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 MONOGRAPH OF THE MACROSTOMINE WORMS
OF TURBELLARIA

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This work is synoptic and presents, for the first time, a summary of the taxonomy of the worm family Macrostomidae (Archoophora; Turbellaria). All members of this family are relatively small, free-living inhabitants of a wide range of waters. They live in the protection of aquatic vegetation, bottom debris, or in the sands of many types of marine, brackish, and fresh water. Although they are capable swimmers, most specimens are taken from the bottom mud and vegetation, and are not commonly collected by plankton nets.

The lower turbellarians are little known to the average zoologist, because of their small size and the requirements of special microscopic and histologic techniques necessary to diagnose them. Taxonomic studies are generally based on numerous living paratypic specimens which are held in place by slight coverslip compression for microscopic examination. By this method the complicated sexual apparatus may be investigated. Determinations made only on fixed histological materials are much more difficult, and may not be adequate for the depiction of hyaline chitinoid structures in the sexual organs.

Macrostomines, as well as most other lower members of Turbellaria, are of interest in morphology and evolution because of their transitory position from free-living to parasitic forms, and because of the variations in the anatomy of the sexual apparatus. Specialists are attracted also to cytological and physiological studies of these worms.

Recent findings of complex systems in such genera as *Paromalostomum* (Ax, 1951a, 1952), *Dolichomacrostomum* (Luther, 1947; Marcus, 1950), and *Myozona* (Marcus, 1949) make it difficult to generalize upon the functions of the various organs in these macrostomines. Some morphological characteristics are discussed first while range in size, general

shape, and body colors are dealt with under generic headings. Other details may be obtained from the references in Table I.¹

Ciliation of the enteric canal, the female tract and the outer body is a common feature, although *Myozona* lacks cilia in the caudal area. There are no true ciliary pits, as in closely related microstomines. Sensory hairs and sensory spines, of varying length and stiffness, are found on the epidermis, principally at the body extremities. There are no unusual features of the central nervous system or the eyes.

The epidermis is well supplied with rhabdites, which are adenal, and probably function as temporary holdfasts. The function of the related streamers of rhammiten in cephalic areas is unknown. The alimentary glands pour their products into various reaches of the enteric tube, especially the pharynx. Many other glands are accessory to the sexual apparatus (exclusive of the genetic functions of the gonads) such as; the adenal structure of the vesicula granulorum with its appended glands, the glandular nature of parts of the bursa copulatrix (of which the function is unknown), and the glands connected to the genital atria. Haftpapillen are adhesive outgrowths of epidermis in the posterior body and while they are not glandose in *Macrostomum* (Ferguson, 1939-1940) they may be in other genera.

The alimentary canal of macrostomines is incomplete, consisting of mouth, pharynx and enteric sack. The posteriorly appended tube in some genera (the ductus-genito-intestinalis) is definitely not a part of the digestive tract from a functional standpoint. The complex structure of the enteric system of *Myozona* is unique in the group. No other macrostomine possesses the masticating structure ("gizzard") of these South American worms (Fig. 30).

Excretion is thought to be a function of paired lateral protonephridia, in which there is no unusual development. External openings are typically dorsal in an antero-lateral position in *Macrostomum*, and are very difficult to locate.

The sexual anatomy in the lower genera, *Macrostomum*, *Archimacro-stomum* (Ferguson, 1937b; Jones, 1944; Marcus, 1952), *Inframacrostomum* (Ax, 1951a), *Protomacrostomum* (Steinböck, 1935), and *Paramacrostomum* (Riedel, 1932), is relatively simple. The typical male system consists of bilaterally placed testes, vasa deferentia, a vesicula seminalis, a vesicula granulorum, a copulatory penis stilette and a male gonopore. The female tract generally is comprised of one, or two ovaries, an oviduct or ducts, a genital atrium, and a female gonopore surrounded by accessory glandose cells. The principal variation in such structures will be found in the morphology of the so-called chitinous stilette. The remaining genera, *Paromalostomum*, *Dolichomacrostomum*, *Karlingia* (Marcus, 1948), *Axia* (Papi, 1951), *Promacrostomum* (An-der-Lan, 1939), and *Myozona*, have relatively complex female systems which are characterized by having from one to three external openings, a bursa copulatrix in some cases which may unite with a female antrum via a ductus spermaticus, and with the common genital atrium via the bursastiel. In some forms a definite bursa copulatrix is questionable, while in some a weakly developed bursa intestinalis occurs. The oviduct is lacking (or has

¹The references selected consist of approximately one-half of the existing works. Those excluded are principally concerned with geographic distribution and ecology of macrostomines.

not been detected) in certain forms. In the more highly developed forms the male system may have but a single testis. The copulatory organ may consist of a principal and a secondary tube, both being of complex construction.

Cross-fertilization appears to be routine in macrostomines, although some of the higher forms apparently are equipped also for auto-fecundation.

These worms are known through the researches of a small group of persons² working principally in the Americas and Europe. Since the publication of the monograph on the type genus in 1939-1940 (Ferguson, 1939-1940), special impetus has been given in recent years by the valued works of Dr. Hyman in North America; Dr. Marcus in South America; Drs. Luther, Ax, Karling, An-der-Lan, Gieysztor and Papi in Europe.

This review, and rectification of certain segments of the taxonomy of the group is based upon the thesis that the morphology of the sexual organs (which combine both male and female apparatus) is of basic importance to intrageneric differential diagnosis. Other anatomical structures are considered to be subsidiary. Strict adherence to this central theme may avoid taxonomic chaos in the study of the approximately one hundred species involved (Table I). Important taxonomic papers include: Braun, 1885; Bresslau, 1933; Claprede, 1883; Duges, 1828; Ferguson, 1939-1940; Graff, 1904-1908, 1913; Karling, 1940; Kukenthal and Krumbach, 1933; Marcus, 1948; Meixner, 1938; Okugawa, 1932; Papi, 1951; Schmidt, 1848.

SYSTEMATICS

Phylum Platyhelminthes, Gegenbaur, 1859

Class Turbellaria, Ehrenberg, 1831

Order Archoophora, Karling, 1940

Sub-order Macrostomida, Karling, 1940 (Macrostomida, Meixner, 1924; Opisthandropora, Bresslau, 1928-1933)

Macrostomidae Van Beneden, 1870

Genera: *Omalostomum* (Van Beneden, 1870)

Paromalostomum Meixner (in Ax, 1951)

Archimacrostomum New Genus

Inframacrostomum New Genus

Macrostomum O. Schmidt, 1848

Paramacrostomum Riedel, 1932

Promacrostomum An-der-Lan, 1939

Axia New Genus

Pro macrostomum Steinböck, 1935

Dolichomacrostomum Luther, 1947

Karlingia New Genus

Myozona Marcus, 1949

²The author expresses deepest appreciation for assistance from these co-workers: Dr. Alex. Luther (Zoological Station, Tvarminne, Finland), Dr. Von Peter Ax (Zoological Institute, University of Kiel, Germany), Dr. Floriano Papi (Zoological Institute, University of Pisa, Italy), Dr. Hannes An-der-Lan (Zoological Institute, University of Innsbruck, Austria), Dr. Marian Gieysztor (Zoological Institute, University of Warsaw, Poland), Dr. Tor Karling (Museum of Natural History, Stockholm, Sweden), Dr. Ernst Marcus (Zoology Department, University of Sao Paulo, Brazil), Dr. E. R. Jones, Jr. (Zoology Department, University of Florida, Gainesville, Florida), Dr. Libbie Hyman (American Museum of Natural History, New York), and Dr. William Kepner (Biology Department, University of Virginia, Charlottesville, Virginia). New genera are named in honor of Drs. Ax and Karling in this work.

Order: Archoophora.

Small turbellarians typically with a rod or sack-shaped enteron, but occasionally with a lobed and/or branched enteron, or with parenchymatous digestion. Mouth simple, or with a pharynx simplex, or pharynx plicatus. Eggs entolecithal. Testes primarily follicular or compact. Ovaries follicular, or compact with vitellaria lacking. Male gonopore always present. Female sexual organs lack accessory apparatus and auxiliary elimination pathways (of sexual products).³ However, there is a sperm receiving vagina connected with a bursa, or a separate common genital atrium discharging the female functions.

Sub-order: Macrostomida.⁴

Archoophora with epitheliated intestine and pharynx simplex. Nervous system with cerebral ganglia and longitudinal nerve cords. Paired protonephridia. Statocyst lacking. The male genital apparatus opens externally (posterior to the female genital apparatus) separately, or from a common genital atrium. With vagina interna or vagina externa. Inhabitants of marine, brackish, and fresh waters.

Family: Macrostomidae.

Archoophorans without preoral enteric blind sack. Posterior end of body generally broadened into an adhesive disk. Ovaries paired (with exception of genus *Omalostomum*). Development sexual (as opposed to zooid formation in microstomines).

GENERIC KEY⁵

1. With pre-oral enteric cecum; reproduction sexual, or asexual (zooidal)..... 2. Microstomidae
Without pre-oral enteric cecum; sexual reproduction only..... 3
2. With papilliated evaginated anterior proboscis..... *Alaurina* Busch, 1851
Without papilliated evaginated anterior proboscis..... *Microstomum* O. Schmidt, 1848
3. Male gonopore anterior to female gonopore; with anterior proboscis.....
Haplopharyngidae Meixner, 1938
Male gonopore posterior to female gonopore, or with common gonopore;
proboscis lacking..... 4. Macrostomidae
4. Mouth terminal..... *Protomacrostromum* Steinböck, 1935
Mouth ventral..... 5
5. Mouth anterior to the brain; eyeless..... *Omalostomum* (Van Beneden, 1870)
Mouth posterior to brain..... 6
6. Female gonopore separate from male gonopore..... 7
Common gonopore; bursa copulatrix united with common genital atrium via
the bursastiel and with the antrum femininum via the ductus spermaticus
..... *Paromalostomum* Meixner, 1938
Common gonopore; with organ resembling a bursa copulatrix, single or paired
ovaries, but without antrum femininum and ductus spermaticus.....
Dolichomacrostromum Luther, 1947

³For a comparative statement note this passage from the original (Karling, 1940): "Dem (female) Apparat fehlen alle Hilfsapparate und Ausführungsgänge oder aber ist eine das Sperma aufnehmende Vagina mit angeschlossener Bursa oder ein entweder getrennt oder in ein Atrium commune mündender (female) Ausführungsgang vorhanden."

⁴Based on a translation of correspondence on subject with Dr. Tor G. Karling, July, 1952.

⁵Based on key to Order Macrostomida Meixner, 1924, p. 19, and 1938, p. 3. Note reference to related families: Microstomidae and Haplopharyngidae (Meixner, 1938).

