

NOTES ON JAPANESE RHIZOCEPHALA, WITH DESCRIPTION OF TWO NEW SPECIES

by

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The following notes are based upon material of parasites on two Crustaceans from Japan, viz., *Pachygrapsus crassipes* Randall and *Petrolisthes japonicus* de Haan¹). Each of these two species may be infested by two different species of Rhizocephala: on *Pachygrapsus crassipes* occur the parasites *Sacculina rotundata* and *S. confragosa*, whilst *Petrolisthes japonicus* may be infested by the two species of *Lernaeodiscus* (*cornutus* and *okadai*) described in the present paper.

I want to express my thanks to Professor Yaichiro Okada of Tokyo Normal College who collected a great deal of the material dealt with in the present paper at the sea shore near the Marine Biological Laboratory at Shimoda.

I. The parasites of *Pachygrapsus crassipes* Randall.

The two species which occur as parasites on *Pachygrapsus crassipes* are *Sacculina rotundata* Miers and *Sacculina confragosa* Boschma.

In *Sacculina rotundata* the testes are found in the posterior part of the body (outside the visceral mass), the external cuticle bears excrescences of conspicuous size, each consisting of a basal part from which numerous spines arise (cf. Miers, 1880, Boschma, 1933). The type specimen was a parasite of *Eriphia laevimana* Latr., but the specimens on *Pachygrapsus crassipes* do not differ in any important detail from those living on *Eriphia*.

In *Sacculina confragosa* the male genital organs are found in the visceral mass, the dorsal extremity of the testes is curved ventrally, the external cuticle is smooth, its surface divided into small areas which have a diameter of 8—18 μ (cf. Boschma, 1933). The only known host of this species is *Pachygrapsus crassipes*.

By means of the characteristic excrescences of *Sacculina rotundata* and the smooth surface of the cuticle in *S. confragosa* a parasite on *Pachygrapsus crassipes* can be easily identified. Among the material which is at my disposal there are 32 specimens of this crab which bear one or (rarely)

1) I am indebted to Prof. Dr. H. Balss for the identification of this Porcellanid.

two or three parasites. 19 of these crabs are infested with *S. confragosa*, 13 with *rotundata*.

The following list contains the localities and other data concerning the material of infested specimens of *Pachygrapsus crassipes* which could be studied.

- Sagami Bay, 1901, Dr. Haberer. Zool. Museum Munich. 4 *Sacculina confragosa*, 2 *Sacculina rotundata*.
 Fukuura, Sagami Bay, 10—20 February 1903, Dr. Haberer. Zool. Museum Munich. 2 *Sacculina confragosa*.
 Sagami Bay, March 1903, Dr. Haberer. Zool. Museum Munich. 2 *Sacculina rotundata*.
 Aburatsuko, Sagami Bay, 6 October 1904, Doflein. Zool. Museum Munich. 1 *Sacculina confragosa*.
 Misaki, July 1909, Madoka Sasaki. United States National Museum. 1 *Sacculina confragosa*.
 Sagami, Misaki, shore, 20 April 1914, Dr. S. Bock. Mus. Stockholm. 1 *Sacculina confragosa*.
 Sagami, Misaki, shore, 30 April 1914, Dr. S. Bock. Mus. Stockholm. 2 *Sacculina confragosa* on one host.
 Misaki, 23 December 1921, Alan V. Insole. British Museum (Natural History). 2 *Sacculina confragosa* (type specimens).
 Aburatsuko, Misaki, litoral, August 1929, A. S. Pearse. Museum Leiden. 2 *Sacculina rotundata*.
 Misaki, Marine Biol. Sta., 1930, Prof. Naohide Yatsu. Museum Leiden. 6 *Sacculina confragosa* (3 on one host), 5 *Sacculina rotundata*.
 Shimoda, Shizuo-ken, sea shore near Marine Biological Laboratory, 3 May 1934, Prof. Yaichiro Okada. Museum Leiden. 1 *Sacculina confragosa*, 3 *Sacculina rotundata*.

