BIOLOGICAL RESULTS OF THE SNELLIUS EXPEDITION

VIII. SOME RHIZOCEPHALA OF THE GENUS LOXOTHYLACUS

by

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The present paper deals with a number of specimens which belong to different species of the genus *Loxothylacus*. When the collections of the Snellius Expedition were made special care was taken to collect Rhizocephala in large numbers, as the study of individual variation in this group promised interesting results. The present paper contains a few examples of the individual variation of some species, which manifests itself in striking differences. To emphasize the degree of variation the various specimens dealt with here are described at some length, afterwards a discussion is given of the differences among the specimens which are considered as to belong to the same species. It appears that these differences in many cases are enormous. In some specimens which, because they show a common, very peculiar character, are united into one species, there are other characters that are extremely variable, even to such a degree that on account of these characters one is inclined to give the individuals different specific or even generic rank.

Even two of the most typical characters of the genus *Loxothylacus*, viz., the distinctly curved male genital organs and the peculiar attachment of the visceral mass to the mantle (at some distance from the stalk), are not apparent or even absent in some of the specimens dealt with here. This shows that the sharp limit between the genera *Sacculina* and *Loxothylacus* is not as pronounced as previous investigations seemed to prove. Some of the specimens dealt with in the following pages would, if they had been present without any other specimens with partially common characters, have been described as representatives of the genus *Sacculina*.

Smith (1906) created a new genus, *Heterosaccus*, for a species in which the mesentery is lacking, in contradistinction to *Sacculina* which has a complete mesentery, running from the stalk to the mantle opening. All the

species of the genus *Heterosaccus*, which I could study during the course of my work on the group, moreover possess distinctly curved male genital organs, so that the latter character could be regarded as of generic rank, again in contradistinction to *Sacculina* in which the chief course of the male organs is one in a ventro-dorsal direction. When later species were found in which there is a well developed, though incomplete mesentery (not reaching the mantle opening) and which besides have distinctly curved male organs, there was sufficient reason to erect for these species a new genus, *Drepanorchis* (Boschma, 1927). Another difficulty arose when species were found with curved male organs and a complete mesentery. It proved, however, that these species differ from the three genera last mentioned in a peculiar constant character, viz., the attachment of the visceral mass to the mantle at some distance from the stalk, so that the establishment of the genus *Loxothylacus* (Boschma, 1928a) was entirely justified. The twelve species of this genus, described in previous papers, distinctly show the generic characters.

In dealing with the material of the Snellius Expedition I have strictly adhered to one important principle, viz., to unite into one species the various specimens which possess certain important common characters, even when these specimens show individual differences of a pronounced character. An example may illustrate this. The five specimens numbered 722 A, 691 A, 707 B, 707 A, and 767 A are united into one species, chiefly because the excrescences of the external cuticle are of a peculiar type, different from what occurs in all other Sacculinidae: numerous small hairs between which there are sparsely distributed long spines. Moreover the five specimens are from the same locality and they are parasites of the same species of crab (*Chlorodiella nigra* (Forsk.) [1]). The latter fact cannot be regarded as a specific character, it only adds to the probability of their specific identity. But now in these five specimens the male genital organs are of pronouncedly different shapes. In the specimens 722 A and 691 A these organs possess a distinct curve, in the specimens 707 B and 707 A the curve is practically absent, in specimen 767 A it is totally absent. Consequently on account of the shape of the male organs the two former specimens ought to be classified in the genus *Loxothylacus*, the three latter in the genus *Sacculina*. If only the three latter specimens had been available they might have been described as a species of *Sacculina*, for another important character of the

1) Miss A. M. Buitendijk identified the hosts of the parasites. As far as concerns the Xanthidae it is not absolutely certain that all the identifications are correct, even two specimens, belonging to the same species, provisionally must remain unnamed.

genus *Loxothylacus* (the attachment of the visceral mass to the mantle at some distance from the stalk) is not pronounced here. On the other hand in the specimens with distinctly curved male organs the visceral mass is definitely separated from the stalk, so that in every respect they are typical representatives of the genus *Loxothylacus*.

In the present paper the characters of each specimen are described at some length. Afterwards the reasons for uniting a number of specimens into one species are given. In this way the strong individual variation at once becomes apparent.

When founding the genus *Loxothylacus* I indicated *Sacculina corculum* Kossmann as the type species of this genus (Boschma, 1928 a, p. 7). This species indeed shows the generic characters in a strongly pronounced manner: the visceral mass is attached to the mantle at a considerable distance from the stalk, the mesentery is complete, and the male genital organs are distinctly curved. In later papers some other species of the genus were described, so that the number of species now amounts to twelve, the chief particulars of which are given below.

1. *Loxothylacus corculum* (Kossmann, 1872).

Type specimen on *Atergatis floridus* (L.) from Bohol Island, P. I.

Kossmann (1872, p. 27; 1874, p. 123) gives the following description of the cuticular excrescences and the genital organs:

„Die Cuticula des Mantels ist von theilweise ziemlich erheblicher Dicke, namentlich auf der Abdominalseite und am meisten in der Umgebung der Mantelöffnung (0,04—0,1 mm., wobei die Verdickung am Rüssel unberücksichtigt geblieben ist). Ueber die ganze Oberfläche des Mantels verstreut finden sich Dornen, welche, auf der Sternalseite in der Nähe des Mundes fast unmerklich, auf der Abdominalseite, und namentlich in der Gegend der Mantelöffnung eine sehr bedeutende Grösse erreichen (Dicke an der Basis bis zu 0,13 mm., Länge bis zu 0,27 m.). S. Taf. I. Fig. 21. Der Körper ist seitlich comprimirt und symmetrisch (S. Taf. II. Fig. 5 a u. b). Die Verwachsung von Mantel und Körper geht vorn ziemlich weit über den Mund hinaus, hinten bis zur Mantelöffnung. Die Mündungen der Ovarien (*m*) finden sich beiderseits ziemlich in der Mitte der Seitenfläche des Körpers, sind verhältnissmässig gross mit etwas wulstigem Rande, und liegen am hintern Rande der etwas zweilappigen Eikittdrüse (*d*). Die paarigen kugligen Hoden (*g*) liegen fast in der Mitte des Körpers, etwas dorsal von den Eikittdrüsen, doch nicht oberflächlich, wie diese. Ihre Ausführungsgänge ziehen in grossem Bogen, zunächst gegen den Rücken bis an den Mantel, dann gegen den Mund hin und etwas über ihn hinaus, wo

sie, ein wenig central vom Munde, in die Bruthöhle münden. Das Lumen der Ausführungsgänge ist spiralig; in einer Anschwellung der letzteren da, wo sie den Mantel erreichen, sind die Windungen am dichtesten."

The following description is based on a specimen of the Siboga Expedition, like the type a parasite of *Atergatis floridus* (L.):

Male genital organs of about equal size and shape, strongly curved, running in a wide arch along the mesentery, their terminal parts in the anterior half of the visceral mass. Colleteric glands with a comparatively large quantity of branched canals. External cuticle with conical excrescenses of large size, about 100 to 500 μ long 75 to 175 μ thick (in their basal part). Retinacula with 8 to 12 spindles of a length of about 18 μ.

2. *Loxothylacus carinatus* (Kossmann, 1872).

Type specimen on "*Lupea* sp. aff. *L. hastatae*" (*Neptunus* spec.?) from Lapinig Canal, P. I.

Kossmann (1872, p. 32; 1874, p. 128) describes the species as follows (particulars of shape and size omitted):

„Die Cuticula ist es nächst dem Grössenverhältnisse, welche diese Sacculina von der dentata unterscheidet. Sie ist so eigenthümlich, dass eine Verwechslung unmöglich ist, denn sie trägt auf der ganzen Manteloberfläche becherförmige Organe, wie sie Fig. 20 auf Taf. I. theils von oben, theils von der Seite gesehen darstellt. Dieselben kehren ihre Oeffnung nach Aussen und waren an dem von mir untersuchten Exemplare ganz mit Schmutz gefüllt. Ihre Höhe ist 0,033 mm., ihr Durchmesser 0,015 mm. In seiner ganzen übrigen Anatomie bildet unser Thier ein verkleinertes Bild der Sacculina dentata."

The anatomical characters of *Sacculina dentata* referred to in this diagnosis read as follows (Kossmann, 1872, pp. 27/28; 1874, pp. 123/124): „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."

Specimens on *Caphyra laevis* A. M. Edw. and on *Thalamita prymna* (Herbst) (cf. Van Kampen & Boschma, 1925; Boschma, 1931 b), on *Neptunus* (*Hellenus*) *hastatoides* (Fabr.) A. M. Edw. and on *Lissocarcinus polybioides* Ad. & White (cf. Boschma, 1931 a), identified as representatives of *Loxothylacus carinatus*, show the following characters:

Male genital organs in the posterior half of the visceral mass, distinctly,

but not very widely curved. Testes of approximately equal size or one somewhat larger than the other. Colleteric glands with a fairly large number of branched canals. External cuticle of the mantle with excrescences consisting of a kind of chitin differing from that of the main layers. Each excrescence is composed of a hollow short cylinder with closed top and a root of varying shape and size, the latter is enclosed in the upper layers of the cuticle. The flat tops of the excrescences bear numerous small hairs or spines. The excrescenses protude for about 20 to 30 μ above the surface of the cuticle. Retinacula with 2 to 6 barbed spindles of a length of 10 to 14 μ.

3. *Loxothylacus panopaei* (Gissler, 1884).

Type specimen on *Panopeus herbstii* M. Edw. from Tampa, Hillsboro County, Florida.

Male genital organs in the posterior half of the visceral mass, rather narrowly curved. As a rule one of the testes somewhat larger than the other. Colleteric glands with a fairly large number of canals. External cuticle of the mantle with hairs of a length of 9 to 35 μ, which rarelv possess minute lateral hairs. Retinacula with 3 to 9 barbed spindles which vary in length from 6 to 12 μ.

4. *Loxothylacus spinulosus* Boschma 1928b.

Type specimen on *Heteropanope serratifrons* Kinah. from the "Pacific Ocean".

Male genital organs in the posterior half of the visceral mass, distinctly curved, testes not strongly differing in size. Colleteric glands with a fairly large number of branched canals. External cuticle of the mantle thin (about 5 μ), covered with small papillae or spines which have a length of approximately 4.5 μ. Retinacula unknown.

5. *Loxothylacus desmothrix* Boschma 1931a.

Type specimen on *Pilumnus normani* Miers from Banda Neira.

The chief characters of the holotype are: Male genital organs of approximately equal size, distinctly curved, in a rather wide arch, but the whole of the male organs in the posterior half of the visceral mass. Colleteric glands with a moderate number of branched canals. Excrescences of the external cuticle consisting of a hyaline kind of chitin. Each excrescence composed of a small number of thick branches which are united in a common basal part; each of the branches in its extremity is divided into a small number of minute spines. Total length of the excrescences from 23 to 55 μ. Retinacula unknown, probably not occurring.

6. *Loxothylacus aristatus* Boschma 1931b.

Type specimen on *Atergatis floridus* (L.) from Beo, Talaud Islands.

Male genital organs of approximately equal shape and size, in the posterior region of the visceral mass, distinctly but narrowly curved. Colleteric glands with a fairly large quantity of branched tubes. Excrescences of the external cuticle consisting of a hyaline kind of chitin. Excrescences as a rule with numerous spines, united on a common basal part. Total length of the excrescences 35 to 85 μ. Retinacula unknown, probably not occurring.

7. *Loxothylacus setaceus* Boschma 1931b.

Type specimen on *Calappa hepatica* (L.) from Celebes (?).

Male genital organs strongly differing in size and shape, the left more or less straight, little developed, the right slightly, but narrowly curved, terminating into a wide thin-walled pouch. Colleteric glands with numerous branched canals. Excrescences of the external cuticle consisting of a hyaline kind of chitin. Each excrescence has 3 to 6 spines, united in the common basal part. Total length of the excrescences 30 to 65 μ. Retinacula with 5 to 10 spindles, till 18 μ long, with minute barbs.

8. *Loxothylacus texanus* Boschma 1933b.

Type specimen on *Callinectes sapidus* Rathbun from Metagorda Bay, near Indianola, Texas.

"Male genital organs in the posterior half of the visceral mass. Testes (at least in full-grown specimens) partially united into a common wide sac. Colleteric glands in the anterior half of the visceral mass, not far from the centre of the lateral surfaces, with a large number of tubes. External cuticle of the mantle with excrescences (short hairs or papillae), which have a length of 4 to 9 μ. Internal cuticle of the mantle with numerous retinacula, which consist of a basal part and several barbed spindles. The latter have a length of 14 to 18 μ." (Boschma, 1933b, p. 237).

9. *Loxothylacus sclerothrix* Boschma 1933b.

Type specimen on *Actaea boletaria* Rathbun from Amirante, Western Indian Ocean.

"Male genital organs in the posterior half of the visceral mass. Closed extremities of the two testes united into a common wide sac. Colleteric glands in the anterior half of the visceral mass, with a moderate number of tubes. External cuticle of the mantle crowdedly covered with papillae which at their extremity bear a number of minute stiff spines and laterally are

covered with minute hairs. The length of the excrescences varies from 10 to 25 μ. Internal cuticle of the mantle with retinacula consisting of a flat basal plate and numerous small spindles which have a length of 4 to 5 μ. These spindles seem to be completely devoid of barbs." (Boschma, 1933b, p. 238/9).

10. *Loxothylacus bicorniger* Boschma 1933b.

Type specimen on *Portunus ventralis* (A. M. Edw.) from Hog Island, Nassau, Bahamas.

"Male genital organs in the posterior half of the visceral mass. One of the testes narrowly curved, the other more or less rudimentary. Colleteric glands near the centre of the lateral surfaces of the visceral mass, with a comparatively small number of tubes. External cuticle of the mantle smooth, its surface divided into small irregular areas which have a diameter of 6 to 20 μ. Internal cuticle of the mantle with retinacula which consist of a basal part and about 6 barbed spindles. The latter have a length of 14 to 17 μ." (Boschma, 1933b, p. 240).

11. *Loxothylacus strandi* Boschma 1936.

Type specimen on *Lambrus contrarius* (Herbst) from Macclesfield Bank, China Sea.

"Testes of approximately equal size and shape, their dorsal part enlarged into thin-walled pouches. Colleteric glands with a large number of branched canals. External cuticle with excrescences consisting of a hyaline kind of chitin, different in structure from that of the main layers. The excrescences consist of pointed spines which usually are united into groups of two to five, rarely remain single. The excrescences vary in length between 30 and 65 μ. Retinacula unknown, probably not occurring." (Boschma, 1936, pp. 385/6). The whole of the male genital organs is contained in the posterior region of the visceral mass, the curve of the male organs is rather narrow (Boschma, 1933a, fig. 50).

12. *Loxothylacus nierstraszi* Boschma 1938.

Type specimen on *Charybdis* (*Goniohellenus*) *truncata* Fabr., probably from the Java Sea.

"Testes not strongly differing in shape and structure, completely separated from each other. Colleteric glands fairly large, with numerous branched tubes. External cuticle of moderate thickness (12—18 μ), its surface covered with small papillae which have a length of 4—6 μ. Internal cuticle of the mantle with retinacula, each of which bears 3—6 spindles with a length of

about 15 μ." (Boschma, 1938, p. 17). The testes are rather widely curved, the whole of the male organs is contained in the posterior half of the visceral mass.

The material of the Snellius Expedition contains, besides representatives of already known forms, a number of new species, some of which are described in the following pages.

Loxothylacus variabilis nov. spec.

(figs. 1—25)

8 specimens examined:

722 A (holotype). Near Koepang, Timor, reef, 5 Dec. 1929, on *Chlorodiella nigra* (Forsk.); 6½ × 4½ × 3 mm [1]).

691 A. Near Koepang, Timor, reef, 29 Nov. 1929, on *Chlorodiella nigra* (Forsk.); 6 × 4 × 2½ mm.

707 B. Near Koepang, Timor, reef or shore, 5 Dec. 1929, on *Chlorodiella nigra* (Forsk.); 6½ × 4½ × 3½ mm.

707 A. Near Koepang, Timor, reef or shore, 5 Dec. 1929, on *Chlorodiella nigra* (Forsk.); 6½ × 5½ × 2 mm.

767 A. Near Koepang, Timor, reef, 3 Dec. 1929, on *Chlorodiella nigra* (Forsk.); 6 × 4½ × 2½ mm.

991 A 1. Kafal near Misool, reef, 3—5 Oct. 1929, on unidentified Xanthid crab; 5 × 4 × 2½ mm.

756. Kafal near Misool, reef or shore, 3—5 Oct. 1929, on same species of host as no. 991 A 1; 5 × 3 × 2 mm.

844. Mamoedjoe, Celebes, reef or shore, 4 or 5 Aug. 1929, on *Actaea rüppellii* (Krauss); 6 × 4½ × 2½ mm.

Specific characters. Male genital organs of equal size or left small and right large. Curvature of male organs distinct, narrow or wide, or male organs slightly bent, or male organs practically straight. Colleteric glands with a moderate to fairly large number of branched canals. External cuticle densely covered with comparatively small hairs (minimum and maximum measurements 6 and 52 μ). Between these hairs there are larger spines in far smaller numbers (minimum and maximum measurements 30 and 186 μ). The excrescences have undivided tips or are irregularly divided into smaller branches. Retinacula with 1 to 5 spindles which may show barbs and vary in length from 9 to 13 μ.

The various specimens do not differ pronouncedly in shape, in general they are oval or reniform, with a concavity in the region of the stalk. The

1) The measurements 6½ × 4½ × 3 mm mean: distance from the ventral to the dorsal border 6½ mm, distance from the posterior to the anterior part 4½ mm, distance between the two lateral surfaces 3 mm. In previous publications I have used other terms, instead of, e. g., 6½ × 4½ × 3 mm the measurements were given as: breadth 6½ mm, height 4½ mm, and thickness 3 mm. This may cause confusion, as the words breadth, etc., are used in a wrong sense.

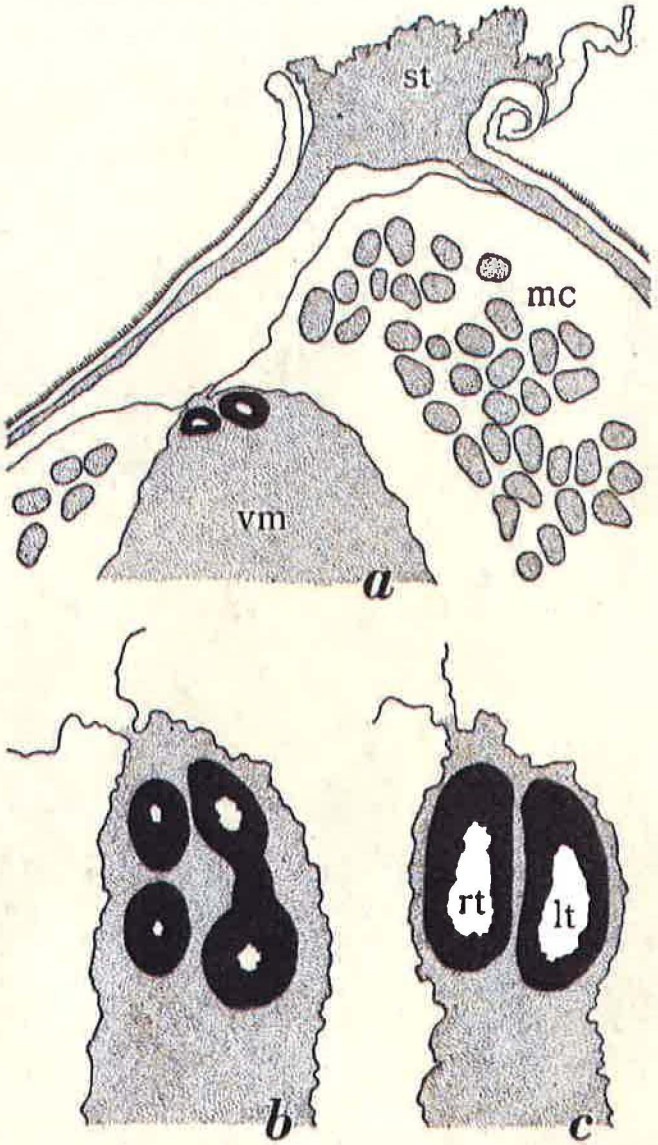

Fig. 1, *Loxothylacus variabilis*, specimen no. 722 A, longitudinal sections; a, through the stalk, each following section from a more dorsal region. lt, left testis; mc, mantle cavity; rt, right testis; st, stalk; vm, visceral mass. × 45.

oval shape may become somewhat triangular, when the posterior region is broader, or the anterior as well as the posterior margins may become slightly concave. The mantle opening in most specimens does not protrude above the surface, an exception forms specimen no. 991 A 1, in which it lies at

the top of a short tube. The mantle opening lies in the marginal part of the surface which was turned against the thorax of the host, at a short distance from the anterior margin; in specimen no. 991 A 1 the tubular expansion of the mantle opening is found in the median plane. In most specimens there is a distinct short groove on the surface which was lying

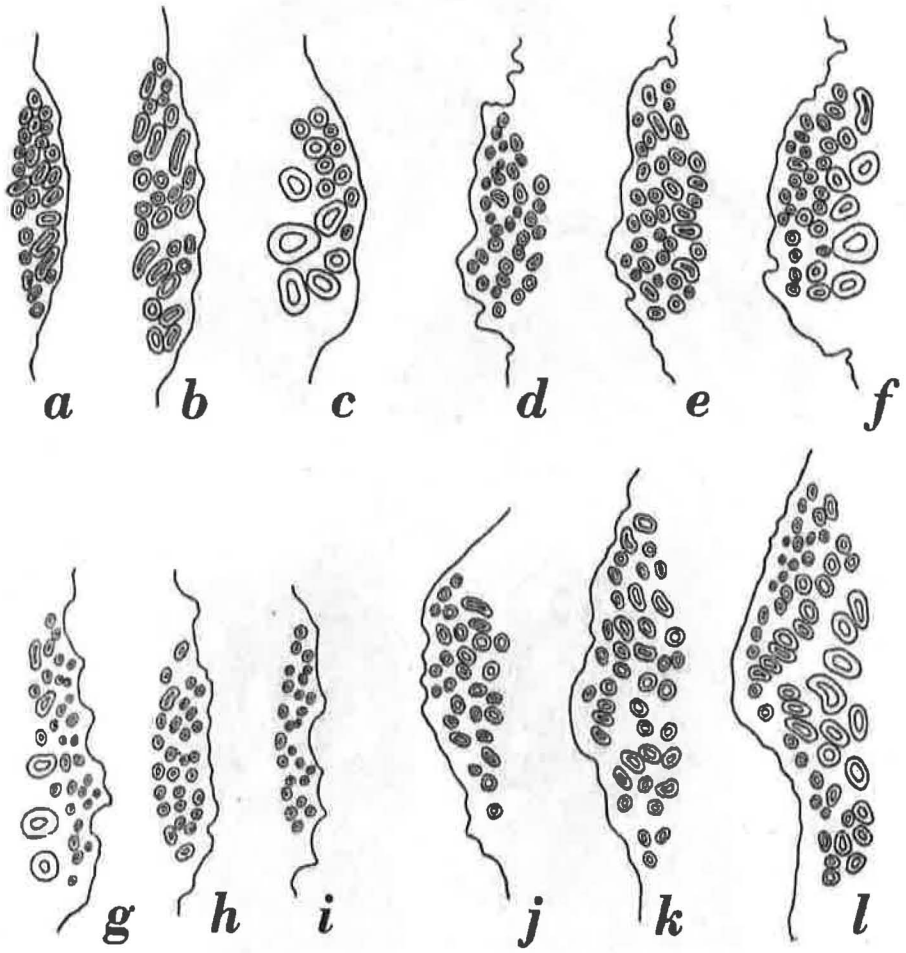

Fig. 2. *Loxothylacus variabilis*, longitudinal sections of colleteric glands, posterior end at the upper side of the figures. a—c, from specimen no. 722 A; d—f, from specimen no. 707 B; g—i, from specimen no. 691 A; j—l, from specimen no. 707 A. × 80.

against the abdomen of the host, caused by pressure of the median ridge of the abdomen against the parasite. With the exception of this groove the surface of the mantle does not show pronounced grooves or wrinkles.

One of the unidentified crabs was infested by two Sacculinids, one of these (991 A 1) was studied.

The particulars of the various specimens examined are given below.

No. 722 A.

In the series of longitudinal sections it appears that the visceral mass has become detached from the mantle, the internal cuticle, however,

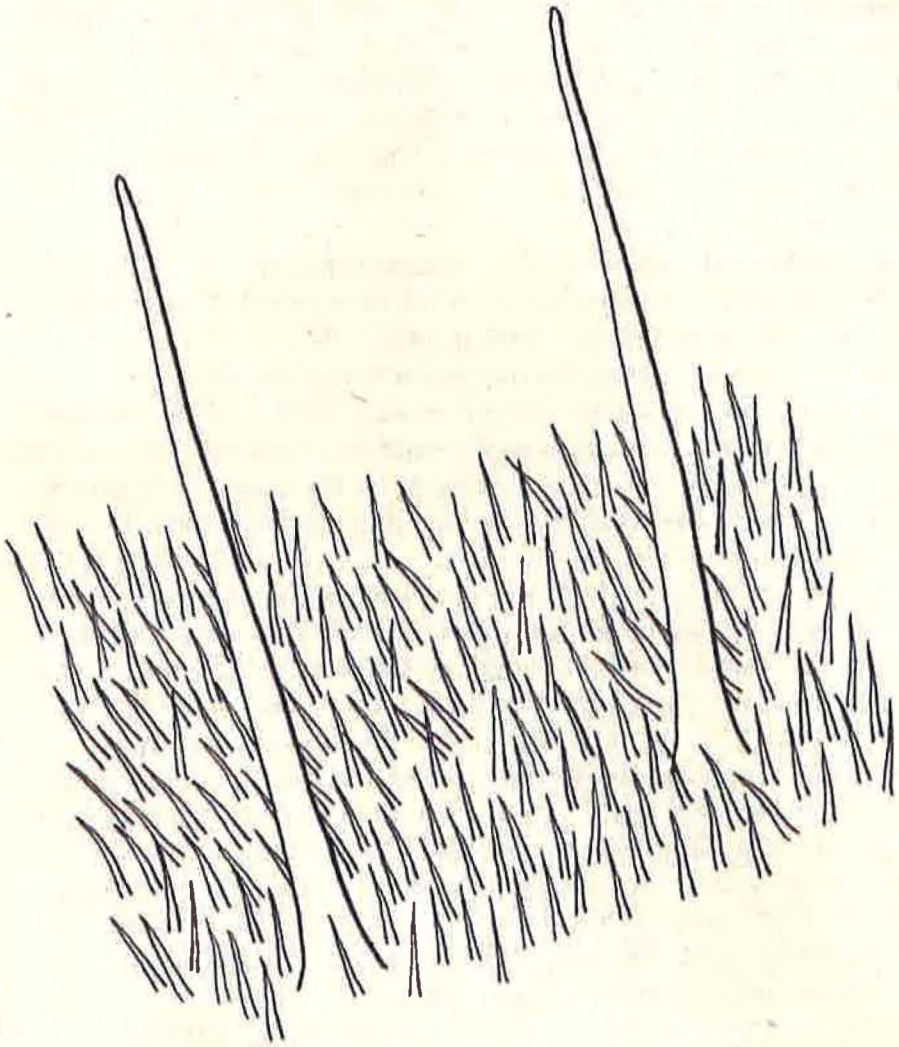

Fig. 3. *Loxothylacus variabilis*, specimen no. 722 A, surface view of excrescences on the external cuticle. × 530.

more or less remained in its original place, so that the drawing (fig. 1 a) shows the real situation of the visceral mass in respect to the stalk. The vasa deferentia are narrow canals, they pass gradually into the testes which have a comparatively thick wall and show a distinct curve (fig. 1 b). They reach about equally far towards the dorsal region of the

body (fig. 1 c) and are of approximately the same size. The entire male genital organs lie in the posterior part of the visceral mass.

The colleteric glands (fig. 2 a—c) are comparatively small, they have a moderately branched canal system. One of the sections (parts of longitudinal sections of the animal) of one of the glands represented in the figure (fig. 2 c) is from the neighbourhood of the female genital opening, here the canals are comparatively wide. Towards the ventral or dorsal region the canals divide into smaller canals, so that in the section drawn in fig. 2 b the number is 29. In sections which are still farther from the central part of the gland (fig. 2 a) this number gradually decreases. The system of canals forms a rather compact mass, which, as a whole, slightly protrudes above the surface of the visceral mass.

Measurements of the thickness of the external cuticle of the mantle gave values between 22 and 38 μ, in general in the anterior half it is somewhat thicker than in the posterior half of the mantle.

The whole surface of the external cuticle is rather thickly covered with small spines or hairs consisting of a rather weak kind of chitin. Between these there occur, though in much smaller number, extremely long spines. The latter are longest in the anterior part of the mantle, towards the posterior region they diminish in size and disappear altogether in the region around the stalk.

Fig. 3 shows the distribution of these small and larger excrescences on the surface of the cuticle. In the figured portion the small hairs have a length of 15 to 20 μ, the largest spine has a length of 186 μ, the other large spine is but slightly smaller. These large spines have a gradually tapering shape, they end in a blunt tip, the basal region has a thickness of about 15 μ.

In sections not only appears that the external cuticle varies in thickness, but also the smaller and larger excrescences are found to vary in size. In some regions the small hairs are as short as 12 to 15 μ (fig. 4 b), in other parts of the cuticle they have a length of 25 to 37 μ (fig. 4 a, d). In fig. 4 c a complete large spine is represented, the basal part of another, and numerous smaller hairs. The large spine has a length of about 150 μ, the smaller excrescences measure here 34 to 40 μ.

Some of the drawings (fig. 4 c, d) show a peculiarity occurring not at all rarely in this specimen, viz., the presence of rather wide canals in which the epithelial cells of the mantle penetrate to a fairly large distance towards the surface of the cuticle. In the long spines these canals even can be traced to a considerable distance above the surface of the cuticle (fig. 4 c). In many parts of the cuticle these canals are found in great numbers. Especially in those parts of the series of sections where the cuticle is seen in an ob-

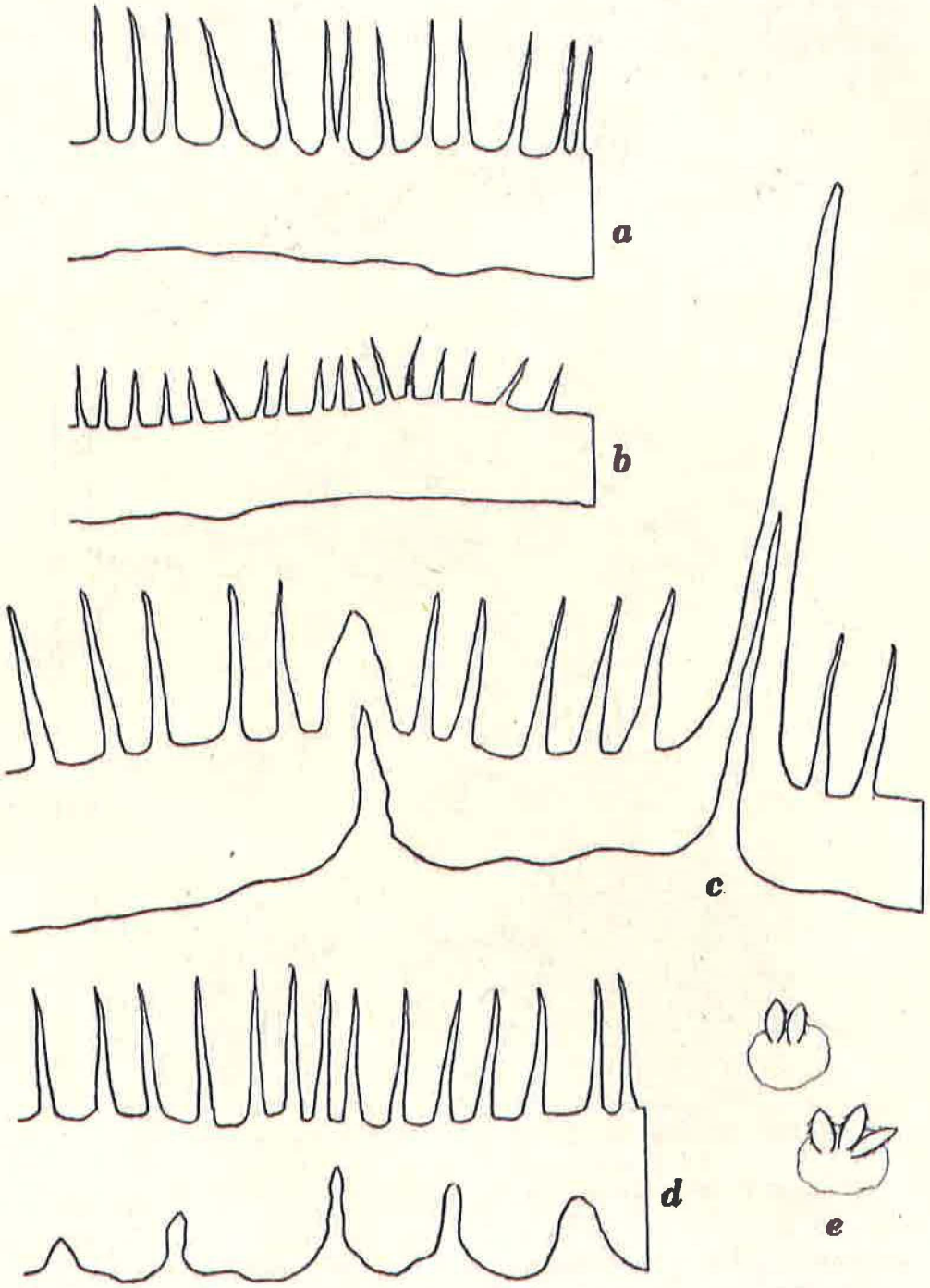

Fig. 4. *Loxothylacus variabilis*, specimen no. 722 A. a—d, sections of the external cuticle; e, retinacula. × 530.

liquely transverse section the distribution of the canals becomes distinct (fig. 5 b). It appears in these sections that the canals often are more or less arranged in groups of three or more.

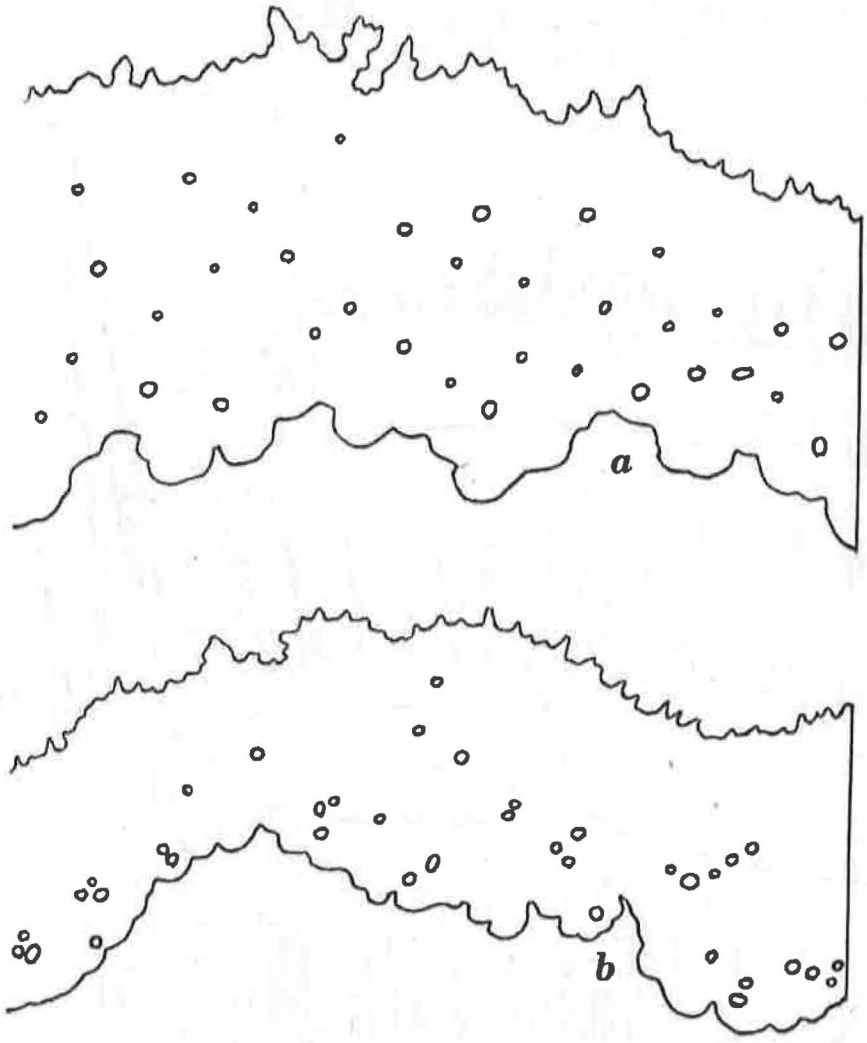

Fig. 5. *Loxothylacus variabilis*, oblique sections of the external cuticle. a, from specimen no. 707 B; b, from specimen no. 722 A. × 300.

