A Monograph of the Genus Macrostomum O. Schmidt 1848. Part IV.

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(With 28 Figures.)

Eingeg. 9. September 1939.

Macrostomum collistylum mihi.

Macrostomum collistylum mihi lives in the cold waters of a spring located near Whittle Springs Road, Knox County, Tennessee. It also occurs in the streams of this immediate region. The length of this animal averages slightly over one-half millimeter. Its shape (Fig. 1) resembles that of a larger species *M. bulbostylum* mihi. The animal is colorless.

The epidermis is heavily impregnated with rhabdites which occur in groups of from 8 to 12. These groups are about 13 μ apart. A peculiar type of cell (?) (Fig. 9) noted in reference to *M. bulbostylum* mihi is found in the epidermis in great numbers. Epidermal spines are absent. Sensory hairs (Fig. 1) in small tufts occur sparsely on the sides of the body. They do not appear at the extremities. The entire external body surface is clothed with a fine coat of cilia.

The morphology of the "brain" is regular. The eyes have a pigment-cup which contain reddish-brown globules and are embedded in the tissues of the "brain". These globules are of an unusually large size approximating 2 μ in diameter. In the eyes of this species, pigment-cups have been studied which possessed only fifteen globules.

The mouth, pharynx, and enteron do not present special features.

The extreme small size of this animal prevented an accurate study of the protonephridial system.

The male reproductive system is composed of testes, vasa deferentia, vesicula seminalis, vesicula granulorum, and penis-stilette, all of which, with the exception of the penis-stilette, are regular in their anatomical details. The stilette is so coiled that only a part of it can be focused upon in one visual plane. It originates (Fig. 2) from a widened crenate base in the vesicula granulorum and by a coiling involving an arc of approximately 315° reaches its termination in a long sharpened point. No region of the stilette visible in one field (oil immersion) is more than 35 μ long. The vesicula seminalis and vesicula granulorum occupy the same plane

while the stilette originates underneath them. The stilette termination is directed posteriorly and toward the ciliated male gonopore.

The sperm cells are elongate, undulating bodies which lack the postero-lateral setae so common to the genus. They measure

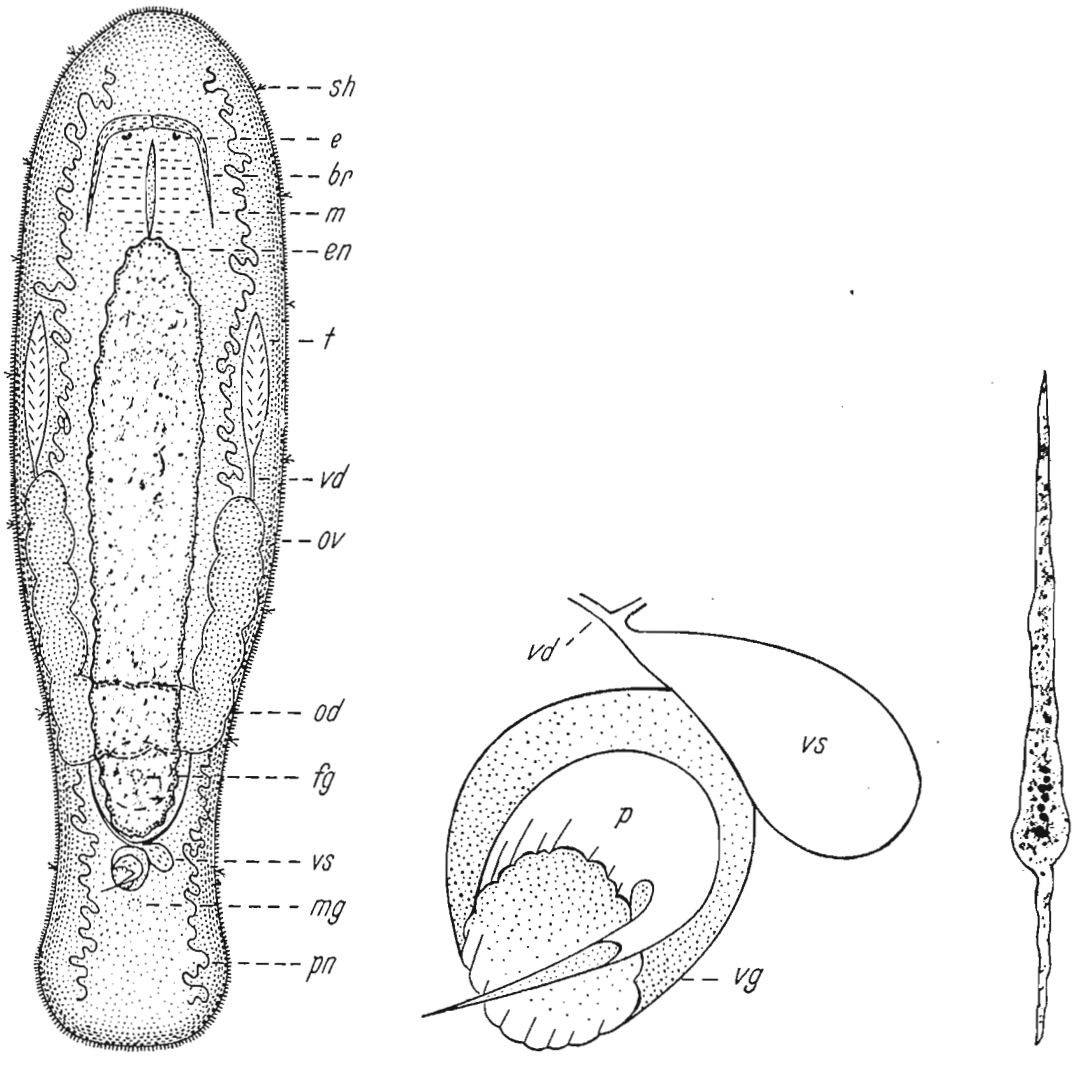

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Fig. 1. *M. collistylum* mihi. Dorsal view of gross anatomy. 150 ×.
Fig. 2. *M. collistylum* mihi. Ventral view of male sex apparatus. 1000 ×.
Fig. 3. *M. collistylum* mihi. Mature sperm-cell. 2000 ×.

about 32 μ and are possessed of chromatin granules in the anterior part of the cell having the largest caliber (Fig. 3).

The morphology of the organs composing the female reproductive system conforms with that observed in other species of the genus.

