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## RHIZOCEPHALA FROM NEW GUINEA. III

### LOXOTHYLACUS VARIABILIS BOSCHMA

by

H. BOSCHMA

The name *Loxothylacus variabilis* was chosen for a Rhizocephalan parasite of *Chlorodiella nigra* (Forskål) and other crabs from the East Indian region to emphasize its pronounced variability in anatomical characters as well as in the peculiarities of the excrescences of the external cuticle (Boschma, 1940). In the materials collected by Dr. L. D. Brongersma, Dr. L. B. Holthuis, and Dr. M. Boeseman on the reef of Biak Island near New Guinea<sup>1)</sup> there are five specimens of *Loxothylacus variabilis* showing peculiarities which distinctly widen the range of variation of the species, leading to the ultimate result that parasites originally described as representatives of a separate species, *Loxothylacus murex* Boschma (1950), now prove to be conspecific with *L. variabilis*.

#### *Loxothylacus variabilis* Boschma

*Loxothylacus variabilis* Boschma, 1940, p. 280; 1947a, p. 277; 1947b, p. 1033; 1955, p. 47.

*Loxothylacus murex* Boschma, 1950, p. 996; 1955, p. 33.

#### Material examined:

No. 1321, reef W. of Sorido, Biak Island, shallow water, February, 1955, 4 specimens on *Cymo andreossyi* (Audouin). One of the parasites (no. 1321B) solitary,  $6\frac{1}{2} \times 5 \times 2\frac{1}{2}$  mm (fig. 1a, b), the remaining three on one host: no. 1321A1,  $6\frac{1}{2} \times 5 \times 2\frac{1}{2}$  mm (fig. 1e, f), no. 1321A2,  $5 \times 4 \times 2$  mm (fig. 1g, h), and no. 1321A3,  $4 \times 3 \times 1\frac{1}{2}$  mm (fig. 1i, j).

No. 1323A, reef W. of Sorido, Biak Island, shallow water, February, 1955, 1 specimen on *Actaea hirsutissima* (Rüppell),  $6 \times 4 \times 2$  mm (fig. 1c, d).

1) The voyage was made possible by a grant of the Netherlands Organization for Pure Research (Z. W. O.) and support from the Government of Netherlands New Guinea and the Royal Netherlands Navy.

Moreover, the following specimens dealt with in previous papers were available:

Near Kupang, Timor, 4 specimens on *Chlorodiella nigra* (Forskål) (cf. Boschma, 1940, p. 280).

Kafal near Misool, 2 specimens on unidentified Xanthid crab (cf. Boschma, 1940, p. 280).

Mamudju, Celebes, 1 specimen on *Actaea rüppellii* (Krauss) (cf. Boschma, 1940, p. 280).

Taliabu, Sula Islands, 1 specimen on *Actaea hirsutissima* (Rüppell) (cf. Boschma, 1947a, p. 272).

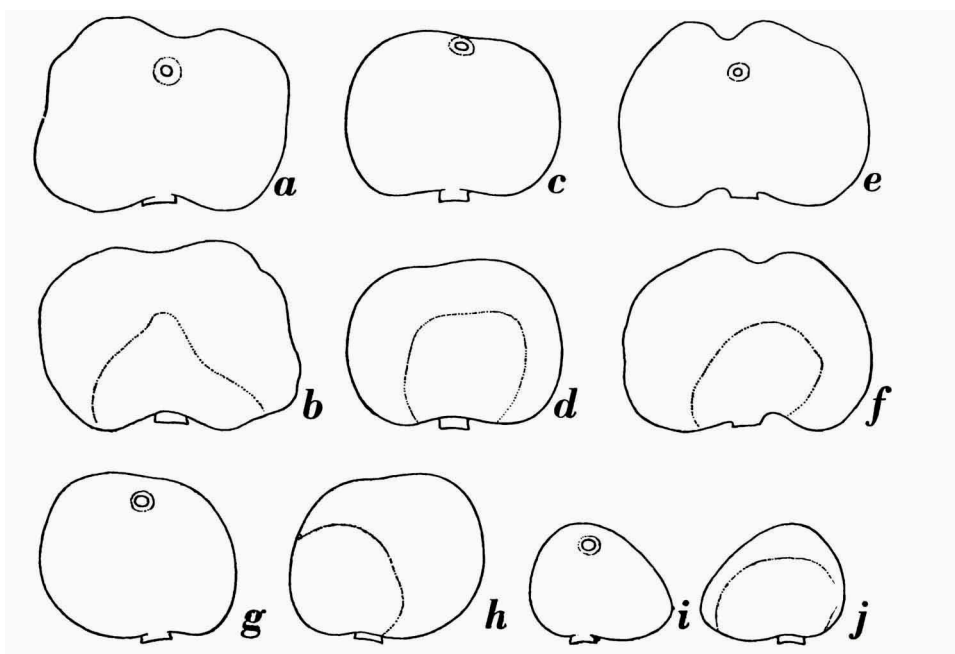


Fig. 1. *Loxothylacus variabilis* Boschma. a, specimen no. 1321B, left side; b, same specimen, right side; c, specimen no. 1323A, left side; d, same specimen, right side; e, specimen no. 1321A1, left side; f, same specimen, right side; g, specimen no. 1321A3, left side; h, same specimen, right side; i, specimen no. 1321A2, left side; j, same specimen, right side. The part covered by the abdomen of the host (or by another parasite, h, j) indicated with a dotted line.  $\times 5$ .

Benkulen, Sumatra, 1 specimen on *Xanthias lamarcki* (H. Milne Edwards) (holotype of *Loxothylacus murex*, cf. Boschma, 1950, p. 996).

Kupang, Timor, 1 specimen on *Cymo andreossyi* (Audouin) (*Cymo melanodactylus* De Haan) (paratype of *Loxothylacus murex*, cf. Boschma, 1950, p. 996).

The contours of the specimens from Biak Island are drawn in fig. 1. The solitary parasite of *Cymo andreossyi* (fig. 1a, b) is of an irregular, quadrangular to oval shape, the parasite of *Actaea hirsutissima* is fairly

regularly oval (fig. 1c, d). Of the three parasites occurring on one specimen of *Cymo andreossyi* the larger is oval to kidney-shaped with a distinct notch in the centre of the anterior region (fig. 1e, f), the second is fairly regularly oval (fig. 1g, h), and the third is of an asymmetrical, triangular shape (fig. 1i, j). In all the specimens the mantle opening lies in the centre