The anatomy of *Sacculina confragosa* has been studied on sections of two type specimens and of two other specimens, all of which show the same shape and arrangement of the internal organs. From two specimens of *Sacculina rotundata* of the list given above sections have been made, their internal organization agrees completely with that of specimens of the same species living on *Eriphia*.

The material referred to above suffices to conclude that the crab *Pachygrapsus crassipes* in Japanese waters is infested by two common species of *Sacculina*, which differ in constant characters and can be easily identified.

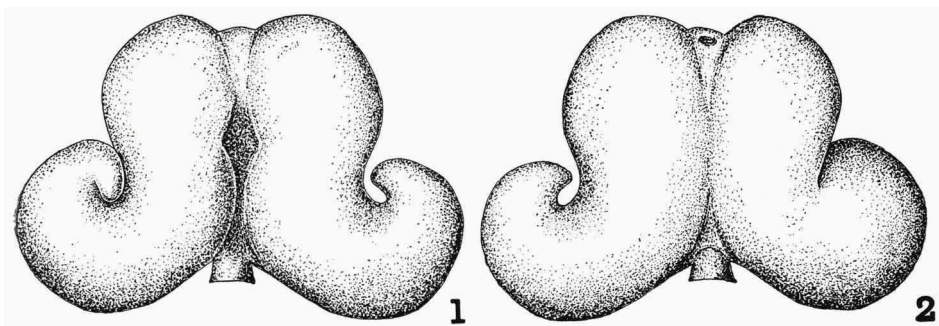
II. The parasites of *Petrolisthes japonicus* de Haan.

The material collected by Profesor Okada at the sea shore near the Marine Biological Laboratory at Shimoda, Shizuo-ken on May 3, 1934, contains 19 specimens of *Petrolisthes japonicus* de Haan, 17 of which bear a parasite of peculiar shape, which is described in the present paper as *Lernaeodiscus cornutus*, whilst the other two are infested by another species, described in the following pages as *L. okadai*. The two species have a strongly different shape so that they can be indentified at once. The

description, including the peculiarities of their internal structure, is given below.

Lernaeodiscus cornutus nov. spec.

Diagnosis. Body symmetrical, flattened dorso-ventrally, posterior angles protruded into conspicuous curved lappets. Mantle opening at anterior extremity, stalk at posterior extremity, each in median plane. Dorsal mesentery longer and broader than ventral. Testes in central part of posterior region of the body, differing in size, the one well developed, the



Lernaeodiscus cornutus.

Fig. 1. Ventral surface (facing the abdomen of the host). Stalk at the lower end of the figure. $\times 7\frac{1}{2}$.

Fig. 2. Dorsal surface (facing the thorax of the host). Mantle opening at the upper end of the figure, stalk at the lower end. $\times 7\frac{1}{2}$.

other rudimentary. Vasa deferentia running in lateral direction. Both male genital openings at the same side of the median plane. Colleteric glands with slightly divided lumen, each at one side of the median plane, the one at the dorsal surface of the visceral mass, the other at the ventral surface.

Externally the animals are neatly symmetrical (fig. 1 and 2). The main body is almost as long as broad, whilst the posterior part is enlarged into curved horns, giving the animals a very peculiar shape. In the larger specimens the dimensions are approximately: height in the median plane, not including the stalk, 4 mm; greater diameter (breadth) of the anterior part 5 mm; greater diameter of the posterior part 8 mm. The thickness amounts to about 2 mm.

The stalk is present in the median part of the posterior region, the mantle opening in the median part of the anterior region. In many specimens the mantle opening is slightly turned towards the dorsal surface.

At the ventral surface there usually is a conspicuous longitudinal groove running from the stalk in anterior direction.

Sections have been made of three of the specimens, two of these transverse, the other longitudinal. From these sections results that the

shape of the genital organs bears a strong resemblance to that of the corresponding organs in *Lernaeodiscus galathea* (cf. Boschma, 1928). The testes and the colleteric glands are found in the posterior part of the body, in the vicinity of the stalk. In figures 3 to 6 the central parts of sections from one animal are drawn, each following section from a slightly farther anterior plane than its predecessor.

