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RHIZOCEPHALA FROM NEW GUINEA. II

PELTOGASTRIDAE

by

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Among the hermit crabs collected by Dr. L. D. Brongersma, Dr. L. B. Holthuis, and Dr. M. Boeseman on the reef of Biak Island near New Guinea [1]) there are five specimens bearing the Peltogastrid parasites dealt with in the present paper. They belong to previously described species but present some peculiarities supplementing certain data mentioned in other papers.

Dipterosaccus indicus Van Kampen & Boschma

Dipterosaccus indicus Van Kampen & Boschma, 1925, p. 3; Boschma, 1931b, p. 6; Van Baal, 1937, p. 25; Shiino, 1943, p. 9.

Material examined:

No. 1331, length 8, breadth 3, height 4 mm (fig. 1*g*-*i*).
No. 1326A, length 7 (in reality somewhat longer, the body showing a pronounced curvature), breadth 3, height 3½ mm (fig. 1*d*-*f*).
No. 1326B, length 7, breadth 3, height 3 mm (fig. 1*a*-*c*).
No. 1327B, length 3, breadth slightly over 1, height 1 mm (fig. 1*j*, *k*).
All specimens on *Calcinus latens* (Randall), from the reef W. of Sorido, Biak Island, January and February, 1955.

Moreover, the following specimens, dealt with in previous publications, were available.

Ati Ati Onin, New Guinea, reef (Siboga Expedition, Sta. 169), 1 specimen on *Calcinus gaimardi* (H. Milne Edwards), length 11 mm, breadth 3½ mm (Van Kampen & Boschma, 1925; Boschma, 1931b).
Pasih Ipah, Sula Islands, shore, Snellius Expedition, 3 specimens on *Calcinus latens* (Randall), one sectioned, length 6 mm (Van Baal, 1937).
Wotap, Tenimber Islands, shore, Snellius Expedition, 1 specimen on *Calcinus latens* (Randall), length 8½, breadth 4, height 2½ mm (Van Baal, 1937).

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.

Beo, Karakelong, Talaud Islands, shore or reef, Snellius Expedition, 3 specimens on one host, *Clibanarius striolatus* Dana, one sectioned, length 6½, breadth 1½, height 2 mm (Van Baal, 1937).

The smallest specimen (fig. 1*j*, *k*) is of an elongated oval shape, the short tube of the mantle opening pointing almost straight forward, the mantle is smooth without grooves. The larger specimens are elongate oval to kidney-shaped with more or less conical posterior extremity; in one (fig. 1*a*-*c*) the small tube of the mantle opening is extending anteriorly, slightly turned dorsally, in the other specimens (fig. 1*d*-*i*) the tube of the mantle opening is distinctly turning to the right side. In all the specimens the stalk is found

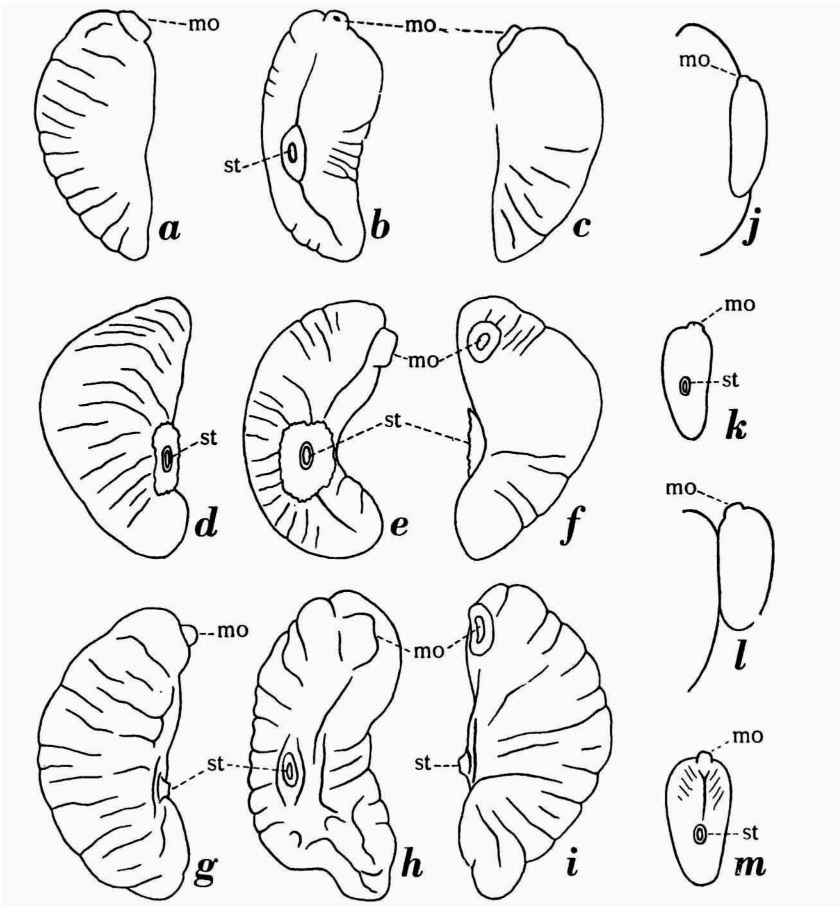

Fig. 1. *a-k*, *Dipterosaccus indicus* Van Kampen & Boschma; *a-c*, specimen no. 1326B; *d-f*, specimen no. 1326A; *g-i*, specimen no. 1331; *j*, *k*, specimen no. 1327B. *a*, *d*, *g*, left side; *b*, *e*, *h*, *k*, dorsal surface; *c*, *f*, *i*, *j*, right side (*j* attached to abdomen of host). *l*, *m*, *Septosaccus snelliusi* Van Baal, specimen no. 1327A; *l*, right side, attached to abdomen of host; *m*, dorsal surface. mo, mantle opening; st, stalk. × 5.