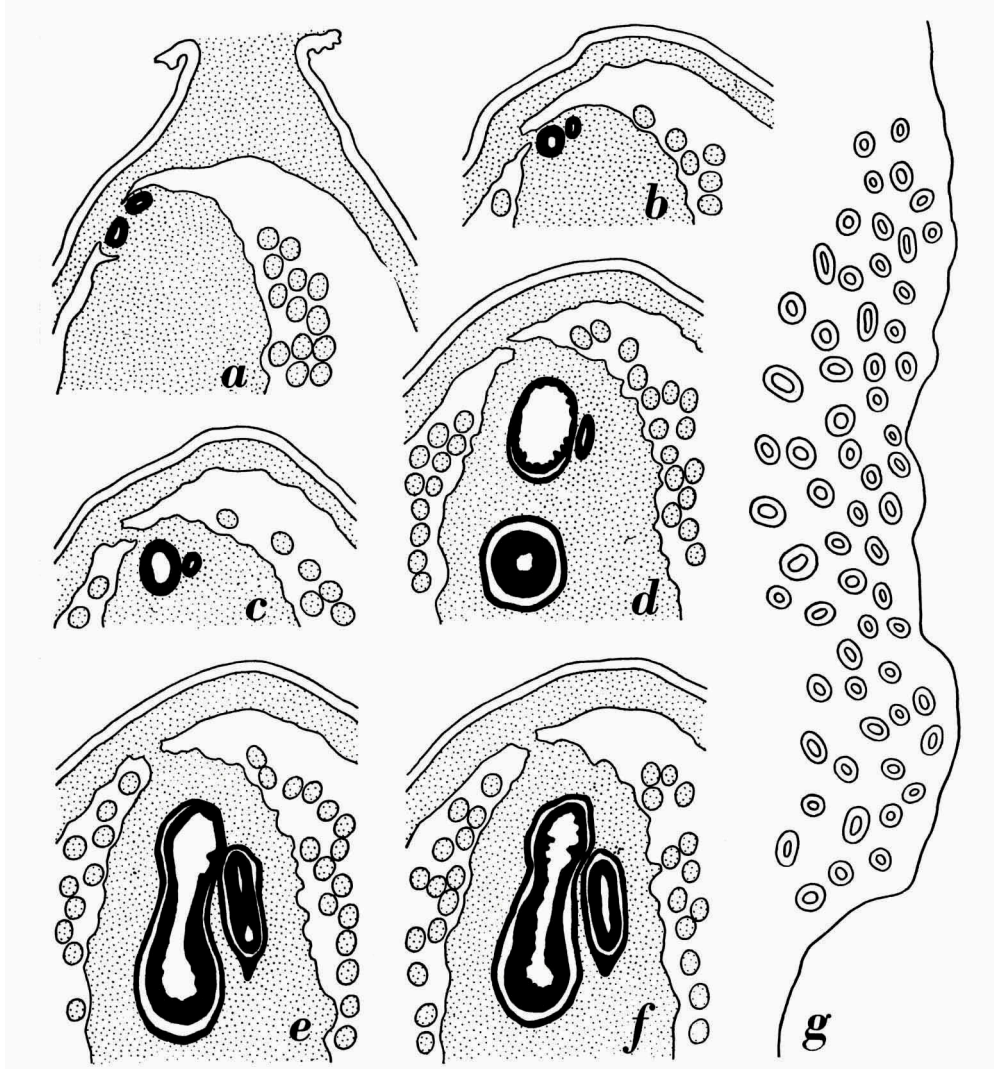


Fig. 2. *Loxothylacus variabilis* Boschma, specimen no. 1323A. a-f, posterior parts of longitudinal sections, a through the stalk, each following section farther towards the dorsal region; g, longitudinal section of one of the colleteric glands. Excrescences of external cuticle omitted. a-f,  $\times 30$ ; g,  $\times 170$ .

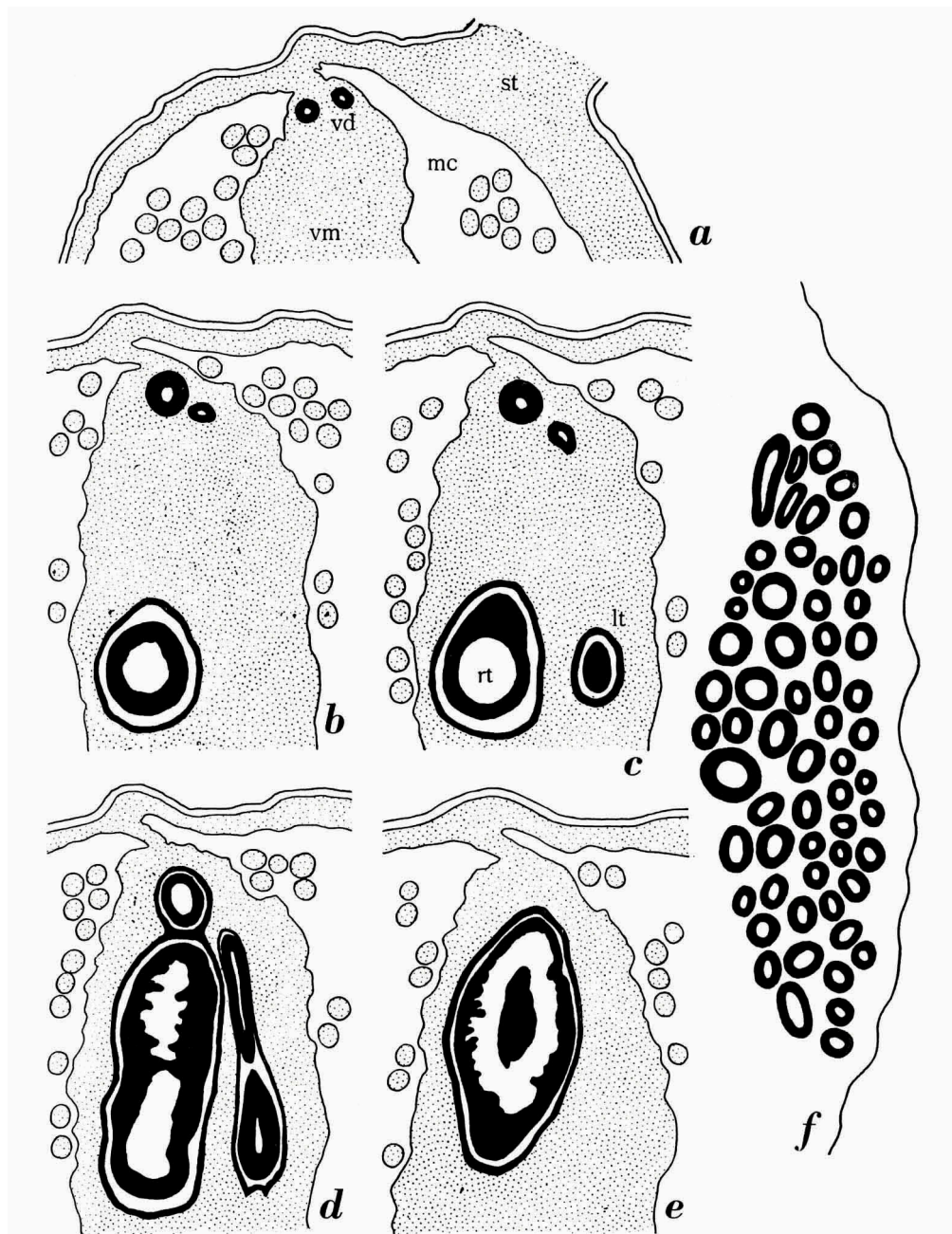


Fig. 3. *Loxothylacus variabilis* Boschma, specimen no. 1321B. *a-e*, posterior parts of longitudinal sections, *a* through the stalk, the other sections gradually farther towards the dorsal region; *f*, longitudinal section of the left colleteric gland. lt, left testis; mc, mantle cavity; rt, right testis; st, stalk; vd, vasa deferentia; vm, visceral mass. Excrescences of external cuticle omitted. *a-e*,  $\times 38$ ; *f*,  $\times 163$ .

of an area with smaller excrescences than occurring on the other parts of the mantle, not extending over the surface of the mantle, at or near the anterior region of the body, at the left side. The solitary specimens have a broad median groove on the right side (not shown in the figures), while the region of the right side which was touching the abdomen of the host (or one of the other parasites) is rather sharply delimited from the remainder of the mantle, in this region the excrescences are not as fully developed as in most other parts of the mantle.

The external appearance of the specimens from Biak Island is altogether similar to that of previously figured specimens of *Loxothylacus variabilis* (cf. Boschma, 1947b, fig. 1); moreover the shape of these specimens closely corresponds with that of the two parasites which were originally described as *Loxothylacus murex* (Boschma, 1950, fig. 1). This shows that, here again, to a certain degree the shape of the animals is of some value as a specific character.

Longitudinal sections were made of all the five specimens from Biak Island. In the five specimens the visceral mass is attached to the mantle at some distance from the region of the stalk (figs. 2a, 3a, 4a; in the specimens of figs. 5 and 6 the situation is altogether similar).

