Fig. 37. *Sacculina gibba*. a-h, transverse sections of the male genital organs. i-k, longitudinal sections of one of the colleteric glands. Posterior end at the upper side of the figures. lt, left testis; lvd, left vas deferens; rt, right testis; rvd, right vas deferens. a-h, $\times 45$; i-k, $\times 80$.

by a double line; this layer of chitin is considerably swollen at the region where it covers the opening of the oviduct (fig. 37 k). The canals of the colleteric glands of this specimen do not contain chitin.

* ***Sacculinidia gibbsii*** Hesse 1867.

Type specimen on *Pisa armata* (Latr.).

Type-locality: Brest, Atlantic coast of France.

In a previous paper (Boschma, 1927) I could show that the parasites of *Pisa armata* belong to the species *Sacculina carcini*.

Sacculina glabra Van Kampen and Boschma 1925.

Type specimen on *Hyastenus subinermis* Zehntner.

Type-locality: Damar Island, East Indies.

Description: Male genital organs in the visceral mass, partially close together, but their cavities completely separated. Dorsal extremities of the testes not in close contact. Testes more or less cylindrical, gradually passing into the vasa deferentia, which are comparatively narrow. Ventral region of the male genital organs with numerous ridges on their inner walls, so that the cavities are more or less irregular. Colleteric glands with a moderate number of canals. External cuticle of the mantle very thin (thickness about 7–8 μ), without excrescences. Retinacula unknown.

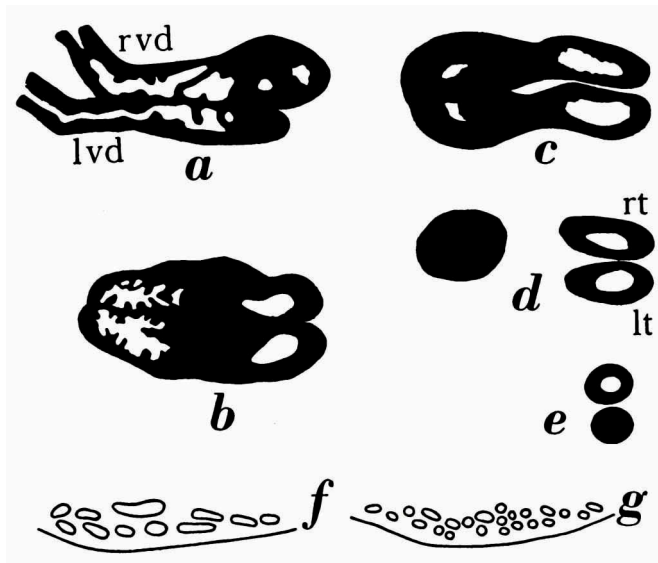


Fig. 38. *Sacculina glabra*. a-e, longitudinal sections of the male genital organs (a, from the posterior region; e, the most anterior part); ventral end at the left side of the figures. f, g, transverse sections of one of the colleteric glands. lt, left testis; lvd, left vas deferens; rt, right testis; rvd, right vas deferens. $\times 45$.

Longitudinal sections of the male genital organs are represented in fig. 38 a—e. The exact region of transition of the vasa deferentia into the testes cannot be determined, but it is probable that the cavities at the left side of fig. 38 b and c are those of the vasa deferentia, the cavities at the right side of these figures then are those of the testes. If his explanation is correct the vasa deferentia may be described as tubes which from their dorsal part gradually increase in size, whilst their cavities, at least in the dorsal part, are greatly diminished by numerous ridges on the inner walls of the vasa deferentia. The testes have a slight bend in an anterior direc-

tion, so that the extremities of the testes in transverse sections of the parasite have a more or less circular contour (fig. 38 e).

The colleteric glands (fig. 38 f, g) contain a fairly large quantity of canals. In the type specimen these canals do not contain chitin. The canal system is represented here in transverse section, so that it cannot be directly compared to that of other colleteric glands which have been studied in longitudinal sections.

Saccolina gonoplaxae Guérin-Ganivet 1911.

Type specimen on *Goneplax angulata* (Penn.).

Type-locality: Gulf of Cadiz, 36 m.

Guérin-Ganivet (1911, p. 62) gives the following description of the anatomical characters of this parasite:

“La masse viscérale est blanche, et reliée au manteau par un mésentère de disposition normale; je n’ai pu apercevoir les testicules, mais les glandes cémentaires sont très nettes, d’un blanc plus mat que celui de la masse viscérale, presque circulaires et situées en plein milieu de chacune des faces de l’ovaire. C’est surtout ce dernier caractère qui me fait supposer que l’espèce est différente de *Saccolina carcini* et des autres espèces précédemment décrites; il sera indispensable de confirmer cette appréciation par d’autres caractères à première occasion.”

The following description is based on material from the Bay of Naples and from the Atlantic Ocean (cf. Boschma, 1927, 1933 a):

Description: Male genital organs in the posterior part of the body, outside the visceral mass, completely separated. Testes of approximately equal size, more or less globular, rather abruptly passing into the narrow vasa deferentia. Colleteric glands with a moderate number of canals (less than 30 in longitudinal sections of the most strongly divided part); the glands are comparatively flat, but the canals are not arranged in distinct rows. External cuticle of the mantle with excrescences consisting of a kind of chitin which does not differ noticeably from that of the main layers of the cuticle. These excrescences are hairs or elongate papillae, which bear numerous minute lateral hairs and vary in length from 15 to 18 μ . The excrescences are not very densely distributed. Retinacula unknown.

The vasa deferentia are slightly tortuous; two sections of one of these canals are seen in fig. 39 a. In fig. 39 b this vas deferens is joining the muscular sheath of its testis; the other vas deferens is seen in the upper part of the picture, in connection with the male genital opening which is closed by a plug of chitin from the layer covering the surface of the visceral

mass. In fig. 39 c the narrow canal with its chitinous wall which forms the transition of the vas deferens and the testis is visible between the testis and its muscular sheath; from the male organs of the other half of the body sections of two coils of the vas deferens are seen (in the right hand upper part of the figure). Gradually now the second testis appears (fig. 39 d) and the narrow chitinous canal (fig. 39 e, between the testis and its muscular sheath). Towards the dorsal region the testes increase somewhat

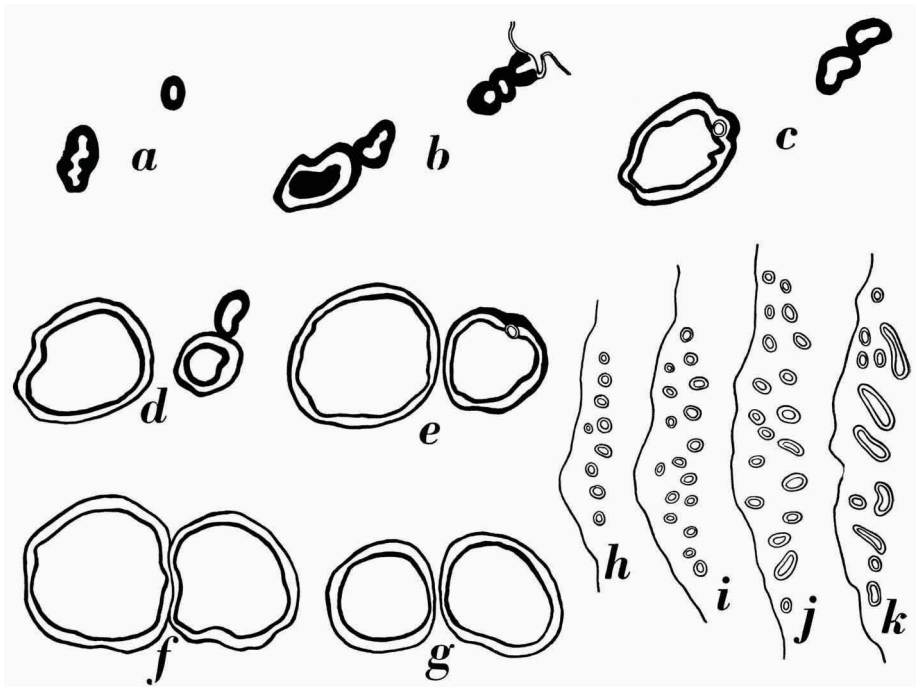


Fig. 39. *Sacculina gonoplaxae*. a-g, transverse sections of the male genital organs. h-k, longitudinal sections of one of the colleteric glands. Posterior end at the upper side of the figures. a-g, $\times 30$; h-k, $\times 53$.

in size, partially they are comparatively close together so that the two muscular sheaths may unite (fig. 39 f); in their extreme dorsal part they diverge again (fig. 39 g).

The colleteric glands are more or less flattened, but their canal system is not arranged in distinct rows parallel to the surface of the visceral mass (fig. 39 h—k). In the figured sections the number of canals does not exceed 20. The section of fig. 39 h is from the peripheral part, that of fig. 39 k is not far from the median region, the two other sections are from intermediate regions.

Sacculina gordonii Boschma 1933 c.Type specimen on *Atergatis floridus* (L.).

Type-locality: Sultan Shoal, Singapore.

Description: Male genital organs in the posterior part of the body, outside the visceral mass, completely separated. Testes more or less globular,

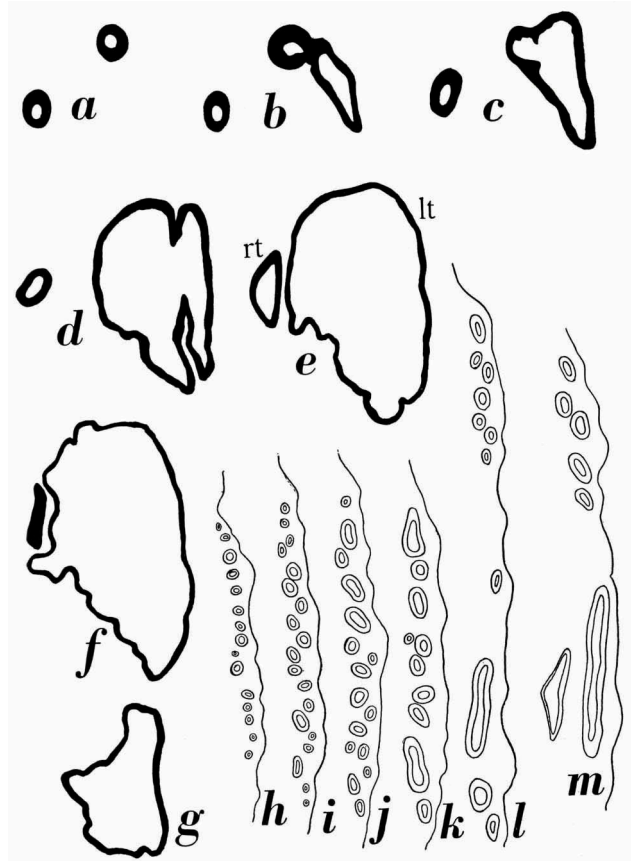


Fig. 40. *Sacculina gordonii*. a-g, transverse sections of the male genital organs. h-m, longitudinal sections of one of the colleteric glands. Posterior end at the upper side of the figures. lt, left testis; rt, right testis. a-g, $\times 12$; h-m, $\times 30$.

rather abruptly passing into the comparatively narrow vasa deferentia. One of the testes enlarged into a wide thin-walled sac. Colleteric glands flattened, with a moderate number of canals (less than 30 in longitudinal sections of the most strongly divided part). Canal system of the colleteric glands not distinctly arranged in one row parallel to the surface of the visceral mass.

External cuticle covered with hairs or elongate papillae, which have the same structure as the main layers of this cuticle. The hairs have a length of 10—20 μ and bear minute lateral hairs. Internal cuticle with narrow bands of retinacula, each of which consists of a basal part and one to six spindles; the latter have a length of 10—20 μ and are not barbed.

One of the testes is strongly enlarged, the other is of comparatively small size. In the original description of the species (Boschma, 1933 c) the two testes are described as enormously enlarged. In the cited paper one of the figures (l.c., fig. 2) shows the large left testis and the small right testis, in another figure (l.c., fig. 3) the left testis is correctly represented as a wide sac; the wide sac at the left of this figure, indicated as right testis, in reality is the dorsal part of the muscular sheath which surrounds this testis; the testis itself is no more visible in this region of the body. In the explanation of the cited figure there is another error, the section of this fig. 3 is from a more dorsal region than the previous figure, and not, as stated, from a more ventral plane. Fig. 40 e of the present paper corresponds more or less with fig. 2 of the cited paper, fig. 40 f of the present paper with fig. 3 of the cited paper.

The two vasa deferentia form comparatively narrow canals. One of these very abruptly passes into its testis (fig. 40 c); in the other male genital organ the region of transition of the vas deferens into the testis cannot easily be indicated. The larger testis possesses some irregular folds and grooves (fig. 40 d—f), it proceeds much farther towards the dorsal region than the smaller, which terminates at a level in which the larger testis has its largest dimension (fig. 40 f, the black spot at the left represents the closed dorsal part of the smaller testis).

Six longitudinal sections of one of the colleteric glands are represented in fig. 40 h—m, as far as concerns their canal system. Fig. 40 h is from the periphery of the gland, fig. 40 m from the median part, the other sections are from intermediate regions. The colleteric glands are rather strongly flattened; there is a tendency of the canal system to arrange itself in a single row parallel to the surface of the visceral mass, but in some regions the canals are found in twos and threes.

Sacculina gracilis Boschma 1931 a.

Type specimen on *Portunus* spec. (probably *Portunus (Hellenus) longispinosus* Dana var. *obtusidentata* Miers).

Type-locality: Koh Kahdat (Siam), 7—9 m.

Description: Male genital organs in the posterior part of the body, outside the visceral mass, completely separated. Testes more or less globu-

lar, rather abruptly passing into the comparatively wide vasa deferentia. Colleteric glands with a small number of canals, the latter arranged in one row parallel to the surface of the visceral mass. External cuticle of the mantle with excrescences consisting of a hyaline kind of chitin, differing from that of the main layers. The excrescences consist of a rather compact basal part which at its upper border bears a more or less circular row of small spines. The spines are not combined into branches, each spine arises independently from the basal part. The length of the spines is less than 12μ ; the length of the excrescences as a whole varies from 15 to 20μ . Retinacula unknown.

Sacculina granulosa Boschma 1931 c.

Type specimen on *Egeria arachnoides* M.-Edw.

Type-locality: "Siboga" Expedition, Stat. 167 (between Ceram and New Guinea), 95 m.

Description: Male genital organs in the visceral mass, partially united so that the two cavities communicate. Dorsal extremities of the two testes distinctly separated. Testes more or less cylindrical, gradually passing into the vasa deferentia, which are narrow, at least in their ventral part. Parts of the male genital organs with ridges on their inner walls. Colleteric glands with a well developed canal system, the canals form a more or less crowded compact mass. External cuticle of the mantle with excrescences consisting of the same kind of chitin as that of the main layers.

These excrescences are blunt papillae which have a length of 6 to 7μ and a thickness of 4 to 5μ ; they bear numerous minute short spines. Internal cuticle of the mantle with more or less evenly distributed retinacula, each retinaculum consists of a basal part and 8 to 12 slender barbed spindles which are approximately 14μ long.

Fig. 41 shows a number of transverse sections of the male genital organs. The ventral part of the vasa deferentia is seen in fig. 40 a; they are narrow

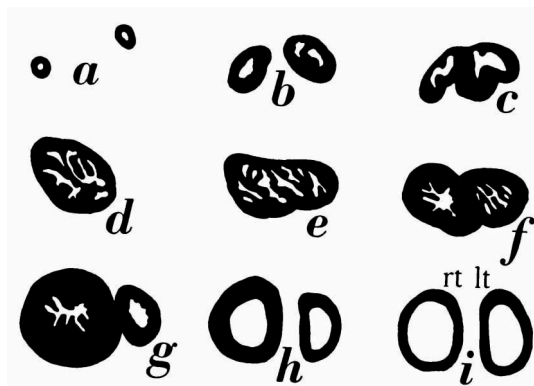


Fig. 41. *Sacculina granulosa*. Transverse sections of the male genital organs; posterior end at the upper side of the figures. lt, left testis; rt, right testis. $\times 30$.

tubes. Towards the dorsal region the male genital organs gradually increase in size and unite in the median plane of the body (fig. 41 b, c). Their cavities become more and more irregular as a result of numerous ridges on the inner walls of the organs. In the region of fig. 41 e the two cavities are in open contact (not distinctly visible in the figure as the cavities are divided into a great many small slits). At a somewhat more dorsal region the two cavities are separated again (fig. 41 f). Farther towards the dorsal region the two male organs diverge again and their cavities become much

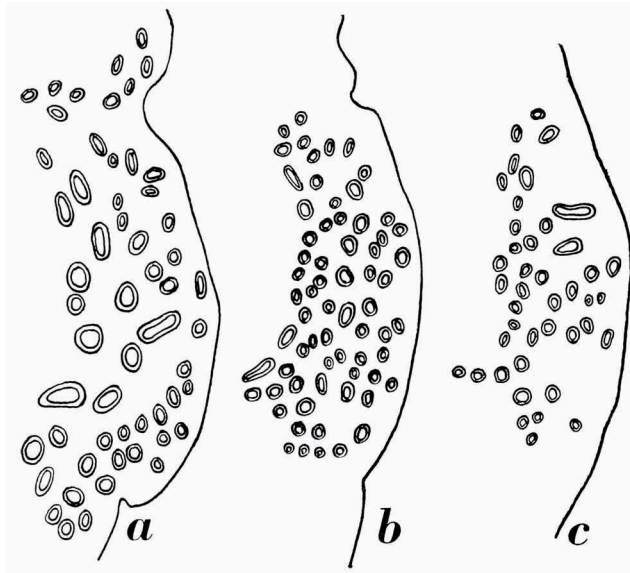


Fig. 42. *Sacculina granulosa*. Longitudinal sections of one of the colleteric glands; posterior end at the upper side of the figures. $\times 60$.

wider (fig. 41 g—i). The region of transition of the testes into the vasa deferentia cannot be determined with certainty, as there is not a narrow canal with a chitinous inner wall indicating this region. The region in which the two cavities are communicating may be the dorsal part of the vasa deferentia or the ventral part of the testes.

The colleteric glands (fig. 42) are well developed; they contain numerous canals. The figured sections are from the vicinity of the median part (a), from the periphery (c), and from an intermediate region (b). The chitin of the canals is well developed in the type specimen.

Sacculina gregaria Okada and Miyashita 1935

Type specimen on *Eriocheir japonicus* de Haan.

Type-locality: River Yura, Japan.

Okada and Miyashita (1935, p. 171/172) give the following description of the anatomical characters of this species:

"The mantle is smooth and devoid of any sort of excrescences on the external surface, but much wrinkled on the internal cuticula. The retinacula, (fig. 3) which can be detected only in grown-up specimens, consist of separated spindles having a length of 14—20 μ with a diameter of ca. 6 μ . Each spindle is smooth, bearing no trace of barbs.

The internal structures (fig. 4) show no peculiar features. The testes (fig. 4 a, ts) are situated outside the visceral mass in the distal part of the stalk. They are oval in shape, about uniform in size (ca. 1 mm in length), and distinctly separated one from the other. From very young stages of externa the testes can be detected as small white bodies which can be easily pressed out by a slight pressure upon the upper part of the body. The colleteric glands (fig. 4 b, cg) are situated at the usual place, nearer to the mantle than to the stalk. When the mantle is removed the gland can be perceived as a white spot of about 3 mm in diameter on the surface of the visceral mass."

Professor Okada had the kindness to send me some material of the species. The description cited above and the other data in the cited paper contain the characters of the species in sufficient detail; the description given below is meant as a diagnosis to distinguish the species from others, which are similar, except in being not gregarious. By the occurrence of numerous external sacs on one host *Sacculina gregaria* is distinct already from all other species of the genus.

Description: Male genital organs in the posterior part of the body, outside the visceral mass, completely separated. Testes more or less globular, rather abruptly passing into the comparatively narrow vasa deferentia. Colleteric glands with a fairly large number of canals (more than 40 in longitudinal sections of the most strongly divided part). External cuticle of the mantle without excrescences, its surface smooth or slightly irregular. Internal cuticle of the mantle with numerous retinacula, each of which consist of a single spindle without barbs. The spindles have a length of 14 to 20 μ .

Transverse sections of the male genital organs of one specimen are drawn in fig. 43. Fig. 43 a shows the two vasa deferentia, in fig. 43 b one of the two possesses a distinct layer of chitin on its inner wall (this part of the vas deferens is its most dorsal region), in fig. 43 c the chitinous layer is

visible in the other vas deferens, surrounded by the extreme ventral part of the testis. On the other side of the figure (at the right) the extreme dorsal part of the vas deferens traverses the wall of the testis (here this wall does no more contain chitin). Fig. 43 d—f represent sections of the two testes which are in comparatively close contact so that the muscular sheaths of the two testes are partially united. One of the testes in this specimen is somewhat larger than the other, the larger testis has a wide cavity whilst the smaller one still is solid. In fig. 43 g the most dorsal part of the larger testis is visible.

In the longitudinal section of *Sacculina gregaria* which is found in the

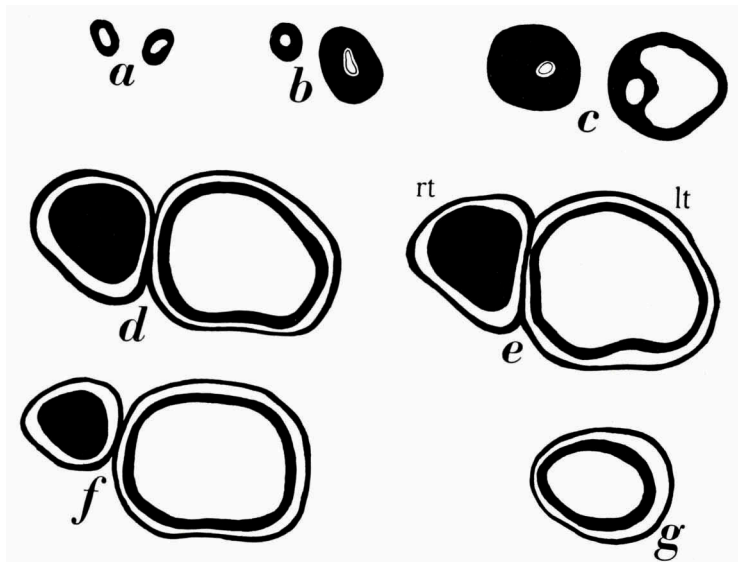


Fig. 43. *Sacculina gregaria*. Transverse sections of the male genital organs; posterior end at the upper side of the figures. lt, left testis; rt, right testis. $\times 30$.

paper by Okada and Miyashita (1935, fig. 4 a) the two testes are of approximately equal size and each of them has a distinct cavity. The fact that the specimen figured in the present paper has the cavity developed in one of the testes only, may be due to individual variation, or the specimen may be in a still immature stage.

A section of the median region of a specimen of *Sacculina gregaria* is given by Okada and Miyashita (1935, fig. 4 b); in this region the colleteric glands contain a few canals only, most of which are of comparatively large size. The figures in the present paper (fig. 44 a—c) represent longitudinal sections of one of the colleteric glands of a specimen, a is from the peri-

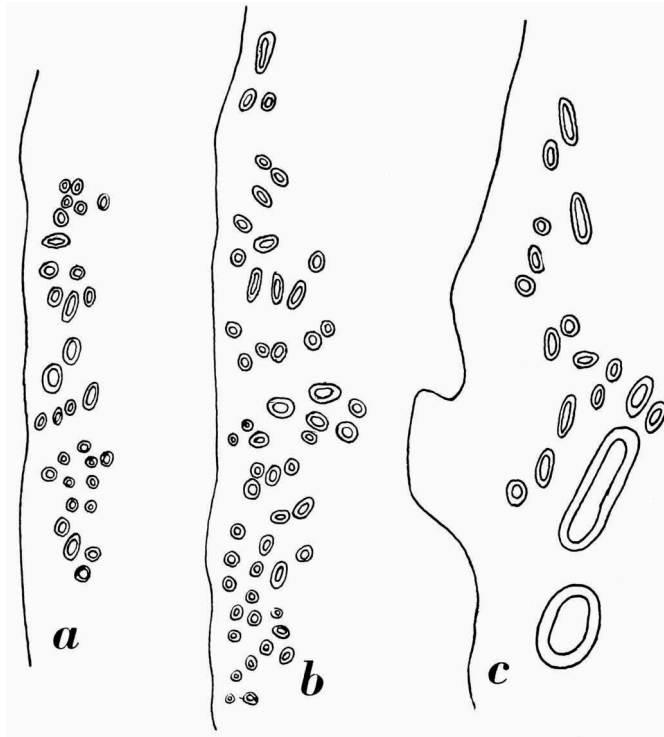


Fig. 44. *Sacculina gregaria*. Longitudinal sections of one of the colleteric glands; posterior end at the upper side of the figures. $\times 107$.

pheral part, c from the vicinity of the median region, b from an intermediate part. The number of canals, especially in sections at some distance from the median region, is fairly large; in fig. 44 b more than 50 of these canals are visible.

* **Sacculinida *Herbstia nodosa*** Hesse 1867.

Type specimen on *Herbstia condyliata* (Herbst).

Type-locality: Brest, Atlantic coast of France.

The description by Hesse (1867) is confined to the external characters; the anatomy of the parasite is unknown.

* ***Sacculina herbstiae*** Kossmann 1872.

The name *Sacculina herbstiae* was used by Kossmann and by other authors for the parasite which was named by Hesse (1867) *Sacculinida Herbstia nodosa*.