The internal cuticle of the mantle bears retinacula, two of these (in reality occurring at a much larger distance) are drawn in fig. 4 c. The retinacula found in the preparations made for this purpose possess 2 or 3 spindles with a length of 10 to 13 μ, the latter are beset with minute barbs.

No. 691 A.

As appears in the series of longitudinal sections the visceral mass is attached to the mantle at a fairly large distance from the stalk (fig. 6 a).

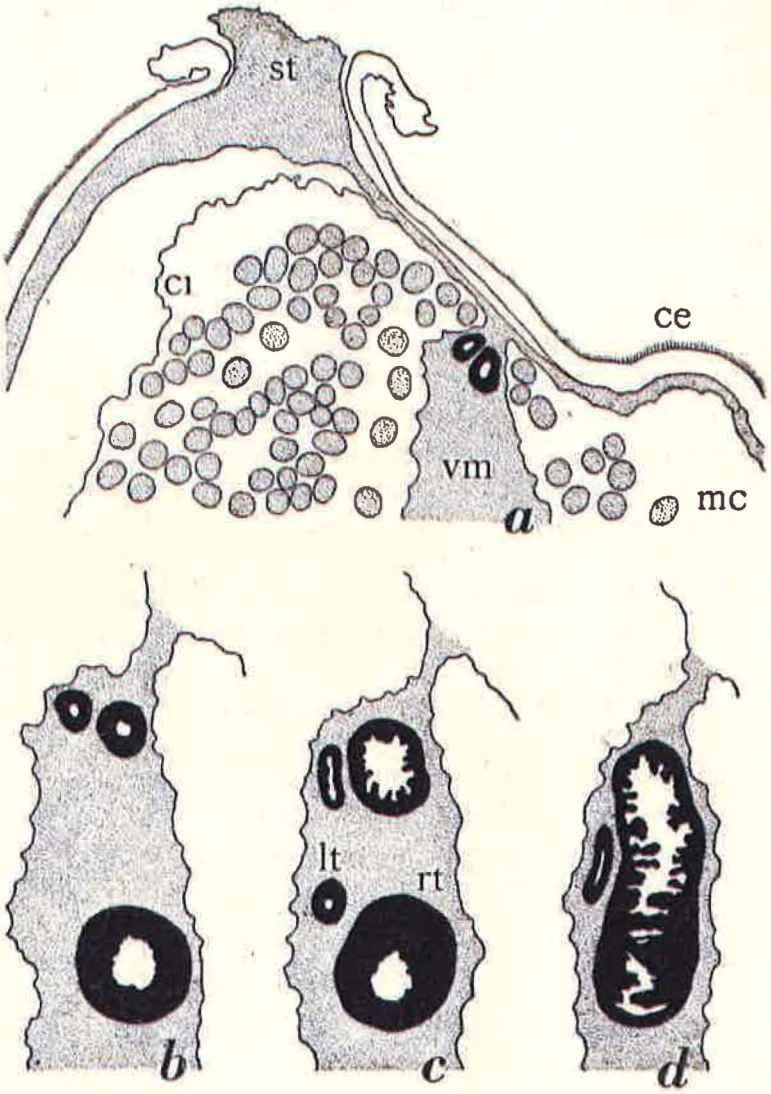

Fig. 6. *Loxothylacus variabilis*, specimen no. 691 A, longitudinal sections; a, through the stalk, each following section from a more dorsal region. ce, external cuticle; ci, internal cuticle; lt, left testis; mc, mantle cavity; rt, right testis; st, stalk; vm, visceral mass. × 45.

In some parts of the mantle the internal cuticle has detached itself from the surface. The vasa deferentia are narrow canals which gradually pass into the testes. The right testis (fig. 6 b, c, d) has a comparatively wide curve,

especially in its terminal part it has a very thick wall. In its most strongly curved part, in the dorsal region of the visceral mass the wall possesses numerous ridges, so that in sections it shows a more or less irregular lumen. The left testis (fig. 6 c, d) is much smaller than the right, its size does not increase beyond that of its vas deferens. As the right testis it is distinctly curved, but it does not stretch as far towards the anterior region as the former. The right testis proceeds into the visceral mass till about the centre of this organ.

In comparison to what is to be seen in specimen no. 722 A the canal system in the colleteric glands of specimen 691 A consists of rather narrow tubes (fig. 2 g—i). It is improbable that this slight difference in size is of any importance: the difference may be caused by a different state of development of the canals in connection with differences in the ripening of the eggs in the two specimens. In sections in the neighbourhood of the female opening this gland shows the largest number of canals (35 in fig. 2 g), towards the peripheral parts of the gland the number of canals gradually decreases (fig. 2 h, i). Probably on account of the narrowness of the canals the colleteric glands in this specimen do not protrude appreciably above their surroundings.

A few measurements of the external cuticle of the mantle gave amounts from 33 tot 66 μ. The surface of this cuticle is rather densely covered with small hairs of the same dimension and shape as in specimen no. 722 A. Between these small hairs there are, rather sparsely distributed, larger excrescences, which at first sight are different from those of the other specimen, but probably in reality are modified only from the kind represented in fig. 3. A number of these larger spines are drawn in fig. 7, on the cuticle they are much more sparingly distributed than shown in the figure. The upper row (fig. 7 a) represents some of the larger forms, they have a comparatively broad base from which they taper towards the extremity. The topmost part of nearly all the spines in specimen no. 691 A is irregularly divided into a number of smaller hairs which bend off from the main stem in different degrees. One gets the impression that the tips of the spines by some reason have become mutilated and split into smaller parts. These larger spines vary in length from 100 to 140 μ, their basal part has a thickness of 15 to 20 μ.

From one region of the mantle to another the size of the larger spines gradually decreases or increases. Some spines of smaller size, but which still are conspicuously larger than the surrounding numerous small hairs, varying in length from 30 to 100 μ, are shown in fig. 7 b, c, d. In all of these the tip consists of two or more branches, sometimes the spines are

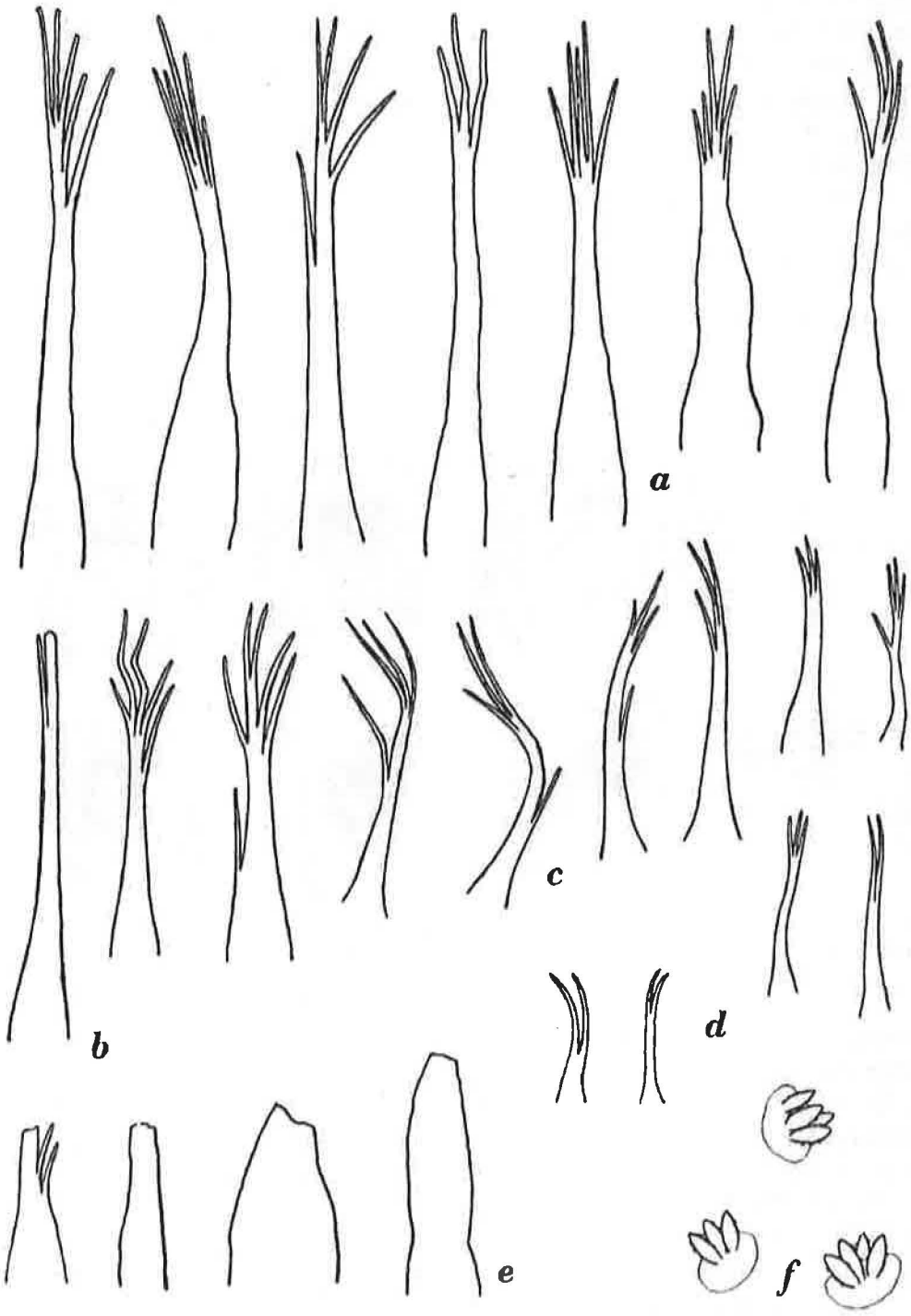

Fig. 7. *Loxothylacus variabilis*, specimen no. 691 A. a—e, excrescences from various parts of the external cuticle; f, retinacula. × 530.

rather strongly bent and on the whole they appear as if the divided tips originally had formed one solid tapering extremity. Evidence for this opinion is found in the occurrence of small stumps which may be seen in the neighbourhood of larger spines (fig. 7 e), and which undoubtedly are nothing else but the basal parts of broken spines, their size and shape and irregularly outlined top give strength for this view.

On the internal cuticle of the mantle there occur retinacula, distributed in the usual manner. Three of these are drawn in fig. 7 f, they have 3 or 4 barbed spindles with a length of 9 to 12 μ.

No. 707 B.

In the longitudinal sections the visceral mass is seen to be attached to the mantle at some distance from the stalk (fig. 8 a). The two male genital

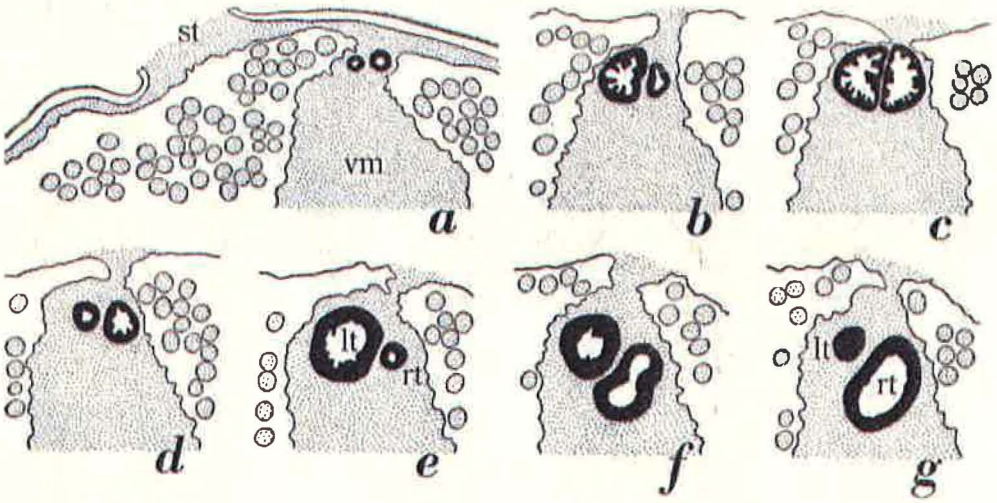

Fig. 8. *Loxothylacus variabilis*, specimen no. 707 B, longitudinal sections; a, through the stalk, each following section from a more dorsal region. lt, left testis; rt, right testis; st, stalk; vm, visceral mass. × 30.

organs are of about equal size, the right terminates in a more dorsal region than the left. The ventral parts of the vasa deferentia form narrow canals (fig. 8 a), during their course in a dorsal direction they gradually become wider, whilst their inner wall acquires numerous ridges (fig. 8 b, c). Before they pass into the testes the vasa deferentia become narrower again (fig. 8 d, and e, rt). The left testis is more or less straight, without appreciable curve (fig. 8 e—g). The right testis too is more or less straight (fig. 8 e—g), although in one region there is an indication of a slight curve, as the lumen is nearly constricted into two halves by distinct ridges on the inner walls

of this testis (fig. 8 f). In the sections following the one represented in fig. 8 g the right testis gradually diminishes in size whilst it keeps its straight course towards the dorsal region of the visceral mass.

The colleteric glands contain a rather compact mass of canals, they protrude somewhat above the surface of the visceral mass (fig. 2 d—f). Fig. 2 d represents a section of the peripheral region of one of these glands, fig. 2 e a section of a more central region, and fig. 2 f one in the neighbourhood of the female opening. Of these fig. 2 e shows the largest number of canals (37).

Measurements of the thickness of the external cuticle in different parts of the mantle gave amounts varying from 33 to 75 μ. In general the cuticle is thicker in the anterior half of the mantle, here also it bears larger excrescences than in the posterior region.

These excrescences again consist of two kinds: numerous small hairs or spines densely covering the surface, and comparatively few larger spines (fig. 9 a). In the part of the cuticle represented in this figure the small hairs have a length of 12 to 16 μ, the two longer excrescences are 75 and 82 μ long. They have irregularly divided tips, as if they were broken and split into fragments.

One of the sections of the cuticle (fig. 9 b) is from a rather thick part (60 to 75 μ). The small hairs on the surface have here a length of 36 to 45 μ, the larger excrescence is of a length of about 140 μ. This long spine possesses two lateral hairs, which probably have arisen by fission from the main stem. The figure is moreover interesting as it shows a few of the canals in which cells from the epithelium penetrate into the cuticle, the canals have here a somewhat irregular corkscrew-like course. In the other section (fig. 9 c) the cuticle has a thickness of about 38 μ, in connection with this smaller thickness the excrescences are rather short, they are from 13 to 16 μ long. Here too two canals are to be seen in the cuticle.

In oblique tangential sections of the cuticle often a great many of these canals are to be seen (fig. 5 a). In this figure the arrangement of these canals in groups is not apparent, the distribution of the canals as seen in fig. 9 b, however, points to an arrangement in groups.

As in the other specimens the internal cuticle of the mantle possesses retinacula, provided with 3 or 4 spindles of a length of 9 to 10 μ (fig. 9 d). Barbs could not be found with certainty, which does not prove that these do not exist: the study of the retinacula is often hindered by the enveloping layers of chitin from the colleteric glands.

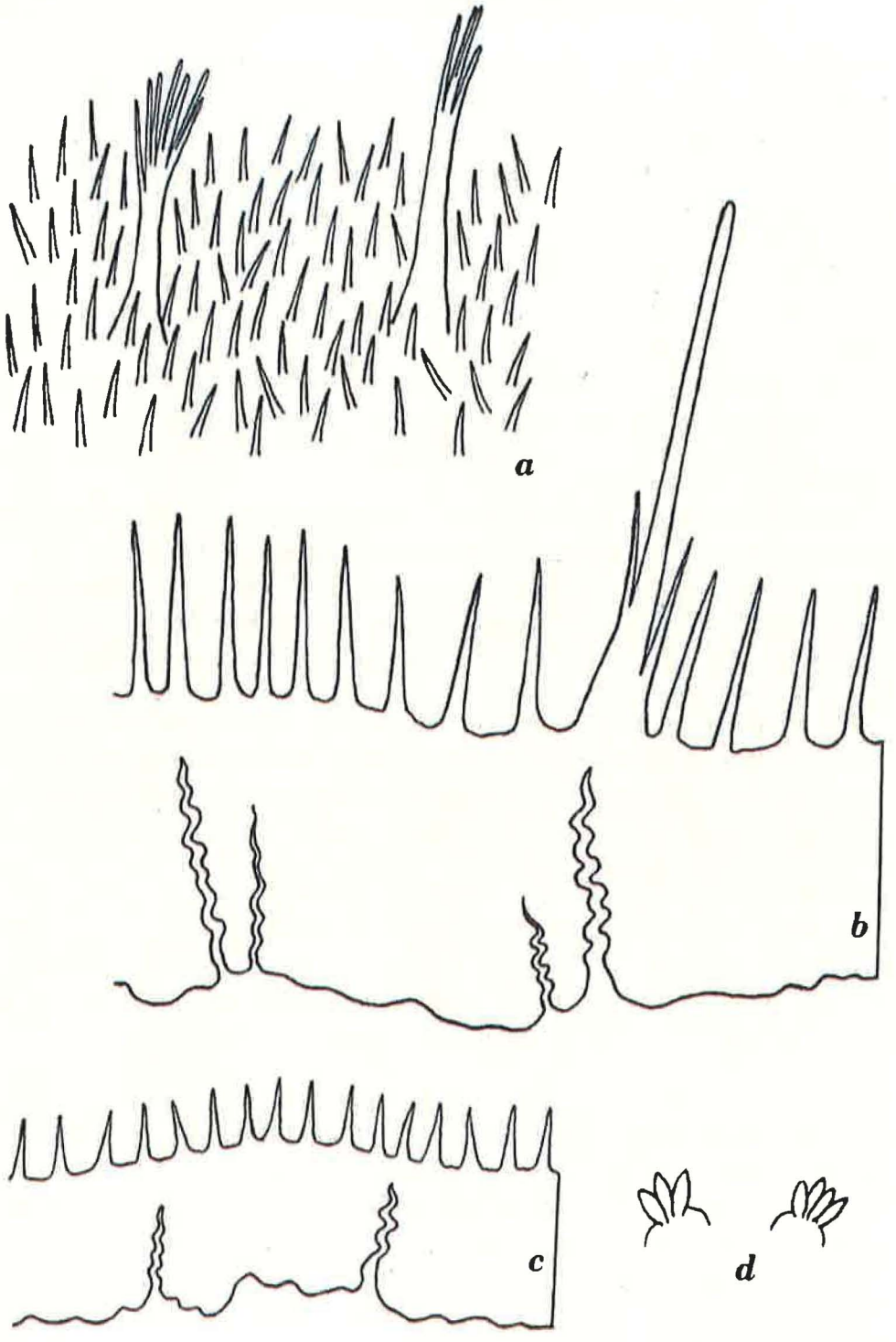

Fig. 9. *Loxothylacus variabilis*, specimen no. 707 B, a, surface view of excrescences on the external cuticle; b, c, sections of the external cuticle; d, retinacula. × 530.

No. 707 A.

In longitudinal sections through the region of the stalk the visceral mass appears to be attached to the mantle at a slight distance from the stalk (fig. 10 a), at all events the stalk is not a direct continuation from the visceral mass. In sections from a more dorsal region the attachment of the mesentery to the mantle is at a much greater distance from the region of the stalk (fig. 10 b, c).

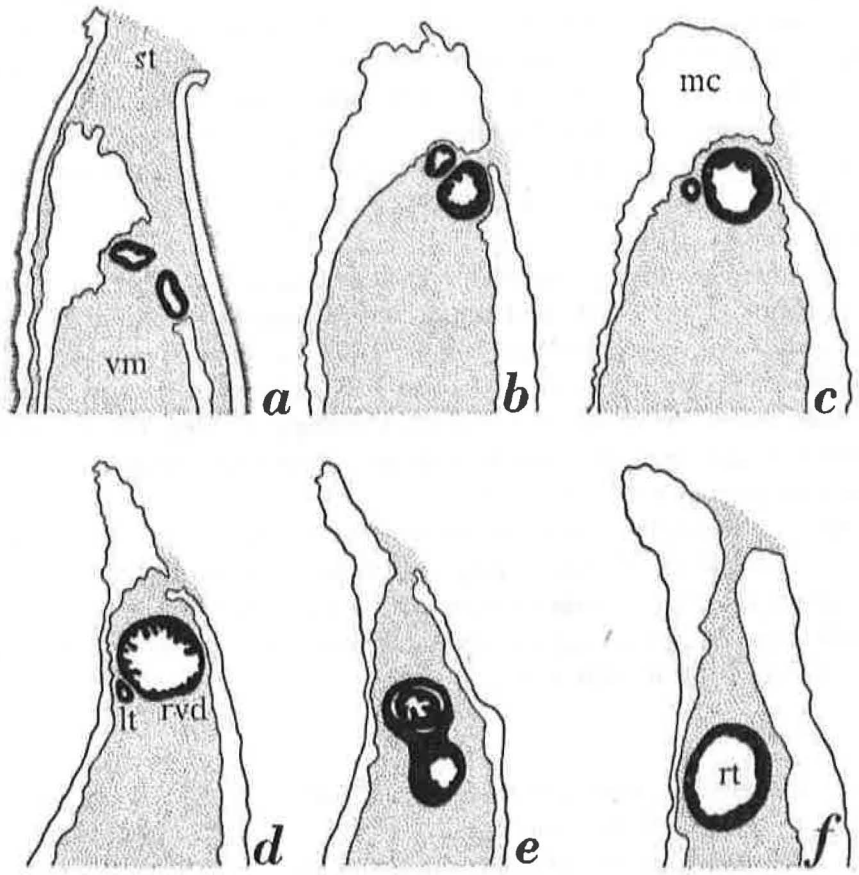

Fig. 10. *Loxothylacus variabilis*, specimen no. 707 A, longitudinal sections; a, through the stalk, each following section from a more dorsal region. lt, left testis; mc, mantle cavity; rt, right testis; rvd, right vas deferens; st, stalk; vm, visceral mass. × 30.

The two male genital organs in this specimen differ among each other in many respects. In sections through the region of the stalk the two vasa deferentia are of approximately equal size, not very narrow (fig. 10 a). The left male genital organ forms a more or less straight tube which proceeds in

a dorsal direction, but diverges towards the anterior region of the body. Whilst its vas deferens gradually passes into the testis the size of the organ continuously diminishes, its dorsal extremity is found in the region where the right vas deferens reaches its largest size (fig. 10 d). The right vas deferens in running towards the dorsal part of the visceral mass also slightly turns in an anterior direction, it gradually becomes wider (fig. 10 b, c), till it reaches about the same thickness as the right testis. In the region where the right vas deferens attains its greatest width its inner wall shows a quantity of ridges (fig. 10 d). Soon afterwards the right vas deferens passes into its testis (fig. 10 e); here the lumen of the vas deferens has become much narrower and at the transition of the two parts the organ shows a distinct curve. But after this curve the terminal part of the testis does not run into a ventral direction, for it proceeds towards the dorsal region. Soon after the slight curve the right testis obtains a fairly large size (fig. 10 f), in still more dorsal parts of the visceral mass it gradually diminishes in size till its blind end.

The colleteric glands are slightly larger than those of the other specimens, they contain a larger number of canals. Three sections of one of the colleteric glands are represented here (fig. 2 j—l), the first of which is from the peripheral part, the last from still some distance from the female opening, the region where the canal system is most strongly divided. On the whole the colleteric glands of this specimen do not differ appreciably from those of the specimens dealt with above.

Some measurements of parts of the external cuticle of the mantle show that the thickness of this cuticle may vary from 44 to 66 μ. The surface of the external cuticle possesses numerous small hairs and large excrescences in smaller number, not principally different from the hairs and spines in the other specimens dealt with here.

No. 767 A.

From the series of longitudinal sections appears that the visceral mass is attached to the mantle at some distance of the stalk (fig. 11 a). The two male genital organs are of different shape and size, the left is rather small, the right is well developed. The two vasa deferentia, which are of about equal size, form narrow canals (fig. 11 a). The left vas deferens soon passes into its testis which can be traced for some distance towards the dorsal region (fig. 11 b, c). The right vas deferens in passing into its testis gradually increases in size (fig. 11 b). At first the lumen of the right male genital organ is comparatively wide, towards the dorsal region this lumen soon becomes narrower by the development of thick ridges on the inner

wall (fig. 11 c), and in a still more dorsal region the lumen becomes very narrow (fig. 11 d). Afterwards the cavity in the right testis becomes wider again (fig. 11 e, f), until its closed extremity is reached (fig. 11 g). Both of the male genital organs have a more or less straight course, they run in

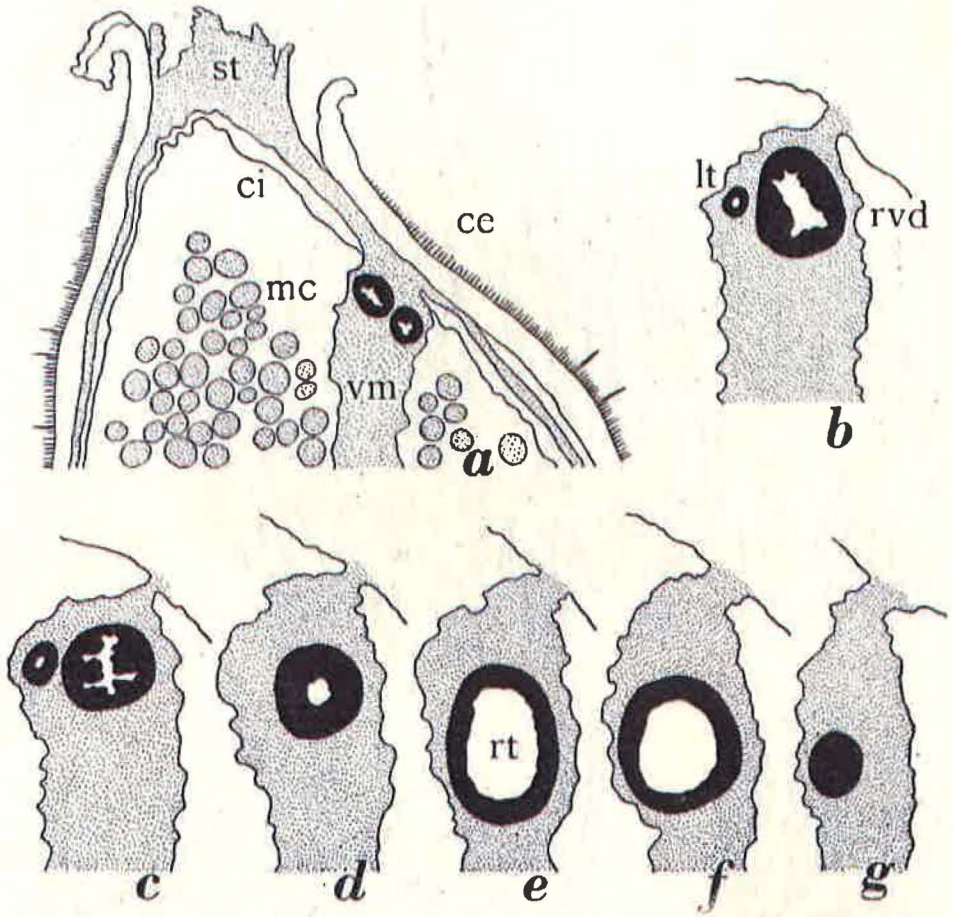

Fig. 11. *Loxothylacus variabilis*, specimen no. 767 A, longitudinal sections; a, through the stalk, each following section from a more dorsal region. ce, external cuticle; ci, internal cuticle; lt, left testis; mc, mantle cavity; rt, right testis; rvd, right vas deferens; st, stalk; vm, visceral mass. × 45.

a dorsal direction, but during this course they diverge appreciably towards the anterior part of the visceral mass, so that the closed extremity of the right testis lies approximately in the central part of the dorsal region of the visceral mass.

The colleteric glands of this specimen do not differ in important details from those of the other specimens, it seemed unnecessary to give drawings of them.

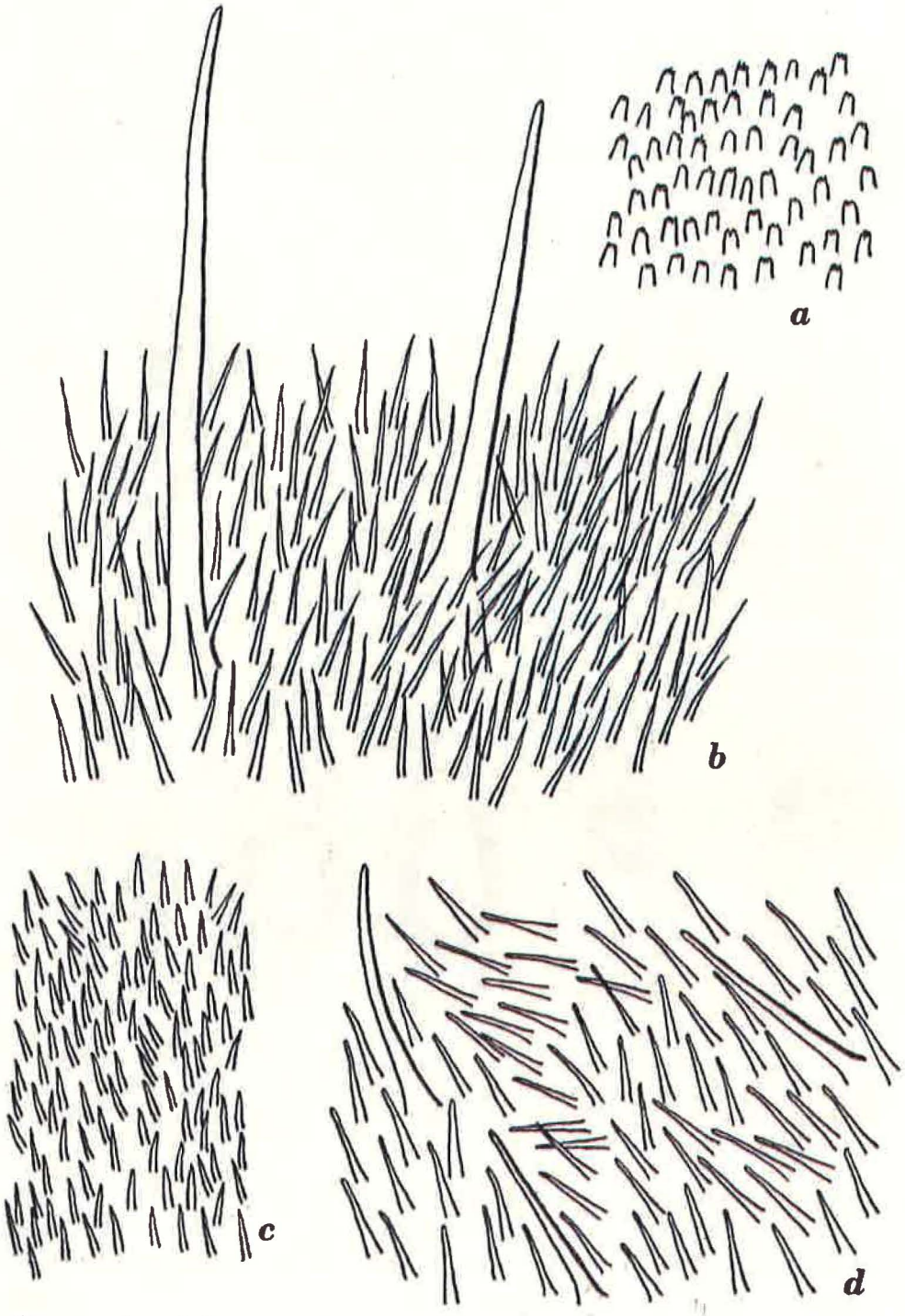

Fig. 12. *Loxothylacus variabilis*, specimen no. 767 A. a—d, surface view of excrescences on various parts of the external cuticle. × 530.

The thickness of the external cuticle was measured in various parts of the mantle, these measurements vary from 38 to 88 μ.

The surface of the external cuticle is rather densely covered with small

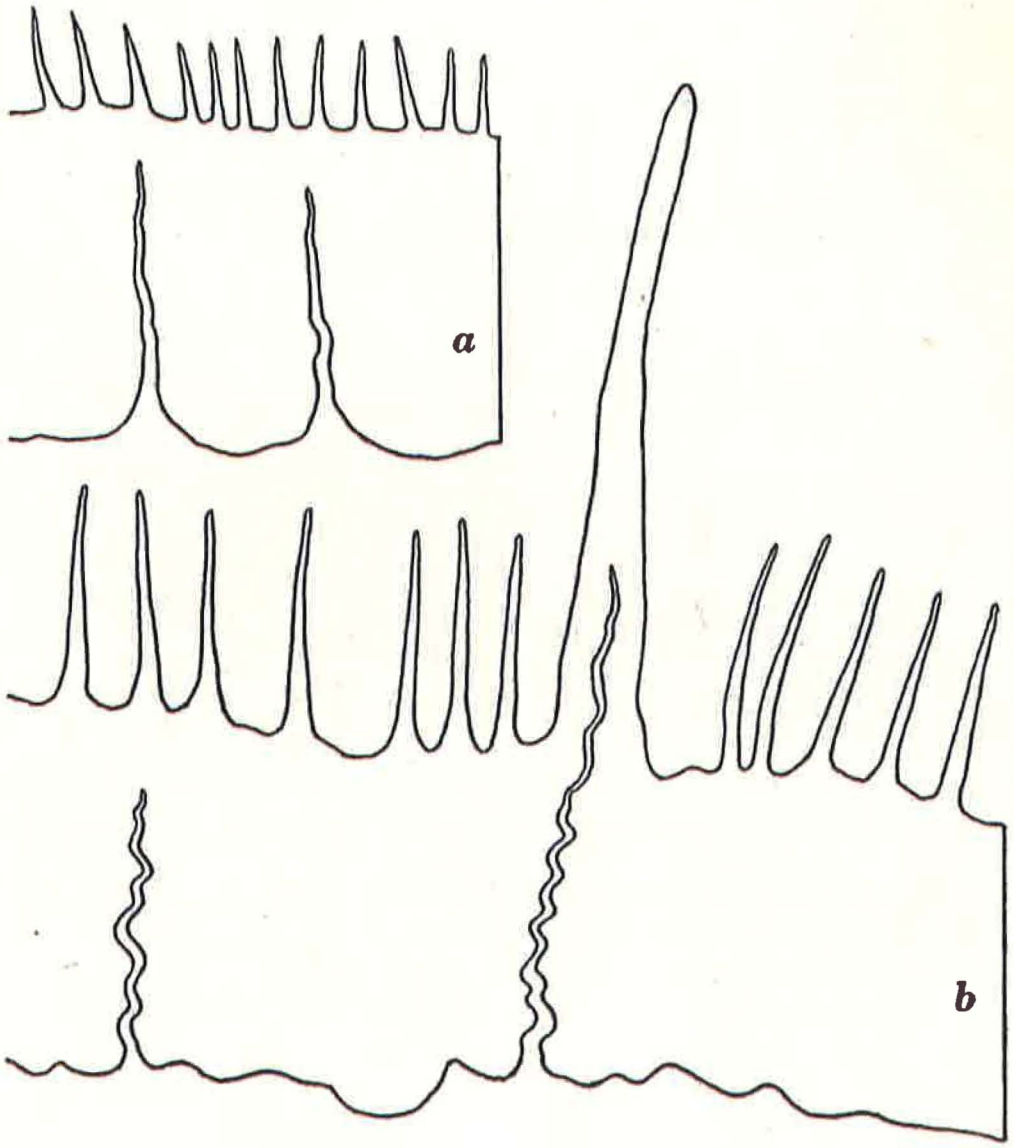

Fig. 13. *Loxothylacus variabilis*, specimen no. 767 A. a, b, sections of the external cuticle. × 530.

hairs among which a few, more sparsely distributed long spines occur. Illustrations of parts of the cuticle in surface view are given in fig. 12. The shape and size of the excrescences as represented in fig. 12 b is of rather

common occurrence in this specimen. Here the small hairs have a length of 18 to 27 μ, the large spines are 120 to 160 μ long. These long spines have undivided tips. In other parts of the cuticle the large spines are smaller in comparison to the surrounding hairs, e. g., in the part of the cuticle

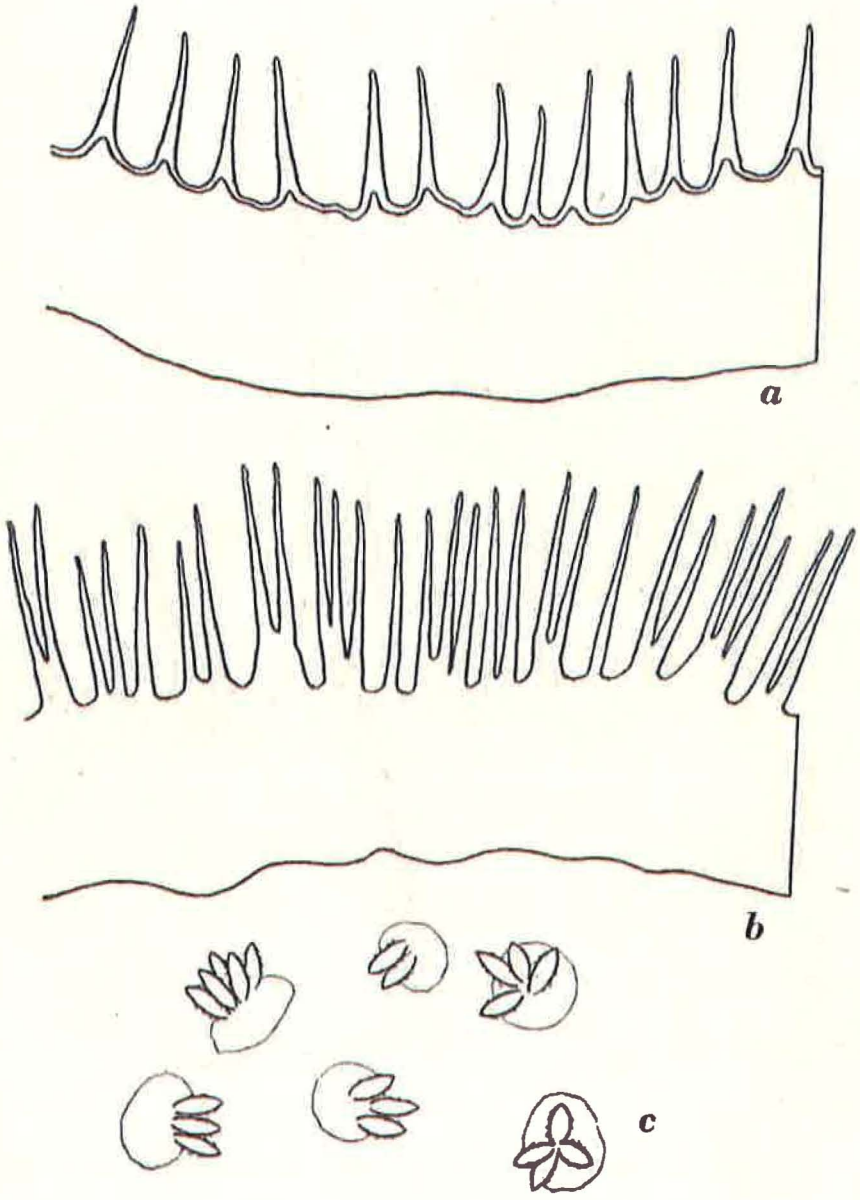

Fig. 14. *Loxothylacus variabilis*, specimen no. 767 A. a, b, sections of the external cuticle; c, retinacula. × 530.

drawn in fig. 12 d. Here the smaller hairs vary in length from 15 to 24 μ, whilst the spines are 50 to 65 μ long. In still other regions of the cuticle the longer spines are altogether absent, whilst the smaller hairs are rather short (fig. 12 c), varying in length from 7 to 13 μ. Finally in one part of the cuticle excrescences occur of a peculiar shape (fig. 12 a), consisting of small papillae, 6 to 8 μ long, with blunt tips which seem to show a few irregular minute spines. Probably these excrescences are nothing else but the basal parts of hairs from which the upper parts have become lost, they appear as being broken or worn off.