The structure of the male genital organs is rather profusely illustrated, consequently a few notes may suffice to show the individual variation.

No. 1323A (fig. 2). Host *Actaea hirsutissima*. Right male organ larger than left. Right testis with distinct, rather narrow curvature, the terminal part directed ventrally (fig. 2d). Left testis curved anteriorly, hardly turning towards the ventral region.

No. 1321B (fig. 3). Host *Cymo andreossyi*. Right male organ larger than left. Both testes with distinct, rather wide curvature (fig. 3c). Dorsal part of the right testis (the top of the curvature) wide (fig. 3e).

No. 1321A1 (fig. 4). Host *Cymo andreossyi*. Right male organ larger than left. Right testis with distinct, rather narrow curvature, the terminal part directed ventrally (fig. 4d). Left male organ with very narrow vas deferens, the testis not much narrower than the right (fig. 4f), the curvature chiefly anteriorly.

No. 1321A2 (fig. 5). Host *Cymo andreossyi*. Right male organ much larger than left. Right vas deferens very wide, with irregular cavity, right testis with distinct, rather narrow curvature, the terminal part directed ventrally (fig. 5a). Left testis much smaller, with narrow curvature, the terminal part directed anteriorly.

No. 1321A3 (fig. 6). Host *Cymo andreossyi* (sectioning of this specimen started at the ventral region, in the other specimens at the dorsal region,



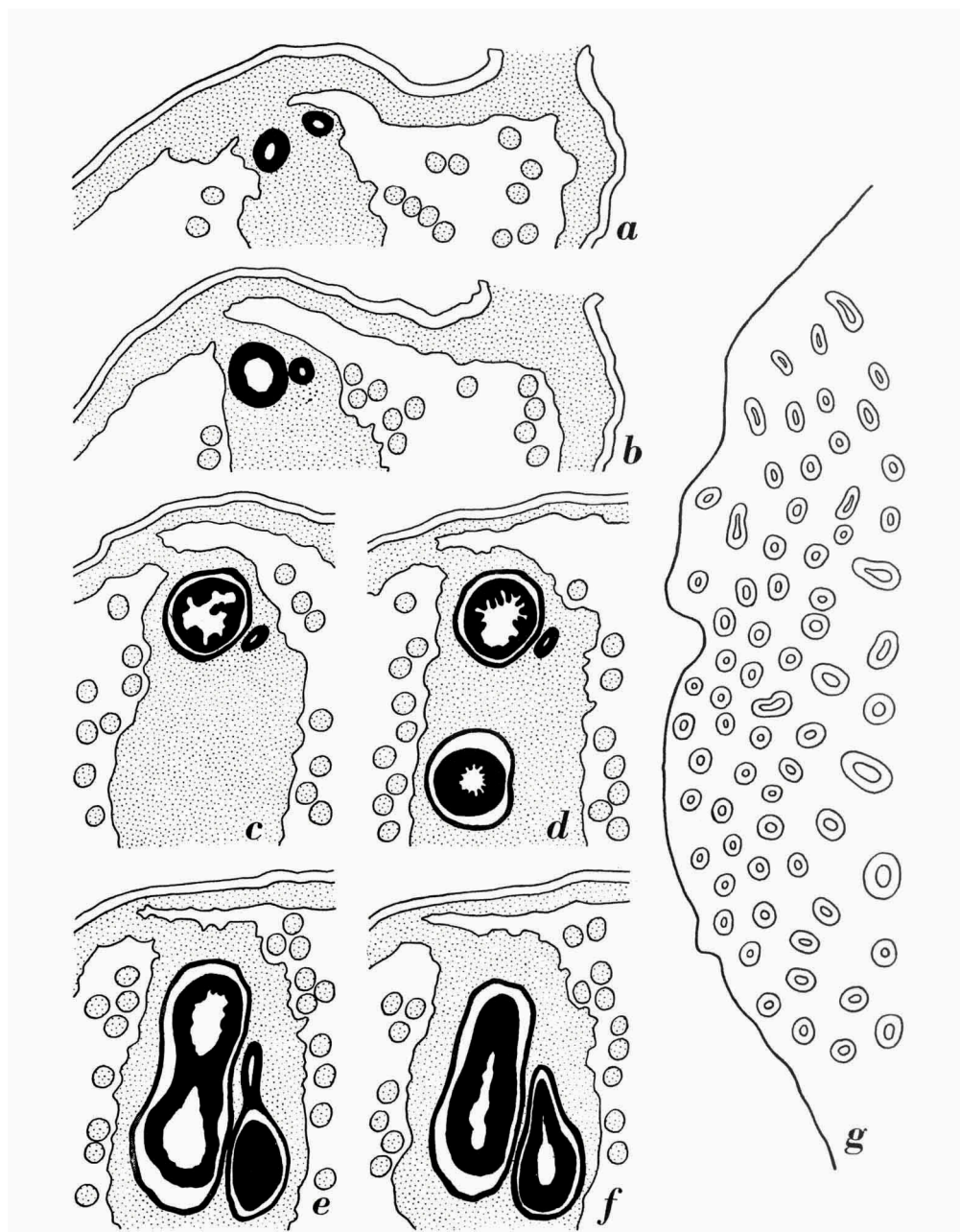


Fig. 4. *Loxothylacus variabilis* Boschma, specimen no. 1321A1. a-f, posterior parts of longitudinal sections from ventral (a) to dorsal region (f) of the male genital organs; g, longitudinal section of one of the colleteric glands. Excrescences of external cuticle omitted. a-f,  $\times 36$ ; g,  $\times 152$ .

so that here the right half is at the right side of the figures). Right male organ much larger than left. Right male organ with distinct, rather narrow curvature, the terminal part of the testis directed ventrally (fig. 6a). Dorsal part of right testis (or right vas deferens) very wide, with irregular cavity. Left testis with curvature chiefly directed anteriorly.