Taxonomically, *M. collistylum* mihi somewhat resembles *M. lineare* Uljanin. Graff (1913, p. 54) has assembled the sparse information upon *M. lineare* Uljanin, which is a marine form found in the Black Sea. The stilette of this species is presented by Graff (1913, Fig. 61) as being a spiralling tube of the same caliber from its base to its distal termination. The

coiling in the stilette involves more than a complete circle and does not start from the base. The opening is not indicated in the figure by GRAFF.

M. collistylum mihi differs from this near relative in that its stilette has a greatly widened and crenated base which terminates in a very long point. While coiling in an unusual fashion, the spiralling in the stilette of the American form is not as complete, nor does it occur at the same place in the tube as it does in the stilette of the European form. The stilette of *M. lineare* ULJANIN does not possess the very noticeable crenation which appears at the base of the stilette of *M. collistylum* mihi. There is, in addition, an extremely long, oblique terminal opening in the stilette of the American form.

Species Diagnosis.

Macrostomum collistylum new species: Body-shape resembles that of *M. bulbostylum*; penis-stilette is a short, coiled funnel possessing a greatly widened base, a long, sharply pointed termination and is ventral to the vesicula seminalis and vesicula granulorum; sperm cell is an elongate undulating cell which lacks postero-lateral setae; body length up to .5 mm.

Paratype: U. S. N. M. No's. 20436, 20462, and 20463.

Macrostomum curvistylum mihi.

Macrostomum curvistylum mihi lives in a swampy meadow fed by a spring at Milam Gap, Skyline Drive, Virginia. This particular place is an excellent collecting station for rhabdocoeles in general. Collections that are made in early spring furnish most material. The waters of this area are always very clear and cold, since the altitude is approximately 4000 feet.

The shape of the animal (Fig. 4) is characteristic of the genus in that it has a compressed cigar-shaped body which is gradually reduced at the spatulate tail. Both ends are rounded. The color of the animal is white. The average measurement is 730 μ by 230 μ which is below the average for the genus, which is about 1 mm. in length.

The epidermis is supplied with the ciliary processes, sensory hairs, spines, and cilia. The spines of the posterior region of the body occupy only the region of the adhesive and spatulate tail. The spines of the anterior end occupy the rounded periphery of the cephalic area. Rhabdites are present in the epidermis.

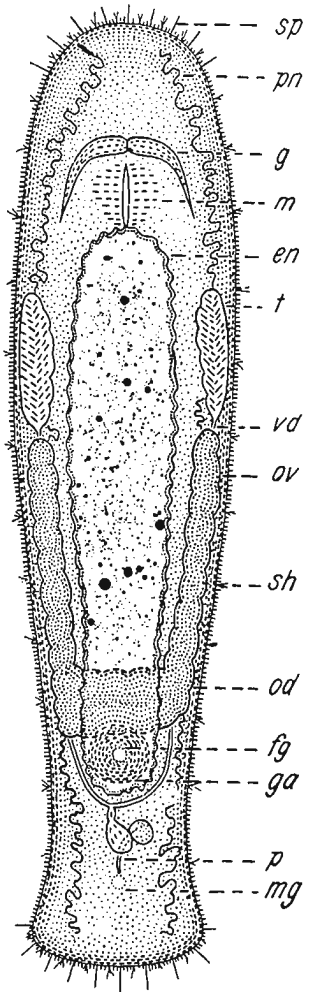
The anatomy of the nervous system conforms to that studied in other species. Those specimens examined lacked eyes[1].

The digestive system composed of mouth, pharynx, and enteron presents ordinary features except for the presence of an abnormally long enteron which extends from the pharynx posteriorly

[1] It is suggested that the pigment may have been lost in this species while the rest of the visual organ remains intact.

to the union of the vasa deferentia. The enteron is dorsal to the sexual systems.

The testes are large and occupy a lateral position in the first half of the body. The lateral wall of each testis is smooth, conforming to the body contour, while the mesial surface is indented. Vasa deferentia follow a normal course from the posterior tip of each testis, running ventral and posterior and unite in the midline



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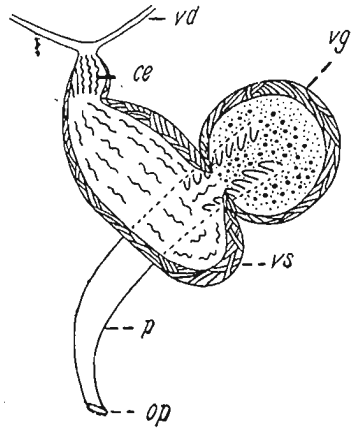

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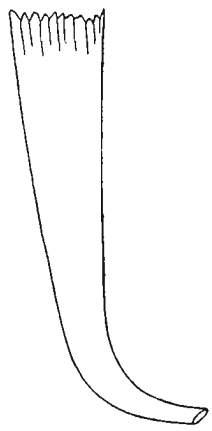

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Fig. 4. *M. curvistylum* mihi. Dorsal view of gross anatomy. 120 ×.
Fig. 5. *M. curvistylum* mihi. Dorsal view of male sex apparatus. 300 ×.
Fig. 6. *M. curvistylum* mihi. Penis-stilette. 564 ×.

just posterior to the female genital atrium to empty into the vesicula seminalis (Fig. 5).

The entrance to this sperm sack is ciliated. The vesicula seminalis and vesicula granulorum lie in the same plane. Both structures have strongly developed sets of muscles within their walls. Ciliated chambers are lacking in the vesicula granulorum. A myotomic pattern of muscles originates in the vesicula granulorum and extends into the basal portion of the penis-stilette. The stilette originates in the dorsal part of the vesicula granulorum and then

bends ventrally under the vesicula seminalis. The penis-stilette (Fig. 6) has the form of a funnel which possesses a distal bend. The external opening of the stilette is at an oblique angle. The proximal, basal part of the stilette is crenated. The stilette measures 68 μ in length. The curved end of this copulatory structure is directed toward the ciliated male gonopore.

The female sex apparatus consisting of ovaries, oviducts, common oviduct, female genital atrium, and female gonopore is regular in its morphology and does not warrant a detailed description.