* **Sacculina hians** Kossmann 1872.

= *Heterosaccus hians* (Kossm.).

Sacculina hirsuta Boschma 1925.

Type specimen on *Pilumnus dasypodus* Kingsley.

Type-locality: Caracas Bay, Curaçao.

Description: Male genital organs in the posterior part of the body, outside the visceral mass, completely separated. Testes more or less globular, rather abruptly passing into the vasa deferentia. Testes not strongly differing in size and shape, but one of the testes somewhat larger than the other. Vasa deferentia narrow and rather tortuous. Colleteric glands distinctly protruding above the surface of the visceral mass, with comparatively few canals (about 10 canals in longitudinal sections of the most strongly divided region). The canals of the colleteric glands are arranged in a single row parallel to the surface of the visceral mass. External cuticle of the mantle about 25 μ thick; its surface covered with hairs or elongate papillae, which have approximately the same structure as that of the main layers. The excrescences usually are covered with numerous minute lateral hairs; they vary in length from 12 to 35 μ . The excrescences are not extremely thin; their basal part is not conspicuously swollen. Internal cuticle of the mantle with numerous retinacula which are arranged in more or less straight rows on its surface. Each retinaculum consists of a single barbed spindle which has a length of 9 to 16 μ .

Fig. 45 a shows the ventral part of the two vasa deferentia, the right with its genital opening closed by a plug which forms a part of the chitinous layer of the visceral mass (this layer is indicated in the figure by a double line). In fig. 45 b the right vas deferens is visible as a single section, the left vas deferens is somewhat coiled so that three sections of this canal are to be seen near the ventral part of the left testis, which at this level as yet has no cavity and is surrounded by its muscular layer. In fig. 45 c the left testis already has reached a fairly large size, from the male genital organs of the right side the vas deferens only is present; at this region this tube is rather tortuous so that it is seen as three sections. Fig. 45 d and e show sections of the two testes, which are rather close together. Their muscular sheaths may come into contact, but the cavities of the testes remain completely separated.

In a previous paper (Boschma, 1925) a mistake was made in the description of the type specimen. In the cited paper the larger testis was regarded as that of the right side; in reality it is the left testis which is of larger size than the right. The series of longitudinal sections of the type specimen

starts at the dorsal region, so that the upper surface of the sections is the dorsal side. Therefore the left side of the sections (when orientated with the posterior end as upper part, as in the figures) represents the right side of the animal.

The three figured sections of one of the colleteric glands are from the median region (fig. 45 h), from the peripheral part (fig. 45 f), and from

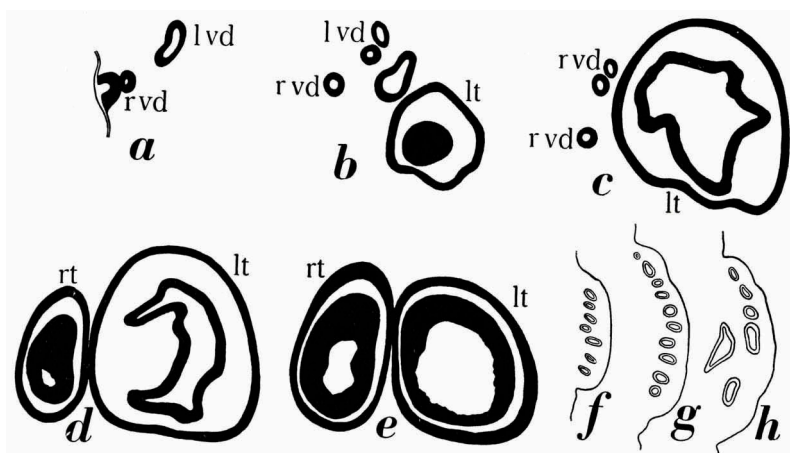


Fig. 45. *Sacculina hirsuta*. a-c, transverse sections of the male genital organs. f-h, longitudinal sections of one of the colleteric glands. Posterior end at the upper side of the figures. lt, left testis; lvd, left vas deferens; rt, right testis; rvd, right vas deferens. $\times 107$.

a region more or less intermediate between these two (fig. 45 g). The canal system of the colleteric glands of the type specimen contains distinct chitinous tubes, which are neatly arranged in one row parallel to the surface of the visceral mass.

***Sacculina hirta* Boschma 1933 a.**

The specimen on *Cryptopodia fornicata* (Fabr.).

Type-locality: Japan.

Description: Male genital organs in the posterior part of the body, outside the visceral mass, partially close together, but their cavities completely separated. Testes more or less globular, of different size, both rather swollen and comparatively thin-walled, abruptly passing into the narrow vasa deferentia. Colleteric glands more or less flat, with a fairly large quantity of canals (more than 30 in longitudinal sections of the most strongly divided part). External cuticle of the mantle with hairs or elongate papillae which have a length of 15 to 24 μ and are covered with minute lateral hairs. The structure of the hairs does not differ from that of the

main layers. Internal cuticle with retinacula which are evenly distributed on its surface: the retinacula consist of a single barbed spindle each, which has a length of $20\ \mu$ approximately; sometimes 2 to 4 spindles are found close together.

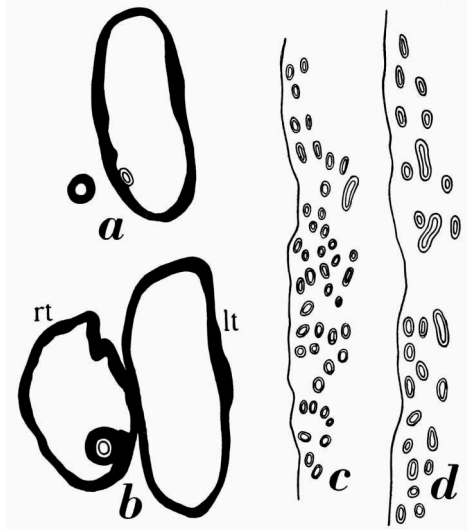


Fig. 46. *Sacculina hirta*. a, b, transverse sections of the male genital organs. c, d, longitudinal sections of one of the colleteric glands. Posterior end at the upper side of the figures. lt, left testis; rt, right testis. a, b, $\times 30$; c, d, $\times 53$.

In a previous paper (Boschma 1933 a, fig. 29) a number of transverse sections of the male genital organs are represented. In the present paper two figures are given of the region corresponding approximately with fig. 29 d and e of the cited paper. These figures show the dorsal extremity of the vas deferens just inside the wall of the testis, at this region of transition of the vas deferens into the testis the wall of the canal possesses a distinct layer of chitin. Fig. 46 a is from the region of transition of the vas deferens into the smaller testis; fig. 46 b shows the same for the larger testis.

Two longitudinal sections of one of the colleteric glands are shown in fig. 46 c and d, both from a region more or less intermediate between the centre and the periphery, that of fig. c is a more peripheral section than that of fig. d. The glands are comparatively flat, but the canal system is well developed.

***Sacculina hispida* Boschma 1928.**

Type specimen on *Zosimus aeneus* (L.).

Type-locality: Amboina, East Indies.

Description: Male genital organs in the posterior part of the body, outside the visceral mass, completely separated. Testes more or less globular, both enlarged into comparatively wide sacs, abruptly passing into the rather narrow vasa deferentia. Colleteric glands more or less flattened, with a large number of canals (more than 30 in longitudinal sections of the most strongly divided part). External cuticle of the mantle with well developed excrescences which consist of approximately the same kind of

chitin as that of the main layers. These excrescences are long, slender hairs, which are 40 to 75 μ long, and which possess, especially in their basal part, numerous minute lateral hairs. Retinacula with a single spindle without barbs, about 9 μ long.

The latter character is doubtful, as only two retinacula were found in

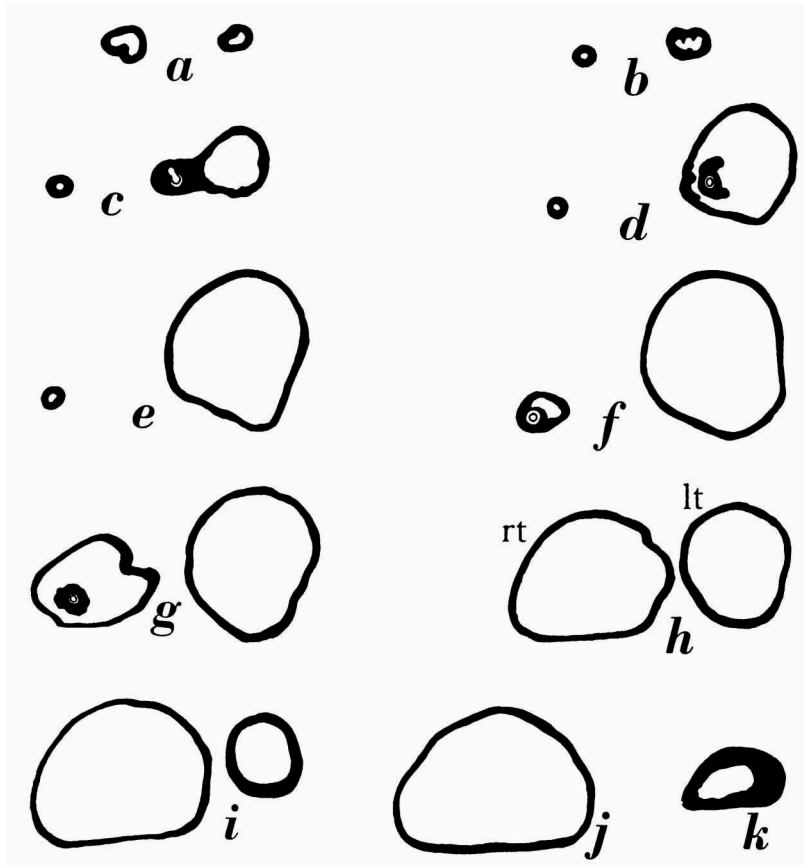


Fig. 47. *Sacculina hispida*. Transverse sections of the male genital organs; posterior end at the upper side of the figures. lt, left testis; rt, right testis. $\times 23$.

one of the two specimens (Boschma, 1928, p. 169), and the exact shape of these organs could not be determined with complete certainty.

The male genital organs of the type specimen of *Sacculina hirta* are represented in fig. 47 as transverse sections from the ventral region (fig. a) to the extreme dorsal part of one of the testes (fig. k). The canal which forms the transition between the vas deferens and the testis, at the inside

covered with a layer of chitin, is visible in the dorsal region of the vasa deferentia in fig. 47 c and f. In fig. 47 d and g this canal has penetrated through the walls of the testes, it protrudes, with its surrounding tissue, somewhat into the cavities of the testes. One of the testes lies nearer to the ventral region than the other, it reaches its greatest width at the part from

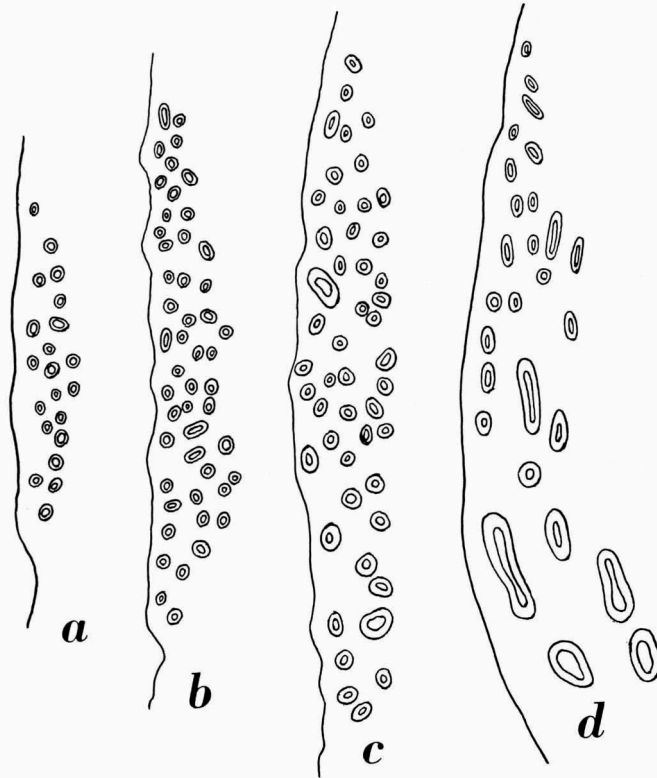


Fig. 48. *Sacculina hispida*. Longitudinal sections of one of the colleteric glands; posterior end at the upper side of the figures. $\times 60$.

which fig. 47 e—g are taken; the other testis only increases in size at a farther dorsal region (fig. 47 h—j). The extreme dorsal end of one of the testes is shown in fig. 47 i, that of the other in fig. 47 k. Although the testes are enlarged into comparatively wide sacs they remain more or less globular, for their wall never becomes extremely thin.

The colleteric glands (fig. 48) form rather flat organs. They contain numerous canals, which in the type specimen possess a distinct layer of chitin.

* **Sacculina hyadis** Malm 1881.

Type specimen on *Hyas araneus* (L.).

Type-locality: Bohuslän, Sweden.

The name *Sacculina inflata* was given by Leuckart (1859) to the parasite of *Hyas araneus*, which name, therefore, has priority over *Sacculina hyadis*.

* **Sacculina hystrix** Van Kampen and Boschma 1925.

Type specimen on *Carpilodes vaillantianus* A. M.-Edw.

Type-locality: Kur, Kei Islands, East Indies.

Description: Male genital organs in the posterior part of the body, outside the visceral mass. Testes more or less globular, rather abruptly passing into the vasa deferentia. Colleteric glands with few canals (in longitudinal sections of the type specimen 8 canals as a maximum), the canals neatly arranged in a row

parallel to the surface of the visceral mass. External cuticle of the mantle with papillae which consist of approximately the same kind of chitin as that of the main layers.

The excrescences have a height of about 10 μ , they have a blunt, conical top and possess

a row of stiff spines at about the middle of their length. Retinacula unknown.

Unfortunately the greater part of the male genital organs is lost in the series of sections. Some particulars may be noted. There is a narrow canal with a distinct chitinous wall which forms the transition of the vas deferens into the testis. In fig. 49 a this canal is seen in the cavity of one of the testes (at the right side of the figure). At the left of this there is a chitinous tube which may represent the part of transition of the other vas deferens into its testis; this is not absolutely certain, for there is nothing else left of the male genital organ of this side of the body. A more dorsal section of the testis of which the extreme ventral part is represented in fig. 49 a is drawn in fig. 49 b. Here it is comparatively wide and surrounded by a muscular sheath. This sheath as well as the wall of the testis itself are incomplete in the sections.

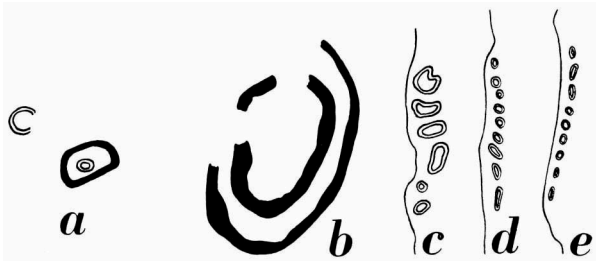


Fig. 49. *Sacculina hystrix*. a, b, transverse sections of the male genital organs. c-e, longitudinal sections of one of the colleteric glands. Posterior end at the upper side of the figures. $\times 80$.

As only the most dorsal part of the vasa deferentia and only the most ventral part of the testes remain preserved it remains unknown whether the vasa deferentia are narrow or wide and whether the two testes remain separated or not.

The colleteric glands (fig. 49) are well preserved. In the type specimen the chitin of the canal system is distinctly visible. Fig. 49 c represents a section from the median region, each of the following figures are from a more peripheral region.

Sacculina inflata Leuckart 1859.

Type specimen on *Hyas araneus* (L.).

Type-locality: Heligoland, North Sea.

Description: Male genital organs in the posterior part of the body, outside the visceral mass, their cavities completely separated. Testes more or less globular, rather abruptly passing into the comparatively narrow vasa deferentia. One of the testes or both rather strongly enlarged. Colleteric glands with a small number of canals (less than 30 in longitudinal sections of the most strongly divided region), the canal system of these glands forming a more or less compact mass. External cuticle of the mantle with hairs or elongate papillae which have approximately the same structure as that of the main layers. These excrescences have a length of 10 to 35 μ , they are covered with minute lateral hairs. Retinacula unknown.

I could not dispose of really "typical" specimens of this species (as "typical" must be regarded the parasites of *Hyas araneus*). I could study, however, a parasite of *Hyas coarctatus*, which, in all probability, has the same characters as "typical" specimens. It is not quite certain that this specimen in some respects is not slightly abnormal. Especially its colleteric glands seem to have much wider canals than appears to be natural.

The description given above is based partially on the specimen on *Hyas coarctatus* and on specimens which lived on *Cancer pagurus*. In a previous paper (Boschma, 1931 b) I came to the conclusion that the parasites of these two crabs belong to the same species. Unfortunately one specimen on *Hyas* only is available; it differs in some respects from the specimens on *Cancer*, but these differences are too slight to warrant a distinction of specific value. Moreover the specimens which lived on *Cancer* show important individual differences.

The figures of the male genital organs are from the specimen on *Hyas coarctatus* (fig. 50, dorso-ventral diameter of the parasite 10.5 mm), from a specimen on *Cancer pagurus* (fig. 51, dorso-ventral diameter of the parasite 10 mm), and from a second specimen on *Cancer pagurus* (fig. 52,

dorso-ventral diameter of the parasite 9 mm). In a third specimen on *Cancer pagurus* from which sections were made (dorso-ventral diameter of the parasite 11 mm) the male organs correspond closely with those of fig. 51. The dimensions show that the studied specimens do not differ appreciably in size; the differences among them therefore cannot be ascribed to different states of maturity.

The series of sections of the parasite on *Hyas coarctatus* starts at the dorsal surface, so that in the figures (fig. 50 a—i) the right side of the organs is at the left. The two vasa deferentia are rather narrow canals (fig. 50 a—c); in the section of fig. 50 d the left vas deferens passes into

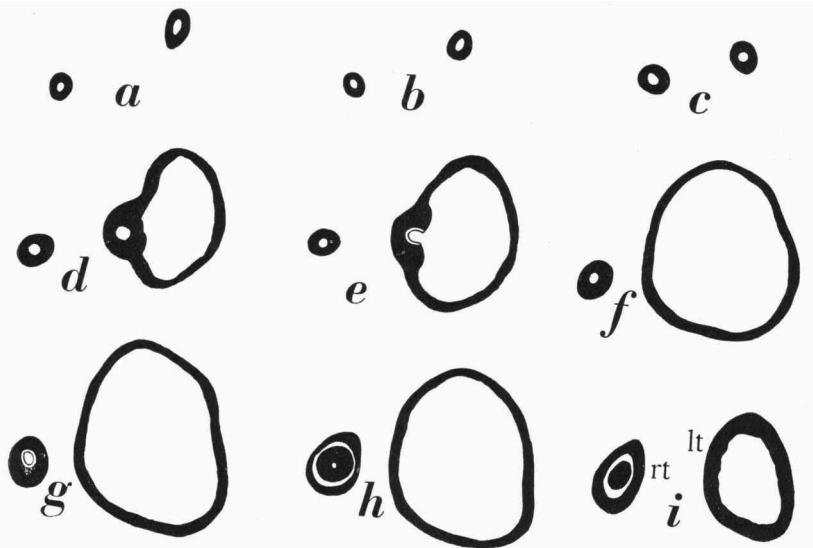


Fig. 50. *Sacculina inflata* on *Hyas coarctatus*. Transverse sections of the male genital organs; posterior end at the upper side of the figures. lt, left testis; rt, right testis. $\times 30$.

its testis, in fig. 50 e the chitinous covering of the inner wall in the most dorsal part of this vas deferens is visible. The left testis develops into a wide sac (fig. 50 f—h); the right testis is much narrower. Fig. 50 g is after a section of the region in which the right vas deferens passes into its testis, the inner wall of the canal shows the layer of chitin which marks the region of transition. Fig. 50 h shows (at the left side of the figure) the right testis with its very narrow cavity; it is surrounded by a muscular sheath. The dorsal end of the right testis is shown in fig. 50 i, the testis itself, which is closed here, is surrounded by its muscular sheath. At the right side of the same figure the dorsal end of the left testis is represented.

The male genital organs of one of the specimens on *Cancer pagurus*,

sections of which are given in fig. 51, show some resemblance to those of the specimen on *Hyas*, but there are differences. In the first place here the right testis is the larger of the two; moreover the two testes partially are found close together. Fig. 51 a shows the left vas deferens; in fig. 51 b this vas deferens passes into its testis, the latter is surrounded by a muscular layer. A narrow canal with a chitinous wall passes into the testis. Fig. 51 c shows the ventral part of the left testis, the ventral part of the right testis

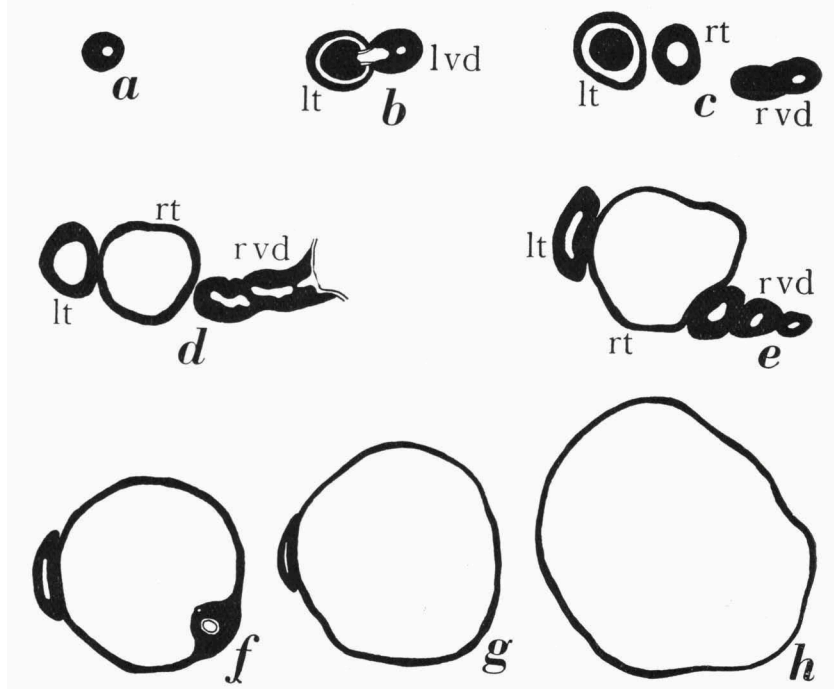


Fig. 51. *Sacculina inflata* on *Cancer pagurus*. Transverse sections of the male genital organs; posterior end at the upper side of the figures. lt, left testis; lvd, left vas deferens; rt, right testis; rvd, right vas deferens. $\times 23$.

and the ventral region of the right vas deferens. This vas deferens is somewhat tortuous, the male genital opening is found at a slightly farther dorsal plane (fig. 51 d). Here a part of the chitinous covering of the visceral mass is drawn (as a double line). This layer of chitin is developed into a kind of plug which closes the male opening. The dorsal part of the right vas deferens is visible in fig. 51 e, next to its testis. At the left of the same figure the left testis is visible; this organ remains narrow for the whole of its extent, its more or less flattened dorsal part is in close contact with the wide right testis (fig. 51 f, g). The region of the transition of the right

vas deferens into its testis is visible in fig. 51 f; the canal has here a distinct layer of chitin. Fig. 51 h shows the right testis in the region of its largest size, after this region it gradually diminishes.

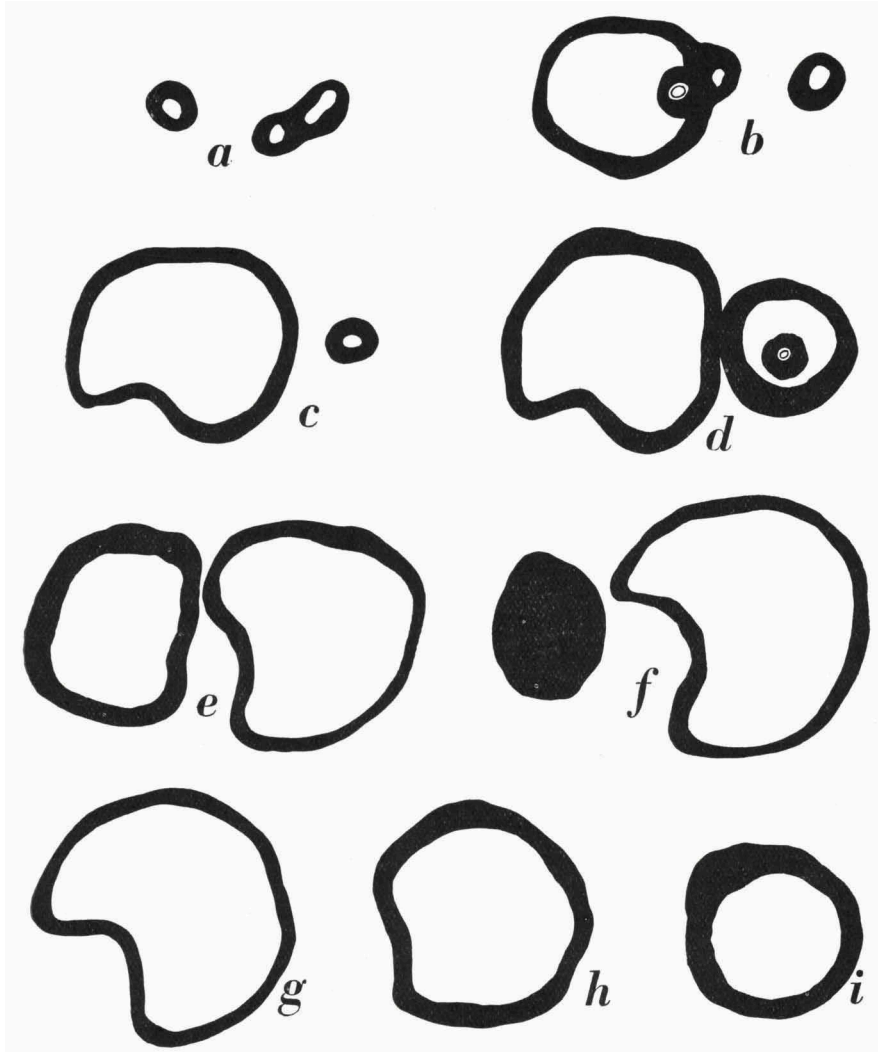


Fig. 52. *Sacculina inflata* on *Cancer pagurus*. Transverse sections of the male genital organs; posterior end at the upper side of the figures. $\times 30$.