- Common gonopore; with definite bursa copulatrix, but without antrum femininum and ductus spermaticus; single gonads, single male copulatory organ of simple construction.....*Karlingia* New Genus
7. External opening to ductus-genito-intestinalis anterior to female gonopore; with three external openings to sex apparatus.....*Promacrostomum* Ander-Lan, 1939
 Without ductus-genito-intestinalis, but otherwise as above....*Axia* New Genus
 Without separate external opening as above, but with primitive bursa-genito-intestinalis; with two external openings to sex apparatus...*Myozona* Marcus, 1949
 Only female and male gonopores present; no sexual-digestive system union.... 8
8. Enteron simple; male-female systems complete...*Macrostomum* O. Schmidt, 1848
 Enteron simple; male system incomplete.....*Archimacrostomum* New Genus
 Enteron simple; female system incomplete.....*Inframacrostomum* New Genus
 Enteron complex with anterior and postero-lateral branching.....*Paramacrostomum* Riedel, 1932

TAXONOMIC REVISIONS

This section gives general instruction on differential characters by illustrations of a well described species from each genus with pertinent notes on the biology, and presents certain figures explaining the realignment and placement of species. Table I contains a complete list of species and the designation of each in this work, plus basic references.

TABLE I
 Taxonomic Placement, Habitat, Distribution and Basic Reference for Valid Species of Macrostomidae.

Scientific Name	Present Designation	Habitat	Original Station	Basic References
<i>Omalostomum</i> (Van Beneden), 1870	<i>O. claparedji</i> (Van Beneden), 1870	Marine	Concarneau, France	Van Beneden, 1870
<i>O. claparedji</i> (Van Beneden), 1870	<i>Paromalostomum dubium</i> (Beauchamp) Ax, 1951	Marine	Arcachon, France	Beauchamp, 1927; Ax, 1951a
<i>O. dubium</i> Beauchamp, 1927	<i>O. schultzei</i> (Claparède), 1863	Marine	St. Vaast de la Hougue, France	Claparède, 1863
<i>O. schultzei</i> (Claparède), 1863	<i>P. dubium</i> (Beauchamp) Ax, 1951	Marine	Kiel	Ax, 1951a
<i>Paromalostomum</i> Ax, 1951	<i>P. fusculum</i> Ax, 1952	Marine	Kiel	Ax, 1952
<i>P. dubium</i> (Beauchamp) Ax, 1951	<i>P. notandum</i> Ax, 1951	Marine	Kiel	Ax, 1951a
<i>P. fusculum</i> Ax, 1952	<i>P. spiralis</i> Ax, 1952	Marine	Kiel	Ax, 1952
<i>P. notandum</i> Ax, 1951				
<i>P. spiralis</i> Ax, 1952				
<i>Archimacrostomum</i> new genus	<i>A. brasiliense</i> (Marcus, 1952)	Marine	Brazil	Marcus, 1952
<i>M. appendiculatum</i> variety <i>brasiliense</i> Marcus, 1952	<i>A. beaufortense</i> (Ferguson, 1937)	Marine	Beaufort, North Carolina	Ferguson, 1937b
<i>M. beaufortense</i> Ferguson, 1937	<i>A. hustedi</i> (Jones, 1944)	Marine	Duxbury, Massachusetts	Jones, 1944
<i>M. hustedi</i> Jones, 1944				
<i>Inframacrostomum</i> new genus	<i>I. rubrocinctum</i> (Ax, 1951)	Marine	Germany	Ax, 1951a
<i>M. rubrocinctum</i> Ax, 1951				
<i>Macrostomum</i> O. Schmidt, 1848	<i>Species dubiae</i>			Higley, 1918
<i>M. album</i> Higley, 1918	<i>Species dubiae</i>	Marine-Fresh		Riedel, 1932
<i>M. anocete</i> Riedel, 1932	<i>M. appendiculatum</i> (O. Fabr.), 1820		Pisa, Italy	Graff, 1913
<i>M. appendiculatum</i> (O. Fabr.), 1820	<i>M. distinguenda</i> (Papi, 1951)	Fresh		Papi, 1951
<i>M. appendiculatum</i> variety <i>distinguenda</i> Papi, 1951				
<i>M. appendiculatum</i> variety <i>sillmani</i> Ferguson, 1939	<i>M. appendiculatum</i> (O. Fabr.), 1820	Fresh	New York	Ferguson, 1939-1940
<i>M. appendiculatum</i> variety <i>stirewalli</i> Jones & Ferguson, 1941	<i>M. appendiculatum</i> (O. Fabr.) 1820	Fresh	Virginia	Jones & Ferguson, 1941

TABLE I—(Continued)

Scientific Name	Present Designation	Habitat	Original Station	Basic References
<i>M. balticum</i> Luther, 1947	<i>M. balticum</i> Luther, 1947	Marine	Finland	Luther, 1947
<i>M. beauchampi</i> Ferguson, 1939	<i>M. elgonense</i> (Beauchamp, 1935)	Fresh	Uganda	Beauchamp, 1935
<i>M. beaufortense</i> Ferguson, 1937	<i>A. beaufortense</i> (Ferguson, 1937)	Marine	North Carolina	Ferguson, 1937
<i>M. boreale</i> Riedel, 1932	<i>M. boreale</i> Riedel, 1932	Marine	Greenland	Riedel, 1932,
<i>M. bulbostylum</i> Ferguson, 1939	<i>M. tubum</i> Graff, 1882	Fresh	Virginia	Ferguson, 1939-1940
<i>M. catarractae</i> Gleysztor,	<i>M. catarractae</i> Gleysztor, 1938	Marine	Spain	Gleysztor, 1938
<i>M. collistylum</i> Ferguson, 1939	<i>M. collistylum</i> Ferguson, 1939	Fresh	Tennessee	Ferguson, 1939-1940
<i>M. curvistylum</i> Ferguson, 1939	<i>M. curvistylum</i> Ferguson, 1939	Fresh	Virginia	Ferguson, 1939-1940
<i>M. curvutuba</i> Luther, 1947	<i>M. curvutuba</i> Luther, 1947	Marine	Finland	Luther, 1947
<i>M. delphax</i> Marcus, 1946	<i>M. delphax</i> Marcus, 1946	Fresh.....	Brazil	Marcus, 1946
<i>M. evelinae</i> Marcus, 1946	<i>M. evelinae</i> Marcus, 1946	Brackish	Brazil	Marcus, 1946
<i>M. gabriellae</i> Marcus, 1949	<i>A. beaufortense</i> (Ferguson, 1937)	Marine	Brazil	Marcus, 1949
<i>M. gigas</i> (Okugawa, 1930) Hymn, 1943	<i>M. tubum</i> Graff, 1882	Fresh	New York	Hymn, 1943
<i>M. gilbertii</i> Ferguson, 1939	<i>M. gilbertii</i> Ferguson, 1939	Fresh	Tennessee	Ferguson, 1939-1940
<i>M. glochostylum</i> Ferguson, 1939	<i>M. glochostylum</i> Ferguson, 1939	Fresh	Virginia	Ferguson, 1939-1940
<i>M. gracile</i> Pereyaslawzowa, 1902	<i>M. gracile</i> Pereyaslawzowa, 1902	Marine	Russia	Pereyaslawzowa, 1902
<i>M. graffi</i> Ferguson, 1939	<i>M. graffi</i> (Pereyaslawzowa) Ferguson, 1939	Marine	Russia	Ferguson, 1939-1940
<i>M. hamatum</i> Luther, 1947	<i>M. hamatum</i> Luther, 1947	Marine	Finland	Luther, 1947
<i>M. hystrix</i> Oersted, 1848	<i>Species dubiae</i>			Oersted, 1848
<i>M. infundibuliferum</i> Plotnikow, 1905	<i>M. infundibuliferum</i> Plotnikow, 1905	Fresh	Russia	Plotnikow, 1905
<i>M. intermedium</i> Tu, 1934	<i>M. intermedium</i> Tu, 1934	Fresh	China	Tu, 1934
<i>M. japonicum</i> Okugawa, 1930	<i>M. japonicum</i> Okugawa, 1930	Fresh	Japan	Okugawa, 1930
<i>M. kawamurai</i> Okugawa, 1930	<i>Species dubiae</i>			Okugawa, 1930
<i>M. leptos</i> An-der-Lan, 1939	<i>M. leptos</i> An-der-Lan, 1939	Fresh	Balkans	An-der-Lan, 1939
<i>M. lewisi</i> Ferguson, 1939	<i>M. lewisi</i> Ferguson, 1939	Fresh	Virginia	Ferguson, 1939-1940
<i>M. lineare</i> Uljanin, 1870	<i>M. lineare</i> Uljanin, 1870	Marine	Russia	Uljanin, 1870
<i>M. lutheri</i> Gleysztor, 1939	<i>M. lutheri</i> Gleysztor, 1939	Fresh	Spain	Gleysztor, 1939
<i>M. megalogastricum</i> Pereyaslawzowa, 1892	<i>M. megalogastricum</i> Pereyaslawzowa, 1892	Marine	Russia	Pereyaslawzowa, 1892
<i>M. mystrophorum</i> Meixner, 1926	<i>M. mystrophorum</i> Meixner, 1926	Marine	Germany	Meixner, 1926
<i>M. nassonovi</i> Ferguson, 1939	<i>M. nassonovi</i> (Nassonov), 1892	Fresh	Russia	Nassonow, 1920
<i>M. norfolkense</i> Jones & Ferguson, 1940	<i>M. norfolkense</i> Jones & Ferguson, 1940	Fresh	Virginia	Jones & Ferguson, 1940
<i>M. obtusum</i> (Vejdovsky, 1895)	<i>M. obtusum</i> (Vejdovsky, 1895)	Fresh	Bohemia	Vejdovsky, 1895
<i>M. ontarioense</i> Ferguson, 1943	<i>M. ontarioense</i> Ferguson, 1943	Fresh	New York	Ferguson, 1943
<i>M. ophiocephalum</i> Steinböck, 1931	<i>Species dubiae</i>			Steinböck, 1931
<i>M. orthostylum</i> Braun, 1885	<i>M. orthostylum</i> Braun, 1885	Fresh	Russia	Braun, 1885;
<i>M. orthostylum</i> variety <i>curvata</i> Papi, 1951	<i>M. curvata</i> (Papi, 1951)	Fresh	Italy	Hofston, 1911 Papi, 1951
<i>M. orthostylum</i> variety <i>recurva</i> Papi, 1951	<i>Nomen nudum</i>			Papi, 1951
<i>M. phillipsi</i> Ferguson & Stirewalt, 1938	<i>M. phillipsi</i> Ferguson & Stirewalt, 1938	Fresh	Virginia	Ferguson & Stirewalt, 1938
<i>M. pseudoobtusum</i> Beklemischeff, 1927	<i>Species dubiae</i>			Beklemischeff, 1927
<i>M. pusillum</i> Ax, 1951	<i>M. pusillum</i> Ax, 1951	Marine	Germany	Ax, 1951b

TABLE I—(Continued)