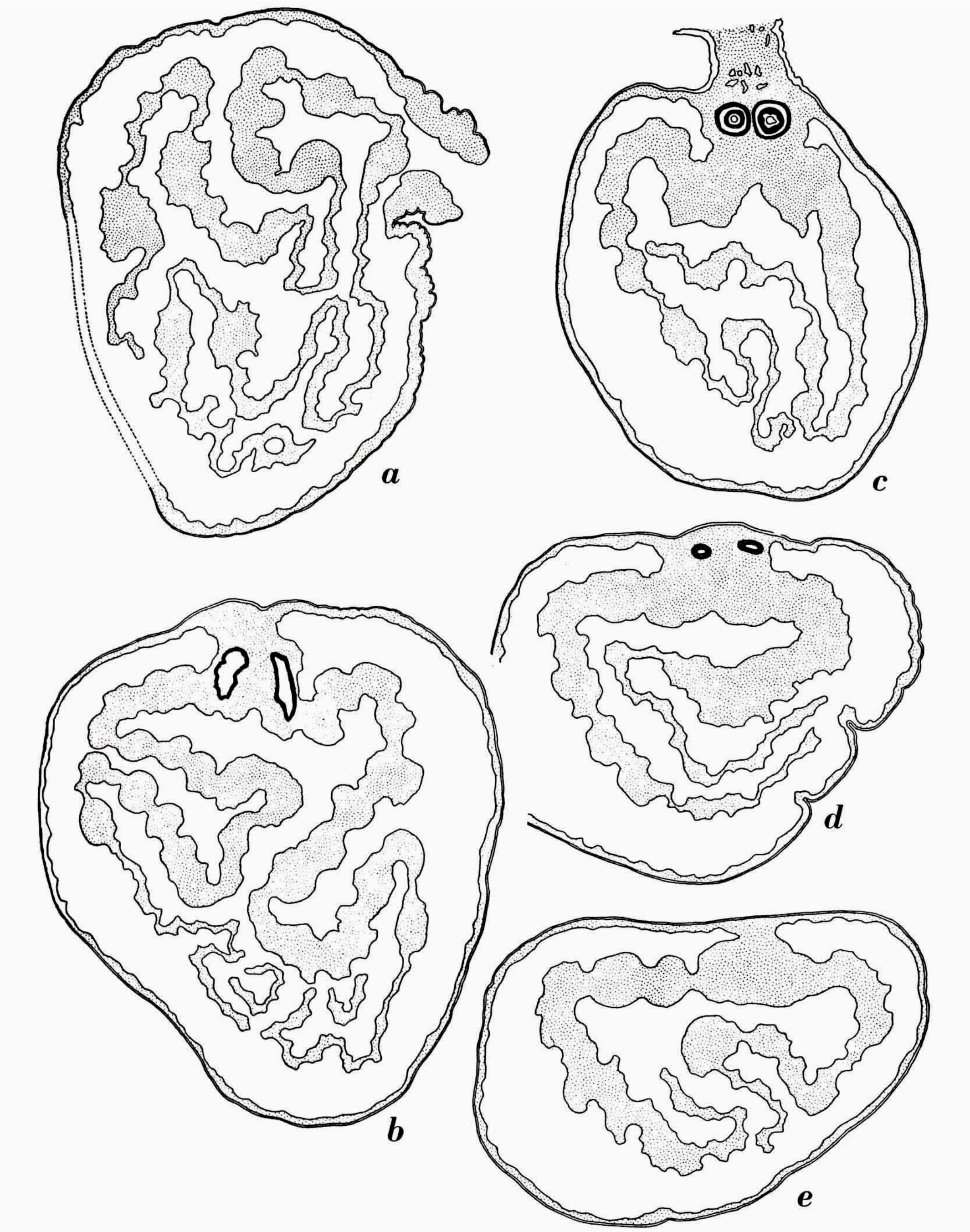

Fig. 2. *Dipterosaccus indicus* Van Kampen & Boschma, specimen no. 1326A, transverse sections from anterior to posterior region. × 23.

at some distance posteriorly of the central region. In the larger specimens the mantle shows numerous grooves arround the body and a few at the dorsal surface.

