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# Studies on the Aquatic Oligochaeta of Japan
# I. Lumbriculids from Hokkaido[1)]

By

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(*With Plates IV–V, 4 Tables and 15 Textfigures*)

There has previously been no record on Lumbriculidae from Japan. In this paper will be described the three following species, *Lumbriculus japonicus* n. sp., *Rhynchelmis orientalis* n. sp., *Hrabea ogumai* n. g. et n. sp. Material dealt with in this paper has been mainly collected by the writer from several localities of Hokkaido within the past several years. Some specimens were collected and kindly placed at the writer's disposal by Prof. K. Oguma and Mr. H. Horié of this Zoological Institute, Mr. H. Hara of the Botanical Institute and Dr. M. Uéno of the Kyoto Imperial University.

Before proceeding further the writer wishes to express his sincere gratitude to these gentlemen for the specimens and also to Prof. T. Uchida for his kind guidance and help rendered in preparation of the paper, and to Prof. T. Inukai who kindly afforded several facilities for this study. The writer's thanks are also due to Dr. W. Michaelsen in Hamburg, Dr. Černosvitov in Prague and Dr. P. S. Welch in Ann Arbor, Prof. S. Hatai, Messrs. M. Oishi and H. Sato, of the Tohoku Imperial University, and to Mr. Y. Ikeda of the Tokyo Imperial University, Mr. S. Ofuchi of the Museum of the Saito Gratitude Foundation, and Messrs. K. Aoki, M. Iwasa, S. Okuda and S. Tarao of our Zoological Institute for literature.

## *Lumbriculus japonicus* sp. nov.

(Pl. IV, 1-4; V, 1; Textfigs. 1–3, 4 C, 5, 7–9)

Body 42–93 mm long and about 1.5 (1–2) mm wide in sexually mature specimens. Colour of the body in general reddish to dark

1) Contribution No. 104 from the Zoological Institute, Faculty of Science, Hokkaido Imperial University, Sapporo.

brown, but anterior part greenish as in other species of the genus. In specimens so far examined, the number of segments is 146–198. Each segment is biannulate with an anterior major and a posterior minor annulus (Fig. 1). Prostomium rounded-cone-like; the length is larger than the basal width. Clitellum slightly whitish in colour,

Fig. 1. *Lumbriculus japonicus* n. sp. Photographs showing ventral view of anterior part of body. Ca. 10×. A, specimen having male pores on XI; B, specimen having male pores on X; C, specimen having male pores on IX; D, specimen without male pore.

extending from segment X or XI to XVIII, XIX or XX. Setae sigmoid and cleft in the distal end (Fig. 2). Their nodulus is located about one-third the setal length from the distal end. There are four pairs of setae per segment, two ventral and two lateral. The setae distance *aa* is about equal to *dd*; *bc* is larger than *aa*. The ventral setae disappear on the atrial segment in mature individuals. Male pores situated on the ventral setae line. They are generally located in a pair on segment XI, rarely on X, and exceptionally on IX. Several specimens are destitute of the male pore, but are provided with well-developed clitellar swellings (Fig. 1). Female pores located on the ventral setae line in intersegmental furrows. They are mostly situated in a pair in intersegmental furrow XII/XIII. Spermathecal pores quite variable in number and position. They are usually found in a pair in each following segment from XIII to XVII or XVIII between the ventral setae line and the lateral line, situated near to the latter (Pl. IV, 1).

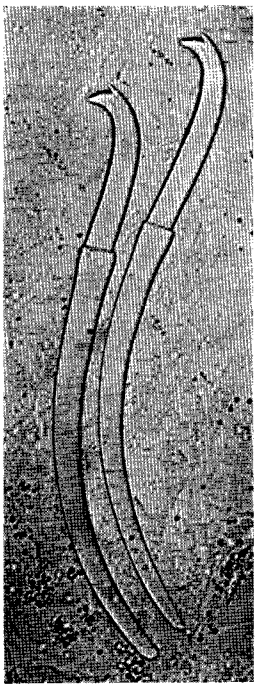

Fig. 2. Photomicrograph of setae of *Lumbriculus japonicus* n. sp. 330×.

Digestive tract destitute of a gizzard. Chloragogue cells on the tract are found first in the anterior end of segment VIII or in the posterior part of segment VII. Chromophile cells are observed in the anterior segments to segment VIII. The nephridial system of the species agrees with Boveri-Boner's description (1920) of *L. variegatus* but differs in having the first nephridia in segment VII (with their funnels in segment VI) from von Haffner's note (1928) on the latter species in which the first nephridia are found in segment XI (or rarely in X). The dorsal vessel gives off two kinds of paired transverse vessels as in other species of the genus; one located in the posterior part of a segment just anterior to the posterior septum, and the other situated in the anterior part of the segment just posterior to the anterior septum. The former vessels connect the dorsal and the ventral vessel; they are naked (without chloragogue cells), and lie in anterior successive segments. The last pair of these commissural vessels lies in one of

segments XXXI–XXXVIII. A few anterior pairs of the vessels are complexly branched to form a vascular plexus in several specimens, as in *L. variegatus* by von Haffner (1927), while in some specimens they are only folded several times, and do not show a plexus (Fig. 3). The latter vessels arising from the dorsal vessel end blindly. They are covered by chloragogue cells throughout their whole length, and are present in most of the segments except the anterior ones. The blind transverse vessels begin to appear in one of segments XIV–XXII. Though short and simple in a few anterior ones, they become longer and much branched towards the posterior part (Pl. IV, 4). All the blind transverse vessels are contractile. Testes and male funnels more or less variable in number and position, but generally paired in segments X and XI. The anterior pair of the testes are attached to the posterior side of septum IX/X, and the posterior pair are attached to the posterior surface of septum X/XI. The male funnels are attached to the anterior surface of the posterior septum of each testicular segment. The atria and the penis are similar in structure to those of *L. variegatus* described by Hesse (1894), Vejdovský (1895), Mrázek (1907), etc. They are mostly one-paired and situated in segment XI. The ovaries are variable in number from one to three pairs, but generally one-paired found attached to the posterior side of septum XI/XII. The oviducal funnels are paired usually in segment XII, attached to the anterior surface of septum XII/XIII. The spermathecae, quite variable in position and number, are frequently disposed in asymmetrical positions (Figs. 7–9) as in other species, but generally placed in a pair in each of the segments from XIII to XIV, XV, XVI, XVII or XVIII. Each spermatheca consists of a bulged ampulla and a narrow duct. The ampulla frequently invades the subsequent segment. There are paired anterior and posterior spermsacs. The anterior pair originate from the septum to which the anterior testes are attached, extending to a few anterior segments; mostly they originate from septum IX/X and extend anteriorly to segment IX or VIII. The posterior pair extends backwards from the septum to which the posterior pair of male funnels are attached. In the specimens at hand they mostly begin to appear in septum XI/XII and extend posteriorly to segment XXV or more posterior segments. The ovisacs are present mostly from septum XII–XIII covering the spermsacs and further extending posteriorly to the end of the latter. In mature individuals, both the sperm- and ovisacs are recognizable through the body wall as white yellowish bodies.

