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

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(With 34 Figures.)

Eingeg. 9. September 1939.

Macrostomum riedeli mihi.

Macrostomum riedeli[1] mihi has only been studied from collections taken at Arsenic Springs, Kelley Flats, Giles County, Virginia.

This mountain dweller has the body form typical of the genus. The cephalic region is a distinct characteristic of this form. The spatulate tail region is not very pronounced. This colorless animal measures .9 mm. in length (Average of twenty specimens).

Rhabdites are prevalent throughout the epidermis in which they are embedded. In the anterior body they are developed in groups of 5, 6, or 8 and measure from 11.2 μ by 1.6 μ to 14.4 μ by 1.2 μ. In the mid-body they are arranged in groups of 2, 3, 5, or 8, while in the posterior body they appear singly and in groups of 2, 3, 5, 6, or 8. In these regions they have a measurement range from 12.8 μ by 1.6 μ to 12.8 μ by 1.2 μ. The rhabdites are cylindrical in shape. Adhesive rhabdites occupy the outer rim of the spatulate tail. They are about 2 μ in diameter when attached to a substratum.

Sensory hairs (Fig. 1) appear in groups of 3 or 4 over the body. They average about 16 μ in length. Those of the posterior body have a length range of from 23.8 μ to 34 μ.

The entire external body surface is covered with cilia (Fig. 1) which are approximately 6.4 μ in length. They are interspersed among the other surface structures of the animal and are constantly in action.

Rigid spinous processes are present over the body surface, appearing in groups of 2 or 3 at the body extremities. On the lateral body surfaces they are about 96 μ apart and may appear singly here. Their average length is 16 μ.

The "brain" (Fig. 1) is the usual type, being composed of two ganglia joined by a medio-dorsal commissure, which has postero-lateral extensions. Glandular ducts may be seen extending an-

[1] *Macrostomum riedeli* mihi has been named in honor of Dr. Greta Riedel, who has made noteworthy contributions to the study of *Macrostomum*.

teriorly passing through the space allowed by the indented commissure. The eyes (Fig. 1) are composed of oblong masses of spheroidal granules. These visual organs average 6.4 μ by 9.6 μ, while the component dark brown spherules are 1.6 μ in diameter. The eyes are 24 μ apart.

The mouth (Fig. 2) is located mid-ventrally in the first sixth of the body. It is bordered by two ciliated muscular lips which are 6.4 μ wide. The lengthened split is 28.8 μ long. The opening may enlarge to engulf copepods one-half the size of the animal. The mouth is bordered by typical glandular ducts which lead into granular radiating streamers laterally and in both axial directions. In a ventral view, the mouth is shown emptying into the conical pharyngeal cavity whose epithelio-muscular walls communicate with the flagellated enteron (Fig. 2).

Externally opening glands, which are characterized by their granular content, are dispersed throughout the body, being more numerous at the external openings. Gland cells as far posterior as the mid-body level appear to join the glandular system of the mouth area. An interesting rim of glands ("Stäbchendrüsen") is located beneath the dorsal epidermis over the spheroidal female genital atrium. These glands, which produce short oblong granules, are smaller than those of the mouth region.

The excretory system is composed of two lateral longitudinal tubules 2.4 μ in caliber. A cross branch has been observed extending at right angles to the main tubules in the mid-body region 176 μ from the anterior end. The tubules become increasingly smaller toward the anterior end of the body (caliber 1.6 μ). Flame cells are abundant throughout the body. It has been noted that sexual immaturity coincides with the lack of protonephridial development. The external opening was not observed.

The testes are located in the typical antero-lateral position some 152 μ posterior to the eye level. They range in size from 40 μ by 8 μ to 56 μ by 16 μ. The structure is that of an elongate muscular sack with a very small lumen. Sperm-cell production has been found to be more prevalent during June and July.

Vasa deferentia extend from the testes at their most postero-ventral point. They describe a longitudinal route, passing ventral to the ovaries, to the false vesicula seminalis just posterior to the enteron where the two unite. The wall of a vas deferens is capable of great distension to accommodate large numbers of sperm-cells. The false vesicula seminalis is a non-muscular distensible

anterior portion of the vesicula seminalis. This latter structure is ciliated and capable of passing the bolus of sperm-cells by means