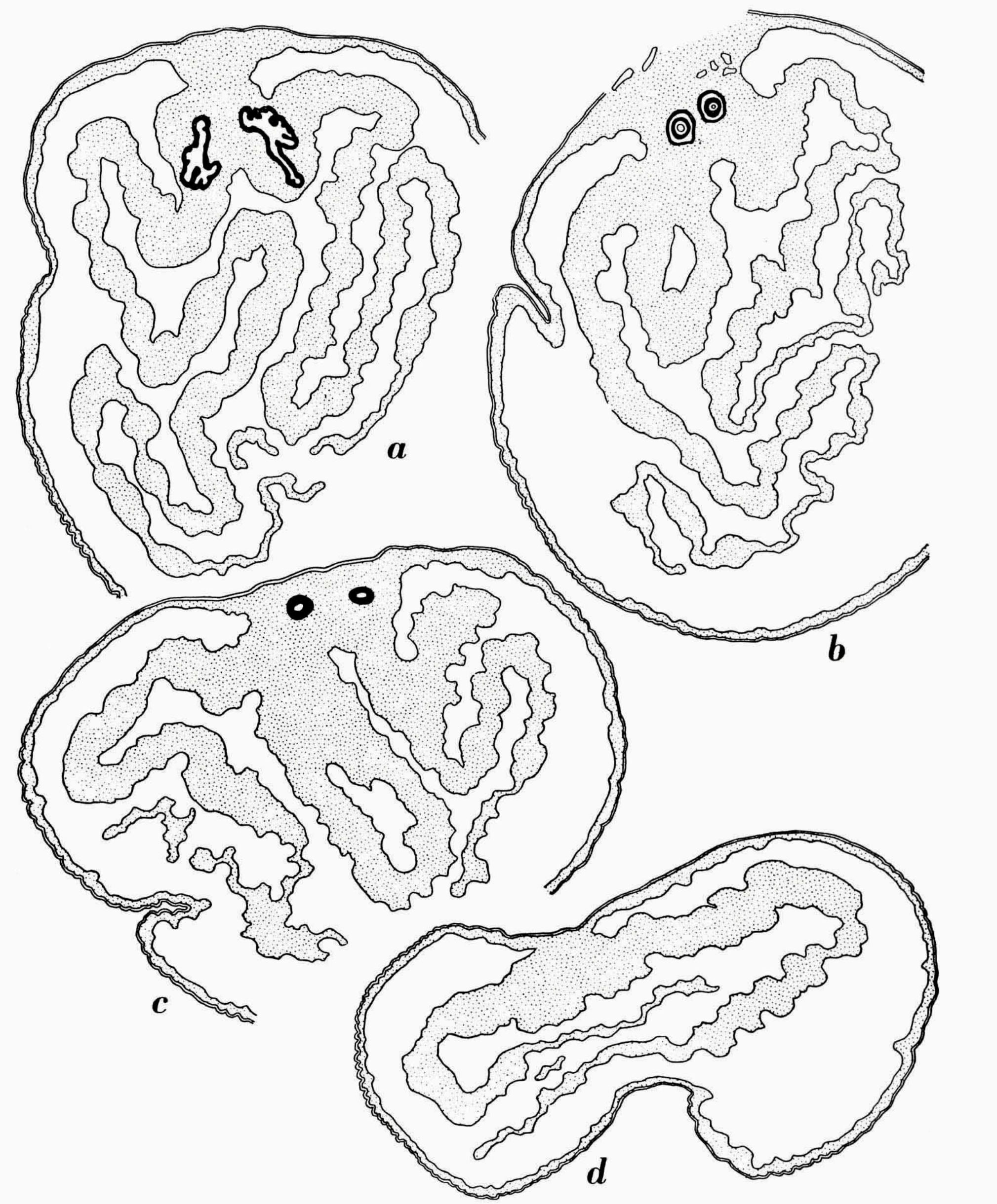

Fig. 3. *Dipterosaccus indicus* Van Kampen & Boschma, specimen no. 1331, transverse sections from anterior to posterior region. × 23.

Of each of the four specimens a complete series of transverse sections was prepared. Some of the sections are here figured, especially to show the diversity in structure of the two lappets in which the visceral mass is divided. In the three large specimens the open spaces between the lappets of the visceral mass are rather densely filled with eggs, these have been omitted in the figures to keep a clearer view of the shape of the visceral mass.

Specimen no. 1326A. Fig. 2*b* was drawn after a transverse section anterior of the stalk, slightly before the terminal parts of the testes. It contains the colleteric glands in their region of greatest width, these are cavities of

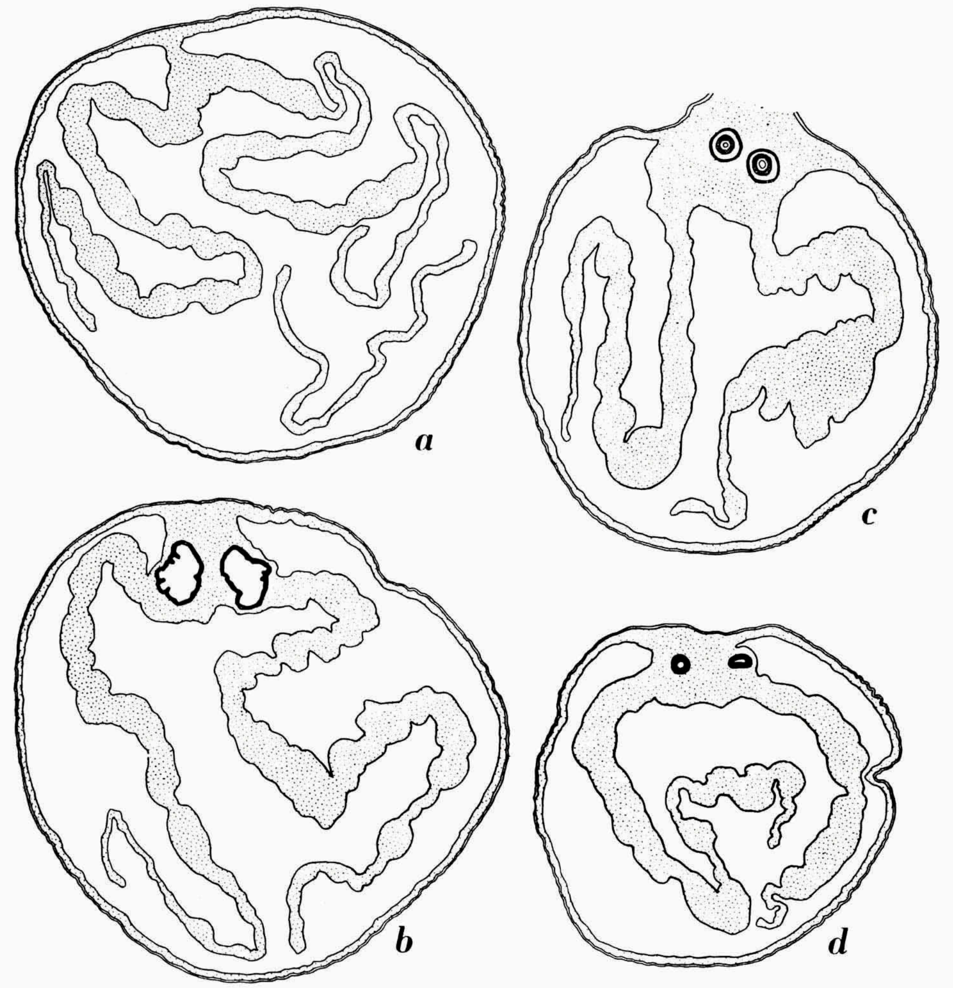

Fig. 4. *Dipterosaccus indicus* Van Kampen & Boschma, specimen no. 1326B, transverse sections from anterior to posterior region. × 23.