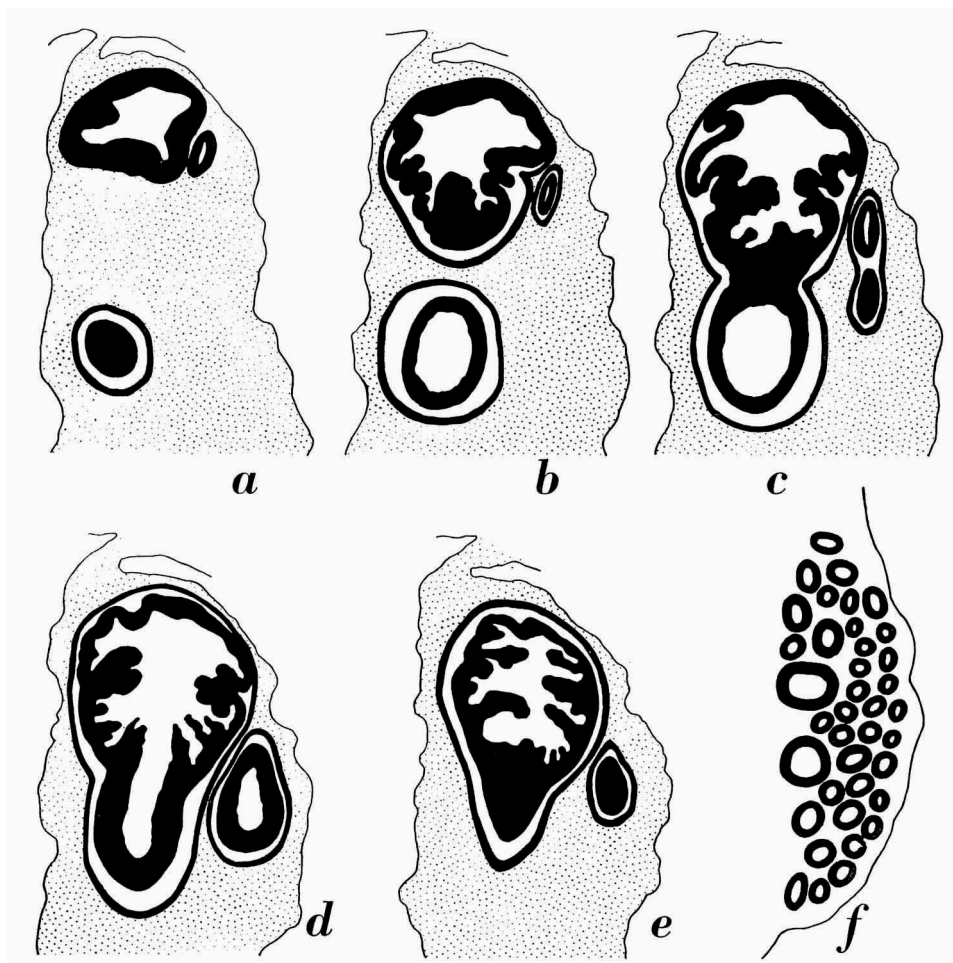


Fig. 5. *Loxothylacus variabilis* Boschma, specimen no. 1321A2. a-e, posterior parts of longitudinal sections of the visceral mass from ventral (a) to dorsal region (e) of the male organs; f, longitudinal section of one of the colleteric glands. a-e,  $\times 53$ ; f,  $\times 93$ .

In a previous paper (Boschma, 1947a) a specimen of *Loxothylacus variabilis* was mentioned, collected during the Snellius Expedition at Taliabu in the Sula Islands. Part of a section of the external cuticle, with two

successive layers, each with the excrescences as they are typical of the species, is shown in fig. 5 of the cited paper. Up to now no data were published concerning the anatomical peculiarities of the specimen; because in these characters the specimen differs from others, the chief details are here noted.

No. 817 (fig. 7). Host *Actaea hirsutissima*. Left male organ much larger than right. The two male organs with distinct, wide curvature, the terminal parts of both testes directed ventrally (fig. 7b). In this specimen the male organs are rather small in comparison to the size of the visceral mass.

The corresponding structures of the specimens described in 1940 and in 1950 are as follows.

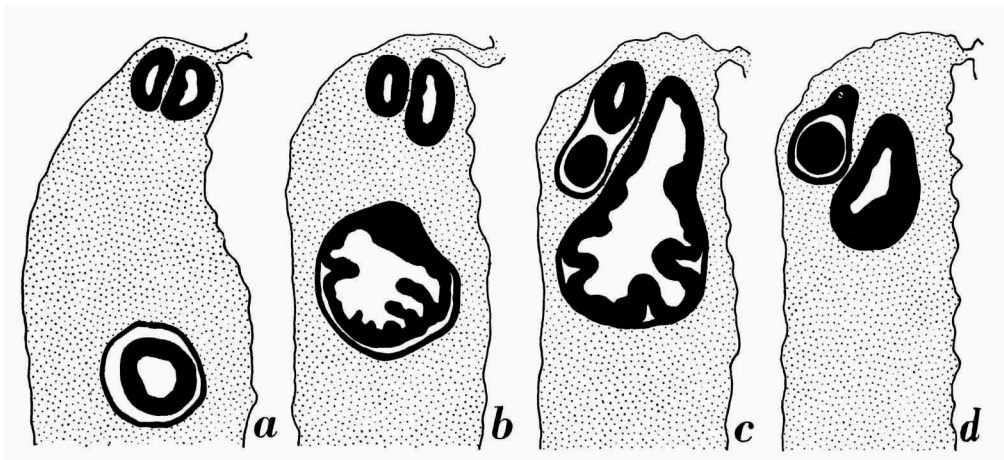


Fig. 6. *Loxothylacus variabilis* Boschma, specimen no. 1321A<sub>3</sub>, posterior parts of longitudinal sections of the visceral mass from ventral (a) to dorsal region (d) of the male genital organs.  $\times 40$ .

No. 722A (Boschma, 1940, fig. 1). Host *Chlorodiella nigra*. The two male organs of approximately equal size and shape, both with distinct, rather narrow curvature.

No. 691A (Boschma, 1940, fig. 6). Host *Chlorodiella nigra*. Right male organ much larger than left, both testes with distinct, rather wide curvature, the terminal ends of both testes directed ventrally.

No. 707B (Boschma, 1940, fig. 8). Host *Chlorodiella nigra*. The two male organs of approximately equal size and shape, curvature in both practically absent.

No. 707A (Boschma, 1940, fig. 10). Host *Chlorodiella nigra*. Right male organ large, left very small. In the right a slight twist, but the general direction is ventro-dorsally. Left testis without curvature.



No. 767A (Boschma, 1940, fig. 11). Host *Chlorodiella nigra*. Right male organ large, left small, in both the curvature totally absent, save a slight deviation towards the anterior region of the visceral mass.

No. 991A1 (Boschma, 1940, fig. 15). Host unidentified Xanthid crab.

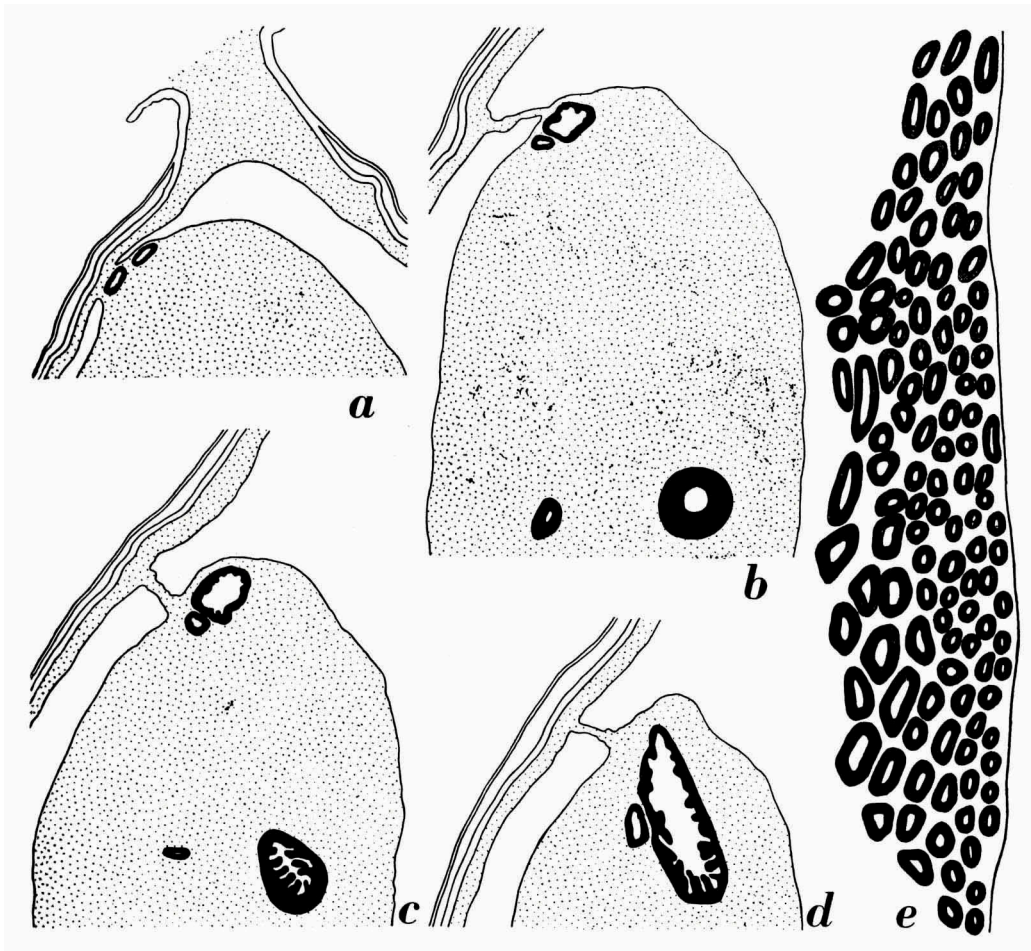


Fig. 7. *Loxothylacus variabilis* Boschma, specimen no. 817, from Taliabu, Sula Islands. a-d, posterior parts of longitudinal sections, from ventral (a) to dorsal region (d) of the male genital organs; e, longitudinal section of one of the colleteric glands. Excrescences of the two layers of the external cuticle omitted. a-d,  $\times 30$ ; e,  $\times 127$ .