The male genital organs of another specimen on *Cancer* are different again. Here the testes have approximately the same dimensions, the right (at the right side of the figures) being slightly more voluminous than the

left. The chitinous canal which forms the transition of the vasa deferentia into the testes is visible in the left testis in fig. 52 b, in the right in fig. 52 d. The right testis lies nearer to the dorsal region than the left. Fig. 52 d is

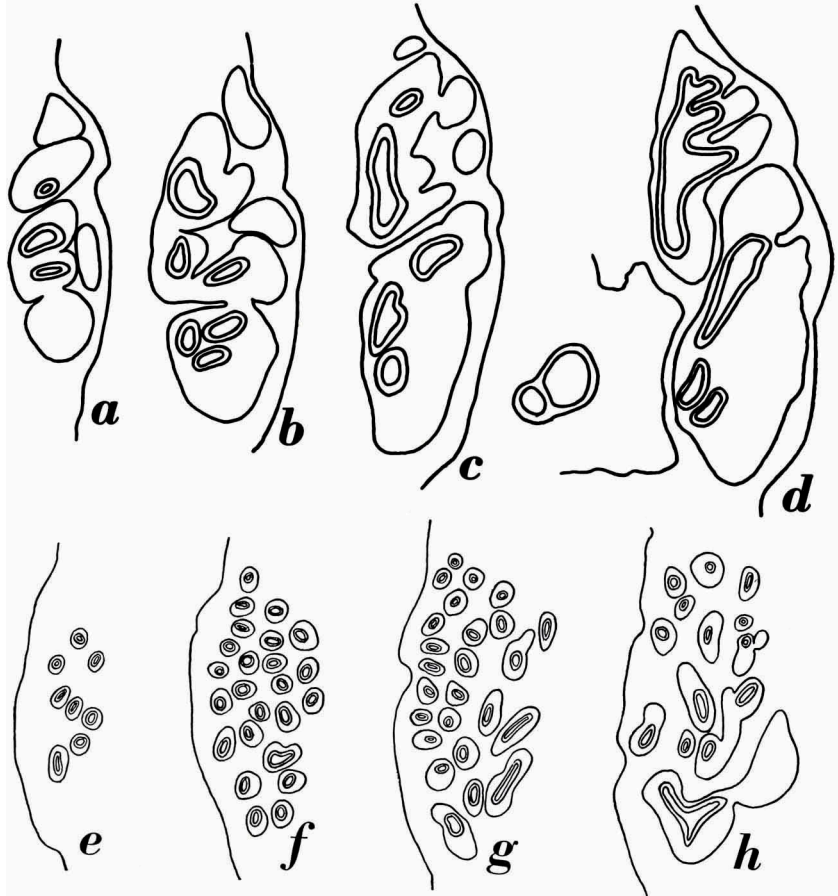


Fig. 53. *Sacculina inflata*. Longitudinal sections of one of the colleteric glands of two specimens. a-d, specimen on *Hyas coarctatus*; e-h, specimen on *Cancer pagurus*. Posterior end at the upper side of the figures. $\times 45$.

from a region in which the left testis reaches its larger diameter, fig. 52 g from a region in which the right testis obtains its largest size.

Parts of the two animals on *Cancer* have been figured in a previous paper (Boschma, 1931 b). Fig. 2 and 3 of the cited paper correspond with fig. 51 d and h of the present paper; fig. 4 of the cited paper corresponds with fig. 52 of the present paper.

Longitudinal sections of the colleteric glands of the specimen on *Hyas*

coarctatus show that these glands contain a small number of very wide cavities in which a larger number of chitinous canals occur (fig. 53 a—d). Of the figured sections fig. 53 d is from the median region, fig. 53 a from the periphery, the two other sections are from intermediate parts. The cavities (including in fig. 53 d the atrium, at the left side of the figure) are drawn with a single line, the chitinous tubes with a double line; the surface of the visceral mass is represented (at the right of each figure) with a single line.

Corresponding sections of one of the colleteric glands of a specimen on *Cancer pagurus* are drawn in fig. 53 e—h. Here too the canal system is drawn as a single line, the chitinous tubes as double lines, and the surface of the visceral mass as a single line. Fig. 53 h is from a more or less median region, fig. 53 e from a peripheral part, the two other sections from intermediate regions. The number of canals in this colleteric gland is much larger than that in the specimen on *Hyas*, and, moreover, as a rule each canal contains a single chitinous tube only.

The general shape of the canal system and the manner of distribution of the canals in the two specimens is not principally different. It remains, however, highly desirable to study more parasites of *Hyas*, to prove whether the figured colleteric gland is of normal appearance or not.

There is a slight difference in size between the excrescences of the external cuticle in the specimen on *Hyas* and those on *Cancer*. In the specimen on *Hyas* the excrescences vary in length between 10 and 16 μ ; in those on *Cancer* they differ in length from 18 to 35 μ . In general the excrescences of the parasites of the two different hosts are very similar; the difference in size is not striking enough to regard the two forms as different species.

Sacculina irrorata Boschma 1934 b.

Type specimen on *Trapezia cymodoce* (Herbst).

Type-locality: Banda Neira, East Indies.

Description: Male genital organs in the posterior part of the body, outside the visceral mass, completely separated. Testes more or less globular, rather abruptly passing into the comparatively narrow vasa deferentia. The two testes have a common muscular sheath. Colleteric glands with a moderate number of canals, the latter not arranged in rows parallel to the surface of the visceral mass. External cuticle of the mantle without excrescences but consisting of two different kinds of chitin. One kind has the usual structure and forms the layers parallel to the surface; the other consists of very small plugs of hyaline matter, which are found in the upper half of the cuticle and are arranged perpendicular to its surface. These chitinous

plugs are very numerous in the region of the mantle which is turned against the thorax of the host; they fail or occur very sparsely in the region of the mantle which is facing the abdomen of the host. Retinacula unknown.

Fig. 54 shows sections of the male genital organs of the type specimen. The vasa deferentia (fig. 54 a, b) are more or less straight, narrow canals, which in their dorsal part possess a well developed chitinous layer on their

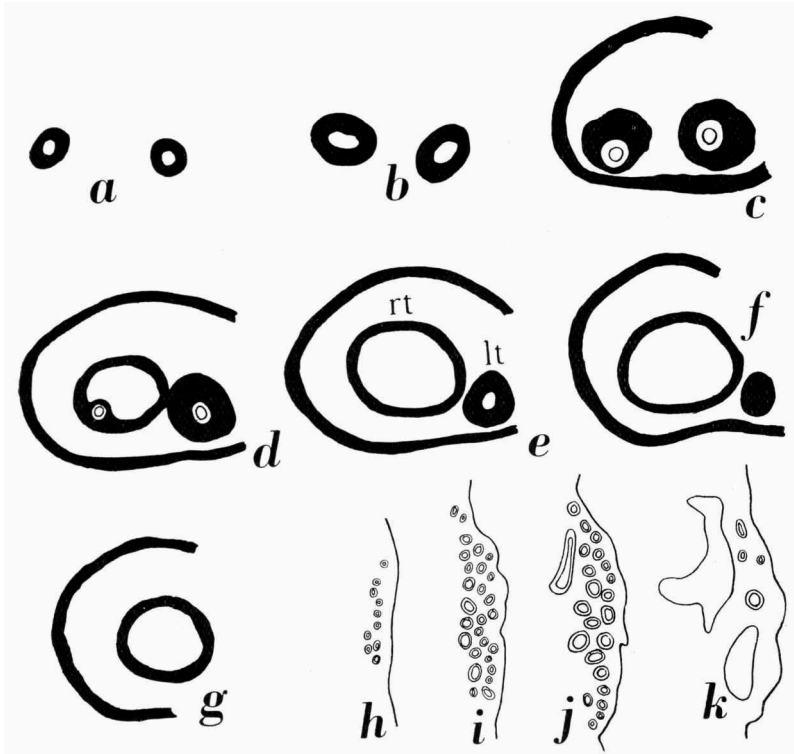


Fig. 54. *Sacculina irrorata*. a-g, transverse sections of the male genital organs. h-k, longitudinal sections of one of the colleteric glands. Posterior end at the upper side of the figures. lt, left testis; rt, right testis. $\times 80$.

inner walls (fig. 54 c). At a slightly more dorsal region the vasa deferentia pass into the testes (fig. 54 d; in both male organs the chitinous tube, which forms the transition of the vasa deferentia into the testes, is visible). Towards the dorsal region one of the testes becomes somewhat wider, the other gradually diminishes in size (fig. 54 e—g). The two testes are surrounded by a common muscular sheath, which in the type specimen at one side is incomplete, as a result of the detachment of the specimen from its host.

The colleteric glands (fig. 54 h—k) have a well developed canal system, though the number of canals in longitudinal sections does not exceed 30. In the type specimen the chitin of the canals is distinctly visible. The figures show from left to right sections from the peripheral part to the median region.

Sacculina lata Boschma 1933 b.

Type specimen on *Charybdis miles* (de Haan).

Type-locality: Misaki, Japan.

Description: Male genital organs in the visceral mass, for their greater

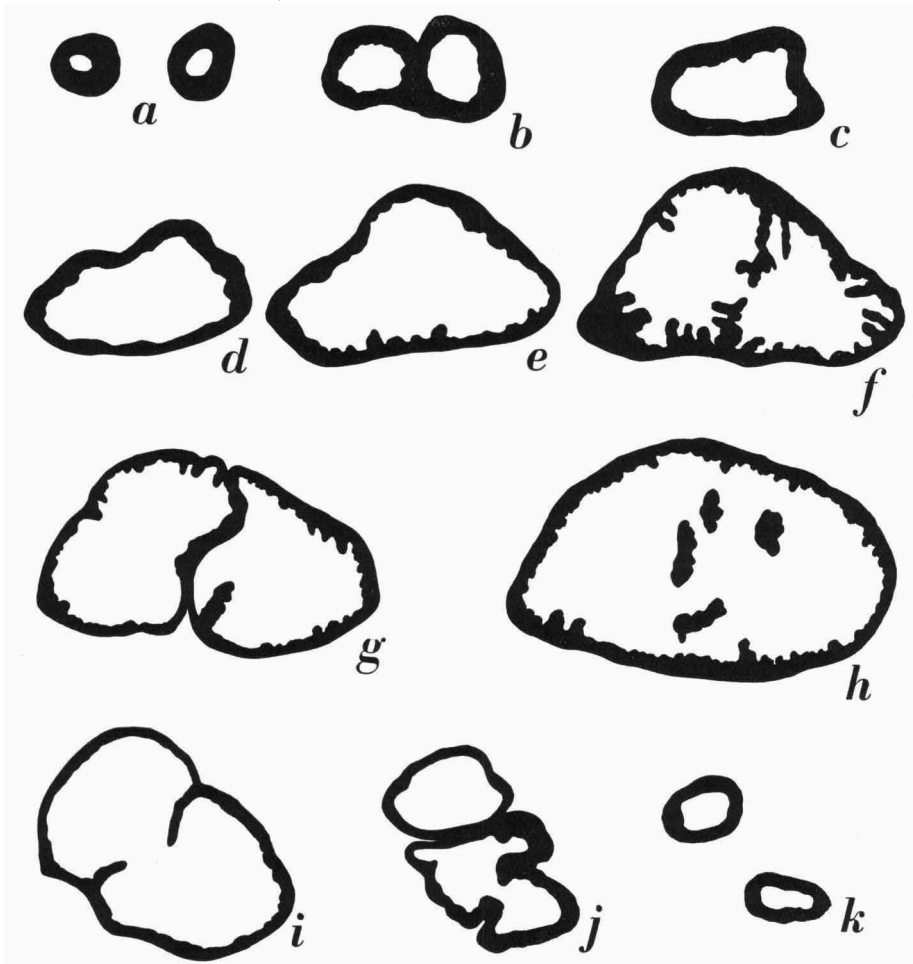


Fig. 55. *Sacculina lata*. Transverse sections of the male genital organs; posterior end at the upper side of the figures. $\times 30$.

part largely united (the cavities of the male genital organs communicate in two different regions). Dorsal extremities of the testes completely separated. Testes with a comparatively thin wall, also in their dorsal part, more or less cylindrical, gradually passing into the rather narrow vasa deferentia. Canal system of the colleteric glands strongly divided (more than 60 canals in longitudinal sections of the most strongly divided region of these glands). External cuticle of the mantle covered with short thick hairs or elongate papillae, which have a length of 4 to 14 μ and are covered with minute lateral hairs. These excrescences consist of approximately the same kind of chitin as that of the main layers. Internal cuticle of the mantle with retinacula which consist of a basal part and 5 to 7 barbed spindles with a length of 11 to 16 μ .

The narrow vasa deferentia (fig. 55 a) soon unite (fig. 55 b) and at a slightly more dorsal plane their cavities communicate so as to form a single canal (fig. 55 c). This common canal of the two male genital organs increases in size (fig. 55 d, e). At a somewhat farther dorsal region a septum develops in the common cavity (fig. 55 f), this septum gradually becomes complete (fig. 55 g). In a still more dorsal region, however, the

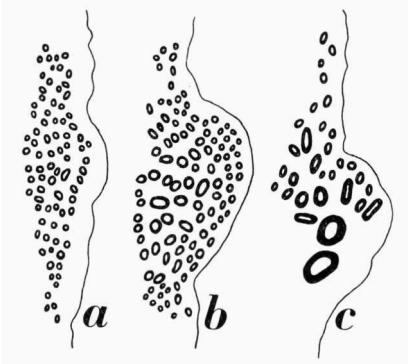


Fig. 56. *Sacculina lata*. Longitudinal sections of one of the colleteric glands; posterior end at the upper side of the figures. $\times 30$.

septum again disappears almost completely (fig. 55 h). Gradually this septum develops again (fig. 55 i), and in the most dorsal region of the male genital organs the two testes are separated again (fig. 55 j); the extremities of the two testes are distinctly diverging (fig. 55 k). This case is very exceptional among the species of the genus *Sacculina*: *S. lata* is the only species known in which the male genital organs are widely communicating in two different regions. The exact region of transition of the testes into the

vasa deferentia is not easily to be indicated, as there is not a narrow canal with a chitinous inner wall as occurs in many other species of the genus.

The colleteric glands (fig. 56) possess a well developed system of branched canals. In the type specimen a longitudinal section of the most strongly divided part of these glands contains more than 100 canals (fig. 56 b). The colleteric glands of the type specimen do not contain chitin, in the figures therefore the epithelium of the gland is drawn in black.

Sacculina leopoldi Boschma 1931 d.

Type specimen on *Cymo melanodactylus* de Haan.

Type-locality: between Banda Neira and Goenoeng Api, East Indies.

Description: Male genital organs in the posterior part of the body, outside the visceral mass, completely separated. Testes not strongly differing

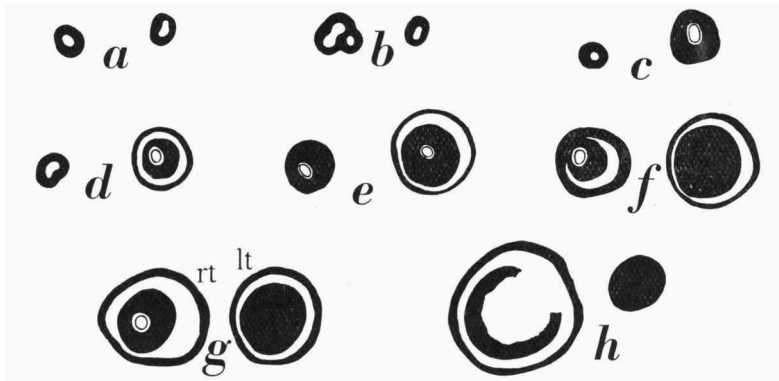


Fig. 57. *Sacculina leopoldi*. Transverse sections of the male genital organs; posterior end at the upper side of the figures. lt, left testis; rt, right testis. $\times 53$.

in size and shape, more or less globular, rather abruptly passing into the comparatively narrow vasa deferentia. Colleteric glands more or less flattened, with a moderate number of canals (about 20 canals in longitudinal sections of the most strongly divided part); the canals not arranged in distinct rows parallel to the surface of the visceral mass. External cuticle of the mantle with excrescences which have approximately the same structure as that of the main layers. These excrescences consist of small hairs with blunt, more or less swollen rounded tops and do not possess minute lateral hairs. Generally these hairs have a length of 12μ approximately; in some parts of the mantle they may reach a length of 24μ . Retinacula unknown.

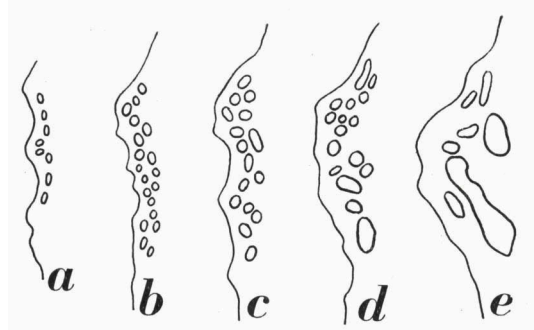


Fig. 58. *Sacculina leopoldi*. Longitudinal sections of one of the colleteric glands; posterior end at the upper side of the figures. $\times 80$.

Fig. 57 shows transverse sections of the male genital organs. The narrow vasa deferentia in some places are slightly tortuous (fig. 57 b); towards their dorsal part the wall increases in thickness, here it is covered internally with a distinct layer of chitin (fig. 57 c at the right side, fig. 57 e at the left side). These thicker parts of the vasa deferentia pass into the testes (fig. 57 d—g). A cavity is visible in one of the testes only (fig. 57 h, a part of the wall of the testis is lost in the sections), the other testis forms a more or less compact mass. The two testes do not differ strikingly in size.

The colleteric glands (fig. 58) are rather small and contain comparatively few canals. Fig. 58 a represents a section from the peripheral part of the gland, each following section is from nearer the median region than its predecessor, fig. 58 e is from approximately the median part of the gland. In the type specimen the canals of the colleteric glands do not contain chitin, in the figures the inner walls of the canals are drawn with a single line.

Sacculina leptodiae Guérin-Ganivet 1911.

Type specimen on *Xanthodius exaratus* (M.-Edw.).

Type-locality: Jibuti, Gulf of Aden.

The anatomical characters of this species are described by Guérin-Ganivet (1911, p. 58) as follows:

“La masse viscérale a une forme analogue à celle du manteau; elle est blanche et reliée à celui-ci par un mésentère occupant la position ordinaire et reliant la partie intérieure du pédoncule au cloaque; dans l'intérieur du sac palléal, le pédicule a une disposition asymétrique, ainsi que l'indique la figure 7; il paraît comme dévié par suite du voisinage des deux testicules, qui sont complètement indépendants, globuleux ou subsphériques, et reliés à la base du pédoncule par un fin canal qui paraît les contourner partiellement; ces testicules sont complètement isolés du reste de la masse viscérale, dans le petit axe duquel on distingue, au niveau de la réunion du tiers moyen et du tiers postérieur, les glandes collétériques blanchâtres et petites.”

Professor Ch. Gravier of the Muséum National d'Histoire Naturelle kindly allowed me to study the characters of the external cuticle of the type specimen. This enabled me to give the following diagnosis of the species (Boschma, 1936 b, p. 344):

“Organes génitaux mâles dans la partie postérieure du corps, en dehors de la masse viscérale. Testicules complètement indépendants, plus ou moins globuleux. Glandes collétériques avec un assez petit nombre de tubes. Appendices de la cuticule externe du manteau composés d'un assez petit

nombre d'épines. Les dimensions des appendices varient de 30 à 90 μ ."

The following description contains some more characters which are needed to distinguish the species from others which have similar excrescences.

Description: Male genital organs in the posterior part of the body, outside the visceral mass, completely separated. Testes more or less globular, rather abruptly passing into the vasa deferentia, which are comparatively wide. Colleteric glands with a moderate number of canals (15—30 canals in longitudinal sections of the most strongly divided part); the canals are somewhat, but not exactly, arranged in a row parallel to the surface of the visceral mass. External cuticle of the mantle with excrescences which consist of a hyaline kind of chitin, different from that of the main layers. These excrescences are composed of groups of spines which are united on well developed basal parts. They are not combined into distinct branches, but each spine is more or less separately attached to its basal part. Each excrescence consists of comparatively few spines, the spines themselves are longer than 18 μ , the length of the excrescences as a whole varies from 25 to 80 μ . Retinacula unknown.

The specimen from Jibuti is regarded here as the type specimen, the two other specimens on which Guérin-Ganivet (1911) based his description were from Grande Comore. In the latter specimens the length of the excrescences varies from 25 to 45 μ , in the type specimen they have a size of 50 to 80 μ .

* **Sacculina leptothrix** Boschma 1933 b.

Type specimen on *Xenocarcinus tuberculatus* White.

Type-locality: Vicinity of Jolo, Philippine Islands.

Description: Male genital organs in the posterior part of the body, outside the visceral mass, completely separated. Testes of approximately equal shape and size, more or less globular, rather abruptly passing into the comparatively narrow vasa deferentia. Colleteric glands with a small number of canals (less than 10 in a longitudinal section of the most strongly divided part), the canals neatly arranged in one row parallel to the surface of the visceral mass. External cuticle of the mantle with crowdedly arranged little hairs or spines which do not possess minute lateral hairs. These excrescences consist of approximately the same kind of chitin as that of the main layers of the cuticle; at their basal part (which is not conspicuously swollen) they have a thickness of 1.5 μ or less, their length varies from 2 to 10 μ . Retinacula unknown.

As the type specimen of *Sacculina leptothrix* is immature it is difficult.

to decide whether the characters of the specimen as given above are of specific value or not. In mature specimens the colleteric glands may obtain

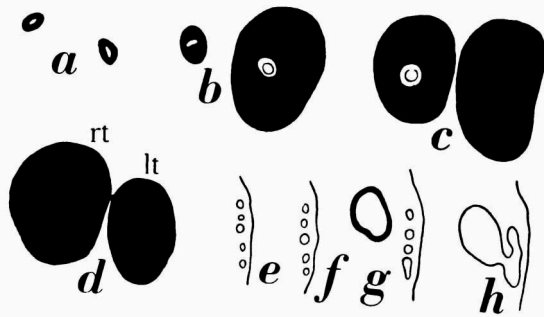


Fig. 59. *Sacculina leptothrix*. a-d, transverse sections of the male genital organs. e-h, longitudinal sections of one of the colleteric glands. Posterior end at the upper side of the figures. lt, left testis; rt, right testis. $\times 53$.

a more complicated canal system and even the excrescences of the external cuticle may be different in adult specimens.

The globular testes (fig. 59 b—d) do not yet possess cavities; the chitinous inner wall of the dorsal part of the vasa deferentia is distinctly visible in the ventral part of the testes (fig. 59 b, c), but these canals terminate

in the ventral region of the testes. The vasa deferentia (fig. 59 a) are narrow, more or less straight canals.

A median section of one of the colleteric glands (fig. 59 h) shows the atrium connected with the beginning of the canal system. Towards the peripheral region (fig. 59 g, f, e) the canal system becomes slightly more branched, but the number of canals remains very low. The figures show the inner walls of the canals (in fig. 59 g moreover the epithelium of a part of the atrium); the canals do not yet possess chitinous tubes.

* ***Sacculina levis*** Boschma 1933 b.

Type specimen on unknown host.

Type-locality: Yenosima, mouth of Bay of Jeddo, Japan.

The name *Sacculina levis* is a synonym of *Sacculina confragosa*. In the diagnosis of *S. levis* the testes were described as lying outside the visceral mass; this must be incorrect, although it seems to be the case in the rather damaged specimen.

Sacculina longipila Boschma 1933 b.

Type specimen on *Micropanope lobifrons* A. M.-Edw.

Type-locality: Barbados, British West Indies.