little complicated structure, the wall not being divided into lobes. The visceral mass is rather broadly attached to the mantle, it is divided into a left and a right lappet which extend with repeated folds in the mantle cavity, thereby forming narrow incubatory chambers for the developing eggs. The free

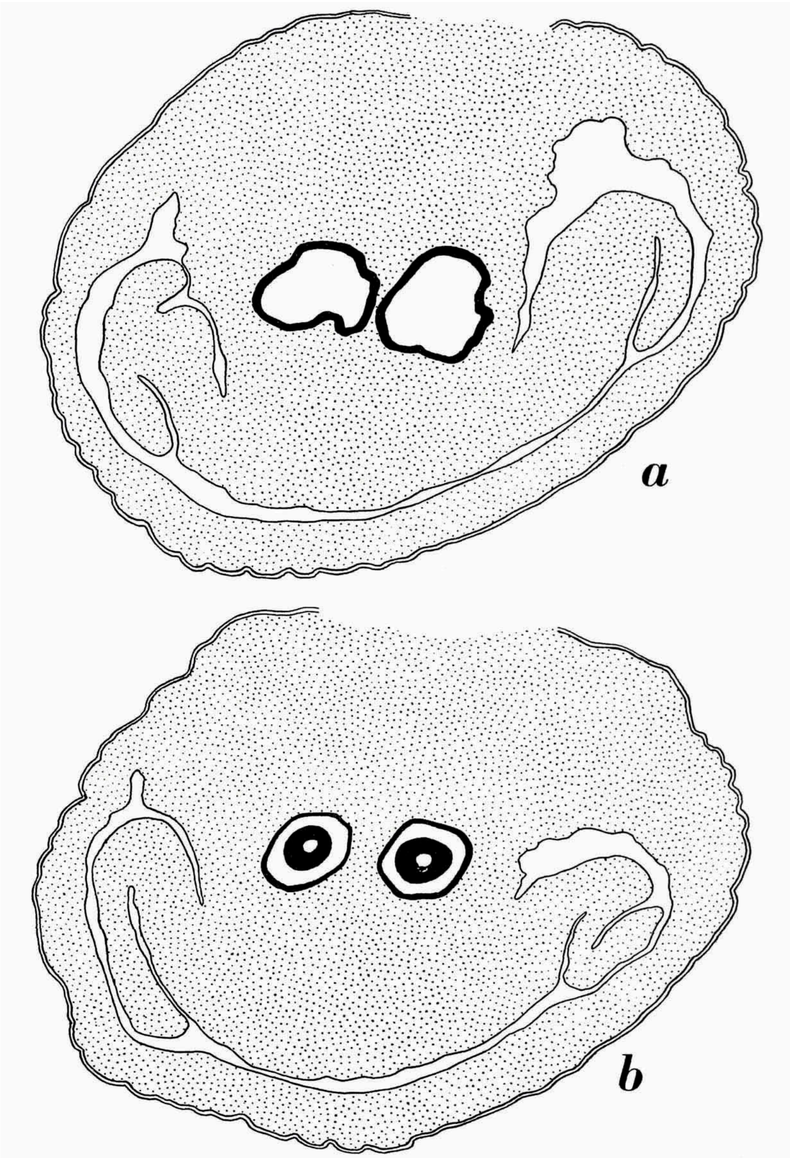

Fig. 5. *Dipterosaccus indicus* Van Kampen & Boschma, specimen no. 1327B, transverse sections, *a* through the colleteric glands, *b* through the testes. × 80.

extremities of the two lappets are somewhat curved in an anteroposterior direction, causing that small parts of the terminal parts of the lappets appear as isolated portions in the section. In the larger portion of each of the lappets thicker regions alternate with narrower parts, the latter do not contain eggs, while the former are densely packed with eggs. Fig. *2a* represents a section of the anterior part of the body, through the mantle opening, before the anterior part of the mesentery, which ends against the sphincter of the mantle opening. The lappets appear here as one continuous ribbon lying in irregular curves in the mantle cavity, everywhere leaving space for the developing eggs. A section through the stalk is shown in fig. *2c;* it contains the anterior parts of the testes, which are surrounded each by its own sheath of muscles, and interiorly are lined by a rather thick layer of chitin, leaving but a narrow cavity. The lappets of the visceral mass again divide the mantle cavity in a fairly regular manner into several brood chambers. The stalk is covered with a rather thick layer of chitin; moreover, irregular projections of chitin extend from the outer part of the stalk far into the interior region (in fig. *2c* just above the testes and in the highest part of the stalk). Structures of a similar kind were found to occur in the specimen of *Dipterosaccus indicus* described by Shiino (1943, fig. 6C, *ch).* Fig. *2d* was drawn after a section from the posterior region, it contains the vasa deferentia, which are slightly farther separated from each other than the testes. Here the visceral mass is very broadly connected with the mantle. The lappets of the visceral mass have a configuration similar to that in the other figures. Fig. *2e* shows a section from the region posteriorly to the male genital openings, here the visceral mass is less broadly attached to the mantle, though not yet forming a mesentery in the true sense. The lappets with their alternating thick and thinner portions correspond with those represented in the other figures.