Right male organ large, left small, both with distinct, rather wide curvature, the terminal parts of both testes directed ventrally.

No. 756 (Boschma, 1940, fig. 19). Host unidentified Xanthid crab. Right male organ large, left small; dorsal part of right vas deferens wide with

irregular cavity. Both male organs with distinct, rather narrow curvature, the terminal parts of both testes directed ventrally.

No. 844 (Boschma, 1940, fig. 22). Host *Actaea rüppellii*. The two male organs of approximately equal size and shape, both with distinct, rather wide curvature, the terminal parts of both testes directed ventrally.

No. 563 (Boschma, 1950, fig. 2). Host *Xanthias lamarcki*, parasite holotype of *Loxothylacus murex*. Right male organ large, with distinct, rather narrow curvature, terminal part of right testis directed ventrally. Left male organ much smaller, curvature little pronounced, terminal part of left testis directed anteriorly.

No. 682A (Boschma, 1950, fig. 4). Host *Cymo andreossyi*, parasite paratype of *Loxothylacus murex*. The two male organs of approximately equal size and shape, both with distinct, moderately wide curvature, the terminal parts of the two testes directed ventrally.

The data compiled above show that the male organs of *Loxothylacus variabilis* are extremely variable, in size as well as in shape. In some specimens the male organs have a more or less straight course, not differing from those in the genus *Sacculina*; the other extreme is found in the specimens with a distinct curvature of the male organs, as typical of the genus *Loxothylacus*. While as a rule in the species the right male organ is decidedly larger than the left (a phenomenon of general occurrence in the genus *Loxothylacus* when the two male organs are differing in size, cf. Boschma, 1948), there are specimens in which the two are of approximately the same size, while in one specimen (fig. 7) the left male organ is the larger of the two.

When one of the male organs is much smaller than the other it is apparently in a more or less rudimentary state; these smaller male organs do not show distinct differences in structure from the ventral parts of the vasa deferentia to the terminal parts of the testes, the whole organ then being a narrow tube with a cavity of strongly reduced size. The larger male organs consist of three parts, a narrow vas deferens in the ventral part of the posterior region of the visceral mass, a comparatively wide terminal part of the testis (with rather thick wall surrounding a cavity which is of a circular shape in transverse section) nearer to the anterior region, generally directed ventrally, and a middle part connecting the two other regions. In this middle part the wall shows numerous ridges or irregular outgrowths, often reducing the cavity to rather narrow slits of a complicated shape. This irregular portion occupies the dorsal region of the male organs including the dorsal curvature. The transition of the irregular part into the terminal part of the testis often is of a gradual manner, sometimes

rather abrupt (cf. fig. 5d), the transition of this part into the vas deferens is always gradual.

The shape of the colleteric glands and the manner of arrangement of the tubes in these glands is of a similar kind in the various specimens of *Loxothylacus variabilis* that up to now have been examined. The number of tubes found in longitudinal sections of the most strongly divided region of these glands is highly variable, as shown below.

Specimens on *Chlorodiella nigra*. No. 722A, 29 tubes (Boschma, 1940, fig. 2b); no. 707B, 37 tubes (l.c., fig. 2e); no. 691A, 35 tubes (l.c., fig. 2g); no. 707A, 57 tubes (l.c., fig. 2l); no. 767A, 43 tubes (not figured).

Specimens on unidentified Xanthid crab. No. 756, 27 tubes (l.c., fig. 16a); no. 991A1, 39 tubes (l.c., fig. 16e).

Specimen on *Actaea rüppellii*. No. 844, 71 tubes (l.c., fig. 23b).

Specimens on *Actaea hirsutissima*. No. 1323A, 61 tubes (present paper, fig. 2g); no. 817, 119 tubes (present paper, fig. 7e).

Specimen on *Xanthias lamarcki*. No. 563, 46 tubes (Boschma, 1950, fig. 2h).

Specimens on *Cymo andreossyi*. No. 682A, 66 tubes (Boschma, 1950, fig. 4d); no. 1321B, 61 tubes (present paper, fig. 3f); no. 1321A1, 68 tubes (present paper, fig. 4g); no. 1321A2, 38 tubes (present paper, fig. 5f); no. 1321A3, 33 tubes (not figured).

These data show that there is not a direct correlation of the size of the parasites with the number of tubes in their colleteric glands. It is a fact that the largest specimen, no. 817, with a greater diameter of 8 mm (cf. Boschma, 1947b, fig. 1f) has by far the largest number of tubes (119 in a longitudinal section), but often in two specimens of about equal size the number of tubes is highly variable. Of two specimens on *Chlorodiella nigra*, both of 6½ mm greater diameter, the one (no. 707A) has up to 57 tubes in a longitudinal section, the other (no. 722A) 29. The variation in numbers of the tubes of the colleteric glands proves again that the specific name *variabilis* is altogether appropriate for the parasite dealt with in the present paper.

The pronounced variation in the shape and the size of the excrescences of the external cuticle became already apparent when the material was studied which led to the description of the species *Loxothylacus variabilis* (Boschma, 1940). Examination of the specimens from Biak Island proved that these belong to the species mentioned above, though being dissimilar to the previously described specimens by having excrescences of hyaline chitin different from that of the main layers of the cuticle. Just as the

previously described specimens of *L. variabilis* the specimens from Biak Island have excrescences of two sorts, rather sparsely distributed long spines, and numerous smaller spines densely covering the cuticle; in the specimens from Biak Islands these smaller spines are invariably united in compounds of varying shape and size. These groups of spines of smaller size proved to correspond with the excrescences found in specimens which were regarded as representing a separate species, *Loxothylacus murex*, characterized by excrescences of hyaline chitin consisting of groups of spines, pointing rather irregularly in various directions (Boschma, 1950, figs. 3 and 5). When studying the specimens described as *L. murex* it seemed that the external cuticle did not possess excrescences of another kind than the compounds of comparatively small spines. The specimens from Biak Islands proving to have part of the excrescences entirely similar to those of the two specimens described as *L. murex*, the series of sections of these two specimens were re-examined, with the result that in each of the two some excrescences were found extending as fairly long spines over the cuticle (fig. 11). In these specimens, however, excrescences of this shape and structure very rarely occur, so that up to now they escaped notice.

The excrescences of the external cuticle of the specimens from Biak Island prove that *Loxothylacus variabilis* is even more variable than supposed before, necessitating the incorporation of *L. murex* in the species. The peculiarities of the specimens from Biak Island are briefly set forth below.