Taxonomically, *M. curvistylum* mihi may be compared with *M. kawamurai* OKUGAWA, *M. japonicum* OKUGAWA, *M. rhabdophorum* BEKLEMISCHEF, *M. saufunicum* NASSONOV, *M. obtusum* VEDJOVSKÝ, and *M. ophiocephalum* STEINBÖCK. The above species all possess a stilette which is funnel-shaped and has a terminal bend.

The stilette of *M. kawamurai* OKUGAWA (Species dubia) differs from the American form in that its tip (Fig. in Part VII) is irregularly twisted and is bent at right angles to the axis of the stilette. The length of this stilette is 150 μ.

M. japonicum OKUGAWA has a stilette which is distinct from that of the American species *M. curvistylum* mihi. This penis-stilette (Fig. 27) is very long and slender. The main part of the tube is somewhat waved and the termination is bent at a right angle. This terminal end may be slightly inflated. The length of this stilette is 170 μ.

The funnel-shaped penis-stilette of *M. rhabdophorum* BEKLEMISCHEF is shown in Fig. in Part V. The proximal end is obliquely truncated while the distal fifth of the tube is bent; then the tube is entirely straight up to its end. The distal end is stumped and rounded. The external opening is an elliptical subterminal one. This penis-stilette is easily distinguished from that of *M. curvistylum* mihi.

The penis-stilette has the form of an extended cone, which has a distal right angle bend in *M. saufunicum* NASSONOV. This stilette (Fig. in Part VII) resembles that of *M. appendiculatum* var. *sillimani* mihi. The end of the stilette is directed toward the basal or proximal portion of the tube. A singular laminated flange is present in the concavity of the distal bend in the stilette. Obviously this stilette may not be confused with that of *M. curvistylum* mihi.

M. obtusum VEDJOVSKÝ possesses a stilette which is bent and sharply pointed. The opening of the stilette is like that of *M. appendiculatum* (O. FABR.), that is, it is non-terminal. This stilette does not compare with the stilette of *M. curvistylum* mihi.

The cuticular tube of the penis-stilette of *M. ophiocephalum* STEINBÖCK is a very short, thick funnel which is bent at right angles in its distal portion. The distal opening is produced by the square truncation of the tube. The proximal, basal region of the stilette is not crenated. This stilette does not compare with that of *M. curvistylum* mihi.

Species Diagnosis.

Macrostomum curvistylum mihi, new species: Body cigar-shaped with spatulate tail, color white, length 730 μ, epidermal cilia, sensory hairs and spines present, unusually long enteron, eyes lacking, penis-stilette has form of distally bent funnel with opening produced by oblique truncation, stilette ventral to both vesicula granulorum and vesicula seminalis.

Macrostomum gieysztori mihi.

1931. *Macrostomum gieysztori* mihi (*M. gracile* Pereyaslawzewa)[2], M. Gieysztor in: Bull. intern. Ac. Polon., Sér. B, 2 (1931) 132.

This *Macrostomum* (1 mm. long) is found in the canals of the rice-fields of Albufera near Valencia, Spain.

The shape of the body recalls that of *M. appendiculatum* (O. Fabr.). Besides the ordinary coat of cilia, this form is provided at the extremities with a mixture of long and short very fine sensory hairs. The colorless body is provided with numerous rhabdites.

The enteron imparts a brown or green color and is possessed of small lateral diverticula.

The small, round eyes are situated laterally with respect to the mouth opening. The distance between the eyes depends to a degree upon the contractions and movements of the animal. As a rule, this distance is one-half that between the eyes and the body wall.

The laterally disposed testes are elongate structures which appear posterior to the pharynx. The vasa deferentia end by joining at the large accessory false vesicula seminalis, which is often larger than the vesicula seminalis proper. A distinct constriction separates these last named structures. The false vesicula seminalis is deprived of musculature. The vesicula seminalis and vesicula granulorum lie close together within a single muscular housing. The ductus ejaculatorius is not visible in pressure preparations of the animal. The disposition of these described organs corresponds to the structue of *M. viride* E. Beneden as depicted in Luther (1905, p. 33).

Fig. 7. *M. gieysztori* mihi. Terminus of penis-stilette. (After Gieysztor 1931, pl. 13, fig. 5.)

The penis-stilette in this *Macrostomum* (Fig. 7) is almost straight and is terminally curved in weakly pressed specimens. There are two flanges in the curved termination, the one on the convexity of the curve being longer than the one on the concavity of the curve. Thus it

[2] The animal described by Gieysztor as *M. gracile* Pereyaslawzewa is given the name of *M. gieysztori* mihi in this work.

appears that this stilette, inwhich four lateroterminal borders may be seen, is cut in bias. The length of the stilette ranges from 50 μ to 130 μ.

The sperm cells are long and large. They appear to be curved in a spiral. They are gradually reduced in one end of the cell to a point, while this reduction in the other end is abrupt. When they contact water a deformity is produced which makes the two lateral setae more apparent. These sperm cells are possessed of constant violent movements.

The ovaries are distinctly lobed.

Taxonomically, GIEYSZTOR had confused this new form with *M. graffi* mihi (*M. gracile* PEREYASLAWZEWA). GIEYSZTOR, in the very laudable work from which the above description was taken (GIEYSZTOR, 1931, p. 83), refers both to the work of PEREYASLAWZEWA on *M. gracile* PEREYASLAWZEWA and VON GRAFF upon *M. graffi* mihi (*M. gracile* PEREYASLAWZEWA); "Quoique ce dernier auteur (VON GRAFF) ait décrit insuffisante, je veux considérer les vers trouvés près de Valence comme appartenant à l'espece *M. gracile* PEREYASLAWZEWA". Thus, it is seen that a comparison between the original description of *M. gracile* PEREYASLAWZEWA and the presently described *M. gieysztori* mihi would be expedient:

(1) GIEYSZTOR (1931, p. 132) remarks on the similarity of the body form of the Spanish species and that of *M. appendiculatum* (O. FABR.), yet *M. appendiculatum* (O. FABR.) as shown by VON GRAFF (1882), VON GRAFF in BRONN (1908, Taf. XVIII, Fig. 12) and by FERGUSON (1937, Textfig. 6) does not compare with the original drawing of *M. gracile* PEREYASLAWZEWA in PEREYASLAWZEWA (1902, Fig. 17).

(2) GIEYSZTOR (1931, p. 132) notes the presence of cilia and fine long sensory hairs for the Spanish form while in comparison *M. gracile* PEREYASLAWZEWA does not have sensory hairs and is possessed of numerous distinct posterior "Haftpapillen".