Description: Male genital organs in the visceral mass, completely separated. One of the testes more or less globular, rather abruptly passing into its vas deferens, the other testis more or less rudimentary. Vasa deferentia comparatively narrow. Colleteric glands with a moderate number

of canals (less than 30 in longitudinal sections of the most strongly divided part). External cuticle of the mantle with long slender hairs which in different parts of this cuticle differ in length between 25 and 85 μ . These excrescences consist of approximately the same kind of chitin as that of

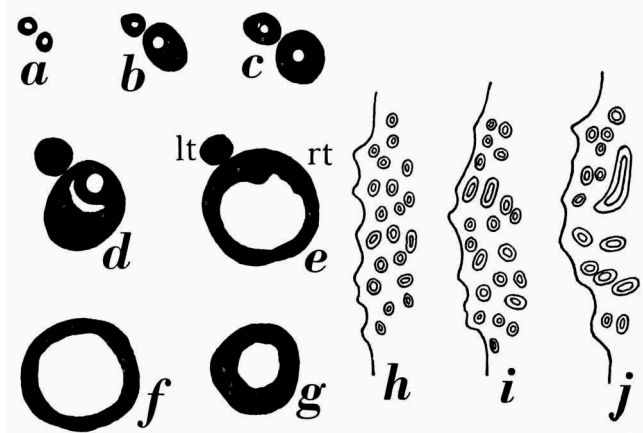


Fig. 60. *Sacculina longipila*. a-g, transverse sections of the male genital organs. h-j, longitudinal sections of one of the colleteric glands. Posterior end at the upper side of the figures. lt, left testis; rt, right testis. a-g, $\times 45$; h-j, $\times 80$.

the main layers of the cuticle; they are covered with minute lateral hairs. Retinacula unknown.

The vasa deferentia form narrow, more or less straight tubes (fig. 60 a—c). In their dorsal part the walls of the vasa deferentia increase in thickness. One of the vasa deferentia then without sharp line of demarcation passes into its testis, which has no cavity (fig. 60 d, e, at the left side in the upper part of the figures). The other testis (fig. 60 d—g) is of much larger size, it has a wide cavity into which the vas deferens rather abruptly passes fig. 60 d). There is, however, not a chitinous layer on the inner wall of the dorsal part of the vas deferens in the region in which it passes into its testis.

The colleteric glands (fig. 60 h—j) contain a moderate number of canals, which do not show an arrangement in rows.

***Sacculina margaritifera* Kossmann 1872.**

Type specimen on *Thalamita* spec.

Type-locality: Lapinig Canal, Bohol, Philippine Islands.

Besides notes on the shape and size of his specimen Kossmann (1872, p. 34; 1874, p. 130) gives the following description:

“Die Cuticula des Mantels trägt perlartige Verdickungen von 0,01 mm. Durchm. Der Hoden ist unpaarig mit doppeltem Ausführungsgange, und liegt, wie bei *S. carcini*; das Lumen der Ausführungsgänge ist spiralich. Die Ovarialöffnungen und Eikittdrüsen liegen ziemlich genau in der Mitte der Seitenflächen.”

Van Kampen and Boschma (1925) identified a specimen on *Oncinopus aranea* de Haan (“Siboga” Expedition, Stat. 37, Paternoster Islands) as *Sacculina margaritifera*. The characters of this specimen are the following:

Description: Male genital organs in the visceral mass, completely separated. Testes more or less cylindrical, gradually passing into the narrow vasa deferentia. One of the testes well developed, its dorsal part extending in a more or less anterior direction; the other testis rudimentary. Colleteric glands with few canals (not more than 10 in transverse sections of the most strongly divided part). External cuticle of the mantle with excrescences which have approximately the same structure as that of the main layers of this cuticle. These excrescences consist of small papillae which at their extremities are divided into a number of small lobes or form more or less globular little bodies. Moreover there are papillae of a shape intermediate between the two. The diameter of the excrescences is 12 μ or less. Retinacula unknown.

The ventral parts of the two vasa deferentia are found in the immediate neighbourhood of the mesentery (fig. 61 a). Towards the dorsal region one of the male genital organs gradually increases in size (fig. 61 b—d); the other remains visible as a narrow canal beside the other, it terminates soon after the region of fig. 61 d. The larger testis extends for some distance towards the dorsal region of the body. Gradually it diverges more or less from the mesentery, so that in its extreme dorsal part (fig. 61 g) it is found at a considerable distance from the mesentery. This testis consequently runs in a more or less oblique direction, it is pointing dorsally and more or less anteriorly.

The colleteric glands (fig. 61 h, i) contain a few canals only. In the peripheral region the canals are neatly arranged in a single row parallel to the surface of the visceral mass (fig. 61 h), towards the median region this arrangement is no longer present (fig. 61 i).

It remains questionable whether the specimen on *Oncinopus aranea* belongs to *Sacculina margaritifera*, the type of which was a parasite of *Thalamita* spec. Kossmann writes that there is one testis with a double vas deferens. This could be said too of the specimen on *Oncinopus* with the restriction that one of the vasa deferentia is not connected with the testis. Moreover Kossmann mentions that the situation of the testis corresponds

with that found in *Sacculina carcini*, which means that these organs are found in the visceral mass. In this respect the specimen on *Oncinopus* corresponds to a certain degree with *S. carcini*, and, therefore, with *S. margaritifera* too. Kossmann's description, however, contains the statement that the vasa deferentia have a spiral lumen; this does not occur in the specimen on *Oncinopus*, which has narrow, more or less straight vasa deferentia.

In a previous paper (Van Kampen and Boschma, 1925) we have made

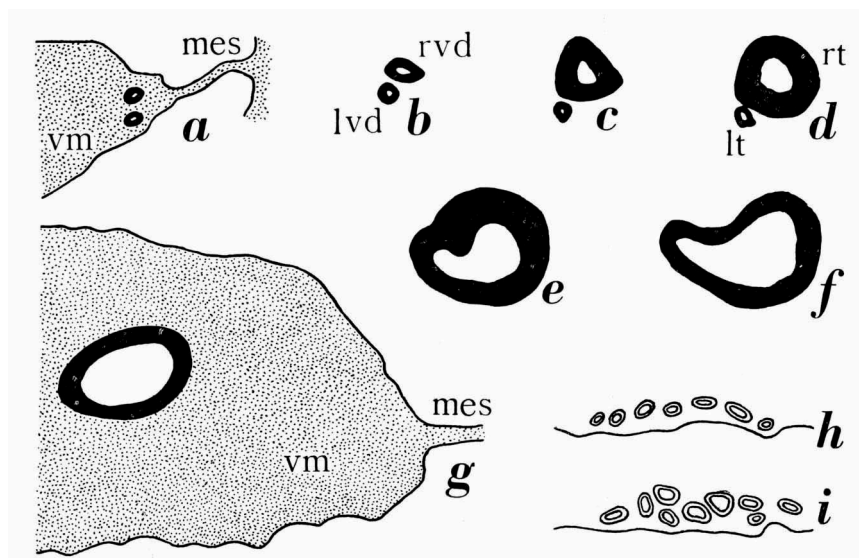


Fig. 61. *Sacculina margaritifera*. Parts of transverse sections. a-g, sections of the male genital organs (in a and g with the surrounding region of the body). h, i, transverse sections of one of the colleteric glands. Dorsal end at the right side of the figures. lt, left testis (or terminal part of the left male genital organ); lvd, left vas deferens; mes, mesentery; rt, right testis; rvd, right vas deferens; vm, visceral mass. $\times 80$.

the mistake to explain the figures of *Sacculina margaritifera* (l.c., Plate III fig. 4 a, b) as longitudinal sections. The specimen is, however, sectioned transversely, so that the upper part of the cited figures is their dorsal region. This explains too that in fig. 4 b of the cited paper the mesentery occurs at the upper part of the figure only.

Sacculina micracantha Boschma 1931 c.

Type specimen on *Percnon planissimus* (Herbst).

Type-locality: Ternate, East Indies.

Description: Male genital organs in the posterior part of the body, out-

side the visceral mass, completely separated. Testes more or less globular, rather abruptly passing into the wide vasa deferentia. Vasa deferentia with a few ridges on their inner walls. Colleteric glands with a fairly large number of canals. External cuticle of the mantle with minute spines which have a length of 2 to 3 μ and which seem to consist of the same kind of chitin as that of the main layers of the cuticle. In many parts of the cuticle

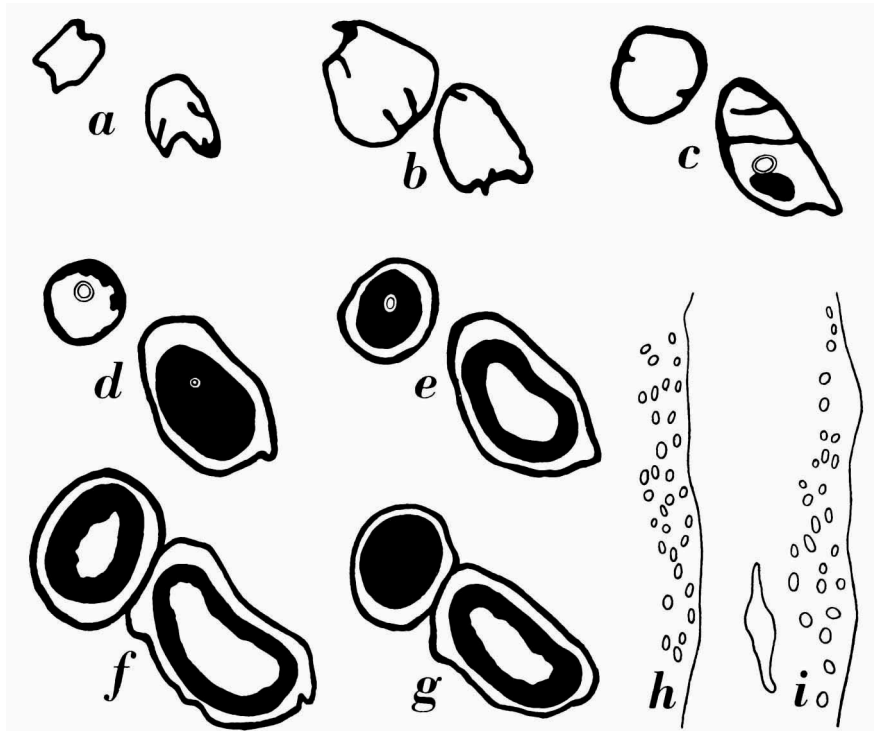


Fig. 62. *Sacculina micracantha*. a-g, transverse sections of the male genital organs. h, i, longitudinal sections of one of the colleteric glands. Posterior end at the upper side of the figures. $\times 80$.

these spines have a somewhat broadened basal part; the chitin of these larger excrescences has a more hyaline appearance than that of the main layers. Retinacula unknown.

The two male genital organs (fig. 62 a--g) do not differ conspicuously in shape and size. The vasa deferentia form rather wide sacs with thin walls, on the inner surface of which there are a few ridges (fig. 62 a--c); their dorsal part is connected with the ventral part of the testes by a narrow chitinous canal. In the right half of fig. 62 c and in the left half of fig. 62 d

this canal is visible in the dorsal part of the vasa deferentia; in the right half of fig. 62 d and in the left half of fig. 62 e it is seen in the ventral region of the testes. The testes (fig. 62 d—g) have rather wide cavities, they possess distinct muscular sheaths.

The colleteric glands are more or less flattened (fig. 62 h, i), but the canals are irregularly distributed in these glands. In the type specimen the canals do not contain chitin so that in the figures the inner walls of the canals are drawn (in fig. 62 i also a part of the atrium).

A previous figure of the type specimen of *Sacculina micracantha* (Boschma, 1931 c, fig. 30) is from the same region as fig. 62 f in the present paper.

* ***Sacculina microthrix*** Boschma 1931 d.

Type specimen on *Actaea hirsutissima* (Rüpp.).

Type-locality: Banda Neira, East Indies.

Description: Male genital organs in the visceral mass, completely separated. Testes more or less globular, rather abruptly passing into the comparatively wide vasa deferentia. Colleteric glands with a moderate number of canals. External cuticle of the mantle densely covered with small thin hairs which have a length of 3 to 8 μ . The structure of the chitin of these hairs is not different from that of the main layers. Retinacula unknown.

The two specimens of *Sacculina microthrix* occur together on one crab (cf. Boschma, 1931 d). Longitudinal sections were made of one of the specimens, which show that the parasites still are in an immature state, so that it is not altogether certain that they possess already the real specific characters. Especially the excrescences of the external cuticle may be different in adult specimens: it is known in other species of *Sacculina* that very young specimens may have other excrescences than those found in adult animals.

Sections of the male genital organs (fig. 63 a—h) show that these organs already are well developed: both testes possess distinct cavities (fig. 63 g—f). The ventral parts of the vasa deferentia are rather narrow (fig. 63 a); in their dorsal part the cavities are much wider, but irregular on account of a number of ridges on their inner walls (fig. 63 b, c). In both male organs there is a region in which the inner wall of the canal shows a distinct layer of chitin (fig. 63 d, e, and g); this part forms the region of transition of the testes into the vasa deferentia. Each testis is surrounded by its own muscular sheath, these two may come close together, but the testes themselves remain completely separated.

The canal system of the colleteric glands is well developed, but the canals do not yet contain chitinous tubes, so that in the figures (fig. 63 i—k) the epithelium of the gland is represented in black. Fig. 63 k, which is drawn

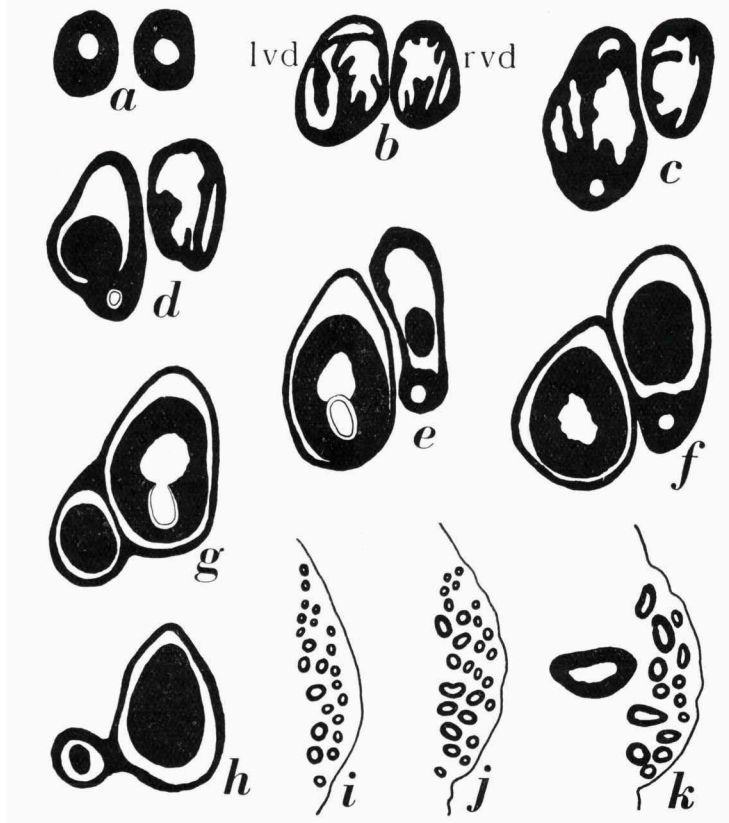


Fig. 63. *Sacculina microthrix*. a-h, transverse sections of the male genital organs. i-k, longitudinal sections of one of the colleteric glands. Posterior end at the upper side of the figures. lvd, left vas deferens; rvd, right vas deferens. $\times 80$.

after a section from the median region, shows a part of the atrium too (the larger of the canals). The canals of the colleteric glands do not show an arrangement in rows parallel to the surface of the visceral mass.

Sacculina muricata Boschma 1931 a.

Type specimen on *Sphenocarcinus stimpsoni* (Miers).

Type-locality: Sagami Sea, Japan, 720 m.

Description: Male genital organs in the visceral mass, completely separated. Testes more or less cylindrical, gradually passing into the

comparatively narrow vasa deferentia. Colleteric glands with a large number of canals (more than 50 in longitudinal sections of the most strongly divided region). External cuticle of the mantle with excrescences which consist of approximately the same kind of chitin as that of the main layers. These excrescences are hairs or elongate papillae which have a length of 8 to 12 μ ; they do not bear minute lateral hairs. Internal cuticle of the mantle with numerous retinacula, which are more or less regularly

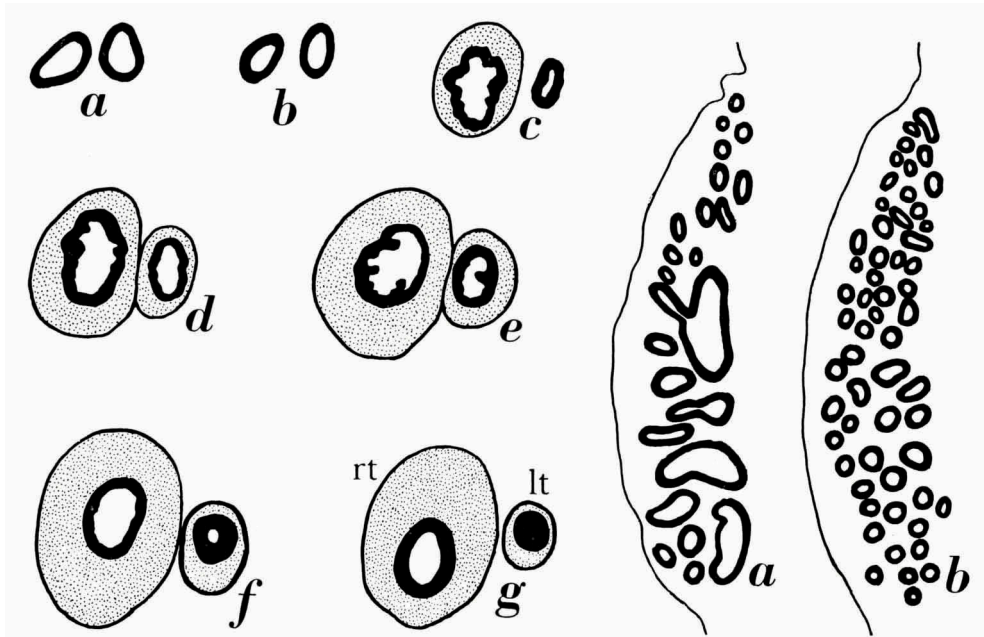


Fig. 64. *Sacculina muricata*. Transverse sections of the male genital organs; posterior end at the upper side of the figures. lt, left testis; rt, right testis. $\times 45$.

Fig. 65. *Sacculina muricata*. Longitudinal sections of one of the colleteric glands; posterior end at the upper side of the figures. $\times 80$.

distributed on its surface. Each retinaculum consists of a basal part and about 5 to 8 spindles; the latter vary in length from 10 to 14 μ .

The vasa deferentia gradually pass into the testes (fig. 64 a—c), the exact region of transition cannot be determined with certainty. The testes, which are but slightly wider than the vasa deferentia, are surrounded by a muscular sheath (fig. 64 c—g); the space between the testes and their muscular sheaths is filled with a kind of connective tissue. In a previous paper (Boschma, 1931 a, fig. 10 a) a longitudinal section from the dorsal region of *Sacculina muricata* is figured; this section is from a region corresponding with that of fig. 64 e in the present paper.

The colleteric glands are somewhat flattened (fig. 65), they contain numerous canals. In the type specimen these canals do not contain chitin, in the figures the epithelium of the canals is represented in black. Fig. 65 a, a section of the median region, shows the wider parts of the canals; fig. 65 b is from a more peripheral region, in which the canal system is more strongly branched.

* *Sacculina neglecta* Fraisse 1877.

= *Drepanorchis neglecta* (Fraisse).

Sacculina nodosa Boschma 1931 a.

Type specimen on *Rhinolambrus cybelis* Alcock.

Type-locality: Danish Expedition to the Kei Islands, Stat. 53, 85 m.

Description: Male genital organs in the visceral mass, partially united, but the dorsal extremities of the two testes completely separated. Testes

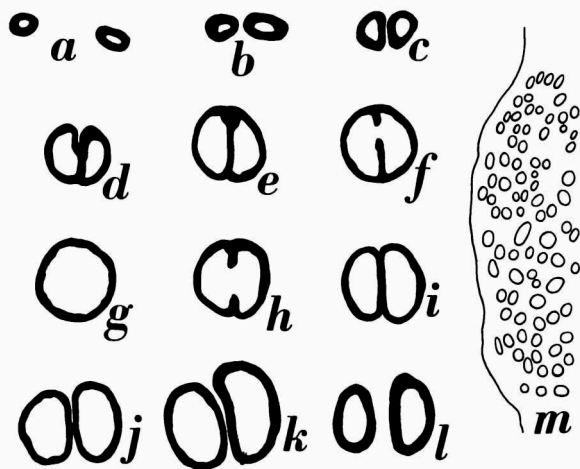


Fig. 66. *Sacculina nodosa*. a-l, transverse sections of the male genital organs. m, longitudinal section of one of the colleteric glands. Posterior end at the upper side of the figures. a-l, $\times 30$; m, $\times 53$.

more or less cylindrical, gradually passing into the comparatively narrow vasa deferentia, which do not possess ridges on their inner walls. Colleteric glands with numerous canals (more than 50 in longitudinal sections of the most strongly divided region). External cuticle of the mantle with hairs which attain a length of 20 to 35 μ . The hairs are evenly distributed on the surface of the cuticle and

consist of approximately the same material as the cuticle itself. They are rather densely covered with minute lateral hairs. Retinacula unknown.

The region of transition of the testes into the vasa deferentia cannot easily be indicated as there is not a narrow canal with a chitinous inner wall. The ventral parts of the two vasa deferentia are separated and rather widely apart (fig. 66 a). Towards the dorsal region the two canals come into close contact (fig. 66 b, c) and gradually unite (fig. 66 d). At first the

two cavities remain separated although the whole appears as a single canal divided into two parts by a median septum (fig. 66 e), but gradually this septum becomes incomplete (fig. 66 f) and in a certain region it vanishes altogether (fig. 66 g). Towards a more dorsal region the septum reappears again (fig. 66 h), it becomes complete (fig. 66 i), and in a still farther dorsal region the two testes are completely separated (fig. 66 j—l).

The colleteric glands of the type specimen do not contain chitin. The canal system of one section is given in fig. 66 m; there are numerous canals which are more or less evenly distributed in the gland. The section is from a more or less intermediate region between the median part and the periphery; this is the region in which longitudinal sections contain the largest number of canals.

* **Sacculina ostracotheris** Pérez 1920.

Type specimen on *Ostracotheres spondyli* Nobili.

Type-locality: Persian Gulf.

Pérez (1920, p. 1027) characterizes this species with the following words:

“..... une Sacculine que l'on peut considérer provisoirement comme suffisamment définie par son hôte, et que j'appellerai *Sacculina ostracotheris*.”

* **Sacculina panopaei** Gissler 1884.

= *Loxothylacus panopaei* (Gissler).

* **Sacculina papilio** Kossmann 1872.

= *Triangulus papilio* (Kossm.).

Sacculina papposa Van Kampen and Boschma 1925.

Type specimen on *Thalamita admete* (Herbst).

Type-locality: Banda, East Indies.

Description: Male genital organs in the posterior part of the body, outside the visceral mass, dorsal parts of the testes united. Testes more or less globular, gradually passing into the comparatively narrow vasa deferentia. The two testes surrounded by a common muscular sheath. Colleteric glands with a moderate number of tubes (nearly 20 in longitudinal sections of the most strongly divided part). External cuticle of the mantle with excrescences which for their greater part are composed of the same kind of chitin as that of the main layers of this cuticle. They consist of somewhat irregular papillae with a flat top, their thickness and height is 22 μ approximately. At their upper surface these papillae are covered with a thin layer

of chitin of a more or less hyaline kind; this layer bears numerous minute sharp spines (length of these spines 3.5 to 6 μ), which are arranged in a more or less circular group on the top of the papillae. Retinacula unknown.

Although the testes gradually pass into the vasa deferentia, in one of the male genital organs there is a region with a distinct layer of chitin on the inner wall of the canal (fig. 67 b, c); this region, therefore, represents the transition of the testis into its vas deferens. The vasa deferentia are

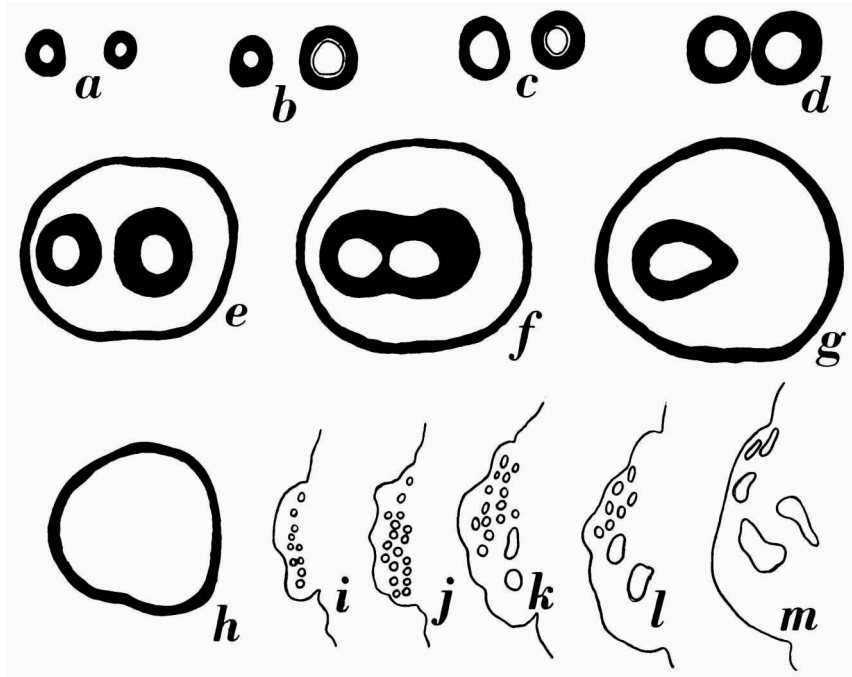


Fig. 67. *Sacculina papposa*. a-h, transverse sections of the male genital organs. i-m, longitudinal sections of one of the colleteric glands. Posterior end at the upper side of the figures. $\times 80$.

rather narrow (fig. 67 a-c), but the testes (fig. 67 d-g) are not much wider. In their dorsal part the two testes are united, at first their cavities remain separated (fig. 67 f), but in the extreme dorsal region the two cavities are united (fig. 67 g). For the greater part of their extent the two testes are surrounded by a common muscular sheath (fig. 67 e-h); this muscle continues somewhat farther in a dorsal direction than the testes (fig. 67 h). In a previous paper (Boschma, 1931 c) a longitudinal section of the type specimen of *Sacculina papposa* is given which is from a region corresponding with that of fig. 67 e of the present paper.