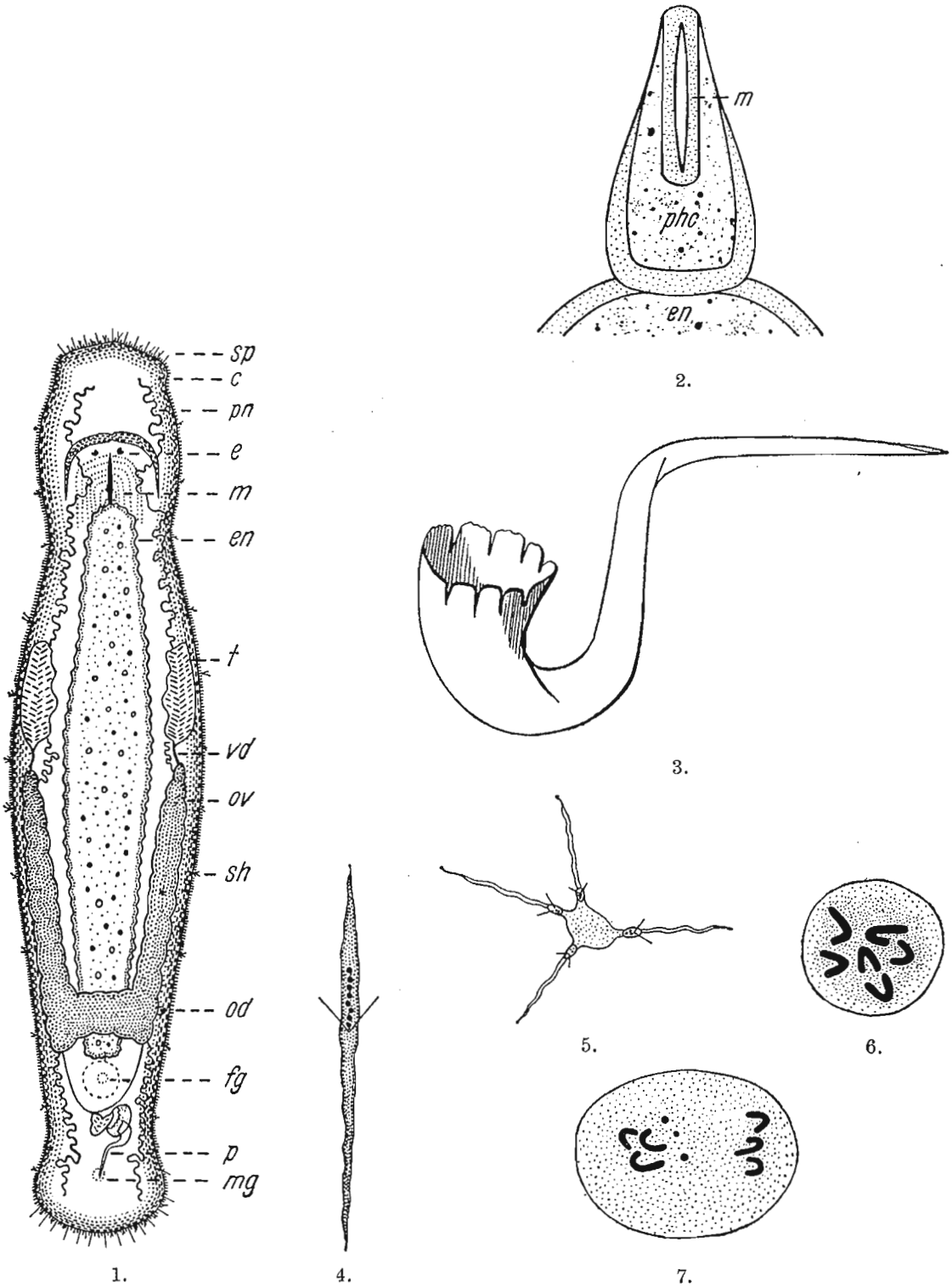

Fig. 1. *M. riedeli* mihi. Dorsal view of gross anatomy. 100 ×.
Fig. 2. *M. riedeli* mihi. Dorsal view of pharyngeal cavity. 420 ×.
Fig. 3. *M. riedeli* mihi. Penis-stilette. 2000 ×.
Fig. 4. *M. riedeli* mihi. Mature sperm-cell. 800 ×.
Fig. 5. *M. riedeli* mihi. Immature sperm-cells with heads buried in nurse-cell. 420 ×.
Fig. 6. *M. riedeli* mihi. Somatic chromosomes. 2400 ×.
Fig. 7. *M. riedeli* mihi. Germinal chromosomes. 2000 ×.

of the release of a set of sphincter muscle fibers into the vesicula granulorum. The granulorum has from 4 to 5 ciliated chambers

which aid in driving the sperm-cells and granular material into the genital canal of the stilette.

The penis-stilette (Fig. 3) is a greatly curved funnel which extends from a very broad, deeply indented base and suffers two changes of direction—one a half circle and the other a right angle bend at which point by a gradual reduction the genital canal terminates in a very sharp point. The external opening is terminal and oval in shape and is formed by an angular truncation of that part of the stilette of about 15°. The average greatest length taken from a study of 20 mature specimens of this form is 24 μ; this figure, however, does not give the actual length of this greatly curved stilette. The range of greatest length in the stilette is from 15 μ to 40 μ in those specimens studied.

The male opening is typically a medio-ventro-posterior one. The marginal lips are ciliated and are located just posterior to the normal position of the stilette point.