(3) GIEYSZTOR (1931, p. 132) remarks on the presence of a false vesicula seminalis in the Spanish form which *M. gracile* PEREYASLAWZEWA does not have.

(4) GIEYSZTOR (1931, pp. 132, 133) shows both vesicula seminalis and vesicula granulorum to be housed in a single muscular tunic in the Spanish form. This is not true of *M. gracile* PEREYASLAWZEWA.

(5) GIEYSZTOR (Fig. 7) depicts the stilette of the Spanish form to be an almost straight tube, which is terminally curved and is possessed of two partitions, which produce four thickened borders of the stilette end. This stilette differs radically from that of *M. gracile* PEREYASLAWZEWA, which is a curved funnel with a widened indented base and an oblique terminal truncation (Fig. 21).

Thus it is shown that the Spanish *Macrostomum* of GIEYSZTOR is new to the literature, and as such receives the name of *M. gieysztori* mihi in honor of Dr. M. GIEYSZTOR, upon whose description this section is based.

Species Diagnosis.

Macrostomum gieysztori new species: Body shape resembles that of *M. appendiculatum* (O. FABR.), epidermal ciliation includes only cilia and long sensory hairs, "Haftpapillen" absent, false vesicula seminalis present, both vesicula seminalis and vesicula granulorum are housed in single muscular tunic, disposition of male sex organs comparable to that of *M. viride* BENEDEN, penis-stilette is almost straight tube with two curved terminal partitions producing four distinct widened borders, sperm cells large and elongate with lateral pair of setae, ovaries lobed, colorless body exceeds 1 mm.

Macrostomum gilberti mihi.

Macrostomum gilberti mihi is found in the springs and streams of the Whittle Springs community, Knox County, Tennessee[3].

This *Macrostomum* has an unusually slender body (Fig. 8) and extended tail region. The average length of the animal is 1 mm. It is colorless except for the color of the enteric contents.

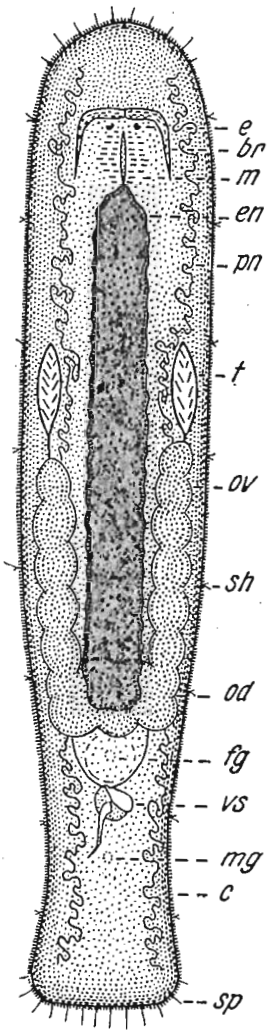
The epidermis is provided with rhabdites of a short and stubby nature, generally disposed in groups of two, four and eight. A large number of finely granulated cells (Fig. 9) are to be found in the cephalic epidermis. This type of cell has been noted in *M. ruebushi* var. *granulophorum* mihi. Spines, sensory hairs and cilia make up the epidermal ciliary complement. The small reniform eyes are not embedded in the tissues of the ganglia composing the "brain".

The anatomy of the digestive system corresponds to that found in the majority of other *Macrostomum*. The extreme small size of the protonephridial system did not allow of satisfactory observation.

The mesial and lateral walls of the testes are smooth in contour. The vasa deferentia and vesicula seminalis are regular in structure. The ductus ejaculatorius opens into the four ciliated chambers of the spheroidal vesicula granulorum (Fig. 10). The penis-stilette is a long, curved funnel which extends from a widened proximal base to end in a slightly bent obliquely truncated terminus. The degree of curving in the tube of the stilette is never as much as 90°. The stilette measures 72 μ in length. The stilette termination (Fig. 10) is distinctly provided with a thin lip which projects slightly beyond the opening proper. There is a high degree of coarse crenation in the proximal part of the penis-stilette. The lips of the male gonopore, into which the stilette is directed, are ciliated.

[3] This species of *Macrostomum* is named in honor of Dr. CHAUNCEY MCLEAN GILBERT of the Miller School of Biology, University of Virginia.

The sperm cell in this form is a spindler-shaped (Fig. 12) structure which is much shorter than usual for *Macrostomum*, measuring about 28 μ in length. Chromatin granules are present in the anterior region of the cell, while posteriorly directed setae are ab-



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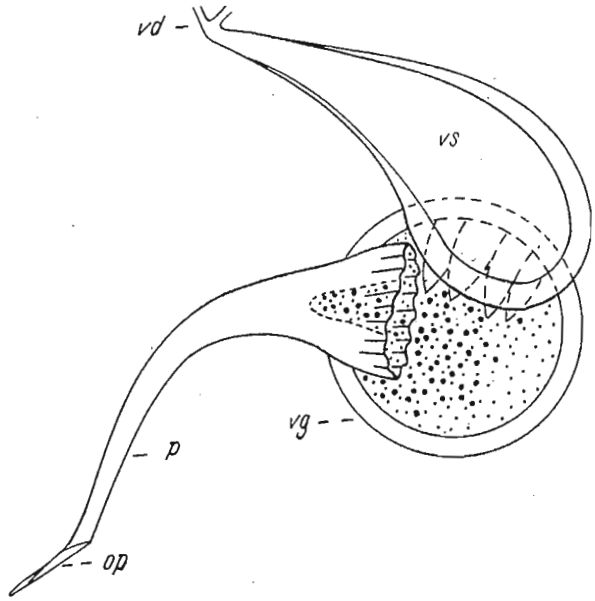

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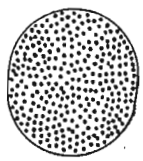

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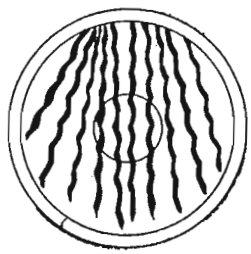

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Fig. 8. *M. gilberti* mihi. Dorsal view of gross anatomy. 105 ×.
Fig. 9. *M. gilberti* mihi. Epidermal inclusion. 780 ×.
Fig. 10. *M. gilberti* mihi. Dorsal view of male sex apparatus. 105 ×.
Fig. 11. *M. gilberti* mihi. Sperm-cells attached to fore wall of female genital atrium. 480 ×.
Fig. 12. *M. gilberti* mihi. Mature sperm-cell. 1020 ×.

sent. Sperm are usually thickly massed on the antero-dorsal wall of the genital atrium (Fig. 11).