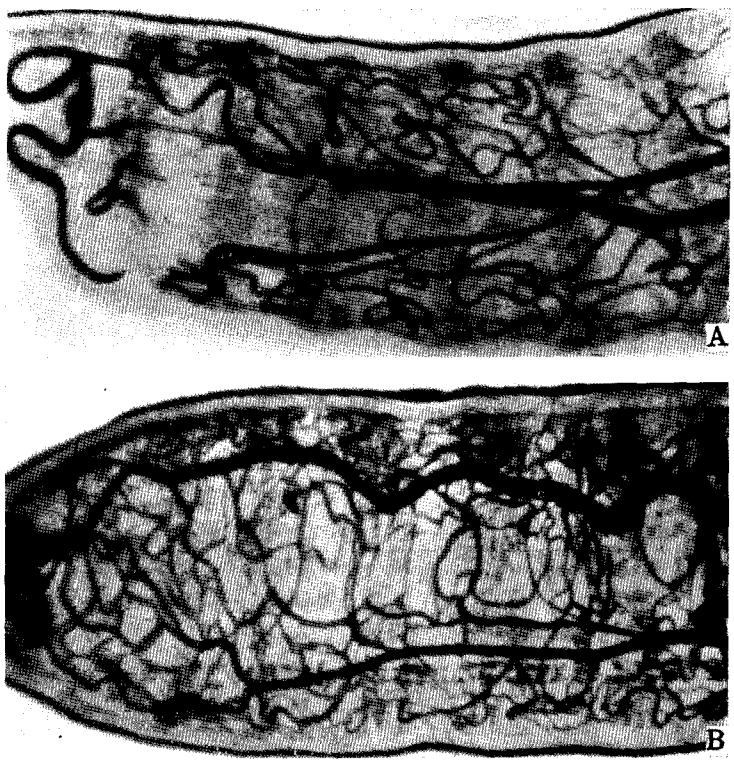


Fig. 3. *Lumbriculus japonicus* n. sp. Photomicrographs showing blood vessels in anterior part of body. Ca. 30×. Photographed from living individuals slightly depressed by a cover-glass through a deep blue filter of C. Zeiss for infrared photography. A, dorso-ventral commissures, folded several times but not branched; B, commissures, branched to form vascular plexus.

*Localities.* In small pools of Maruyama (near Sapporo); in a puddle of Sapporo; in moss on shores of small brooks running into a tundra pond in Yamagaru (near Hamatonbetsu). Specimens from the shore of a tundra pond in Sarufutsu and from bottom mud of Akan lake and ponds near the lake are probably referable to the species.

*Remarks.* The description of the present species is principally based on specimens collected from Maruyama and Yamagaru. Specimens from other localities were mostly in immature state or fragmental.

So far as the writer is aware, the genus *Lumbriculus* has hitherto been represented by the two valid species, *variegatus* and *inconstans*. The present species differs from both the species in distribution of genital organs, and the position of the first nephridia, the first blind transverse vessels and the last pair of the commissural vessels, connecting the dorsal with the ventral vessel. As is shown in other species of *Lumbriculus*[1], in the present species also the genital organs are quite variable in number and position. Therefore, distribution of genital organs alone is of no significance for distinguishing species of *Lumbriculus*. When many individuals of these species are examined, however, the variations seem to be distinct in each species, for example male pores are located in pair most frequently on segment VIII in *L. variegatus* (65.5%, Mrázek, 1907), on segment X in *L. inconstans* (Smith and Welch, 1919) and on segment XI in *L. japonicus* n. sp. (87.4%, see p. 81). The schema of genital organs of the three species is given in Fig. 4. The differences of these species are summarised in the following table.

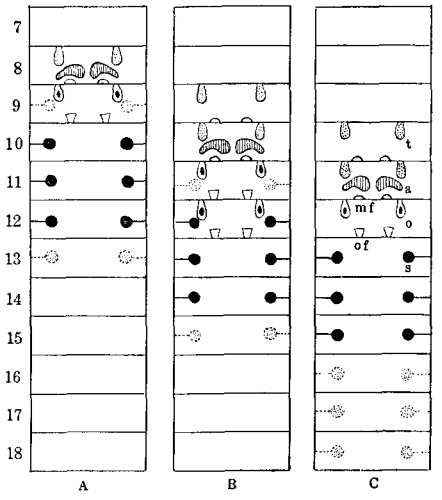


Fig. 4. Diagrams showing normal distribution of reproductive organs in three species of *Lumbriculus*. A, *L. variegatus*; B, *L. inconstans*; C, *L. japonicus* n. sp. Numerals designate the segments; a, atrium; mf, male funnel; o, ovary; of, oviducal funnel; s, spermatheca; t, testis.

*Ecological notes.* The present worms are found in mud among decaying leaves in small pools or lakes, and also among moss on shores of brooks or ponds. In aquaria they dwell on the bottom with the anterior part of the body embedded in the mud and their tail extending out of the mud. The tail is observed from time to time to move slowly in every direction or to float horizontally with the distal part motionlessly along the surface of water. When a slight shock is given in the water of

1) Hesse, 1894; Vejdovský, 1895; Wenig, 1902; Mrázek, 1907; Smith, 1919, Smith and Welch, 1919; Welch, 1921, Michaelsen, 1929; etc.

TABLE I.