Scientific Name	Present Designation	Habitat	Original Station	Basic References
<i>M. retortum</i> Papi, 1951	<i>M. retortum</i> Papi, 1951	Fresh	Italy	Papi, 1951
<i>M. reynoldsi</i> Ferguson, 1939	<i>M. reynoldsi</i> Ferguson, 1939	Fresh	Virginia	Ferguson, 1939-1940
<i>M. rhabdophorum</i> Beklemischeff, 1927	<i>M. rhabdophorum</i> Beklemischeff, 1927	Fresh	Russia	Beklemischeff, 1927
<i>M. riedeli</i> Ferguson, 1940	<i>M. riedeli</i> Ferguson, 1940	Fresh	Virginia	Ferguson, 1939-1940
<i>M. rubrocinctum</i> Ax, 1951	<i>I. rubrocinctum</i> (Ax, 1951)	Marine	Germany	Ax, 1951b
<i>M. ruebushi</i> Ferguson, 1940	<i>M. ruebushi</i> , Ferguson, 1940	Fresh	Tennessee	Ferguson, 1939-1940
<i>M. ruebushi</i> variety <i>carolinense</i> Ferguson, 1940	<i>M. carolinense</i> (Ferguson, 1940)	Fresh	North Carolina	Ferguson, 1939-1940
<i>M. ruebushi</i> variety <i>finlandense</i> Ferguson, 1940	<i>M. appendiculatum</i> variety <i>finlandense</i> (Ferguson) Luther, 1947	Fresh	South Finland	Luther, 1947
<i>M. ruebushi</i> variety <i>frigorophilum</i> Ferguson, 1940	<i>M. frigorophilum</i> (Ferguson, 1940)	Fresh	Virginia	Ferguson, 1939-1940
<i>M. ruebushi</i> variety <i>granulophorum</i> Ferguson, 1940	<i>M. granulophorum</i> (Ferguson, 1940)	Fresh	Connecticut	Ferguson, 1939-1940
<i>M. ruebushi</i> variety <i>kepneri</i> Ferguson & Jones, 1940	<i>M. kepneri</i> (Ferguson & Jones, 1940)	Brackish	Virginia	Ferguson & Jones, 1940a
<i>M. ruebushi</i> variety <i>recurvostylum</i> Ferguson, 1940	<i>M. recurvostylum</i> (Ferguson, 1940)	Fresh	Connecticut	Ferguson, 1939-1940
<i>M. ruebushi</i> variety <i>schmitti</i> Hayes & Ferguson, 1940	<i>M. schmitti</i> (Hayes & Ferguson, 1940)	Fresh	Tennessee	Hayes & Ferguson, 1940
<i>M. ruebushi</i> variety <i>shenandoahense</i> Ferguson, 1940	<i>M. shenandoahense</i> (Ferguson, 1940)	Fresh	Virginia	Ferguson, 1939-1940
<i>M. ruebushi</i> variety <i>truncatum</i> Ferguson, 1940	<i>M. truncatum</i> (Ferguson, 1940)	Fresh	Virginia	Ferguson, 1939-1940
<i>M. saifunicum</i> Nasonov, 1929	<i>M. saifunicum</i> Nasonov, 1929	Fresh	Russia	Nassinov, 1929
<i>M. sensitivum</i> Silliman, 1884	<i>M. appendiculatum</i> (O. Fabr.) 1829	Fresh	New York	Silliman, 1884
<i>M. setosum</i> Schmarda, 1859	<i>Species dubiae</i>			Schmarda, 1859
<i>M. stylopancillum</i> Jones, 1940	<i>M. stylopancillum</i> Jones, 1940	Marine	North Carolina	Ferguson, 1939-1940
<i>M. tennesseense</i> Ferguson, 1940	<i>M. tennesseense</i> Ferguson, 1940	Fresh	Tennessee	Ferguson, 1939-1940
<i>M. tenuicauda</i> Luther, 1947	<i>M. tenuicauda</i> Luther, 1947	Marine	Finland	Luther, 1947
<i>M. thermale</i> Reisinger, 1934	<i>M. thermale</i> Reisinger, 1934	Fresh	Java	Reisinger, 1929
<i>M. thermophilum</i> Riedel, 1932	<i>Species dubiae</i>			Riedel, 1932
<i>M. timavi</i> Graff, 1905	<i>M. timavi</i> Graff, 1905	Marine	Europe ?	Graff, 1905
<i>M. tuba</i> (Graff, 1882)	<i>M. tuba</i> (Graff, 1882)	Fresh	Germany	Graff, 1882
<i>M. tuba</i> variety <i>gigas</i> Okugawa, 1930	<i>M. tuba</i> (Graff, 1882)	Fresh	Japan	Okugawa, 1930
<i>M. tuba</i> variety <i>minuta</i> , Luther, 1947	<i>M. minuta</i> (Luther, 1947)	Marine	Finland	Luther, 1947
<i>M. vejdoskyi</i> Ferguson, 1940	<i>M. vejdoskyi</i> Ferguson, 1940	Fresh	Connecticut	Ferguson, 1939-1940
<i>M. virginianum</i> Ferguson, 1937	<i>M. virginianum</i> Ferguson, 1937	Fresh	Virginia	Ferguson, 1937b
<i>M. viride</i> Van Beneden, 1870	<i>M. viride</i> Van Beneden, 1870	Fresh	Sweden	Van Beneden, 1870
<i>M. viride</i> variety <i>elgonense</i> Beauchamp, 1935	<i>M. elgonense</i> (Beauchamp, 1935)	Fresh	Africa	Beauchamp, 1935
<i>M. viride</i> variety <i>rostratus</i> Papi, 1951	<i>M. rostratus</i> (Papi, 1951)	Fresh	Italy	Papi, 1951
<i>Paramacrostomum</i> Riedel, 1932				
<i>P. tricladoides</i> Riedel, 1932	<i>P. tricladoides</i> Riedel, 1932	Marine	Greenland	Riedel, 1932
<i>Promacrostomum</i> Anderlan, 1930				

TABLE I—(Continued)

Scientific Name	Present Designation	Habitat	Original Station	Basic References
<i>P. paradoxicum</i> An-der-Lan, 1939	<i>P. paradoxicum</i> An-der-Lan, 1939	Marine	Balkans	An-der-Lan, 1939
<i>Azia</i> new genus				
<i>P. gieysztori</i> (Ferguson) Papi, 1951	<i>A. gieysztori</i> (Papi, 1951)	Fresh	Italy	An-der-Lan, 1939 Papi, 1951
<i>Protomacrostomum</i> Steinböck, 1935				
<i>P. groenlandicum</i> Steinböck, 1935	<i>P. groenlandicum</i> Steinböck	Marine	Greenland	Steinböck, 1935
<i>Dolichomacrostomum</i> Luther, 1947				
<i>D. mortenseni</i> Marcus, 1951	<i>D. mortenseni</i> Marcus, 1951	Fresh	Brazil	Marcus, 1950
<i>D. uniporum</i> Luther, 1947	<i>D. uniporum</i> Luther, 1947	Marine	Finnland	Luther, 1947
<i>Karlingia</i> new genus				
<i>D. lutheri</i> Marcus, 1948	<i>K. lutheri</i> (Marcus, 1948)	Fresh	Brazil	Marcus, 1948
<i>Myozona</i> Marcus, 1949				
<i>M. evelinae</i> Marcus, 1949	<i>M. evelinae</i> Marcus, 1949	Marine	Brazil	Marcus, 1949

Species dubiae: *Macrostomum album* Higley, 1918; *M. anocela* Riedel, 1932; *M. hystrix* Oersted, 1843; *M. hystrix* Oersted, of Luther, 1905; *M. kawamurai* Okugawa, 1930; *M. ophiocephalum* Steinböck, 1931; *M. pseudobiusum* Becklemisheff, 1927; *M. setosum* Schmarda, 1850; and *M. thermophilum* Riedel, 1932.

Nomen nudum: *M. orthostylum* variety *recurva* Papi, 1951.

Genus *Omalostomum* (Van Beneden, 1870)

The information on the two species listed (Beauchamp, 1927; Van Beneden, 1870; Claparède, 1863) is quite meager and it is possible that each will receive a new position once they are adequately described. Certainly the most unusual feature of these worms is the anterior position of the mouth with respect to the brain and eyes. It is hoped that *Omalostomum* may be accurately described since it has been reported from Woods Hole, Massachusetts. Figures 1 and 2 are diagrammatic and are based on the gross anatomy of *O. claparèdi*; (Van Beneden) 1870 and the male apparatus of *O. schultzei* (Claparède) 1863, respectively.

Genus *Paromalostomum* Ax, 1951

The sound work of Ax upon this group is based on an unpublished notation by Meixner (1938) in which he split off this genus from *Omalostomum*. Luther (1947) has also given the opinion that there is close affinity, based on similarities in the male stilettes, between *Dolichomacrostomum* and *Omalostomum dubium* Beauchamp, 1927, which latter was the subject species. The sexual anatomy of *Omalostomum* is elementary compared to that of either *Paromalostomum* or *Dolichomacrostomum* (Figs. 1, 3, 25). The sexual apparatus of *Paromalostomum* is the most highly evolved in the family (Fig. 4). The gross anatomy of *P. dubium* (Beauchamp) Ax (1951a) shows the general relationship of organs (Fig. 3); a schematic lateral view (Fig. 6) illustrates the complexities of the female system. The female antrum is a somewhat bipartite structure with the possibility of a sphincter existing between divisions. The male canal is said to empty laterally into the common genital atrium. The cuticular piece (anhang) of the bursa is shown in Figure 6.

Paromalostomum has the most complicated of the male systems in macrostomines (Fig. 4) with a prominent vas deferens, a well developed vesicula granulorum and an ornate, twisted, stilette. The secondary, somewhat simple tube, with its large appended glandose sack is very

probably a weapon (poison tube), as has been postulated in other genera of Turbellaria. *P. spiralis* Ax, 1952, has an interesting variation in this regard, in that the "poison tube" is a solid pointed rod, which has no accessory gland.

All of the presently described species of *Paromalostomum* are valid with descriptions based on careful morphological studies by Ax.

Genus *Archimacrostomum* New Genus

The worms in this unspecialized group resemble those of the type genus *Macrostomum* except for the lack of a complete male sexual system. The male apparatus in *Macrostomum* is not only complete (Fig. 15), but the vesicula seminalis and vesicula granulorum are well developed. The macrostomines which deviate from this requirement deserve new generic placement. Figures 5 and 7 show the lack of a discrete vesicula granulorum in *A. beaufortense* (Ferguson, 1937b). The other two species, *A. brasiliense* (Marcus, 1952) and *A. hustedti* (Jones, 1944), fit the requirements of the new genus. *A. hustedti* has somewhat unusual additional characters described by Jones (1944): "The male genital system consists of a curved stilette directed posterad, a granular portion weakly supplied with prostatic gland cells, a small vas deferens, or seminal vesicle, and two vasa efferentia leading from the two subspherical testes, which lie on either side in the oesophageal region. Sperm cells are filiform, without flagella or setae. The female genital system consists of the vagina, with its surrounding mass of glandular tissue, the common oviduct (here serving the common functions of oviduct and atrium, since no histological separation can be made between such regions), and two oviducts leading from the lateral ovo-vitellaria."