The mature sperm-cells, as taken from the vesicula seminalis and studied in macerated preparations, measure 44.8 μ for the average length. They possess a tactile feeler, an undulating mid-body provided with two short setae, and a highly vibratile tail region (Fig. 4). The setae appear early, already existing when the sperm-cell is yet joined with the nurse cell (Fig. 5). A longitudinal row of chromatin granules extends from the origin of the latero-posterior pair of setae.

The ovaries are latero-dorsally disposed lobate bodies which occupy a position in the posterior third of the animal. The ovaric proper are longer than the oviducts are wide (Fig. 1, *ov*). These latter are grayish-black and are filled with granular yolk material which has free concourse within their boundaries. The broadened oviducts lead into a common oviduct, which in turn communicates with the spheroidal female genital atrium (Fig. 1, *ga*). This structure is destined to hold maturing eggs and may be temporarily distended to accommodate them.

The female gonopore is located in the hollowed ventral portion of the genital atrium and is supplied with ciliated margins. The ciliary action creates a characteristic whirling current in the gonopore. This opening to the exterior marks the termination of the female reproductive system. The diameter of the mature light brown egg contained in the genital atrium is approximately 119 μ. The deutoplasmatie spherules composing the major portion of the eggs are about 1.6 μ in diameter.

Good chromosomal plates are obtainable by the use of BELLING's Iron-aceta-carmine technic. The chromosome number is $n = 3$, $2n = 6$. The somatic complement is shown (Fig. 6) in a metaphase plate, while the germinal complement is shown (Fig. 7) in an early telophase of meiosis; this plate has three unusual chromatic spherules which fail to pass to either pole.

Taxonomically, *M. riedeli* mihi is related to that group of *Macrostomum* whose penis-stilettes have a sharpened point and a terminal opening. This group includes: *M. crenatostylum* mihi, *M. collistylum* mihi, *M. gilberti* mihi, *M. ruebushi* mihi, *M. ruebushi* var. *shenandoahensis* mihi, *M. lineare* ULJANIN, *M. orthrostylum* BRAUN, *M. ruebushi* var. *frigorophilum* mihi, *M. ruebushi* var. *granulophorum* mihi, *M. ruebushi* var. *truncatum* mihi, *M. vedjovskýi* mihi, *M. virginianum* FERGUSON, *M. viride* BENEDEN, *M. ruebushi* var. *carolinensis* mihi. However, *M. riedeli* mihi differs from all of these above named forms for none of them have the greatly widened and indented proximal portion of the stilette, which then endures a very gradual reduction to the sharpened point, including one bend of a complete half-circle and one right angle bend.

The unique structure of the sperm-cell and the mid-body commissure of the protonephridia are also peculiar features of this species.

Species Diagnosis.

Macrostomum riedeli new species: Body has cephalic mid-body and tail regions, colorless, rhabdites in three sizes, adhesive rhabdites on posterior body rim, epidermal inclusions encompass sensory hairs, spines and cilia, rosette of "Stäbchendrüsen" dorsal to female genital atrium, protonephridia joined at mid-body level, non-muscular false vesicula seminalis present, ciliated chambers in vesicula granulorum, penis-stilette is funnel with widened indented base extending by means of two bends to terminate in sharp point, opening terminal, length 24 μ, sperm-cells are undulant filaments with two short postero-lateral setae (44.8 μ long), ovaries lobate, chromosome number $n = 3$, $2n = 6$, body length .9 mm.

Macrostomum ruebushi mihi.

Macrostomum ruebushi[2] mihi may be found living in the waters of Little River, Blount County, Tennessee, which is within the boundaries of the Great Smoky National Park, and at Prince Lake, Suffolk, Virginia.

The animal's shape is that of a cigar with rounded extremities. There is a peculiar absence of the spatulate tail. This colorless worm measures about 1.7 mm. in length (Fig. 8).

A "Rhabditenstrassen" composed of sparse streamers is located in the anterior body (Fig. 8, *rm*). Epidermal ciliation consists of cilia, sensory hairs, and a few anterior spines. The lateral sensory

[2] This new species, which forms a basis or type species for a number of varieties, has been named in honor of my friend and critic, Dr. T. K. RUEBUSH of the Osborne Zoological Laboratory, Yale University, New Haven, Connecticut.

hairs measure about 30 μ in length. Rhabdites are thickly spread over the body surface in groups of from six to eight. They measure about 13 μ in length.

The small black eyes (Fig. 8, *e*) are located dorso-posteriorly to the "brain". The morphology of the bi-ganglionic "brain" is ordinary (Fig. 8, *br*).