Characteristics in species of *Lumbriculus*.

| | *L. variegatus* | *L. inconstans* | *L. japonicus* n. sp. |
|---|---|---|---|
| Male pores and atria | usually 1 pair on VIII. | usually 1 pair on X. | usually 1 pair on XI. |
| Testes and male funnels | usually 1 pair in VIII. | usually 2 pairs in IX, X. | usually 2 pairs in X, XI. |
| Female pores | *usually 1 pair in IX/X. | usually 2 pairs in XI/XII, XII/XIII. | usually 1 pair in XII/XIII. |
| Ovaries and oviducal funnels | *usually 1 pair in IX. | usually 2 pairs in XI, XII. | usually 1 pair in XII. |
| Nephridia commence to appear | **usually in XI. | ? | in VII. |
| Blind transverse vessels | **from IX. | ***from XI. | from XIV—XXII. |
| The last pair of dorsoventral commissure vessels | **usually in XVIII. | ***in XVII. (?) | in XXXI or more posterior segments. |

Note: As to *L. variegatus* and *L. inconstans* in this table, Mrázek (1907) *, von Haffner (1927, 1928) ** and Smith (1905) ***, are referable.

aquaria, the worms instantaneously hide themselves under the mud. Sometimes, these worms slip from the mud, aggregate together and form entangled lumps. The similar phenomenon is also observable, when the worms are placed in a vessel containing water alone, as in many tubificids. The ball formed by the worms is liable to be dissolved by a mechanical stimulus. When irritated by a needle or a slight shock, the worms making up the ball, rapidly swim away by lateral undulating movements in their own directions.

Individuals found in a pool of Maruyama in April 1935, were mostly in state of sexual maturity. Male germ cells and eggs were easily recognized through the body walls. These mature individuals

were mostly in water, assembled in entangled lumps which were attached to decaying leaves or small branches. Some of them brought to the laboratory were found after a few hours in copula (Fig. 5).

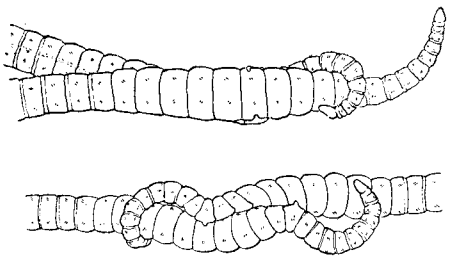

Fig. 5. *Lumbriculus japonicus* n. sp. in copula. Ca. 3.5×.

There were occasionally found individuals provided with a regenerated anterior or posterior end. According to von Haffner's (1928) experiment on *L. variegatus*, when the anterior segments fewer eight were amputated, the exact number of lost segments were regenerated; but when eight or more segments were removed, only eight segments were regenerated. In the writer's trial experiment on a few individuals of the Japanese species the same facts were observed.

The present species is usually parasitized by two species of astomatous ciliates (*Mesnilella clavata* and *M. trispiculata*?), which are found in the alimentary canal (Fig. 6).

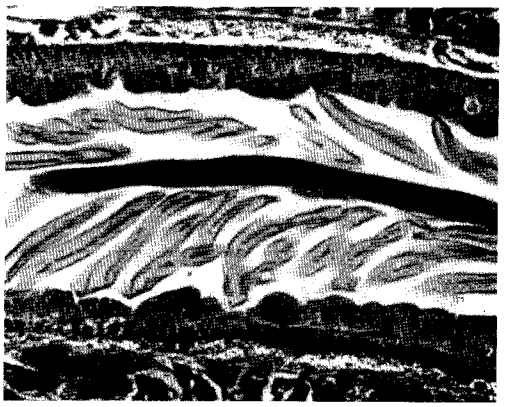

Fig. 6. Parasitic ciliates in alimentary tract of *Lumbriculus japonicus* n. sp. Photographed from a longitudinal section of the host. 150×.

*Variation of genital organs.* In regard to variation of number and position of genital organs, there will be given data based on 174 mature individuals collected from Maruyama and Yamagaru. Clitellar swellings and male pores are generally present in these specimens. The male pores are usually located on segment IX, X or XI (Fig. 1, A–C) but are deficient in a few specimens with well-developed clitellar swellings (Fig. 1, D). Regarding the number and position of male pores, the specimens have been divided into five groups as shown in Table II. From the table, it is clear that Group A contains a much larger number of individuals than the others.

TABLE II.

Variation of number and position of the male pores of *Lumbriculus japonicus* n. sp.

| Groups | Characters | Number of specimen | | | Percentages |
|---|---|---|---|---|---|
| | | from Maruyama | from Yamagaru | Total | |
| A | One pair of male pores on XI | 137 | 15 | 152 | 87.4% |
| B | One pair of male pores on X | 5 | 1 | 6 | 3.4% |
| C | One pair of male pores on IX | 3 | 0 | 3 | 1.7% |
| D | Male pore absent | 11 | 1 | 12 | 6.9% |
| E | One male pore on XI (one side) | 1 | 0 | 1 | 0.6% |
| | | 157 | 17 | 174 | 100.0% |

Sections have been made from 21 individuals, in order to examine the distribution of the internal genital organs. These specimens include 13 individuals provided with one pair of male pores on segment XI (Group A), two individuals with them on segment X (Group B), two with them on segment IX (Group C) and four individuals lacking any male pore (Group D). Variations in distribution of gonads, male funnels, oviducal funnels, atria and spermatheca are shown in Table III.

Group A. The number and position of testes, male funnels, atria, ovaries and oviducal funnels are invariable in this group (No. 1–13), i.e. there are two pairs of testes and male funnels in segments X and XI, one pair of atria in segment XI, one pair of ovaries and oviducal funnels in segment XII (see Table III, No. 1–13). Spermathecae are, however, variable in number and position. They are found from segment XIII to XV, XVI, XVII or XVIII; these segments are each provided usually with one pair of the organs, of which one member on one side is sometimes lacking. In Fig. 7 are shown four individuals belonging to Group A.