In the cited figure the colleteric glands too are visible, neatly protruding above the surface of the visceral mass. Of one of the colleteric glands a number of longitudinal sections are represented in fig. 67 i—m. As in the type specimen these glands do not contain chitin the inner walls of the canals are drawn only. In their median part the glands contain a few large canals only (fig. 67 m), towards the periphery the number of branches gradually increases (fig. 67 l, k, j); in the extreme peripheral part just a few of the smaller branches of the canal system remain (fig. 67 i).

* **Sacculina pauli** Popov 1929.

Type specimen on *Brachynotus lucasi* H. M.-Edw. 1).

Type-locality: Azof Sea.

Specimens of *Sacculina* on *Brachynotus lucasi* from the east coast of Spain were shown (Boschma, 1927) to belong to *S. carcini*; it is almost certain that the specimens from the Azof Sea described by Popov as *S. pauli* are also to be regarded as representatives of *S. carcini*.

Sacculina pertenuis Boschma 1933 a.

Type specimen on *Pinnotheres* spec.

Type-locality: Gulf of Suez.

Description: Male genital organs in the visceral mass, their dorsal parts largely united. Testes more or less cylindrical, gradually passing into the comparatively narrow vasa deferentia. Colleteric glands with a moderate number of canals (about 30 canals in longitudinal sections of the most strongly divided region). External cuticle of the mantle comparatively thin (thickness approximately $10\ \mu$), its surface quite smooth and without small areas. Retinacula unknown.

In the male genital organs there is not a region in which the inner wall of the canals is covered with chitin, so that the transition of the testes into the vasa deferentia cannot be easily determined. A longitudinal section of the type specimen from the region in which the two male genital organs are largely united is given in a previous paper (Boschma, 1933 a, fig. 19);

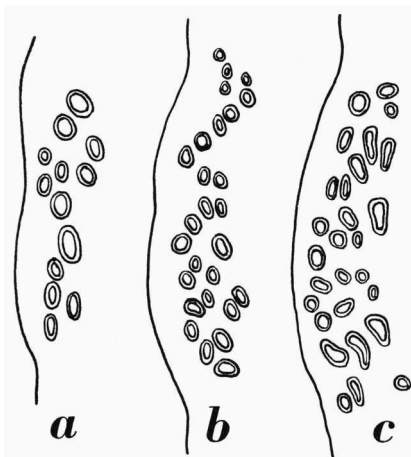


Fig. 68. *Sacculina pertenuis*. Longitudinal sections of one of the colleteric glands; posterior end at the upper side of the figures. $\times 60$.

1) cf. footnote on p. 195.

in the same paper (l.c., fig. 20) transverse sections of the male genital organs at different levels are found. The two vasa deferentia are distinct, towards the dorsal region of the body the two canals soon unite (l.c., fig. 20 c, d), and gradually the two testes form a single tube with a wide cavity (l.c., fig. 20 e—h).

The chitinous canals of three longitudinal sections of one of the colleteric glands are drawn in fig. 68. The canal system is not very strongly divided, but in some sections there are nearly 30 canals. They are not arranged in rows.

Sacculina phacelothrix Boschma 1931 a.

Type specimen on *Chlorodiella nigra* (Forsk.).

Type-locality: Triancomalee, Ceylon, 4 m.

Description: Male genital organs in the posterior part of the body, outside the visceral mass, completely separated. Testes more or less globular, rather abruptly passing into the vasa deferentia; the latter are comparatively wide. Colleteric glands with few canals (less than 10 in longitudinal sections of the most strongly divided part), the canals neatly arranged in a single row parallel to the surface of the visceral mass. External cuticle of the mantle with excrescences of a hyaline kind of chitin, differing from that of the main layers of the cuticle. These excrescences are composed of groups of spines which in their basal part usually are not united, but they may be combined on a very little developed basal part. The spines have a length of 15 to 30 μ , they may possess numerous minute lateral hairs. Internal cuticle of the mantle with retinacula which are more or less regularly distributed on its surface. Each retinaculum consists of a basal part and 3 to 5 spindles; the latter have a length of 9 μ approximately.

The description given above is based mainly on the characters of the type specimen. Among the material which is at my disposal there is another specimen of a parasite on *Chlorodiella nigra*, which has colleteric glands with strongly branched canal system (with more than 50 canals in longitudinal sections of the most strongly divided region). It is not altogether certain that this specimen belongs to *Sacculina phacelothrix*, if it proves to belong to this species the description given above should be emended.

Sacculina phacelothrix forms an exception among the species of the genus which possess excrescences consisting of groups of hyaline spines in so far as it possesses well developed retinacula. In nearly all other species of the genus with similar excrescences never retinacula are found. As from some species a fairly large number of specimens are examined

in this respect in many cases we may safely conclude that the retinacula do not occur in these species. *Saccolina pilosella* is the only other species of the group which possesses retinacula, which, however, are different from those of *S. phacelothrix*.

* ***Saccolina phalangi*** Hoek 1878.

= *Drepanorchis neglecta* (Fraisie).

Saccolina pilosa Kossmann 1872.

Type specimen on "*Pisa*" spec.

Type-locality: Bohol, Philippine Islands.

Kossmann's (1872, p. 29; 1874, p. 125) description of this species runs as follows (characters of shape and size omitted):

"Die Cuticula des Mantels zeichnet sich dadurch aus, dass sie mit langen Haaren bedeckt erscheint. Je 5—7 derselben nehmen ihren Ursprung aus einer gemeinsamen Wurzel, wie dies Fig. 23 auf Taf. I. darstellt. Der Durchmesser dieser Wurzeln beträgt etwa 0,032 mm., die Länge der Haare incl. der Wurzel 0,85 mm¹⁾. Der Körper ist mässig, seitlich comprimirt und symmetrisch. Die Öffnungen der Ovarien und die Eikittdrüsen liegen sehr weit nach hinten; die männlichen Sexualorgane gleichen in Lage und Gestalt ziemlich genau denen der *S. dentata*."

Van Kampen and Boschma (1925) regarded numerous specimens on different hosts as representatives of *Saccolina pilosa*. In a later paper Boschma (1925) restricted the name *S. pilosa* for those specimens of the "Siboga" Expedition only, which were parasites of *Actaea tomentosa* (H. M.-Edw.) (locality: Ati Ati Onin, New Guinea). The characters of these specimens are:

Description: Male genital organs in the visceral mass, completely separated. Testes more or less globular, rather abruptly passing into the vasa deferentia, which are comparatively wide, and possess a few ridges only on their inner walls. Colleteric glands with a moderate number of canals (nearly 30 in longitudinal sections of the most strongly divided part). External cuticle of the mantle with excrescences consisting of a hyaline kind of chitin, differing from that of the main layers of this cuticle. The excrescences are composed of groups of spines which are united on common basal parts. The groups consist of 2 to 8 spines each; the length of the excrescences as a whole varies from 20 to 60 μ . Retinacula unknown.

1) It is evident that Kossmann means here "0.085 mm", as results from the drawing on his Plate I.

This description does not correspond closely enough with Kossmann's diagnosis to warrant the correctness of the identification of the specimens on *Actaea tomentosa* as *Sacculina pilosa*. Especially the excrescences of the type specimen were of larger size ($85\ \mu$) than those of the specimens of the "Siboga" Expedition ($20-60\ \mu$). These differences, however, are not striking enough to prove that the identification is incorrect. It remains, however, uncertain, and it is unfortunate that the host of Kossmann's species is not exactly known.

Sacculina pilosella Van Kampen and Boschma 1925.

Type specimen on *Quadrella coronata* Dana.

Type-locality: off Segli, north coast of Sumatra, 125—540 m.

Description: Male genital organs in the posterior part of the body, outside the visceral mass, completely separated. Testes more or less globular, rather abruptly passing into the comparatively wide vasa deferentia. Colleteric glands with few canals (less than 15 canals in longitudinal sections of the most strongly divided region). External cuticle of the mantle comparatively thin (thickness about 10 to $15\ \mu$), its surface with excrescences consisting of a hyaline kind of chitin, differing from that of the main layers of this cuticle. Each excrescence is composed of a small number (2 to 4) of comparatively thick branches, which at their extremities are divided into numerous minute sharp spines. The length of the excrescences varies from 15 to $38\ \mu$. Internal cuticle of the mantle with retinacula, which are arranged more or less in rows on its surface. Each retinaculum consists of a single spindle without distinct basal part. The spindles have a length of $11\ \mu$ approximately.

* ***Sacculina pirimelae*** Guérin-Ganivet 1911.

Type specimen on *Pirimela denticulata* (Mont.).

Type-locality: Pointe à Zoie, Atlantic coast of France.

Concerning the only specimen known of this parasite (collected in 1905 by Giard) Guérin-Ganivet (1911, p. 49) remarks:

"Ce cas de parasitisme est complètement nouveau et sa découverte résulte des recherches effectuées par GIARD, sur les côtes avoisinant le Laboratoire maritime de Wimereux. GIARD, toujours fidèle à la doctrine de la spécificité parasitaire, lui avait donné le nom de *Sacculina pirimelae* destiné à rappeler son hôte. Je ne puis y voir anatomiquement autre chose que *Sacculina carcini* jusqu'à preuve du contraire."

* **Sacculina pisae** Hoek 1878.Type specimen on *Pisa armata* (Latr.).

Type-locality: Gulf of Naples.

In a previous paper (Boschma, 1927) I showed that the parasite of *Pisa armata* belongs to *Sacculina carcini*.* **Sacculina pisiformis** Kossmann 1872.Type specimen on *Hyastenus aries* (Latr.).

Type-locality: Lapinig Canal, Bohol, Philippine Islands.

Concerning the anatomical characters of this species Kossmann (1872, p. 28; 1874, p. 124) remarks:

“Die Cuticula zeigt keine erheblichen Eigenthümlichkeiten. Der Erhaltungszustand war schlecht, doch liessen sich die beiden Hoden und die Eikittdrüsen unterscheiden.”

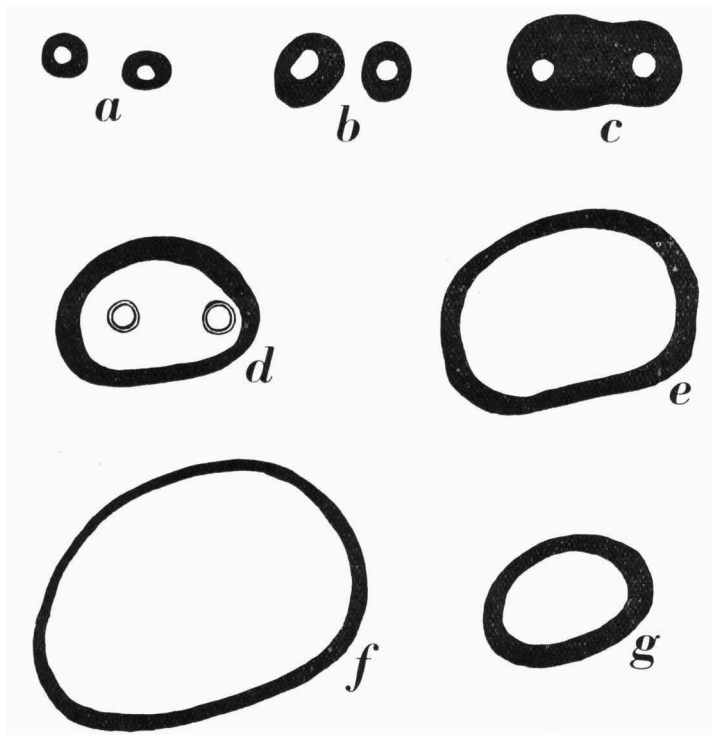
Sacculina plana Boschma 1933 a.Type specimen on *Grapsus strigosus* (Herbst).

Fig. 69. *Sacculina plana*. Transverse sections of the male genital organs; posterior end at the upper side of the figures. $\times 45$.

Type-locality: Takao, South Formosa.

Description: Male genital organs in the posterior part of the body, outside the visceral mass. Testes completely united, forming together one more or less globular testis, into which the vasa deferentia pass more or less abruptly. The vasa deferentia are comparatively narrow. Colleteric glands more or less flattened, with numerous canals (about 50 in longitudinal sections of the most strongly divided region). External cuticle of the mantle without distinct excrescences; its surface smooth or slightly irregular, not divided into small areas. Internal cuticle of the mantle with retinacula which are more or less evenly distributed on its surface. Each retinaculum consists of a feebly developed basal part and a single spindle. The latter is not barbed and on an average has a length of 18 μ .

Sections of the male genital organs of the type specimen (cf. Boschma, 1933 a, fig. 36 and 37) are represented in fig. 69. The vasa deferentia,

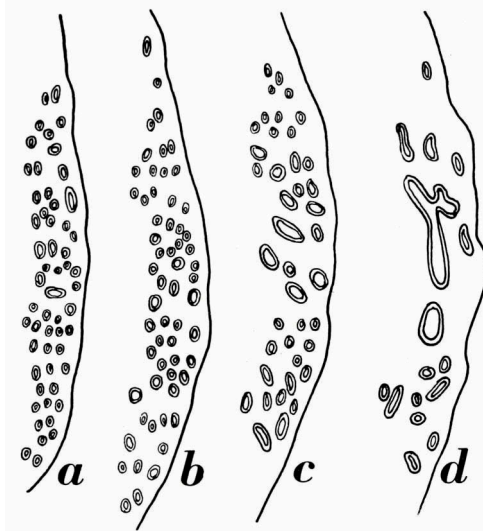


Fig. 70. *Sacculina plana*. Longitudinal sections of one of the colleteric glands; posterior end at the upper side of the figures. $\times 60$.

which are rather narrow, unite in their dorsal part, but their cavities remain separated (fig. 69 c). In this region the inner wall of the cavities obtains a layer of chitin, these chitinous tubes pass through the wall of the testis and penetrate for a small distance into its cavity (fig. 69 d). The greater part of the united male genital organs is a wide sac of more or less globular shape (fig. 69 d—g). Fig. 36 of the cited paper corresponds with fig. 69 f of the present paper, fig. 37 of the cited paper with fig. 69 c of the present paper.

Sections of another specimen (Boschma, 1933 a, fig. 38 and 39) show a similar structure of the male genital organs. The two vasa deferentia do not pass here into the common testis at the same level, but at slight distances from each other (l.c., fig. 39 b and e; the canal possesses here a layer of chitin, which is not drawn in the figures).

The colleteric glands of the type specimen (fig. 70) contain a well developed system of branched canals, which form a rather flattened group,

but the canals are not arranged in rows. Fig. 70 d represents the canal system of a section of the median part of the gland, corresponding more or less with the region of fig. 36 in the paper cited above. Each other section (fig. 70 c, b, a) is from a more peripheral region.

* **Sacculina pomum** Kossmann 1872.

Type specimen on *Chlorodopsis areolata* (M.-Edw.).

Type-locality: Manila, Philippine Islands.

Kossmann (1872, p. 31; 1874, p. 127) gives the following description (characters of shape and size omitted):

“Die Cuticula ist ein wenig rauh; der Mantel des mir vorliegenden Exemplares war ganz bedeckt von Diatomeen. Die Verwachsung des Mantels mit dem Körper geht vorn weit herunter, hinten bis zur Mantelöffnung. Über die Lage der Ovarialöffnungen und Eikittdrüsen kann ich keine Auskunft geben. Die männlichen Sexualorgane bestehen aus einem unpaaren Hoden von cylindrischer Form mit doppeltem Ausführungsgange. Der Körper ist stark seitlich zusammengedrückt.”

* **Sacculina priei** Giard 1887.

Type specimen on *Liocarcinus puber* (L.).

Type-locality: Atlantic coast of France.

Giard considered this parasite as a distinct species on account of his theory of specificity of the parasites. The anatomical characters of this form are unknown; probably it is identical with *Sacculina carcini*.

Sacculina pulchella Boschma 1933 b.

Type specimen on *Huena proteus* de Haan.

Type-locality: Seychelles, Western Indian Ocean, 61 m.

Description: Male genital organs in the posterior part of the body, outside the visceral mass, completely separated. Testes more or less globular, rather abruptly passing into the narrow vasa deferentia. Colleteric glands with a moderate number of canals (about 20 canals in longitudinal sections of the most strongly divided region); the canals not arranged in distinct rows. External cuticle of the mantle covered with excrescences which consist of a kind of chitin differing from that of the main layers. These excrescences are short papillae with numerous spines at their top and with a small number of root-like expansions at their bases. The height of the excrescences varies from 12 to 18 μ . Retinacula unknown.

The vasa deferentia (fig. 71 a) are narrow, their dorsal part contains a distinct chitinous inner wall; this latter part is connected with the testes (fig. 71 b, c). The two testes are of approximately equal size and shape, one proceeds somewhat farther in a dorsal direction than the other (fig. 71 e).

Longitudinal sections of the median region of the colleteric glands contain a few large canals only (fig. 71 i). Towards the peripheral region the canals

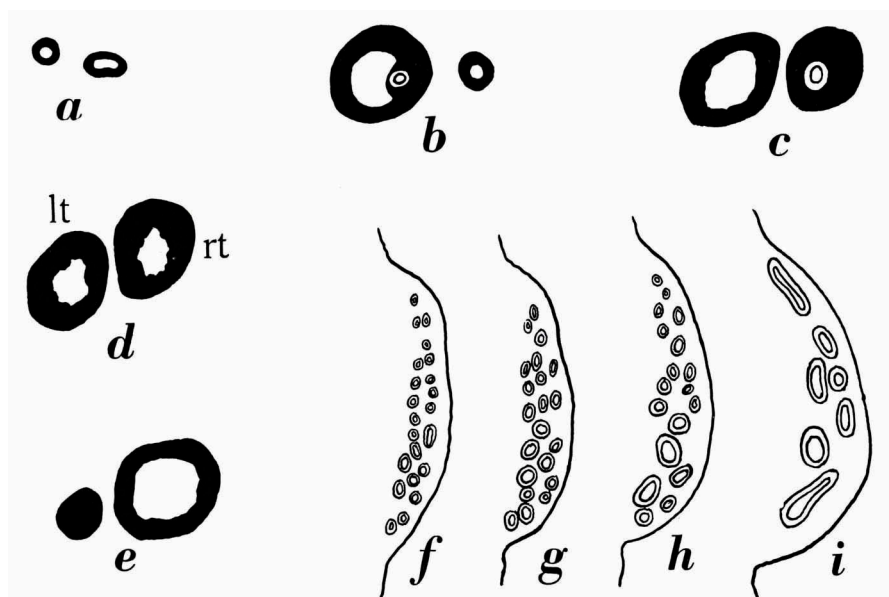


Fig. 71. *Sacculina pulchella*. a-e, transverse sections of the male genital organs. f-i, longitudinal sections of one of the colleteric glands. Posterior end at the upper side of the figures. lt, left testis; rt, right testis. a-e, $\times 60$; f-i, $\times 107$.

divide into smaller branches (fig. 71 h, g, f). The type specimen of *Sacculina pulchella* has colleteric glands with well developed chitinous tubes, these only and the surface of the visceral mass are drawn in the figures.

Sacculina punctata Boschma 1934 a.

Type specimen on *Plagusia dentipes* de Haan.

Type-locality: Kaseda, Satuma, Japan.

Description: Male genital organs for their greater part in the posterior part of the body, outside the visceral mass, completely separated. Testes more or less globular, rather abruptly passing into the wide vasa deferentia. Colleteric glands with numerous canals (more than 100 in longitudinal

sections of the most strongly divided region). External cuticle of the mantle without distinct excrescences, smooth, or covered with small roundish papillae, or provided with irregular outgrowths which give it a more or less ragged appearance. Surface of the external cuticle with distinct little areas which have a diameter varying from 7 to 18 μ . Generally in these areas there is a central column consisting of hyaline chitin differing in structure from that of its surroundings. Internal cuticle of the mantle

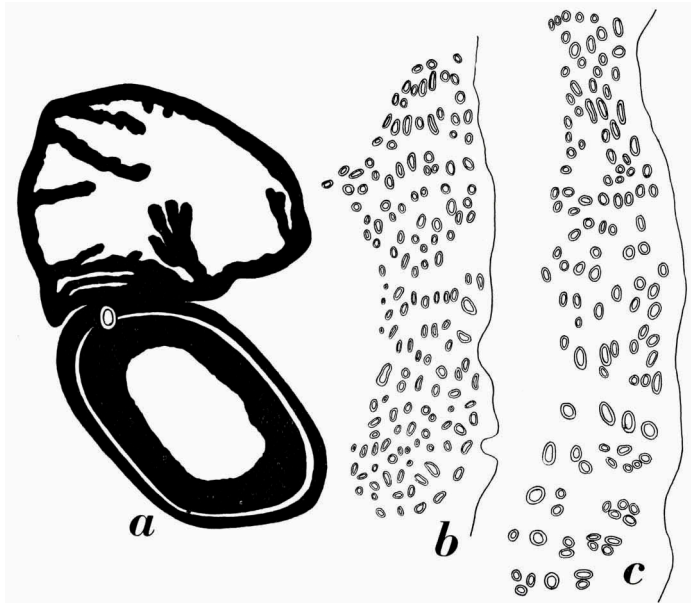


Fig. 72. *Saccolina punctata*. a, transverse section of one of the male genital organs. b, c, longitudinal sections of one of the colleteric glands. Posterior end at the upper side of the figures. $\times 30$.

with numerous retinacula, arranged in rows on its surface. Each retinaculum consists of a single spindle which has a length of 7 to 12 μ .

Figures of longitudinal sections containing parts of the male genital organs are given in a previous paper (Boschma, 1934 a, fig. 1). These figures show that the testes almost completely are found in the posterior part of the body, outside the visceral mass, the ventral part of the vasa deferentia in the visceral mass. The wide vasa deferentia extend dorsally behind the ventral part of the testes (l.c., fig. 1 b; fig. 72 a of the present paper, which is from approximately the same region). Between the testes and the vasa deferentia there is a narrow canal with a chitinous wall which

connects the two parts of the male organs; this canal is visible slightly to the left of the centre of fig. 72 a; it is not represented in fig. 1 of the cited paper. The inner wall of the vasa deferentia bears a number of ridges of irregular shape; the testes are surrounded by distinct muscular sheaths. The cavities of the testes are wide, slightly wider than those of the vasa deferentia.

The colleteric glands (fig. 72 b, c) are slightly flattened. They contain numerous canals which are more or less evenly, not very crowdedly, distributed in the glands. The section of which the chitinous tubes are drawn in fig. 72 b is from a more peripheral region than that of fig. 72 c.

* ***Sacculina purpurea*** Müller 1862.

= *Peltogaster purpureus* (Müller).

Sacculina pustulata Boschma 1925.

Type specimen on *Hemus cristulipes* A. M.-Edw.

Type-locality: Spanish Water, Curaçao.

Description: Male genital organs in the posterior part of the body, outside the visceral mass, completely separated. One of the testes well developed, more or less globular, rather abruptly passing into its vas

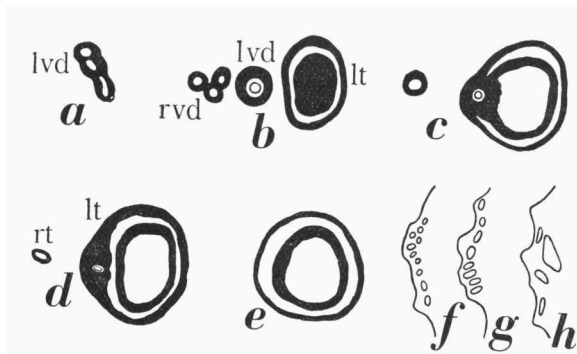


Fig. 73. *Sacculina pustulata*. a-e, transverse sections of the male genital organs. f-h, longitudinal sections of one of the colleteric glands. Posterior end at the upper side of the figures. lt, left testis; lvd, left vas deferens; rt, right testis (or terminal part of the right male genital organ); rvd, right vas deferens. $\times 53$.

deferens, the other testis rudimentary. Vasa deferentia narrow, rather tortuous. Colleteric glands with few canals (about 10 in longitudinal sections of the most strongly divided region), the canals not distinctly arranged in a row parallel to the surface of the visceral mass.

External cuticle of the mantle without excrescences, its surface divided into more or less circular areas which are separated by small grooves. The diameter of these areas is 12 to 16 μ . Retinacula unknown.

A section of the ventral region of one of the vasa deferentia (that of

the large testis) is shown in fig. 73 a. It is slightly tortuous. A more dorsal section of the male genital organs (fig. 73 b) shows the terminal region of the other vas deferens (at the left), the dorsal part of the vas deferens of the large testis (in the centre), and the ventral part of the large testis, surrounded by its muscular sheath (at the right). The vas deferens of the large testis possesses here a distinct layer of chitin on its inner wall. In the next figures (fig. 73 c, d) the narrow chitinous tube is seen passing the muscular sheath of the large testis, the other male genital organ (at the left of the figures) is visible as a narrow canal, which soon terminates. Fig. 73 e represents a section of the large testis in a more dorsal region.