The differences in shape and size of the excrescences of the external cuticle are further shown in figures of sections of this cuticle. The hairs are rather small (16 to 22 μ) in fig. 13 a, in fig. 13 b they are rather long (45 to 55 μ), this section shows one long spine with a length of 155 μ. The excrescences represented in fig. 14 b have a length of 33 to 52 μ, they are more or less arranged in groups with a common basal part. In fig. 14 a the hairs have a length of 27 to 33 μ, here they consist of a much harder kind of chitin than in the other parts of the cuticle. In contradistinction to these other parts the spines are not stained, whilst in the other parts the excrescences have the same colour as the main layers of the cuticle. Not only the hairs consist of a kind of hyaline, brittle chitin, but also the surface of the cuticle is covered with a thin layer of this kind of chitin so that the excrescences are strongly united.

In some parts of the cuticle there are numerous canals which in a more or less corkscrew-like manner penetrate for a rather long distance towards the surface of the cuticle (fig. 13). Many of these canals are continued into the long spines so that they terminate at some distance above the surface of the cuticle.

On the internal cuticle of the mantle retinacula are found, distributed in the usual manner. They have 2 to 5 barbed spindles of a length of 9 to 13 μ (fig. 14 c; in reality the retinacula occur at much larger distances from each other).

No. 991 A 1.

One of the figures (fig. 15 a) represents a part of a longitudinal section through the stalk. It shows the left colleteric gland and the greater part of the right colleteric gland, which are found in about the centre of the lateral surfaces of the visceral mass. The figure moreover shows that the visceral mass is attached to the mantle at some distance from the stalk.

The two vasa deferentia have an approximately equal size (fig. 15 a),

at least in their ventral part. Towards the dorsal region the left vas deferens becomes still narrower (fig. 15 b), it gradually passes into the left testis, the terminal part of which is seen in the lower part of fig. 15 c, towards the right. Fig. 15 d shows a section of the dorsal part of the left testis, in the region where this organ is strongly curved. The right male genital organ is of much larger size than the left. In fig. 15 b the wide vas deferens (in the upper part of the figure) and the wide terminal part (in the lower part

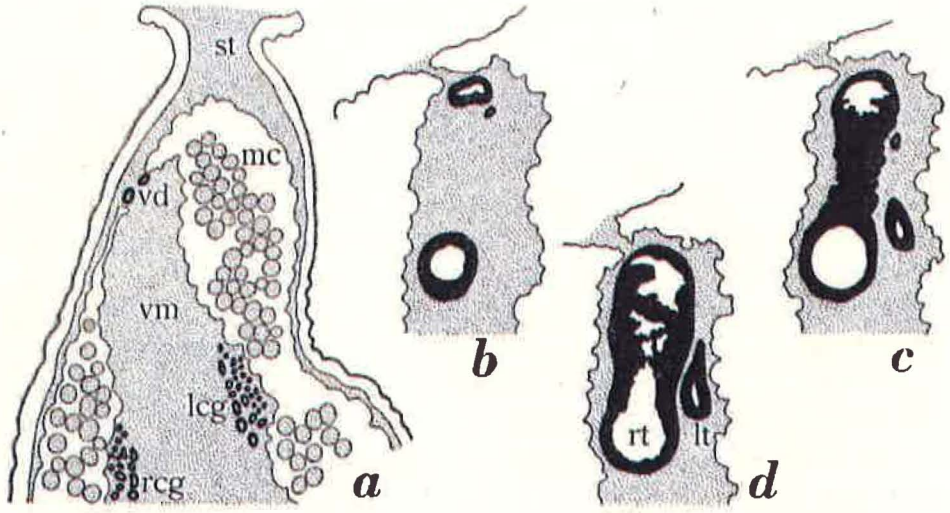

Fig. 15. *Loxothylacus variabilis*, specimen no. 991 A 1, longitudinal sections; a, through the stalk, each following section from a more dorsal region. lcg, left colleteric gland; lt, left testis; mc, mantle cavity; rcg, right colleteric gland; rt, right testis; st, stalk; vd, vasa deferentia; vm, visceral mass. × 30.

of the figure) of the right male organ are to be seen. In fig. 15 c this organ is sectioned through the ventral part of the curved part. In a still more dorsal region (fig. 15 d) the right testis is seen to possess a somewhat irregular lumen, caused by ridges on its inner wall. The figures show that the right male genital organ penetrates the visceral mass till about the central part. As appears also from fig. 15 b the curvature of the right testis is comparatively wide.

Two longitudinal sections of one of the colleteric glands are figured here. One of these (fig. 16 d) is from a slight distance of the female opening, it still shows some wide canals. The other (fig. 16 e) is from a more peripheral region, it contains 39 canals; towards the peripheral region of the gland this number gradually decreases. Together the canals form a rather compact mass.

The thickness of the external cuticle was measured in various parts of the mantle, the amounts obtained differ from 30 to 106 μ.

The surface of the external cuticle is densely covered with small excrescences, between these in many parts large spines occur in smaller numbers. In almost every part of the mantle the small excrescences are divided into a number of smaller hairs, whilst the large spines as a rule remain undivided. Some figures of these excrescences may illustrate the variety of size and

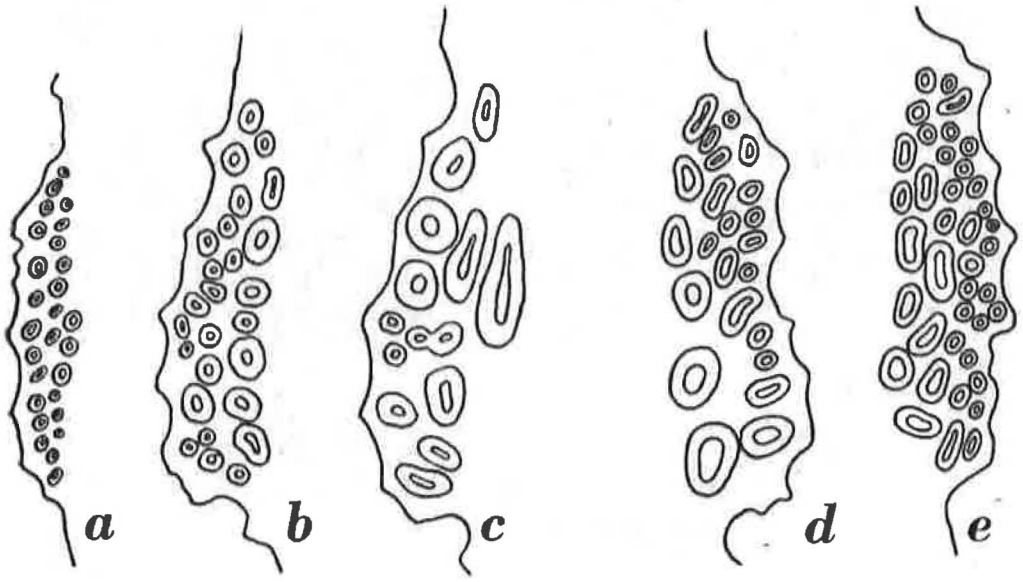

Fig. 16. *Loxothylacus variabilis*, longitudinal sections of colleteric glands, posterior end at the upper side of the figures. a—c, from specimen no. 756; d, e, from specimen no. 991 A 1. × 107.

shape. Fig. 17 a represents a surface view of the external cuticle, it shows numerous small excrescences (length 6 to 10 μ), the topmost part of which is divided into minute spines or hairs. The two larger spines in this part of the cuticle are 48 and 60 μ long. Another part of the cuticle shows excrescences of about the same shape (fig. 17 b). Here the smaller have a length of 9 to 16 μ, the two larger are 68 and 75 μ long. The smaller excrescences have somewhat longer spines, but in general the differences are not important. The excrescences shown in fig. 17 c (in this part of the cuticle no large spines were present) are still somewhat larger, their length varies from 15 to 22 μ. Other instances showing the variation in size and shape of the excrescences are represented in fig. 18. In one part of the cuticle the smaller excrescences vary from 10 to 18 μ (fig. 18 a), in another

from 28 to 34 μ (fig. 18 b), in a third from 25 to 30 μ. Nearly all these excrescences are divided in their upper part. Fig. 18 b moreover shows two of the larger spines, one in longitudinal section, the length of the latter is 106 μ.

In connection with the remarks given above on the larger spines of the

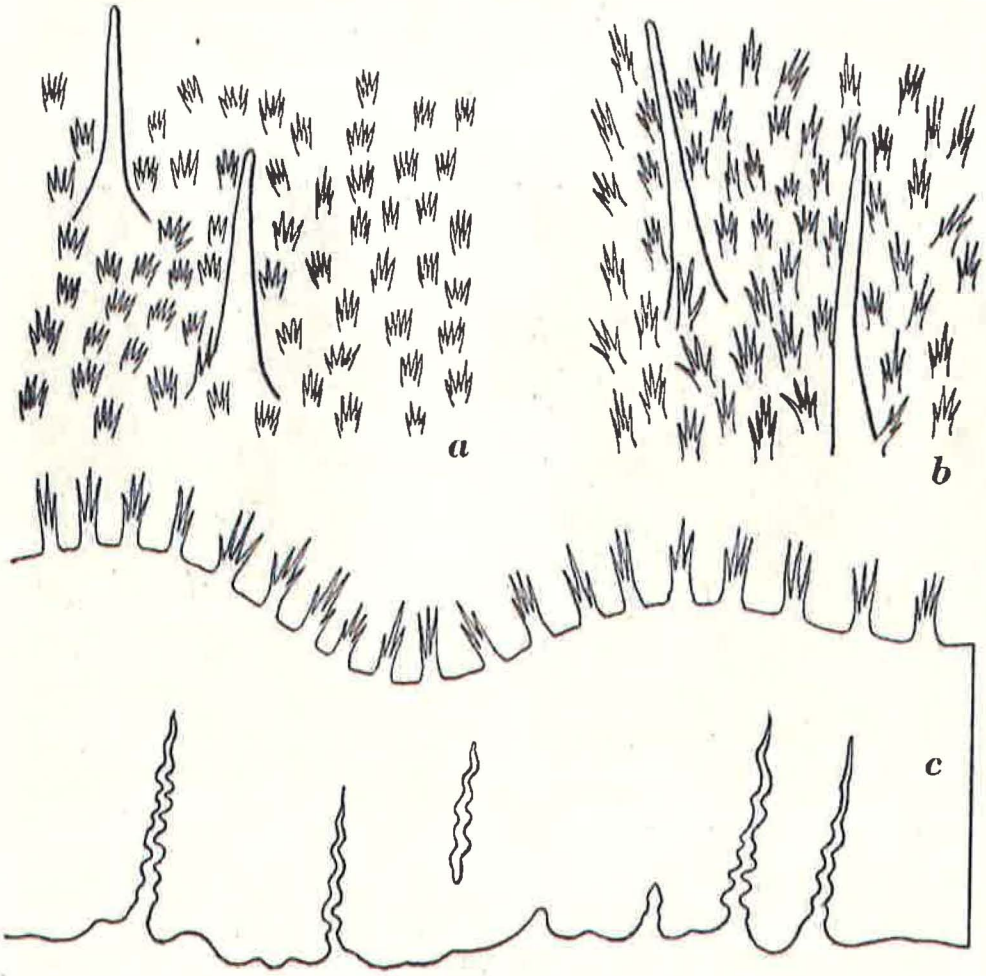

Fig. 17. *Loxothylacus variabilis*, specimen no. 991 A 1. a, b, surface view of excrescences in various parts of the external cuticle; c, section of the external cuticle. × 530.

cuticle in the parasites of *Chlorodiella nigra* (Forsk.), it is not impossible that the divided excrescences in this specimen in reality are transformed single hairs or spines in which the topmost part has divided into smaller

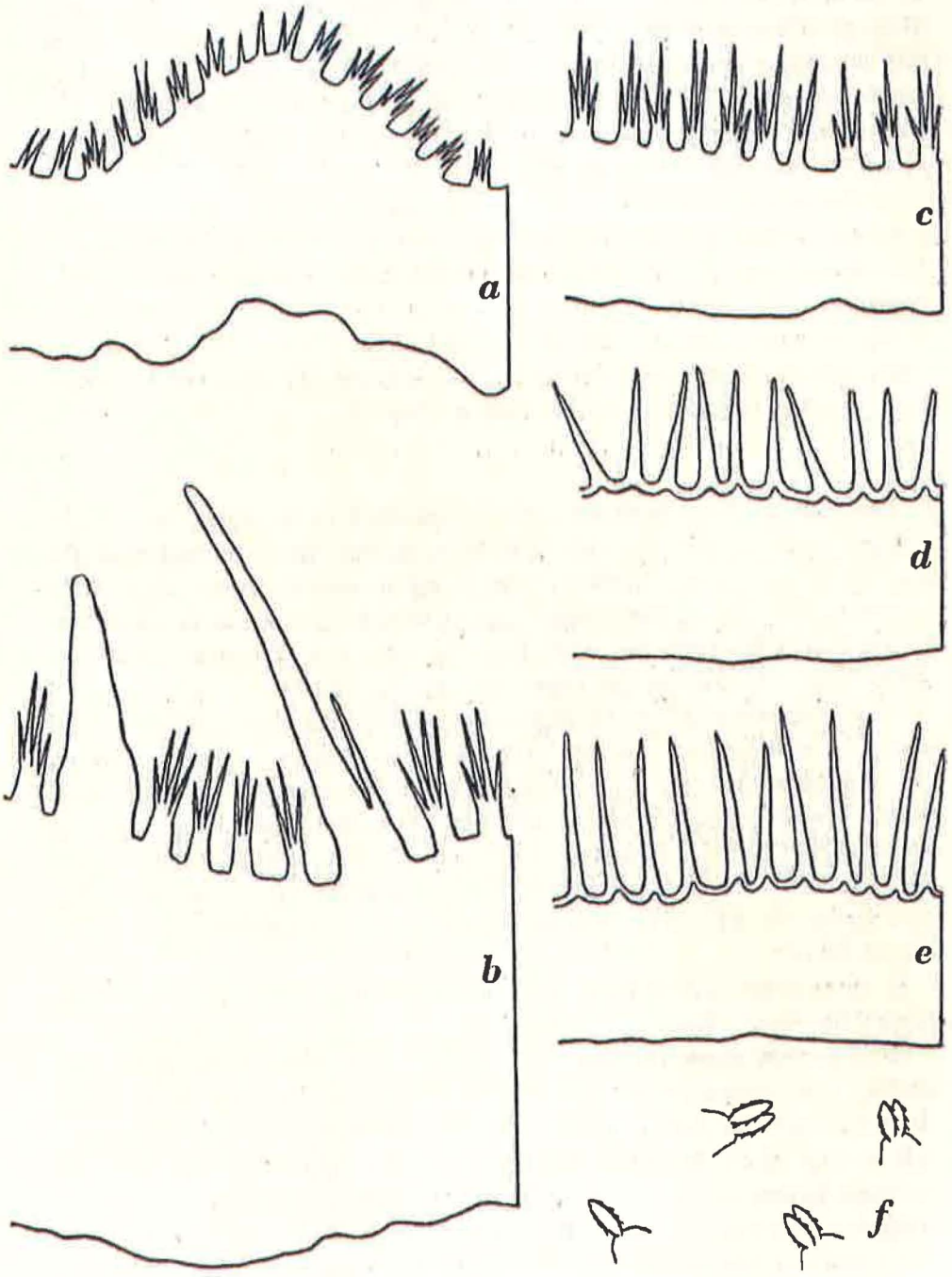

Fig. 18. *Loxothylacus variabilis,* specimen no. 991 A 1. a—e, surface view of excrescences in various parts of the external cuticle; f, retinacula. × 530.

parts. This is nothing but a supposition, and there is only one fact in favour of this opinion. In some parts of the cuticle, especially in the neighbourhood of the stalk, we find its surface covered by undivided hairs or spines (fig. 18 d, e). Here the spines consist of a rather hard hyaline kind of chitin which remains unstained. In their basal parts these spines are connected by a thin superficial layer of the cuticle, which has the same structure. The length of these spines varies from 24 μ (the smaller spines in fig. 18 d) to 45 μ (the larger spines in fig. 18 e)).

In the sections several parts of the external cuticle are found to possess numerous canals penetrating from the lower surface to the upper half of the cuticle (fig. 17 c). These canals often have a twisted, more or less corkscrew-like course.

The retinacula found in the preparations of the internal cuticle, made for this purpose, possess one or generally two spindles, the latter have a length of 9 to 12 μ, they are distinctly barbed (fig. 18 f).

No. 756.

The male genital organs are entirely contained in the dorsal half of the visceral mass, so that the vasa deferentia do not reach the region of the stalk. In longitudinal sections from a more ventral region than those represented in fig. 19 the visceral mass is seen to be attached to the mantle at some distance from the stalk, here the stalk is found in a region corresponding with that of the upper part of the figures.

Right and left male genital organs are of different shape and size. Soon after the male genital openings the right vas deferens already is much larger than the left (fig. 19 a). The left vas deferens is a very narrow canal which gradually passes into its distinctly curved testis. In fig. 19 b the terminal part of the left testis is represented in the lower part at the right; the small canal in the upper part of the figure is the left vas deferens. Fig. 19 c shows the left testis sectioned in a plane in the neighbourhood of its dorsal curve.

In the greater part of its ventral region the right vas deferens is fairly large (fig. 19 a). Towards its dorsal part the right vas deferens shows a kind of narrow curve (sectioned as the two thick canals in the upper part of fig. 19 b). Immediately after this curve it becomes very thick, whilst its lumen remains rather narrow, as the inner wall is covered with thick ridges (fig. 19 c). In the dorsal region of the right male organ the vas deferens passes into the testis (fig. 19 d), here the vas deferens has an irregular lumen on account of the ridges mentioned above, whilst the testis has a more or less smooth wall. The testis now runs in a ventral direction,

at first it is comparatively wide (fig. 19 c), but towards the ventral region it gradually becomes narrower (fig. 19 b and a). From the figures results that the male genital organs are distinctly and rather widely curved.

Fig. 16 a—c represents three sections of one of the colleteric glands, one

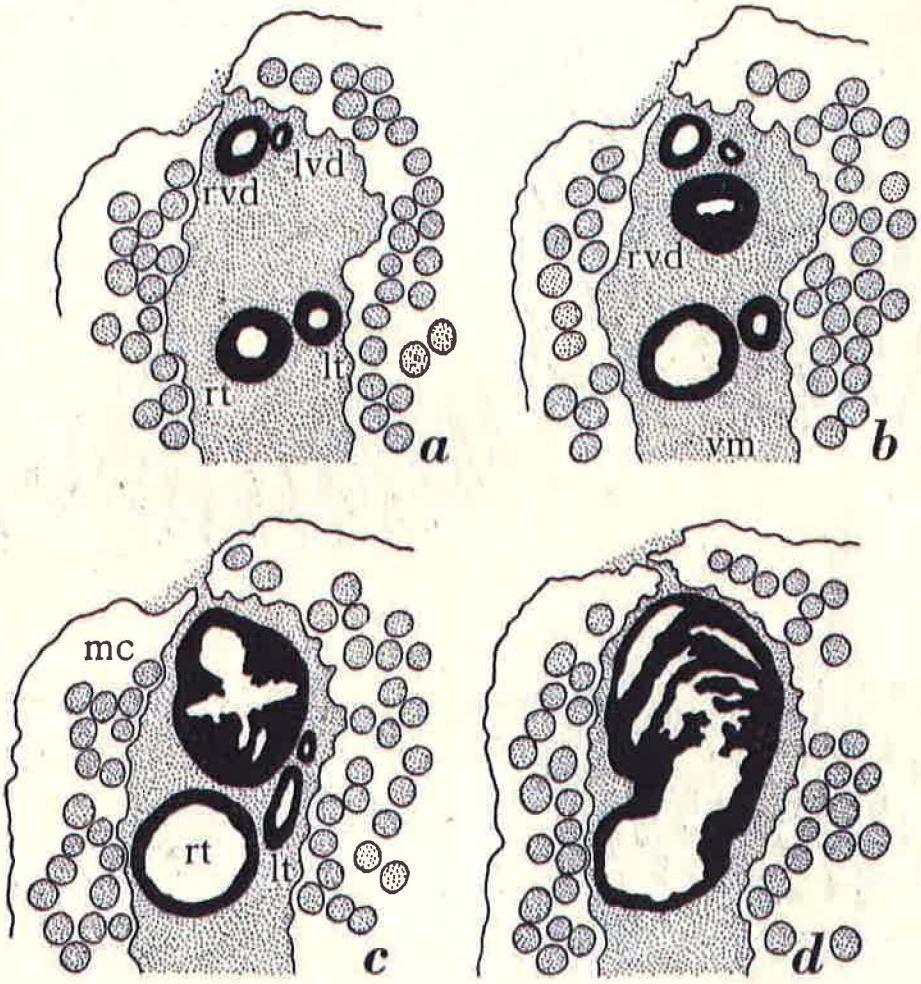

Fig. 19. *Loxothylacus variabilis*, specimen no. 756, longitudinal sections; a, through the ventral region of the male organs, each following section from a more dorsal region. lt, left testis; lvd, left vas deferens; mc, mantle cavity; rt, right testis; rvd, right vas deferens; vm, visceral mass. × 45.

from the central region, at some distance from the female opening (fig. 16 c), the second (fig. 16 b) from a more ventral or dorsal plane, and the third (fig. 16 a) from the peripheral region. In the region of fig. 16 b the number of canals is largest, though moderate. The figures show that the

branches of the canals towards the peripheral region appreciably diminish in size.

Measurements of the thickness of the external cuticle in different parts of the mantle gave amounts varying from 44 to 69 μ.

On its surface the external cuticle bears numerous small hairs, between these there is a far smaller number or large spines. The small excrescen-

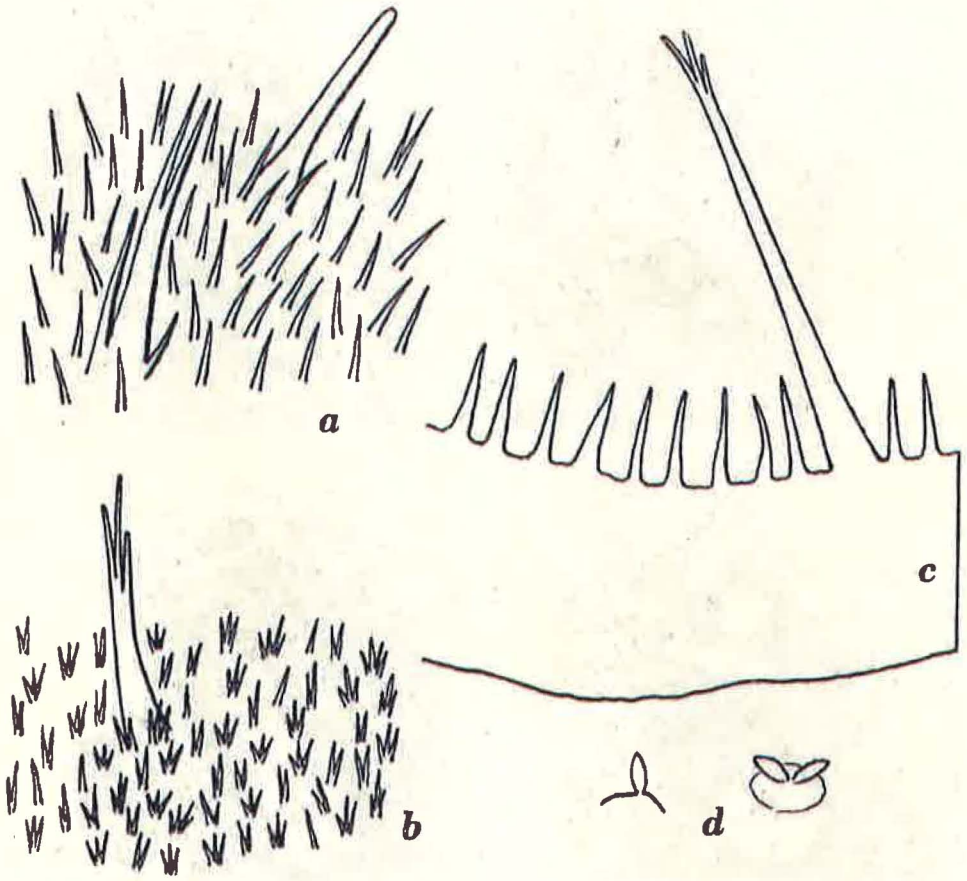

Fig. 20. *Loxothylacus variabilis*, specimen no. 756. a, b, surface view of excrescences in various parts of the external cuticle; c, section of the external cuticle; d, retinacula. × 530.

ces in many parts of the cuticle as a rule are undivided (fig. 20 a, length of the hairs 12 to 18 μ), in other parts these hairs for the greater part are split into two, three or four smaller spines (fig. 20 b, length of these excrescences 6 to 10 μ). The large spines drawn in fig. 20 a are 52 and 68 μ long, the one of fig. 20 b has a length of 60 μ. As the figures show these spines may have an undivided top or may appear as if split into two or more

smaller spines. In the section of the external cuticle drawn in fig. 20 c the smaller hairs have a length of 18 to 23 μ, the large spine is 112 μ long, the topmost part of this spine is divided into smaller parts. Some isolated spines from different regions of the external cuticle are drawn in fig. 21 a. Here again all stages between undivided spines and those in which the upper part is split into several smaller hairs are represented. The length of the

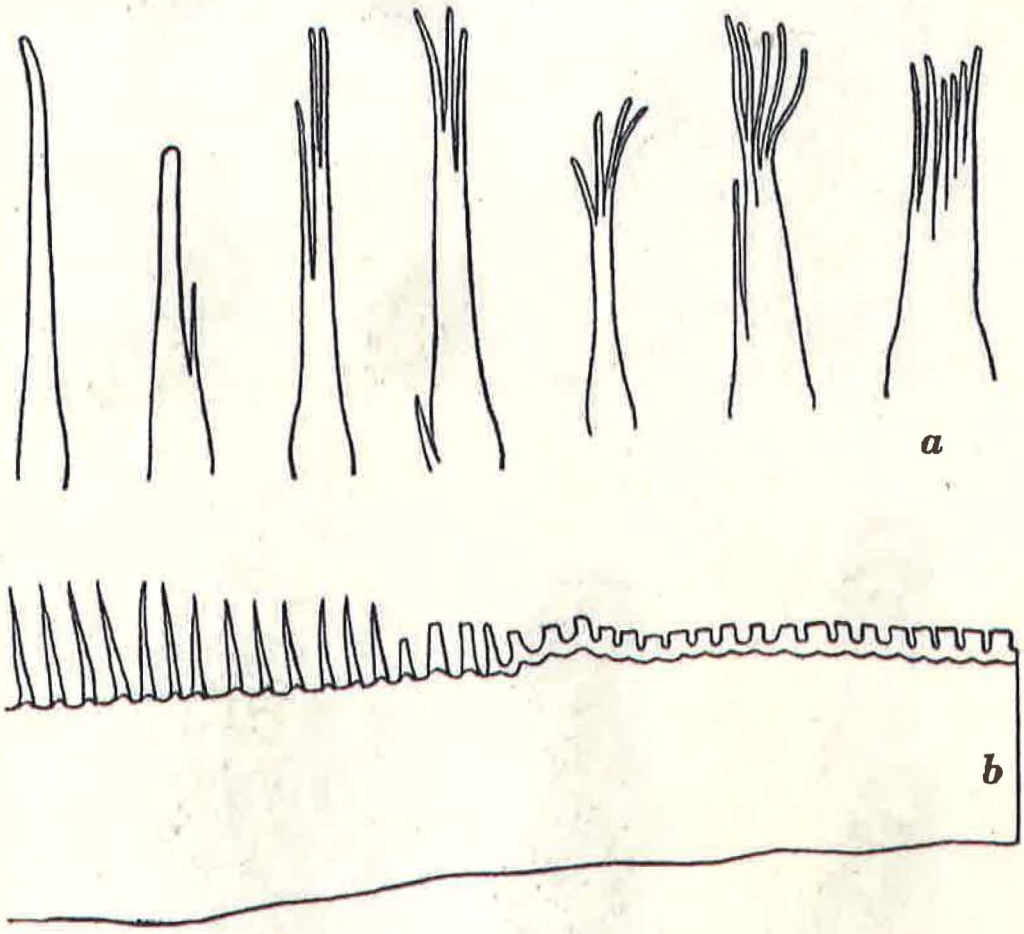

Fig. 21. *Loxothylacus variabilis*, specimen no. 756. a, excrescences from various parts of the external cuticle; b, section of the external cuticle. × 530.

figured spines varies from 75 to 106 μ, the thickness of their basal parts is from 9 to 24 μ.

In some parts of the external cuticle, in the neighbourhood of the stalk, the hairs consist of a hard, hyaline kind of chitin, so that they form a sharp basal boundary against the cuticle. In these parts the cuticle itself also may

form a hyaline layer of chitin on its surface, forming a common basal layer for these excrescences. Fig. 21 b shows a part of the cuticle on which excres-

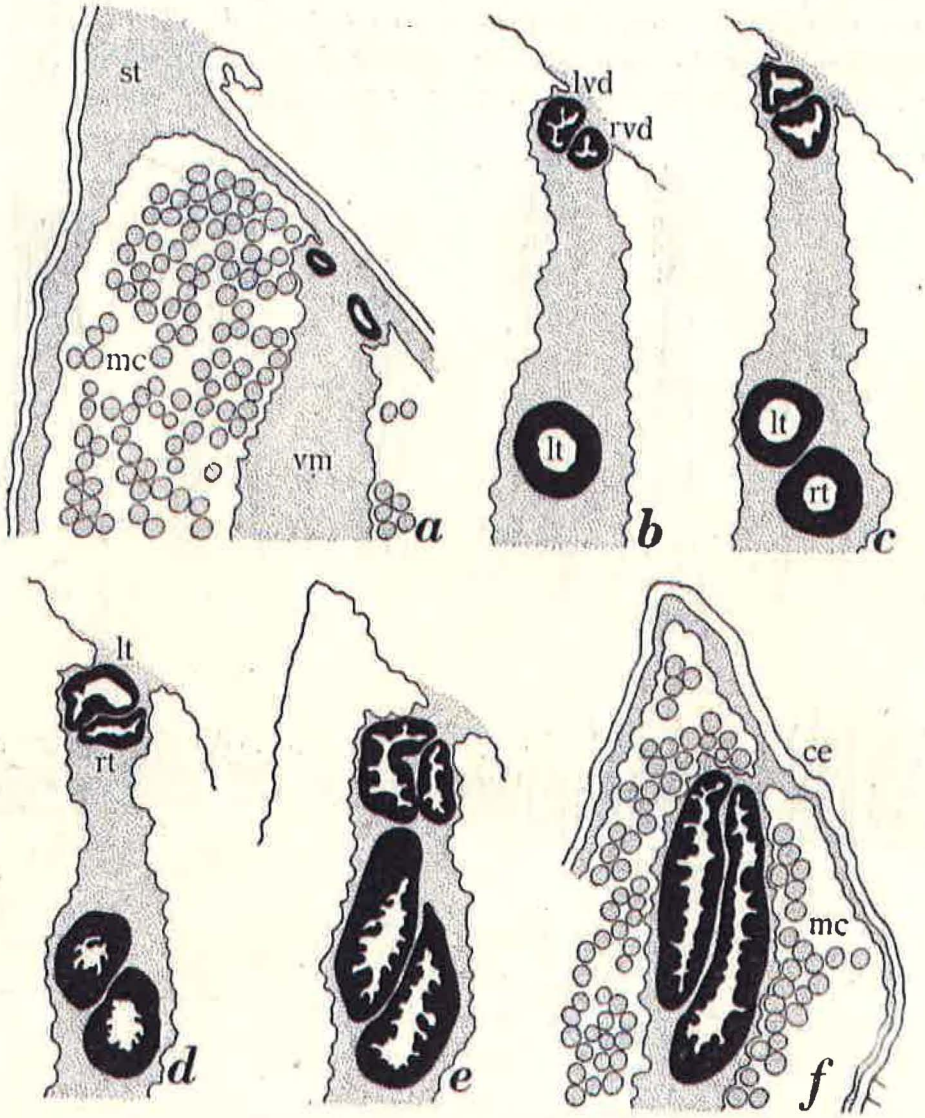

Fig. 22. *Loxothylacus variabilis*, specimen no. 844, longitudinal sections; a, through the stalk, each following section from a more dorsal region. ce, external cuticle; lt, left testis; lvd, left vas deferens; mc, mantle cavity; rt, right testis; rvd, right vas deferens; st, stalk; vm, visceral mass. × 30.

cences of this kind occur, these vary in length from 20 to 30 μ. In the right half of the figure the hyaline surface layer of the cuticle, which here has a

thickness of about 3 μ, is shown. The excrescences on this part have blunt tips, they appear as if broken or worn off.

Retinacula are present on the internal cuticle of the mantle. Their spindles are few in number (one or two)), they are 9 to 10 μ long (fig. 20 d). Barbs could not be found with certainty on these spindles.

No. 844.

In the middle part of the series of longitudinal sections we see that the visceral mass is attached to the mantle at a distance from the stalk (fig.

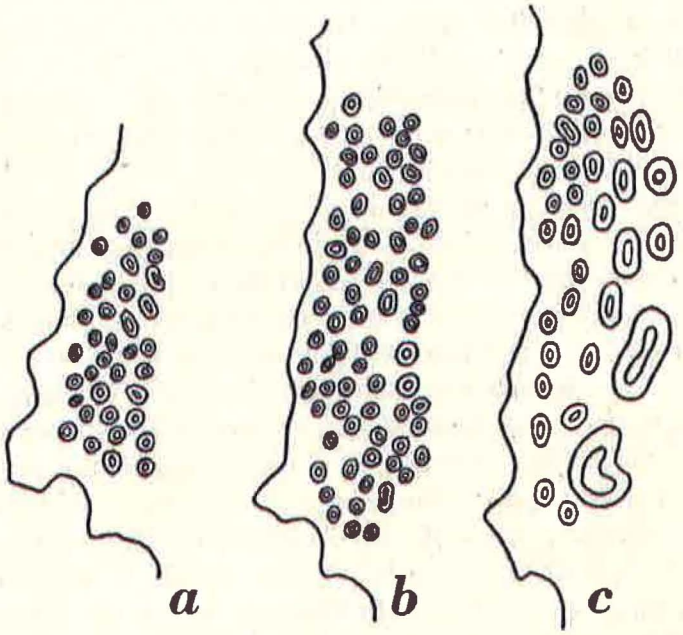

Fig. 23. *Loxothylacus variabilis*, specimen no. 844, longitudinal sections of one of the colleteric glands, posterior end at the upper side of the figures. × 107.