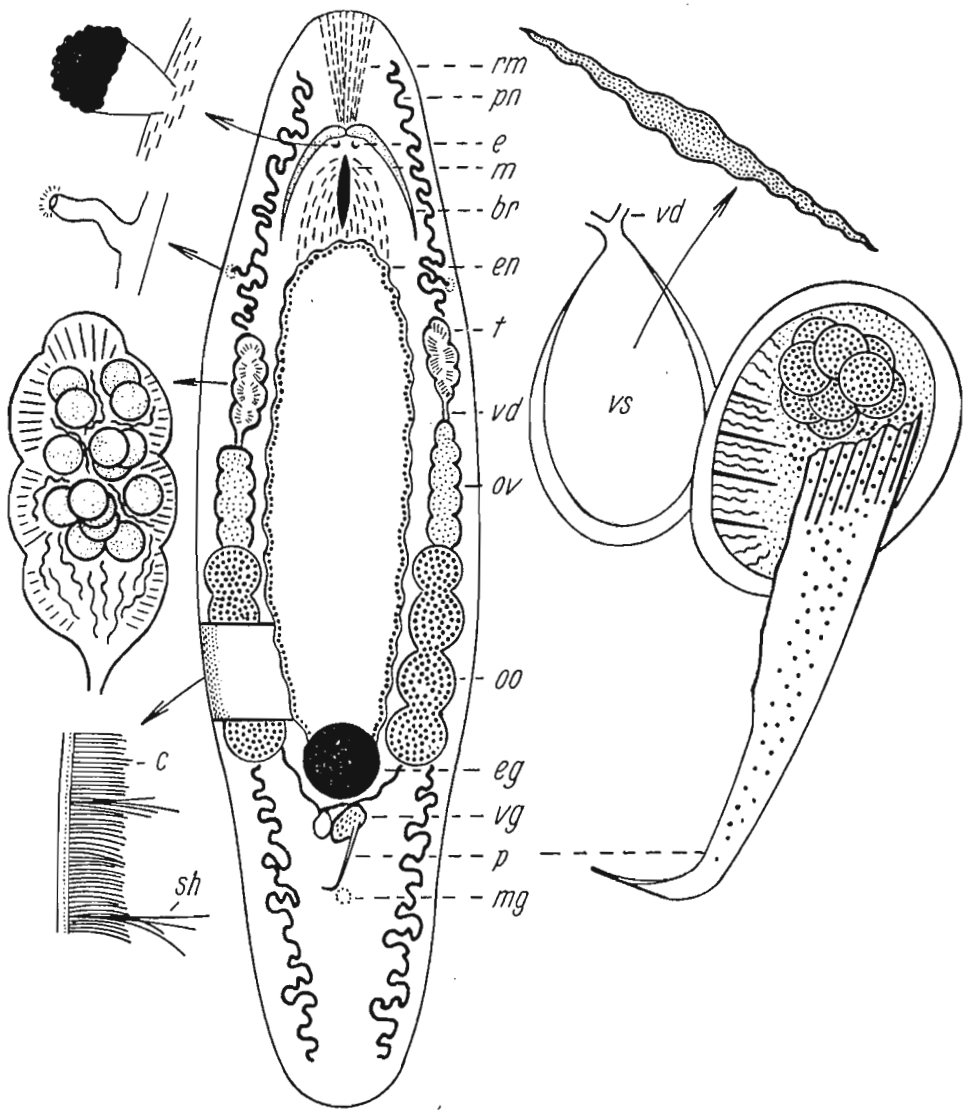

Fig. 8. *M. ruebushi* mihi. Dorsal view of gross anatomy. 90 ×. Detail of male sex apparatus. 675 ×. Mature sperm-cell. 144 ×. Gross anatomy of eye. 600 ×. Dorsal opening to protonephridia. 600 × Testis showing large nurse-cells. 600 ×. Epidermal ciliation. 810 ×.

The anatomy of the digestive system does not present features worthy of specific description. The accessory glands outlining the borders of the mouth (Fig. 8) pour their products consisting of mucus and rhammitten into the mouth opening. These products are elaborated in separate type gland cells.

The protonephridia are disposed laterally, the coiling tubules extending from one extremity to the other.

The external, dorsal openings to this system (Fig. 8) are

located some 240 μ posterior to the level of the eyes. A small secondary collecting vesicle communicates (Fig. 8) directly with the circular ciliated opening. Cross-commissures to this system were not observed.

The testes (Fig. 8, *t*) are short pyriformed organs located laterally in the first third of the body. The nurse cells, between which are wound numerous sperm-cells, are unusally large, measuring 12 μ in diameter. The appended vasa deferentia join caudally just to the left of the midline and posterior to the female genital atrium, to communicate with the vesicula seminalis. This structure is a ciliated and thickly walled sack which is connected by a short ductus ejaculatorius to the vesicula granulorum (Fig. 8, *vg*).

The vesicula granulorum is provided with four or five ciliated chambers (Fig. 8) at its connection with the vesicula seminalis. Accessory glands to the granulorum are present. The granular material is congregated in that part of the granulorum which communicates with the penis-stilette and in which the walls are very thin (Fig. 8). This massing of the granular material into discrete spheroidal masses is continued into the stilette and down the genital canal to the end of the penis-stilette.

The penis-stilette (80 μ) is unique in that the proximal basal portion is not only dentated but is truncated at an oblique angle (Fig. 8). This penis funnel is terminally curved and sharply pointed. The opening is terminal on this stilette.