The small colleteric glands (fig. 73 f—h) contain few canals only. They are not distinctly arranged in a row parallel to the surface of the visceral mass. In the type specimen the colleteric glands do not contain chitin, in the figures the inner walls of the canals are drawn only.

Sacculina rathbuni Boschma 1933 b.

Type specimen on *Arachnopsis filipes* Stimp.

Type-locality: "Grampus", Stat. 5076 (west coast of Florida).

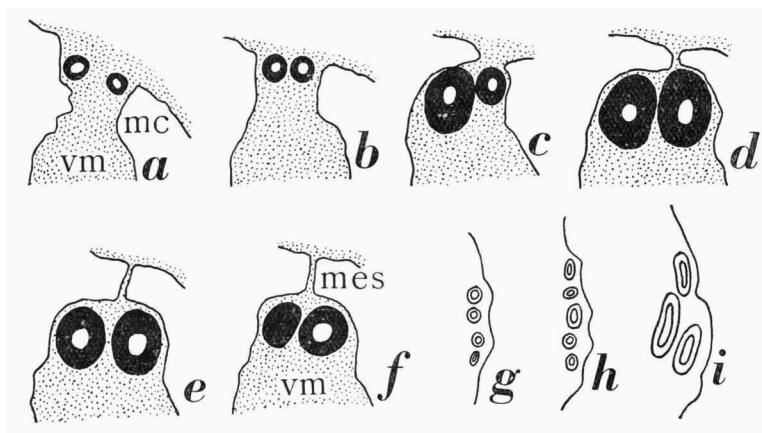


Fig. 74. *Sacculina rathbuni*. a-f, parts of longitudinal sections, containing transverse sections of the male genital organs. g-i, longitudinal sections of one of the colleteric glands. Posterior end at the upper side of the figures. mc, mantle cavity; mes, mesentery; vm, visceral mass. a-f, $\times 45$; g-i, $\times 80$.

Description: Male genital organs in the visceral mass, completely separated. Testes more or less cylindrical, gradually passing into the comparatively narrow deferentia. Colleteric glands with few canals only (less than 10 in longitudinal sections of the most strongly divided region), the canals

neatly arranged in one row parallel to the surface of the visceral mass. External cuticle of the mantle without excrescences, very thin (thickness from 3 to 6 μ). Retinacula unknown.

The male genital organs (fig. 74 a—f) have approximately the same shape and size, they consist of more or less straight tubes which towards their dorsal region gradually increase in size.

The colleteric glands of the type specimen contain distinct chitinous tubes (fig. 74 g—i; g is from the peripheral region, i not far from the median part, and h from an intermediate region).

* ***Pachybdella rathkei*** Diesing 1850.

= *Sacculina carcini* Thomps.

Sacculina reniformis Boschma 1933 b.

Type specimen on *Podochela riisei* Stimp.

Type-locality: "Fish Hawk", Sta. 7351 (off Cape Sable, Florida), 6.5 m.

Description: Male genital organs in the posterior part of the body, outside the visceral mass, dorsal parts largely united. Testes more or less cylindrical, gradually passing into the comparatively narrow vasa deferentia. Colleteric glands with a small number of canals (10—15 in longitudinal sections of the most strongly divided region), the canals not arranged in distinct rows. External cuticle of the mantle with small pointed papillae which have a length of 3 to 9 μ . They consist of approximately the same kind of chitin as that of the main layers, and do not possess lateral hairs. Retinacula unknown.

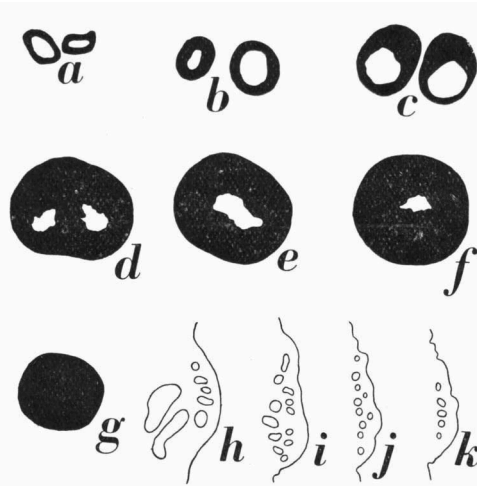


Fig. 75. *Sacculina reniformis*. a-g, transverse sections of the male genital organs. h-k, longitudinal sections of one of the colleteric glands. Posterior end at the upper side of the figures. a-g, $\times 30$; h-k, $\times 53$.

outside the visceral mass, dorsal parts largely united. Testes more or less cylindrical, gradually passing into the comparatively narrow vasa deferentia. Colleteric glands with a small number of canals (10—15 in longitudinal sections of the most strongly divided region), the canals not arranged in distinct rows. External cuticle of the mantle with small pointed papillae which have a length of 3 to 9 μ . They consist of approximately the same kind of chitin as that of the main layers, and do not possess lateral hairs. Retinacula unknown.

The male genital organs do not show a region in which the cavities possess a layer of chitin on their inner wall, so that the exact region of transition of the testes into the vasa deferentia cannot easily be determined. The vasa deferentia are narrow in

their ventral part (fig. 75 a). Towards the dorsal region the organs increase in size especially by thickening of their walls (fig. 75 b, c). Gradually the two male organs unite, at first their cavities remain separated (fig. 75 d), but soon these unite too (fig. 75 e, f), so that the dorsal part of the two united testes consists of a single tube with an undivided cavity. The extreme dorsal part of the united testes is shown in fig. 75 g; here too no indication is found of the double origin.

The colleteric glands (fig. 75 h—k) protrude slightly above the surface of the visceral mass. They contain a small number of canals, which in the median region (fig. 75 h) are much wider than in the peripheral parts (fig. 75 j, k). In the type specimen no chitinous tubes are found in the colleteric glands, the drawings represent the inner walls of the canals.

***Sacculina rotundata* Miers 1880.**

Type specimen on *Eriphia laevimana* Latr.

Type-locality: Malaysia.

Besides particulars on the shape and size of the animal and remarks on the mantle and the mantle opening Miers (1880, p. 470/471) gives the following description of the type specimen:

"I cannot identify it with any of the numerous described species; but as I have not had the opportunity of comparing it with any of Kossmann's types, it is with much hesitation that I regard it as distinct.

In most particulars this species is very nearly allied to *S. corculum*, Kossmann (l.c. p. 122, pl. V. fig. 1), parasitic on *Atergatis floridus* from the Philippines. It differs chiefly in the transverse oval, not cordiform shape of the sac. The integument is armed with numerous minute spicules, which are most abundant and conspicuous near the distal opening, but quite imperceptible except under the microscope. They seem to be rooted in the cellular tissue, beneath the outer cuticle, and furthermore differ from the spinules of *S. corculum*, and more nearly resemble the infracuticular spicules of *S. crucifera*, Kossmann, in being very slender, not broader at base; their apices are somewhat blunt. Such, at least, is the form of the spicules taken from the vicinity of the distal opening of the sac (Pl. XV. fig. 19)."

Van Kampen and Boschma (1925) regarded *Sacculina rotundata* as a synonym of *Sacculina pilosa*. Boschma (1931 c) united under the name *Sacculina rotundata* several parasites on different hosts from the "Siboga" Expedition. This undoubtedly was wrong. The following is based on specimens of *Sacculina rotundata* on *Eriphia laevimana* only:

Description: Male genital organs in the posterior part of the body, outside

the visceral mass, completely separated. Testes more or less globular, rather abruptly passing into the comparatively wide vasa deferentia. Colleteric glands with a large number of canals (more than 50 in longitudinal sections of the most strongly divided region). External cuticle of the mantle with groups of hyaline spines, consisting of a kind of chitin which is different from that of the main layers of this cuticle. The groups generally consist of more than 10 spines each, exceptionally of compounds of 3 to 4. The spines of each group are united on a common, well developed basal part, they are not united on distinct branches, but take their origin from the basal part more or less independently. The spines of the excrescences as a rule are longer than 60μ , the excrescences as a whole vary in length from 80 to 150μ . Retinacula unknown, probably not occurring.

A study of the specific characters of *Sacculina rotundata* was published some time ago (Boschma, 1936 a).

Sacculina rugosa Van Kampen and Boschma 1925.

Type specimen on *Cryptodromia bullifera* Alc.

Type-locality: Sailus ketjil, Paternoster Islands, East Indies.

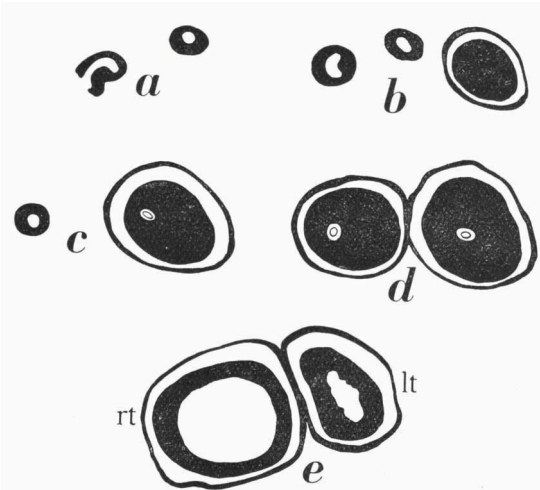


Fig. 76. *Sacculina rugosa*. Transverse sections of the male genital organs; posterior part at the upper side of the figures. lt, left testis; rt, right testis. $\times 53$.

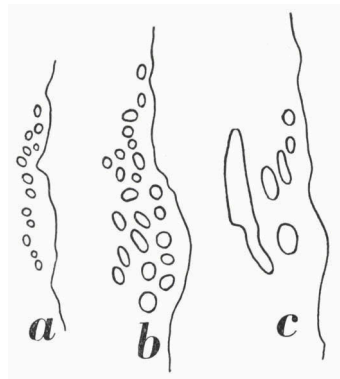


Fig. 77. *Sacculina rugosa*. Longitudinal sections of one of the colleteric glands; posterior end at the upper side of the figures. $\times 80$.

Description: Male genital organs in the posterior part of the body, outside the visceral mass, completely separated. Testes more or less globular, rather abruptly passing into the vasa deferentia, which are comparatively

narrow. Testes not conspicuously differing in size, at about equal distances from the dorsal region. Colleteric glands with a moderate number of canals (less than 30 in longitudinal sections of the most strongly divided region). External cuticle of the mantle consisting of one kind of chitin only; its surface without distinct excrescences, but slightly uneven and wrinkled. Internal cuticle of the mantle with retinacula which possess a single barbed spindle only. The length of these spindles is 12μ approximately.

Fig. 76 a shows one of the male genital openings and the ventral part of the vas deferens of the other side of the body. In fig. 76 b next to the two vasa deferentia the ventral part of one of the testes is seen. The narrow chitinous canals, which form the transition of the vasa deferentia into the testes, are visible in fig. 76 c and d; they traverse here the ventral wall of the testes. A farther dorsal section through the two testes is represented in fig. 76 e, each of the two testes has a wide cavity and is surrounded by a muscular layer.

The colleteric glands are inconspicuous; they contain a moderate number of canals. In the type specimen these canals do not contain chitin, so that in the figures (fig. 77 a—c) the inner walls of the canals are drawn only. Fig. 77 a is after a section from the peripheral part, fig 77 c after one from the median region, fig. 77 b after a section more or less intermediate between these two.

Sacculina scabra Boschma 1931 c.

Type specimen on *Thalamita investigatoris* Alc.

Type-locality: Pulu Sebangkatan, Borneo-Bank.

Description: Male genital organs in the visceral mass, their median parts largely united. Testes more or less cylindrical, gradually passing into the vasa deferentia, which, at least in their ventral part, are comparatively narrow. Dorsal extremities of the testes distinctly separated. Colleteric glands with a moderate number of canals (about 20 in transverse sections of the most strongly divided region). External cuticle of the mantle consisting of one kind of chitin only, its surface more or less rough and uneven but without distinct excrescences. Retinacula unknown.

From the only available specimen a series of transverse sections was made so that the male genital organs had to be examined as longitudinal sections (fig. 78 a—i). Fig. 78 i and h show the two male genital openings and the ventral parts of the vasa deferentia. These canals are comparatively narrow and very little tortuous, towards their dorsal ends they open into spacious sacs, which are widely communicating. The dorsal ends of these sacs are separated by a septum (fig. 78 e—i, at the right side of the

figures); the same occurs in the ventral end of the wide cavity (fig. 78 e—i, at the left side of the figures). The dorsal end of one of the testes is directed in a slightly anterior way (fig. 78 d—f, at the extreme right of the figures); the other testis is smaller and points more or less straight in

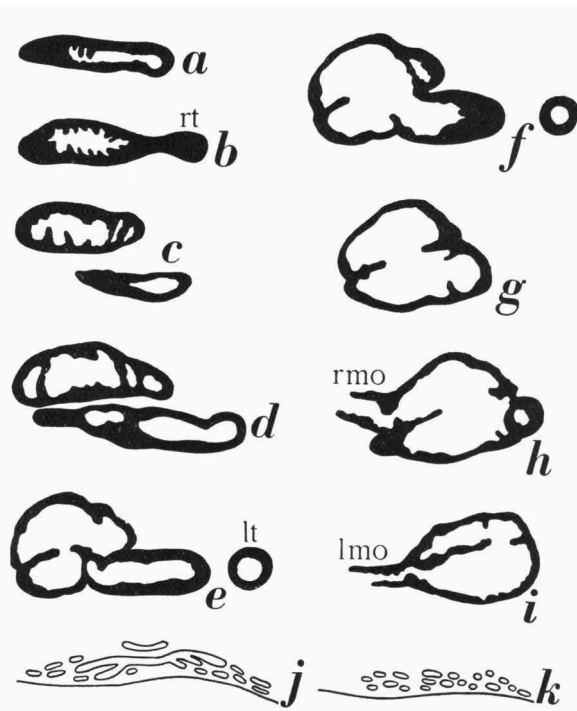


Fig. 78. *Sacculina scabra*. a-i, longitudinal sections of the male organs (a, from the extreme posterior region; i, from the extreme anterior region); ventral part at the left side of the figures. j, k, transverse sections of one of the colleteric glands. lmo, left male genital opening; lt, left testis; rmo, right male genital opening; rt, right testis. $\times 30$.

a dorsal direction (fig. 78 a, b, at the extreme right of the figures). In its posterior part the common wide cavity of the male genital organs becomes divided into two separate parts, one to the right and one to the left (fig. 78 d); the walls of these two cavities possess a number of ridges (fig. 78 d, c, b). The posterior region of the larger male genital organ is visible in fig. 78 c (in the lower part of the figure); the posterior region of the smaller male genital organ is seen in fig. 78 a. As there is not a region in which the cavities of the male genital organs are covered internally with chitin the exact region

of transition of the testes into the vasa deferentia is not easily to be determined: the wide sac may represent the common ventral part of the testes or the common dorsal part of the vasa deferentia.

A transverse section of the median region of one of the colleteric glands (fig. 78 j) shows a number of comparatively large canals; towards the periphery of the glands these canals become smaller and larger in number (fig. 78 k). In the type specimen the canals do not contain chitin, in the drawings the inner walls of the canals are represented.

Saccolina schmitti Boschma 1933 b.Type specimen on *Anomalothir furcillatus* (Stimp.).

Type-locality: "Albatross", Stat. 2401 (Gulf of Mexico).

Description: Male genital organs in the posterior part of the body, out-

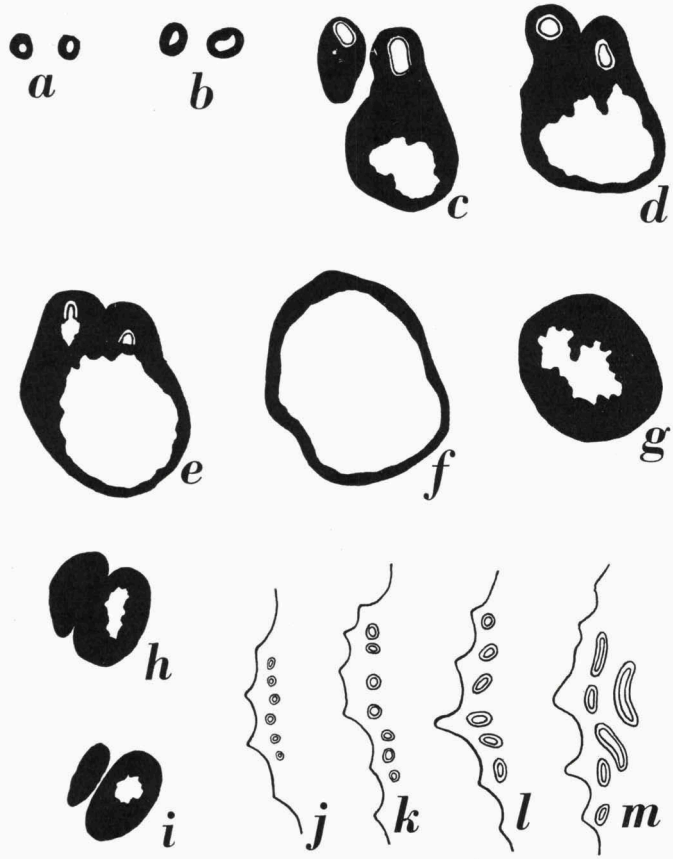


Fig. 79. *Saccolina schmitti*. a-i, transverse sections of the male genital organs. j-m, longitudinal sections of one of the colleteric glands. Posterior end at the upper side of the figures.

a-i, $\times 45$; j-m, $\times 80$.

side the visceral mass. Testes almost completely united, their extreme dorsal parts separated. Testes more or less globular, rather abruptly passing into the narrow vasa deferentia. Colleteric glands with a small number of canals (less than 10 in longitudinal sections of the most strongly divided part); the canals arranged in one row parallel to the surface of the visceral mass.

External cuticle without excrescences, its surface smooth or slightly irregular. Retinacula unknown.

The vasa deferentia (fig. 79 a, b) are narrow canals, which in their extreme dorsal part possess a distinct internal layer of chitin. At the posterior region of the ventral part of the testes the vasa deferentia unite with them (fig. 70 c—e) and the cavities of the vasa deferentia soon communicate with that of the common testis. The cavity of the two united testes is rather wide (fig. 79 e, f), towards the dorsal region this cavity becomes narrower (fig. 79 g). The extreme dorsal extremities of the testes are separated (fig. 79 h, i).

The colleteric glands (fig. 79 j—m) are flat, small organs, which contain a few canals only. The canals are arranged practically in one row parallel to the surface of the visceral mass; from the median region (fig. 79 m) towards the periphery (fig. 79 j) the canals gradually become narrower. In the type specimen the canals of the colleteric glands contain distinct chitinous tubes.

Sacculina semistriata Van Kampen and Boschma 1925.

Type specimen on *Conchoecetes andamanicus* Alc.

Type-locality: "Siboga" Expedition, Stat. 164 (south of Salawati).

Description: Male genital organs in the posterior part of the body, outside the visceral mass, completely separated. Testes more or less globular, rather abruptly passing into the comparatively narrow vasa deferentia. Colleteric glands with a small number of canals (10 to 15 in longitudinal sections of the most strongly divided part). Anterior part of the external cuticle of the mantle with distinct folds. The cuticle bears here excrescences of a hyaline kind of chitin, differing in structure from that of the main layers. The excrescences consist of a basal part with an irregularly sinuous contour, in the centre of which there is a single conical papilla with a blunt top. Posterior part of the external cuticle with conical papillae which consist of approximately the same kind of chitin as that of the main layers. Retinacula unknown.

The two testes have approximately the same size and shape, one (fig. 80 c) lies somewhat nearer to the ventral region than the other (fig. 80 e). The more or less straight, narrow vasa deferentia (fig. 80 a, b) are connected with the testes by narrow canals with well developed chitinous inner walls (fig. 80 c—e). Each testis is surrounded by a muscular sheath.

The colleteric glands are small and contain few canals only. The canals are not arranged in rows parallel to the surface of the visceral mass. In the type specimen the colleteric glands do not contain chitin.

In a previous paper (Van Kampen and Boschma, 1925, Plate III fig. 3) a longitudinal section of *Sacculina semistriata* is drawn. Here the

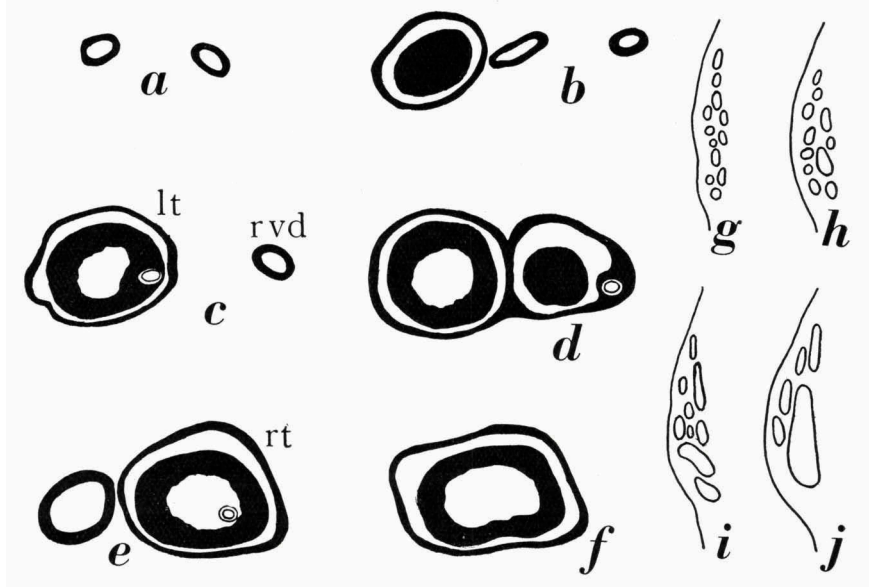


Fig. 80. *Sacculina semistriata*. a-f, transverse sections of the male genital organs. g-j, longitudinal sections of one of the colleteric glands. Posterior end at the upper side of the figures. lt, left testis; rt, right testis; rvd, right vas deferens. $\times 80$.

epithelium of the canals of the colleteric glands is drawn as a double line. The figure is from a region of the body corresponding more or less with the section of fig. 80 c of the present paper.

Sacculina senta Boschma 1933 b.

Type specimen on *Brachynotus sanguineus* (de Haan).

Type-locality: Rikuoku, Japan.

Description: Male genital organs in the posterior part of the body, outside the visceral mass, partially close together, but their cavities completely separated. Testes more or less globular, rather abruptly passing into the comparatively narrow vasa deferentia. Colleteric glands with a large number of canals (about 50 canals in longitudinal sections of the most strongly divided region). External cuticle of the mantle with excrescences which consist of approximately the same kind of chitin as that of the main layers. These excrescences are small papillae which possess numerous stiff little spines. The spines occur on the apices of the papillae only and diverge in

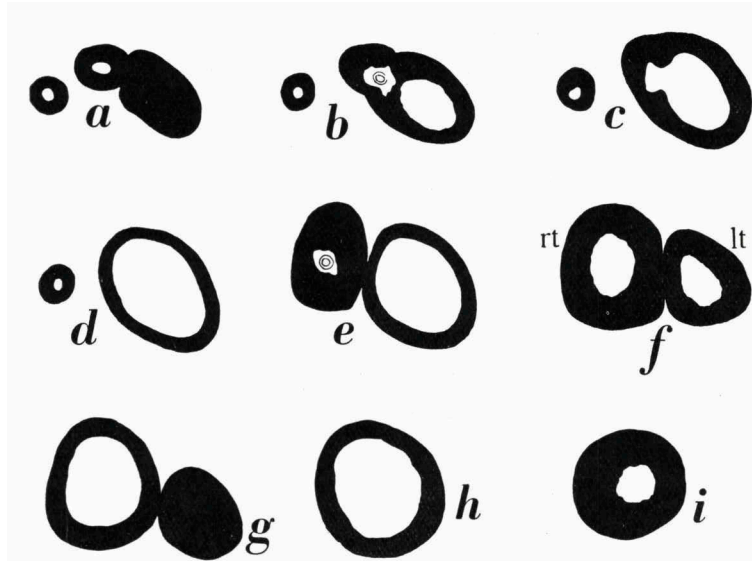


Fig. 81. *Sacculina senta*. Transverse sections of the male genital organs; posterior end at the upper side of the figures. lt, left testis; rt, right testes. $\times 30$.