22 a). This section also shows the ventral part of the vasa deferentia, which here are comparatively narrow canals. In a more dorsal plane the vasa deferentia become wider, but their lumen remains narrow on account of ridges on the inner surface (fig. 22 b). Gradually the vasa deferentia increase in width whilst the transition of these organs into the testes is not distinct (fig. 22 c, d), it is not even certain whether the canals indicated with lt and rt in fig. 22 d represent the testes or still the vasa deferentia. In one region the canals are not running beside each other, but the one before the other (fig. 22 d). Towards the dorsal region the testes form a broadly

curved part (fig. 22 e, f), here the inner surface shows again numerous ridges. The terminal part of the testes runs in a ventral direction (fig. 22 d, lower part of the figure), gradually the inner surface of the testes looses its ridges (fig. 22 c). The two male organs have an approximately equal size, the left proceeds somewhat farther towards the ventral region (fig. 22 b, lt). As far as concerns their shape they are widely curved, so that the extremities of the testes lie in the central part of the visceral mass, rather far from the vasa deferentia (fig. 22 c).

Longitudinal sections of one of the colleteric glands are given in fig. 23, one (c) from a region not far from the centre, a second (b) from a more peripheral region, and a third (a) from a still more peripheral region. Wide canals occur in the central part of the gland only, towards the periphery these canals divide into smaller ones of narrower size. The largest number of canals is present in the region of the section of fig. 23 b, in the figured section this number amounts to 71. In the colleteric glands the canal system forms a rather compact mass.

The external cuticle of the mantle differs in thickness in various parts, measurements of this thickness gave amounts from 27 to 70 μ. In general the cuticle is thickest in the anterior half of the body. Here also the excrescences as a rule are longer than in the posterior half of the mantle.

A part of the external cuticle with well developed excrescences is drawn in fig. 24 a. Here the surface of the cuticle is covered with numerous small hairs or spines (length of these 16 to 23 μ), between these there occur, in a far smaller number, large spines which vary in length from 110 to 186 μ. These spines have a rather broad, swollen basal part, the remainder is slender and tapering towards the tip. Another part of the external cuticle is shown in surface view in fig. 24 b. Here the smaller excrescences partially are divided into two or three smaller branches, the length of these hairs or spines varies from 7 to 12 μ. Between these small excrescences there are a few thicker ones, 20 to 45 μ long, which correspond in shape and size with the basal parts of the large spines represented in fig. 24 a. Undoubtedly these larger excrescences are the remainders of broken spines. The divided tips of many of the smaller spines probably also are the result of splitting or originally undivided ones. A third part of the external cuticle is drawn in fig. 25 a, here the smaller hairs or spines have a length of 6 to 13 μ, the large spines vary in length from 66 to 130 μ. Many of the small excrescences have divided tips, the same has occurred in all the larger spines, so that they are split into three or four branches. It is probable that the tips of the excrescences have obtained this shape by breaking or wearing off.

In the three figures of excrescences in surface view a few of the smaller

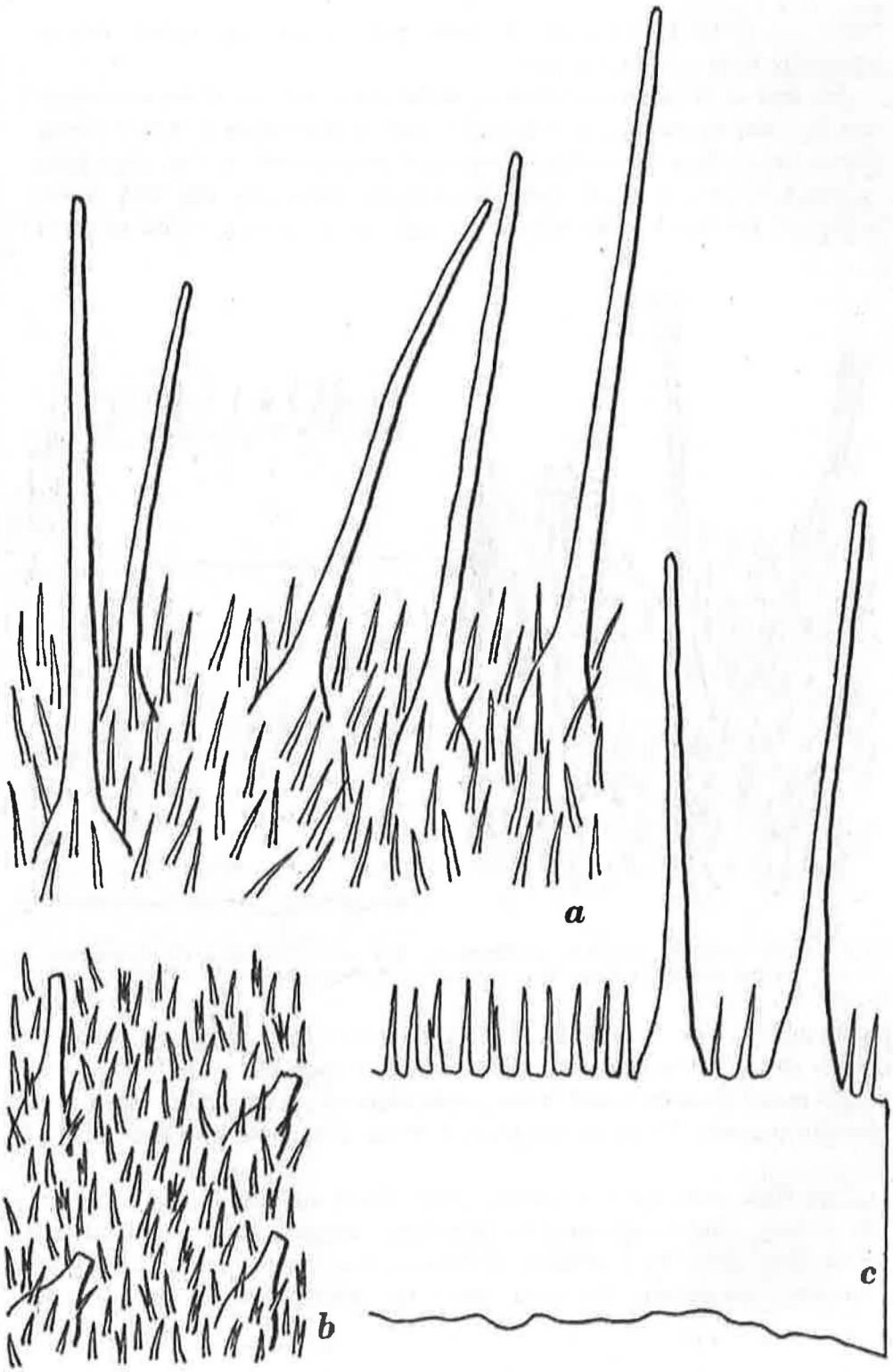

Fig. 24. *Loxothylacus variabilis*, specimen no. 844. a, b, surface view of excrescences in various parts of the external cuticle; c, section of the external cuticle. × 530.

hairs are found to occur on the basal part of the large spines, this is especially to be seen in fig. 24 b.

Sections of the external cuticle show the shape and size of the excrescences in a similar manner. In fig. 24 c a part of the cuticle is drawn which shows two large spines and numerous smaller excrescences. The latter have a length of 20 to 25 μ, the spines are 130 and 148 μ long. Fig. 25 b shows a part of the cuticle with hairs of a length of 13 to 16 μ, a few of these

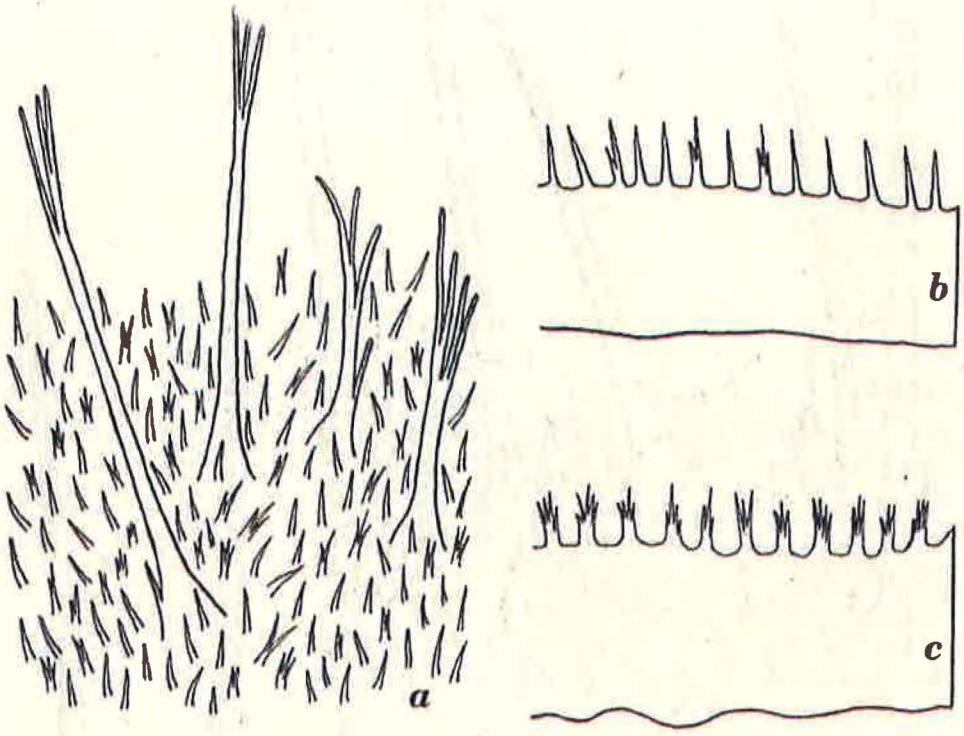

Fig. 25. *Loxothylacus variabilis*, specimen no. 844. a, surface view of excrescences of the external cuticle; b, c, sections of the external cuticle. × 530.

have divided tips. Finally fig. 25 c represents a part of the cuticle with rather strongly divided hairs, varying in length from 12 to 15 μ.

No retinacula were found in the preparations of the internal cuticle, made for this purpose. This does not mean, however, that these do not exist here.

The eight specimens described above form an interesting group of individuals which correspond in important characters, but which on the other hand show such striking differences that their specific identity is not absolutely certain. The chief reason for uniting them into one species

is the peculiar state of the excrescences of the external cuticle, different from that found in any other species of the Sacculinidae. In each of the eight specimens the external cuticle is densely covered with comparatively small hairs, among which there occur, much more sparsely distributed, large spines. The spines as well as the small hairs rather strongly vary in shape and size, but this variation in the different specimens is not more pronounced than in the different parts of the cuticle of one and the same specimen. An important indication for the specific identity of at least the five specimens first mentioned in the list of material is the fact that these five specimens are from one locality and are parasites of one species of host, *Chlorodiella nigra*. The differences of the two specimens on the unidentified Xanthid and of the specimen on *Actaea rüppellii* from the specimens on *Chlorodiella* are not more striking than those of the specimens on *Chlorodiella* among each other, so that there is no sufficient reason to regard these three specimens as specifically distinct from the five on *Chlorodiella*.

The large spines and, as a rule, the small hairs consist of approximately the same kind of chitin as that of the main layers. In sections no differences in staining are to be observed and the excrescences are united to the cuticle without any border-line. Exceptionally the small hairs may consist of a different kind of chitin, a more hyaline, harder kind. Then there is always a sharp line of demarcation where the excrescence is adhering to the cuticle, unless it is attached to a superficial layer of the cuticle of hyaline character which itself is sharply limited from the main part of the cuticle. These hard, hyaline spines always are undivided. They may be broken, but then the tips are flat and broad. Now this fact gives evidence for the opinion already expressed in former pages that the divided spines and hairs which occur in many specimens, in reality are damaged excrescences, split into branches on account of breaking or wearing off. In all specimens at least a part of the excrescences is undivided, but also in all specimens at least a part of the excrescences is divided. In specimen 722 A nearly all excrescences are undivided, the same holds for no. 767 A and no. 844. In no. 691 A and no. 707 B the large spines as a rule are divided, the greater part of the small hairs are undivided. In no. 756 the spines are divided, the hairs in some parts of the cuticle are undivided, in other parts rather strongly divided. Specimen no. 991 A 1 has undivided spines, whilst most of the small hairs are divided. This proves that not a division of the group into different species can be made based on the condition of the excrescences. The dimension of the spines and the hairs too is subject to extensive variation in the various parts of the cuticle of each single specimen, a

variation of the same order as that occurring in the excrescences of the whole group of specimens.

The retinacula of the eight specimens, as far as they were found, too are of sufficiently corresponding size and shape. In no. 722 A and in no. 767 A they are distinctly larger and robuster than in no. 756, but in general they are of the same type.

The collecteric glands of the eight specimens are of a uniform type. In general the number of canals is of the same order, in one of the specimens on *Chlorodiella nigra* (no. 707 A) and in the specimen on *Actaea rüppellii* (no. 844) this number is slightly larger. But the development of the canal system in the colleteric glands often is in direct correlation to the size of the animals, so that the differences mentioned above are of no importance. The distribution of the canals in the colleteric glands in all the specimens is rather uniform.

The real difficulty arises when we compare the male genital organs of the eight specimens. Then all kinds of differences are met with, some of these striking enough to regard them as specific or even as generic differences. In the following table the chief particulars of the male organs of the eight specimens are shown.

Number of specimen and name of host	Size of male genital organs	Curvature of male genital organs
722 A, on *Chlorodiella nigra*	about equal	distinct, narrow
691 A, on *Chlorodiella nigra*	left small, right large	distinct, rather wide
707 B, on *Chlorodiella nigra*	about equal	practically absent
707 A, on *Chlorodiella nigra*	left small, right large	one slight bend in right testis, but this testis running in dorsal direction
767 A, on *Chlorodiella nigra*	left small, right large	totally absent
991 A 1, on unidentified Xanthid crab	left small, right large	distinct, rather wide
756, on same species of host as no. 991 A 1	left small, right large	distinct, rather narrow
844, on *Actaea rüppellii*	about equal	distinct, wide

To the data of this table may be added that in specimen no. 707 B there is a wide region in the vasa deferentia preceded and followed by narrower

parts, a feature which does not occur in this manner in any of the other specimens, except, to a lesser degree, in no. 707 A.

As far as concerns the cuticular excrescences the eight specimens form a homogeneous group. As the parasites of this group were living on three different species of crabs we have to admit the possibility that we are dealing with three species, and therefore we must make a comparison of the characters of three groups of specimens, viz., the five parasites of *Chlorodiella nigra*, the two specimens on the unidentified Xanthid, and the single specimen on *Actaea rüppellii*.

But first of all we must decide whether or not the five specimens on *Chlorodiella* belong to one and the same species. When studying the male genital organs it is hardly to believe that they really are representatives of one species. The nos. 722 A and 691 A without any doubt belong to *Loxothylacus*, on account of the distinct curvature of the male organs. But in this character the two specimens are not completely alike, for in one the curvature is wide, in the other narrow. On account of the shape of the male organs no. 767 A should be placed into the genus *Sacculina*, for its male organs have a straight course. The two remaining specimens, nos. 707 B and 707 A, have male organs which for nearly the whole of their extent have a straight course, but which show, in their ventral half, a kind of double turn, so that at first the male organs continue their course in a postero-anterior direction, and soon afterwards resume their original course in a dorsal direction. The situation found here therefore reminds of what we find in *Sacculina*, but the double turn proves that the specimens are not typical representatives of the latter genus. This peculiarity is less distinct in no. 707 B than in no. 707 A. In these specimens there is a beginning of a curvature, the terminal part, however, does not proceed in a ventral direction, but continues in a dorsal direction. It may be regarded as an attempt for a curvature, but an attempt without complete success. Explained in this way the five specimens form a continuous series in which one specimen only does not show at least a distinct trace of a curvature. The differences between the specimens are not sufficiently striking to regard them as specifically different.

When the five specimens on *Chlorodiella* must be regarded as representatives of one species this species has to be placed into one of the genera *Loxothylacus* or *Sacculina*, as the mesentery is complete. In some specimens the curvature of the male organs is so pronounced, that it would be impossible to include them into *Sacculina*. Adding this to the fact that the situation of the visceral mass in respect to that of the stalk is at least

unlike to that in *Sacculina*, there is ample reason to classify the species into the genus *Loxothylacus*.

The specimens on the unidentified Xanthid undoubtedly belong to the genus *Loxothylacus*. The shape of the male genital organs of these two specimens corresponds closely with those of no. 691 A, so that in all probability they are specifically identical.

In the specimen on *Actaea rüppellii* the male organs are of the same general shape as those of no. 722 A: in each specimen the two male organs are of equal size and are distinctly curved. Specimen no. 844 differs, however, to a certain degree from all the other specimens, the curvature of the male organs here is wider than in any other specimen. Moreover the part of the male organs in which the wall is covered with ridges occupies a much longer region than in the other specimens: the ridges are found even in the anterior part of the curvature. But these differences do not seem to be of sufficient importance to warrant a specific separation of this single parasite.

Nothwithstanding the pronounced individual differences the eight specimens described above are united into one species, chiefly on account of the cuticular excrescences which are unlike those of any previously described species. In the genus *Loxothylacus* there is but one species with excrescences of the same size (or of larger size) than those of *L. variabilis*, viz., *L. corculum*. The conical spines of *L. corculum*, however, are so unlike those of *L. variabilis* that a further comparison of the characters of the two species is unnecessary.

Loxothylacus echioides nov. spec.

(figs. 26—29)

1 specimen examined:

821. Mamoedjoe, Celebes, reef or shore, 4—5 Aug. 1929, on *Euxanthus exsculptus* (Herbst); 12 × 10 × 5 mm.

Specific characters. Male genital organs rather widely curved, terminal parts not far from the centre of the visceral mass. Left testis larger than the right. Colleteric glands with a fairly large quantity of branched canals. External cuticle of the mantle densely covered with small hairs varying in length from 19 to 45 μ. Between these hairs there occur, in far smaller number, large conical spines which are covered over the whole of their surface with hairs of the same shape as those just mentioned. The large spines have a length of 100 to 250 μ. Retinacula with 4 to 6 barbed spindles which are 9 to 13 μ long.

The specimen is of reniform shape, the stalk being placed in a concavity at the posterior region. The mantle opening with its surroundings does not project noticeably above the surface of the mantle. At the surface which was

touching the abdomen of the host the mantle shows one median and two lateral pronounced grooves, caused by pressure of the abdomen and the pleopods of the host. For the rest the mantle has a comparatively smooth surface.

A few more details of the specimen are given below.

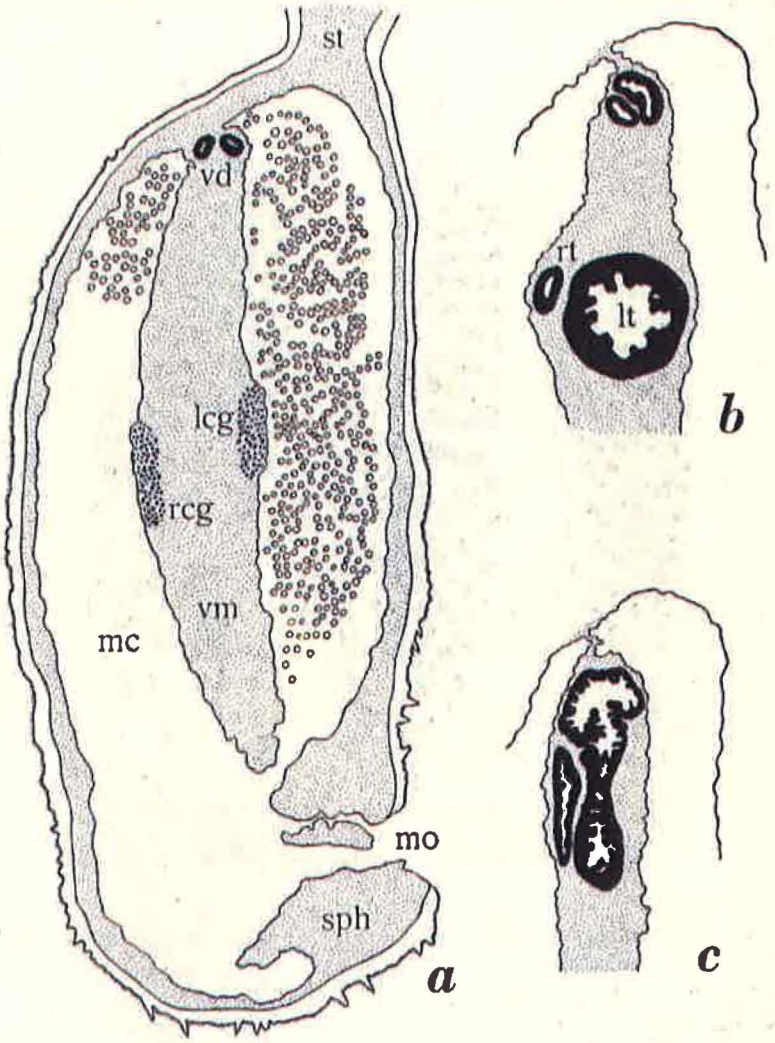

Fig. 26. *Loxothylacus echioides*, longitudinal sections; a, through the stalk and the mantle opening, each following section from a more dorsal region. lcg, left colleteric gland; lt, left testis; mc, mantle cavity; mo, mantle opening; rcg, right colleteric gland; rt, right testis; sph, sphincter of mantle opening; st, stalk; vd, vasa deferentia; vm, visceral mass. × 12.

A section from the central part of the series of longitudinal sections shows that the visceral mass is attached to the mantle at some distance from the stalk (fig. 26 a). The same section shows that the colleteric glands are found in about the central part of the lateral surfaces of the visceral mass. The section further shows the mantle opening, in a slightly farther dorsal plane this opening has vanished and the mesentery is visible.

In their ventral part the vasa deferentia are narrow canals (fig. 26 a). Towards the dorsal region they gradually increase in size, whilst ridges

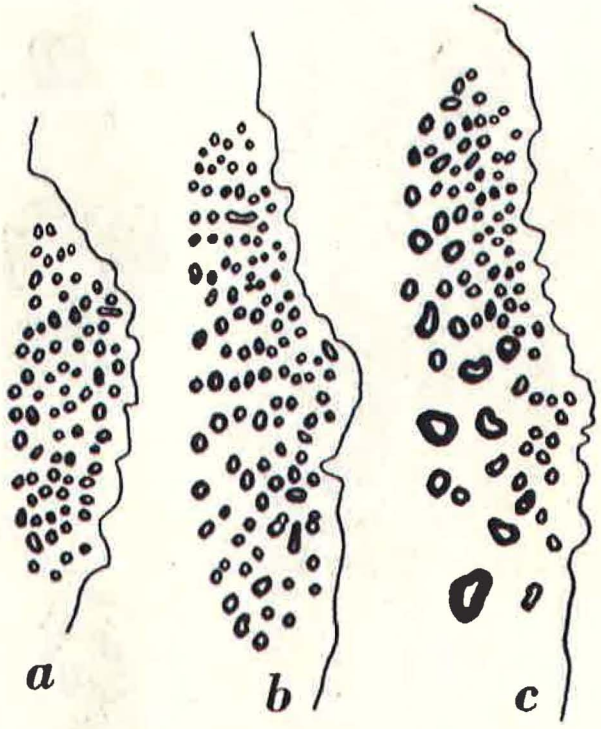

Fig. 27. *Loxothylacus echioides*, longitudinal sections of one of the colleteric glands, posterior end at the upper side of the figures. × 60.

develop on their inner surface (fig. 26 b). There is a gradual transition from the vasa deferentia into the testes. In their dorsal parts the male organs form a wide curve (fig. 26 c), so that the closed extremities of the testes lie not far from the central region of the visceral mass. The two testes greatly differ in size, the right testis remains comparatively small, whilst the left has a very thick terminal part, which causes a considerable swelling of the visceral mass (fig. 26 b).

In this specimen the canals of the colleteric glands possess a distinct layer of chitin, represented in black in the figures of sections of one of these glands (fig. 27). One of these sections (a) is from the peripheral region, a second (b) from a more central part, and the third (c) from a still more central part, though still at some distance of the centre of the organ. These glands contain a fairly large number of branched canals, so that in one region (fig. 27 b) 109 sections of canals can be counted. The canal system of the colleteric glands forms a rather compact mass, which, however, does

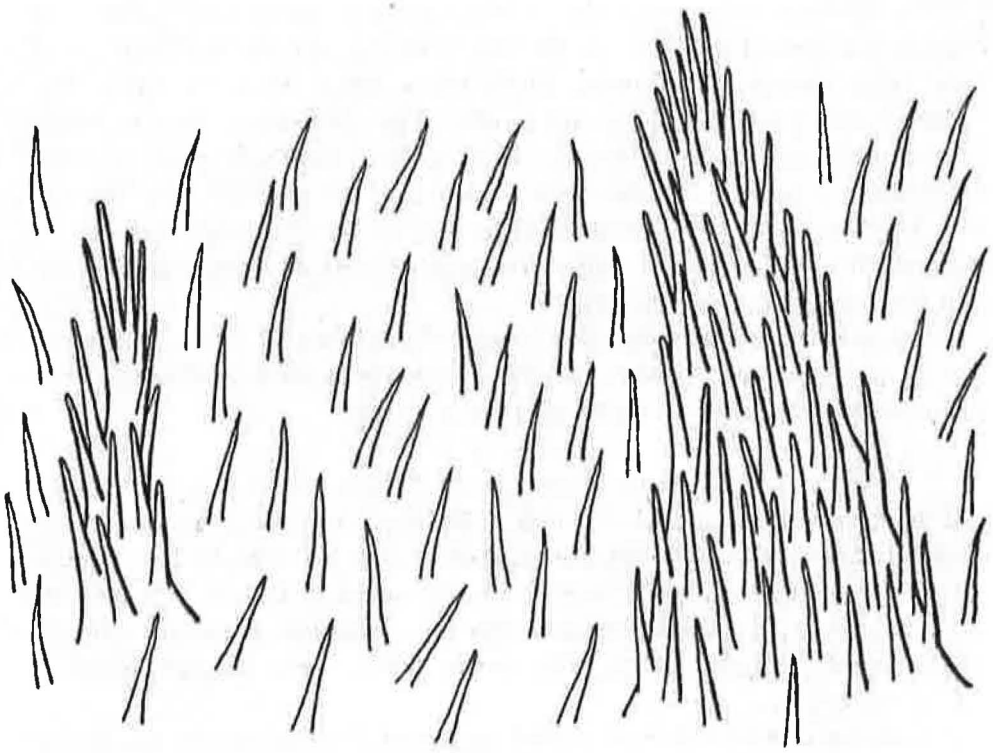

Fig. 28. *Loxothylacus echioides*, surface view of excrescences of the external cuticle. × 530.

not cause the glands to protrude appreciably above the surface of the visceral mass.

Some measurements of transverse sections of the external cuticle of the mantle gave values varying from 52 to 194 μ.

The surface of the external cuticle is rather densely covered with comparatively small hairs or spines, between these occur large spines which over the whole of their surface are covered with similar hairs or spines. A part of the cuticle is represented in surface view in fig. 28. Here the small

hairs have a length of 20 to 30 μ, the two large spines present in this part of the cuticle are 98 and 159 μ long. The largest of these spines has a basal thickness of 78 μ. This spine, however, is not one of the very largest, some of these spines reach a length of 250 μ and a basal thickness of 110 μ. As appears from the figures and from the measurements the shape of the large spines is more or less conical. Their covering of smaller hairs is rather uniform in every part, so that in all probability these hairs form a typical part of the spines, not having arisen on account of division of an originally smooth spine.

Fig. 29 shows two sections of different parts of the external cuticle, the one drawn around the other. In the section of fig. 29 b the median plane of one large spine is represented, which has a length of about 165 μ. The smaller spines on the cuticle and on the large excrescence vary in length from 25 to 45 μ. In the other section (fig. 29 c) two basal parts of large spines are to be seen together with a number of the smaller hairs. The size of the hairs in this part of the cuticle is from 19 to 27 μ. In general the excrescences (the hairs as well as the large spines) are longer and thicker on the thicker parts of the cuticle.

The internal cuticle of the mantle bears retinacula (fig. 29 a), distributed in the usual manner. Usually they have 4 to 6 spindles with distinct barbs. The length of these spindles varies from 9 to 13 μ.

Loxothylacus echioides is pronouncedly different from all other species of the genus except one, *L. corculum*. The spines, which occur on the external cuticle of the two species, are of similar shape and size. In *L. corculum*, however, the spines have a smooth surface, whilst in *L. echioides* they are covered with numerous hairs. Moreover in *L. echioides* there occur similar hairs on the cuticle between the spines, whilst these are not found in *L. corculum*.

A comparison of the male genital organs of the two species shows that also in this respect there are differences. In *L. corculum* the two male organs are of approximately equal size, they have a very wide curvature so that the terminal part of the testes lies in the anterior half of the visceral mass (Van Kampen & Boschma, 1925, pl. II fig. 3). On the other hand in the type specimen of *L. echioides* the left testis is much larger than the right, the curvature of the male organs is rather wide, but the male organs are entirely contained in the posterior half of the visceral mass.

Moreover the retinacula are different in the two species. In *L. echioides* they possess 4 to 6 spindles of a length of 9 to 13 μ, whilst in *L. corculum* they have 8 to 12 spindles of a length of about 18 μ.

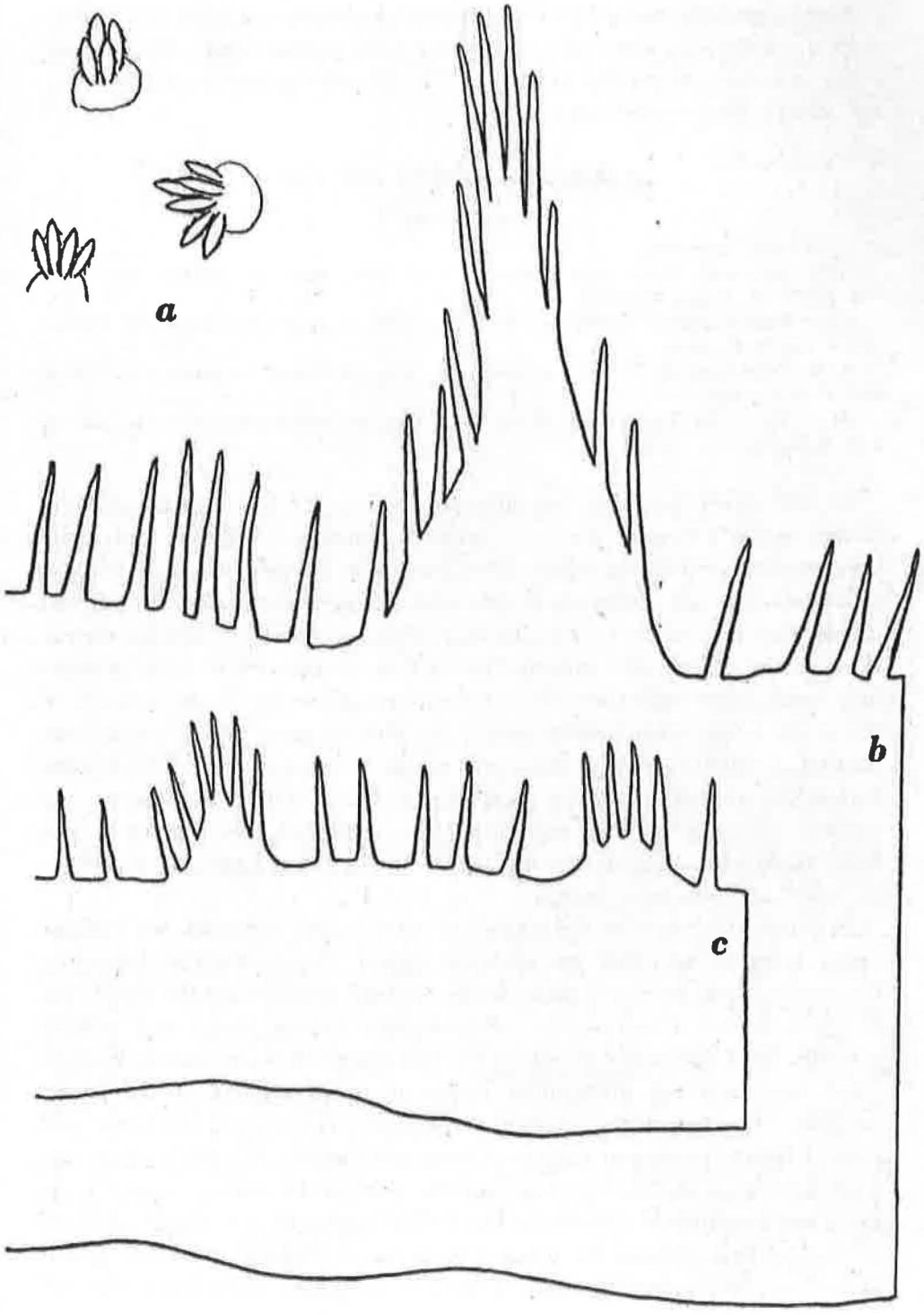

Fig. 29. *Loxothylacus echioides*. a, retinacula; b, c, sections of the external cuticle. × 530.

As only one specimen of *Loxothylacus echioides* is available it is not quite certain whether the shape and size of the male genital organs as described above is a constant specific character. The cuticular excrescences, however, sufficiently characterize the species.

Loxothylacus torridus nov. spec.

(figs. 30—40)

4 specimens examined:
794 B (holotype). Kera near Timor, 15—16 Nov. 1929, on *Actaea tomentosa* (M. Edw.); 8 × 6½ × 2 mm.
703 A. Near Koepang, Timor, reef, 8—9 Dec. 1929, on *Actaea tomentosa* (M. Edw.); 8½ × 8½ × 2½ mm.
703 B. Near Koepang, Timor, reef, 8—9 Dec. 1929, on *Actaea tomentosa* (M. Edw.); 7½ × 7 × 2 mm.
684 A. Kera near Timor, reef, 22—23 Nov. 1929, on *Actaea tomentosa* (M. Edw.); 9 × 8 × 2½ mm.

Specific characters. Male genital organs not curved, but as a rule showing in one region a definite deviation in postero-anterior direction. Left male organ slightly or pronouncedly smaller than right. Cavities of vasa deferentia separated or united. Colleteric glands with a moderate quantity of branched canals. External cuticle besides the main layers composed of hyaline formations in the upper part, causing the surface of the cuticle to be divided into small areas with very distinct contours (diameter of the areas 6 to 18 μ). As a rule each hyaline object has five or more lateral extensions, causing a pronouncedly sinuous contour in a surface view. The hyaline formations consist of upper parts which are in rather narrow mutual contact and variously tapering roots. The length of these formations is from 16 to 44 μ. Retinacula with 2 to 6 spindles of a length of 6 to 13 μ, on which no barbs were found.

In general the shape of the animals is more or less trapezoid, the anterior region being broader than the posterior region. The four angles, especially the anterior two, project as small knobs. Instead of trapezoid the shape may be more or less quadrangular, with slightly convex dorsal and ventral margins. In all specimens the surface of the mantle shows numerous grooves which are especially pronounced in the marginal regions of the lateral surfaces. Here they form a system of parallel grooves along the dorsal and ventral region, passing at the above mentioned knobs with sharp angle into a similar system of grooves on the anterior part of the mantle. Besides these there are longitudinal grooves in the central region of the lateral surfaces. Owing to these grooves the whole mantle has a strongly wrinkled appearance. The mantle opening does not project noticeably above the surface of

the mantle, it is rather narrow, and lies in the middle of the anterior region.

Some more details of the specimens follow here.

No. 794 B.