Genus *Inframacrostomum* New Genus

This new group is also based on an incomplete sexual system. The type species, *I. rubrocinctum* (Ax, 1951b) cannot be a *Macrostomum* since it lacks a discrete female genital atrium. On this subject, Ax is quoted: "Von einer grossen Keimzelle laufen die Wände des Antrums schräg zur Ventralseite und gehen ohne scharfe Grenze in die Vagina über. Um die Keimzelle herum ist nur eine dünne Membran erkennbar, die Vagina ist dagegen von flachen, bewimperten Epithelzellen ausgekleidet. Die Vagina nimmt das Sekret zahlreicher Kittdrüsen, welches aus kleinen, länglichen Stäbchen besteht, auf. Eine Säckformige Ausbildung des Antrums und eine deutliche Abgrenzung gegen den Ovidukt, wie es von mehreren Arten der Gattung bekannt ist, lässt sich hier nicht feststellen" (Figs. 8, 9, 10).

Genus *Macrostomum* O. Schmidt, 1848

Early basic works on the type genus are: Ferguson, 1937a, b, 1939-1940, 1943; Ferguson and Jones, 1940a, 1940b; Ferguson and Stirewalt, 1938; Ferguson et al., 1939; Hayes and Ferguson, 1940; Jones and Ferguson, 1940, 1941. More recently studies have been made by Luther, 1947; Papi, 1950, 1951; Hyman, 1943; Ax, 1951a; Marcus, 1949, and others. By careful morphological study of the male stilette, the author has indicated a number of rectifications in the taxonomy of this genus. The following comments apply only to species with new designations (Table I). The *species dubiae* in *Macrostomum* remain essentially unchanged from

1939-1940 (Table I, footnote); however, one *nomen nudum* has developed from the designation of a form with two names in the same original work (Papi, 1951).

In the genus *Macrostomum* the cumbersome *M. ruebushi* varietal group in the U. S. is now avoided by recombination; several troublesome varieties of the basic species, *M. appendiculatum* (Barrett, 1930; Beauchamp, 1935; Carter, 1929; Diesing, 1850; Fabricius, 1826; Ferguson, 1939-40; Gieysztor, 1931; Girard, 1893; Graff, 1904-1908, 1909, 1911, 1913; Hofsten, 1912; Jones and Ferguson, 1941; Luther, 1947; Marcus, 1952; Papi, 1951; Silliman, 1885; Stringer, 1909, 1918) are given similar treatment; and the same may be said for the variants of *M. tubum* (Duges, 1828; Ehrenberg, 1831; Ferguson, 1939-1940; Ferguson et al., 1939; Graff, 1913; Hyman, 1936, 1943; Kepner and Stiff, 1932; Luther, 1947; Marcus, 1946; Okugawa, 1930; Papi, 1951; Phillips, 1936; Ruhl, 1927; Vialli, 1927). The latter conversion of all *Macrostomum* with lengthy bulb-ended stilettes (Fig. 16) into *M. tubum* is a major compromise of all contributing authors. The description of the variant, *M. bulbostylum* Ferguson, 1939-1940, is cited as informative (Fig. 15). Resolution of the controversy as to the presence or absence of this worm in various parts of the world might well be aided by the interchange of live materials among specialists.⁶ Examination of fixed museum materials is not satisfactory since fixation produces marked distortions in the stylette.

The following notes give reasons for taxonomic conversions in Table I: *M. distinguenda* (Papi, 1951) is certainly of specific stature with its singular stylette (Fig. 17). *M. appendiculatum* varieties *sillimani*, *sensitivum*, and *stirewalli* (Ferguson, 1939-1940; Jones and Ferguson, 1941) are returned to specific standing (Fig. 14). The work of Luther (1947) on *M. appendiculatum* variety *finlandense* is acceptable. *M. elgonense* is given proper nomenclatorial handling by the present listing (Beauchamp, 1935). *M. beaufortense*, *brasiliense* and *hustedti* were treated above under *Archimacrostomum*. *M. bulbostylum*, *gigas*, *tuba*, and *tuba* variety *gigas* are part of the same homogeneous complex and are now designated as conspecific with *M. tubum*. *M. tuba* variety *minuta* (Fig. 19) is not of the *tubum* complex (Luther, 1947). *M. orthostylum* variety *curvata* (Papi, 1951) is singular enough to carry species status (Fig. 18). *M. rubrocinctum* has been accepted as the type species of the new genus *Inframacrostomum* (see above). Most of the varieties of *M. ruebushi* (*carolinense*, *frigorophilum*, *granulophorum*, *recurvostylum*, *schmitti*, *shenandoahense*, *truncatum*) are presented in this work (Figs. 11 and 12) as species (Ferguson, 1939-1940; Ferguson and Jones, 1940a; Hayes and Ferguson, 1940). Finally, *M. rostratus* bears no significant relation to *M. viride* and is named a species on the basis of unusual stylette morphology (Papi, 1951). All presently known forms of *Macrostomum* have been considered in this analysis with the exceptions of *M. auriculatum* Nasonov, 1935, and *M. korsakovi* Nasonov, 1921. These works were not available for reference.

Genus *Promacrostomum* An-der-Lan, 1939

The type species, *P. paradoxicum* is carefully described in all parts of the sex apparatus, with exception of the oviduct which An-der-Lan

⁶Living *Macrostomum* are very satisfactorily mailed in small thermos jugs, with ice water surrounding a vial containing worms.

(1939) did not locate from histological material. There are the typical macrostomine structures in the male system (Figs. 20, 21), but in the female there are two external openings to the apparatus as well as a clearly defined ductus-genito-intestinalis equipped with a sphincter leading to the enteron. The reported absence of an oviduct has led to speculation on methods of egg handling by this genus.

Genus *Axia*, New Genus

The type species, *A. gieysztori*, has the basic promacrostomine characteristics (Figs. 22, 23, 24), but, in contrast, lacks the ductus-genito-intestinalis, and possesses a discrete oviduct. Papi (1950) described *A. gieysztori* as follows: "*P. gieysztori* differisce da *P. paradoxicum* per l'assenza di una comunicazione genito-intestinale, per la presenza di ovidutti, nonché per la forma dello stiletto e per altri caratteri di secondaria importanza." Both the vagina, with its external pore, and the female atrium with its outer opening are ciliated, but the antrum femininum connecting the two is without cilia, being lined with gland-like cells. The anterior margin of the antrum femininum, as well as the walls of the oviduct, are provided with stopper type cells (Verschlusszellen) thought to be regulators in the passage of sperm cells (Ferguson, 1939-1940; Gieysztor, 1931).

Genus *Protomacrostomum* Steinböck, 1935

The type species, *P. groenlandicum*, has not been adequately described, but is included here for comparative purposes (Steinböck, 1935). The most significant feature of these worms is the occurrence of an anterior mouth. Steinböck described the enteric system from sectioned material: "Die übrige Organisation dürfte in den wesentliche Zügen mit dem, was wir über die gattung *Macrostomum* wissen übereinstimmen. Sehr verwickelt gebaut ist der männliche Kopulationsapparat . . . also ein langes spiraligewundenes Rohr von verwickeltem Bau darstellt." He gave no drawings of sexual apparatus. If this form is eventually accepted, it will add variety to the described macrostomine alimentary systems.

Genus *Dolichomacrostomum* Luther, 1947

These are characterized (Luther, 1947) as having slender bodies, a common gonopore, an organ resembling a bursa copulatrix (but without the antrum femininum, or ductus spermaticus) and a complex male apparatus (Figs. 25, 26, 27). Marcus (1948) noted that bursa-like organs of *Dolichomacrostomum* contain cuticular structures ("peças cuticulares") which might be capsules around spermatozoa produced in the female accessory organs. Auto-fecundation has been postulated for the group by Luther.

One of the three described forms under this generic grouping has been transferred to the new genus *Karlingia*. The remaining species, *D. uniporum* and *D. mortensenii*, are easily separable forms (Luther, 1947; Marcus, 1950). One of the two male copulatory tubes might be interpreted as a defensive poison unit since each of the two species has large, well-developed accessory secretory masses in the caudal area, the function of which is not otherwise explained. Both Luther and Marcus have indicated that the larger tube is the principal copulatory organ, although Marcus refers to the sperm regulating function of the complex major bend

in the secondary tube of *D. mortlensei* as follows: "Rostralmente á articulacao (ou regulador do fluxo dos espermatozoides), o tubo secundário . . . etc." A further complication with respect to the secondary tube of this latter species, lies in the apparent belief of Marcus that the polyflexed tube is anatomically joined to the bursa-like structure. Since such union is not clearly described, the author advances an alternative interpretation. The entire structure (Fig. 26) is the bursa copulatrix with the usual bursastiel and anhang, but lacks a ductus spermaticus. The "bursa" of *D. uniporum* is only diagrammatically indicated in Figure 26.

Genus *Karlingia* New Genus

The type species, *K. lutheri*, is placed close to the dolichomacrostromines; however, the general body morphology of the two types of worms has very little in common (Luther, 1947; Marcus, 1948). The presence of a definite bursa copulatrix with cuticular bursastiel and anhang, plus single gonads, and a simple, single male stilette are distinguishing generic features (Figs. 28, 29). The South American form is eyeless and lacks ciliated pits.

Genus *Myozona* Marcus, 1949

The type species, *M. evelinae*, has perhaps the most atypical anatomical features of any macrostomine (Marcus, 1949). This form has simple (degenerate?) organs in the male system; it has complex female apparatus, and an amazingly complex alimentary system. The bursa intestinalis is weakly developed (Figs. 30, 31) but functional, while the antrum femininum has strong muscular support. The oviduct has a unique sphincter at its union with the bursa. The muscular, pyriform penis is quite simple in construction.

Since *Myozona* has a masticating unit midway in the intestinal tract, it may be compared with *Dinophilus* of the Archiannelida, which resembles lower turbellarians upon gross examination. Primitive "annelidan" features of *Myozona* are: lack of ciliation in certain areas (caudally here); the presence of a "gizzard" comparable to the strong muscular pharynx of the annelid; the presence of a complete alimentary canal; a simplified male system resembling that of the dinophilines; and the presence of unpaired gonads. Had there been an antero-caudal placement of the female gonopore and some indication of body segmentation, it would be difficult indeed to separate this *Myozona* from some North American species of *Dinophilus*.

There are insufficient data, at present, to form the basis for a clear cut intrafamilial evolutionary line of development in Macrostromidae. While the lower genera are satisfactorily placed (*Inframacrostromum*, *Archimacrostromum* and *Macrostromum*), as regards their simplicity of sexual anatomy, placement of the other presently known genera is difficult. Additional work on the physiological significance of the united sexual-digestive systems, as displayed in the presence of the ductus-genito-intestinalis, or bursa intestinalis will clarify matters. The functional relationships of the two copulatory tubes of some higher genera needs investigation. The work of An-der-Lan in 1939 on *Promacrostromum* has shown that marked morphological heterogeneity exists within the family.

SUMMARY

The taxonomic placement of approximately one hundred species of the family *Macrostomidae* is given and the new genera (*Axia*, *Karlingia*, *Archimacrostomum* and *Inframacrostomum*) have been erected on the basis of the anatomy of the sexual apparatus. Tabulations of all known forms, plus drawings and discussions of the taxonomically modified forms, are included.