No. 1321B, on *Cymo andreossyi* (fig. 8). Three sections, of different parts of the external cuticle, are represented, in each of these the main layers of the cuticle having a thickness of 30 to 38  $\mu$ . In one of the figured sections (fig. 8a) the surface of the cuticle is beset with small excrescences only, consisting of compounds of small spines of various sizes, the total height of the excrescences being from 24 to 30  $\mu$ . In the section of fig. 8b the excrescences are larger, the greater part having a total height of 50 to 75  $\mu$ , while their spines generally are pointing upward. One of the excrescences in this part of the cuticle has a large spine of a length of 140  $\mu$  and a thickness at its base of about 8  $\mu$ . In the section of fig. 8c the smaller excrescences vary in height from 40 to 55  $\mu$ ; they consist of groups of spines pointing upward. One of the excrescences has a very long and strong spine, length 235  $\mu$ . The very large excrescences of specimen no. 1321B generally are surrounded by a few smaller, thinner spines, these are not attached directly to the basal part of the large spine, but arise independently from a common basal part.

No. 1323A, on *Actaea hirsutissima* (fig. 9). The main layers of the cuticle

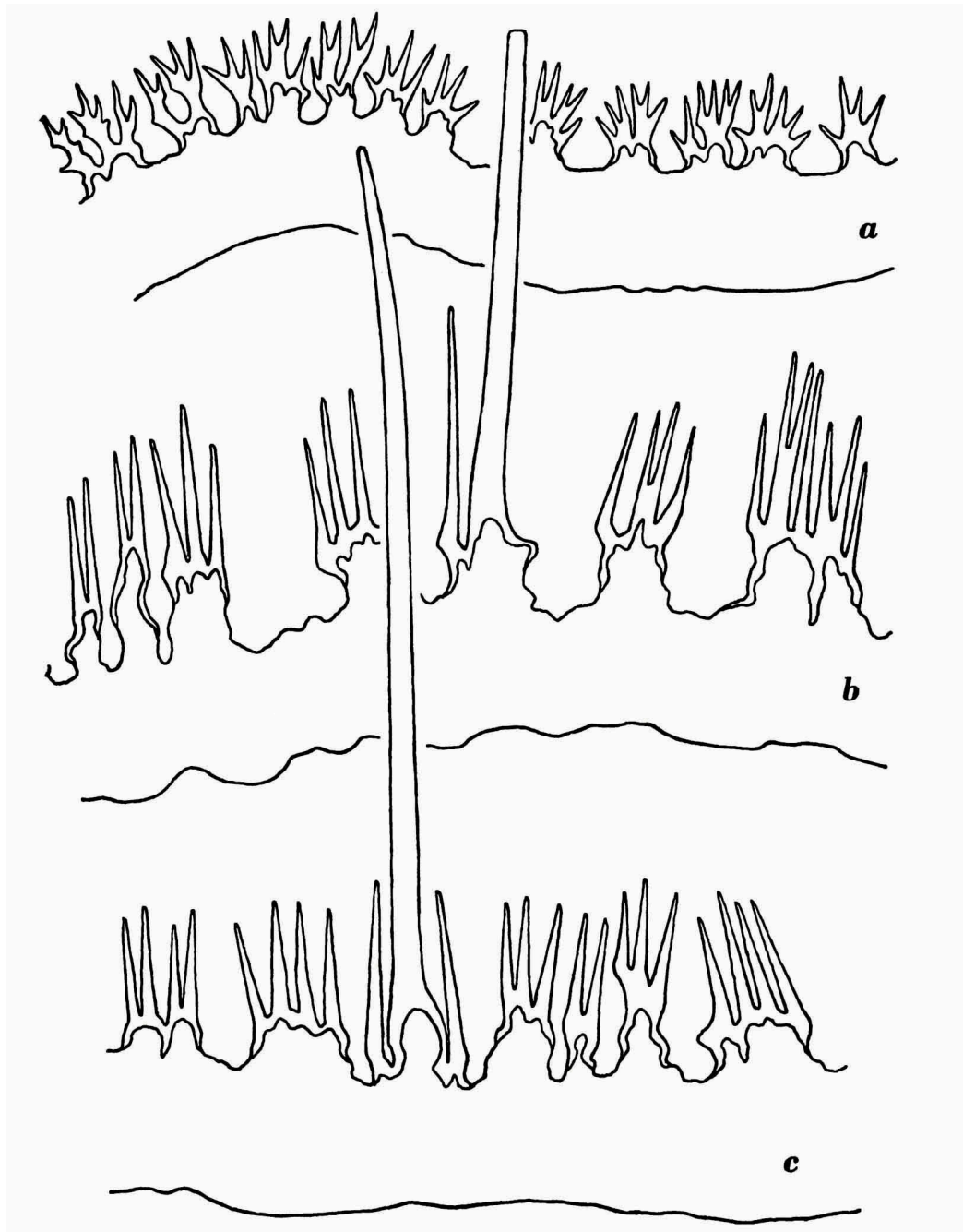


Fig. 8. *Loxothylacus variabilis* Boschma, specimen no. 1321B, sections of the external cuticle.  $\times 530$ .



of this specimen have a thickness of 18 to 25  $\mu$ . The figure shows a number of isolated excrescences; some of these, with a total height of 50 to 75  $\mu$  (fig. 9b-d) have the shape as considered typical of the species *L. murex*, consisting of spines pointing in various directions. Among these smaller excrescences a few have one of the spines thicker and longer than the others

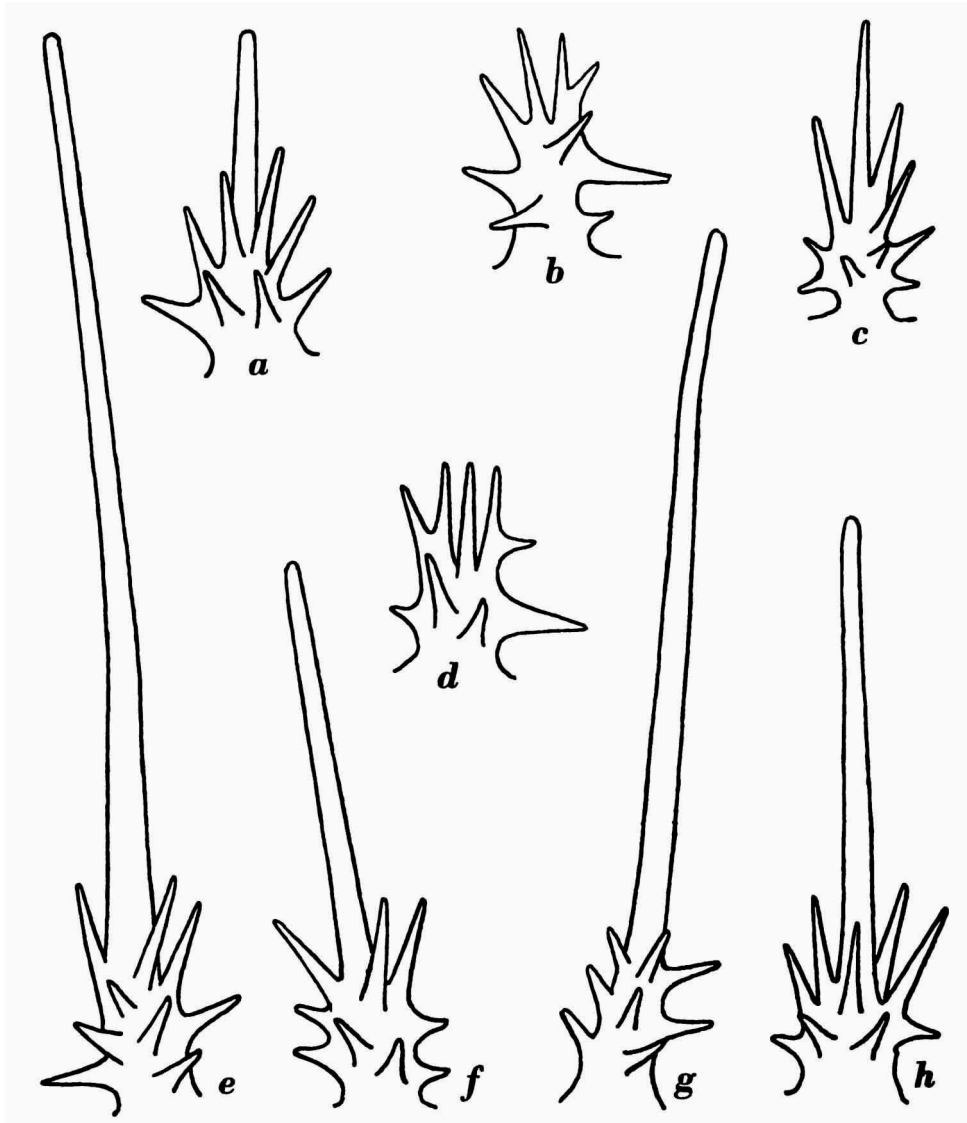


Fig. 9. *Loxothylacus variabilis* Boschma, specimen no. 1323A, excrescences of the external cuticle.  $\times 530$ .