From the series of longitudinal sections it appears that in the middle part of the body the stalk is in direct contact with the visceral mass, the latter has only shifted somewhat to one side (fig. 30 a). In more dorsal

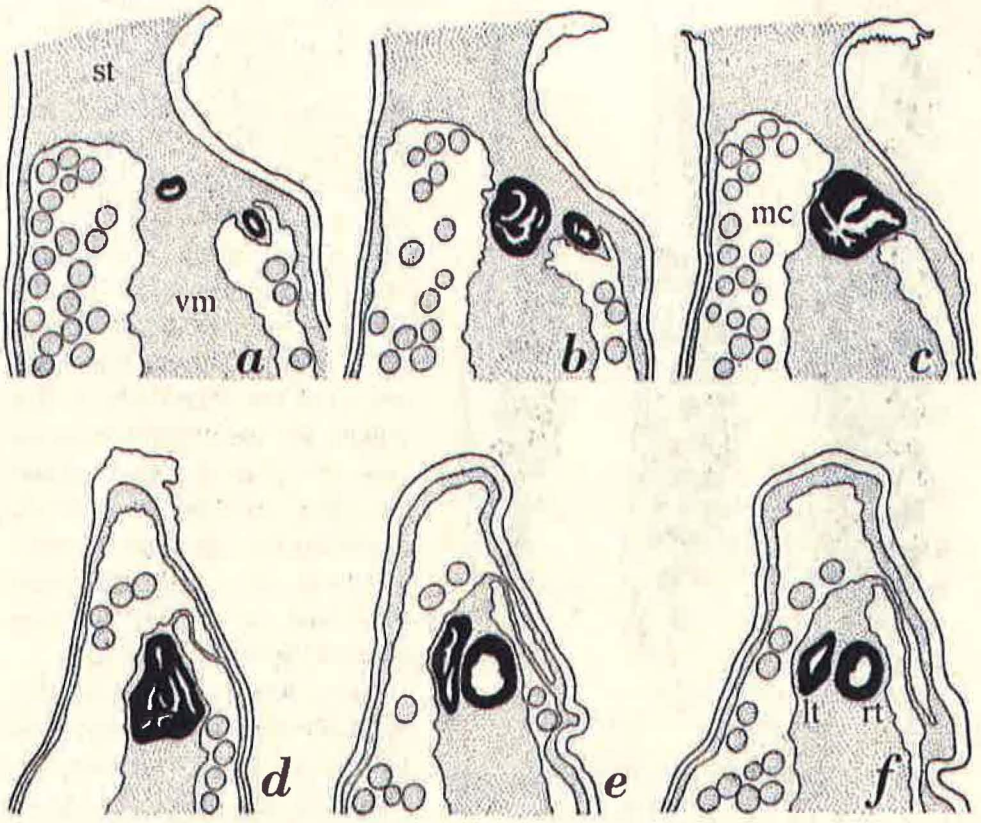

Fig. 30. *Loxothylacus torridus,* specimen no. 794 B, longitudinal sections; a, through the stalk, each following section from a more dorsal region. lt, left testis; mc, mantle cavity; rt, right testis; st, stalk; vm, visceral mass. × 30.

regions the visceral mass gradually moves towards the right half of the mantle (fig. 30 b, c), and the mesentery at last is attached to the mantle at a considerable distance from the posterior region of the body (fig. 30 d, e, f).

The vasa deferentia, which in the region of the male genital openings are narrow canals (fig. 30 a), soon increase in thickness, whilst their cavities

become irregular on account of numerous ridges on the inner surface (fig. 30 b). For some distance the two vasa deferentia remain separated, but towards their dorsal part they are completely united, so that even the cavities from one space (fig. 30 c). In some parts of this region the sections show numerous small openings only, so that it is not distinct whether the two cavities are separated or not (fig. 30 d). In a slightly more dorsal plane the two male organs are completely separated again (fig. 30 e), and from this region the testes, which do not increase in size, continue into a dorsal direction (fig. 30 f).

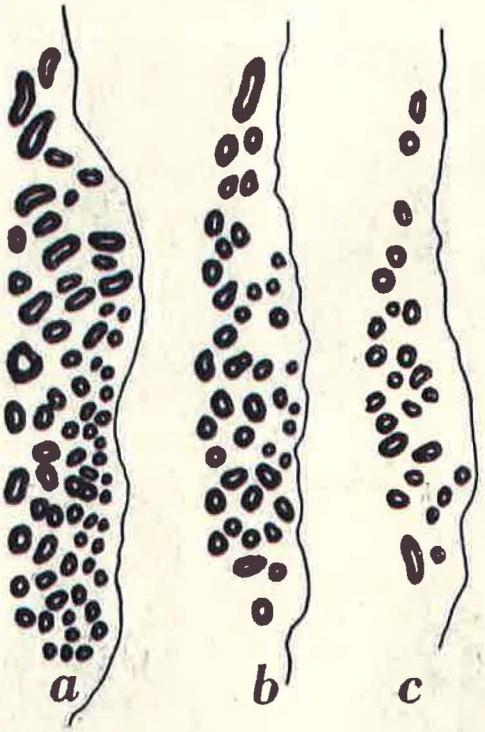

Fig. 31. *Loxothylacus torridus*, specimen no. 794 B, longitudinal sections of one of the colleteric glands, posterior end at the upper side of the figures. × 80.

The male genital organs do not show a distinct curve. There is a slight change in the course of these organs in the region of fig. 30 d, e. The part of the male organs at the ventral side of this region lies in the extreme posterior part of the visceral mass, whilst the part of the male organs at the dorsal side of this region lies at a slight distance from the posterior part of the visceral mass (fig. 30 f). Principally in this specimen there is a similar curve as in specimen no. 684 A (fig. 38), but this curve is hardly to be seen.

In the colleteric glands of this specimen the canals show the product of secretion, drawn in black in fig. 31. The canal system of the colleteric glands is well developed, the glands are rather flat, but comparatively large. Figures of three sections of one of these glands are given here, one (fig. 31 c) from a peripheral region, the second (b) from a more central part, the third from a still more central region, but at a fair distance from the opening of the gland. In the section of fig. 31 a, which is from the part in which the canal system shows the largest amount of branches, 71 canals can be counted.

Some measurements of the external cuticle of the mantle yielded values

of 22 to 75 μ, in general this cuticle is thicker in the anterior region of the body, thinner in the posterior part.

The external cuticle does not possess distinct excrescences, but it consists of two kinds of chitin. In the upper half of the cuticle there are small conical objects of a highly transparent, hyaline kind of chitin which are not stained. With their pointed ends they are embedded in the main layers of the cuticle, forming a continuous mass with their more or less flat broad ends towards

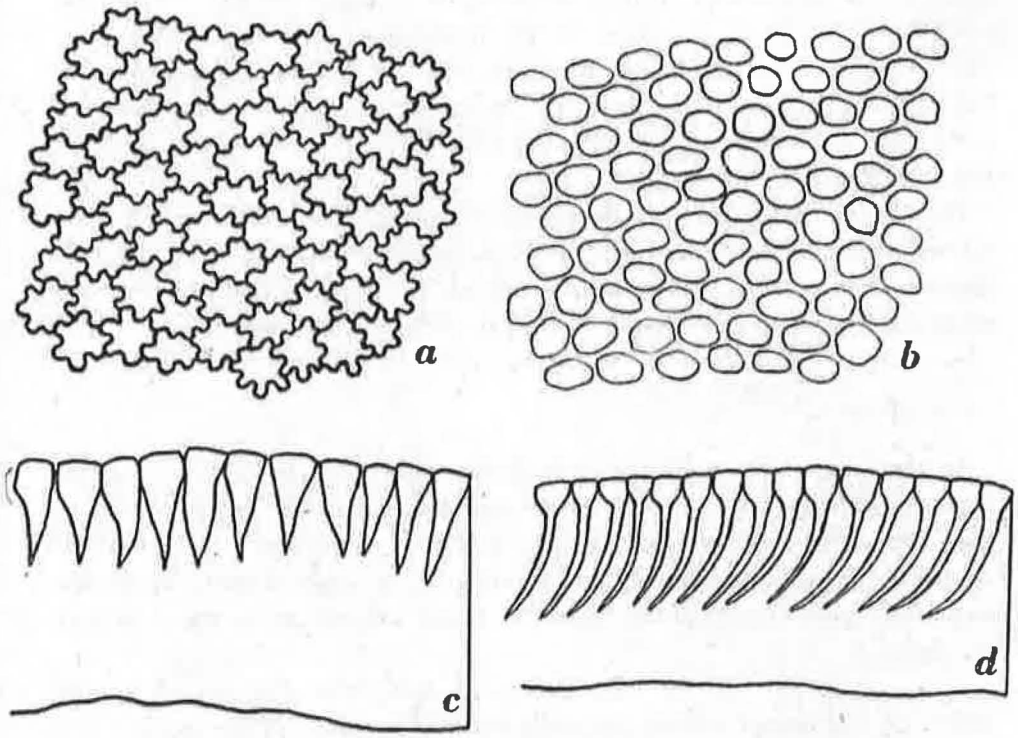

Fig. 32. *Loxothylacus torridus*, specimen no. 794 B. a, surface view of the external cuticle; b, roots of the excrescences as seen slightly below the surface of the external cuticle; c, d, sections of the external cuticle. × 530.

the surface of the cuticle (fig. 32 c). In some parts of the cuticle these hyaline objects have another shape, at the surface of the cuticle they consist of a corpuscle of about the same breadth and height, which is projected into a rootlike expansion directed towards the lower layers of the cuticle in a straight or somewhat curved course (fig. 32 d). The hyaline parts of the cuticle drawn in fig. 32 c have a length of 21 to 27 μ, their thickness, in the superficial region of the cuticle, amounts to 7 to 10 μ. The hyaline parts shown in fig. 32 d have a length of 30 to 36 μ, the thickness of their upper

part is 5 to 7 μ. The thicker upper part of the hyaline objects has an irregularly undulating contour, as results from a surface view of the cuticle (fig. 32 a). The hyaline chitinous parts are in close mutual contact, their numerous lateral excrescences fit exactly in niches between excrescences of the other hyaline chitinous parts. In this way a surface view of the cuticle reminds of what occurs in many species of Sacculinidae with a cuticle without excrescences, showing the parts originally secreted by each individual cell of the epithelium. Here, however, the margins of each area are much more pronounced. When focussing at a slight distance below the surface of the cuticle the roots of the hyaline parts become visible (fig. 32 b), these have a more or less round or oval or slightly polygonal contour. The areas in fig. 32 a, representing the upper surface of the hyaline chitinous parts, have a diameter of 6 to 15 μ, the roots in the plane shown in fig. 32 b have a diameter of 4 to 12 μ.

On the internal cuticle of the mantle there occur retinacula of approximately the same shape and size as those of the other specimens of this species. They are in a less suitable condition for drawing than those of the other specimens, so that I refer to the latter for further particulars.

No. 703 A.

In the middle region of the body the visceral mass is in direct contact with the stalk (fig. 33 a), the visceral mass has here but slightly moved to the right of the median plane of the body. In a more dorsal region the mesentery is attached to the mantle at a fairly large distance from the posterior region (fig. 33 d, the posterior region is shown in the upper part of the figure).

The ventral part of the vasa deferentia is narrow (fig. 33 a). In the region on the dorsal side of the stalk the male organs become thicker and partially are in close contact (fig. 33 b, c, d), so that in some sections it is difficult to state whether the two cavities remain separated or not (fig. 33 b). In this region the main course of the male organs is in a postero-anterior direction. After this region the testes continue their course in a dorsal direction (fig. 33 e). The left testis is distinctly smaller than the right.

Here again the male organs do not show a distinct curve as occurs in other species of the genus *Loxothylacus*. The male organs are only bent twice at about right angles: once in a postero-anterior direction and once in a dorsal direction.

The posterior part of a longitudinal section from the middle region of the body is represented in fig. 34. It shows the two colleteric glands, which

are found in the anterior end of the visceral mass. One of these, the right (in the right half of the figure), is sectioned through about the centre, so that some of the widest branches of the canal system are shown. Of the left

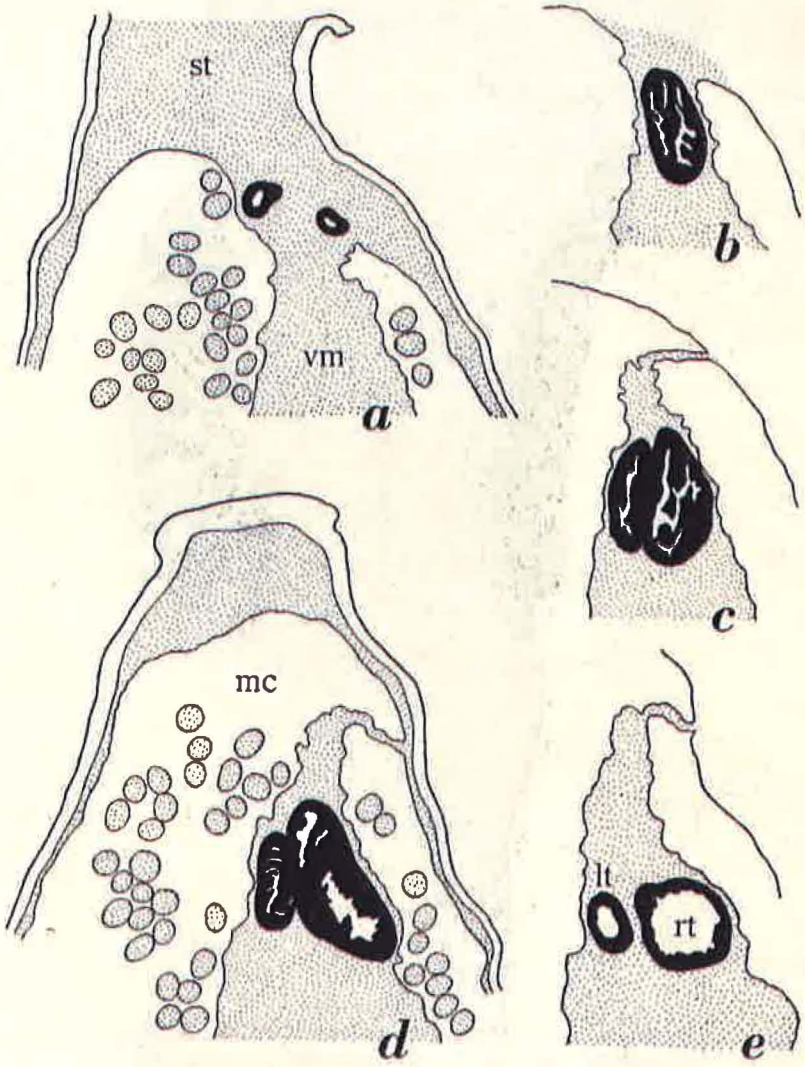

Fig. 33. *Loxothylacus torridus*, specimen no. 703 A, longitudinal sections; a, through the stalk, each following section from a more dorsal region. lt, left testis; mc, mantle cavity; rt, right testis; st, stalk; vm, visceral mass. × 30.

colleteric gland a section is represented from a region at a slight distance from the centre. In the drawing the number of canals in the right colleteric

gland is 42, in the left 55, in some other sections this number is somewhat higher.

The external cuticle varies in thickness in different parts of the mantle.

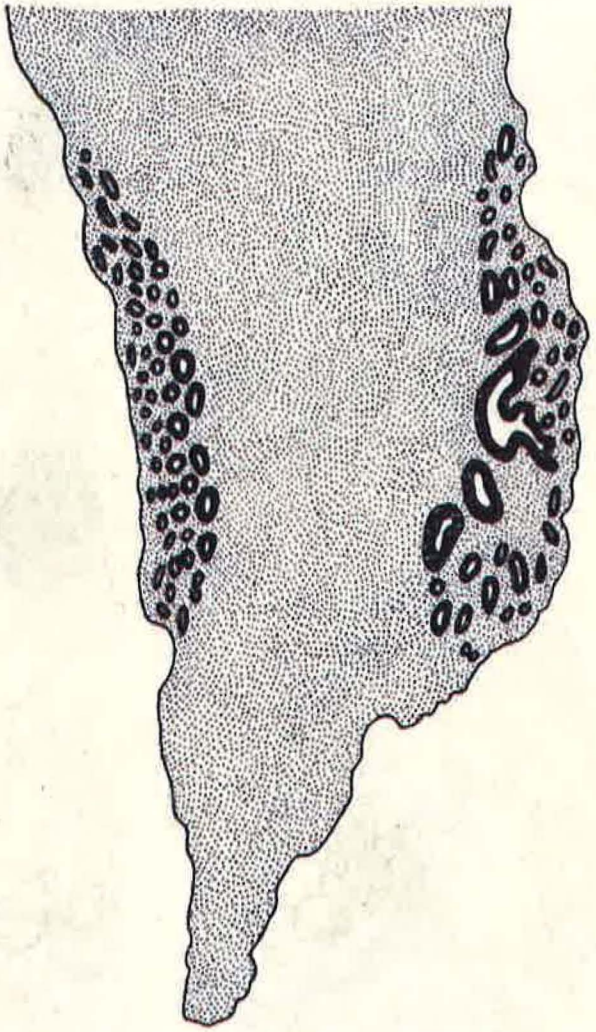

Fig. 34. *Loxothylacus torridus*, specimen no. 703 A, longitudinal section of the anterior part of the visceral mass, showing the two colleteric glands. × 60.

Measurements of some parts of this cuticle gave amounts from 33 to 66 μ.

The surface of the external cuticle does not possess distinct excrescences, but there are more or less conical parts of chitin of a strongly hyaline matter

which are placed in the upper half of the cuticle, their broader part upwards. In certain parts of the cuticle these hyaline objects are of a neatly conical

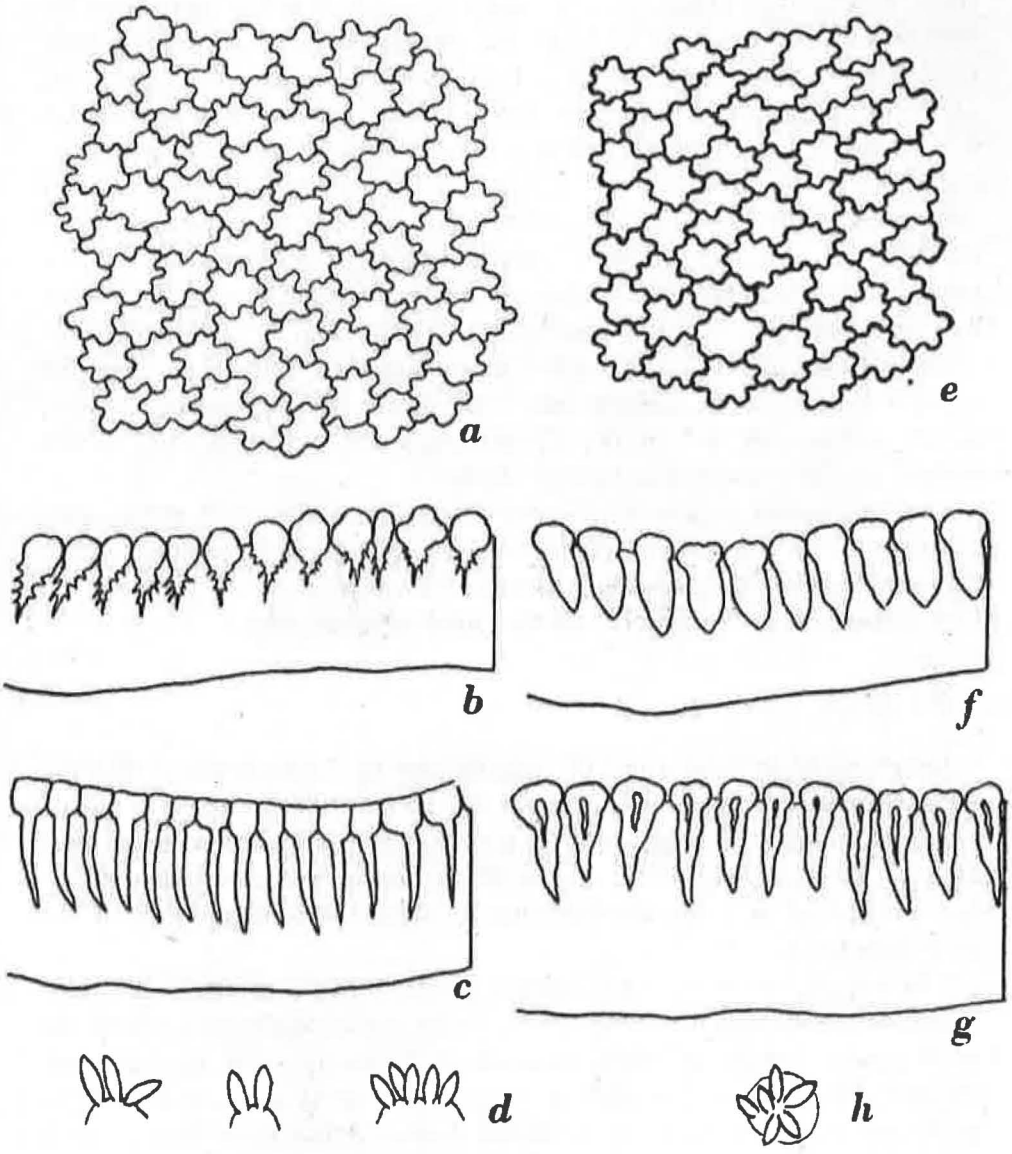

Fig. 35. *Loxothylacus torridus*. a—d, specimen no. 703 B; e—h, specimen no. 703 A. a, and e, surface view of the external cuticle; b, c, and f, g, sections of the external cuticle; d, and h, retinacula. × 530.

shape (fig. 35 g), gradually tapering from the broader part towards the top of the cone which is directed towards the lower region of the cuticle.

Often these conical chitinous plugs show a small central cavity as drawn in fig. 35 g. The length of these cones is 21 to 30 μ, their thickest part has a diameter of 6 to 12 μ. In other parts of the cuticle the plugs of hyaline chitin have another shape, as, e. g., those represented in fig. 35 f. Here the thicker part forms a kind of knob, the remainder forms a comparatively thick root pointing towards the lower region of the cuticle. The upper part of the hyaline parts of chitin here has a diameter of 8 to 10 μ, the objects as a whole have a length of 19 to 24 μ. As already appears from fig. 35 f, g, the upper part of the chitinous plugs is extended laterally. These lateral extensions of the individual plugs are fairly numerous, so that each hyaline object has five or more of these lateral extensions, the latter neatly fit into each other so that each lateral extension is enclosed in the space between two extensions of another conical part of chitin. This is distinctly visible when the external cuticle is studied in surface view (fig. 35 e), then the surface appears to be divided into small areas with a sinuous contour, having a diameter of 6 to 18 μ. These areas are the broad parts of the conical objects consisting of hyaline chitin.

On the internal cuticle there occur retinacula of the usual shape, they are distributed in the same way as in most species of Sacculinidae. Each retinaculum has 3 to 6 spindles which have a length of 6 to 9 μ (fig. 35 h). The occurrence of barbs could not be stated with certainty.

No. 703 B.

Longitudinal sections from the middle part of the body show that the visceral mass is in wide contact with the region of the stalk (fig. 36 a). Towards the dorsal region, however, the place of attachment of the visceral mass or the mesentery to the mantle shifts farther to the right, so that at last it is found at a considerable distance from the posterior part of the body (fig. 36 f).

The ventral part of the vasa deferentia runs straight along the posterior region of the visceral mass (fig. 36 a). In the region of the stalk one of the male genital organs, the right, changes its course into one in a postero-anterior direction, as it is slightly tortuous the cavity appears in sections in several parts (fig. 36 b). In a slightly farther dorsal plane the two male organs are in close contact (fig. 36 c), this lasts for a short distance only. In a still more dorsal region the right testis attains its largest width (fig. 36 d), from here it continues its course again in a dorsal direction. Farther towards the dorsal region the left male organ shows a bend in postero-anterior direction (fig. 36 e), this part also shows an irregular lumen. Soon after-

wards the left testis runs for some distance in a dorsal direction (fig. 36 f). The left testis does not develop into an as wide tube as the right, but it does not differ appreciably from the latter in shape. As the figures show, the male organs, which in the beginning of their course are found at the extreme posterior end of the visceral mass (fig. 36 a), in their terminal

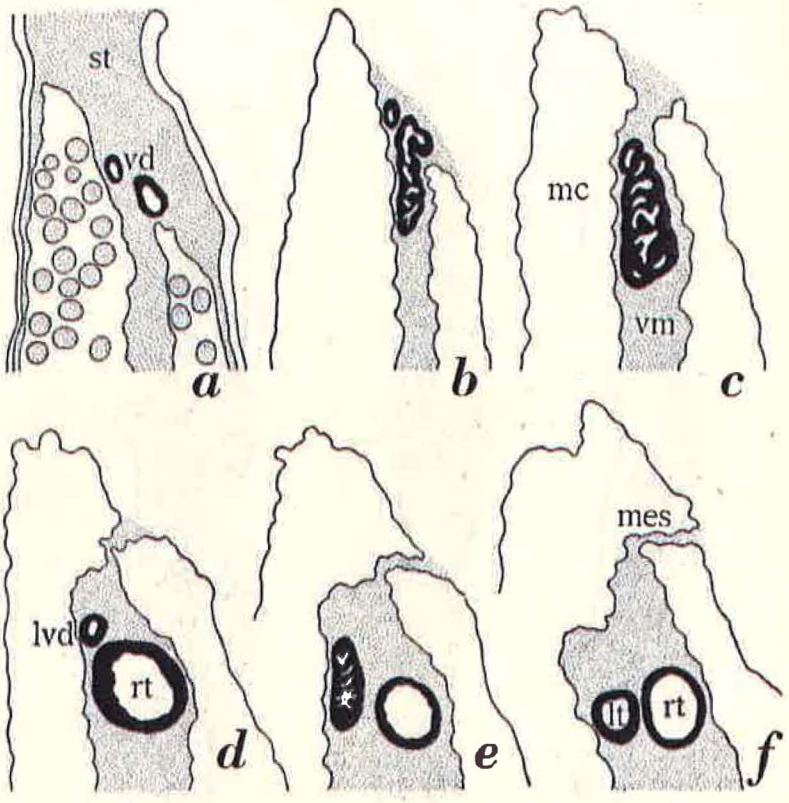

Fig. 36. *Loxothylacus torridus*, specimen no. 703 B, longitudinal sections; a, through the stalk, each following section from a more dorsal region. lt, left testis; lvd, left vas deferens; mc, mantle cavity; mes, mesentery; rt, right testis; st, stalk; vd, vasa deferentia; vm, visceral mass. × 30.

part are found at a fairly large distance from the posterior extremity of the visceral mass (fig. 36 f).

Longitudinal sections of the canal system in one of the colleteric glands are drawn in fig. 37. One of these (a) is from a peripheral region, each of the following (b, c) are from nearer the centre than the other. The figures show that the colleteric gland is rather flat and that it does not contain a very large number of branched canals. In section b 32 of these canals are present, in section c there are 33.

Some measurements of the thickness of the external cuticle of the mantle showed that this thickness varies from 22 to 55 μ.

The external cuticle does not possess excrescences which project noticeably above its surface. The cuticle consists of two different kinds of chitin, the main layers are formed of chitinous matter which can easily be stained,

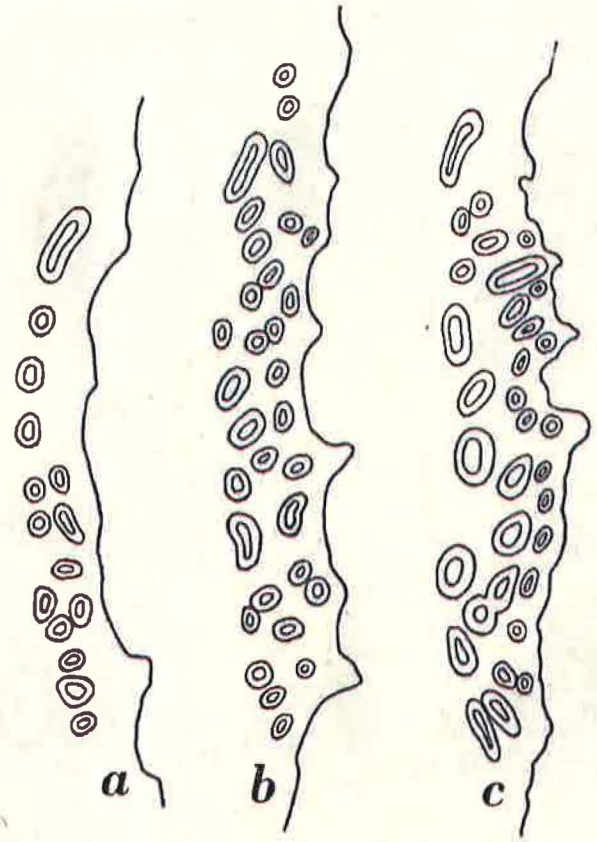

Fig. 37. *Loxothylacus torridus*, specimen no. 703 B, longitudinal sections of one of the colleteric glands, posterior end at the upper side of the figures. × 107.

whilst in the upper part of the cuticle there are found objects of a harder, strongly hyaline kind of chitin, embedded in the main layers. These hyaline objects have one pointed extremity which is directed downwards towards the lower surface of the cuticle. The other end of these objects is broader. As a whole the hyaline chitinous objects are of variable shape and size, as appears from the figures made after two different parts of the cuticle

(fig. 35 b, c). In some parts of the cuticle the hyaline chitin-formations are of a more or less conical shape, with a sharp point directed towards the lower surface of the cuticle. Besides this sharp point they possess numerous small spines on their sides. The upper surface is more or less rounded, so that they remind of minute turnips with numerous roots (fig. 35 b). The length of these objects is 16 to 21 μ, the thickness of the upper part is 4 to 12 μ. In other parts of the cuticle the hyaline chitinous formations consist of a short thick part with a flat upper surface and a root-like extension pointing towards the lower surface of the cuticle (fig. 35 c). Here the upper part has a thickness of 5 to 9 μ, the whole objects vary in length from 39 to 44 μ. Besides these there are parts of the cuticle in which the hyaline objects have a more or less conical form, as they have been described in other specimens. A surface view of the external cuticle shows how the broader parts of the hyaline chitinous inclusions closely fit together in a pattern of small areas with undulating margins, which have a diameter of 6 to 18 μ. Here each of the numerous lateral extensions of the hyaline objects fits into a notch between two of such extensions of another of these objects.

On the internal cuticle of the mantle there are numerous retinacula, distributed in the usual manner. The retinacula possess two to six spindles, which are 7 to 12 μ long (fig. 35 d). On these spindles no barbs could be detected.

No. 684 A.

Longitudinal sections through the stalk show that the visceral mass is widely in contact with the stalk, though on the right side (fig. 38 d). In a more dorsal region the visceral mass has shifted farther to the right side, so that the mesentery is attached to the mantle at some distance from the posterior part of the mantle cavity (fig. 38 f, the upper part of the figure shows the dorsal part of the stalk).

In their ventral part the vasa deferentia are narrow canals (fig. 38 a). In the middle part of the body, in the region of the stalk, the vasa deferentia bend at about a right angle and continue their course in an anterior direction. In the series this part of the male genital organs is sectioned longitudinally, four sections through this part are represented in fig. 38 b, c, d, e. In this region the lumen of the male organs is narrow on account of ridges on the inner surface. In fig. 38 c the straight ventral part of the vasa deferentia is seen to pass into the postero-anterior part (right male organ, left side of the figure). When the male organs have reached a region at some

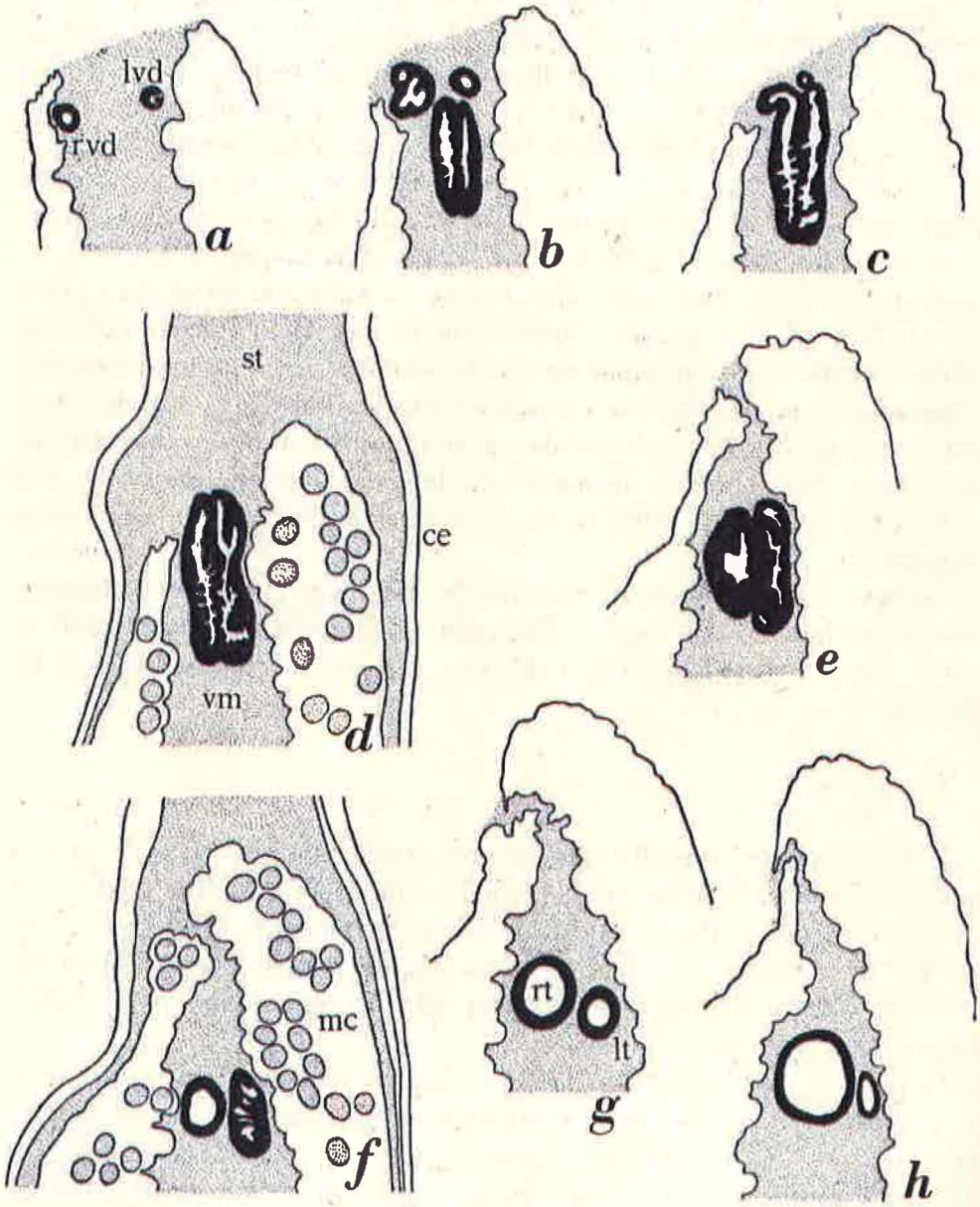

Fig. 38. *Loxothylacus torridus*, specimen no. 684 A, longitudinal sections; a, through the ventral region of the male organs, each following section from a more dorsal region. ce, external cuticle; lt, left testis; lvd, left vas deferens; mc, mantle cavity; rt, right testis; rvd, right vas deferens; st, stalk; vm, visceral mass. × 30.

distance from the mesentery (fig. 38 f) the testes continue their course in a dorsal direction (fig. 38 g, h). At first (fig. 38 g) the testes are of approximately equal size, but farther towards the dorsal region the right testis grows considerably larger than the left (fig. 38 h). Though in some parts of the visceral mass the two male organs are in close contact, their cavities remain completely separated.

The colleteric glands do not protrude noticeably above the surface of the visceral mass. They contain a large number of branched canals.

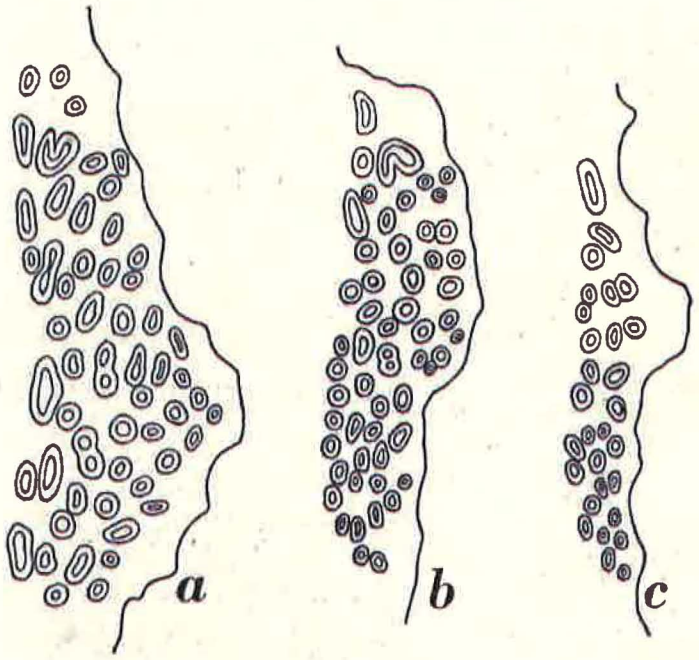

Fig. 39. *Loxothylacus torridus*, specimen no. 684 A, longitudinal sections of one of the colleteric glands, posterior end at the upper side of the figures. × 80.

Longitudinal sections of one of these glands are given in fig. 39. One of these sections (a) is from the neighbourhood of the centre of the gland, it contains 57 canals, which at least partially are of comparatively large size. A second section (b) is from a more peripheral region, 56 canals are to be seen here, these as a rule are of smaller size. A third section (c), from the peripheral part of the gland, contains a far smaller number of canals.

In different parts of the mantle the thickness of the external cuticle varies from 33 to 80 μ, as far as concerns the measurements taken in a few instances.