## TABLE III

Distribution of genital organs of *Lumbriculus japonicus* n. sp.

| Groups | Specimens | Atrial segments | Testicular segments | Segments bearing male funnels | Ovarian segments | Segments bearing oviduc. funnels | Spermathecal segments | Atria in | Testes in | Male funnels in | Ovaries in | Oviducal funnels in | Spermathecae in |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | No. 1 | 1 | 2 | 2 | 1 | 1 | 5 | XI | X, XI | X, XI | XII | XII | XIII–XVII |
| | 2 | 1 | 2 | 2 | 1 | 1 | 6 | XI | X, XI | X, XI | XII | XII | XIII–XVIII |
| | 3 | 1 | 2 | 2 | 1 | 1 | 4 | XI | X, XI | X, XI | XII | XII | XIII–XVI |
| | 4 | 1 | 2 | 2 | 1 | 1 | 3 | XI | X, XI | X, XI | XII | XII | XIII–XV |
| | 5 | 1 | 2 | 2 | 1 | 1 | 5 | XI | X, XI | X, XI | XII | XII | XIII–XVII |
| | 6 | 1 | 2 | 2 | 1 | 1 | 5 | XI | X, XI | X, XI | XII | XII | XIII–XVII |
| | 7 | 1 | 2 | 2 | 1 | 1 | 6 | XI | X, XI | X, XI | XII | XII | XIII–XVIII |
| | 8 | 1 | 2 | 2 | 1 | 1 | 5 | XI | X, XI | X, XI | XII | XII | XIII–XVII |
| | 9 | 1 | 2 | 2 | 1 | 1 | 5 | XI | X, XI | X, XI | XII | XII | XIII–XVII |
| | 10 | 1 | 2 | 2 | 1 | 1 | 6 | XI | X, XI | X, XI | XII | XII | XIII–XVIII |
| | 11 | 1 | 2 | 2 | 1 | 1 | 5 | XI | X, XI | X, XI | XII | XII | XIII–XVII |
| | 12 | 1 | 2 | 2 | 1 | 1 | 2 | XI | X, XI | X, XI | XII | XII | XIII–XIV |
| | 13 | 1 | 2 | 2 | 1 | 1 | 5 | XI | X, XI | X, XI | XII | XII | XIII–XVII |
| B | 14 | 1 | 2 | 2 | 1 | 1 | 4 | X | IX, X | IX, X | XI | XI | XII–XV |
| | 15 | 1 | 2 | 2 | 1 | 1 | 5 | X | IX, X | IX, X | XI | XI | XII–XVI |
| C | 16 | 1 | 2 | 2 | 1 | 1 | 5 | IX | VIII, IX | VIII, IX | X | X | XI–XV |
| | 17 | 1 | 1 | 1 | 2 | 2 | 4 | IX | IX | IX | X, XI | X, XI | XII–XV |
| D | 18 | 0 | 0 | 0 | 3 | 3 | 7 | — | — | — | XII–XIV | XII–XIV | XI–XVII |
| | 19 | 0 | 0 | 1 | 3 | 5 | 6 | — | — | XI | XII–XIV | XI–XV | XI–XVI |
| | 20 | 0 | 0 | 0 | 3 | 3 | 4 | — | — | — | X–XII | X–XII | X–XIII |
| | 21 | 0 | 0 | 0 | 2 | 2 | 7 | — | — | — | X, XI | X, XI | X–XVI |

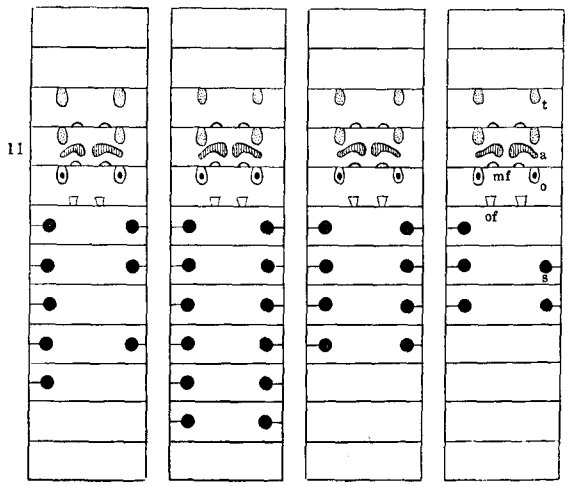


Fig. 7. Diagrams showing distribution of reproductive organs in four individuals of *Lumbriculus japonicus* n. sp., Group A. a, atrium; mf, male funnel; o, ovary; of, oviducal funnel; s, spermatheca; t, testis.

Group B. The number and relative position of genital organs are not different from Group A (see Table III, No. 14–15), but all the genital organs are located one segment further forward than in Group A (Fig. 8).

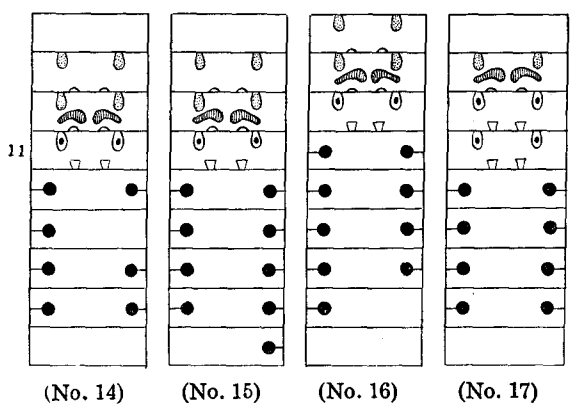


Fig. 8. Diagrams showing distribution of reproductive organs in four individuals of *Lumbriculus japonicus* n. sp. No. 14–15, Group B; No. 16–17, Group C.

Group C. One specimen (No. 16) is similar in respect to number and relative position of the genital organs to Groups A and B. In another one (No. 17), testes and male funnels are restricted to only one segment, while ovaries and oviducal funnels are found in two segments. These two specimens agree each other in the point that all the genital organs are situated two segments anteriorly to the corresponding ones of specimens in Group A (Fig. 8).

Group D. Individuals belonging to this group lack male genital organs except one specimen (No. 19) which has a single, small male funnel in segment XI. Ovaries and oviducal funnels are more numerous than those of Group A. The most anterior pair of ovaries is situated in segment XII or X. Spermathecae are quite variable in number and position as in other groups. It is noticeable that the organs are not only found in ovarian segments but also in the segment preceding the most anterior ovarian segment. These specimens contain only eggs and no male cells except in spermathecae. The group is illustrated in Fig. 9.