DESCRIPTION OF TEXT-FIGURES⁷

1. *Omalostomum claparèdii* (Von Beneden)—Gross anatomy. After VanBeneden, 1870, p. 64, Pl. 4, Fig. 10. (Body colorless; body length up to 0.6 mm.)
2. *Omalostomum schultzei* (Claparède)—Male apparatus. After Claparède, 1863, p. 15, Pl. 4, Fig. 2. (Body colorless; body length 0.37 mm.)
3. *Paromalostomum dubium* (Beauchamp)—Gross anatomy. After Ax, 1951, p. 37 et seq., Fig. 15. (Body gray; body length up to 2 mm.)
4. *P. dubium* (Beauchamp)—Male apparatus. $\times 500$. After Ax, 1951, Fig. 20.
5. *A. beaufortense* (Ferguson)—Male apparatus. $\times 1500$. After Ferguson, 1937, Fig. 4.
6. *P. dubium* (Beauchamp)—Lateral view based on saggital sections. $\times 450$. After Ax, 1951, Fig. 24.
7. *Archimacrostomum beaufortense* (Ferguson)—Gross anatomy. $\times 100$. After Ferguson, 1937, Fig. 1.
8. *Inframacrostomum rubrocinctum* (Ax)—Gross anatomy. After Ax, 1951, Fig. 1a. (Body golden with anterior purple-red band; body length up to 2 mm.)
9. *I. rubrocinctum* (Ax)—Detail of copulatory organ. After Ax, 1951, Fig. 1b.
10. *I. rubrocinctum* (Ax)—Detail of female apparatus. $\times 240$. After Ax, 1951, Fig. 1d.
11. *Macrostomum ruebushi* Ferguson—Gross anatomy. $\times 90$. After Ferguson, 1939, Pt. VI, Fig. 8. (Body colorless; body length up to 1.7 mm.)
12. *M. ruebushi* Ferguson—Detail of copulatory organ. $\times 675$. After Ferguson, 1939, Pt. VI, Fig. 8.
13. *Macrostomum appendiculatum* (O. Fabr.)—Gross anatomy. $\times 100$. After Ferguson, 1939, Pt. III, Fig. 1.
14. *M. appendiculatum* (O. Fabr.)—Detail of copulatory organ. $\times ca. 1000$. After Luther, 1947, p. 9, Fig. 4.
15. *Macrostomum tubum* (Graff)—Gross anatomy. $\times 50$. After Ferguson, 1939, Pt. III, p. 61, Fig. 22. (Body colorless; body length up to 3.5 mm.)
16. *M. tubum* (Graff)—Detail of copulatory organ. After Gieysztor, 1931, p. 210, Fig. 3. (Stilette up to 312 μ long in U. S.)
17. *Macrostomum distinguenda* (Papi)—Detail of copulatory organ. After Papi, 1951, p. 314, Fig. 38. (Stilette measures 19 μ at proximal opening; length 70 μ .)
18. *Macrostomum curvata* (Papi)—Detail of copulatory organ. After Papi, 1951, p. 309, Fig. 25. (Stilette length 61 μ .)
19. *Macrostomum minula* (Luther)—Detail of copulatory organ. After Luther, 1947, p. 28, Fig. 47. (Stilette length 82 μ .)
20. *Promacrostomum paradoxicum* An-der-Lan—Diagrammatic lateral view. After An-der-Lan, 1939, p. 200, Fig. 3. (Body colorless; body length up to 1 mm.)
21. *P. paradoxicum* An-der-Lan—After An-der-Lan, 1939, p. 201, Fig. 4. Details of copulatory organ. (Stilette length 40 μ .)

⁷Magnification is not known for those figures where such is not given.

22. *Axia gieysztori* (Papi)—Gross anatomy. After Papi, 1951, p. 320, Fig. 45. (Body colorless; body length up to 2 mm.)
23. *A. gieysztori* (Papi)—Diagrammatic lateral view. After Papi, 1950, p. 464, Fig. 1b.
24. *A. gieysztori* (Papi)—Details of male copulatory organ. After Papi, 1951, p. 320, Figs. 48, 49. (Stilette length 135 μ .)
25. *Dolichomacrostomum mortenseni* Marcus—Gross anatomy. After Marcus, 1950, p. 138, Fig. 49. (Body colorless; body length up to 1.2 mm.)
26. *D. mortenseni* Marcus—Diagrammatic lateral view. After Marcus, 1950, p. 138, Fig. 50.
27. *D. uniporum* Luther—Detail of male copulatory organ. \times ca. 480. After Luther, 1947, p. 33, Fig. 54. (Stilette, main tube length not given.)
28. *Karlingia lutheri* (Marcus)—Gross anatomy. After Marcus, 1948, p. 206, Fig. 8. (Body colorless; body length up to 0.15 mm.)
29. *K. lutheri* (Marcus)—Diagram of sex apparatus. After Marcus, 1948, p. 206, Fig. 11. (Stilette length up to 30 μ .)
30. *Myozona evelinae* Marcus—Gross anatomy. After Marcus, 1949, p. 118, Fig. 22. (Body colorless; body length 1.2 mm.)
31. *M. evelinae* Marcus—Diagrammatic lateral view. After Marcus, 1949, p. 118, Fig. 23.

LIST OF ABBREVIATIONS

ac—accessory glands	g—"gizzard"
af—antrum femininum	h—haftpapillen
ao—antrum ovipositorium	k—chitinhang of bursa copulatrix
ap—passage apparatus (Durchsgangapparat)	m—mouth
b—brain	mgp—male gonopore
bc—bursa copulatrix	mp—muscular penis
bs—bursa seminalis (also bursa intestinalis)	n—Nebenrohr, or secondary tube
c—cilia	o—ovocytes
cga—common genital atrium	od—oviduct
cgp—common gonopore	op—distal opening to stilette
cod—common oviduct	ov—ovary
cp—"ciliated pits"	pol—egg laying pore
dg—digestive glands	ph—pharynx
dgi—ductus-genito-intestinalis	pn—protonephridia
di—ductus intersingularis	r—rhabdites
ds—ductus spermaticus	rh—rhammiten
e—eyes	sh—sensory hairs
en—enteron	sp—sensory spines
ex—excretory pore	st—penis stilette
fga—female genital atrium	t—testes
fgp—female gonopore	va—vagina
fs—false vesicula seminalis	vd—vas deferens
	vg—vesicula granulorum
	vs—vesicula seminalis