The external cuticle possesses excrescences which at the most project

for about 5 μ above its surface, and in many regions do not project at all, so that they hardly may be called excrescences. The cuticle consists of two kinds of chitin. The main layers are of the usual consistence, easily to be stained. In the upper part of the cuticle there are objects of a hard, hyaline kind of chitin consisting of a thick knob and a sharp spine, the latter directed towards the lower part of the cuticle. In surface view the knob-like parts are seen to fit nicely together in a kind of mosaic. Each knob has five or more lateral extensions which fit in into the notches between the

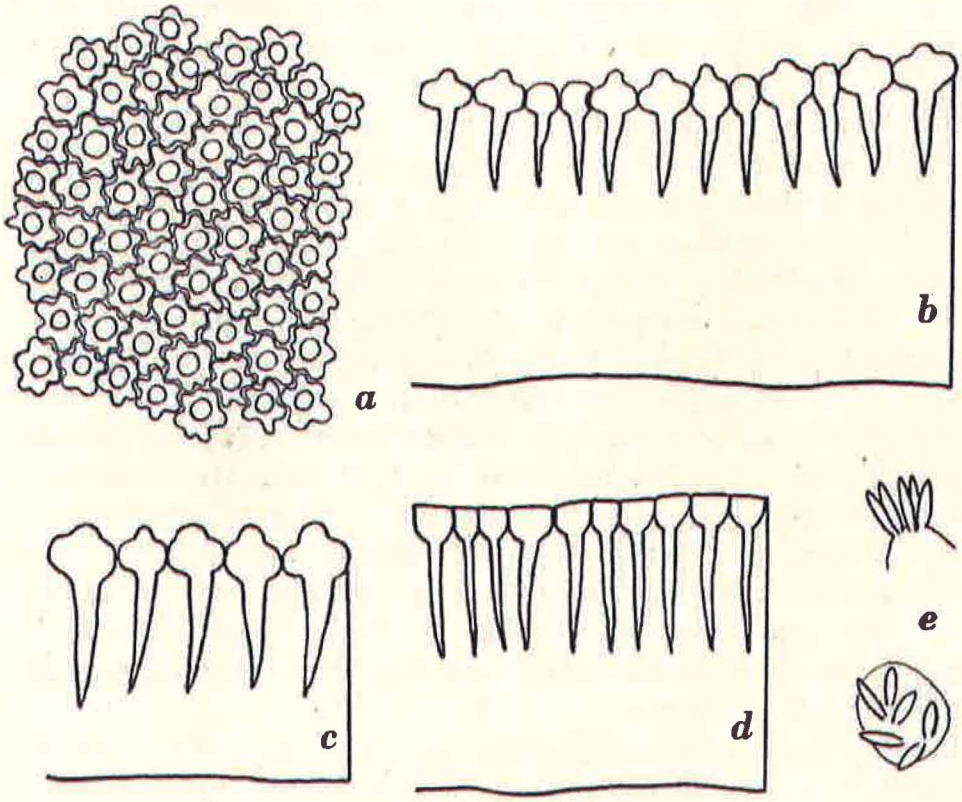

Fig. 40. *Loxothylacus torridus*, specimen no. 684 A. a, surface view of the external cuticle; b—d, sections of the external cuticle; e, retinacula. × 530.

extensions of other knobs (fig. 40 a). In the represented part of the cuticle each knob has a kind of central cap rising above the rest of the knob. The areas with more or less undulating margins formed by the knobs of the hyaline parts have a diameter of 6 to 15 μ, the central papillae of the knobs vary in size from 3 to 6 μ. In sections of the cuticle the shape of the hyaline parts becomes more distinct. Generally they are shaped as in fig. 40 b, here the knobs with their lateral extensions and their central papilla are shown.

The pointed objects have a length of 24 to 30 μ, the thickness of the upper part varies from 6 to 15 μ. In other parts of the cuticle the hyaline objects are larger, though of corresponding shape (fig. 40 c). Here the length amounts to 39 to 44 μ, the thickness of the upper part is 10 to 15 μ. In again other regions of the cuticle the hyaline parts are flat-topped and have slenderer root-like downward extensions (fig. 40 d). The length of the hyaline parts varies here from 33 to 36 μ, their thickness (in the upper part) from 5 to 10 μ.

The internal cuticle of the mantle bears numerous retinacula, distributed in the usual manner. Each retinaculum has four to six spindles which have a length of 7 to 13 μ (fig. 40 e). On these spindles no barbs could be seen.

Nothwithstanding the fact that in one specimen the vasa deferentia are completely separated, in another the cavities of the two vasa deferentia are partially united, and in the remaining two it is not certain whether these parts of the male organs are separated or not, the four parasites of *Actaea tomentosa* undoubtedly belong to the same species. To this species the name *Loxothylacus torridus* was given, but it remains questionable whether the species belongs to the genus *Loxothylacus* or not. In species which show the characters of the genus *Loxothylacus* in a typical manner the visceral mass is attached to the mantle at some distance from the stalk, and the male genital organs show a pronounced curvature. In the four specimens dealt with here the two characters mentioned above appear in a very defective manner. The same holds, perhaps in an even more pronounced manner, for the specimens described in the following pages as *L. musivus*. In the six specimens belonging to these two species (which form a homogeneous group also as far as concerns the structure of their external cuticle) corresponding peculiarities are to be observed.

In the six specimens the visceral mass is in direct contact with the region of the stalk. It is true, the two parts of the body are not as closely united as in most species of *Sacculina*, but they are not separated as in most species of *Loxothylacus*. The mesentery, which in *Sacculina* is attached to the median region of the mantle, in the six specimens dealt with here towards the dorsal region gradually shifts to one side of the mantle, so that at last it is attached to the mantle at a considerable distance from the posterior margin. This latter fact shows that the visceral mass in the dorsal part of the body has a tendency to occupy an oblique position in the mantle cavity.

The male genital organs of the six specimens again are similar to a certain degree though there are differences, which may be of some importance. In one specimen (no. 689 A, *L. musivus*) the two male organs are of about

equal size, in one (no. 693 A, *L. musivus*) the right is somewhat smaller than the left, and in the four specimens of *L. torridus* the left is smaller than the right. In all the specimens the general course of the male organs is more or less straight. Some of the specimens have male organs with a distinct double turn, in others this peculiarity is absent. The double turn, when present, occurs in a part of the male organs in which there are ridges on the inner surface, the male organs which at first were running in a ventro-dorsal direction here change their course into one in a postero-anterior direction. This part always is rather short, soon the male organs resume their course in a ventro-dorsal direction. Instead of a real curvature we may regard this double turn as a curvature resulted into a failure.

The peculiarities of the male organs of the six specimens are shown in the following table which facilitates the comparison of the specimens in this respect.

Number of specimen and name of host	Size of male genital organs	Cavities of vasa deferentia	Parts of male genital organs in postero-anterior direction
794 B, on *Actaea tomentosa*	left slightly smaller than right	united	not distinct
703 A, on *Actaea tomentosa*	left slightly smaller than right	(completely?) separated	distinct
703 B, on *Actaea tomentosa*	left smaller than right	(completely?) separated	distinct
684 A, on *Actaea tomentosa*	left smaller than right	completely separated	distinct
689 A, on *Cymo melanodactylus*	about equal	united	practically absent
693 A, on *Phymodius ungulatus*	right slightly smaller than left	united	practically absent

In the colleteric glands of the four specimens of *Loxothylacus torridus* no striking difference are found.

The cuticular formations of the four specimens are built after the same pattern. A surface view of the external cuticle always shows numerous hyaline objects in close arrangement, each with its lateral extensions fitting into spaces between those of other objects. The size and shape of the roots with which the hyaline parts are embedded in the main layers of the cuticle is subject to some variation. The hyaline objects form such a peculiar feature of the species that it is at once distinct from all other species of the genus.

Loxothylacus musivus nov. spec.

(figs. 41—47)

2 specimens examined:

689 A (holotype). Near Koepang, Timor, reef, 3 Dec. 1929, on *Cymo melanodactylus* De Haan; 7 × 5 × 2 mm.

693 A. Near Koepang, Timor, shore or reef, 5 Dec. 1929, on *Phymodius ungulatus* (H. M. Edw.); 7 × 4½ × 2½ mm.

Specific characters. Male genital organs practically straight, of equal size or one slightly smaller than the other. Cavities of vasa deferentia partially united. Colleteric glands with a moderate number of branched canals. Excrescences of the external cuticle protruding for 3 to 12 μ above the surface. Their upper part has a sinuous contour (diameter 3 to 15 μ), they have three or four lateral expansions, and, especially their upper part, consists of a hyaline kind of chitin. The excrescences are placed on the upper surface of the cuticle or penetrate the upper layers of this cuticle with roots of different size. The total length of the excrescences varies from 3 to 30 μ. Retinacula with 2 to 6 spindles, which have a length of 7 to 14 μ.

The chief particulars of the anatomy and the cuticular excrescences of the two specimens are given below.

No. 689 A.

The animal has more or less trapezoid shape, the posterior margin and the two lateral margins are more or less straight, but the anterior margin is sinuous, as the angles are roundly protruding and the central part too is enlarged. The mantle opening, which does not protrude noticeably above the surface, is rather narrow. It lies at some distance from the margin, on the surface which faced the thorax of the host. To the naked eye the mantle does not show pronounced grooves.

The region of the stalk is not clearly separated from the visceral mass, in the middle part of the body the two parts are more or less in contact with each other (fig. 41 a). Towards the dorsal region the mesentery is attached to the mantle at some distance from the posterior region (fig. 41 g, here the posterior part of the body is at the upper side of the figure).

The ventral parts of the vasa deferentia are narrow canals, running along the posterior margin of the visceral mass (fig. 41 a). In the most dorsal region in which the visceral mass is attached to the mantle the two vasa deferentia are in close contact (fig. 41 b). In the longitudinal sections they have here an oval contour, so that we can say (if we want to find any possible character which is peculiar to the genus *Loxothylacus*) that the male organs are very slightly bent here. But this bend is really

of so little importance that we can better say that the male organs are slightly laterally compressed in this region. In a somewhat farther dorsal plane the two male organs are largely united, so that they form a single, rather wide canal which shows some ridges on its inner surface (fig. 41 c). For some time there remains a common cavity, whilst the wall increases in thickness (fig. 41 d). In a more dorsal region the two cavities of the male organs become separated again (fig. 41 e) and gradually the two testes loose their mutual contact (fig. 41 f). Towards the dorsal region of the visceral mass the testes slightly increase in size and obtain a wider lumen

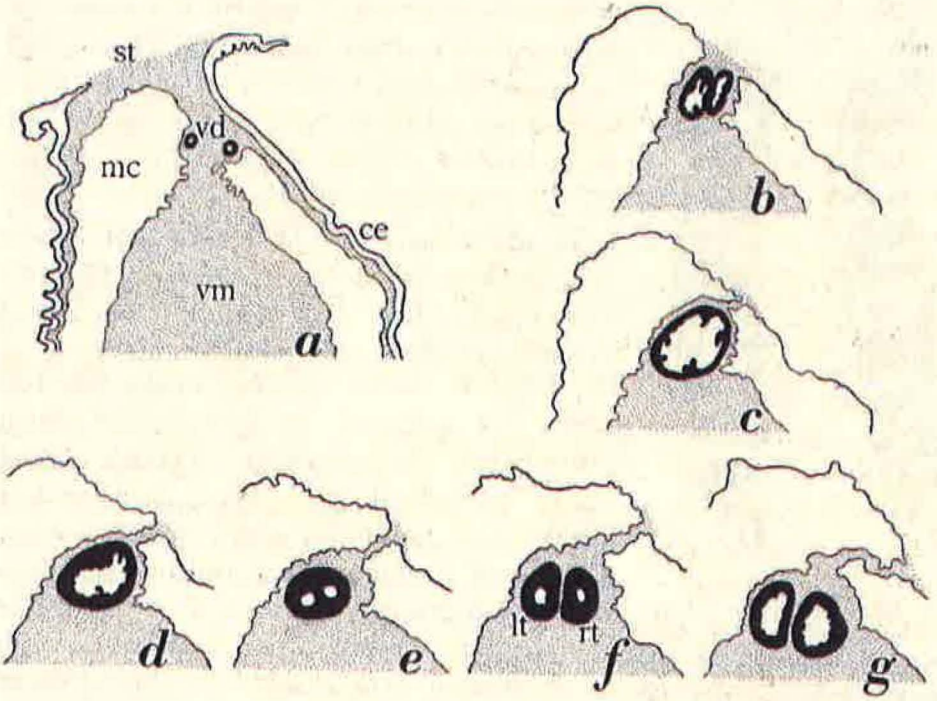

Fig. 41. *Loxothylacus musivus*, specimen no. 689 A, longitudinal sections; a, through the stalk, each following section from a more dorsal region. ce, external cuticle; lt, left testis; mc, mantle cavity; rt, right testis; st, stalk; vd, vasa deferentia; vm, visceral mass. × 30.

(fig. 41 g). In the region farther dorsally than the section of fig. 41 g the testes soon terminate. The male genital organs therefore form nearly straight organs which stretch along the posterior margin of the visceral mass. The two male organs are of approximately equal size.

Two longitudinal sections of one of the colleteric glands are given in fig. 42, both from the region in which the canal system is most strongly branched. One of these (b) is from a slightly more peripheral region

than the other (a). The number of canals in these sections is 34 and 36. The glands do not noticeably protrude above the surface of the visceral mass.

The thickness of the external cuticle of the mantle was measured in various regions, these measurements gave values from 12 to 62 μ.

The external cuticle is covered with excrescences which have a height of 3 to 9 μ above the surface of this cuticle. They are so closely arranged that between them very narrow grooves remain. This is clear especially when the excrescences are studied in surface view (fig. 43 a, b). Owing to mutual pressure during their development the excrescences have obtained an irregularly sinuous contour, with comparatively few (usually four, more or less cross-wise arranged) lateral expansions. The diameter of these excrescences varies from 3 to 12 μ. In the various parts of the cuticle these excrescences are of a more or less uniform shape. Fig. 43 a is drawn after a part of the cuticle from the surface of the mantle which was lying against the thorax of the host, fig. 43 b after a part of the cuticle from the other lateral surface, but there is hardly any difference in the shape of the excrescences in the two figures. The parts of the excrescences which project above the surface of the cuticle consist wholly or partially of a hard, more or less hyaline kind of chitin, which does not stain with borax carmine. This hard kind of chitin is at least present in the outer part of the excrescences, the interior often consists of an easily staining weaker kind of chitin. When studying the excrescences in sections of the cuticle it appears that their length and shape in side view are different in the various parts of the mantle. In some places we find excrescences which are attached to the surface of the cuticle only, not penetrating into the cuticle (fig. 43 c). In this figure the excrescences have a height of 3 to 5 μ. In other parts of the cuticle each of the excrescences at its under surface is prolonged into a small thin root, penetrating for a short distance into the main layers of the cuticle (fig. 44 c). In the section shown in this figure the total length of the excrescences is 7 to 13 μ. The small root seems to consist of a similar kind of chitin as that of the cuticle itself, at all events it is not of the strongly hyaline structure as at least the outer part of the excrescences.

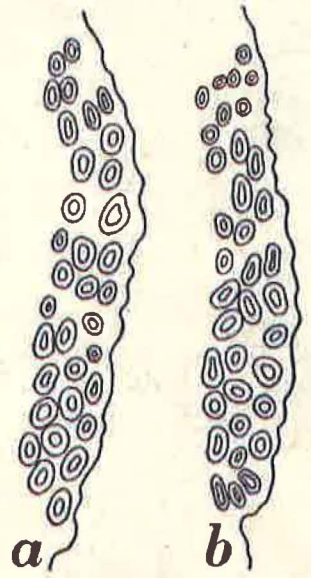

Fig. 42. *Loxothylacus musivus*, specimen no. 689 A, longitudinal sections of one of the colleteric glands, posterior end at the upper side of the figures. × 80.

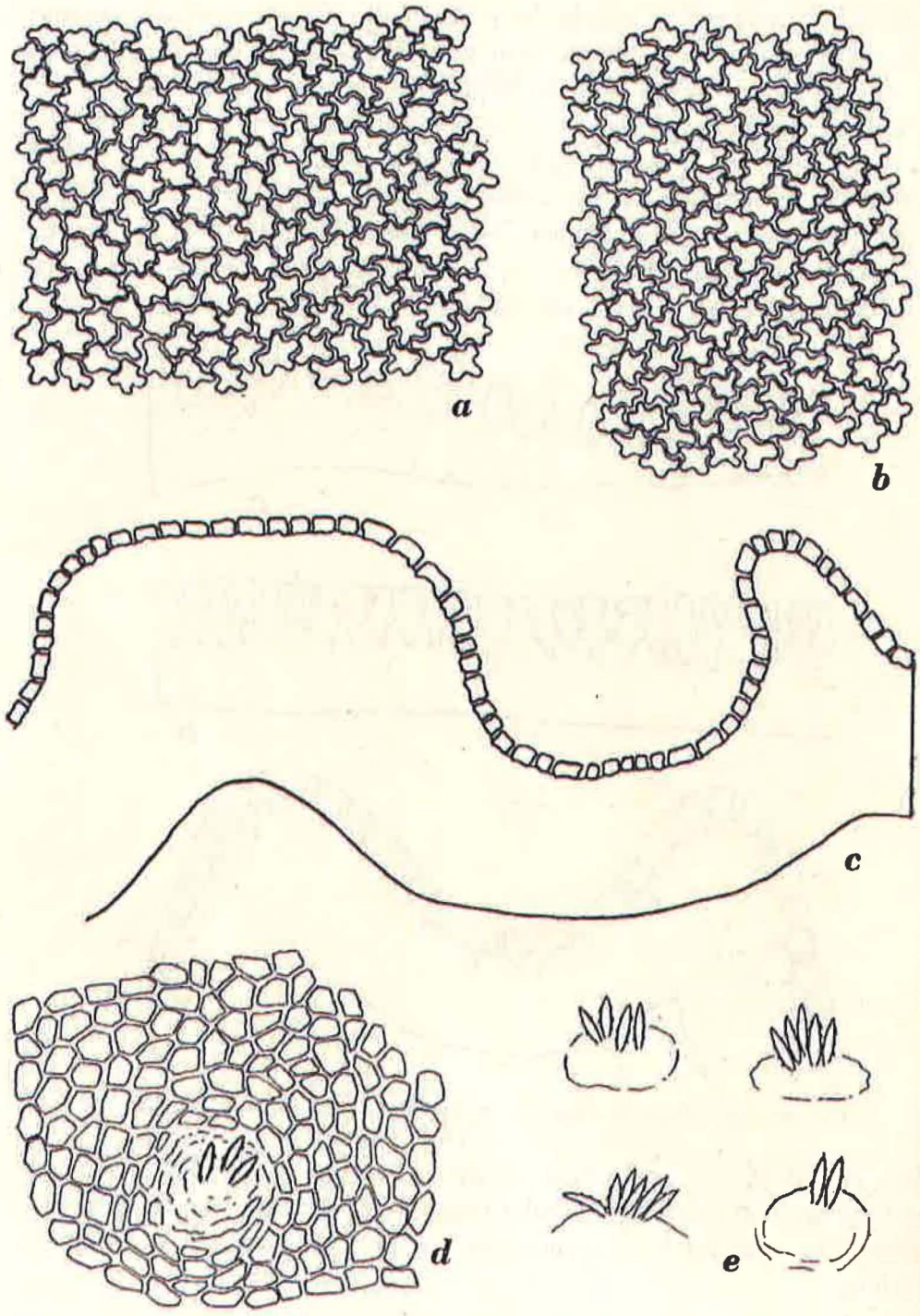

Fig. 43. *Loxothylacus musivus*, specimen no. 689 A. a, b, surface view of excrescences in various parts of the external cuticle; c, section of the external cuticle; d, retinaculum on the internal cuticle; e, retinacula. × 530.

In still other parts of the cuticle the roots of the excrescences are slightly thicker, but they always remain comparatively short (fig. 44 a, b); the roots of the excrescences are never longer than the remainder. The whole length of the chitinous objects represented in the two latter figures is from 9 to 13 μ (fig. 44 a) and from 14 to 19 μ (fig. 44 b).

On the internal cuticle of the mantle there occur many retinacula, which are distributed in the usual manner. They form the centre of a part of the cuticle where the cells form a more or less circular group, so that the parts of the cuticle secreted by each cell have a neatly concentrical arrangement

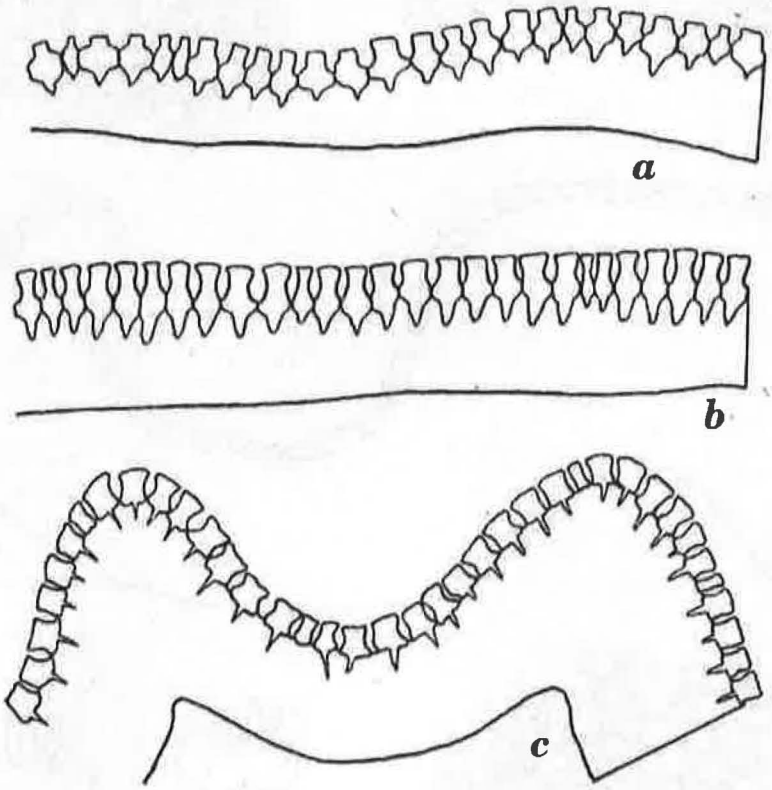

Fig. 44. *Loxothylacus musivus*, specimen no. 689 A. a—c, sections of the external cuticle. × 530.

(fig. 43 d). A few isolated retinacula are shown in fig. 43 e. Each retinaculum has two to six spindles (usually four or more), the latter are distinctly barbed. The spindles have a more or less slender shape, they are 10 to 14 μ long.

No. 693 A.

The shape of the animal is more or less oval. The posterior region has a concave centre (attachment of the stalk), in the anterior region the two

angles are protruding as small rounded knobs. The mantle opening is narrow, not protruding noticeably above the surface, it lies at a slight distance from the anterior region, on the surface which was turned against the thorax of the crab.

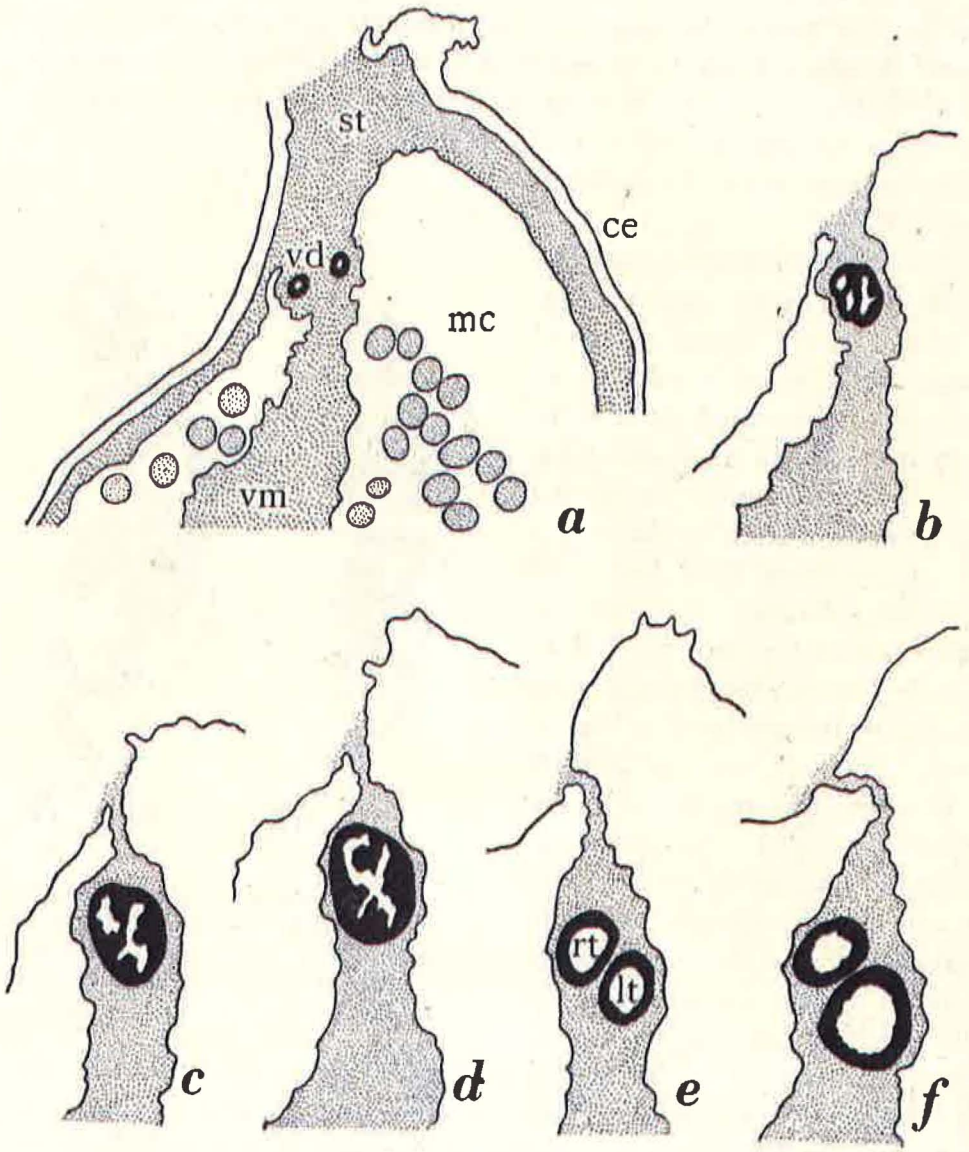

Fig. 45. *Loxothylacus musivus*, specimen no. 693 A, longitudinal sections; a, through the stalk, each following section from a more dorsal region. ce, external cuticle; lt, left testis; mc, mantle cavity; rt, right testis; st, stalk; vd, vasa deferentia; vm, visceral mass. × 45.

A series of longitudinal sections was made from this specimen. This series is not without faults, the animal was very hard and difficult to handle. Moreover various parts of the body, especially the colleteric glands, could not be stained in a perfect manner. Notwithstanding these deficiencies the chief particulars of the anatomy of the specimen could be ascertained with sufficient accuracy.

In the middle part of the body the visceral mass is distinctly united to the region of the stalk, though it is separated from the left half of the mantle and adhering to the right side (fig. 45 a). In a more dorsal region the mesentery is attached to the mantle at some distance from the posterior region (fig. 45 e).

In their ventral part the vasa deferentia form narrow canals (fig. 45 a). Towards the dorsal region of the stalk they increase in size and become more or less united. At first the two cavities remain separated (fig. 45 b, c), but gradually they form one single lumen of irregular shape as a result of ridges on their thick wall (fig. 45 d). Farther towards the dorsal region of the visceral mass the two male organs become separated again, at first the two testes are rather narrow (fig. 45 e) but especially the left increases in size before it terminates (fig. 45 f). The dorsal extremities of the male organs are found at a considerable distance from the posterior margin of the visceral mass, so that the general course of the male organs is more or less oblique. In their terminal region one of the testes (the left) is lying more anteriorly than the right (fig. 45 f). The male organs have an approximately straight course, in one region (fig. 45 b) they are slightly compressed in a lateral direction whilst their cavities have a postero-anterior direction. This might indicate that the male organs form a slight bend in this region, but it is too inconspicuous to lay stress on this fact.

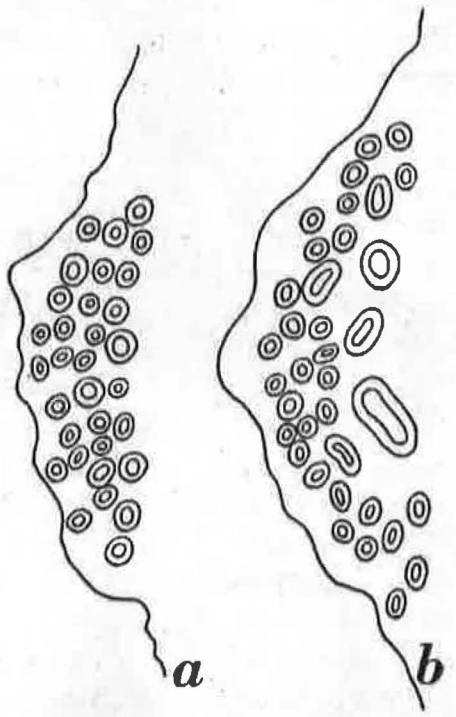

Fig. 46. *Loxothylacus musivus*, specimen no. 693 A, longitudinal sections of one of the colleteric glands, posterior end at the upper side of the figures. × 107.

Two longitudinal sections of one of the colleteric glands are shown in

fig. 46, one (b) from the neighbourhood of the female genital opening, the other (a) from a more peripheral region. One of these (a) shows 32 canals, the other (b) 37. Possibly this number may be larger in other sections, but in many sections the structure of the colleteric glands is rather indistinct. The gland protrudes somewhat above the surface of the visceral mass, the branches of the canals form a rather compact system.

In various parts of the mantle the thickness of the external cuticle was measured, this resulted in amounts varying from 27 to 55 μ.

In surface view the external cuticle appears to possess excrescences which extend for 6 to 12 μ above the surface. They have a peculiar shape, showing lateral extensions which closely fit in the space left between similar extensions of other excrescences (fig. 47 a). The lateral extensions are few in number (three or four), they are large in comparison to the central part, usually the extensions are broader in their distal part than in their proximal part, so that the excrescences appear as if strongly compressed. Between the excrescences there are narrow grooves of an irregularly sinuous course. Sections of the external cuticle show that the excrescences below the surface of the cuticle possess a kind of root. This root may be thick and short (fig. 47 d) or long and slender (fig. 47 e). In contradistinction to the upper part of the excrescences the roots consist of a kind of chitin which easily can be stained. The upper parts of the excrescences at least partially consist of a harder, hyaline kind of chitin. This may be confined to the superficial region, so that a central mass of weaker, stainable chitin is distinctly visible (indicated with dotted lines in fig. 47 c, d), but in other parts of the cuticle the whole or nearly the whole of the excrescences, except the roots, consists of hard chitin (fig. 47 e, f). The diameter of the excrescences, as seen in surface view, varies from 3 to 15 μ, their length, including the roots, is different in different parts of the mantle. The excrescences drawn in fig. 47 c vary in length from 16 to 21 μ, those of fig. 47 d from 15 to 18 μ, those of fig. 47 e from 21 to 27 μ, and those of fig. 47 f from 27 to 30 μ. These differences are largely due to the different sizes of the roots, the upper parts of the excrescences vary in height from 7 to 12 μ.

Retinacula are found in the usual manner, as far as concerns distribution and quantity, on the internal cuticle of the mantle. They possess three to six spindles, which have a length of 7 to 9 μ (fig. 47 b). On these spindles no barbs were visible.

The specimens described here as *Loxothylacus musivus* correspond in many details with the specimens of *L. torridus* described above. The male organs and the colleteric glands are not principally different in the two species (the vasa deferentia for a part of their course are much more

widely united than in any of the specimens of *L. torridus*, but it is questionable whether this peculiarity may constitute a specific character). The

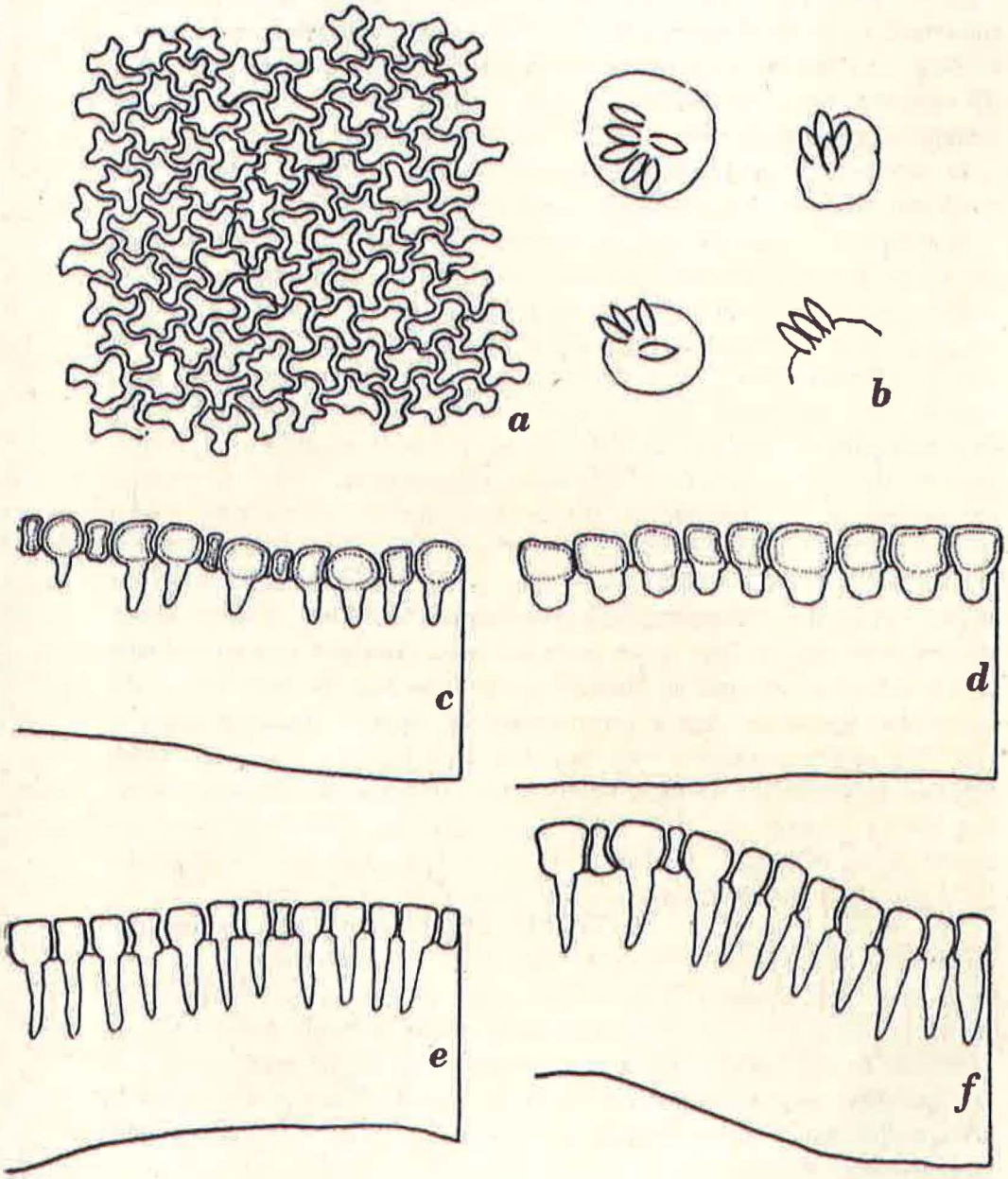

Fig. 47. *Loxothylacus musivus*, specimen no. 693 A. a, surface view of excrescences of the external cuticle; b, retinacula; c—f, sections of the external cuticle. × 530.

cuticular excrescences, however, are of a slightly different kind. In the four specimens of *L. torridus* the hyaline objects of the cuticle are so

strongly alike in the part which lies at the surface of the cuticle, that it is highly improbable that the specimens dealt with here, in which the hyaline parts of the cuticle have another shape, belong to the same species. It is difficult to point out the differences between the hyaline objects in the two species. In *L. torridus* they always have a larger number of lateral expansions than in *L. musivus*, so that surface views of the cuticle of the two species are quite different. As a rule in *L. torridus* there are five or more lateral extensions on each hyaline object, whilst in *L. musivus* this number is three or four. Therefore in *L. torridus* the centre of the hyaline formations is large in comparison to the lateral expansions, whilst in *L. musivus* the central part is much narrower. Moreover in *L. musivus* the hyaline parts rise slightly above the surface of the cuticle; in *L. torridus* they do not rise perceptibly above the cuticle and therefore do not deserve the name excrescences. The figures show the differences mentioned much better than a detailed description.

The retinacula of one specimen of *Loxothylacus musivus* (no. 689 A) have longer spindles than those of *L. torridus*, moreover the spindles in the former specimen are slenderer than those of the latter. To these minute differences, however, should not be given too much importance. Moreover the retinacula of the other specimen of *L. musivus* (no. 693 A) are very similar to those of *L. torridus*.