Specimen no. 1331. Fig. *3a* represents a section in the region of the colleteric glands. They are seen to be divided into a few lobes. The visceral mass corresponds with that of no. 1326A in having the two lappets, which extend in large folds, containing the alternating thicker and thinner parts, into the mantle cavity. The shape of the lappets brings about that the eggs (not drawn in the figure) are fairly regularly distributed in the brood chambers between the folds. Fig. *3b* shows a section through the stalk, containing the anterior parts of the testes, of a structure similar to those in the other specimens. A few irregular projections of chitin are to be seen just above one of the testes. The visceral mass has the two lappets as they occur in the other specimens, but, moreover, there is a central outgrowth extending into the mantle cavity, this central part has a cavity filled with eggs. It appears as if one of the lappets at some distance of its point of origin from the visceral mass has fused again with the visceral mass. The central part of the visceral mass continues posteriorly for a considerable distance, gradually becoming larger (fig. 3*c*), slightly farther posteriorly the cavity of this central part again is in open connexion with the rest of the mantle cavity. In the region of the section of fig. 3*c* the visceral mass shows some further irregularities, the terminal part of one of the lappets is divided into two portions, while the proximal part of the other lappet has a separate outgrowth of large size. Fig. 3*c* shows the vasa deferentia, which again occur at a slightly larger distance from each other than do the testes. Here again the visceral mass is broadly attached to the mantle. Farther posteriorly the shape of the visceral mass becomes again similar to that in the other specimen, the region where the visceral mass is attached to the mantle becoming narrower (fig. 3*d*). In this region the specimen is distinctly flattened dorso-ventrally, but the brood chambers formed by the folds of the visceral mass remain comparatively wide.

Specimen no. 1326B. Fig. 4*a* was drawn after a section slightly behind the mantle opening, showing that here the visceral mass is rather narrowly attached to the mantle, forming a mesentery in the true sense. Besides the two lappets of the visceral mass the figure shows a curved part of one of the lappets, appearing as a separate portion in the section. For the rest the specimen does not present any important differences as compared with the other parasites. The lappets of the visceral mass are not as strongly folded as those of the other specimens, apparently because no. 1326B is of somewhat smaller size. The colleteric glands are shown in fig. 4*b*, the testes in fig. 4*c*, the vasa deferentia in fig. 4*d*. These organs correspond in every important detail with those of specimen no. 1326A.

Specimen no. 1327B is immature and does not yet present the peculiarities characteristic of the species, though adumbrations of the lappets of the visceral mass do occur. The specimen was a parasite of the same hermit crab as the hosts of the other specimens, moreover, it came from the same locality, so that its conspecifity with the other parasites is fairly certain. Two sections of this specimen are here figured (fig. 5), showing that the visceral mass is broadly united with the dorsal part of the body, while the lappets are small protuberances on each side of the visceral mass, showing a beginning of folding. The mantle cavity is a mere slit between the visceral mass and the mantle. The colleteric glands (fig. 5*a*) and the testes (fig. 5*b*) have a structure not appreciably different from that of the other specimens, with the exception that the male organs do not yet contain an inner layer of chitin.

In all the specimens the external cuticle is extremely thin, with a smooth surface, and finely grooved. The thickness of the external cuticle is 3 to 4½ μ in no. 1326A (fig. 6*c, d*), 1½ to 3 μ in no. 1326B (fig. 6*e, f*), 3 to 4½ μ in no. 1331 (fig. 6*g, h*), and 1½ to 2¼ μ in no. 1327B (fig. 6*i, j*).

When the figures of the three larger specimens of *Dipterosaccus indicus* from Biak Island are compared it appears that the visceral mass of the smallest specimen (no. 1326B, fig. 4) has comparatively little folded lappets of the visceral mass, while in the next larger specimen (no. 1326A, fig. 2) the lappets are larger and more strongly folded, and in the largest specimen (no. 1331, fig. 3) besides a similar development of the lappets with many folds there are additional outgrowths of the visceral mass. This is in accordance with the figures of Shiino (1943, fig. 6), representing a specimen with lappets showing a few folds only, the size of his specimens is noted by Shiino as length 5.5 mm, width 1.6 mm. On the other hand the specimen from the Siboga Expedition, the type of the species, had a length of 11 mm and a transverse diameter of 3½ mm; here the lappets of the visceral mass have a structure not distinctly more complicated than in the larger specimens from Biak Island (cf. Boschma, 1931, fig. 2).

The irregular outgrowths occurring next to the two large lappets of the visceral mass in the largest specimen from Biak Island to a certain degree present a similarity to the corresponding parts of *Temnascus foresti* Boschma. In this species, however, the visceral mass is of a much more pronouncedly irregular structure than in the specimen here described (cf. Boschma, 1951), in comparison with *Temnascus foresti* the larger specimen from the present collection has a much more bilaterally symmetrical structure. Moreover, the only known specimen of *Temnascus foresti* has a length of 7½ mm, slightly less than that in specimen no. 1331 (8 cm), indicating that the complicated structure of *Temnascus foresti* is not directly correlated with the size of the animal as compared to *Dipterosaccus indicus*.

Septosaccus snelliusi Van Baal

Septosaccus snelliusi Van Baal, 1937, p. 33.

Material examined:

No. 1327A, length 3, breadth 1¾, height 1½ mm (fig. 1*l, m*), on *Clibanarius striolatus* Dana, reef W. of Sorido, Biak Island, February, 1955.

The parasite has an elongated oval shape, gradually tapering towards the posterior extremity (fig. 1*l, m*). The mantle opening lies at the top of a short tube protruding anteriorly. The surface of the mantle is smooth when feebly enlarged, presenting a few oblique grooves at the dorsal surface.