The sperm-cell in this form measures about 17 μ in length. Setae are lacking in this cell.

The present literature upon this genus does not encompass a description which corresponds to that of *M. ruebushi* mihi.

Species Diagnosis.

Macrostomum ruebushi new species: Body cigar-shaped with rounded extremities, spatulate tail lacking, epidermal ciliation includes cilia, sensory hairs and anterior spines, protonephridia open to exterior latero-dorsally behind pharynx, testes are short and pyriform, vesicula granulorum has proximal thick walls, distal thin walls and four to five ciliated chambers at the ductus ejaculatorius, granules are massed to form spheroidal bodies in genital canal, penis-stilette has dentate and obliquely truncated base and a terminally curved end, body length up to 1.7 mm.

Paratype: U.S.N.M. No's. 20444, and 20467.

Macrostomum ruebushi var. *carolinensis* mihi.

Macrostomum ruebushi var. *carolinensis* mihi lives in a beautiful spring-fed lake upon the Cohen estate, Blowing Rock, North Carolina. The water of

this lake maintains a low temperature throughout the year, since it rests at an altitude of 4000 feet. This animal thrives in the algae lining the shores of this lake.

The average dimensions of the specimens studied were about 1 mm. by 2 mm. The animals are colorless except for the yellow-green enteron. The shape of the body is peculiar to this animal. I have not seen another *Macrostomum* which has the distinct shape of this one. The head is truncated at its anterior tip and has a pair of lateral convexities at the level of the mouth. The middle portion of the body is broadest. There is a narrowed region at the level of the sex apparatus. The tail has an unusual degree of spatulation and by adhering with this "Haftscheibe" the animal is able to twist and turn in every possible direction without losing contact with the sub-stratum. This variety is a rapid swimmer and when in motion loses its characteristic crawling shape just described and assumes the contour of a cigar.

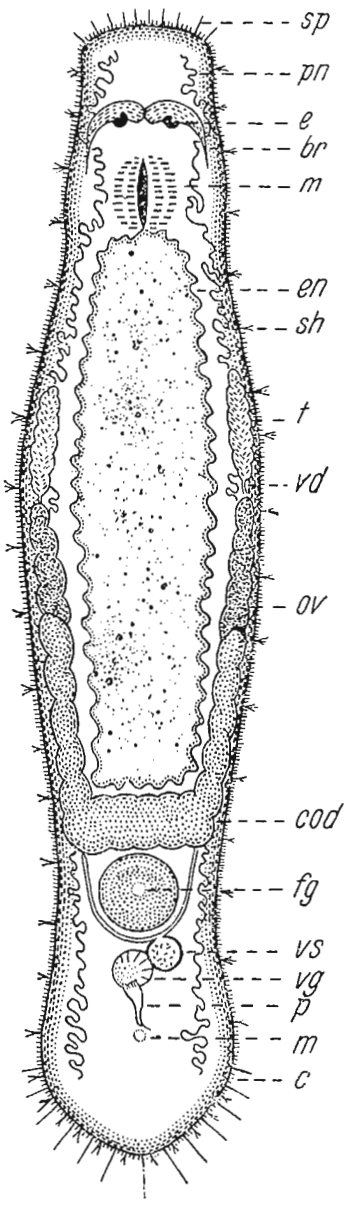

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Fig. 9. *M. ruebushi* var. *carolinensis* mihi. Dorsal view of gross anatomy. 105 ×.
Fig. 10. *M. ruebushi* var. *carolinensis* mihi. Penis-stilette. 600 ×.

The rhabdites to not present any unusual feature except that the epidermis is very thickly supplied with them. The spines in this variety are very long. Those of the posterior body are about twice the length of those of the anterior region. A normal complement of sensory hairs and cilia are present on the surface of the epidermis.

The eyes (Fig. 9, *e*), which are large and very black, are embed-

ded in the surface of the "brain". They have the typical pigmented cup plus a lens. The "brain" is (Fig. 9, *br*) characteristic of the genus. "Rhabditenstrassen" extend to the anterior from below and above the commissure of the "brain".

The mouth is amply supplied with mucous glands which radiate from the ciliated lips of this mid-ventral opening. The pharynx simplex opens to a comparatively large ciliated enteron which is diverticulated more so than in other *Macrostomum* that I have examined. The yellowish-green color of the enteron is due to the algae upon which the animal feeds.

The excretory system, as in all *Macrostomum* that I have studied, is constituted of two lateral, very small, convoluted tubules. Subsidiary branches and flame cells are present in the system. The external opening has not been determined.