Taxonomically, this species has no near relative which has been recorded in the literature.

Species Diagnosis.

Macrostomum gilberti new species: Body very slender with long tail region, testes with smooth walls, four ciliated chambers in vesicula granulorum, sperm cells are small, spindle-shaped and lack setae, oblong granular inclusion

cells in cephalic epidermis, penis-stilette has greatly widened proximal base which narrows as the tube undergoes a long, graceful curve to terminate in a slightly bent point with a small lip projecting beyond opening proper; body length 1 mm.

Paratype: U. S. N. M. No. 20464.

Macrostomum glochistylum mihi.

Macrostomum glochistylum mihi lives in the cold, spring-fed swamps of Milam Gap, Skyline Drive, Greene County, Virginia, at an altitude of about 3500 feet. The animal is collected in masses of green algae.

The body is boat-shaped (Fig. 13) and has the characteristic *Macrostomum* spatulate tail. Both ends are blunted. The animal is small, averaging .8 mm. by .2 mm. There is no color except for that given by the sex organs.

Rhabdites are numerous in the epidermis where they occur in either groups of two and three, or in larger groups of six to nine. The rhabdites measure 12 μ by 1 μ. Sensory hairs, spines and cilia adorn the epidermis. Sensory hairs are arranged in tufts over the body surface and range in length from that of cilia length to that of spine length (10 μ). The spines are located at the body extremities.

The "brain" and eye structure are typical for the genus. The reniform eyes are not embedded in "brain" tissue (Fig. 13, *e*).

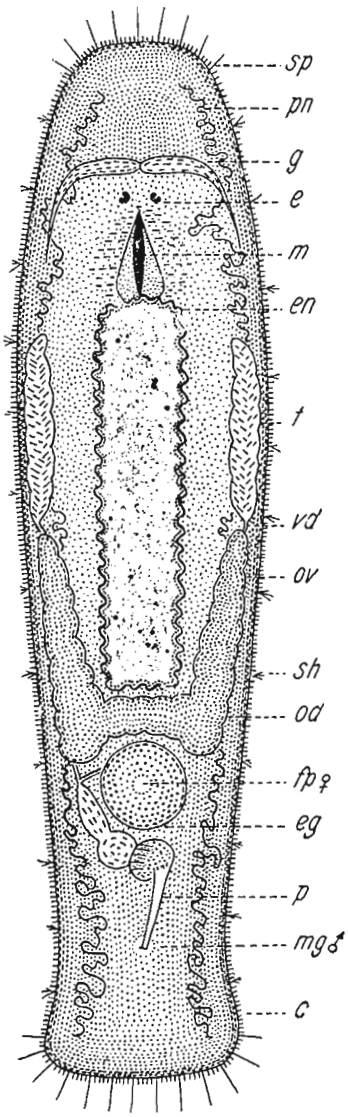
The region of the mouth (Fig. 13, *m*) is peculiar in that the pharyngeal cavity is always in evidence as a result of the unusually strong development of the pharynx simplex. This structure assumes a triangular shape in optical section (Fig. 1 Part II). The enteron is short and rod-like and is well supplied with small, lateral, temporary diverticula.

The excretory system is typical of *Macrostomum*. Its external opening was not located.

The testes are large, sac-like structures occupying a lateral mid body position. Both mesial and lateral walls are slightly indented. The vasa deferentia unite just posterior to the left oviduct (Fig. 13) to enter the vesicula seminalis. The false vesicula seminalis is enormous in this form; occasionally it is found to be as long as the entire remainder of the male sex apparatus. The vesicula granulorum is located in an median position of the same plane with the vesicula seminalis. In this form the vesicula granulorum does not contain the ciliated chambers so common to this structure but small triangular crypts which are filled with granular material. Glandular cells, which contain the same type of granule as that

found in the vesicula granulorum, lie in follicular masses dispersed over the entire posterior body region. Presumably, these are the accessory glands to the vesicula granulorum.

The penis-stilette (Fig. 14), extending from the vesicula granulorum, maintains a position ventral to both this structure and the



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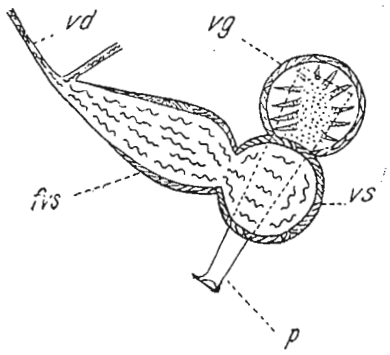

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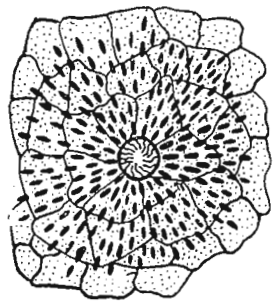

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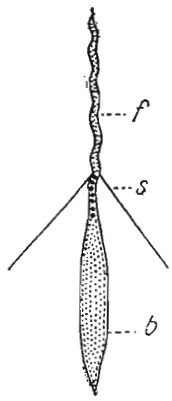

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Fig. 13. *M. glochostylum* mihi. Dorsal view of gross anatomy. 120 ×.
Fig. 14. *M. glochostylum* mihi. Dorsal view of male sex apparatus. 300 ×.
Fig. 15. *M. glochostylum* mihi. Penis-stilette. 60 ×.
Fig. 16. *M. glochostylum* mihi. Mature sperm-cell. 1200 ×.
Fig. 17. *M. glochostylum* mihi. Ventral view of female gonopore showing "Stäbchen". 420 ×.
Fig. 18. *M. glochostylum* mihi. Somatic chromosomes. 3000 ×.
Fig. 19. *M. glochostylum* mihi. Germinal chromosomes. 4000 ×.

vesicula seminalis in some cases. The more normal position for the penis-stilette is shown in Fig. 13. The stilette has the form of the typical *Macrostomum* funnel which contains a widend crenate base and which narrows to quite an unorthodox termination (Fig. 15). The opening is terminal and is limited by a turned up and shar-

pened margin. The stilette is unusually long (64 μ) for the body length. The male gonopore has ciliated margins.