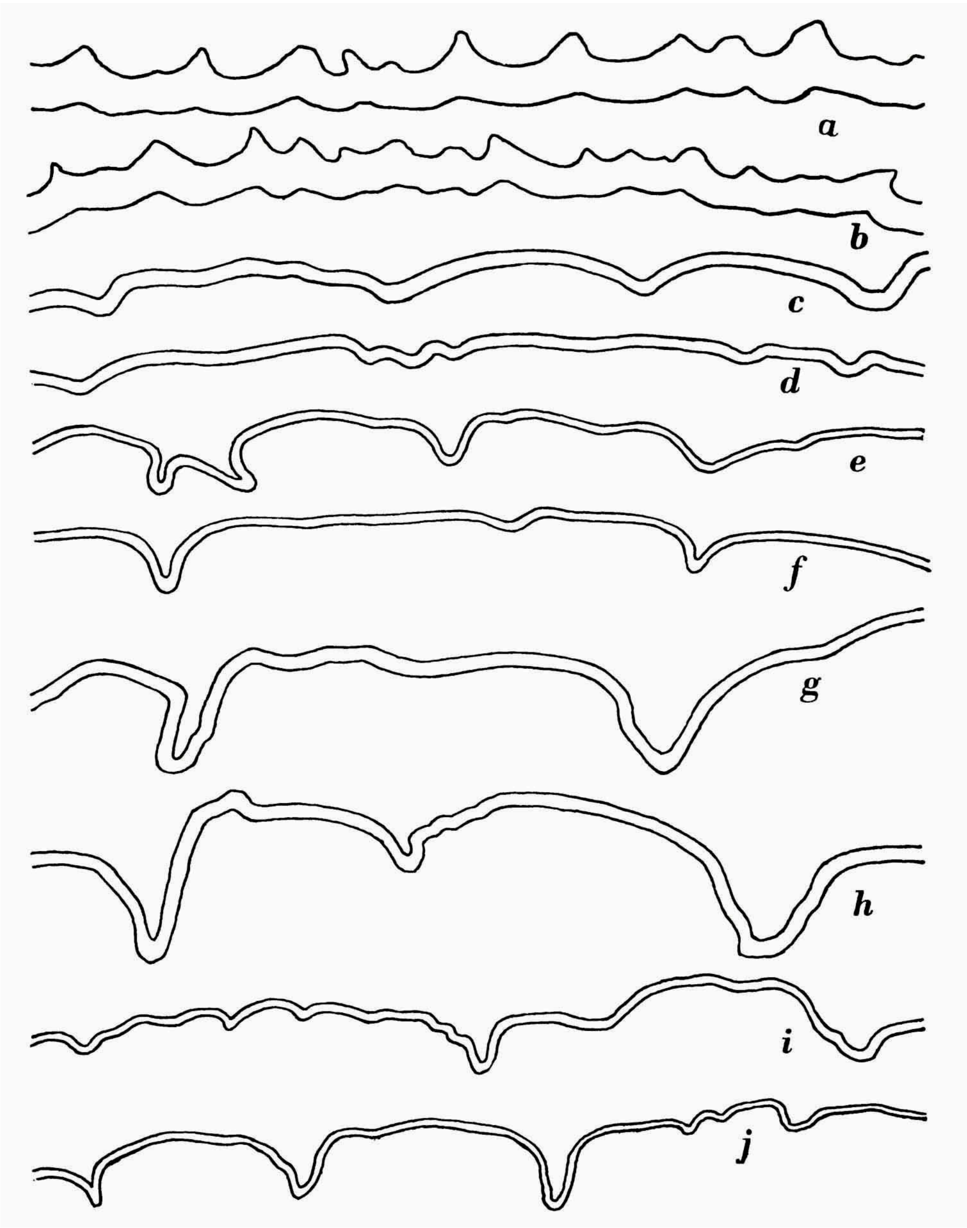

Fig. 6. *a, b, Septosaccus snelliusi* Van Baal, specimen no. 1327A, sections of the external cuticle. *c-j, Dipterosaccus indicus* Van Kampen & Boschma, sections of the external cuticle; *c, d,* specimen no. 1326A; *e, f,* specimen no. 1326B; *g, h,* specimen no. 1331; *i, j,* specimen no. 1327B. × 530.

The stalk is found in the posterior half of the body, distinctly behind the centre of the dorsal surface.

The parasite was transversely sectioned, two of the sections are here figured. The one (fig. 7) is from a region slightly before the stalk, the section contains the widest parts of the colleteric glands, which in this specimen have a rather simple structure, without pronounced lateral ex-

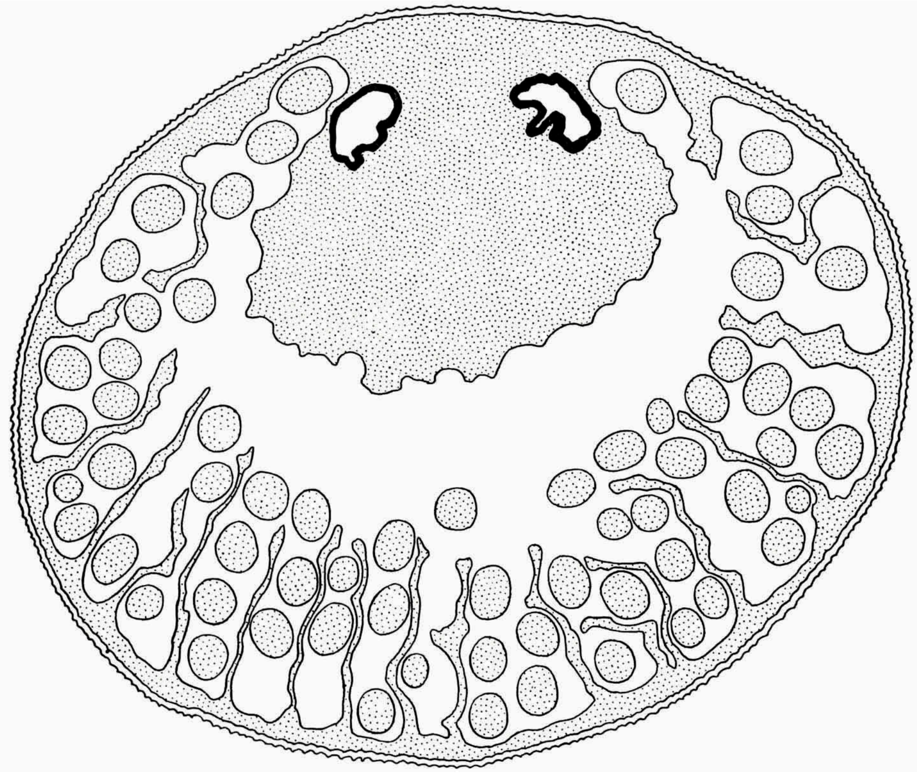

Fig. 7. *Septosaccus snelliusi* Van Baal, transverse section containing the colleteric glands. × 70.

tensions of the epithelium. The visceral mass is broadly attached to the mantle, its ventral surface does not possess a median groove. Though small, the specimen is sexually mature, the spaces between the septa being filled with eggs. The septa are few in number, 19 in the section of fig. 7.