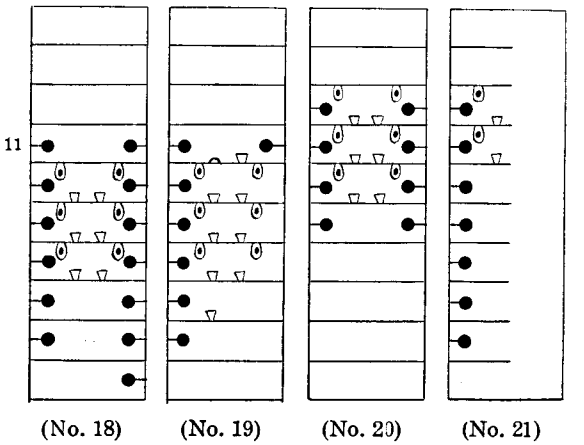


Fig. 9. Diagrams showing distribution of reproductive organs in four individuals of *Lumbriculus japonicus* n. sp., Group D.

As is clear from the above description *Lumbriculus japonicus* n. sp. is provided most frequently with one pair of male pores and atria, two pairs of testes and male funnels, one pair of ovaries and oviducal funnels and a variable number of spermathecae. Though the position of those organs is variable, the relative arrangement of them is almost

invariable, e.g. the posterior pair of testes and male funnels are in the atrial segment, the ovaries and oviducal funnels in the next posterior segment, regardless to positions of atria.

The Lumbriculidae have generally one to four pairs of testes and one or two pairs of ovaries; e.g. *Lamprodrilus satyriscus* f. *typica* with four pairs of testes and one pair of ovaries (Michaelsen, 1901, 1905), *Lumbriculus inconstans* with two pairs of testes and two pairs of ovaries (Smith and Welch, 1919), *Stylodrilus brachystylus* with two pairs of testes and one pair of ovaries (Hrabě, 1929), *Rhynchelmis orlodi* with one pair of testes and one pair of ovaries (Smith and Dickey, 1918). The testes and ovaries are arranged in a series in several segments and no segment intervenes between the testicular and the ovarian segments (except in *Stylos-colex*). The demarcating septum separating the male and the female region exists, therefore, in intersegmental part XI/XII in *Lamprodrilus*, in X/XI in most of genera, in IX/X in *Premnodrilus* and in VIII/IX in *Lumbriculus variegatus*. The demarcating septum of *L. japonicus* belonging to Group A is located in intersegmental part XI/XII, those of Group B in X/XI and those of Group C in IX/X (Fig. 10, a-c). According to Mrázek (1907) *L. variegatus* has the testes in segments VII–XI (usually in VIII) and from the description of Smith and Welch (1919) *L. inconstans* has them in segments IX–XI (usually in X) as is given in Fig. 10. These three species agree with each other in that the most posterior position of the demarcating septum is always in XI/XII

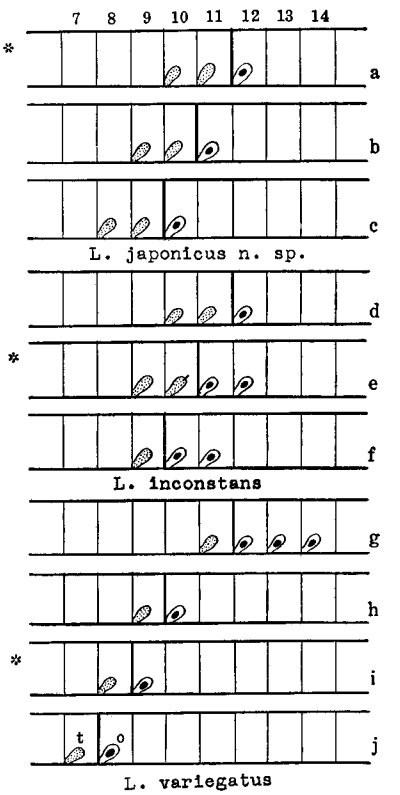


Fig. 10. Diagrams showing position of demarcating septum in three species of *Lumbriculus*. Numerals designate the segments. Demarcating septum shown by a heavy intersegmental line. a, Group A; b, Group B; c, Group C; d–f, according to Smith and Welch (1919); g–j, modified from Mrázek's figures (1907). Those with an asterisk are normal form in these species.

(Fig. 10). The normal position of the septum lies in VIII/IX in *L. variegatus*, in X/XI in *L. inconstans* and in XI/XII in *L. japonicus* n. sp.

### *Rhynchelmis orientalis* sp. nov.

(Pl. IV, 5-6; V, 2-3. Texfigs. 11-13)

Colour pinkish to purplish. Body size variable in specimens, the largest being 110 mm long and 2 mm wide. Number of segments 196–245. The anterior part of the prostomium is produced into a slender tentacle-like proboscis (Fig. 11). Each segment biannulate, with an anterior major and a posterior minor annulus. The clitellum was recognized in three specimens, occupying segments VIII–XVI in the first specimen, X–XIII in the second and IX–XV in the third one. Clitellar swellings conspicuous in segments X–XIII. Eight setae per segment in two ventral and two lateral pairs. All the setae are sigmoid and singly pointed. The nodulus is located about one-third the length of the setae from the distal end (Fig. 12), setae distance *aa* being about 3/4 of *bc* and about equal to *dd*. One pair of male pores is situated on the ventral setae line behind the setae of segment X. The female pores lie in pair on the ventral setae line in intersegmental furrow XI/XII. One pair of spermathecal pores is located on the ventral setae line behind the setae of segment VIII. Longitudinal muscle

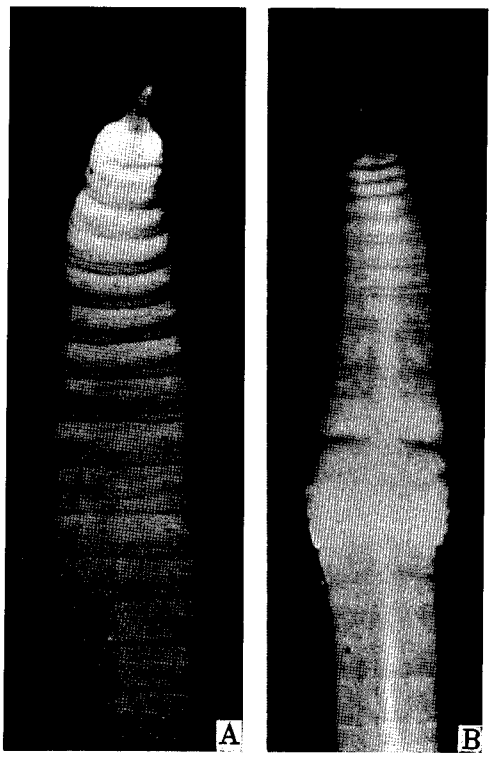


Fig. 11. *Rhynchelmis orientalis* n. sp. Photographs showing ventral view of anterior part of body. Ca. 10×. A, large specimen with no clitellar swelling; B, small specimen with well-developed clitellar swelling.