The sperm-cell is long and contains a feeler, a pair of latero-posteriorly directed setae and a body region. A definite tail region, common to cells of this type, is lacking. This cell, which measures 51 μ by 2 μ, contains a moniliform series of chromatic granules (Fig. 16).

The female sex apparatus does not possess deviations from the normal which would warrant a specific discussion. The radiating system of glandular bodies accessory to the female genital atrium is shown in Fig. 17.

Both somatic (Fig. 18) and germinal (Fig. 19) plates have been studied with reference to the chromosome morphology. The $2n$ spermatogonial complement (Fig. 19) displays a large slightly bent pair, a medium sized horse-shoe-shaped pair, and a smaller V-shaped pair of chromosomes. It is interesting to note the difference in size between the somatic and germinal chromosomes.

The taxonomic position of *M. glochistylum* mihi is unique in that the present literature upon the genus does not afford a description of a species which compares with that of this animal.

Species Diagnosis.

Macrostomum glochistylum new species: Body is boatshaped, pharynx simplex strongly developed, penis-stilette is an elongated funnel with an expanded blunted termination and is located ventral to the vesicula seminalis and vesicula granulorum, chromosome morphology is peculiar to this species, body length up to .8 mm.

Paratype: U. S. N. M. No. 20437.

Macrostomum gracile Pereyaslawzewa.

1902. *Macrostoma gracile*, Pereyaslawzewa in: Zap. Novoross. Obsch. **17** (3) 243, t. 3, f. 17.

1905. *Macrostomum gracile* (?), L. Graff in: Z. wiss. Zool. **83**, 81, t. 2, f. 2.

1905. *Macrostoma gracile* (?), A. Luther in: Zur Kenntnis der Gattung Macrostoma. Festschrift für Palmén. N. 05. Helsingfors., pp. 28—37.

1908. *Macrostomum gracile* (?), L. Graff in: Bronn, H. G., Klassen und Ordnungen des Thier-Reichs, wissenschaftlich dargestellt in Wort und Bild. **4**, Vermes, Abt. Ic: Turbellaria, pp. 2568, 2590.

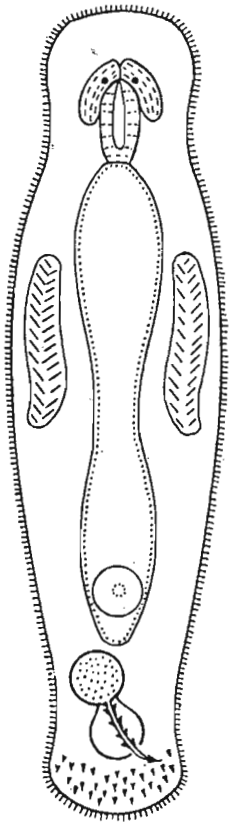
1913. *Macrostomum gracile* (?), L. Graff in: Tierreich. Turbellaria II. Rhabdocoelida. Berlin, p. 50, f. 53.

1931. *Macrostomum gracile* (?), M. Gieysztor in: Contribution à la connaissance des Turbellariés Rhabdocèles (Turbellaria Rhabdocoela) d'Espagne. Bull. intern. Ac. Polon., Sér. B, Sci. nat. (**11**), 132, pl. 13, f. 5.

Macrostomum gracile Pereyaslawzewa is found living in the waters of the Black Sea at Sebastopol, Crimea. Dr. Sophie Pereyaslawzewa, in

describing this form in 1902, did not give an accurate or adequate presentation of the morphological details of the animal. While the scanty written description in PEREYASLAWZEWA (1902, p. 243) does not compare with contemporary taxonomic standards, it must be said that (Fig. 17) of that publication is far above the average. This latter figure, as copied by the author (Fig. 20), confirms the statement of PEREYASLAWZEWA (1902, p. 243) that the enteron is partially obscured by the presence of a large egg. With the exception of the reference to the vesicula seminalis, vesicula granulorum and the penis-stilette, there is little else to the original description of *M. gracile* PEREYASLAWZEWA. The body of this form is divided into cephalic, mid-body and spatulate tail regions. The bi-ganglionic "brain" and eyes are distinctly figured (Fig. 20).

A very peculiar stomatal arrangement is provided in that the slit-like mouth, which opens abruptly into the ciliated enteron, seemingly negates the structure of the pharynx.



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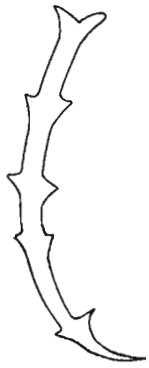


21.

Fig. 20. *M. gracile* Pereyaslawzewa. Gross anatomy. (After Pereyaslawzewa, 1892, fig. 18.)
Fig. 21. *M. gracile* Pereyaslawzewa. Penis-stilette. (After Pereyaslawzewa 1892, fig. 18.)

The entire body surface is ciliated. Apparently there are no sensory hairs or spines. The spatulate tail region is provided with numerous "Haftpapillen" (Fig. 20).

The male sex apparatus is composed of testes, vasa deferentia, vesicula seminalis, vesicula granulorum, accessory gland cells and penis-stilette. The testes are large, elongate structures located laterally (Fig. 20). The vesicula seminalis (Fig. 20) is a large pyriform structure which lies medially and just posterior to the female gonopore (Fig. 20). The vesicula granulorum (Fig. 20) is an egg-shaped organ, directly communicating with the vesicula seminalis anteriorly and the penis-stilette posteriorly. There are numerous longitudinal rows of granular masses in this structure, which receive this material from several lateral accessory glands at the region of the ductus ejaculatorius (Fig. 20). The penis-stilette is a slightly curved funnel with a widened base which is deeply indented. The external opening is terminal (Fig. 21). The above description was taken from PEREYASLAWZEWA (1902).

Species Diagnosis.

Macrostomum gracile PEREYASLAWZEWA: Body has rounded cephalic region, a widened mid-body and a "Haftpapillen" supplied tail region, epidermal ciliation includes only cilia, mouth opens directly into anterior enteron, no distinct pharynx, testes one-fourth of body length, egg unusually large, pyriform vesicula seminalis, oval vesicula granulorum, penis-stilette a curved funnel with indented base and terminal opening.

Macrostomum graffi mihi[4].

1905. *Macrostomum graffi* mihi (*M. gracile* PEREYASLAWZEWA), L. GRAFF in: Z. wiss. Zool. 83, 81, t. 2, f. 2.