(fig. 9a). Often these larger spines become considerably longer, the largest, shown in fig. 9e, attaining a total length of  $270\ \mu$ . The excrescences containing the large spines differ from those in the specimen dealt with above by having their basal part beset with a fairly large number of smaller spines (fig. 9c-h). In its excrescences this specimen completely combines the

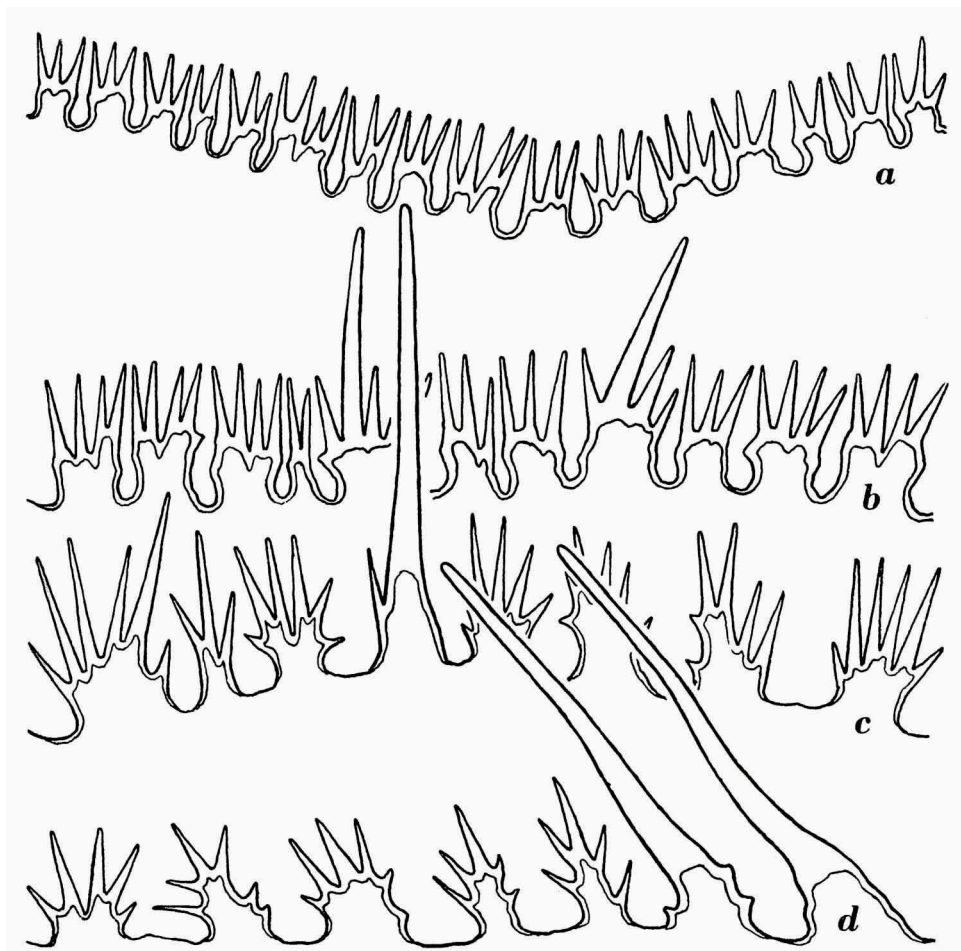


Fig. 10. *Loxothylacus variabilis* Boschma, upper parts of sections of the external cuticle. a, b, specimen no. 1321A1; c, specimen no. 1321A3; d, specimen no. 1321A2.  $\times 530$ .

characters as they were originally described for the supposedly separate species *L. variabilis* and *L. murex*.

No. 1321A1, on *Cymo andreossyi* (fig. 10a, b). The excrescences shown in fig. 10a occur on the upper surface of a part of the cuticle of a thickness

of about  $23\ \mu$ ; those of fig. 10b on a part with a thickness of about  $45\ \mu$ . The excrescences of fig. 10a consist of small groups of spines united on common basal parts, the spines having a length of 12 to  $18\ \mu$ , the basal parts of about  $9\ \mu$ . In the other section (fig. 10b) the greater part of the excrescences are of a similar shape, though the spines are slightly larger (up to  $24\ \mu$ ) and the basal parts slightly higher (12 to  $18\ \mu$ ). In this part of the cuticle two of the excrescences have one longer spine each (length 45 and  $53\ \mu$ ). The larger spines are of comparatively rare occurrence in this specimen.

No. 1321A3, on *Cymo andreossyi* (fig. 10c). The part of the external cuticle of which the figure represents the upper portion has a thickness of about  $38\ \mu$ . The smaller excrescences are of rather variable size and shape, their height (including the basal parts) varying from 38 to  $53\ \mu$ . One of the excrescences consists of a long spine with one short spine attached to its basal region, it has a total length of  $114\ \mu$ .

No. 1321A2, on *Cymo andreossyi* (fig. 10d). The main layers of the cuticle in this part of the mantle have a thickness of about  $30\ \mu$ . Most of the excrescences in the figured section are distinctly of the "murex-type"; their total length is from 29 to  $37\ \mu$ . The section further contains two longer spines (length about  $115\ \mu$ ), the one without smaller spines in its basal parts, the other with adumbrations of smaller spines only.

As remarked above, a re-examination of the specimens described as *Loxothylacus murex* revealed the presence of a few large spines; of each of the specimens a part of the cuticle showing one or two of these spines is represented in fig. 11, giving occasion to the following notes.

No. 563, on *Xanthias lamarcki* (fig. 11a). In the figured part the cuticle has a thickness of about  $37\ \mu$ , the excrescences as a rule have a total height of about  $38\ \mu$ ; in one of the excrescences one of the spines has become much longer ( $90\ \mu$ ), the excrescence as a whole becoming of a length of  $110\ \mu$ . Several of the smaller excrescences of this specimen, of a total length of 30 to  $60\ \mu$ , were figured in a previous paper (Boschma, 1950, fig. 3).

No. 682A, on *Cymo andreossyi* (fig. 11b). In the figured section the main layers of the cuticle have a thickness of about  $24\ \mu$ . Most of the excrescences have a total length of 45 to  $53\ \mu$ , in two of the excrescences one of the spines has become much larger ( $120$  and  $135\ \mu$ ), as a result the top of the longest of the excrescences extends for a height of  $165\ \mu$  above the surface of the cuticle. Several of the smaller excrescences of this specimen, of a total length of 22 to  $60\ \mu$ , were figured in a previous paper (Boschma, 1950, fig. 5).

For comparison with the specimens described above the chief peculiari-

ties of the excrescences of the external cuticle of previously described specimens of *Loxothylacus variabilis* may be briefly mentioned (cf. Boschma, 1940, pp. 280-316; 1947a, pp. 276-278).