fibers divided into eight more or less distinct bands. Alimentary tract destitute of a gizzard. Chromophile cells are found in the oesophageal portion of the body backward to segment VII. Vascular system similar to that of other species of the genus. The ventral vessel forks in segment VII, giving rise to two anterior branches near the cerebral ganglion. The dorsal vessel is connected with the ventral and its branches by paired transverse vessels in the posterior part of segments II-XII (Fig. 13). Similar transverse vessels in segments posterior to segment XII are connected only with the dorsal vessel and provided with a few caecal branches. There is another set of paired transverse vessels which are situated in the anterior part of segments. They are present from segment VIII backward. The first pair are somewhat shorter than the others and have no branch, but others are provided with several caecal branches. In the posterior portion of the body, those vessels are provided with a large number of small, globular or pear-shaped contractile caecal appendages (Pl. V, 3). The so-called "Blutdrüsen" are found in segments XII–XVI or XVII; they are closely associated with the ventromedian wall of the intestine. The nephridial system is not different in general from other species of the genus. The first nephridia are present in segment XIV, with nephrostomes opening in segment XIII. The nephridiopores are on the line of and anterior to the ventral setae. One pair of testes in segment X, attached to the posterior surface of septum IX/X. Ovaries in pair in segment XI, attached to the posterior side of septum X/XI. A pair of spermsacs extends from there posteriorly on the sides of digestive tract, with their openings in the posterior septum of segment X. In one specimen the spermsacs were found to reach segment XXVII. Paired ovisacs extend posteriorly from the posterior septum of segment XI, covering spermsacs. Male funnels

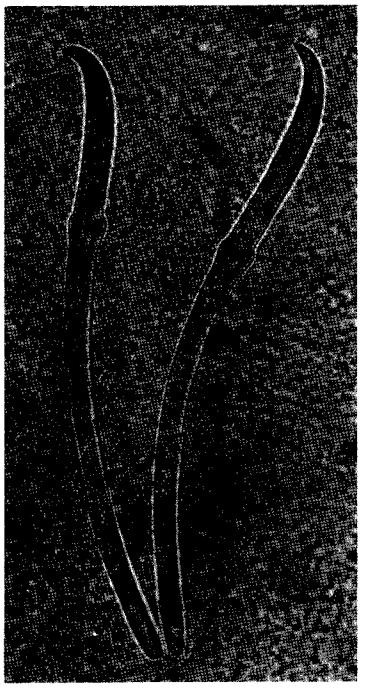

Fig. 12. Photomicrograph of setae of *Rhynchelmis orientalis* n. sp. 330×.

in two pairs; the first pair, smaller than the second, attached to the anterior surface of septum IX/X, and the second attached to the anterior side of septum X/XI. One pair of atria, long, tubular, extending backwards through spermsacs and barely reaching the posterior end of the spermsacs. Rudimental atrium (albumen gland), found in other species are not found. Paired oviducal funnel present on the anterior surface of septum XI/XII. One pair of spermathecae in segment VIII. They are long tubular, and extend backwards through several segments in spermsacs (Pl. IV, 5; V, 2). No communication of the spermatheca with the alimentary tract.

Fig. 13. *Rhynchelmis orientalis* n. sp. Photomicrograph showing anterior part of vascular system. 30×. Taken from a living individual through a deep blue filter as in Fig. 3.

*Localities.* In small pools in Maruyama (near Sapporo), with *Lumbriculus japonicus* n. sp. In mud of a brook in Nopporo.

*Remarks.* The present species is distinguished from other species[1] of the genus by the possession of very long spermathecae running in several posterior segment into spermsacs and having no communication with the alimentary canal. The distribution of genital organs of the present species is similar to that of *Rh. vejdovskyi* described by Hrabě and Černosvitov (1925). But the former is distinguished from the latter by colour, size, number of segments, form of spermathecae and the presence of caecal appendages in the transverse vessels.

1) The description of *Rh. olchonensis* Burow and Koshow, 1932, could not be referred to.

## Genus *Hrabea*[1] gen. nov.

Setae single-pointed. Male pores in a single pair on X; female pores one-paired in furrow XI/XII; spermathecal pores in a single pair on IX. Testes and male funnels both one-paired in X. Atria pear-shaped, paired in X. Vasa deferentia communicating with atrium in its apical end. No penis. Ovaries one-paired in XI; spermathecae one-paired in IX. No transversal blind vessel (or appendage).

The genus stands in intermediate position between *Bythonomus* and *Stylodrilus* as shown in the following table. The genus is distinguished from *Stylodrilus* in number of testes and male funnels and in the absence of bifid setae, and from *Bythonomus* in number of testes and male funnels and in the point that the vas deferens is communicated with the apical end of the atrium.

TABLE IV.

Characteristics of *Hrabea* n. g., *Bythonomus* and *Stylodrilus*

| | *Bythonomus* | *Hrabea* n. g. | *Stylodrilus* |
|---|---|---|---|
| Setae | Singly pointed. | Singly pointed. | Doubly pointed; in anterior ventral bundles singly pointed. |
| Male pores | 1 pair on X. | 1 pair on X. | 1 pair on X. |
| Female pores | 1 pair at XI/XII. | 1 pair at XI/XII. | 1 pair at XI/XII. |
| Spermathecal pores | 1 pair on IX. | 1 pair on IX. | 1 pair on IX. |
| Transversal vessels in the middle and hinder regions of body | Present (except *B. Sulci*) and branched. | Absent. | Absent or present; when present, the vessels not branched. |
| Testes | 2 pairs on IX, X. | 1 pair in X. | 2 pairs in IX, X. |
| Ovaries | 1 pair in XI. | 1 pair in XI. | 1 pair in XI. |

1) The name of the new genus has been chosen to honor Dr. S. Hrabě in Brno, who is an excellent investigator of this group of the Oligochaeta.