1913. *Macrostomum graffi* mihi (*M. gracile* PEREYASLAWZEWA), L. GRAFF in: Tierreich. Turbellaria II. Rhabdocoelida. Berlin, p. 50, f. 53.

This Black Sea form resembles *M. appendiculatum* (O. FABR.) in body shape. The length of this colorless animal is slightly over 1 mm. The anterior end is blunt and is provided with individual sensory hairs down to the level of the mouth. The spatulate posterior is provided with numerous "Haftpapillen". The entire body surface is provided with packets of rhabdites containing from three to seven rhabdites, each of which is about 6 μ in length.

The small black eyes are located laterally to the anterior end of the mouth and are approximately one-fourth of the body with apart and about one-seventh of the body length from the anterior extremity of the body.

The enteron is ciliated and finely diverticulated laterally. The food content gives this structure a gold-to-black color.

The testes are tubular and elongate. They are located behind the mouth and are gradually reduced posteriorly to empty into the vasa deferentia, which communicates caudally with the vesicula seminalis. The testes are one-half as long as the distance from the pharynx to the posterior end of the animal. The vesicula seminalis and vesicula granulorum are regular in their anatomy. A false vesicula seminalis may be present.

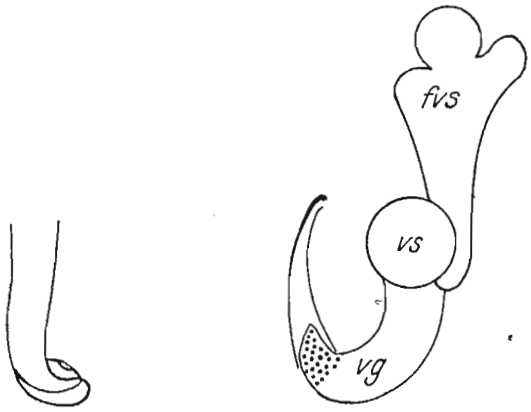
The penis-stilette is almost straight (Fig. 22) and is a funnel extended to a termination which is somewhat bent. The opening is in the convexity of this peculiar stilette end, in which a gradually thickening distal curved wall encircles the opening papilla (Fig. 22).

The sperm cells resemble those of *M. appendiculatum* (O. Fabr.) as figured in GRAFF (1882, Taf. IV, Fig. 6). They are described as being very thin and threadlike.

[4] The animal known to VON GRAFF (1905) as *M. gracile* PEREYASLAWZEWA is herein given the name of *M. graffi*.

The ovaries lie posterior to, and ventral to the posterior end of the testes.

Taxonomically, VON GRAFF confused this form, which he had taken in the Black Sea, with that of *M. gracile* PEREYASLAWZEWA, which is found in the same habitat. A comparison of the original descriptions and appended



22. 23.

Fig. 22. *M. graffi* mihi. Lateral view of terminus of penis-stilette. (After Graff 1913, p. 50, fig. 53.)
Fig. 23. *M. infundibuliferum* Plotnikow. Male sex apparatus. (After Plotnikow 1905, fig. 7.)

figures of these two forms shows there is a great specific dissimilarity, especially with reference to the morphology of the respective penis-stilettes of these two species.

The stilette of *M. gracile* PEREYASLAWZEWA is a funnel with a widened, greatly indented proximal and basal portion and a curving distal region of the genital canal which terminates in a simple oblique truncation (Fig. 21). In contrast, the penis-stilette of the form which VON GRAFF studied (Fig. 22) is composed of a relatively narrow funnel with non-indented proximal region. The genital tube is almost straight up to its termination. It has a thickened forewall and an external opening located in the convexity of its curve and upon a terminal papilla. Since the literature, neither at the time of VON GRAFF'S work nor at the present writing, contains a species which compares with this one, it is presented as a new species honoring its discoverer, Dr. LUDWIG VON GRAFF. This description was taken from the references noted above.

Species Diagnosis.

Macrostomum graffi new species: Body shape resembles that of *M. appendiculatum* (O. FABR.), posterior "Haftpapillen", penis-stilette almost straight funnel with thickened basal end, opening is in convexity upon terminal papilla, sperm cells thinly filamentous, ovaries posterior to and ventral to testes, marine form, body length up to 1 mm.

Macrostomum infundibuliferum PLOTNIKOW.

1905. *Macrostoma infundibuliferum*, PLOTNIKOW in: Zool. Jb. Syst. **21**, 480, t. 25, f. 7.

1905. *Macrostoma infundibuliferum*, A. LUTHER, pp. 28—37.

1913. *Macrostomum infundibuliferum*, L. v. GRAFF, p. 52.

This Siberian *Macrostomum* may be found in the waters of the community

of Korobeinikowo (35 km. from Elizabethinsky-Fabrik) in Tomsk. Three specimens were studied by PLOTNIKOW in the original description of *Macrostomum infundibuliferum* PLOTNIKOW.

The body of this animal is planoconvex in cross-section. The anterior end is broadly rounded and there is a spatulate tail region, much as in *M. appendiculatum* (O. FABR.). The disposition of the sensory hairs, of the groups of rhabdites, and of the eyes compares also with that of the last named species. The animal measures up to 2 mm. in length.

A large false vesicula seminalis (Fig. 23, *fvs*) is accessory to the spherical vesicula seminalis which communicates with the larger vesicula granulorum. There is a concentration of granular material in the base of the penis-stilette which is appended to the granulorum. This stilette (Fig. 23) is a gradually curved funnel which extends from a smoothly rimmed proximal portion to terminate in a curved end. The outer convex distal wall of the stilette is longer and thicker than the inner concave wall.

VON GRAFF in 1913 expressed the opinion, which this author does not share, that *M. infundibuliferum* PLOTNIKOW is a variety of *M. orthrostylum* BRAUN. The above description was taken from PLOTNIKOW (1905).

Species Diagnosis.

Macrostomum infundibuliferum PLOTNIKOW: Body shape resembles that of *M. appendiculatum* (O. FABR.), plano-convex in cross section, sensory hairs, rhabdites present, false vesicula seminalis appended to spherical vesicula seminalis, penis-stilette is a gradually curved funnel with smooth rimmed base and a curved termination in which the outer convex wall is thickened, body length up to 2 mm.