No. 722A, on *Chlorodiella nigra*. Large spines up to 186  $\mu$ ; smaller excrescences, consisting of single spines, 12 to 40  $\mu$ .

No. 691A, on *Chlorodiella nigra*. Large spines up to 140  $\mu$ , their tops

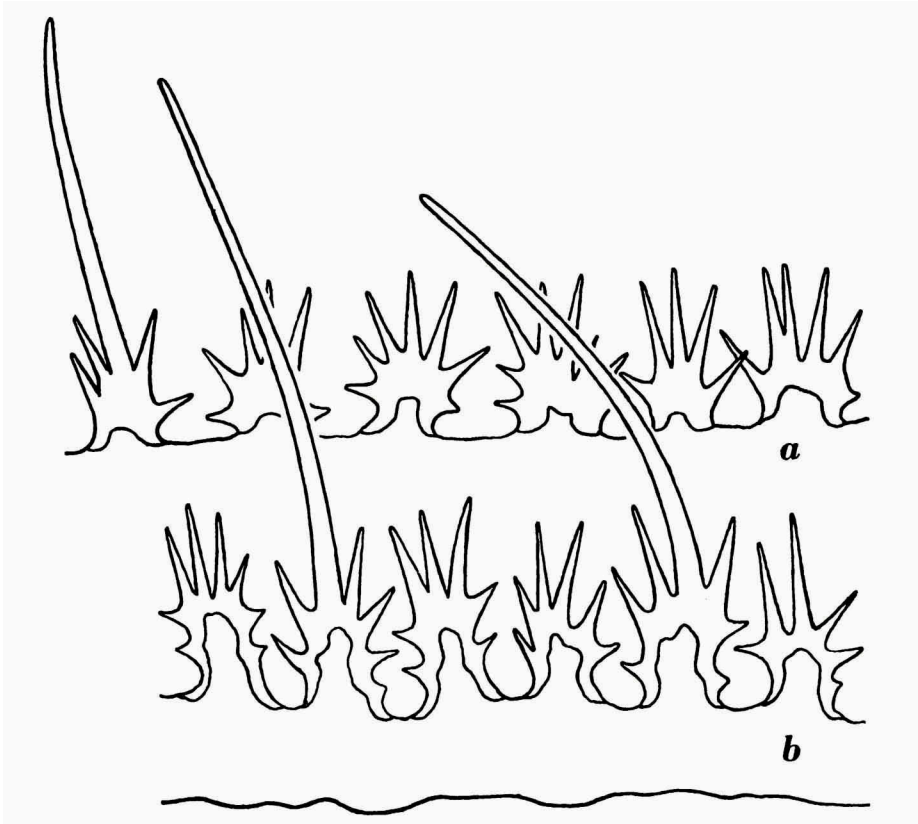


Fig. 11. *Loxothylacus variabilis* Boschma. a, specimen on *Xanthias lamarcki* (H. Milne Edwards), type specimen of *Loxothylacus murex*, upper part of section of the external cuticle; b, specimen on *Cymo andreossyi* (Audouin) from Kupang, Timor, previously identified with *Loxothylacus murex*, section of the external cuticle.  $\times 530$ .

divided (probably split) into small branches; smaller excrescences as in the previous specimen.

No. 707B, on *Chlorodiella nigra*. Large spines up to 140  $\mu$ , sometimes with divided tops, sometimes with a few basal spines; smaller excrescences consisting of single spines, 13 to 45  $\mu$ .

No. 707A, on *Chlorodiella nigra*. Excrescences large and small, not principally different from those of the other specimens.

No. 767A, on *Chlorodiella nigra*. Large spines up to 160  $\mu$ , sometimes with a few basal spines; smaller excrescences consisting of single spines, 7 to 27  $\mu$ , or of small papillae (basal parts of abraded spines?), 6 to 8  $\mu$ .

No. 991A1, on unidentified Xanthid crab. Large spines up to 106  $\mu$ ; smaller excrescences consisting of single spines, 24 to 45  $\mu$ , or of groups of small spines united on a common base, total length 6 to 34  $\mu$ .

No. 756, on unidentified Xanthid crab. Large spines up to 112  $\mu$ , often with divided tops, sometimes with basal spines; smaller excrescences consisting of single spines, 12 to 23  $\mu$ , or of groups of spines united on a common base, total length 6 to 10  $\mu$ .

No. 844, on *Actaea rüppellii*. Large spines up to 186  $\mu$ , often with basal spines; smaller excrescences consisting of single spines, 7 to 23  $\mu$ , or of groups of spines united on a common base, total length 12 to 15  $\mu$ .

No. 817, on *Actaea hirsutissima* (measurements after Boschma, 1947a, fig. 5). Large spines up to 106  $\mu$ , with small spines in their basal parts; smaller excrescences consisting of single hairs, 7 to 15  $\mu$ .

Next to the large spines most of the previously known specimens of *Loxothylacus variabilis* have smaller excrescences consisting of single hairs only; in some of the specimens the smaller excrescences are groups of spines united on a common basal part. In connexion with the fact that the split tops of the large spines as they occur in some of the specimens look as if they have arisen as a result of wear or of abrasion, it was tentatively presumed (Boschma, 1940, p. 313) that the divided appearance of the smaller excrescences in some of the specimens might have developed in a similar manner. It remains probable that the split tops of the large spines represent a stage of wear. On the other hand the smaller excrescences with numerous spines must have had this structure as soon as they had been formed on the upper layers of the cuticle, they represent the initial stages of excrescences as they occur in the specimens of *Loxothylacus variabilis* of the "murex-type".

The specimens in the material of the Snellius Expedition as a rule have excrescences consisting of the same kind of chitin as the main layers of the cuticle; exceptionally part of the smaller excrescences are spines of a hyaline structure, then usually the upper layer of the cuticle also consists of this kind of chitin (Boschma, 1940, figs 14a, 18d, e, 21b). On the other hand the two specimens on which the description of *Loxothylacus murex* is based have the smaller excrescences almost entirely consisting of hyaline chitin (Boschma, 1950, fig. 3a-c, fig. 5d, e), while in some parts of the cuticle, at least in one of the specimens, the basal parts of the excrescences have



a cavity completely filled with the ordinary stainable chitin (l.c., fig. 5a-c). The specimens from Biak Island now form the connecting link between the specimens from the Snellius Expedition and those of the "murex-type".

It is rather surprising that of the two specimens on *Actaea hirsutissima* the one has the smaller excrescences in the shape of single spines (Boschma, 1947a, fig. 5), while in the other the smaller excrescences are fairly large compounds with numerous strong spines (present paper, fig. 9b-d). To this difference at first sight might be added that in the specimen from Biak Island (fig. 9) the large and the smaller spines consist of hard, hyaline chitin, in contradistinction to the other specimen in which the chitin of all the spines does not differ from that of the main layers of the cuticle. The two specimens, however, do not lend themselves for a direct comparison, because in the specimen from Biak Island the excrescences of the external cuticle are present in their definite shape and structure, while in the other specimen the outer layer of the external cuticle has a provisional character only and the second layer has not yet reached its fully mature stage of development.

As far as the previously examined material is concerned the spines of two specimens (no. 722A on *Chlorodiella nigra* and no. 844 on *Actaea rüppellii*) proved to have excrescences of exceptional length (up to 186  $\mu$  in each of the specimens). The large spine of fig. 9e in the present paper, with its total length of 270  $\mu$ , occurring on the cuticle of no. 1323A, a parasite of *Actaea hirsutissima*, proves to be nearly one and a half times as long as those formerly considered of record length.

Retinacula were found on the internal cuticle of several of the specimens from Biak Island. They correspond with those in previously described specimens as far as number, size, and shape of their spindles is concerned; it seemed superfluous to give new figures and detailed descriptions.

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