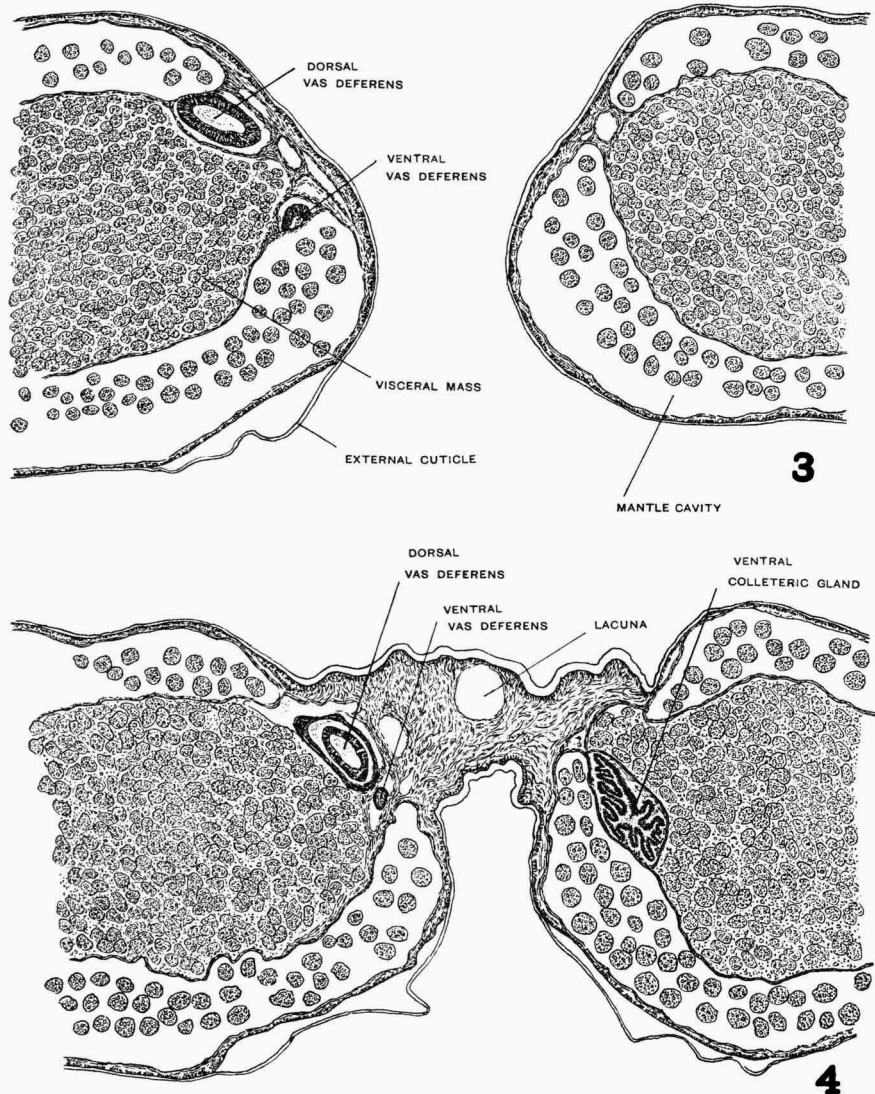
The visceral mass forms the central part of the body. It is slightly flattened in a dorso-ventral direction. In the plane of symmetry of the body the visceral mass is attached to the mantle by the mesentery. At one side of the visceral mass the mesentery stretches from the stalk to the mantle opening, here it is comparatively broad, at least in the posterior half of the body. According to Smith (1906, 1915) this is the dorsal part of the mesentery. The ventral mesentery is distinctly narrower, at least in the posterior region of the body, and it does not reach as far to the anterior part of the body as that of the dorsal side. Moreover the dorsal mesentery does not terminate in the stalk, it divides here into two parts, each of which run along the posterior region of the body. These two parts are seen in fig. 3; fig. 4 is a section through the basal part of the stalk, whilst in fig. 5 and 6 the differences between the dorsal and ventral mesenteries are evident.