The testes (Fig. 9, *t*) in this animal at maturity are very small. Their walls are slightly indented upon both their median and lateral sides. Vasa deferentia extend from them to the vesicula seminalis and communicate with this structure as they join just to the right of the mid-line of the body. The vesicula seminalis is large and round and the vesicula granulorum is relatively small. Ciliated pits are present in the vesicula granulorum. The penis-stilette (Fig. 10) originates in the granulorum and terminates at the male gonopore. The stilette has the shape of a funnel whose walls are slightly bent and whose stem appears to have become bent and then mashed almost flat. The long oval opening occupies the entire end of the bent portion of the stilette. The base is crenated. The hooked end of the stilette points ventrally toward the male opening.

The female system, consisting of ovaries, oviducts, common oviduct, genital atrium, and female gonopore, does not present an unusual picture except that the ovaries are very dark, while the oviducts are quite light in color. The glandular radiations extending from the ventral female gonopore appear to be oblong in shape. The mature egg is blackish-brown in color. An amphiaster so large as to be readily examined under the 16 mm. objective in the living condition has been observed.

A study of the anatomical differences between this form and *M. ruebushi* mihi shows that they are of varietal value.

Variety Diagnosis.

Macrostomum ruebushi var. *carolinensis* new variety: Body anteriorly truncated, cephalic region distinct, colorless, well developed "Haftscheibe", epidermal structures include rhabdites, spines, sensory hairs, cilia, „Rhab-

ditenstrassen" present, testes small, indented, ciliated chambers present in vesicula granulorum, penis a bent funnel with crenated proximal end, body length up to 1 mm.

Macrostomum ruebushi var. *crenatostylum* mihi.

Macrostomum ruebushi var. *crenatostylum* mihi is found living in eastern Tennessee near Knoxville. It has been collected from a small spring-fed lake on the Sevierville highway five miles from Knoxville, from a spring-fed lake (Andrew Johnson Lake) ten miles from Knoxville, on the Chattanooga high-

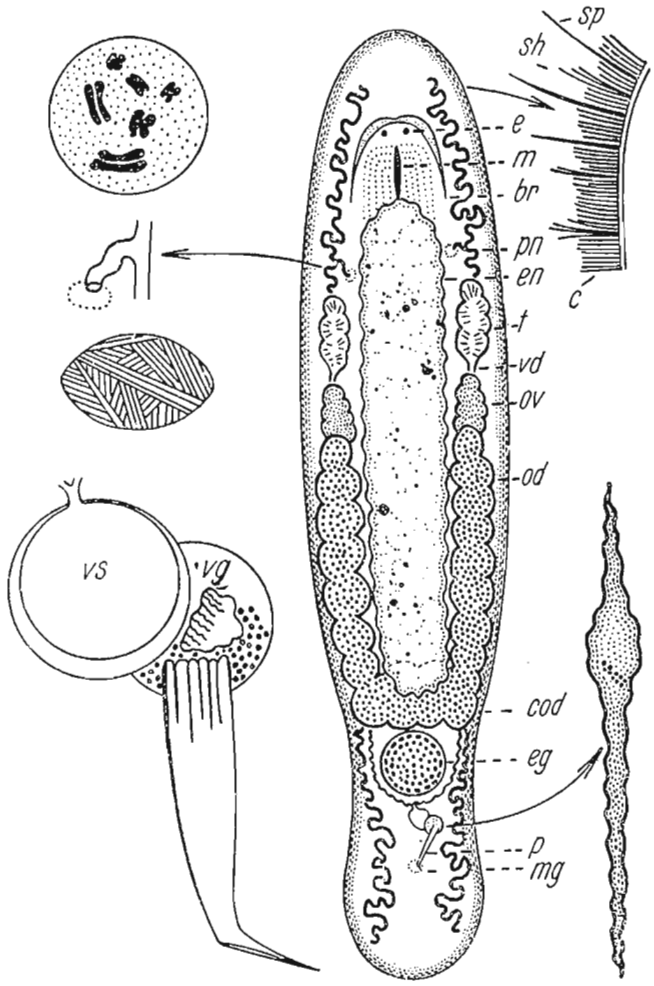

Fig. 11. *M. ruebushi* var. *crenatostylum* mihi. Dorsal view of gross anatomy. 69 ×. Detail of male sex apparatus. 600 ×. Sub-dermal cell. 300 ×. Metaphase of somatic chromosomes. 1680 ×. Ciliation. 510 ×. Mature sperm-cell. 1200 ×.

way, and from the Little River at Townsend, Tennessee, in the Great Smoky National Park. It lives associated with various water plants, including filamentous algae.

The animal (Fig. 11) has a slender cylindrical shape with rounded extremities. It is colorless except for the grayish-black ovaries and eggs. This *Macrostomum* measures 1.3 mm. by .3 mm.

Epidermal rhabdites which are found in groups of eight to ten over the body surface measure 11 μ by 1.6 μ. Many smaller single rhabdites are to be found which measure only 8 μ in length. The

cilliation consists of anterior spines 17 μ in length (Fig. 11, *sp*), sensory hairs (Fig. 11, *sh*) which occur over-all and cilia (Fig. 11, *c*). Many spindle-shaped antero-posteriorly directed cells (Fig. 11) lie in the epidermis. These epidermal cell-like inclusions are laterally massed to form two or three strata just anterior to the testes. Another type of cell has an occasional occurrence in the epidermis of the anterior body (Fig. in part IV). The light brown cell is filled with moving particles. In acetocarmine preparations, ameboid units which suggest a cellular structure appear in the epidermis over all.