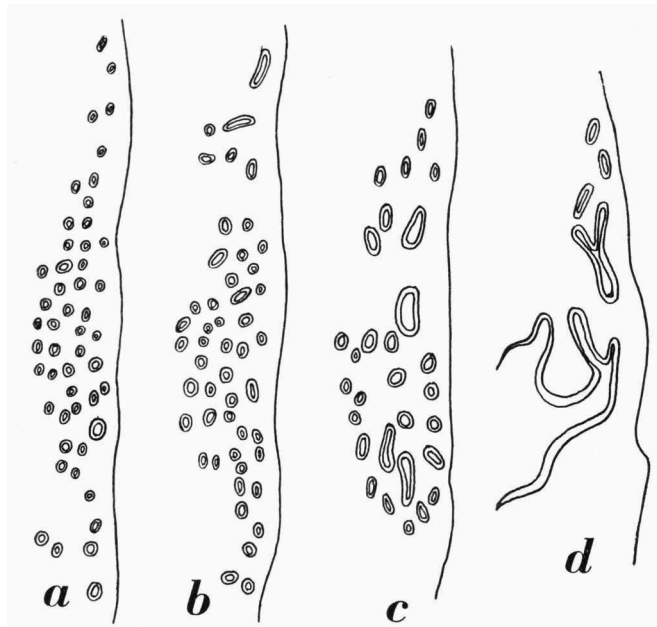


Fig. 82. *Sacculina senta*. Longitudinal sections of one of the colleteric glands; posterior end at the upper side of the figures. $\times 60$.

lateral directions. The papillae do not possess a central cavity; the spines are long in comparison to the diameter of the papillae. The length of the excrescences varies between 3 and 8 μ , the spines may attain a length of 8 μ . Internal cuticle of the mantle with numerous retinacula, consisting of single spindles which have a length of approximately 13 μ . The retinacula are more or less evenly distributed on the surface of the internal cuticle.

The testes are of approximately equal shape and size; one (fig. 81 a—d) lies slightly nearer to the ventral region than the other (fig. 81 h, i). The vasa deferentia are narrow, more or less straight canals, they communicate with the testes by means of narrow chitinous tubes (fig. 81 b, e). Partially the two testes are found close together (fig. 81 e—g); they are not tightly united and their cavities remain completely separated.

The colleteric glands are comparatively flat; they contain numerous canals, which are not arranged in rows. Fig. 82 d represents the canal system in a median longitudinal section of one of the glands; in the lower part of the figure the atrium is visible, widely opening towards the ovary. The other sections (fig. 82 c, b, a) each are from a more peripheral part of the gland. The chitinous tubes of the canal system are drawn only.

Saccolina setosa Van Kampen and Boschma 1925.

Type specimen on *Xanthias lamarcki* (H. M.-Edw.).

Type-locality: Talaud Islands, East Indies.

Description: Male genital organs in the posterior part of the body, outside the visceral mass. Testes partially united, their cavities largely communicating. Testes more or less globular, rather abruptly passing into the comparatively narrow vasa deferentia. Colleteric glands with a moderate number of canals (20 to 30 canals in longitudinal sections of the most strongly divided region). External cuticle with excrescences consisting of approximately the same kind of chitin as that of the main layers. These excrescences form a dense covering of the upper surface of the cuticle, they consist of long slender hairs which do not possess minute lateral hairs and have a length of 70 μ approximately. Internal cuticle of the mantle with retinacula which are composed of a basal part and about 8 spindles. The latter have a length of 13 μ approximately.

The vasa deferentia are narrow canals (fig. 83 a); in their dorsal region they have a well developed layer of chitin on their inner wall (fig. 83 b). The ventral part of each vas deferens is united with the dorsal region of its testis (fig. 83 c—e); the narrow chitinous tube protrudes rather far into the cavity of its testis (fig. 83 e, in the right half of the figure; fig. 83 f, in the left half of the figure). For their greater part the two testes are in

close contact (fig. 83 e—h); in one region the common wall of the two testes is incomplete, so that the cavities widely communicate (fig. 83 f, g).

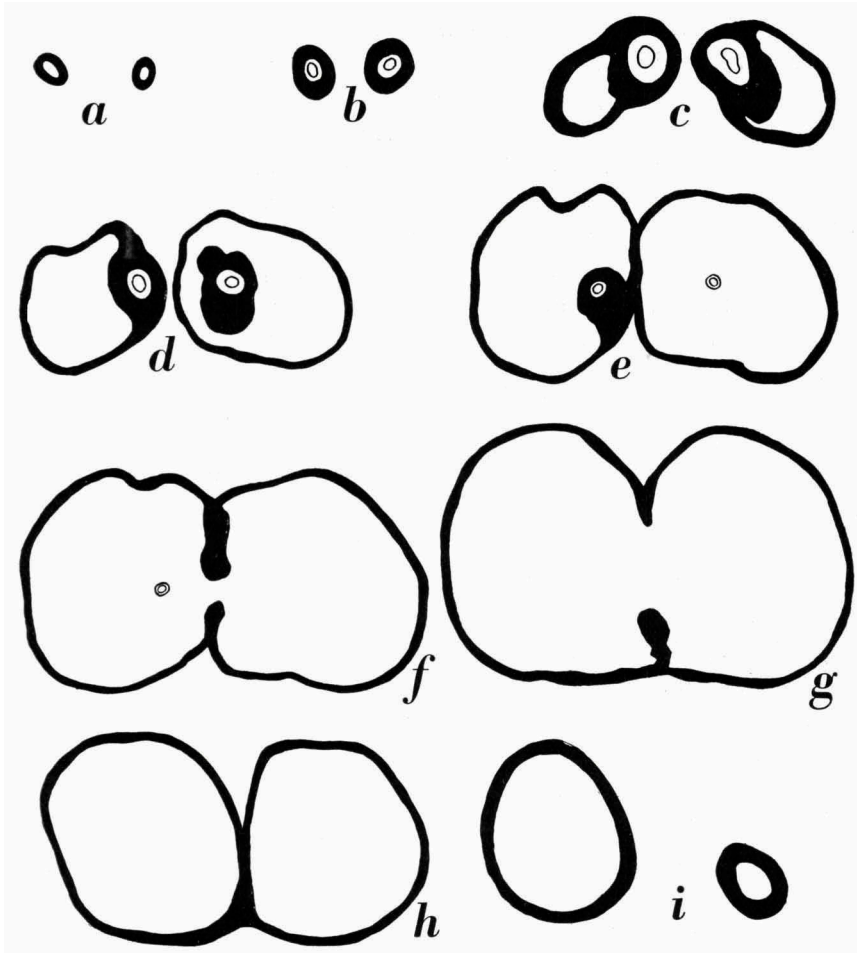


Fig. 83. *Sacculina setosa*. Transverse sections of the male genital organs; posterior end at the upper side of the figures. $\times 30$.

The dorsal extremities of the two testes are completely separated (fig. 83 i). The testes have a rather wide lumen and a comparatively thin wall.

More or less median sections of the colleteric glands (fig. 84 c) contain a few large canals only. Towards the periphery the canal system becomes more strongly divided (fig. 84 b, a). The number of canals is not very large

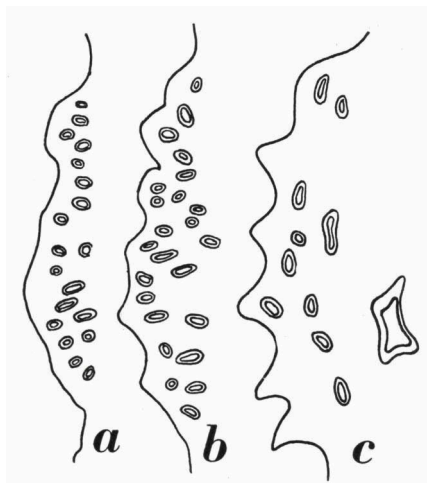


Fig. 84. *Sacculina setosa*. Longitudinal sections of one of the colleteric glands; posterior end at the upper side of the figures. $\times 80$.

(less than 30 in longitudinal sections of the most strongly divided region).

In the type specimen the chitin of the canals is well developed.

* ***Sacculina similis*** Giard and Bonnier 1887.

Type specimen on *Liocarcinus arcuatus* (Leach).

Type-locality: Concarneau, Atlantic coast of France.

The parasite of *Liocarcinus arcuatus* was considered as a distinct species on account of Giard's theory of specificity of the parasites. The anatomy of this parasite now is known (Boschma, 1933 a), and it could be proven that the form is identical with *Sacculina carcini*.

Sacculina sinensis Boschma 1933 a.

Type specimen on *Xanthodius exaratus* (M.-Edw.).

Type-locality: Hongkong, China.

Description: Male genital organs in the visceral mass, completely separated. Testes more or less globular, rather abruptly passing into the comparatively wide vasa deferentia. Colleteric glands with a moderate number of canals (20 to 30 in longitudinal sections of the most strongly divided region). External cuticle of the mantle with excrescences which consist of approximately the same kind of chitin as that of the main layers of this cuticle. These excrescences are slender hairs which are rather sparsely distributed on the surface of the cuticle; they do not possess

minute lateral hairs and vary in length between 10 and 30 μ . Retinacula unknown.

The vasa deferentia are, except in their extreme dorsal part, wide; their cavities are rather irregular as a result of numerous ridges on the inner walls (fig. 85 a, b). In their dorsal region the vasa deferentia pass into the narrow canals which connect them with the testes, these canals have

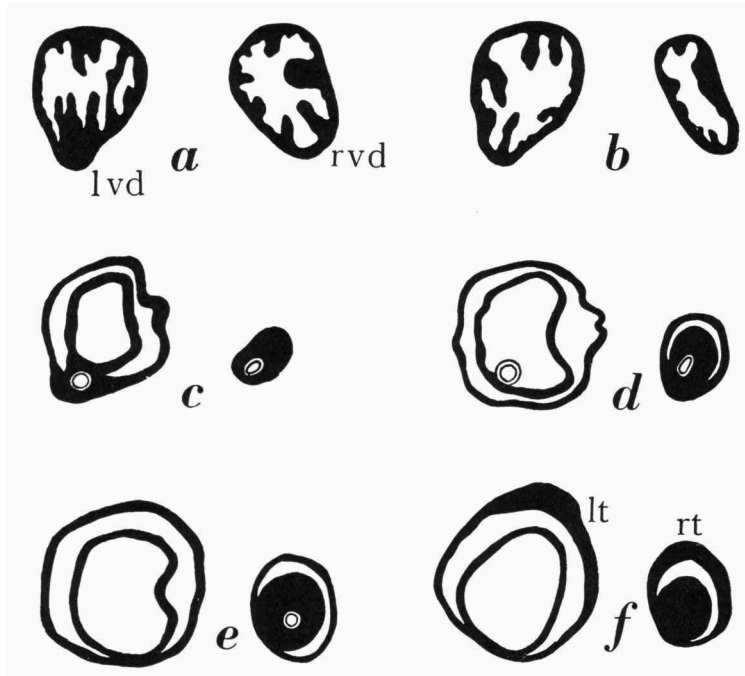


Fig. 85. *Sacculina sinensis*. Transverse sections of the male genital organs; posterior end at the upper side of the figures. lt, left testis; lvd, left vas deferens; rt, right testis; rvd, right vas deferens. $\times 45$.

a distinct layer of chitin on their inner wall (fig. 85 c—e). Each of the testes is surrounded by a muscular sheath.

In the type specimen (fig. 85 and Boschma, 1933 a, fig. 13; the latter figure corresponds with fig. 85 e of the present paper) one of the testes has a wide cavity, the other forms a solid mass. The same occurs in the other specimen from which longitudinal sections have been made.

Fig. 86 shows four longitudinal sections of one of the colleteric glands of the type specimen; fig. 86 a is from the peripheral part, each following section from a more medial region. The canals of the glands of the type specimen do not contain chitin, so that the inner walls of the canals are

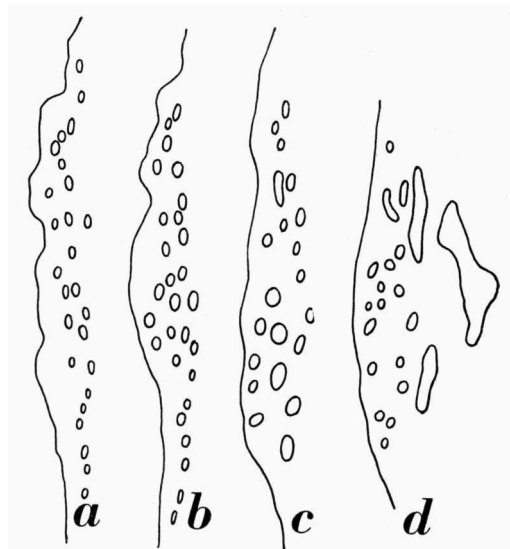


Fig. 86. *Sacculina sinensis*. Longitudinal sections of one of the colleteric glands; posterior end at the upper side of the figures. $\times 80$.

drawn with single lines. The colleteric glands of *Sacculina sinensis* are comparatively flat, but the canals are not arranged in rows parallel to the surface of the visceral mass.

* *Sacculina* sp. dub. Metzger 1891.

= *Drepanorchis neglecta* (Fraisse).

Sacculina spinosa Van Kampen and Boschma 1925.

Type specimen on *Actaea hystrix* Miers.

Type-locality: "Siboga" Expedition, Stat. 274, Aru Islands, 57 m.

The following description is based on the characters of the type specimen only. It is not certain that the specimens on *Pleistacantha sancti-johannis* Miers from Japan and on *Heteropanope hilarulus* (de Man) from the Kei Islands (cf. Boschma, 1931 a, p. 333—339) which were identified as *Sacculina spinosa*, really belong to this species. Moreover it is not absolutely certain that the type specimen in every respect is a characteristic representative of the species: its mantle cavity contained a large Bopyrid, so that especially the colleteric glands may be in a more or less reduced state.

Description: Male genital organs in the posterior part of the body, outside the visceral mass, completely separated. Testes of approximately

equal size, more or less globular, rather abruptly passing into the comparatively narrow vasa deferentia. Colleteric glands with a small number of canals (about 10 in longitudinal sections of the most strongly divided region); the canals are more or less, but not completely, arranged in a single row parallel to the surface of the visceral mass. External cuticle of the mantle with excrescences which consist of approximately the same kind of chitin as

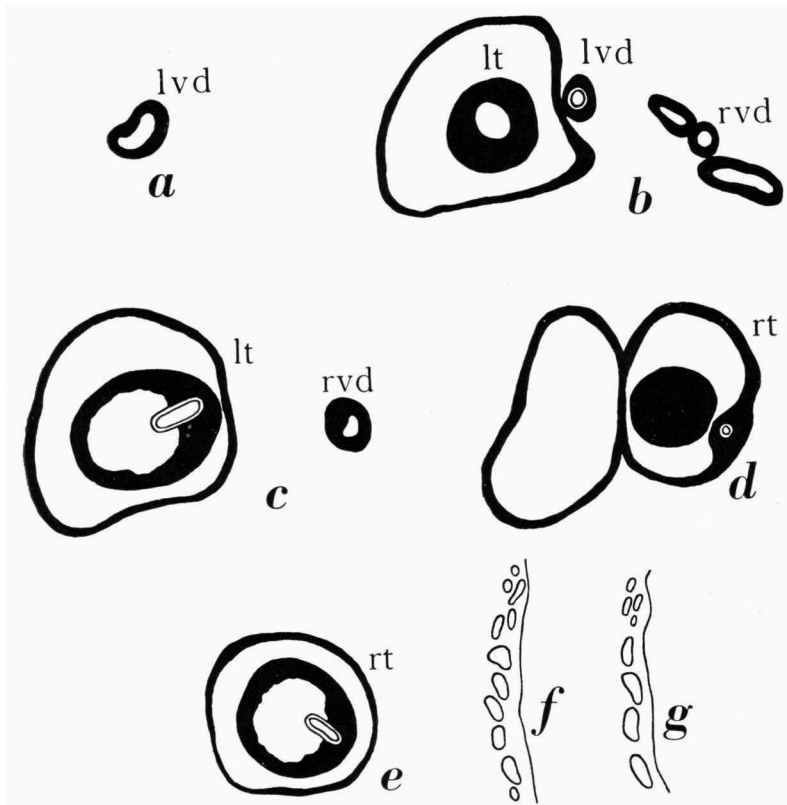


Fig. 87. *Sacculina spinosa*. a-e, transverse sections of the male genital organs. f, g, longitudinal sections of one of the colleteric glands. Posterior end at the upper side of the figures. lt, left testis; lvd, left vas deferens; rt, right testis; rvd, right vas deferens. $\times 80$.

that of the main layers. These excrescences are hairs or spines with more or less swollen basal parts, they possess, especially in their basal parts, a number of sharp, stiff little lateral spines. The excrescences have a length of 25 to 30 μ . Retinacula unknown.

Fig. 87 a shows the ventral part of one of the vasa deferentia (the other vas deferens does not extend as far towards the ventral region). In fig.

87 b this vas deferens is visible next to the muscular sheath of its testis, from the latter the ventral region is visible, it has already a distinct cavity. At the right side of the same figure the slightly tortuous ventral part of the other vas deferens is seen. In fig. 87 c the most ventral vas deferens is penetrating the wall of its testis, as in the previous figure this canal possesses a distinct layer of chitin. At the right side the vas deferens of the other male genital organ is visible. In fig. 87 d this vas deferens passes through the muscular sheath of its testis, which as yet has not a cavity as it is seen in its most ventral part. The other testis does not extend as far dorsally, its muscular sheath only is visible in this section (at the left side of the figure). Fig. 87 e represents a section of the most dorsal testis in the region in which the narrow canal with its chitinous wall (the extreme dorsal part of the vas deferens) passes through the wall of the testis.

Two sections of one of the colleteric glands are given in fig. 87 f and g. As the colleteric glands of the type specimen of *Sacculina spinosa* do not contain chitin the inner walls of the canals are drawn only.

* ***Sacculina stenorhynchi*** Malm 1881.

= *Drepanorchis neglecta* (Fraisse).

Sacculina striata Boschma 1931 a.

Type specimen on *Calocarcinus africanus* Calman.

Type-locality: Danish Expedition to the Kei Islands, Stat. 59, 385 m.

Description: Male genital organs in the visceral mass, partially united, their dorsal extremities separated and at some distance from the mesentery. Testes more or less cylindrical, gradually passing into the comparatively narrow vasa deferentia. Inner walls of the male genital organs without ridges. Colleteric glands with rather few canals (less than 20 canals in longitudinal sections of the most strongly divided region). External cuticle of the mantle with excrescences which consist of approximately the same kind of chitin as that of the main layers. These excrescences are short papillae which bear a variable number of minute spines. The height of the papillae varies from 3 to 9 μ , the spines have a length of 3 to 8 μ approximately. Retinacula unknown.

Fig. 88 shows a number of sections of the male genital organs, from the ventral region (fig. 88 a) to the dorsal part (fig. 88 k). One of these sections (fig. 88 f) corresponds with a figure in a previous paper (Boschma, 1931 a, fig. 12 a), another (fig. 88 k) with fig. 12 b of the cited paper. This figure 12 b shows how the dorsal extremities of the testes are found at a considerable distance from the mesentery: the male genital organs which

are running in a ventro-dorsal direction to a certain amount are bent in an anterior direction.

The vasa deferentia are narrow, more or less straight canals (fig. 88 a, b). Gradually the two vasa deferentia become close together (fig. 88 c) and soon the two male genital organs are united (fig. 88 d, e). At first there are two cavities separated by a median septum, but in a slightly farther dorsal region this septum disappears so that the united male genital organs have a single cavity (fig. 88 f). Farther towards the dorsal region the

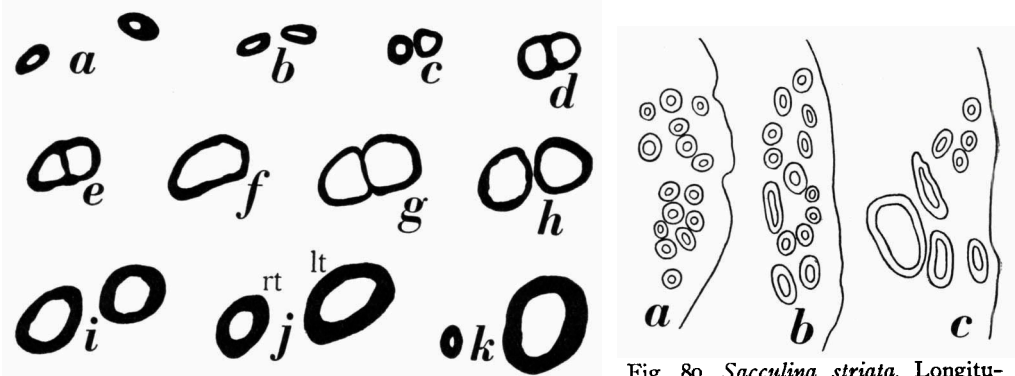


Fig. 88. *Sacculina striata*. Transverse sections of the male genital organs; posterior end at the upper side of the figures. lt, left testis; rt, right testis. $\times 30$.

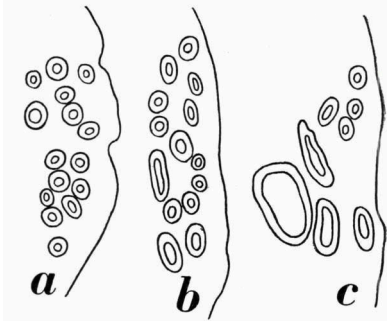


Fig. 89. *Sacculina striata*. Longitudinal sections of one of the colleteric glands; posterior end at the upper side of the figures. $\times 107$.

septum appears again (fig. 88 g) and gradually the two male genital organs become completely separated (fig. 88 h). In the dorsal region of the body the extremities of the two testes are more widely separated (fig. 88 i—k). The male genital organs gradually increase in size from the ventral to the dorsal region of the visceral mass, the exact place of transition of the testes into the vasa deferentia is not easily to be determined, as there does not occur here a region with a chitinous inner wall. One of the testes is of a somewhat larger size than the other (fig. 88 j, k).

The colleteric glands contain a small, compact group of canals, which in the type specimen possess well developed chitinous tubes. Fig. 89 c is drawn after a longitudinal section from the median region, fig. 89 b and a are from more peripheral regions.

Sacculina sulcata Van Kampen and Boschma 1925.

Type specimen on *Ethusa (Ethusina) gracilipes* Miers var. *robusta* Miers.
Type-locality: "Siboga" Expedition, Stat. 88 (Makassar Strait).

Description: Male genital organs in the posterior part of the body, out-

side the visceral mass, completely separated. Testes more or less globular, rather abruptly passing into the comparatively narrow vasa deferentia. Colleteric glands with few canals (between 10 and 20 in transverse sections of the most strongly divided region). External cuticle of the mantle without excrescences, its surface somewhat granular or uneven. This cuticle is composed of more or less prismatic columns which consist of two different kinds of chitin. The central part of the columns is composed of a hyaline kind of chitin, the peripheral part of the columns consists of chitin of a more opaque kind, the latter is built of layers parallel to the surface of the mantle. The hyaline central parts of the columns extend through the whole of the cuticle, from the basal region to the surface. Retinacula unknown.

The type specimen is transversely sectioned. Some of the sections contain longitudinal sections of almost the whole of the male genital organs. Such a section is figured in a previous paper (Boschma, 1931 c, fig. 32) and in fig. 90 a of the present paper. In the upper part of fig. 90 a one of the testes is visible with its muscular sheath (at the right) and a part of its vas deferens (at the left). In the lower part of the same figure the other testis is seen with the narrow chitinous canal, which forms the dorsal end of the vas deferens, passing through the wall of the testis. To the left of this testis the rather tortuous vas deferens is visible with its genital opening (at the extreme left of the figure). The figure shows that the testes are more or less globular, passing abruptly in the short, narrow, tortuous vasa deferentia.

The colleteric glands (fig. 90 b, c) contain a small number of canals. In the type specimen these canals have well developed chitinous tubes. The number of canals cannot be directly compared to that in other species of the genus as they are visible here in transverse sections.

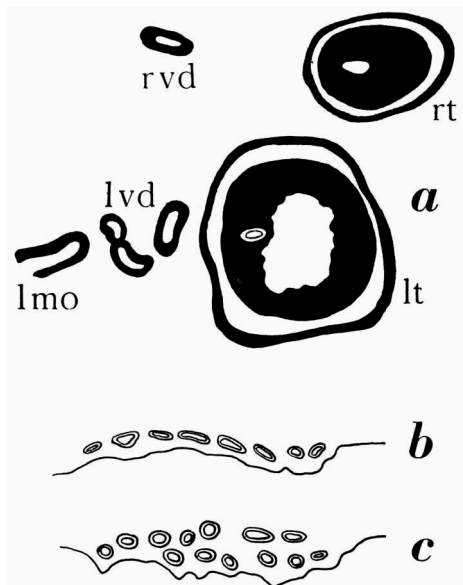


Fig. 90. *Sacculina sulcata*. a, longitudinal section of the male genital organs, ventral end at the left side of the figure. b, c, transverse sections of one of the colleteric glands. lmo, left male genital opening; lt, left testis; lvd, left vas deferens; rt, right testis; rvd, right vas deferens. $\times 80$.

Sacculina teres Boschma 1933 a.

Type specimen on *Notopoides latus* (Henderson).

Type-locality: Kei Islands, East Indies.

Description: Male genital organs in the posterior part of the body, outside the visceral mass, completely separated. Testes more or less globular, rather abruptly passing into the comparatively narrow vasa deferentia.

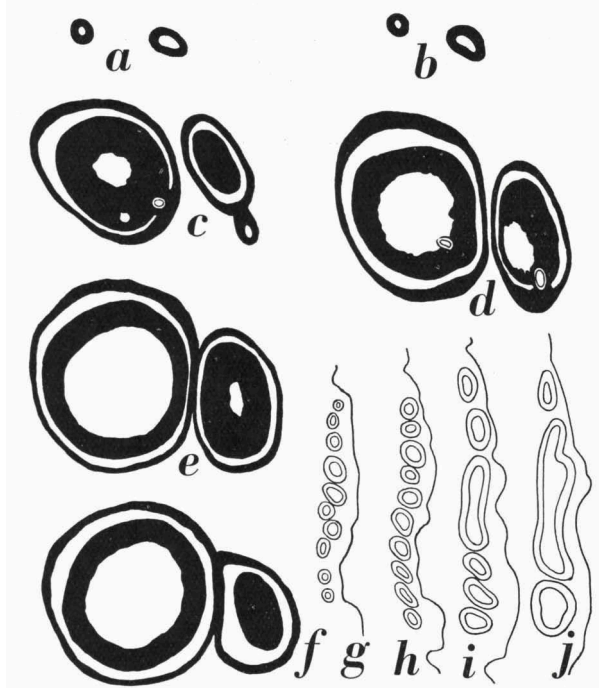


Fig. 91. *Sacculina teres*. a-f, transverse sections of the male genital organs. g-j, longitudinal sections of one of the colleteric glands. Posterior end at the upper side of the figures. $\times 30$.