TABLE IV.—(*Continued*)

| | *Bythonomus* | *Hrabea* n. g. | *Stylodrilus* |
|---|---|---|---|
| Spermathecae | 1 pair in IX. | 1 pair in IX. | 1 pair in IX. |
| Atria | 1 pair in X, "schlauchförmig" | 1 pair in X, pear-shaped. | 1 pair in X, spherical to pear-shaped. |
| Penis | Absent. | Absent. | Present or absent. |
| Male funnels | 2 pairs in IX, X. | 1 pair in X. | 2 pairs in IX, X. |
| Vasa deferentia | Communicating with lower half of atrium. | Communicating with atrium in its apical end. | Communicating with atrium in its apical end. |

### *Hrabea ogumai* gen. nov. et sp. nov.

(Pl. V, 4–7; Textfigs. 14–15)

Body 70–80 mm long and about 1.5–2.0 mm wide. Body wall thin, transparent and colourless, but under reflex light it is light greenish blue. The worm swims actively by lateral undulating movements. Number of segments is 146–183. Segments biannulate, consisting of an anterior minor and a posterior major, except a few of the most anterior segments. Prostomium rounded, without proboscis-like elongation (Fig. 14). Eight setae per segment, in two ventral and two lateral pairs. Setae distance *aa* is about equal to *bc* and to 1/2 *dd*. Setae all singly pointed and sigmoid, with a nodulus at about one-third the setal length from the distal end (Fig. 15). One pair of male pores located on the ventral setal line behind the setae of segment X. Female pores in pair on the ventral side between segments XI and XII. One pair of spermathecal pores on segment IX, situated on the ventral setae line behind setae. Alimentary canal destitute of a gizzard. Nephridial system similar to that of *Lumbriculus variegatus* described by Boveri-Boner (1920). The nephridia located on one side of the body, are connected by a longitudinal tubule on either side, located above the ventral nerve cord. Each nephridium consists of a small glandular part attached to posterior surface of a septum, a nephridial funnel projecting from

the glandular part in the preceding segment through the septum, and two tubules given off from the glandular part. One of the tubules running downward and slightly backwards, opens externally in front of

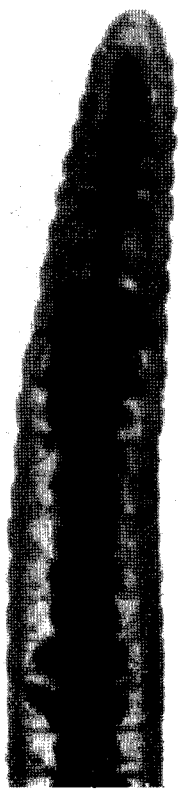

Fig. 14. *Hrabea ogumai* n. g. et n. sp. Photograph showing anterior part of body. Dorsal view. Ca. 10×.

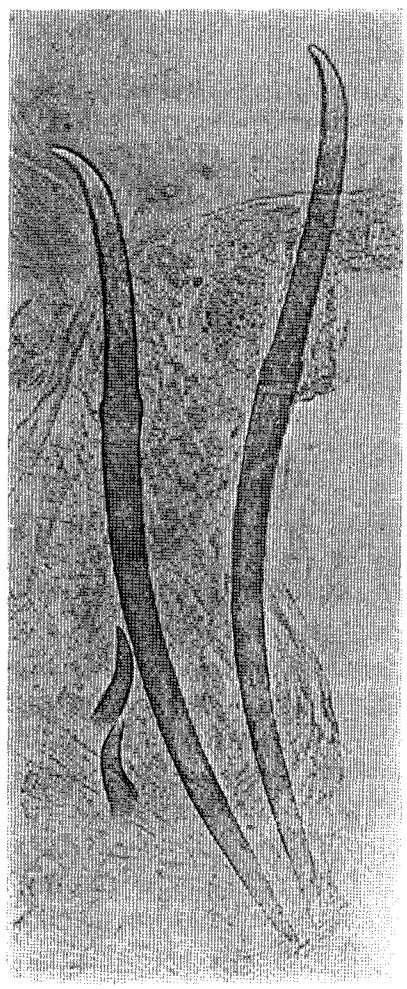

Fig. 15. Photomicrograph of setae of *Hrabea ogumai* n. g. et n. sp. 330×.

the ventral setae, while the other extends backward, inward and downward, and finally communicates with the longitudinal connective tubules. The first nephridia are in segment VII (nephridial funnels in

segment VI). In segments IX–XII no nephridia except the paired longitudinal tubules, and thence no nephridial funnels in segments VIII–XI. They are often absent on one side or on both sides in the middle and posterior region of the body. No transversal vessel runs in the middle and the posterior regions. One pair of testes in segment X, attached to the ventral part of the posterior surface of septum IX/X (Pl. V, 5). Ovaries paired in segment XI, attached to the posterior side of septum X/XI. In one specimen one more pair of rudimentary ovaries were found in segment XII. One pair of spermsacs arising from the posterior septum of segment X and extending backwards to about segment XX. Male germ cells in various stages in development found in spermsacs and coelomic cavity of segment X. In addition, one pair of rudimentary spermsacs as outgrowths from the anterior septum of segment X, extending backwards into spermsacs. In septum XI/XII are found similar paired outgrowths extending backwards enclosing spermsacs. These outgrowths are undoubtedly ovisacs, though containing no egg cells. Male funnels in a pair present in segment X, attached to septum X/XI (Pl. V, 4–7). They are widely expanded, with their dorsal margin united to the septum and the inner surface of the head of the spermsacs. Vasa deferentia relatively wide and short, communicating with a pair of atria in their apical ends. Different from those of *Anastylus parvus*[1] and *Stylodrilus brachystylus*, the vasa deferentia are not conveyed with the next segment through septum X/XI. Atria present in segment X, more or less elongated oval or pear-shaped in form. No penial apparatus. Prostate glands attached to atrial walls grouped in pear-shaped cell masses, surrounding the atria. One pair of oviducal funnels in segment XI, attached to the anterior surface of septum XI/XII (Pl. V, 6). Spermathecae in pair in segment IX, composed of a large ampulla and a tubular duct (Pl. V, 4). Spermatozoa found in the ampullae of a specimen.

*Locality.* In subterranean water in Sapporo.

*Remarks.* The specimens were collected from drinking water pumped out from deep wells. One individual found by Prof. K. Oguma in March, 1932 and three by Mr. H. Hara in April, 1933.

1) The species has been referred to *Stylodrilus* by Hrabě (1929), but to *Bythonomus* by Stephenson (1930).