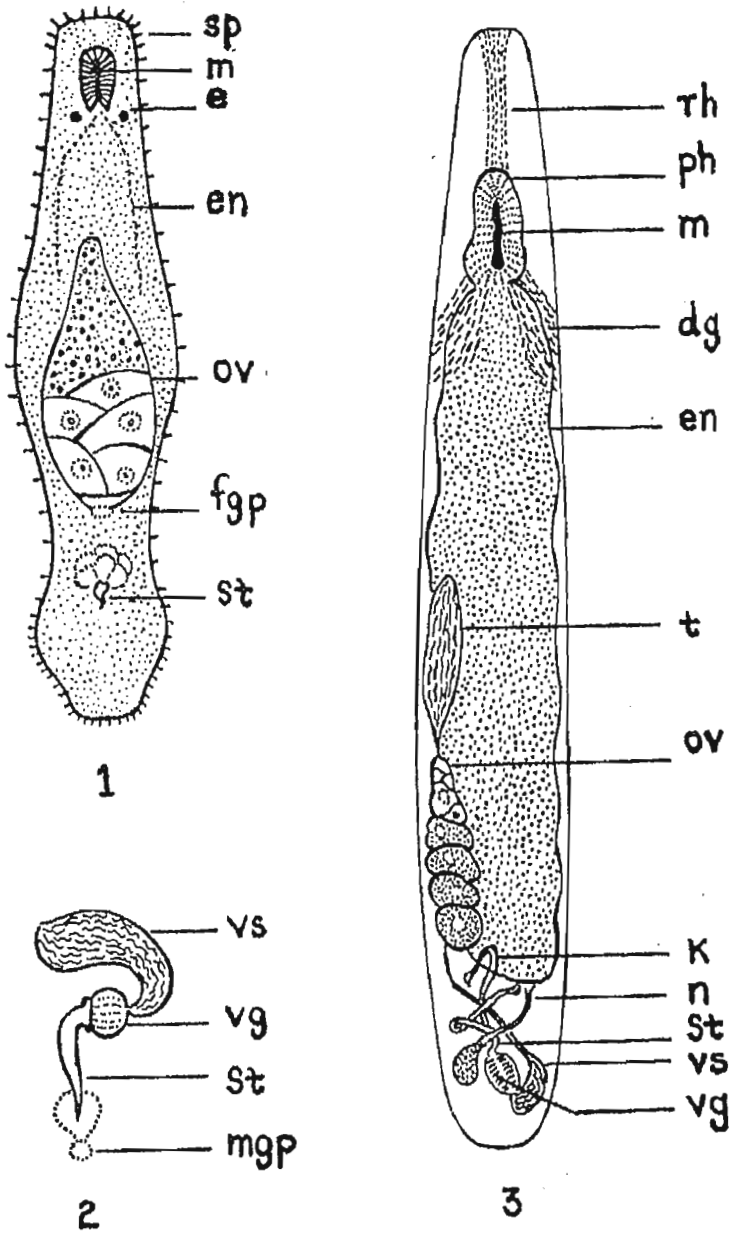


PLATE I

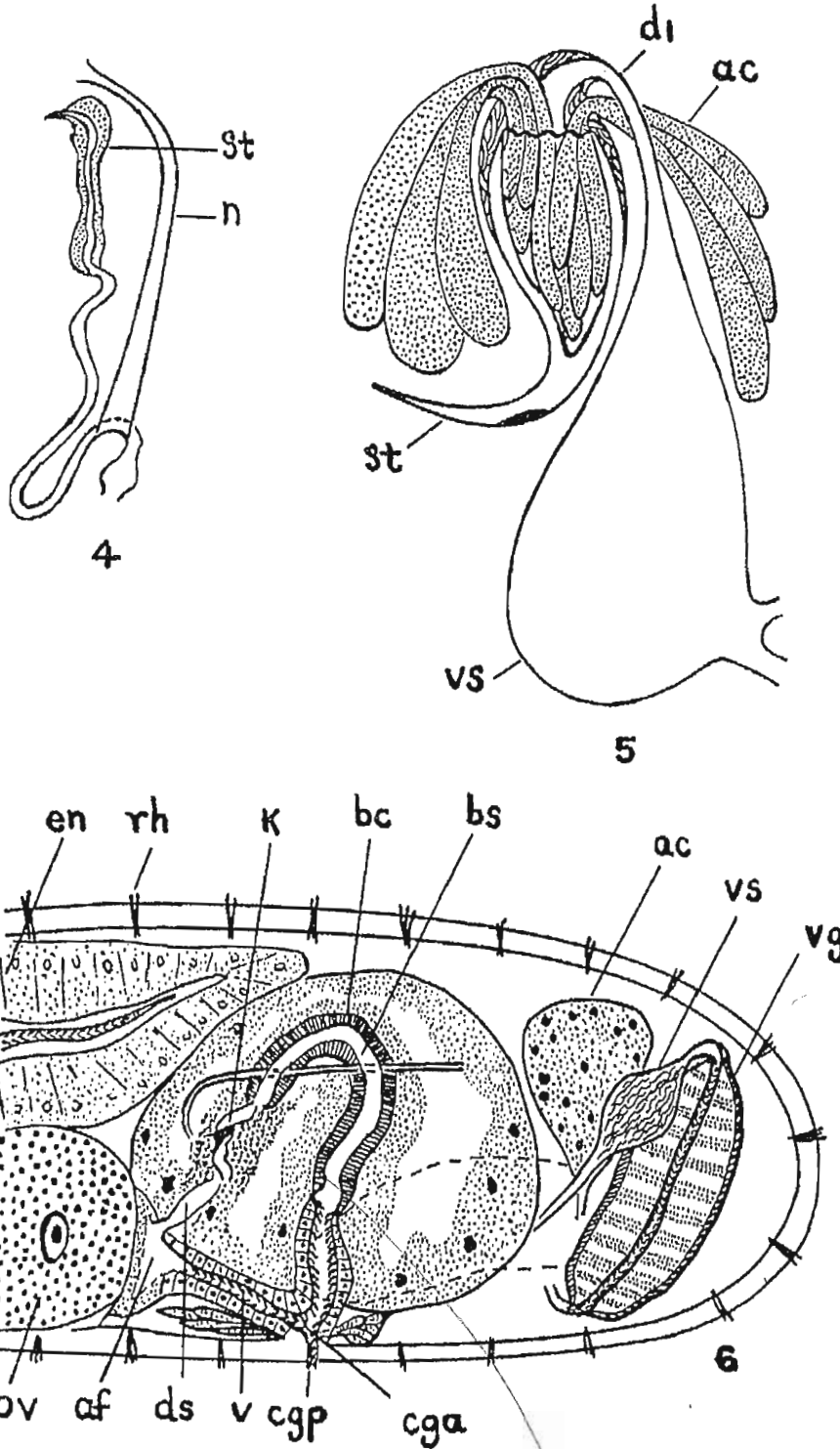


PLATE II

Paromalostomum debicium

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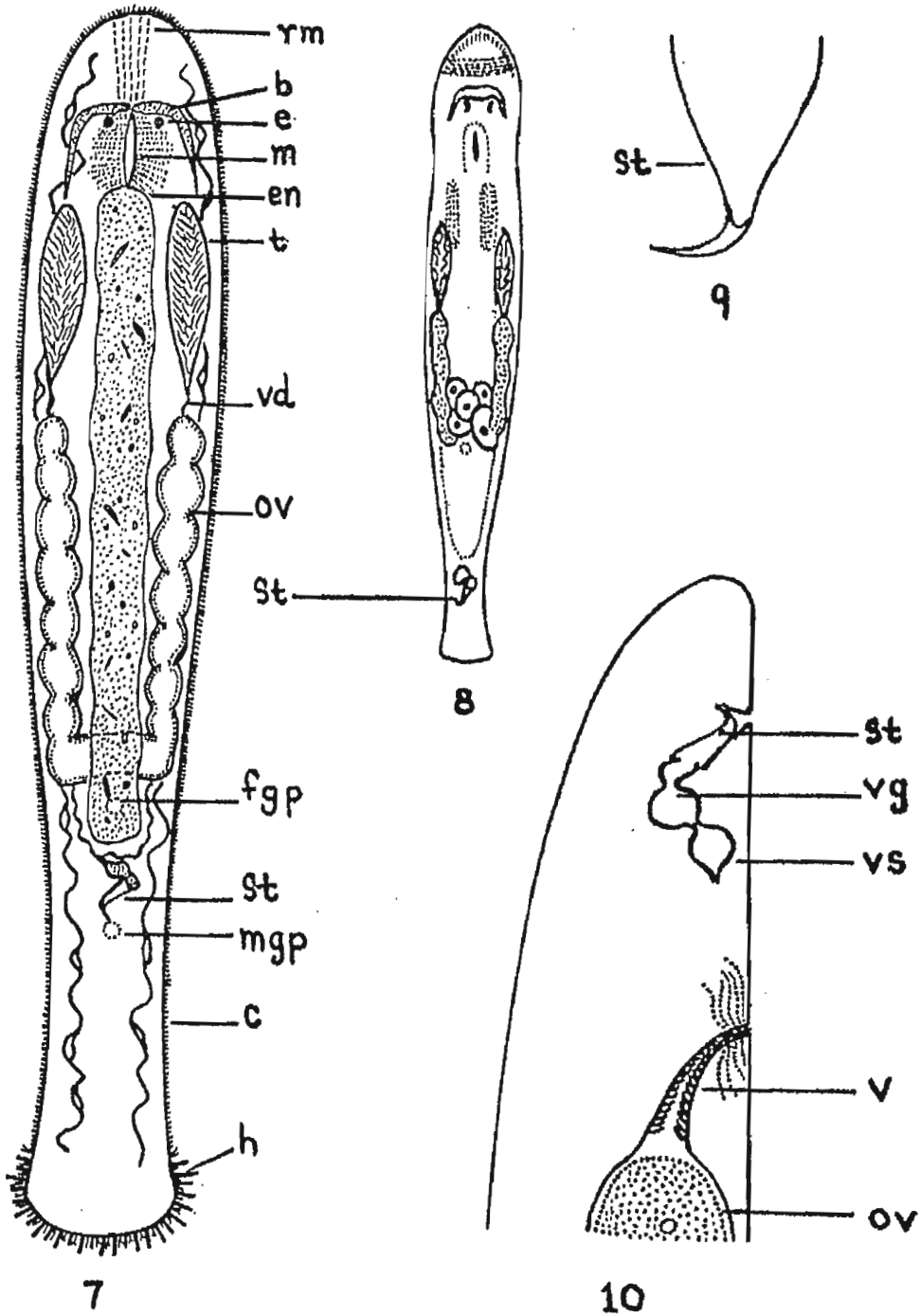


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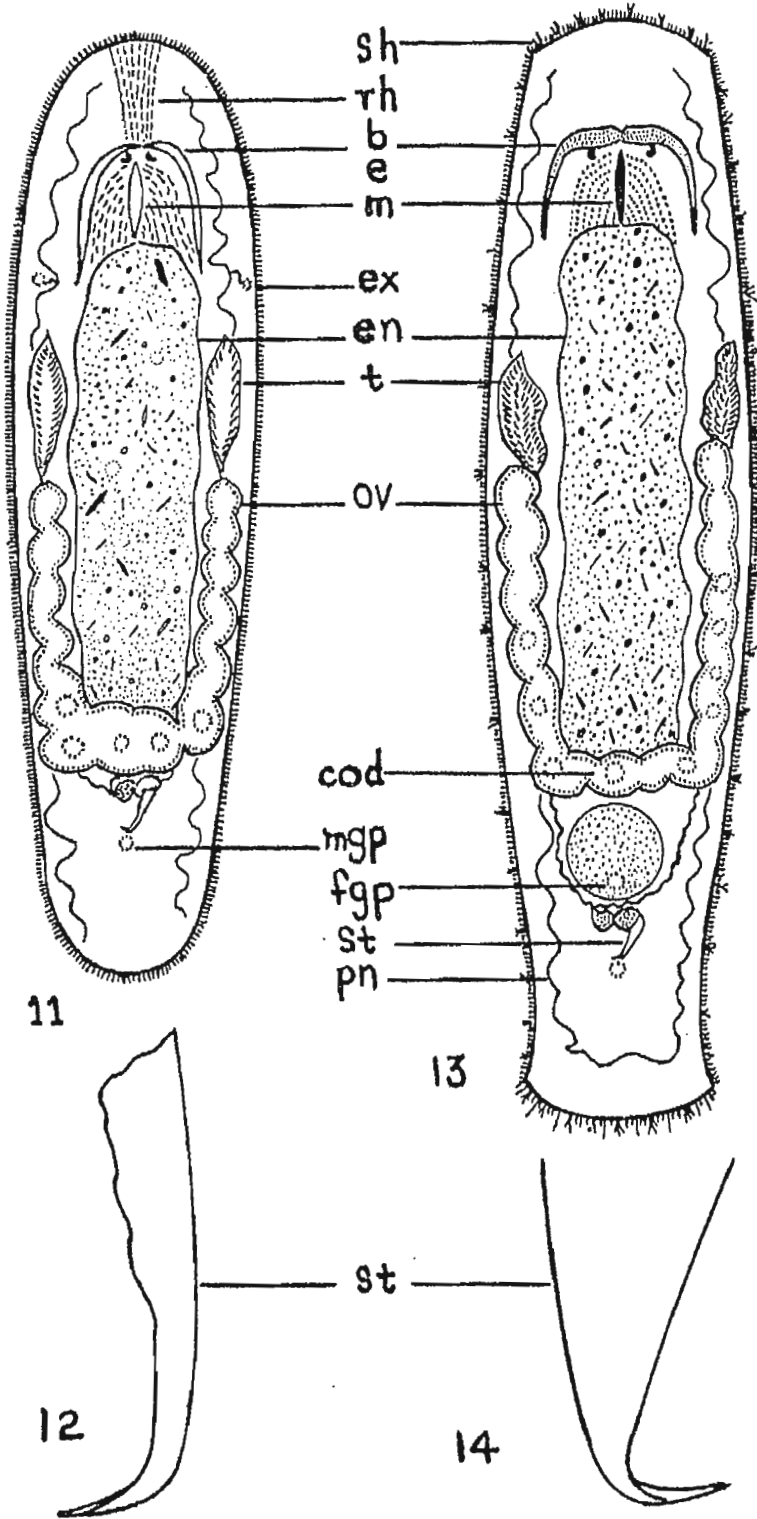