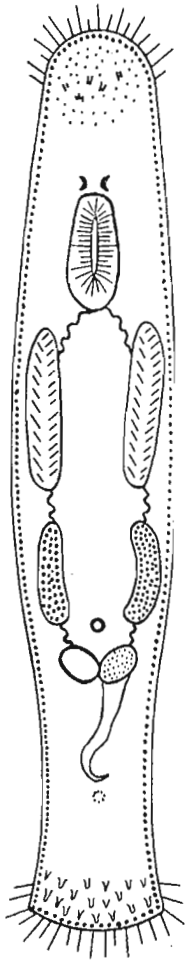
Macrostomum intermedium TU.

1934. *Macrostomum intermedium*, T. J. TU in: Sci. Rep. Tsing Hua Univ., Ser. B, 1 (6), 194, 199, pl. 1, f. 2.

Macrostomum intermedium TU lives in the fresh water pools of the Tsing Hua campus, Tsing Hua University, China. It may be collected at any season of the year but is only found to be sexually mature in the winter. These animals are slow moving forms and have not been seen to swim. They have the ability to withstand radical changes in their environment, such as lowering of the pH in the aquaria.

The animal, which measures up to 2 mm. in length, has a slender body with a spatulate tail (Fig. 24). The color is milky white. The rhabdites are quite numerously spread over the body surface. Sensory hairs and cilia are present. "Haftpapillen" are located upon the spatulate posterior surface.

The morphology of the "brain" is not given, while the eyes (Fig. 24) are described as reni-form and located close to the pharyngeal wall. The mouth is unusually long, occupying about one-half of the pharyngeal cavity. This extensive cavity communicates with the laterally diverticulated enteron. The glandular tissue and the excretory system are undescribed.



24. 25.

Fig. 24. *M. intermedium* Tu. Gross anatomy. 42 ×. (After Tu 1934, pl. I, fig. 2.)
Fig. 25. *M. intermedium* Tu. Penis-stilette. 165 ×.

The component parts of the male sexual apparatus are regular in their morphology. The vesicula seminalis and the vesicula granulorum occupy the same plane in the posterior body. The penis-stilette (Fig. 25) is a curved and distally hooked funnel with a terminal opening. This stilette measures about 225 μ in length. The sperm cells have not been described.

Species Diagnosis.

Macrostomum intermedium Tu: Body slender, rounded anterior end, spatulate posterior end, milky white in color, rhabdites, sensory hairs, "Haftpapillen" and cilia present, eyes small, reniform, pharynx unusually long, vesicula seminalis and vesicula granulorum in same plane, penis-stilette is greatly curved and hooked funnel, opening distal, length 225 μ, body length up to 2 mm.

Macrostomum japonicum Okugawa.

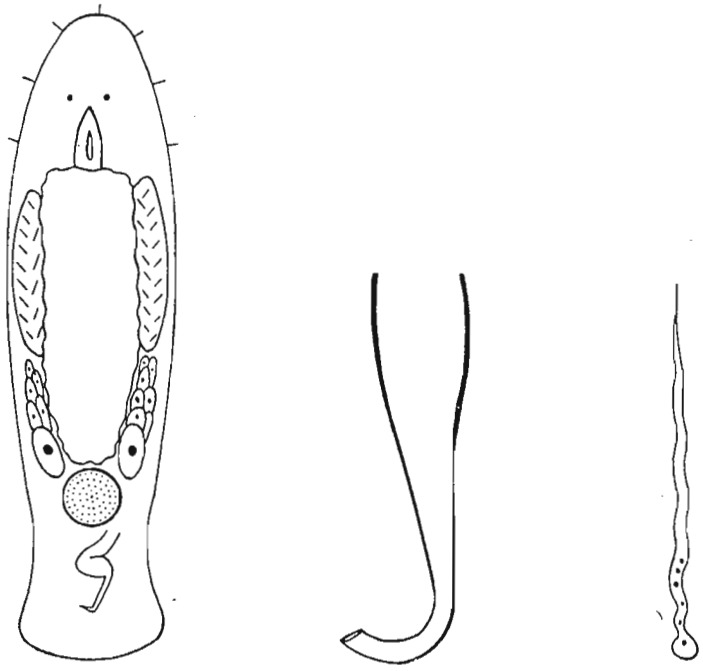
1930. *Macrostomum japonicum*, K. Okugawa in: Mem. Coll. Sci. Kyoto, Ser. B, 5 (1), 75—88, 79, f. 10—13.

Numerous specimens of *Macrostomum japonicum* Okugawa may be found in the lakes, ponds, and pools of middle Japan in August and September.

This darkly colored animal (Fig. 26) has the typical anterior rounded, spatulate posterior shape found in the genus. It is more cylindrical than *M. kawamurai* Okugawa (Fig. in part VII). It measures 2 mm. by .4 mm.

Epidermal rhabdites are dispersed over the body surface in groups of twos and sixes. They are smaller and more compactly disposed than those of *M. kawamurai*. The ovaries are lobed.

The vesicula seminalis (Fig. 26) is large in proportion to the vesicula granulorum (Fig. 26). The penis-stilette (Fig. 27) is long and slender with a somewhat undulant main axis. It is terminally bent at right angles in a semi-circle. The walls of the main axis are



26. 27. 28.

Fig. 26. *M. japonicum* Okugawa. Gross anatomy. (After Okugawa 1930, pl. III, fig. 10.)
Fig. 27. *M. japonicum* Okugawa. Penis-stilette. (After Okugawa 1930, pl. III. fig. 12.)
Fig. 28. *M. japonicum* Okugawa. Sperm-cell. (After Okugawa 1930, pl. III, fig. 12.)

thicker than those of the termination. This stilette, which measures 170 μ in length, has a small circular external opening (Fig. 27).

The sperm cell is a thin filament with a small knobbed head containing granules. Setae are lacking in this cell. It is this present author's opinion that OKUGAWA has depicted an immature sperm cell (Fig. 28).

The above description has been taken from the original work of OKUGAWA (1930) upon *M. japonicum* OKUGAWA.

Species Diagnosis.

Macrostomum japonicum OKUGAWA: Body anteriorly rounded with spatulate tail, rhabdites compactly disposed in groups of twos and sixes, ovaries lobed, penis-stilette is long and slender funnel terminally bent in right angle with circular opening at distal end (170 μ in length), sperm cell is slender filament with knobbed anterior end, body length up to 2 mm.