In the posterior lateral corners of the mantle a tapering excrescence of the visceral mass projects for some distance, so that the dorsal and ventral surfaces of the visceral mass are very similar to those of the complete animal.

In the three animals from which sections have been made there is a noticeable difference in size between the two testes. One of these organs is well developed, swollen in its median part, whilst the other is more or less rudimentary. The vas deferens of the well developed testis, which may be called the dorsal, has a wide lumen (fig. 3 and 4), it passes rather abruptly in the more or less globular main part of the testis (fig. 5); the anterior part of this testis is slightly curved (fig. 6), whilst the extremity is pointing into a posterior direction (fig. 5, at the right). In the other male genital organ (the ventral) only the posterior part of the vas deferens shows a lumen (fig. 3 represents the genital opening), and also the testis (figs. 5, 6) for the greater part consists of a solid piece of tissue. This rudimentary testis is not bent noticeably at its extremity. The male genital openings are found in the posterior part of the body, at each side of the left half of the visceral mass¹⁾, the vasa deferentia form straight

1) In the figures 3 to 6 the left and right sides correspond with the left and right sides of the animal. When sectioning this animal the posterior region formed the beginning, so that all the sections have been mounted with their posterior surface up.

canals, which in the neighbourhood of the median plane pass into the testes. The colleteric glands are somewhat flattened organs which possess a



Lernaeodiscus cornutus.

Fig. 3. Transverse section of the posterior region of the body. $\times 32$.

Fig. 4. Transverse section slightly nearer anteriorly to that of fig. 3. $\times 32$.

lumen composed of slightly branched tubes. One of these glands, the ventral (fig. 4), is found in the right half of the body; the other, the dorsal (fig. 6), in the left half of the body. The ventral colleteric gland

lies in the region of the stalk, the dorsal in a more anterior transverse plane.

All the sections represented are from the posterior region of the body: the region between those of fig. 3 and 6 occupies about one fourth of the height in the median plane.

The musculature of the body is strongly developed in the region of the stalk and in the posterior part of the dorsal mesentery. The anterior part of the latter and the whole of the ventral mesentery are less muscular. In the anterior part of the body there is a well developed sphincter around the mantle opening. In both of the mesenteries large lacunae are found which communicate with other, smaller lacunae in the mantle. Large lacunae surrounding the testes are found in the central part of the posterior region.

The mantle cavity contains numerous eggs in course of development, whilst the visceral mass is crowdedly filled with unripe eggs.

On the greater part of the body the external cuticle of the mantle forms a thin layer of chitin, in the region of the stalk it is slightly thicker. This layer does not show any excrescences of a definite shape. The internal cuticle of the mantle is still thinner, it does not show any characteristic particulars.