The eyes are located postero-dorsal to the ganglia of the "brain". The anatomical features of these structures do not warrant a detailed description.

Those organs composing the digestive system are regular in their morphology. The pharynx in this species is capable of expanding in the triangular shape noted in the study of other species (Fig. in part II).

The paired protonephridia, which consist of coiled lateral tubules, empty to the exterior just anterior to the testes (Fig. 11). Cross-commissures were not observed.

The testes are elongate spindle-shaped laterally disposed organs (Fig. 11, *t*) located about 170 μ posterior to the mouth. The vesicula seminalis is a strongly muscular sack which is ciliated and oval in contour. The vesicula granulorum, with which it communicates diretly (Fig. 11) is small in proportion. The granulorum has a discrete ciliated cavity extending from the ductus ejaculatorius. Granular material is massed at the base of and in the genital canal of the penis-stilette.

The penis-stilette (Fig. 11) is a funnel with almost a straight main axis and a sharply pointed and bent termination. The terminal portion enclosing the external opening is bent at an angle of 115°. This stilette, whose basal proximal rim is unevenly crenated, measures 53 μ in length.

The sperm cells (Fig. 11) are about 43 μ in length. They have a feeler, body region and a thin filamentous tail. Setae are not present. There is a noticeable massing of chromatic granules in the body region of the cell.

A late metaphase plate taken from somatic tissue presents six pairs of chromosomes (Fig. 11): a large greatly bent pair, two large pairs with medium bends, a small uncurved pair and two small bent pairs.

The female reproductive system has no noteworthy features. The gray-black mature eggs measure 112 μ in diameter (circa).

The literature upon *Macrostomum* does not encompass a description comparable to that of *M. ruebushi* var. *crenatostylum* mihi. A comparison will show that the differences between this form and *M. ruebushi* mihi are varietal in nature.

Variety Diagnosis.

Macrostomum ruebushi var. *crenatostylum* new variety: Body is cylindrical with rounded extremities, colorless except for gray-black eggs and ovaries, two types of rhabdites, epidermal ciliation includes spines, sensory hairs and cilia, protonephridia open dorsally posterior to mouth in lateral position, vesicula seminalis strongly muscular, vesicula granulorum reduced, ciliated chambers absent in vesicula granulorum, penis-stilette is funnel with angular bend of 115° at sharp-pointed termination, opening terminal, lengt 53 μ, sperm-cells lack setae, measures 43 μ in length, possess chromatic granules, body length up to 1.3 mm.

Paratype: U.S.N.M. No's. 20445, 20468, and 20469.

Macrostomum ruebushi var. *finnlandensis* mihi (*M. viride* of Luther 1905)[3].

1905. "*Macrostomum viride*" Beneden, A. Lulher in: Festschr. Palmén, **1** (5), t. 4, 48, t. 3, t. 1, f. 1, 9, 11; t. 2, f. 2, 3, 9; t. 3, f. 8; t. 4, f. 8—11, 23—25, 29, 36—39.

Macrostomum ruebushi var. *finnlandensis* mihi may be found in the fresh-waters of south Finnland at Kirchspiel Lojo. It is best collected in masses of water vegetation.

This form has a slender body (Fig. 12) rounded at both extremities; except for the dorso-ventral flattening of these extremitie the body is cylindrical in shape. There is no color to the body except that imparted by the enteric contents.

The ciliated epithelium is stated to contain numerous hyaline vesicular spaces. A basal membrane is lacking. Sensory hairs (75 μ long posteriorly) are developed over the external body surface. Rhabdites are concentrated in the usual epidermal surface groups being more numerous at the posterior end. The mouth is surrounded by a type of very thin rhammiten which measure about 6 μ in length and are elaborated in a system of radiating gland-cells around the stomatal opening. The rhabditic structures assume the form of ovoid "Stäbchen" in the region of the female gonopore where they appear as a radiating system. These "Stäbchen" measure about 6 μ long.

[3] The form studied by Dr. Luther under the name of *M. viride* is here given a new varietal position.

The fairly large reniform eyes are oriented in a latero-anterior fashion with the retinulae projecting forward. The pigmented spherules of the retaining cup are unusually large measuring 4 μ in diameter. The discoidal nucleus of the retinal cell occupies a lateral position.

The vasa deferentia join posteriorly and open into the dorsal part of the vesicula seminalis, which is supplied with circular and spiral muscle fibers. There is no false vesicula seminalis produced in this form. The vesicula seminalis and vesicula granulorum are said to lie very closely attached to one another. The penis-stilette (Fig. 13) is a slightly curved funnel with a distally sharpened point. The opening is terminal. The stilette is well supplied with protractor muscles. The mature sperm cells, as studied from sectioned material, are shown to possess a row of three chromatin granules. Two rodshaped chromosomes are described in the maturing egg. The ovaries are indented. This description was taken from LUTHER (1905).