The other figured section is from the region of the central part of the stalk (fig. 8). It contains the posterior part of the testes, each with its own muscular sheath and an internal layer of chitin. The visceral mass has a shape similar to that in the other section; there are 14 septa, dividing the peripheral part of the mantle cavity into separate brood chambers.

When strongly magnified the external cuticle of the mantle is seen to possess very small irregular notches and grooves, a peculiarity already noted by Van Baal (1937, p. 34) as characteristic of the species. Somewhat diagrammatically these irregularities are drawn in figs. 7 and 8; the sections of the cuticle shown in fig. 6*a*, *b* give a more exact representation of the

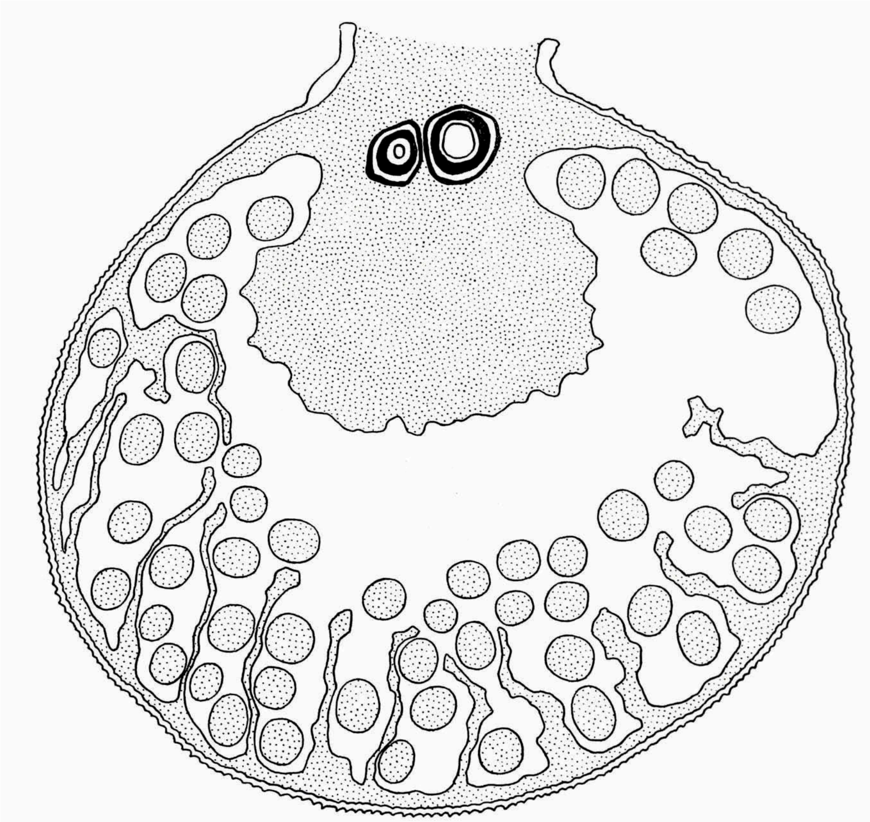

Fig. 8. *Septosaccus snelliusi* Van Baal, transverse section containing the testes. × 70.

cuticular structure. The surface appears to be covered with small blunt spines with a height of up to 9 μ. The external cuticle itself has a thickness of 7 to 10 μ.

Van Baal (1937) elaborately described the material of his new species *Septosaccus snelliusi*, occurring as a parasite of *Clibanarius striolatus* Dana, *Cl. longitarsus* (De Haan), *Cl. aequabilis* Dana var. *merguiensis* De Man, and of an unidentified Pagurid, in various localities of the East Indies (Aru Islands, Talaud Islands, and Celebes); a specimen on *Cl. longitarsus*, from Manumbai, Aru Islands, was selected as the type of the species. Van Baal found that evidently there is a direct correlation between the size of the parasites and their number of septa, this number increasing during growth (l. c., table on p. 36). The number of the septa in the specimen from Biak Island (19 and 14 in the figured sections, figs 7 and 8) corresponds with Van Baal's data (14 to 31 septa in specimens with a length of under 4 mm).

Several non-gregarious Peltogastridae have been recorded from the Indo-westpacific region. The first to become known was *Peltogaster philippinensis*, mentioned with this name by Kossmann (1872) without indication of the host and of the exact locality in the Philippines. Kossmann's figures (l. c., Pl. II fig. 8*a*-*d*) contained sufficient details to enable Van Baal (1937) to redescribe the species as *Pterogaster philippinensis* (Kossmann).

Krüger (1912) records from Japanese localities *Peltogaster paguri* Rathke as a parasite of *Pagurus gracilipes* (Stimpson), and *Peltogaster ovalis* Krüger on *Paguristes* spec. Up to that time *Peltogaster paguri* was known from the Atlantic region only, so that the identification remained uncertain. Since, however, Reinhard (1944) showed that *Peltogaster paguri* occurs in the Alaskan and the Aleutian regions as a parasite of at least two hermit crabs, *Pagurus capillatus* (Benedict) and *Pagurus hirsutiusculus* (Dana), it is highly probable that the range of the parasite extends farther in a westernly direction. Moreover, Shiino (1943) identified Japanese specimens occurring on the hermit crab *Pagurus samuelis* (Stimpson) with *Peltogaster paguri*, differing from the specimens described from the Atlantic only by having the stalk more anteriorly inserted.