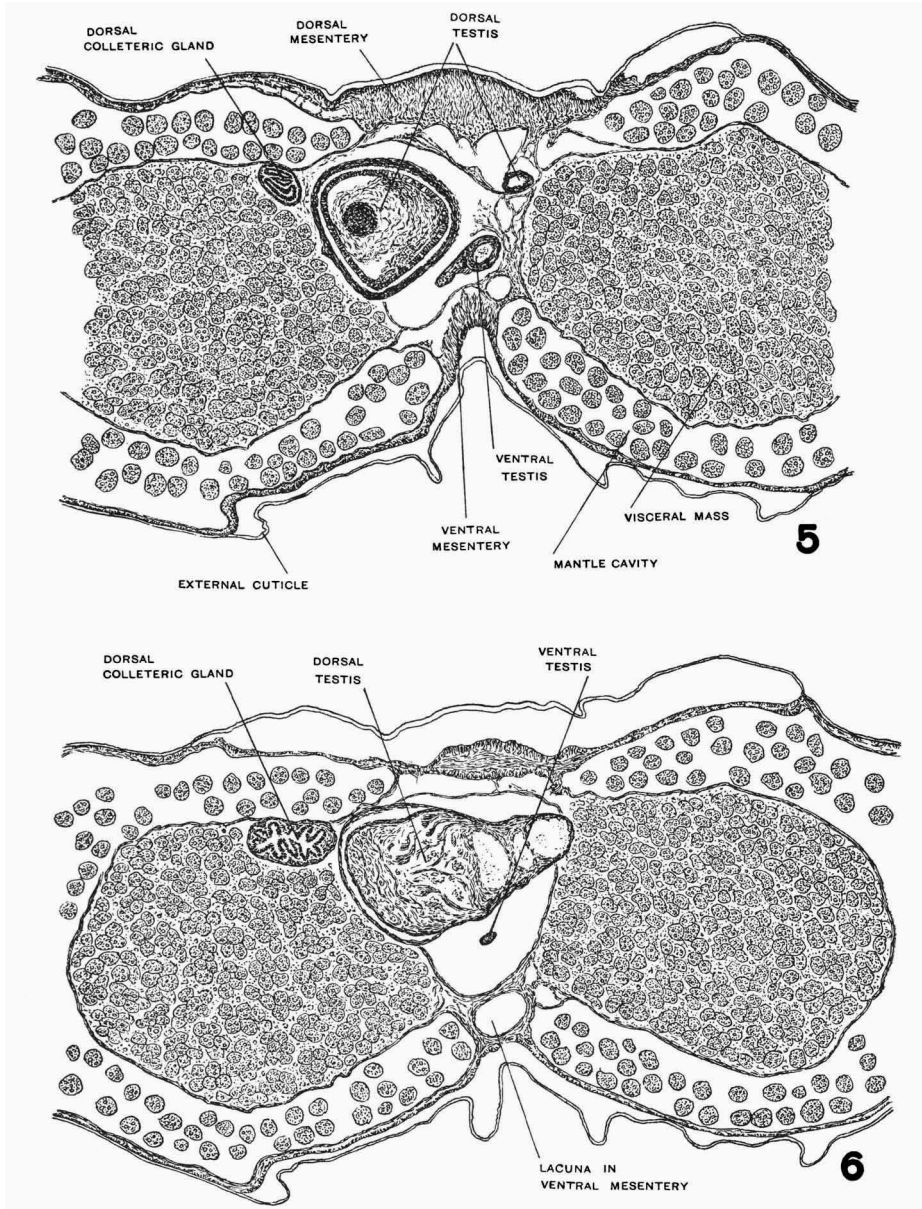
Lernaeodiscus cornutus externally is neatly bilaterally symmetrical, but internally the symmetry, as far as it manifests itself, does not correspond with the external. We can construct a plane which is nearly a plane of internal symmetry so that one of the testes and one of the colleteric glands is found at each side of this plane. But then this plane is about perpendicular to that which divides externally the body into two symmetrical halves. It is, therefore, difficult to say which of the internal organs is the right or the left, in the description the terms "dorsal" and "ventral" have been used for these organs as unambiguous terms.

The species differs from all other species of the genus by its conspicuous posterior horns, which are found already in the smallest specimens in the collection.

Lernaeodiscus okadaï nov. spec.

Diagnosis. Body symmetrical, more or less trapezoid, flattened dorso-ventrally. Contour of body irregular, but without distinct lappets. Mantle opening and stalk in the median plane, the latter at the posterior extremity, the former at some distance from the anterior margin. Dorsal mesentery very broad and long, ventral mesentery much smaller. Male genital organs symmetrical, at each side of the median plane, each curved in a dorso-

ventral and in a lateral direction. Colleteric glands small, globular, with undivided cavities, at the extreme lateral parts of the visceral mass.



Lernaeodiscus cornutus.

Fig. 5. Transverse section slightly nearer anteriorly to that of fig. 4. $\times 32$.

Fig. 6. Transverse section slightly nearer anteriorly to that of fig. 5. $\times 32$.