Colleteric glands with few canals (about 10 in longitudinal sections of the most strongly divided region); the canals neatly arranged in one row parallel to the surface of the visceral mass. External cuticle with excrescences which consist of approximately the same kind of chitin as that of the main layers. These excrescences are more or less elongate papillae with blunt extremities. At these extremities they possess a number of minute spines. At the centre of each papilla there is a small pit which opens at the top. The papillae may attain a height of 20μ ; their diameter varies between 6 and 12μ . Retinacula unknown.

The vasa deferentia are narrow, more or less straight tubes (fig. 91 a, b). The inner wall of their dorsal region is covered with a distinct layer of chitin; this chitinous canal passes through the muscular sheath and the wall of each testis (fig. 91 c, d). One of the testes (at the left side of the figures) is somewhat larger than the other; in other respects they do not show striking differences. In their dorsal region the two testes are close together, so that their muscular sheaths are united (fig. 91 e, f); the cavities of the two testes remain completely separated.

The canals of the colleteric glands are arranged practically in one row parallel to the surface of the visceral mass (fig. 91 g—j). In the type specimen the chitinous tubes of the canals are well developed. The canals decrease in size from the median part (fig. 91 j) towards the periphery of the glands (fig. 91 g).

The figures of *Sacculina teres* in a previous paper (Boschma, 1933 a, fig. 33 and 34) correspond with fig. 91 e and h of the present paper.

Sacculina teretiuscula Boschma 1931 a.

Type specimen on *Scalopidia spinosipes* Stimp.

Type-locality: off Koh Chang (Siam), ca. 36 m.

Description: Male genital organs in the visceral mass, partially close together, but their cavities completely separated. Testes more or less globular, rather abruptly passing into the wide vasa deferentia. Colleteric glands with a moderate number of canals (20 to 30 in longitudinal sections of the most strongly divided region). External cuticle of the mantle with excrescences which consist of approximately the same kind of chitin as that of the main layers. The excrescences are small papillae which are covered with numerous minute lateral hairs, they have a length of 4 to 8 μ . Retinacula unknown.

Fig. 92 a shows the terminal part of one of the vasa deferentia with its genital opening (at the left of the figure) and the ventral part of the other vas deferens. The two vasa deferentia are in close contact, separated by their united median walls only. Especially in one of the vasa deferentia there are numerous ridges on the inner wall, so that the cavity has become rather irregular. Fig. 92 b represents a section of the middle part of one vas deferens (left side of the figure) and the dorsal region of the other (right half of the figure). In the latter the cavity is divided into many small divisions by ridges on its inner wall. Moreover here the narrow chitinous canal is visible which forms the transition between the testis and the vas deferens. Fig. 92 c shows the corresponding region of the other vas deferens (left half of the figure) and (in the right half of the figure) the

testis of the other side of the body, surrounded by its muscular sheath. In fig. 92 d, which is from a farther dorsal region, sections of the two testes are represented, both with their muscular sheaths. One of the testes has a wide cavity, the other is solid. This may be due to the more or less immature

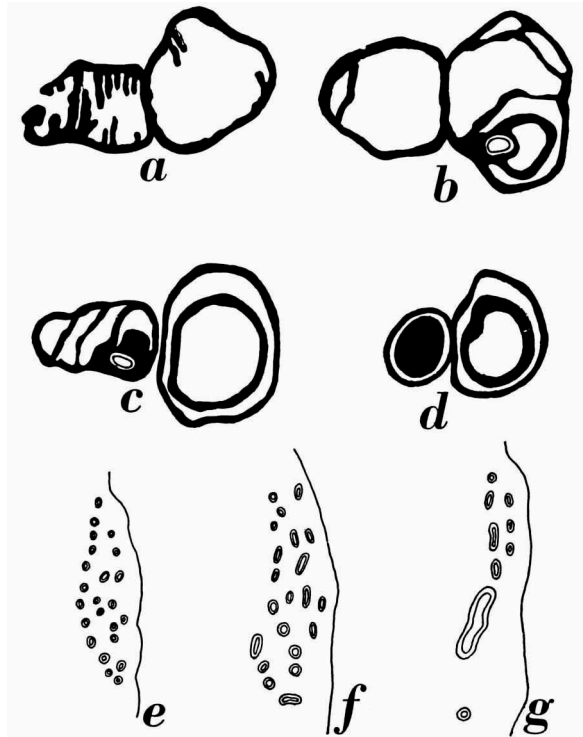


Fig. 92. *Sacculina teretiuscula*. a-d, transverse sections of the male genital organs. e-g, longitudinal sections of one of the colleteric glands. Posterior end at the upper side of the figures. a-d, $\times 45$; e-g, $\times 80$.

state of the specimen (the external cuticle of the mantle is still covered by another layer, cf. Boschma, 1931 a, fig. 18 a).

The colleteric glands contain a moderate number of comparatively narrow canals (fig. 92 e—g). In the type specimen these canals possess well developed chitinous tubes. Fig. 92 e represents a section of the peripheral region, fig. 92 f one from a more median part, and fig. 92 g one from a still more median region of one of the colleteric glands.

* ***Sacculina tessellata*** Boschma 1925.
= *Heterosaccus tessellatus* (Boschma).

* **Sacculina triangularis** Anderson 1862.

Type specimen on *Cancer pagurus* (L.).

Type-locality: Firth of Forth, Scotland.

Anderson (1862) remarked already that the testes of this parasite are found in the immediate neighbourhood of the stalk. He moreover showed that the comparatively narrow vasa deferentia abruptly pass into the more or less globular testes, and that there is a horny substance in the centre of the part where vas deferens and testis meet (this is the thick cuticular inner wall of the most dorsal region of the vas deferens).

Some years ago (Boschma, 1931 b) I could show that *Sacculina triangularis* is a synonym of *Sacculina inflata*.

Sacculina vankampeni Boschma 1931 c.

Type specimen on *Ozius rugulosus* Stimp.

Type-locality: Humboldt bay (North New Guinea).

Description: Male genital organs in the posterior part of the body, outside the visceral mass, completely separated. Testes more or less globular, rather abruptly passing into the comparatively wide vasa deferentia. Colleteric glands with few canals (about 10 in longitudinal sections of the most strongly divided region); the canals arranged practically in a single row parallel to the surface of the visceral mass. External cuticle of the mantle with excrescences consisting of a hyaline kind of chitin, different from that of the main layers of this cuticle. Each excrescence is composed of a small number of spines which in their basal region are united into a common foot. The spines are not combined into branches: each spine arises more or less independently from the common basal part. As a rule the spines are longer than 18μ ; the excrescences as a whole vary in length from 25 to 55μ . The spines may possess minute lateral hairs. Retinacula unknown.

Sacculina verrucosa Van Kampen and Boschma 1925.

Type specimen on *Achaeus cadelli* Alc.

Type-locality: Labuan Badjo, Flores, East Indies.

Description: Male genital organs in the posterior part of the body, outside the visceral mass, completely separated. Testes more or less cylindrical, gradually passing into the vasa deferentia, which are comparatively narrow. Colleteric glands with few canals (less than 10 in longitudinal sections of the most strongly divided region). External cuticle of the mantle with excrescences which consist of approximately the same kind of chitin as

that of the main layers. These excrescences are small papillae which possess numerous minute spines: the papillae have a length of $7\ \mu$ approximately. Retinacula unknown.

A figure of a longitudinal section showing the testes is found in a previous paper (Van Kampen and Boschma, 1925, Pl. II fig. 5). In this paper already attention was drawn to the extremely small size of the male

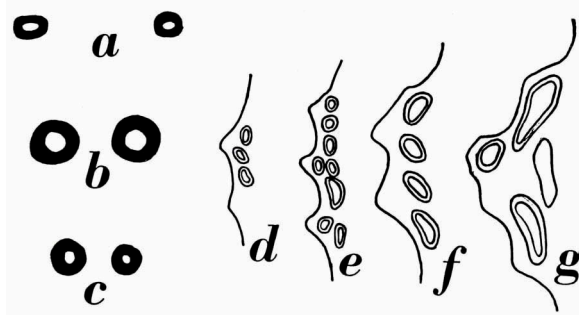


Fig. 93. *Sacculina verrucosa*. a-c, transverse sections of the male genital organs. d-g, longitudinal sections of one of the colleteric glands. Posterior end at the upper side of the figures. $\times 80$.

genital organs (l.c., p. 44). Three sections of these organs are shown in fig. 93 a—c; one of these (fig. 93 a) is from the ventral region, the second (fig. 93 b) from the middle part, and the third (fig. 93 c) from the dorsal region. The region of transition of the testes into the vasa deferentia is not easily to be determined, as the inner walls of the male organs do not contain chitin.

The colleteric glands (fig. 93 d—g) are small and contain a few canals only. These are not arranged in a distinct row parallel to the surface of the visceral mass. In the type specimen the canals contain distinct chitinous tubes.

Sacculina vieta Boschma 1933 b.

Type specimen on *Actaea savignyi* (M.-Edw.).

Type-locality: Seychelles, Western Indian Ocean, 56 m.

Description: Male genital organs in the posterior part of the body, outside the visceral mass, completely separated. Testes of approximately equal size, more or less globular, rather abruptly passing into the comparatively narrow vasa deferentia. Colleteric glands more or less flattened, with a small number of canals (about 10 in transverse sections of the most strongly divided region). External cuticle of the mantle about $50\ \mu$ thick; its surface

covered with excrescences which consist of approximately the same kind of chitin as that of the main layers. These excrescences are slender hairs which have a length of 20 to 30 μ and on the whole of their surface bear minute lateral hairs. Retinacula unknown.

The type specimen has been sectioned transversely, so that the male genital organs had to be examined in longitudinal sections. Fig. 94 c represents a section from the anterior part of the male organs, it shows the two narrow vasa deferentia which are slightly tortuous. Fig. 94 b is from a section which is somewhat farther in posterior direction, it shows the dorsal extremities of the vasa deferentia with their chitinous inner wall. In

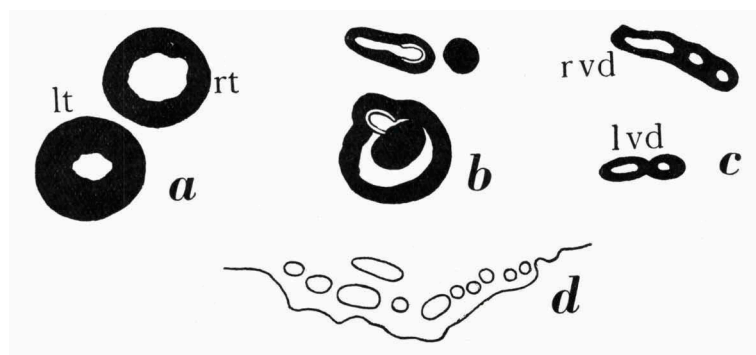


Fig. 94. *Sacculina vieta*. a-c, longitudinal sections of the male genital organs (a, from the posterior region; c, from the extreme anterior part); ventral end at the left side of the figures. d, transverse section of one of the colleteric glands. lt, left testis; lvd, left vas deferens; rt, right testis; rvd, right vas deferens. $\times 45$.

the upper part of this figure the posterior wall of one of the testes is visible (at the right side); in the lower part of the figure the chitinous canal of the other vas deferens is passing into the testis. Fig. 94 a, which is still farther towards the posterior region, shows about median sections of the two testes. The two testes are of approximately equal size; they have a comparatively thick wall.

Fig. 94 d represents a transverse section of the most strongly divided region of one of the colleteric glands. The number of canals is small, they are not distinctly arranged in a row parallel to the surface of the visceral mass. In the type specimen the canals of the colleteric glands do not contain chitin, so that the figure shows the inner walls of the canals.

* ***Sacculina villosa*** Van Kampen and Boschma 1925.

= *Drepanorchis villosa* (V. K. & B.).

Sacculina weberi Boschma 1931 c.

Type specimen on *Atergatis floridus* (L.).

Type-locality: Celebes (?).

Description: Male genital organs in the visceral mass, partially united; dorsal parts of the testes completely separated. Testes more or less cylindrical, gradually passing into the vasa deferentia, which, at least in their ventral part, are comparatively narrow. Parts of the male genital organs with numerous ridges on their inner walls. Colleteric glands with numerous canals (more than 50 in longitudinal sections of the most strongly divided region). External cuticle of the mantle with excrescences which consist of approximately the same kind of chitin as that of the main layers of this cuticle. These excrescences are hairs or elongate papillae, which, especially

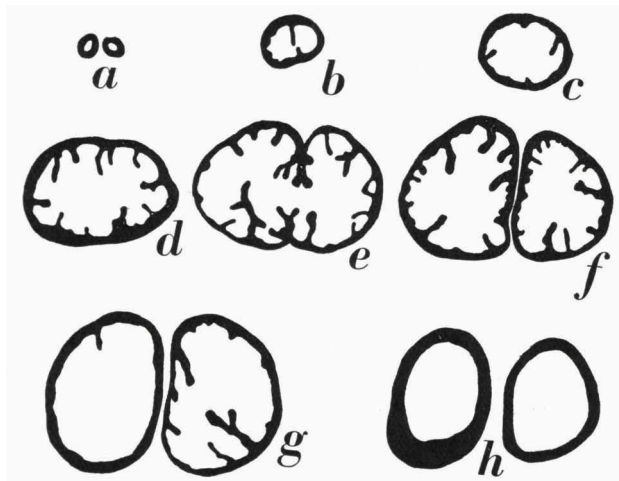


Fig. 95. *Sacculina weberi*. Transverse sections of the male genital organs; posterior end at the upper side of the figures. $\times 30$.

in their basal part, possess some minute lateral stiff spines or hairs. The excrescences have a length of 18μ approximately. Internal cuticle with retinacula consisting of a basal part and 6 to 10 barbed spindles, the latter may reach a length of 16μ .

The vasa deferentia, at least their ventral parts, are narrow canals (fig. 95 a). Soon the two canals unite, at first their cavities are still separated by a septum consisting of their united walls, but this septum becomes incomplete (fig. 95 b) and gradually disappears (fig. 95 c). The united male genital organs increase in size whilst some ridges develop on their inner wall (fig. 95 d). At a more dorsal region the two male genital organs

become separated again (fig. 95 e, f) the ridges on their walls gradually disappear (fig. 95 g) and the walls of the testes become somewhat thicker, especially in the dorsal part of these organs (fig. 95 h). The exact region of transition of the testes into the vasa deferentia is not easily to be determined, as there are no chitinous tubes indicating this region.



Fig. 96. *Sacculina weberi*. Longitudinal sections of one of the colleteric glands; posterior end at the upper side of the figures. $\times 45$.

The two figures in a previous paper showing particulars of the male genital organs (Boschma, 1931 c, fig. 8 a, b) correspond with fig. 95 d and h approximately. In the cited paper fig. 8 a is indicated as a section from the ventral half of the body; this is incorrect: it is a section from the dorsal half of the body.

The colleteric glands of *Sacculina weberi* possess a well developed canal system. Fig. 96 shows five longitudinal sections of one of these glands, fig. 96 a is from the periphery, each following section nearer to the median part, fig. 96 e is an approximately median section. The canals are strongly divided, in fig. 96 b 82 of these canals are visible. In the figures the chitin

of the canals is drawn and the chitinous covering of the visceral mass (the double line at the left of each figure). In fig. 96 e the plug of chitin which closes the female genital opening is seen in the lower half of the figure; in the right half of this figure a part of the atrium is visible.

Sacculina yatsui Boschma 1936 a.

Type specimen on *Pachygrapsus crassipes* Randall.

Type-locality: Misaki, Japan.

Description: Male genital organs in the posterior part of the body, outside the visceral mass, completely separated. Testes more or less globular, rather abruptly passing into the comparatively wide vasa deferentia. Colleteric glands comparatively flat, with a moderate number of canals (20—30 canals in longitudinal sections of the most strongly divided region). External cuticle of the mantle with groups of hyaline spines, consisting of a kind of chitin which is different from that of the main layers of this cuticle. The spines usually are united into compounds of two or a few more, sometimes they remain isolated. When the spines are united their common basal parts are feebly developed. The excrescences vary in length from 30 to 65 μ . Retinacula unknown, probably not occurring.

LITERATURE

- ANDERSON, J., 1862. On the Anatomy of Sacculina, with a Description of the Species. *Ann. Mag. Nat. Hist.* (3), vol. 9.
- BONNIER, J., 1887. Catalogue des Crustacés Malacostracés recueillis dans la Baie de Concarneau. *Bull. Scient. Nord France et Belg.* (2), vol. 10.
- BOSCHMA, H., 1925. Rhizocephala of Curaçao. *Bijdragen tot de Dierkunde*, vol. 25.
- , 1927. Über europäische Formen der Gattung Sacculina. *Zool. Jahrb., Syst.*, vol. 54.
- , 1928. The Rhizocephala of the Leiden Museum. *Zool. Meded.*, vol. 11.
- , 1931 a. Rhizocephala. Papers from Dr. Th. Mortensen's Pacific Expedition 1914—16, LV. *Vidensk. Medd. Dansk naturh. Foren.*, vol. 89.
- , 1931 b. On the Identity of Sacculina triangularis and Sacculina inflata. *Proc. Roy. Soc. Edinburgh*, vol. 51.
- , 1931 c. Die Rhizocephalen der Siboga-Expedition. Supplement. Siboga Exp., monogr. XXXI bis.
- , 1931 d. Rhizocéphales. Résult. Scient. Voy. Ind. Orient. Néerl. de LL. AA. RR. le Prince et la Princesse Léopold de Belgique. *Mém. Mus. Roy. Hist. Nat. Belg.*, hors série, vol. 3.
- , 1933 a. The Rhizocephala in the Collection of the British Museum. *Jour. Linn. Soc., Zool.*, vol. 38.
- , 1933 b. New Species of Sacculinidae in the Collection of the United States National Museum. *Tijdschr. Ned. Dierk. Ver.* (3), vol. 3.
- , 1933 c. On Sacculina gordonii, a new Species of the Genus, parasitic on Atergatis floridus. *Bull. Raffles Mus.*, vol. 8.
- , 1934 a. On Sacculina punctata, a new Species from Japan. *Zool. Meded.*, vol. 17.
- , 1934 b. Rhizocéphales (Supplément). Résult. Scient. Voy. Ind. Orient. Néerl. de LL. AA. RR. le Prince et la Princesse Léopold de Belgique. *Mém. Mus. Roy. Hist. Nat. Belg.*, hors série, vol. 3.
- , 1936 a. The Specific Characters of Sacculina rotundata Miers and Sacculina yatsui nov. spec. *Zool. Meded.*, vol. 19.
- , 1936 b. Sur la Sacculina carpiliae et la Sacculina leptodiae de Guérin-Ganivet. *Bull. Mus. Hist. Nat. Paris* (2), vol. 8.
- , 1936 c. Rhizocephala. Flora en Fauna der Zuiderzee, Supplement.
- DELAGE, Y., 1884. Evolution de la Sacculine (Sacculina carcini Thomps.) Crustacé endoparasite de l'Ordre nouveau des Kentrogonides. *Arch. Zool. Exp. Gén.* (2), vol. 2.
- DIESING, C. M., 1850. *Systema Helminthum*, vol. 1. Vindobonae.
- FRAISSE, P., 1877. Die Gattung Cryptoniscus Fr. Müller. *Inaug.-Diss. Würzburg* (also in: *Arb. zool.-zoot. Inst. Würzburg*, vol. 4, 1878).
- GIARD, A., 1886. De l'Influence de certains Parasites Rhizocéphales sur les Caractères sexuels de leur Hôte. *C. R. Ac. Sc. Paris*, vol. 103.
- , 1887. La Castration Parasitaire et son Influence sur les Caractères extérieurs du Sexe mâle chez les Crustacés Décapodes. *Bull. Scient. Nord France et Belg.* (2), vol. 10.
- , 1888. Le Laboratoire de Wimereux en 1888 (Recherches fauniques). *Bull. Scient. France Belg.* (3), vol. 1.
- GIARD, A., and BONNIER, J., 1887. Contributions à l'Etude des Bopyriens. *Trav. Inst. Zool. Lille et Lab. Zool. Marit. Wimereux*, vol. 5.
- , 1890. Prodrôme d'une Monographie des Epicarides du Golfe de Naples. *Bull. Scient. France Belg.* (4), vol. 1.

- GISSLER, C. F., 1884. The Crab Parasite, *Sacculina*. Amer. Naturalist, vol. 18.
- GRUVEL, A., 1920. Cirrhipèdes provenant des Campagnes scientifiques de S. A. S. le Prince de Monaco (1885—1913). Résult. Camp. Scient. Prince Albert I, fasc. 53.
- GUÉRIN-GANIVET, J., 1911. Contribution à l'Etude systématique et biologique des Rhizocéphales. Trav. Scient. Lab. Zool. et Physiol. Marit. Concarneau, vol. 3.
- HESSE, E., 1867. Observations sur des Crustacés rares ou nouveaux des Côtes de France. 14me article. Description de deux Sacculinidiens, d'un Peltogaster, d'un Polychliniophile et de deux Cryptopodes nouveaux. Ann. Sci. Nat. (5), Zool., vol. 8.
- HOEK, P. P. C., 1878. Carcinologische Aanteekeningen. Bijdrage tot de Kennis der Noordzee-Fauna. Tijdschr. Ned. Dierk. Ver., vol. 3.
- KAMPEN, P. N. VAN, and BOSCHMA, H., 1925. Die Rhizocephalen der Siboga-Expedition. Siboga Exp., monogr. XXXI bis.
- KOSSMANN, R., 1872. Beiträge zur Anatomie der schmarotzenden Rankenfüssler. Inaug.-Diss. Würzburg (also in: Arb. zool.-zoot. Inst. Würzburg, vol. 1. 1874).
- , 1873. Suctoria und Lepadidae. Untersuchungen über die durch Parasitismus hervorgerufenen Umbildungen in der Familie der Pedunculata. Habilitationsschrift, Würzburg (also in: Arb. zool.-zoot. Inst. Würzburg, vol. 1, 1874).
- KRÜGER, P., 1912. Über ostasiatische Rhizocephalen. Abh. math.-phys. Kl. K. Bayer. Ak. Wiss., suppl.-vol. 2.
- LEUCKART, R., 1859. Carcinologisches. Arch. Naturg., 25. Jahrg., vol. 1.
- LILLJEBORG, W., 1859. Les Genres Liriope et Peltogaster, H. Rathke. Nova Acta Reg. Soc. Scient. Upsal. (3), vol. 3.
- MAITLAND, R. T., 1897. Prodrome de la Faune des Pays-Bas et de la Belgique Flamande. Leide.
- MALM, A. W., 1881. Om Cirripeder funna vid Bohusläns Kust. Göteborgs Naturh. Mus. zool. zoot. Afd., 3. Årsskr.
- METZGER, A., 1891. Nachträge zur Fauna von Helgoland. Bemerkungen und Nachträge zu Prof. Dr. K. W. v. Dalla Torre's Schrift „Die Fauna von Helgoland“. Zool. Jahrb., Syst., vol. 5.
- MIERS, E. J., 1880. On a Collection of Crustacea from the Malaysian Region, Part IV. Ann. Mag. Nat. Hist. (5), vol. 5.
- MÜLLER, F., 1862. Die Rhizocephalen, eine neue Gruppe schmarotzender Kruster. Arch. Naturg., 28. Jahrg., vol. 1.
- NORMAN, A. M., and SCOTT, TH., 1906. The Crustacea of Devon and Cornwall. London.
- OKADA, Y. K., and MIYASHITA, Y., 1935. Sacculinization in *Eriocheir japonicus* de Haan, with Remarks on the Occurrence of complete Sex-reversal in parasitized male Crabs. Mem. Coll. Sc. Kyoto Imp. Univ., ser. B, vol. 10.
- PÉREZ, CH., 1920. Le Complexe Ethologique du Spondyle sur les Bancs Perliers du Golfe Persique. C. R. Soc. Biol. Paris, vol. 83.
- POPOV, W., 1929. Rhizocephala and Bopyridae of the Bay of Sevastopol. Trav. Stat. Biol. Sébastopol, vol. 1.
- RATHKE, H., 1843. Beiträge zur Fauna Norwegens. Nova Acta Ac. Caes. Leop. Car. Nat. Cur., vol. 12.
- SMITH, G., 1906. Rhizocephala. Fauna und Flora des Golfes von Neapel, monogr. 29.
- STEBBING, T. R. R., 1893. A History of Crustacea. Recent Malacostraca. Int. Scient. Series, vol. 74.
- THOMPSON, J. V., 1836. Natural History and Metamorphosis of an anomalous crustaceous Parasite of *Carcinus Maenas*, the *Sacculina* *Carcini*. Entomol. Magaz., vol. 3.
- WELTNER, W., 1897. Verzeichnis der bisher beschriebenen recenten Cirripedenarten. Arch. Naturg., Jahrg. 1897, vol. 1.