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## Explanation of Plate IV

(Photomicrographs)

1. Transverse section of segment XIV in *Lumbriculus japonicus* n. sp. 80×.
2. Horizontal section of the same species, showing several genital organs. 35×.
3. Longitudinal (para-sagittal) section of the same species. 35×.
4. Blind transverse vessels in posterior part of body of the same species. 35×. Photographed from a specimen after removing body walls.
5. Longitudinal (para-sagittal) section of *Rhynchelmis orientalis* n. sp. 200×.
6. Transverse section of segment XV in the same species. 150×.

## Explanation of Plate V

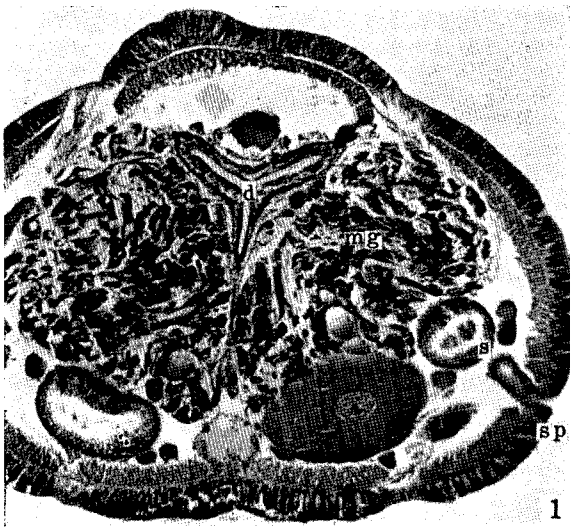
(Photomicrographs)

1. Transverse section of penial apparatus of *Lumbriculus japonicus* n. sp. 150×.
2. Transverse section of segment XIII in *Rhynchelmis orientalis* n. sp., showing spermatheca and atrium within spermsac. 150×.
3. Oval or pear-shaped, caecal appendages of transverse vessels in the posterior part of body of the same species. 60×. Photographed from a specimen of which ventral half of the body wall and digestive tract were removed.

4-7. Longitudinal (para-sagittal) sections of *Hrabea ogumai* n. g., n. sp., showing several genital organs. 4-6, 35× ; 7, 80×.

## Abbreviations in Plates

a, atrium; b, blood gland (Blutdrüsen); d, digestive tract; mf, male funnel; mg, male germ cells in various stages of development within spermsac; o, ovary; of, oviducal funnel; p, prostate gland; s, spermatheca; sp, spermathecal pore; t, testis; v, vas deferens.



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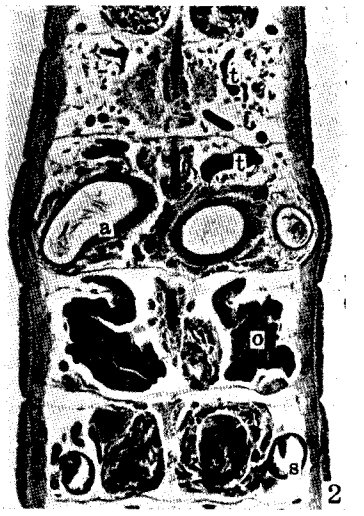

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*H. Yamaguchi photo.*

*H. Yamaguchi: Lumbriculids from Hokkaido*

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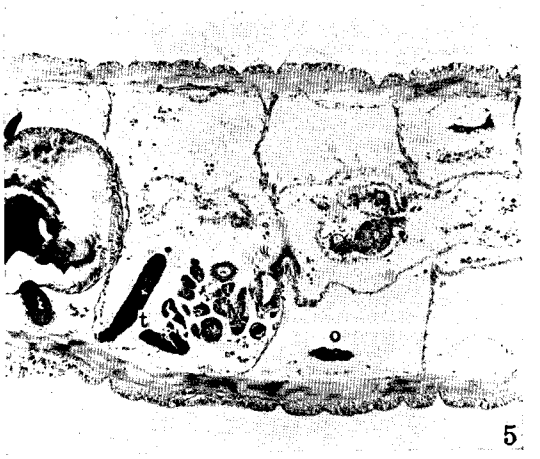


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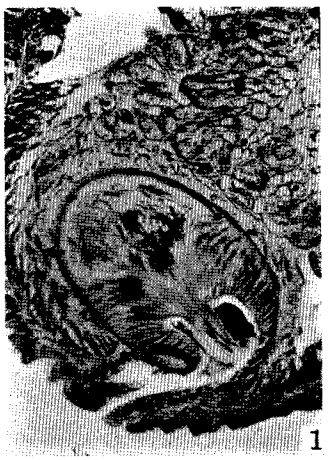

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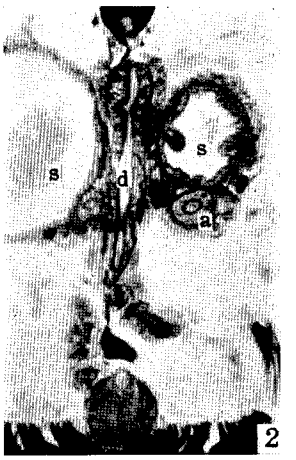


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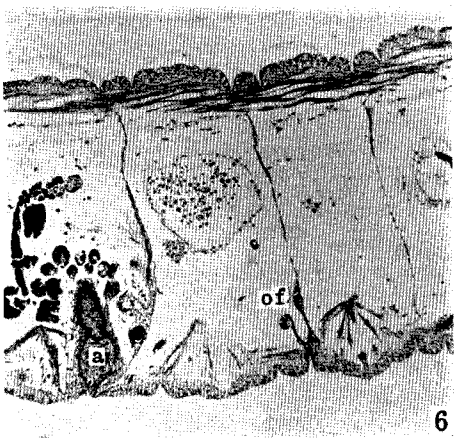


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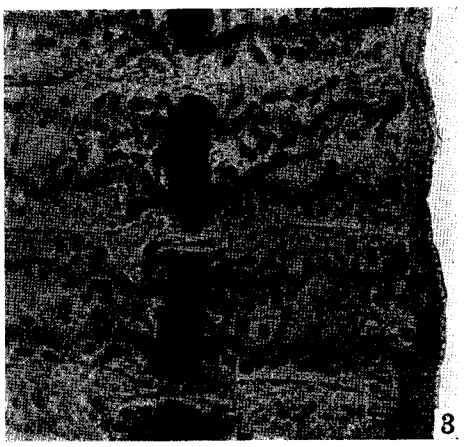

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*H. Yamaguchi photo.*