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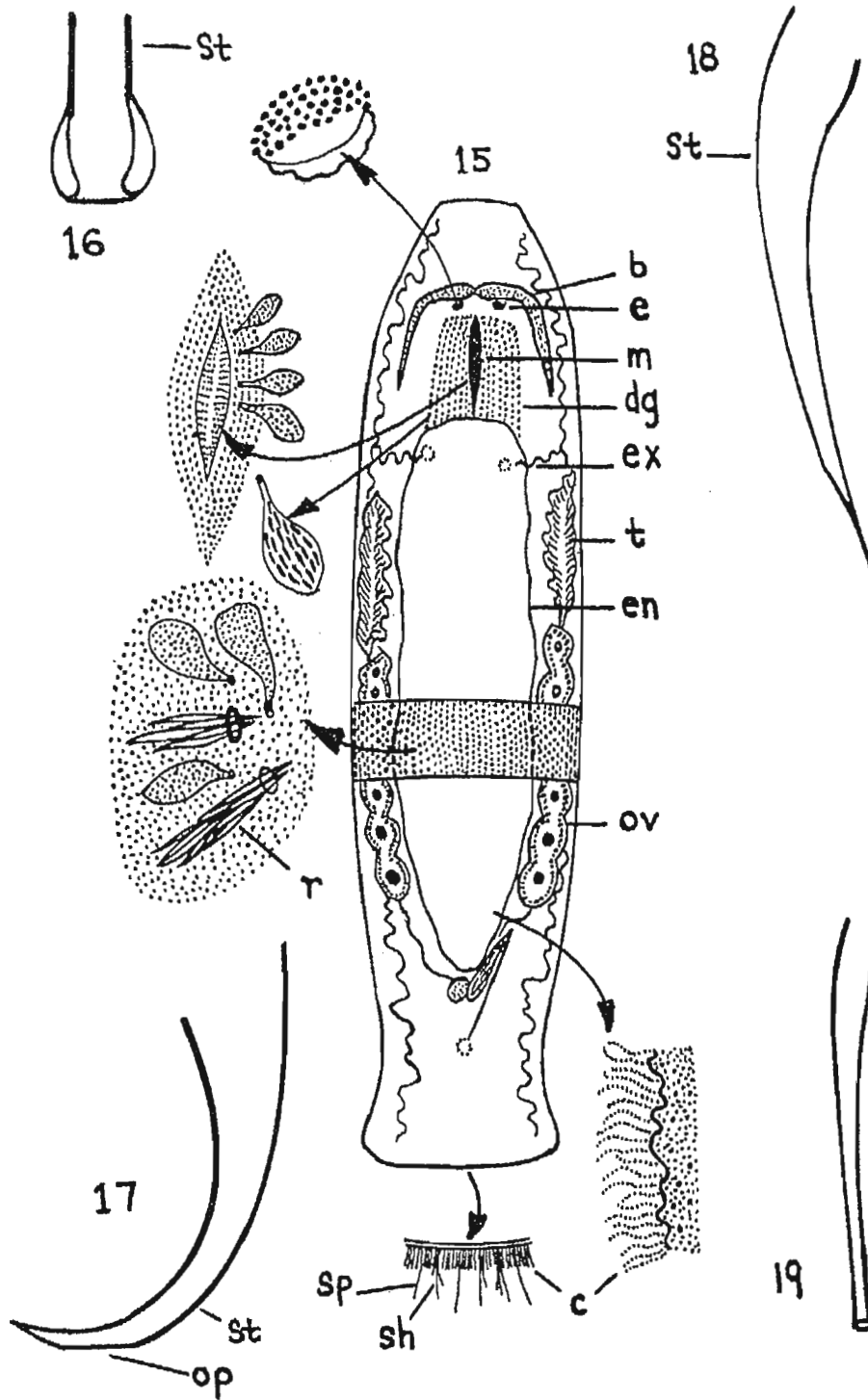


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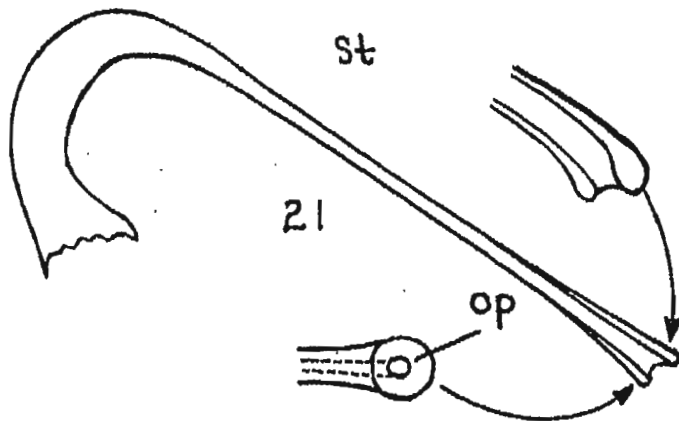
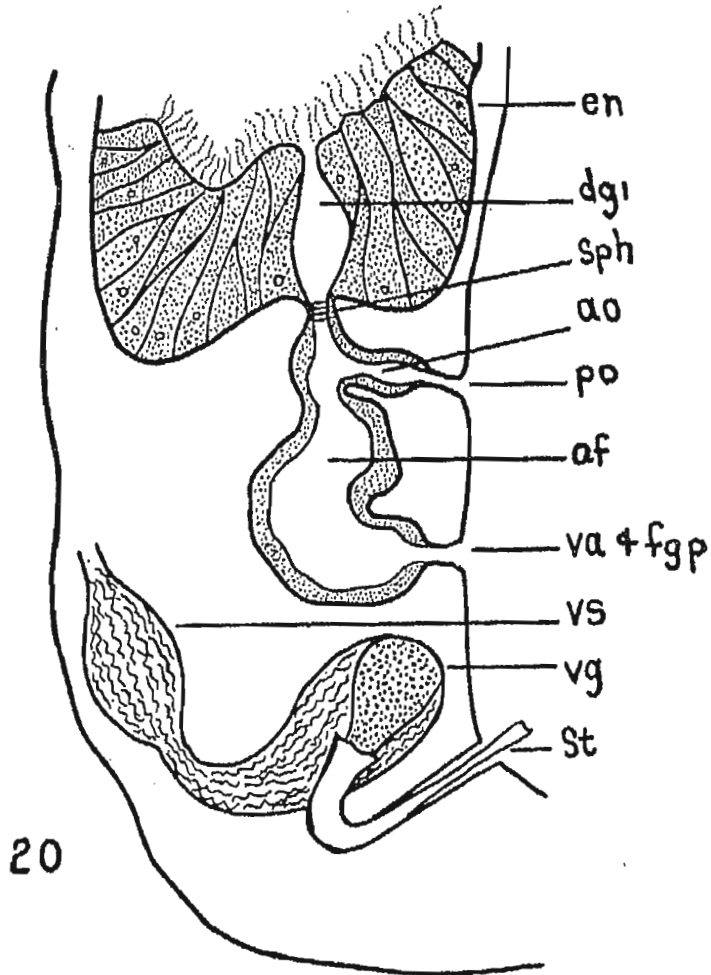


PLATE VI

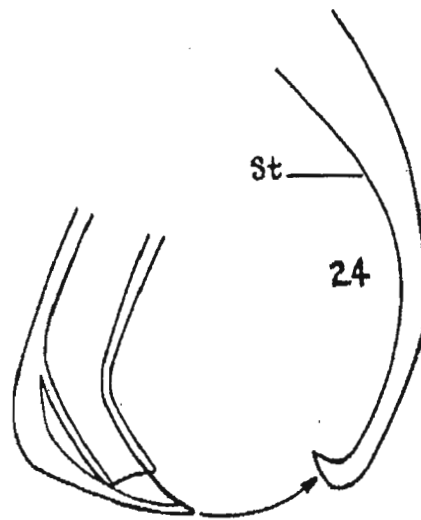
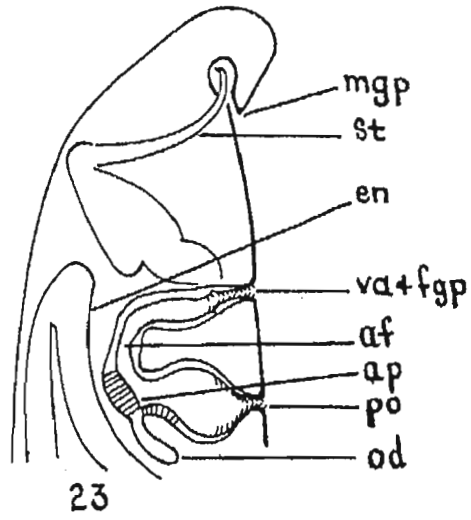
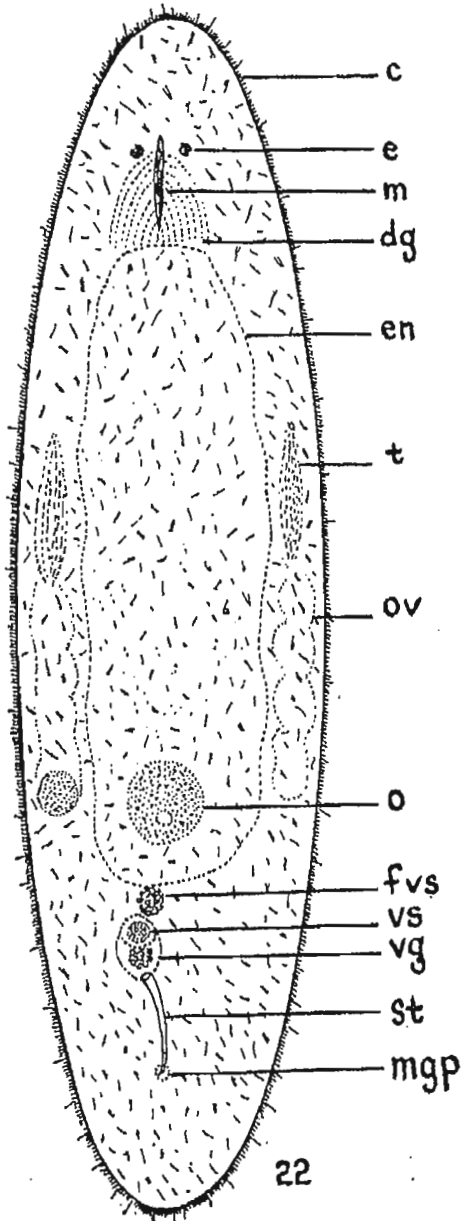