In the specimen on *Cymo melanodactylus* the excrescences are of a different shape from those of the specimen on *Phymodius ungulatus*. As the other characters of the specimens do not distinctly point to a specific difference it seems right to unite the two, at least provisionally, into one species.

Loxothylacus brachythrix nov. spec.

(figs. 48—58)

4 specimens examined:

814 A (holotype). Ternate, shore, 1—2 April 1930, on *Xantho sanguineus* (M. Edw.); 10 × 7½ × 5 mm.

702 A. Tidore, shore, 24—29 Sept. 1929, on *Xantho sanguineus* (M. Edw.); 12½ × 8 × 5 mm.

897 A. Ternate, 29 Sept. 1930, on *Xantho sanguineus* (M. Edw.); 13 × 10 × 4 mm.

749 A 1. Near Koepang, Timor, reef, 3 Dec. 1929, on *Lybia tessellata* (Latr.); 4½ × 3 × 2½ mm.

Specific characters. Male genital organs in the posterior part of the visceral mass, both or at least one enlarged into a wide pouch. Curvature of male organs distinct or slight. Colleteric glands with a moderate quantity of branched canals. External cuticle of the mantle with papillae or small hairs

which on their tips bear a crown of minute spines. These excrescences vary in length from 4 to 27 μ. Retinacula with 3 to 6 barbed spindles which vary in length from 9 to 15 μ.

Three of the specimens are broadly oval with concave anterior and posterior margins, so that they are more or less dumb-bell shaped. In one specimen (no. 749 A 1) the anterior region is rather narrow, so that it is of a more or less triangular shape. The mantle opening lies at the top of a distinct tubular expansion of the mantle, in the centre of the anterior margin, the opening itself is slightly turned towards the thorax of the host. With the exception of a pronounced longitudinal groove in the region of the stalk, at the surface facing the abdomen of the host, the mantle does not show pronounced grooves or ridges.

Two Sacculinids were present on the abdomen of the specimen of *Lybia tessellata*, one of these was studied.

A more detailed description of the various specimens follows here.

No. 814 A.

The middle part of the series of longitudinal sections shows that visceral mass and stalk are partially united, so that an important character of the genus *Loxothylacus* (visceral mass attached to the mantle at some distance from the stalk) is not apparent in this specimen. On the other hand the stalk does not form a direct continuation of the visceral mass, the latter has shifted somewhat to one side (fig. 48).

In their ventral part the vasa deferentia are comparatively wide (fig. 48 a), in a more dorsal region they become slightly narrower (fig. 48 b), afterwards they widen again and gradually pass into the voluminous testes (fig. 48 c). The testes form wide, rather thin-walled, sacs which are slightly compressed laterally (fig. 48 d, e). The male genital organs are curved in so far that they show a distinct bend in the place of transition of the vasa deferentia into the testes. The vasa deferentia run in a ventro-dorsal direction, the testes have their greater length in a posterio-anterior direction. In a small part of the series only an indication of a further curvature is to be seen (right testis in fig. 48 c). So also this character of the genus *Loxothylacus* (terminal part of the male genital organs recurved in a ventral direction) is hardly observable.

The colleteric glands have a well developed canal system. Three longitudinal sections of one of these glands are shown in fig. 49 a—c. Of these one (a) is from a peripheral part, each of the other is from a more central region, though the last (c) is still at a certain distance from the centre. In

the section of fig. 49 b a fairly large amount of canals (62) is to be seen. The external cuticle of the mantle is rather thin, as appears from fig.

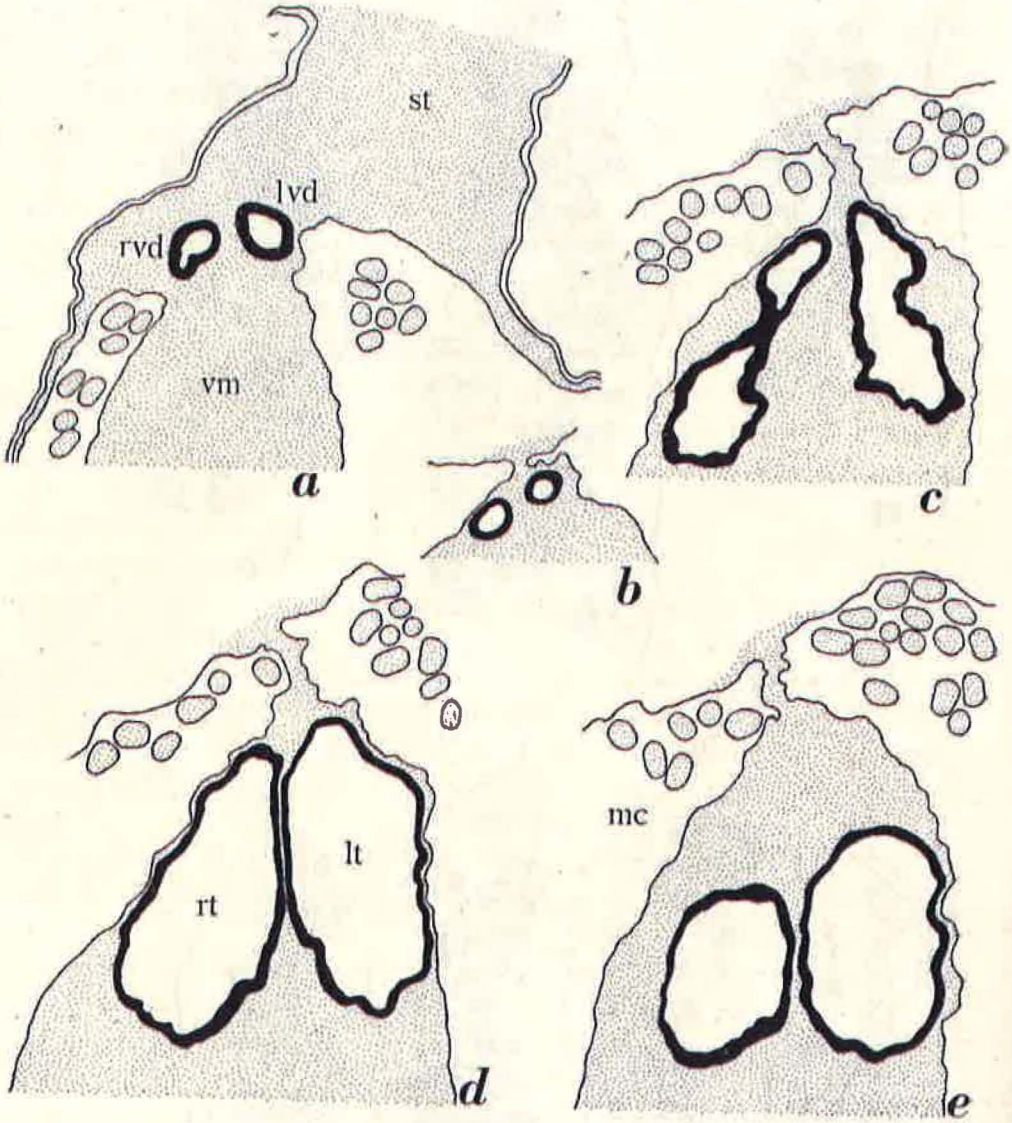

Fig. 48. *Loxothylacus brachythrix*, specimen no. 814 A, longitudinal sections; a, through the stalk, each following section from a more dorsal region. lt, left testis; lvd, left vas deferens; mc, mantle cavity; rt, right testis; rvd, right vas deferens; st, stalk; vm, visceral mass. × 30.

50 d—f. Here its thickness varies from 9 to 18 μ. In some parts of the mantle it is somewhat thicker, but its thickness rarely exceeds 30 μ.

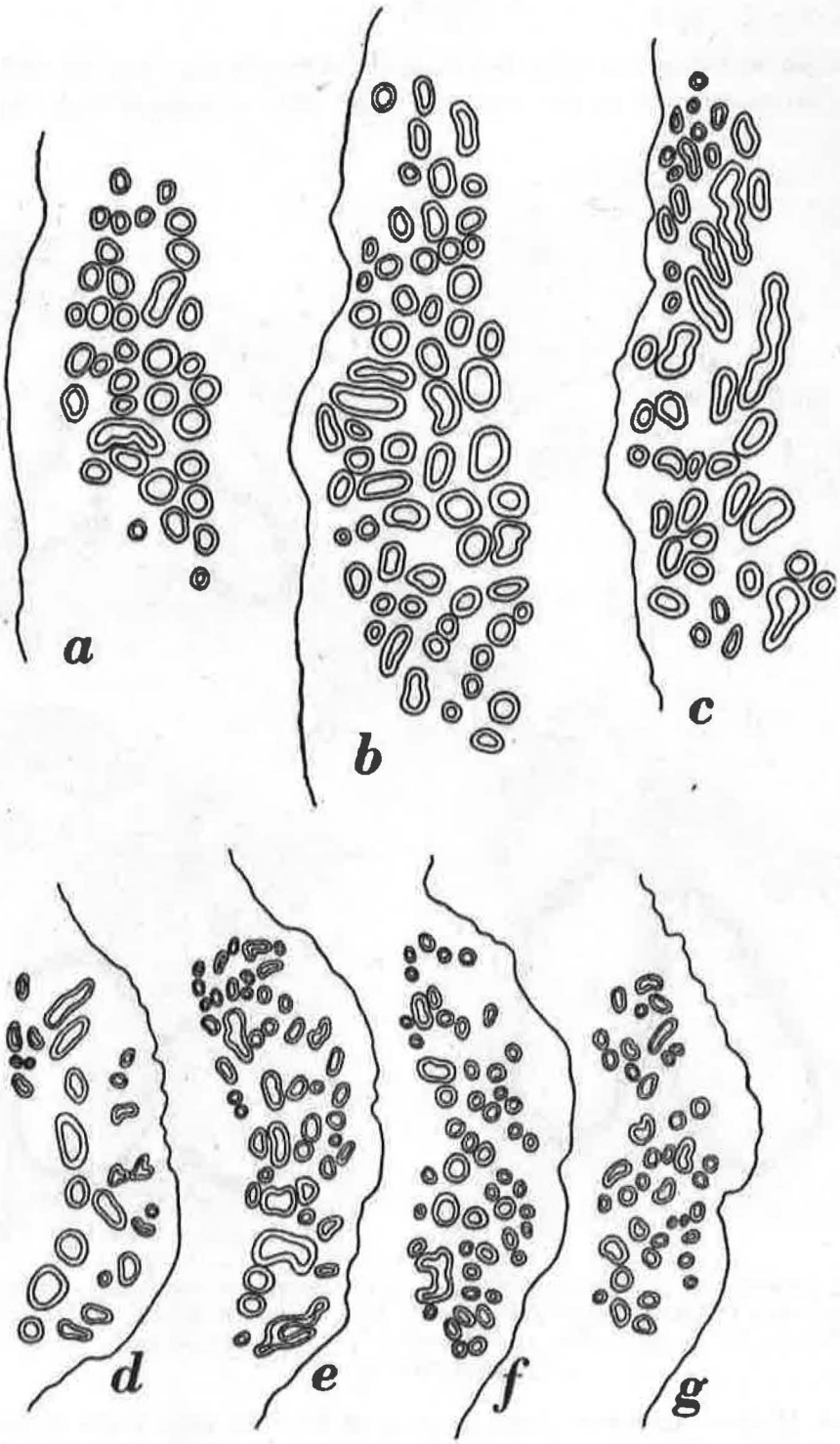

Fig. 49. *Loxothylacus brachythrix*, longitudinal sections of colleteric glands, posterior end at the upper side of the figures. a—c, from specimen no. 814 A; d—g, from specimen no. 897 A. a—c, × 80; d—g, × 45.

Nearly the whole of the surface of the external cuticle is covered with papillae or small hairs which differ in shape and size in various parts. Only occasionally parts of the cuticle are met with which are devoid of these excrescences. Then often the areas with irregular contours (diameter

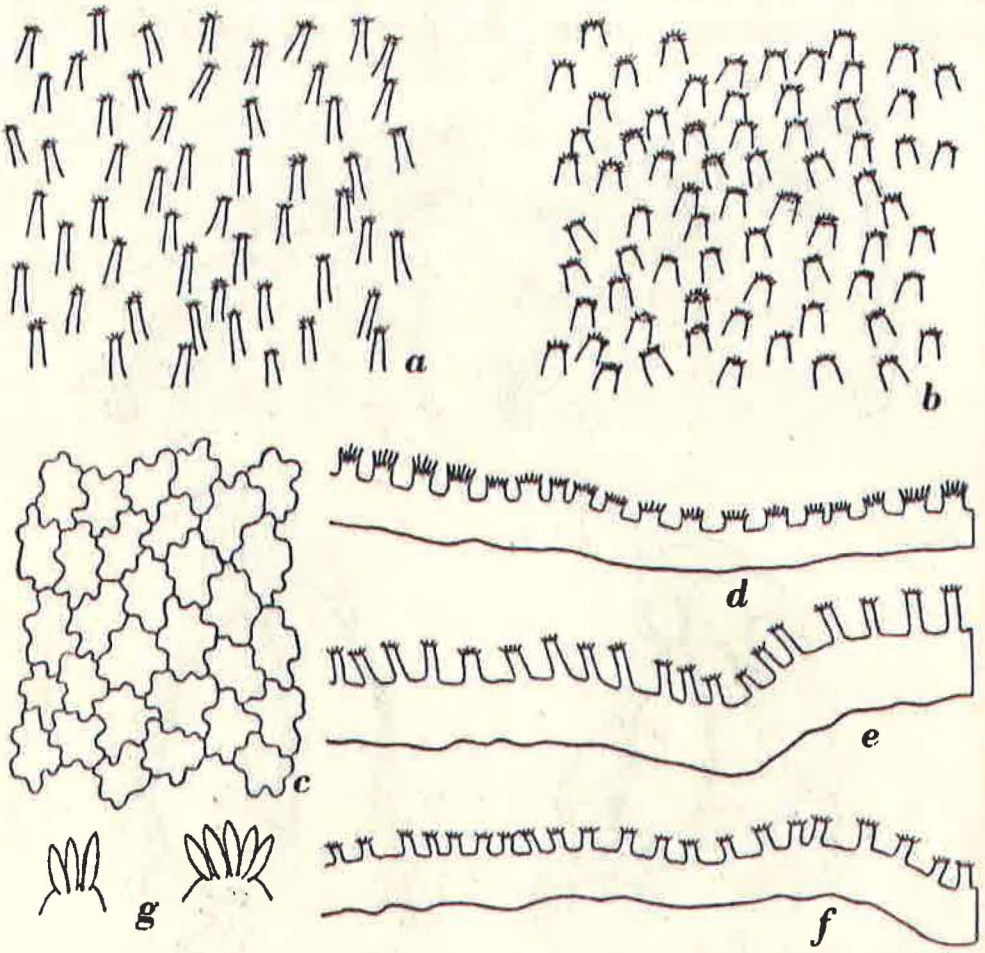

Fig. 50. *Loxothylacus brachythrix*, specimen no. 814 A. a, b, surface view of excrescences in various parts of the external cuticle; c, surface view of a part of the external cuticle without excrescences; d—f, sections of the external cuticle; g, retinacula. × 530.

varying from 7 to 22 μ) are visible, which are the parts of the cuticle secreted by each individual cell of the epithelium of the mantle (fig. 50 c). The papillae or hairs may be rather slender (fig. 50 a), varying in length from 7 to 12 μ, attaining a thickness of about 3 μ. On their extremities these

excrescences bear a number of minute spines, which are arranged in a more or less circular crown on the tips. When the excrescences are shorter they usually are thicker, in the shape of papillae (fig. 50 b). In the figured part of the cuticle these papillae have a length of 6 to 8 μ, their thickness amounts to maximally about 6 μ. Here again they possess distinct minute spines on their tips, arranged in a more or less circular manner. The three sections of the cuticle represented in the same figure again show the

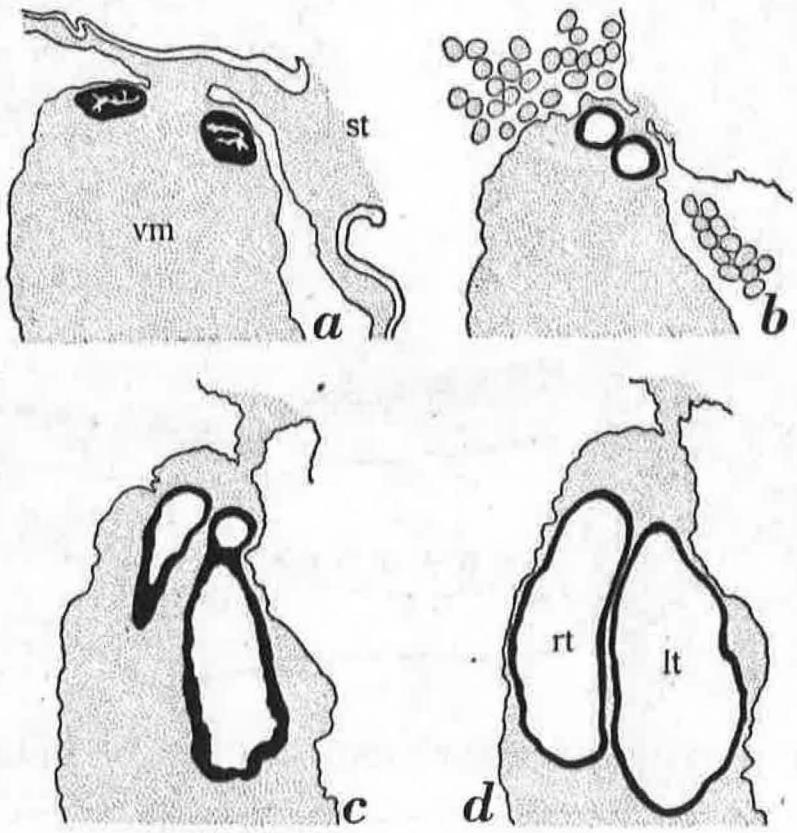

Fig. 51. *Loxothylacus brachythrix*, specimen no. 702 A, longitudinal sections; a, through the stalk, each following section from a more dorsal region. lt, left testis; rt, right testis; st, stalk, vm, visceral mass. × 20.

variation in size and shape of the excrescences. In one part of the cuticle (fig. 50 d) the papillae have a length of 4 to 9 μ, they are rather thick and bear comparatively strong minute spines. In another part of the cuticle (fig. 50 e) the excrescences vary in length from 6 to 12 μ, they correspond with the hairs of fig. 50 a. In a third part of the cuticle (fig. 50 f) the hairs are shorter (4 to 6 μ), but of about the same thickness as those of fig. 50 a.

The excrescences shown in the two latter figures have very small spines on their extremities.

Numerous retinacula occur on the internal cuticle of the mantle, distributed over the surface of this cuticle in the usual way. Each retinaculum possesses three to five spindles, which have a length of 11 to 14 μ (fig. 50 g). The retinacula in this specimen are more or less covered with detritus and remains of chitinous layers from the colleteric glands, so that it could not be determined with certainty whether they possess barbs or not.

No. 702 A.

The visceral mass is attached to the mantle at a slight distance from the stalk, the latter is short and somewhat obliquely placed on the body (fig. 51 a).

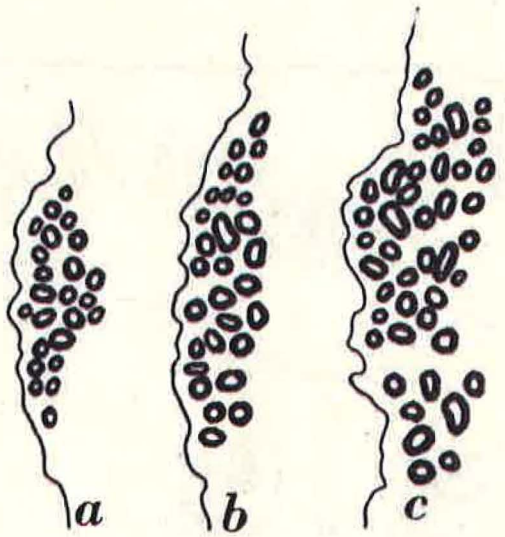

Fig. 52. *Loxothylacus brachythrix*, specimen no. 702 A, longitudinal sections of one of the colleteric glands, posterior end at the upper side of the figures. × 30.

In their ventral part the vasa deferentia have a comparatively thick wall which on the inner surface shows a number of ridges (fig. 51 a), in more dorsal regions they have a wider lumen and in this state they gradually pass into the testes (fig. 51 b, c). The testes are not strongly differing in size, they are enlarged into voluminous sacs which are slightly compressed laterally; their long axis practically runs along the chief axis of the body (fig. 51 d). In the place of transition of the vasa deferentia into the testes the male organs show a distinct bend, more or less at a right angle. They are, therefore, not so strongly curved that their lumen appears twice in many sections; in some sections only (fig. 51 c) this occurs.

The colleteric glands in this specimen show the chitinous secretion in the canals. Three longitudinal sections of one of these glands are shown in fig. 52. One section (a) is from a peripheral part, the second (b) from a more central region, the third (c) from a still more central part of the gland, but still at a considerable distance from the centre, so that the largest

branches of the canal system are not shown. The section of fig. 52 c is from the region which contains the largest amount of branches of the canal system, 45 of these are to be counted in this section.

The external cuticle of the mantle is not very thick, it usually measures from 20 to 30 μ. In some places it is thicker, up to 50 μ (in the drawing of the longitudinal section in fig. 51 it is in some places rather exaggerated).

On its surface the external cuticle bears hairs which at their tips show a quantity of minute spines, more or less arranged as a circular crown. In general these hairs have a length of 7 to 12 μ (fig. 53 a) or slightly longer.

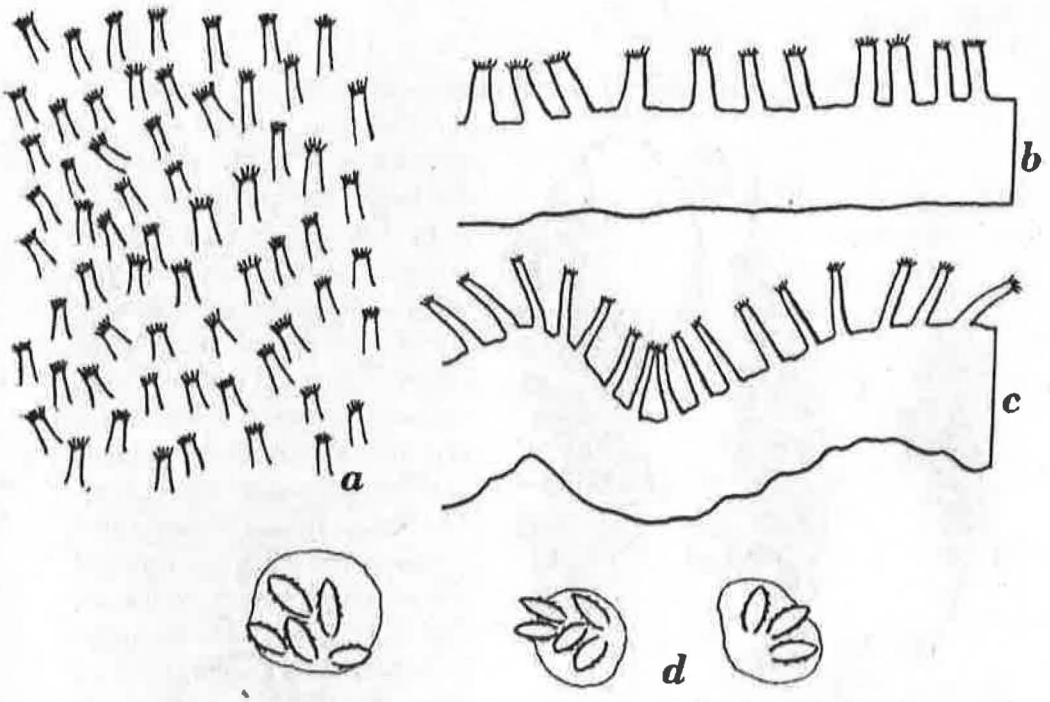

Fig. 53. *Loxothylacus brachythrix*, specimen no. 702 A. a, surface view of excrescences on the external cuticle; b, c, sections of the external cuticle; d, retinacula. × 530.

In some parts of the cuticle the hairs are comparatively thick, up to 5 μ (fig. 53 b, length of the hairs 12 to 15 μ), in other parts they are slenderer (fig. 53 c, thickness about 3 μ, length 15 to 18 μ).

The internal cuticle of the mantle bears numerous retinacula, distributed over the surface of this cuticle in the usual way. They are distinctly visible, not covered with foreign matter, so that the barbs with which the spindles are covered are clearly visible (fig. 53 d). Each retinaculum has three to five spindles, which have a length of 9 to 13 μ.

No. 897 A.

As appears from the series of longitudinal sections the visceral mass is attached to the mantle at a considerable distance from the stalk (fig. 54 b).

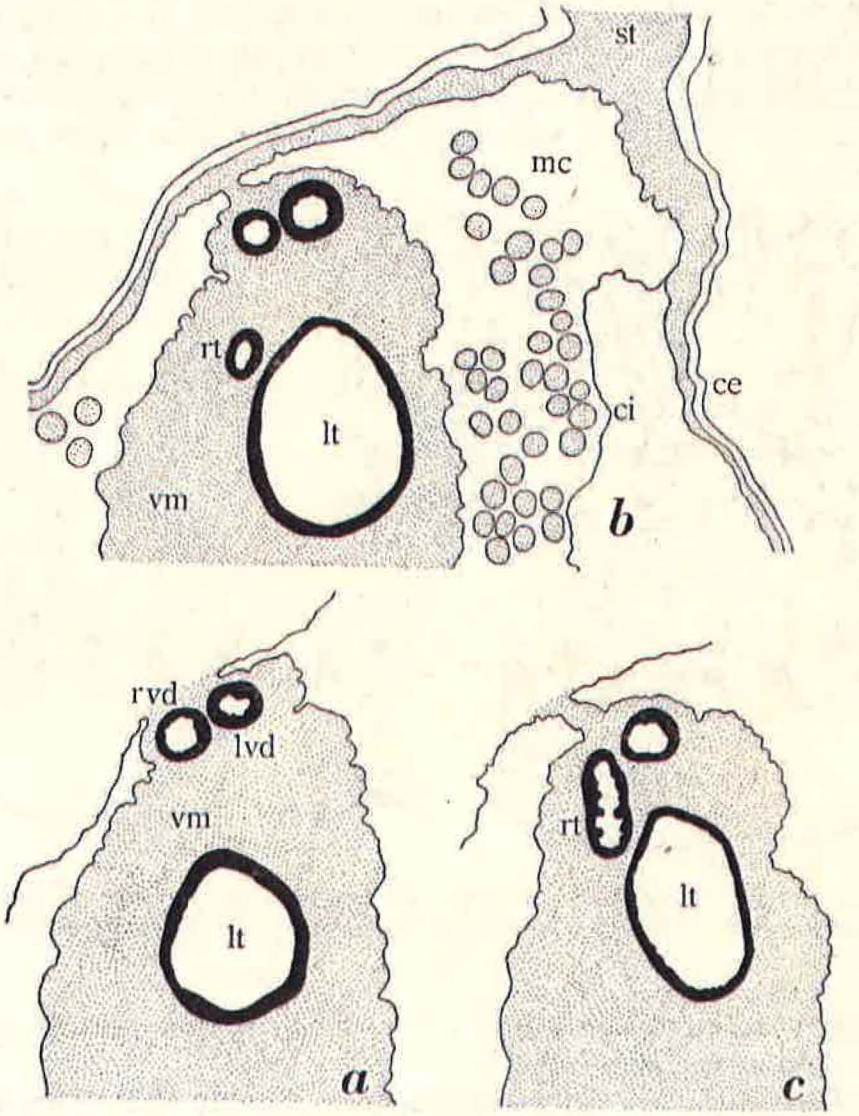

Fig. 54. *Loxothylacus brachythrix*, specimen no. 897 A, longitudinal sections; a, through the ventral region of the male organs, each following section from a more dorsal region. ce, external cuticle; ci, internal cuticle; lt, left testis; lvd, left vas deferens; mc, mantle cavity; rt, right testis; rvd, right vas deferens; st, stalk; vm, visceral mass. × 30.

In some places the internal cuticle of the mantle (ci in fig. 54 b) has lost its contact wih the surface.

The male genital openings are found in the ventral half of the body, beyond the stalk. The male organs are so distinctly curved that the terminal part of the left testis proceeds ventrally into the visceral mass till a region beyond the stalk (fig. 54 a). The two vasa deferentia (fig. 54 a, b) are of approximately equal size, the two testes have a strongly different size and shape. The right testis (fig. 54 b, c) forms a narrow, distinctly curved canal, in its dorsal part its inner wall has some ridges. The left testis forms a wide

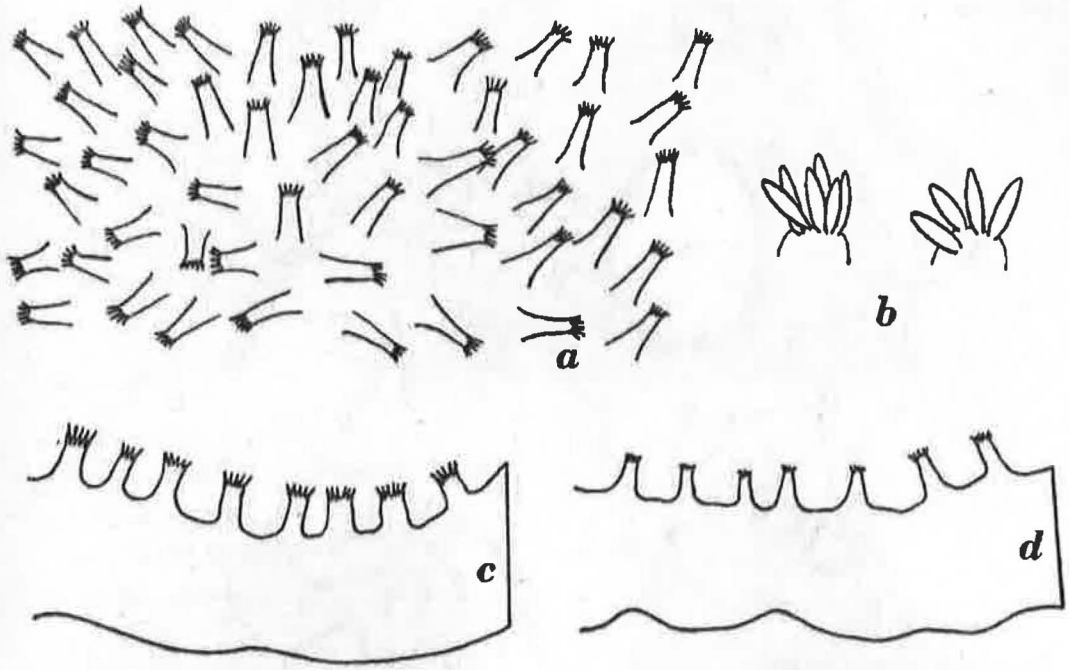

Fig. 55. *Loxothylacus brachythrix*, specimen no. 897 A. a, surface view of excrescences on the external cuticle; b, retinacula; c, d, sections of the external cuticle. × 530.

sac, which is slightly compressed in a lateral direction. Its inner surface does not show pronounced ridges.

In the colleteric glands a fairly large amount of branched canals is present. Four sections of the canal system of one of these glands in longitudinal section are given in fig. 49 d—g. Fig. 49 d is from a region near the centre, here several large branches of the canal system are to be seen. Each following section is from a more peripheral region. The number of canals is largest in fig. 49 e (48) and f (52), towards the periphery the number of canals gradually diminishes.

The external cuticle of the mantle is comparatively thin, in the greater part of the mantle its thickness varies from 20 to 35 μ. In some parts of the mantle the cuticle is thicker, to about 60 μ.

The surface of the external cuticle bears hairs or papillae which in general have the appearance of those drawn in fig. 55 a. Here they have a length of 10 to 16 μ, the thickness of their basal part is up to 8 μ. On their tips they bear a crown of minute spines. Excrescences of a slightly different character

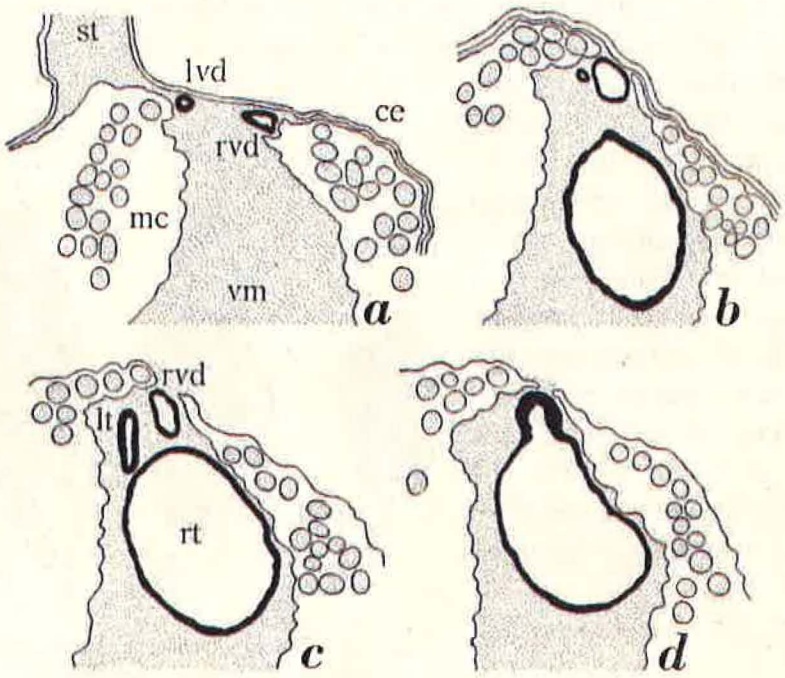

Fig. 56. *Loxothylacus brachythrix*, specimen no. 749 A 1, longitudinal sections; a, through the stalk, each following section from a more dorsal region. ce, external cuticle; lt, left testis; lvd, left vas deferens; mc, mantle cavity; rt, right testis; rvd, right vas deferens; st, stalk; vm, visceral mass. × 30.

are shown in fig. 55 c and d. The excrescences of fig. 55 c are rather short and thick (length 9 to 12 μ, thickness about 6 μ), they possess rather strong minute spines. The excrescences of fig. 55 d are thinner (length 7 to 10 μ, thickness about 4 μ), here the minute spines are much shorter and thinner.

The internal cuticle of the mantle bears numerous retinacula which possess four to six spindles, which are 12 to 15 μ long (fig. 55 b). On these spindles no barbs could be detected with certainty.

No. 749 A 1.

In the series of longitudinal sections it is distinctly visible that the visceral mass is attached to the mantle at some distance from the stalk (fig. 56 a).

The left vas deferens (fig. 56 a) forms a narrow canal which gradually passes into the left testis which also remains narrow. This testis is slightly curved, so that its terminal part chiefly runs in a postero-anterior direction (fig. 56 c). The right vas deferens (fig. 56 a, b, c) towards its dorsal part more or less increases in size, till it passes into the right testis (fig. 56 d). The latter consists of a wide pouch of more or less globular shape but which from the part of transition of the right vas deferens into this testis distinctly protrudes in a ventral direction, so that in sections from a more ventral plane this testis is clearly visible (fig. 56 c, b). Therefore without exaggeration it may be stated that the right male genital organ is definitely curved.

The canal system of the colleteric glands is not very strongly divided. Three sections of this canal system are shown here (fig. 57). Of these one (a) is from a peripheral part, the second (b) nearer to the centre, and the third (c) from the neighbourhood of the central region. In each of the two latter sections there are 20 canals.

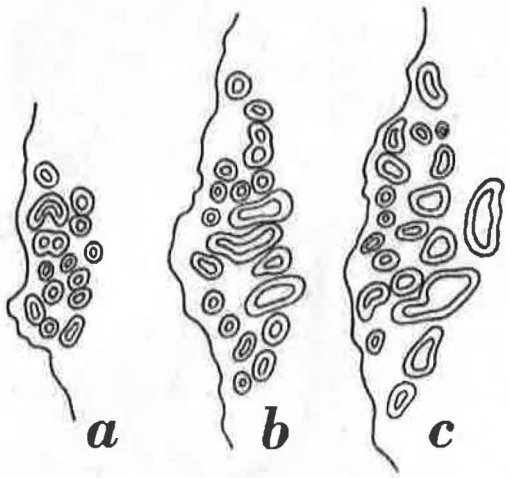

Fig. 57. *Loxothylacus brachythrix*, specimen no. 749 A 1, longitudinal sections of one of the colleteric glands, posterior end at the upper side of the figures. × 80.

Measurements of the thickness of the external cuticle of the mantle gave values varying from 16 to 37 μ.