One of the two specimens is slightly smaller than the other, in other respects they are similar. The specimen from which sections have been made (the larger of the two) is represented in fig. 7 (the surface which was turned towards the thorax of the host) and fig. 8 (the surface facing the abdomen of the host). The longer diameter of this specimen is nearly 4 mm, its height (in the median plane) 2.5 mm approximately, its thickness is less than 1 mm. Both specimens were attached to the proximal part of the abdomen of their hosts, their longer diameter being perpendicular to that of the hosts.

The shape of the parasites is more or less trapezoid, the surface of the mantle is rather uneven, but its lateral part does not form distinct lappets. In the sectioned specimen the unevenness of the mantle is due to numerous lacunae lying between the external cuticle and the epithelium of the mantle.

In both specimens the mantle opening is found at the surface which was turned towards the thorax of their hosts, it lies in the median plane of the body, at a short distance from the anterior margin.

Externally the body of the parasites is neatly bilaterally symmetrical, and internally there is found a corresponding symmetry, which manifests itself especially in the shape of the genital organs.

The visceral mass is strongly flattened in a dorso-ventral direction (fig. 9). Nearly the whole dorsal surface of the visceral mass is attached to the mantle, so that the dorsal mesentery is very broad. This dorsal mesentery terminates in the anterior region near the mantle opening. At the ventral side of the visceral mass there is a much shorter and much narrower ventral mesentery.

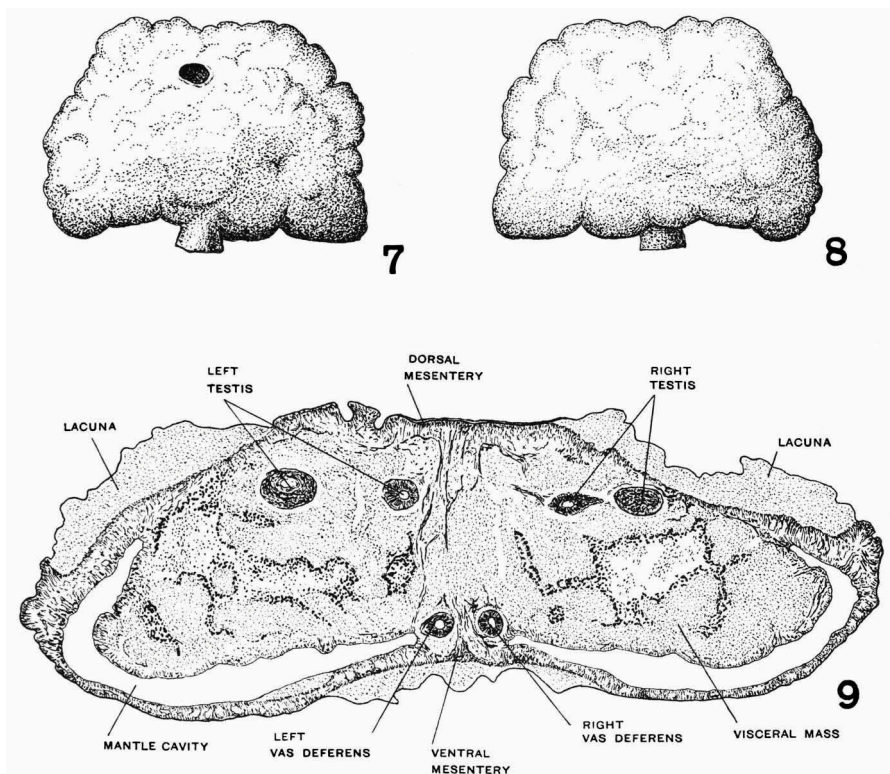
The male genital openings are found at each side of the anterior part of the ventral mesentery. The vasa deferentia are running in a posterior direction along the margins of the ventral mesentery. In the posterior part of the body the vasa deferentia are bending towards the dorsal surface of the visceral mass, they gradually pass into the testes which are directed anteriorly. At their anterior extremity the testes again are bent in a lateral direction. Moreover this terminal part of the testis recurves again slightly towards the posterior region of the body. As a result of this repeatedly curved shape of the male genital organs three sections of each of these are found in fig. 9. The terminal part of the testis is a little thicker than the proximal part and the vas deferens, the lumen in the male genital organs is not tortuous in any part.