The material brought together by the Siboga Expedition (Van Kampen & Boschma, 1925; Boschma, 1931b) proved to contain *Septosaccus reticulatus* Van Kampen & Boschma as a parasite of *Dardanus deformis* (H. Milne Edwards), *Dipterosaccus indicus* Van Kampen & Boschma as a parasite of *Calcinus gaimardi* (H. Milne Edwards), and *Dipterosaccus* spec. (a very young parasite) infesting the hermit crab *Dardanus deformis* (H. Milne Edwards). Van Baal (1937) definitely showed that this young parasite belongs to the species *Septosaccus reticulatus*.

In the material of the Danish Expedition to the Kei Islands (Boschma, 1931a) there are two species of non-gregarious Peltogastrids, described as *Septosaccus plicatus* Boschma (a parasite of *Dardanus deformis)* and *Peltogaster rugosus* Boschma (a parasite of *Clibanarius* spec.). Re-examination of the type specimen of *Septosaccus reticulatus* (Boschma, 1931b) proved that *S. plicatus* is to be considered a synonym of *S. reticulatus*, a fact also arrived at by Van Baal (1937).

In his elaborate studies on the non-gregarious Peltogastridae of the East Indian region Van Baal (1937) dealt with the following species:

Peltogaster latus Van Baal on *Calcinus laevimanus* (Randall) (*Calcinus herbstii* De Man), on *Calcinus gaimardi* (H. Milne Edwards), on *Clibanarius striolatus* Dana(?), on *Calcinus latens* (Randall).

Peltogaster spec. on *Diogenes* spec.

Pterogaster philippinensis (Kossmann) on *Calcinus latens* (Randall).

Pterogaster involvulus Van Baal on *Clibanarius virescens* (Krauss).

Dipterosaccus indicus Van Kampen & Boschma on *Calcinus latens* (Randall), on *Clibanarius striolatus* Dana.

Septosaccus snelliusi Van Baal on *Clibanarius striolatus* Dana, on *Clibanarius longitarsus* (De Haan), on *Clibanarius aequabilis* Dana var. *merguiensis* De Man.

Septosaccus reticulatus Van Kampen & Boschma on *Dardanus deformis* (H. Milne Edwards).

From Japanese localities the following species of non-gregarious Peltogastridae are recorded by Shiino (1943): *Peltogaster paguri* Rathke on *Pagurus samuelis* (Stimpson), *Peltogaster lineatus* Shiino on *Pagurus japonicus* (Stimpson), *Peltogaster reticulatus* Shiino on *Pagurus constans* (Stimpson), and *Dipterosaccus indicus* Van Kampen & Boschma on *Calcinus laevimanus* (Randall).

Besides the specimens of *Peltogaster paguri* Rathke on two different hermit crabs, mentioned above, Reinhard (1944) described two species of non-gregarious Peltogastridae from the Northwest region of America, viz., *Peltogaster boschmai* Reinhard as a parasite of *Orthopagurus schmitti* (Stevens), and *Peltogaster depressus* Reinhard as a parasite of *Pagurus capillatus* (Benedict).

The single non-gregarious Peltogastrid that has become known from the tropical eastern part of the Pacific is *Temnascus foresti* Boschma, a parasite of *Calcinus spicatus* Forest from the Gambier Islands (Boschma, 1951).

Finally the parasite recorded by Weltner (1898) as "*Peltogaster* sp.", occurring on the abdomen of *Lithodes antarcticus* Jacquinot in Smyth Channel in Southern Chile, must be mentioned. In a previous paper (Boschma, 1953) the opinion was brought forward that it belongs to the Peltogastrid genus *Briarosaccus*.

Of the species dealt with in the present paper *Dipterosaccus indicus* Van Kampen & Boschma now has become known as a parasite of a host different from those previously known, viz., *Calcinus latens* (Randall). On the other hand, *Clibanarius striolatus* was already known as a host of *Septosaccus snelliusi* Van Baal.

Several of the hermit crabs mentioned above are known as a host of one species of non-gregarious Peltogastridae only; those which are known to be infested with two or more species of these parasites are: *Pagurus gracilipes* with the parasites *Peltogaster paguri* and *Peltogaster depressus; Calcinus gaimardi* with the parasites *Dipterosaccus indicus* and *Peltogaster latus; Clibanarius striolatus* with the parasites *Peltogaster latus, Dipterosaccus indicus,* and *Septosaccus snelliusi; Calcinus latens* with the parasites *Peltogaster latus, Dipterosaccus indicus,* and *Pterogaster philippinensis;* and *Calcinus laevimanus* with the parasites *Peltogaster latus* and *Dipterosaccus indicus.*

Of the parasites mentioned above, eight species are known to infest one species of hermit crab only, while the remaining four each are known to occur on three or four species of hosts, viz., *Peltogaster paguri* (not counting the hosts of this parasite from the Atlantic region) on four species of *Pagurus (P. gracilipes, P. capillatus, P. hirsutiusculus,* and *P. samuelis); Dipterosaccus indicus* and *Peltogaster latus* on *Calcinus gaimardi, C. latens, C. laevimanus,* and *Clibanarius striolatus*; and *Septosaccus snelliusi* on *Clibanarius striolatus, Cl. aequabilis,* and *Cl. longitarsus.* The situation becomes rather complicated because *Dipterosaccus indicus* and *Peltogaster latus* have exactly the same set of hosts. On the other hand it is a curious fact that one of the species of the genus *Septosaccus, S. reticulatus,* which is known from several localities, seems to be restricted to the hermit crab *Dardanus deformis,* while the other species, *S. snelliusi,* is known as a parasite of three species of the genus *Clibanarius.* The complicated relations of the non-gregarious Peltogastridae of the Pacific with their various hosts brings about that for a reliable identification each specimen has to be studied in sections.

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