On the surface of the external cuticle there occur numerous hairs or papillae, slightly varying in size and shape. Two parts of the external cuticle are represented in surface view in fig. 58, one (a) from the side which was turned against the thorax of the host, the other (b) from the side which faced the abdomen of the host. But the latter surface also possesses parts of the cuticle with shorter excrescences, and the former surface also shows longer hairs. The papillae represented in fig. 58 a vary in length from 4.5 to 9 μ, their thickness is up to 4 μ, the excrescences of fig. 58 b are 9 to 15 μ long and up to 4 μ thick. All these excrescences bear a crown of

minute spines on their extremities. Two sections of the external cuticle are drawn in the figure, one (fig. 58 c) with short papillae (length 4 to 7 μ), the other (fig. 58 d) with much longer excrescences (19 to 27 μ long). In general all these excrescences are of the same type, nothwithstanding their different dimensions.

On the internal cuticle of the mantle there occur numerous retinacula,

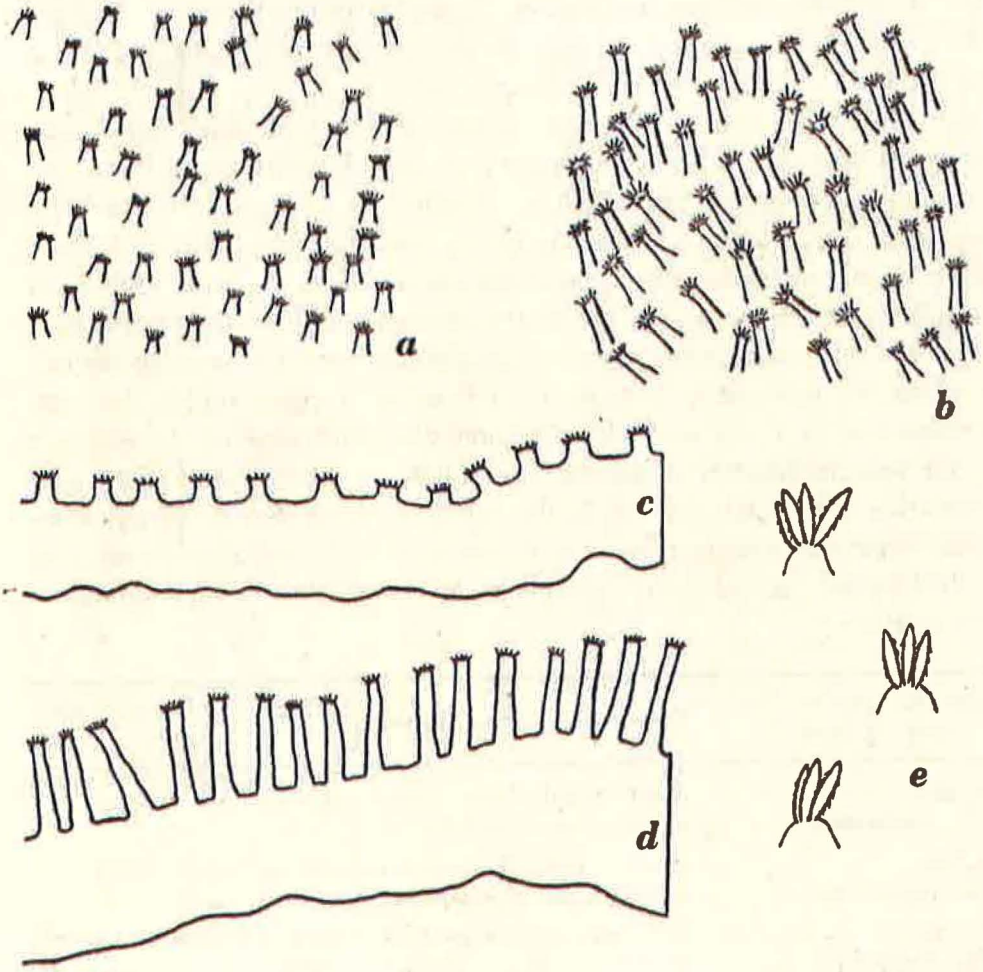

Fig. 58. *Loxothylacus brachythrix*, specimen no. 749 A 1. a, b, surface view of excrescences in various parts of the external cuticle; c, d, sections of the external cuticle; e, retinacula. × 530.

distributed in the usual manner. Three retinacula are drawn in fig. 58 e, they have three or four spindles each, the latter have a length of 12 to 15 μ and are distinctly barbed.

The three specimens on *Xantho*, together with the specimen on *Lybia*, have sufficient common characters to regard them as specifically identical. Especially the uncommon wide shape of at least one of the testes forms an important common character. On the other hand the differences among the specimens are rather striking. In the first place the mutual situation of visceral mass and stalk may differ. As far as concerns the three specimens on *Xantho*, in one (897 A) there is a considerable distance between the two organs, in another (702 A) this distance is slight, and in the third (814 A) the two organs are in direct contact. In the specimen on *Lybia* there is a slight distance between visceral mass and stalk.

The male genital organs too show distinct differences. They may be of about equal size (nos. 814 A and 702 A) or one of the testes is large, the other small (nos. 897 A and 749 A 1). Finally the curvature of the male organs may be pronounced or not. As far as concerns this curvature it must be stated here that in *Loxothylacus brachythrix* it is not a wide arch as in most species of the genus. Owing to the enlarged state of the testes these parts of the male organs are more or less globular or short sausage-shaped. The curvature principally consists of a bend at a right angle: the vasa deferentia run in a ventro-dorsal direction, the chief axis of the testes is one in a postero-anterior direction. The following table gives a survey of the variation in the male organs. In this table moreover the chief particulars of these organs in specimen no. 723 A, the type of *Loxothylacus amoenus*, described in the present paper, are given, as this species is very similar to *L. brachythrix*.

Number of specimen and name of host	Size of male genital organs	Curvature of male genital organs
814 A, on *Xantho sanguineus*	about equal, both testes enlarged into wide pouches	not very pronounced
702 A, on *Xantho sanguineus*	about equal, both testes enlarged into wide pouches	not very pronounced
897 A, on *Xantho sanguineus*	left large, ending as wide pouch; right smaller, narrow	very pronounced in both testes
749 A 1, on *Lybia tessellata*	right large, ending as wide pouch; left small	left not very pronounced, right very pronounced
723 A, on *Phymodius granulatus*	about equal, both testes enlarged into comparatively wide pouches	very pronounced in both testes

The colleteric glands of the four specimens of *Loxothylacus brachythrix* do not differ in important details. In the specimen on *Lybia* the number

of canals is smaller than in the specimens on *Xantho*, but this may be caused by the difference in size: the larger diameter of the specimen on *Lybia* is 4½ mm, the specimens on *Xantho* have a larger diameter of 10 to 13 mm.

In the four specimens the cuticular excrescences are strongly alike. Their dimensions vary considerably, but the grade of variation in the different parts of the cuticle of each separate specimen is wider than that of the excrescences of the various specimens among each other. The same holds for the retinacula, which slightly vary in shape and size.

Besides *Loxothylacus brachythrix* there are some more species of the genus in which the excrescences of the external cuticle consist of small hairs, spines or papillae. These species differ from *L. brachythrix* in the following characters (for each species only one or two important characters given):

L. panopaei, testes not enlarged into wide pouches.

L. spinulosus, testes not enlarged into wide pouches, spines of the cuticle about 4½ μ long.

L. texanus, testes partially united into a common wide pouch.

L. sclerothrix, testes widely communicating at their terminal parts, retinacula with numerous small spindles.

L. nierstraszi, testes not enlarged into wide pouches, papillae 4 to 6 μ long.

L. amoenus, described in the following pages, excrescences of the external cuticle with minute hairs, which are not arranged in a kind of crown on the tip, retinacula with minute knobs instead of spindles.

Loxothylacus amoenus nov. spec.

(figs. 59—61)

1 specimen examined:

723 A. Near Koepang, Timor, reef, 5 Dec. 1920, on *Phymodius granulatus* (Targ. Torz.); 5 × 4 × 2 mm.

Specific characters. Male genital organs in the posterior part of the visceral mass, of about equal size, both enlarged into comparatively wide pouches. Curvature of male organs distinct. Colleteric glands with a moderate quantity of branched canals.

External cuticle covered with hairs or papillae which on their tips bear minute lateral hairs. The size of the excrescences varies from 2 to 13 μ. Retinacula with about 8 or 10 small chitinous knobs of a size of about 1.5 μ, without barbs.

The specimen has a roundish shape, the posterior region is slightly narrower than the anterior part. The mantle opening is surrounded by a short

tube, which forms a papilla on the anterior margin. The mantle opening itself is turned against the thorax of the host. As there are no eggs in the mantle cavity the shape of the animal probably cannot be regarded as typical for the species, in general the appearance of the animal is similar to that of young specimens of other species. The mantle does not show pronounced grooves or ridges.

The particulars of the specimen as far as concerns the genital organs and the cuticular excrescences are described below.

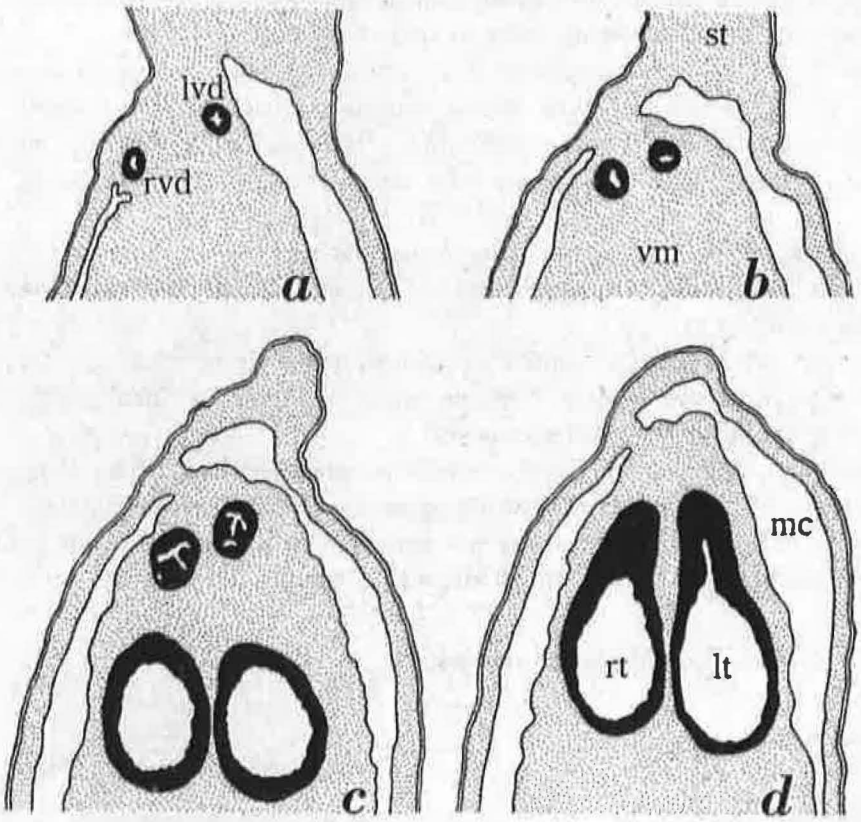

Fig. 59. *Loxothylacus amoenus,* longitudinal sections; a, through the stalk, each following section from a more dorsal region. lt, left testis; lvd, left vas deferens; mc, mantle cavity; rt, right testis; rvd, right vas deferens; st, stalk; vm, visceral mass. × 30.

In longitudinal sections through the centre of the stalk one of the generic characters of *Loxothylacus* in this specimen is not distinct: the visceral mass is in contact with the stalk (fig. 59 a). Towards the dorsal region of the stalk the visceral mass already is shifted to one side (fig. 59 b), in sections of a more dorsal region this character remains distinct (fig. 59 c, d).

In the neighbourhood of the stalk the vasa deferentia are narrow canals (fig. 59 a, b), towards their transition into the testes they become somewhat wider, but the lumen remains narrow as a result of ridges on the inner surface (fig. 59 c). At the beginning of the dorsal curvature of the male organs they have a thick wall (fig. 59 d), the testes themselves are comparatively wide. The male genital organs of the left and the right side both are equally well developed.

Three longitudinal sections of the canal system in one of the colleteric glands are given in fig. 60, one (a) from the region in which the canal

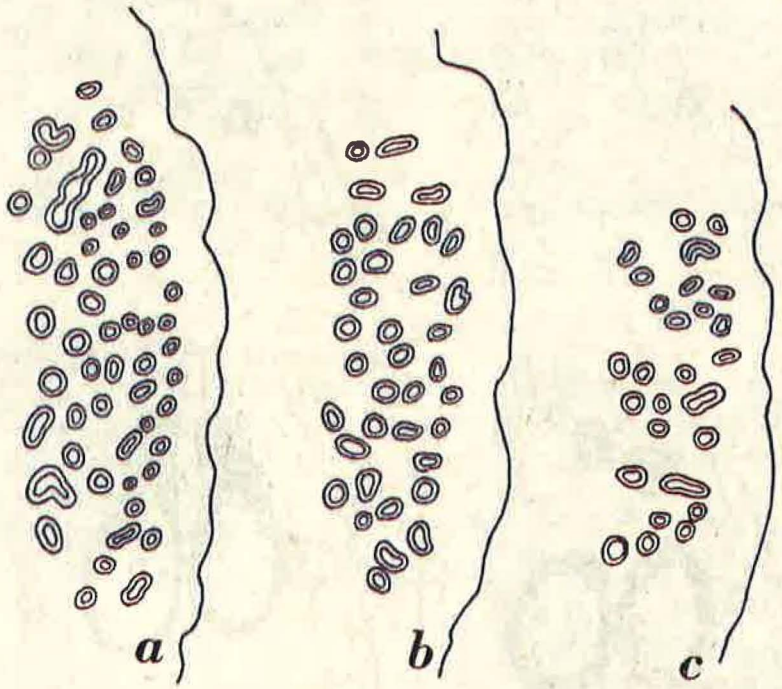

Fig. 60. *Loxothylacus amoenus*, longitudinal sections of one of the colleteric glands, posterior end at the upper side of the figures. × 107.

system is most strongly divided, the second (b) from a more peripheral part, the third (c) from a still more peripheral region. In fig. 60 a the number of large and smaller branches of the canal system is 54, a fairly large amount.

The external cuticle of the mantle is rather thin, in general its thickness varies from 4 to 9 μ, though in certain parts it may become thicker, to about 30 μ.

The surface of the external cuticle is covered with papillae which vary

in length from 2 to 13 μ and usually bear a large number of minute spines, chiefly on their tips. On the surface of the mantle which was in contact with the thorax of the host (fig. 61 a, b, e, f) the excrescences as a rule are

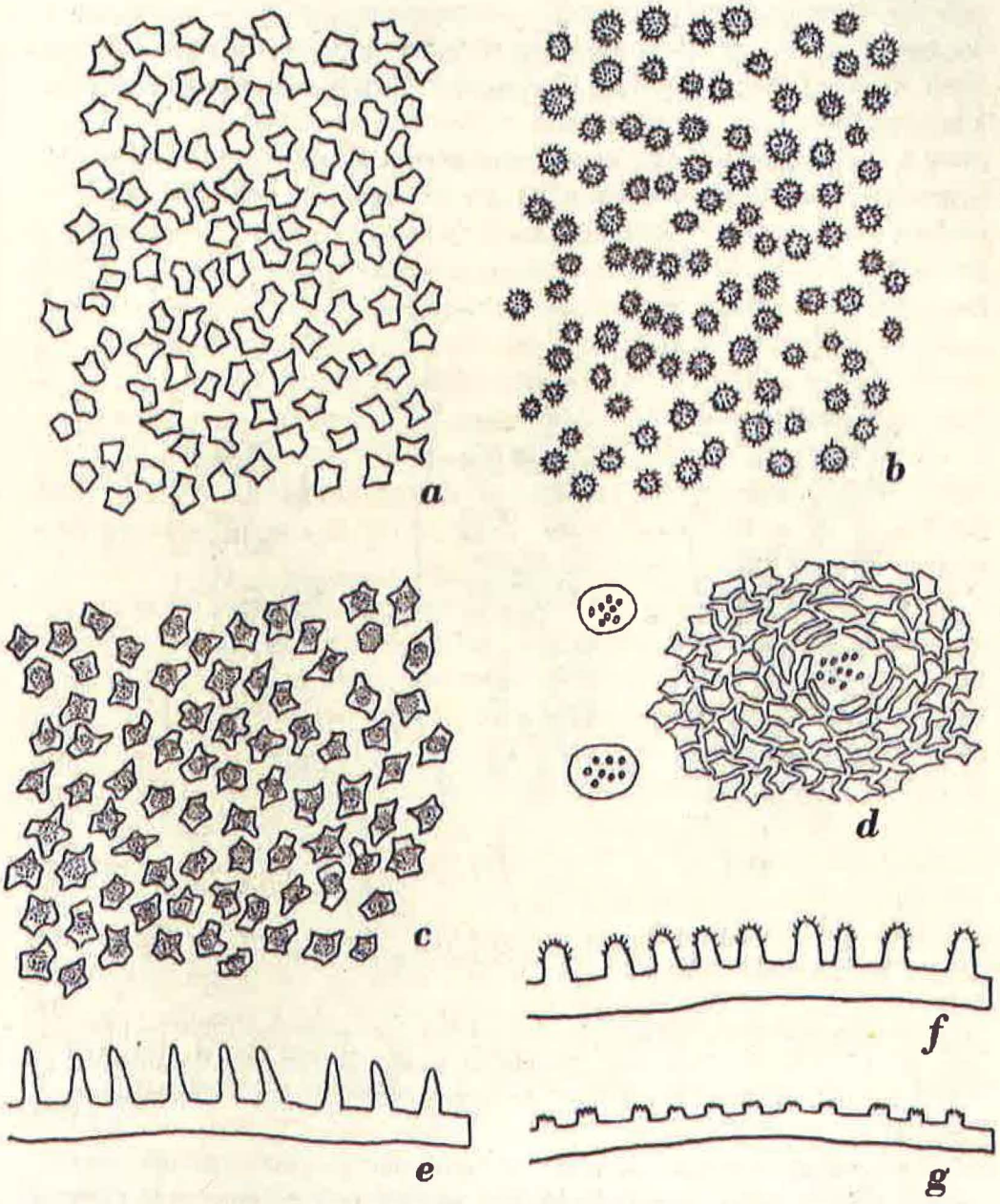

Fig. 61. *Loxothylacus amoenus*. a, basal parts of the excrescences on the external cuticle; b, upper parts of the same excrescences; c, surface view of excrescences on the external cuticle; d, one retinaculum on the internal cuticle and two other retinacula; e—g, sections of the external cuticle. × 530.

somewhat larger than those on the surface which was turned against the abdomen of the host (fig. 61 c, g). Fig. 61 a shows a number of excrescences as they are distributed on the cuticle, only the basal parts of these are drawn here. In fig. 61 b exactly the same part of the cuticle is represented with the topmost parts of the same excrescences. As these figures show, the tops of the excrescences are more or less round, they possess numerous small spines. Towards the base the papillae become irregularly polygonal. The diameter of the topmost parts is 3 to 7 μ, the diameter of the basal parts 3 to 10 μ. In fig. 61 c a part of the cuticle with very short papillae is drawn. The minute spines which occur in the tops are represented together with the basal parts with their irregularly polygonal contours. Here the basal parts have a diameter of 3 to 12 μ. In the sections drawn in the same figure some papillae in full length are to be seen. One section (fig. 61 e) shows papillae of a length of 10 to 13 μ, which are devoid of minute spines. A second section (fig. 61 f) represents papillae of fairly large size (length 7 to 10 μ) bearing numerous small spines, especially in their upper parts. In a third section (fig. 61 g) small papillae are visible of a length of 2 to 3 μ, which in their upper parts are divided into numerous small spines. The papillae of fig. 61 f correspond with those of fig. 61 a, b, those of fig. 61 g correspond with the excrescences of fig. 61 c.

On the internal cuticle of the mantle there occur retinacula of an uncommon shape. It is certain that we are dealing with retinacula here, for they occur on parts of the cuticle where the cells of the epithelium of the mantle are regularly arranged in more or less circular patches, indicated by the parts of the cuticle secreted by each individual cell (fig. 61 d). In the centre of these patches there occurs a more or less circular region on which there are about 8 or 10 small chitinous knobs with a diameter of about 1.5 μ. The figure shows besides one of these retinacula with the surrounding parts of the cuticle two more (from other parts of the internal cuticle) without these surroundings. It is not certain whether the retinacula in this shape are typical for the species or perhaps are in a more or less degenerated state. The chitin of the internal cuticle, including that of the retinacula, however, is of a transparent kind, so that probably the retinacula of this species are of this aberrant shape, with very small excrescences which hardly may be regarded as spindles.

In the specimen of *Loxothylacus amoenus* described above the visceral mass is directly in contact with the visceral mass, so that an important character of the genus is not typical.

The male organs remind strongly of those in *Loxothylacus brachythrix*,

their curvature is rather pronounced as compared with the latter genus. Both testes are enlarged into wide pouches, which have a comparatively thick wall. It is improbable that this may form a character of the species. Probably the specimen is comparatively young, for there are no eggs in the mantle cavity, and the shape of the animal too points to the fact that it has not yet obtained its definite form. When this is right the testes during further growth may become still wider and acquire a thinner wall.

The colleteric glands of *L. amoenus* do not differ in important details from those of *L. brachythrix*.

The excrescences of the external cuticle are of a slightly different type from those of *L. brachythrix*. The minute hairs on the tips of the excrescences in *L. amoenus* are not as regularly arranged as in the other species. The retinacula of *L. amoenus* (if really the chitinous formations described and figured here are the typical retinacula of the species) differ from those of all the other species of the genus.

From the other species of the genus *Loxothylacus* which have excrescences of a similar kind the species described here is distinct, the chief characters causing the differences are given on a previous page (under *L. brachythrix*).

Loxothylacus sclerothrix Boschma 1933 b

(figs. 62—65)

1 specimen examined:

998 A. Amboina, 11—17 Sept. 1930, on *Xantho sanguineus* (M. Edw.); 7 × 5 × 2½ mm.

The specific characters of *Loxothylacus sclerothrix* are given in the first part of the present paper. The particulars of specimen no. 998 A may be described as follows.

The animal is broadly oval with concave anterior and posterior regions, so that it is more or less dumb-bell shaped. The mantle opening does not protrude above the surface of the mantle, it is a narrow opening lying near the anterior margin, on the surface which was turned against the thorax of the host. With the exception of a pronounced groove in the posterior part of the surface which was facing the abdomen of the host the mantle does not show distinct grooves or ridges.

The specimen shows the following particulars.

In the figures drawn from the series of longitudinal sections (fig. 62) the stalk is not shown, it occurs in a region corresponding with the upper part of the drawings, so that the visceral mass is attached to the mantle at some distance from the stalk.

The two male genital organs are of approximately equal size and shape.

In their ventral region the two vasa deferentia are comparatively narrow (fig. 62 a), towards their ventral part they considerably increase in size (fig. 62 b, c), whilst distinct ridges develop on the inner surface of these organs. They pass into the testes which first run along the mesentery (fig. 62 d, e), and in a more dorsal plane show a distinct curve of medium width

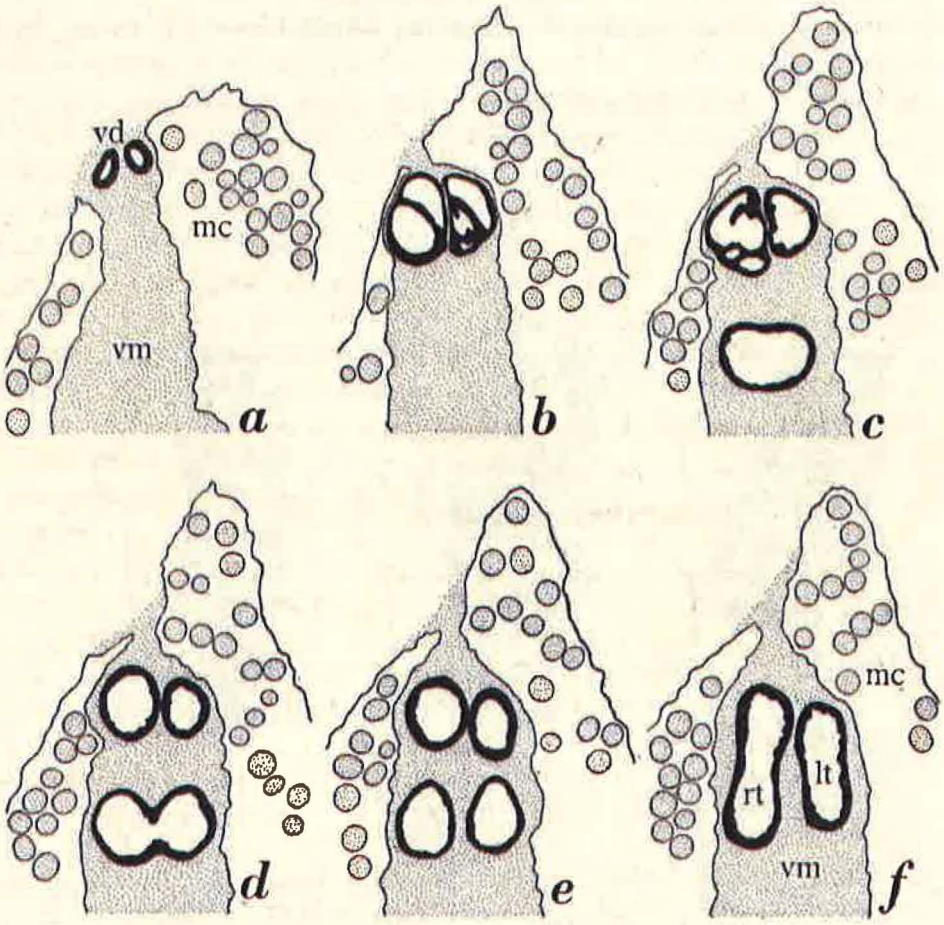

Fig. 62. *Loxothylacus sclerothrix*, specimen no. 998 A, longitudinal sections: a, through the ventral region of the male organs, each following section from a more dorsal region. lt, left testis; mc, mantle cavity; rt, right testis; vd, vasa deferentia; vm, visceral mass. × 30.

(fig. 62 f). The recurved parts of the testes at first remain separated (fig. 62 e, lower part), but the terminal parts of the testes become united (fig. 62 d), and at last form but a single wide, slightly compressed tube (fig. 62 c), so that the terminal parts of the two testes are widely communicating.

The colleteric glands possess a fairly large amount of branched canals. Longitudinal sections through one of these glands, showing the distribution of the canals, are represented in fig. 63. One of the sections (a) is from the neighbourhood of the female genital opening, so that it shows some of the larger branches of the canal system. The second (a) is from a more peripheral part, from the region in which the canal system is most strongly divided, so that 48 of the canals are visible. The third section (c) is from a still more peripheral region, in which the canals become narrower and smaller in number.

Some measurements of the thickness of the external cuticle gave amounts

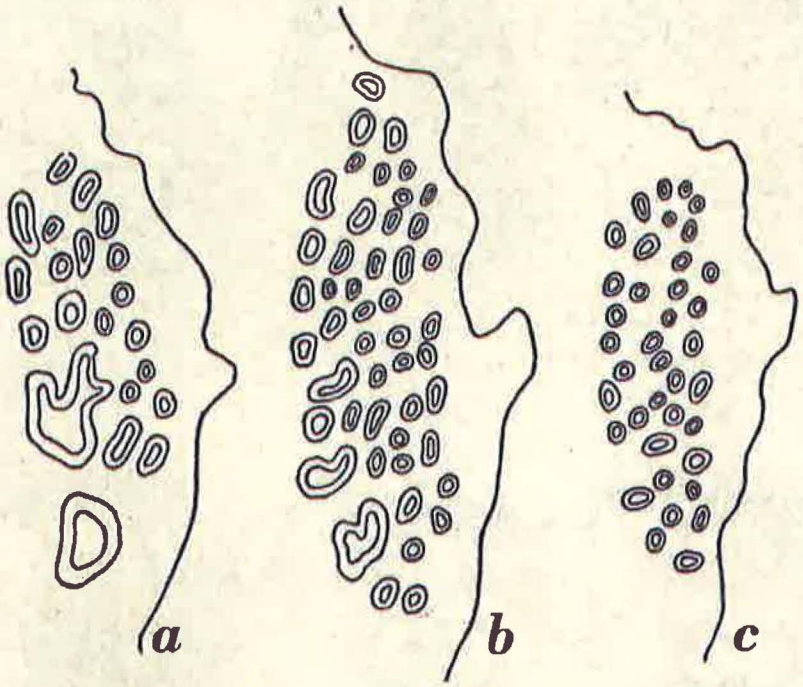

Fig. 63. *Loxothylacus sclerothrix*, specimen no. 998 A, longitudinal sections of one of the colleteric glands, posterior end at the upper side of the figures. × 107.

of 18 to 40 μ, but there may be parts of the mantle in which this cuticle is thinner or thicker.

On its surface the external cuticle is rather densely covered with small papillae which at their tops possess a number of minute spines, as a rule arranged in one circular row. The shape and size of these papillae is subject to slight variation, as fig. 64 c, d, e shows. In one of the sections represented in this figure the papillae are 6 to 9 μ long (c), in another the length is 6 to 8 μ (d), and in a third 9 to 12 μ (e). The thickness of the papillae

varies from 3 tot 7 μ. The spines at the top of the papillae may be short (c) or much longer (e). The papillae form a rather dense covering of the upper surface of the cuticle (fig. 64 a), in some parts of the cuticle they form such a compact mass that the individual papillae are almost in close contact (fig. 64 b). In surface view it is apparent that the minute spines of the papillae form a more or less circular crown.

The surface of the internal cuticle of the mantle shows retinacula in

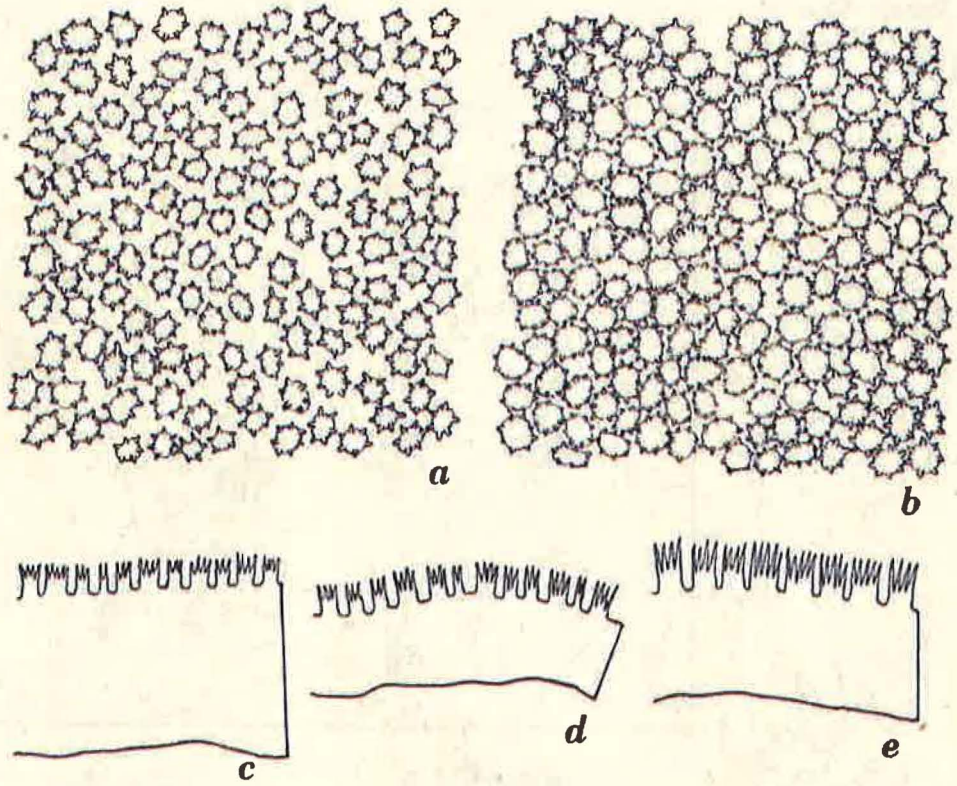

Fig. 64. *Loxothylacus sclerothrix*, specimen no. 998 A. a, b, surface view of excrescences in various parts of the external cuticle; c—e, sections of the external cuticle. × 530.

large numbers. Fig. 65 a shows the distribution of these retinacula, they are far more numerous than generally in the Sacculinidae. A few individual retinacula are represented on a larger scale in fig. 65 b—f. Each retinaculum occupies a fairly large area of the internal cuticle (diameter of this area 30 to 50 μ). On this area there are 15 to 30 spindles, a much larger number than usually in the Sacculinidae. The individual spindles, however, are of small size, varying in length from 4 to 8 μ, they seem to be devoid of barbs.

The type specimen of *Loxothylacus sclerothrix* was a parasite of *Actaea holetaria* Rathbun from the Western Indian Ocean. Moreover another specimen from the same locality, a parasite of *Carpilodes pediger* Alcock, was identified as *L. sclerothrix* (Boschma, 1933 b). The retinacula of the

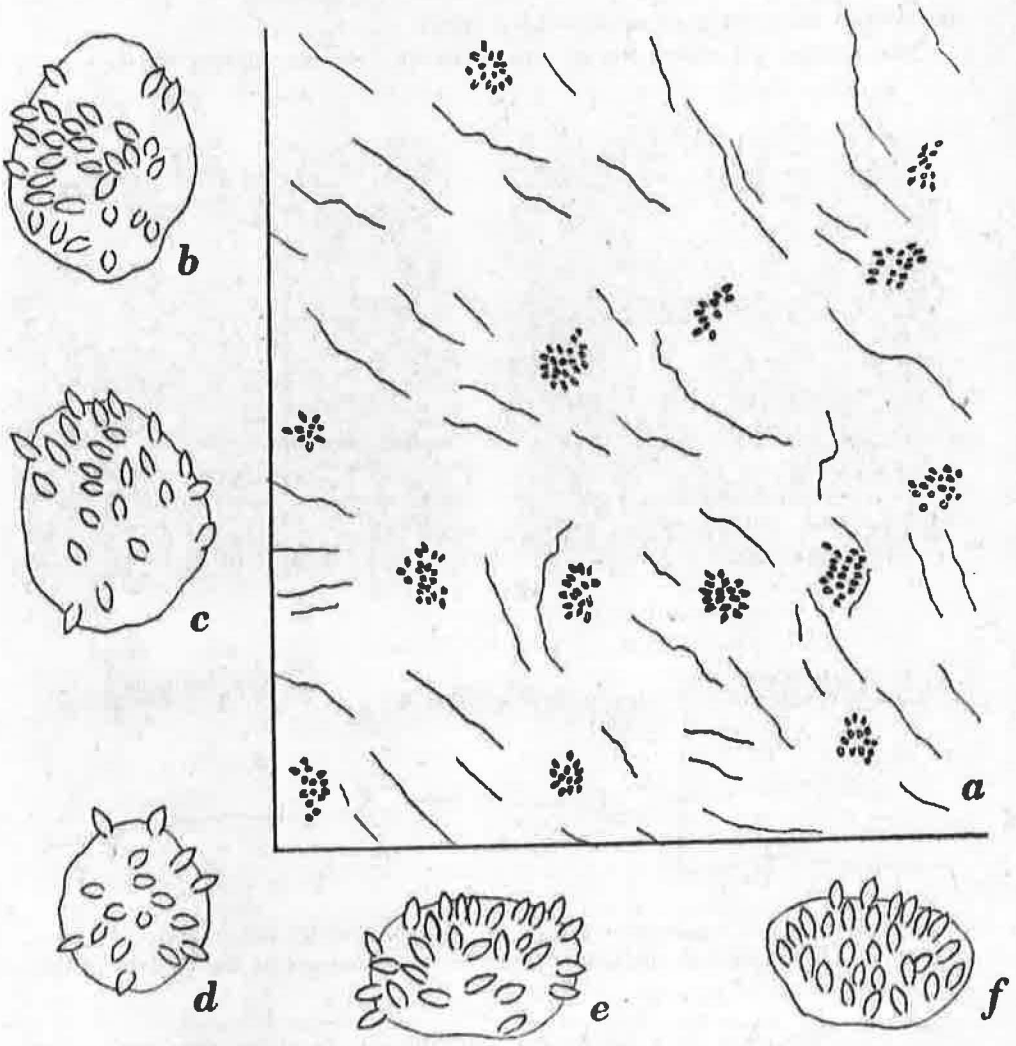

Fig. 65. *Loxothylacus sclerothrix*, specimen no. 998 A. a, retinacula as they are distributed on the internal cuticle; b—f, retinacula. a, × 130; b—f, × 530.

specimen on *Xantho sanguineus* described above in all respects are similar to those of the type specimen, a strong argument in favour of the identity of the specimen on *Xantho* with the type of the species. Moreover male genital organs and colleteric glands are alike in all important details. The

excrescences of the external cuticle are different to some degree, in the type specimen they are 10 to 25 μ long, in the specimen described here they measure 6 to 12 μ. Moreover the excrescences of the type specimen possess minute lateral hairs, which have not been observed in the specimen described above. These differences however, certainly are a result of individual variation.

Loxothylacus sclerothrix is a well defined species of the genus, it differs from all other described species by the peculiarly united testes and by the retinacula of very uncommon structure.

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