PLATE VII

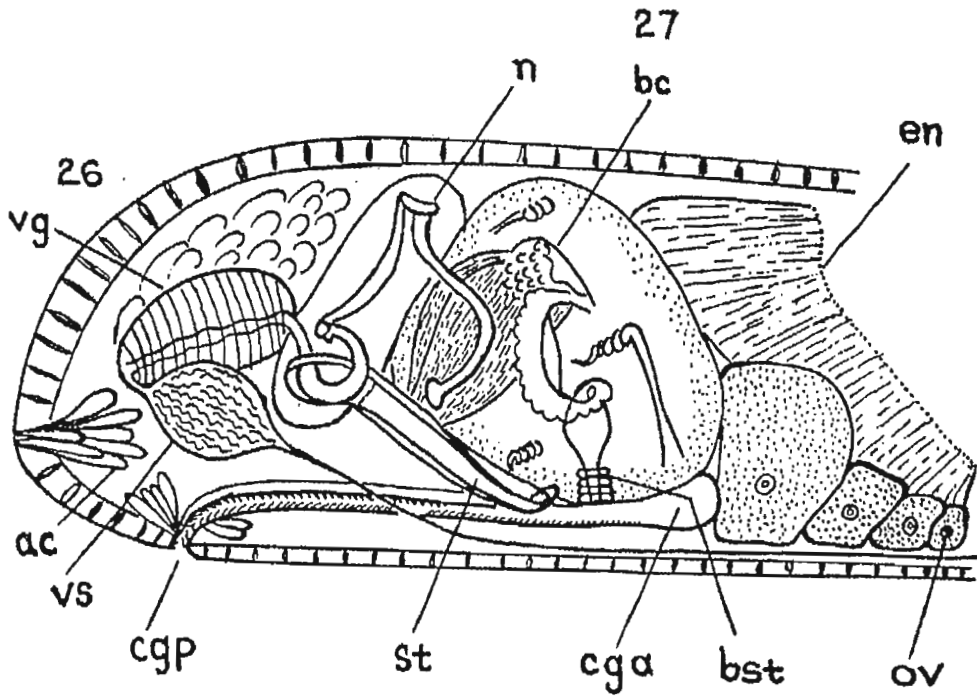
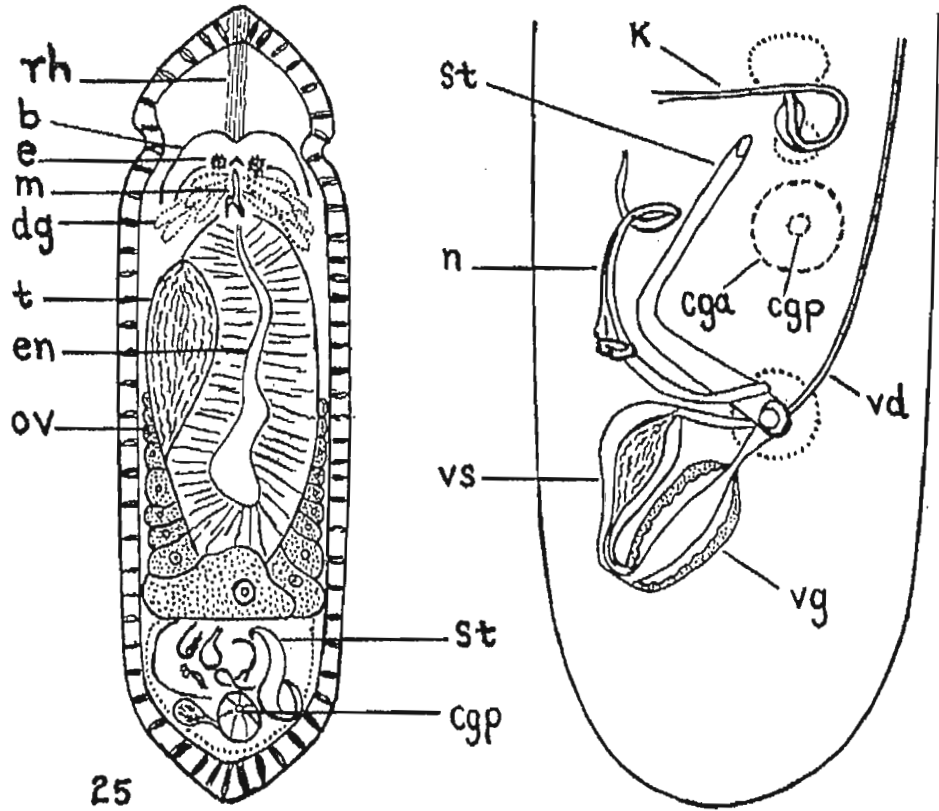


PLATE VIII

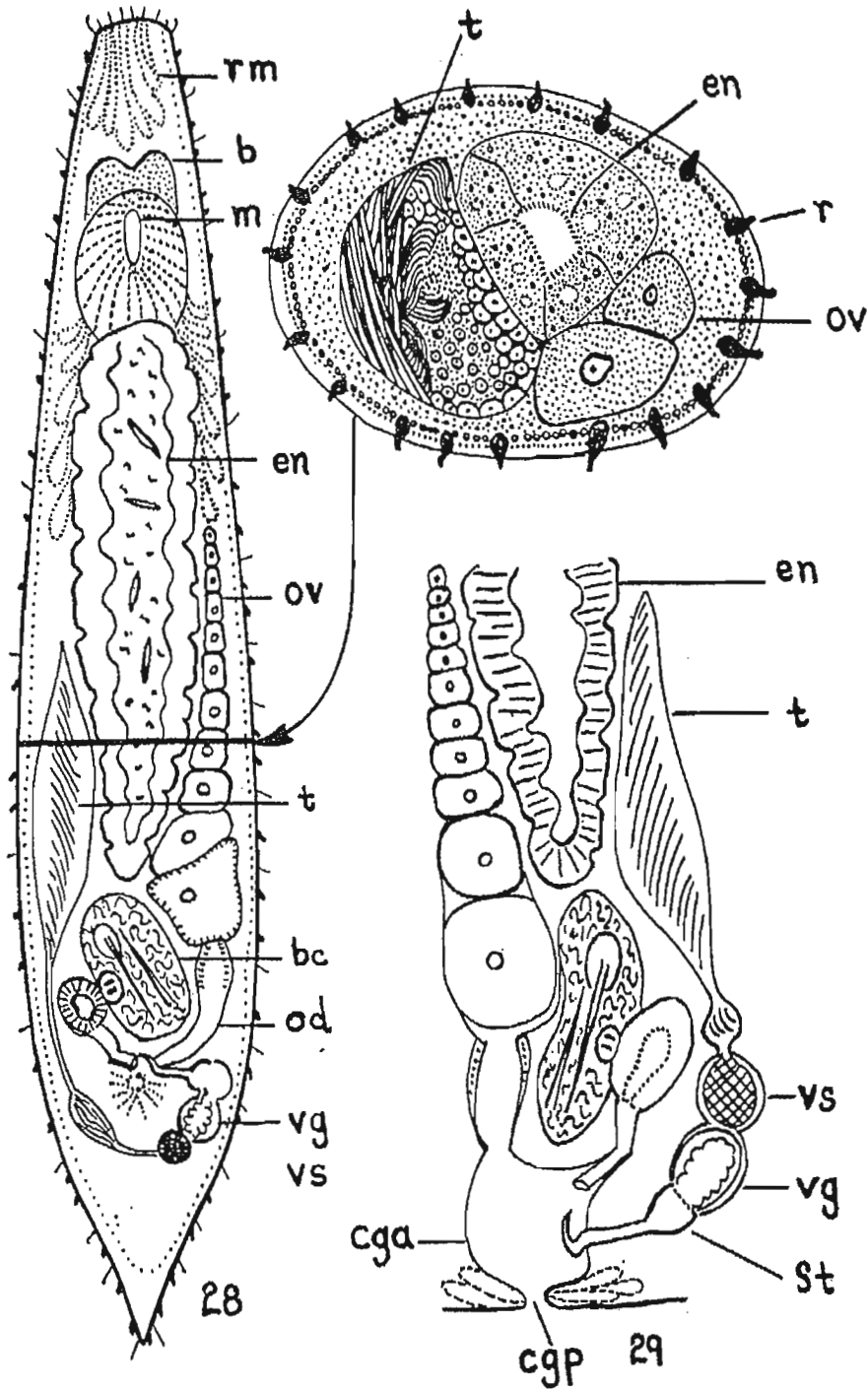


PLATE IX

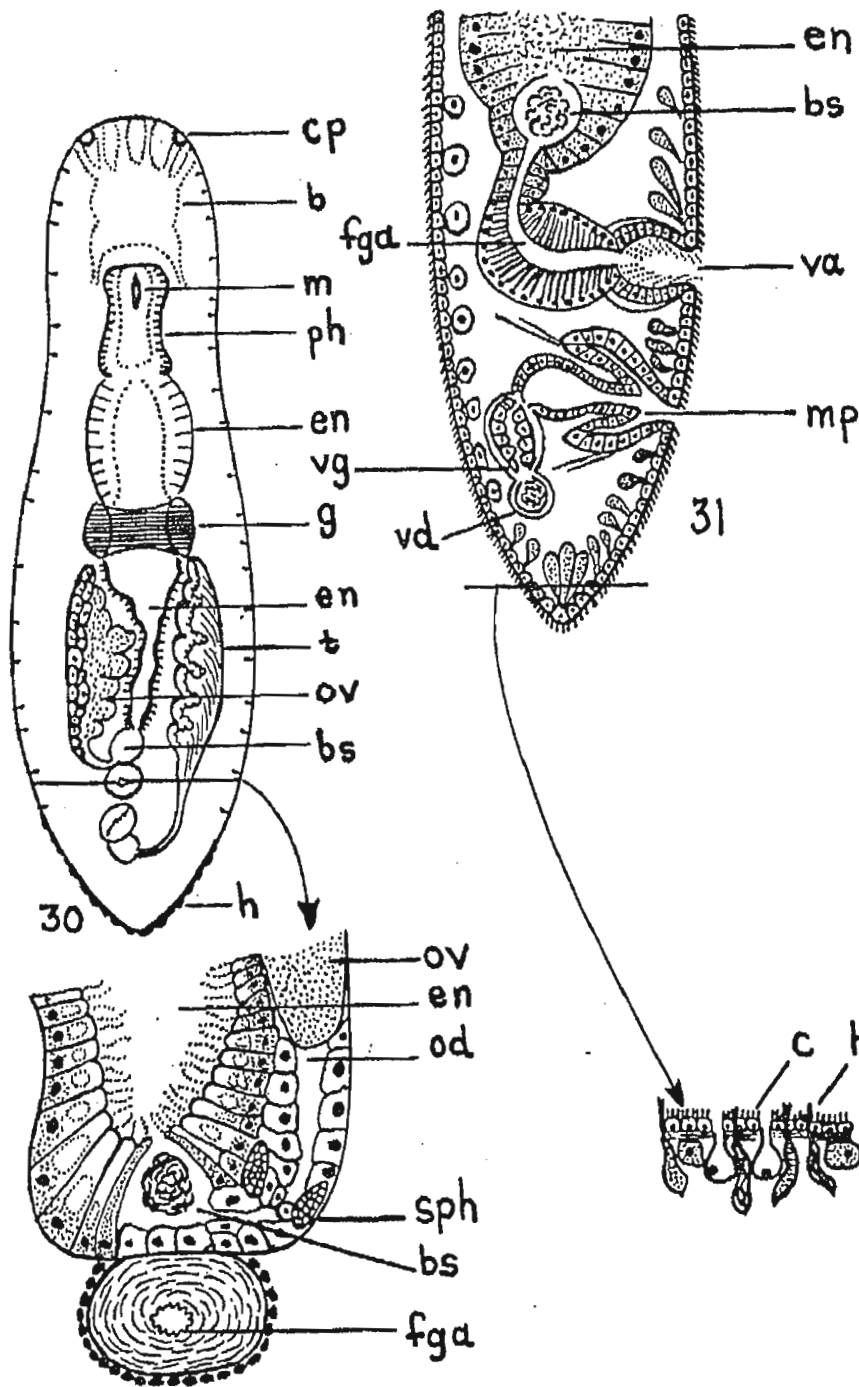


PLATE X

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A CHROMOSOME STUDY OF *LUMBRICUS TERRESTRIS* (L.)

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Previous estimates of chromosome numbers in the oligochaetes have been very few. Foot and Strobell (1905) found 11 chromosomes as the haploid number in *Allolobophora foetida*. Monné (1925 and 1927) found the same number in the first meiotic metaphase and 22 as the diploid number in spermatogonial and somatic cells of the same animal. Harvey (1916) lists a few other species with haploid numbers of 16 and 32 and diploid numbers of 32 and 64. Meek (1913) and Heuman (1931) independently reported the number 16 for the haploid and 32 for the diploid cells of *Lumbricus terrestris*. Bugnion and Popoff (1905) observed 16 chromosomes in the spermatocytes of *Lumbricus agricola*. Calkins (1895) has the same number for an unidentified species of *Lumbricus* which is probably *L. terrestris*. In *Lumbricus herculeus*, Chatton and Tuzet (1943) have seen numbers ranging from 30 to 36 for the diploid cells. The most frequent haploid number which they saw was 16. Muldal (1950) found haploid numbers ranging from 11 to 18 in various species of oligochaetes.