The male genital openings are found at about one third from the posterior extremity, the extreme dorsal parts of the testes project about as far towards the anterior region.

Slightly farther towards the anterior region the collecteric glands are

found. These organs have a more or less globular shape, they have a small size and possess a simple, undivided cavity. Each of these glands lies at the lateral surface of the visceral mass near the spot where the mantle joins the dorsal mesentery. Although one of the collectric glands lies somewhat nearer to the anterior region than the other they occupy a nearly symmetrical position in respect to the median plane of the body.

Besides the genital organs the visceral mass contains a large quantity of



Lernaeodiscus okadai.

Fig. 7. Dorsal surface (facing the thorax of the host). Mantle opening at the upper part, stalk at the lower end of the figure. $\times 11$.

Fig. 8. Ventral surface (facing the abdomen of the host). Stalk at the lower end of the figure. $\times 11$.

Fig. 9. Transverse section through the posterior part of the body. $\times 32$.

very young eggs (indicated with dark spots in fig. 9). The greater part of the visceral mass, however, consists of a system of large irregular lacunae, which contain a coagulated mass of material which has taken an even colour in the stained sections. Moreover there are a few muscles, especially in the region of the dorsal and the ventral mesentery, some of which run from one mesentery to the other.

The mantle cavity does not contain eggs. The mantle is not strongly muscular, except at the anterior region, where a well developed sphincter surrounds the mantle opening. In the mantle several lacunae are found which have separated the external cuticle from the epithelium of the mantle.

With the exception of the region of the stalk and for some distance along the dorsal mesentery the external cuticle of the mantle is extremely thin. In surface view it appears as a smooth layer of chitin. The very thin internal cuticle of the mantle does not show any important peculiarity.

As far as concerns its internal organization *Lernaeodiscus okadai* corresponds closely with *L. porcellanae* Müller (cf. Boschma, 1931). Both species have a broad and long dorsal mesentery, whilst the ventral mesentery is much smaller. The male genital organs have approximately the same shape and the colleteric glands are very similar in the two species.

Externally the two species show distinct differences: in *L. porcellanae* the mantle has a number of distinct lappets (cf. Müller, 1862, Boschma 1931), which do not occur in *L. okadai*. Moreover there is a difference in size between the two species. According to Müller (1862) *L. porcellanae* reaches a size of 10 or more mm, and the only specimen collected by Dr. Mortensen at Tobago, B.W.I. (cf. Boschma, 1931) had a greater diameter of 10.5 mm. The larger specimen of *L. okadai* measures nearly 4 mm. It is possible, however, that this species may grow larger: as the mantle cavity in the sectioned specimen does not contain eggs, and the visceral mass contains only young egg-cells, the specimen may be immature. But if so, one would expect in such a young stage at least an indication of lappets when they should occur in a well-developed form in a later stage.

LITERATURE CITED.

- BOSCHMA, H., 1928. Rhizocephala of the North Atlantic Region. Danish Ingolf Exp., vol. 3, part 10.
 — 1931. Rhizocephala. Papers from Dr. Th. Mortensen's Pacific Expedition 1914—16. Vidensk. Medd. Dansk naturh. Foren., vol. 89.
 — 1933. The Rhizocephala in the collection of the British Museum. Journ. Linn. Soc., Zool., vol. 38.
 MIERS, E. J., 1880. On a collection of Crustacea from the Malaysian Region. IV. Ann. Mag. Nat. Hist. (5), vol. 5.
 MÜLLER, F., 1862. Die Rhizocephalen, eine neue Gruppe schmarotzender Kruster. Arch. Naturg., Jahrg. 28, vol. 1.
 SMITH, G., 1906. Rhizocephala. Fauna und Flora des Golfes von Neapel, 29. monogr.
 — 1915. The genus *Lernaeodiscus* (F. Müller, 1862). Jour. Linn. Soc., Zool., vol. 32.