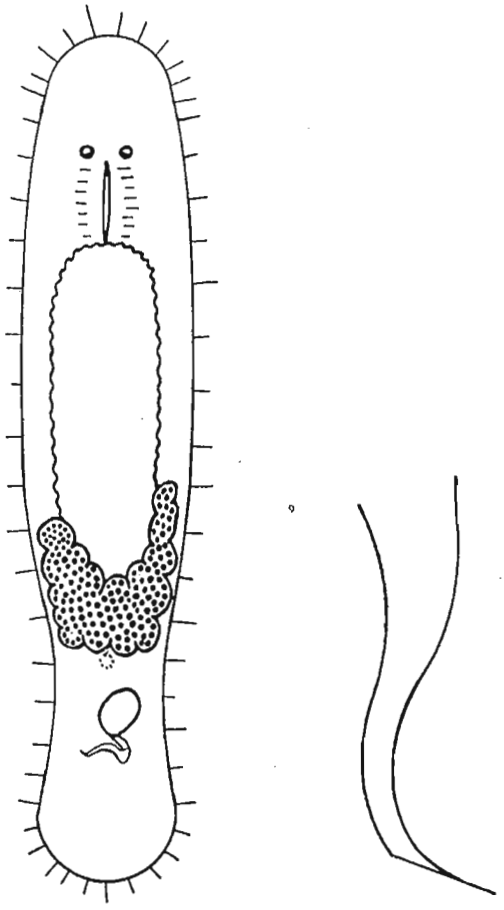

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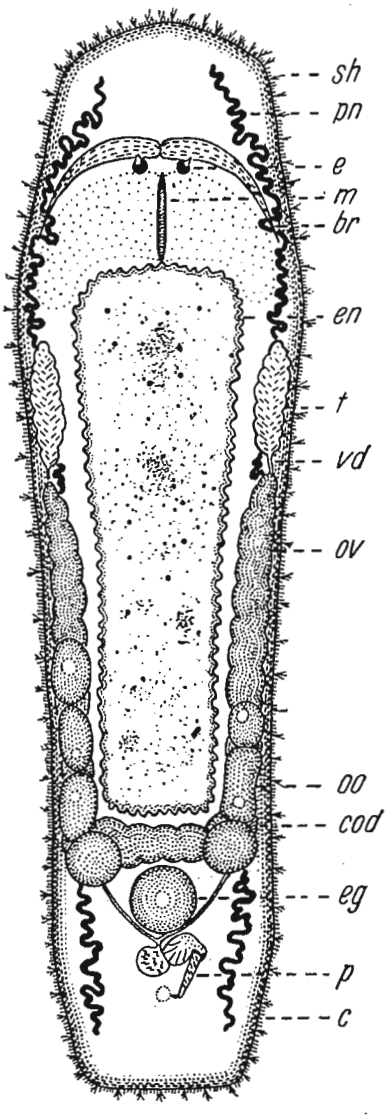
Fig. 12. *M. ruebushi* var. *finnlandensis* mihi. Dorsal view of gross anatomy. ? ×. (After Luther, 1905, Taf. III, Fig. 9.)
Fig. 13. *M. ruebushi* var. *finnlandensis* mihi. Penis-stilette. ? ×. (After Luther 1905, Taf. III, Fig. 9.)

Taxonomically, this new variety of the type species *M. ruebushi* mihi was mistaken by LUTHER (1905) for M. *viride* BENEDEN. However, this form does not resemble the form that BENEDEN described in 1870 (*M. viride* BENEDEN) in its anatomical features; this being particularly true with respect to the body shape and the morphology of the penis-stilette. Thus, it is more properly placed as a variety of the American form *M. ruebushi* mihi, since the stilette of this new variety and that of the type species are of the same common pattern.

Variety Diagnosis.

Macrostomum ruebushi var. *finnlandensis* new variety: Body slender, cylindrical, flattened and rounded at extremities, colorless, sensory hairs very long posteriorly, rhabdites more numerous posteriorly, hyaline vesicles present in epithelium of body surface, mouth surrounded by adenal rhammiten,

lemale gonopore surrounded by ovoid "Stäbchen", false vesicula seminalis facking, vesicula seminalis and vesicula granulorum in close union, penis-stilette is slightly curved funnel with distal point, opening terminal, mature sperm-cells have row of three chromatin granules, two rod-shaped chromosomes in maturing oöcyte, ovaries indented.



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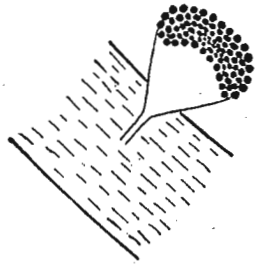

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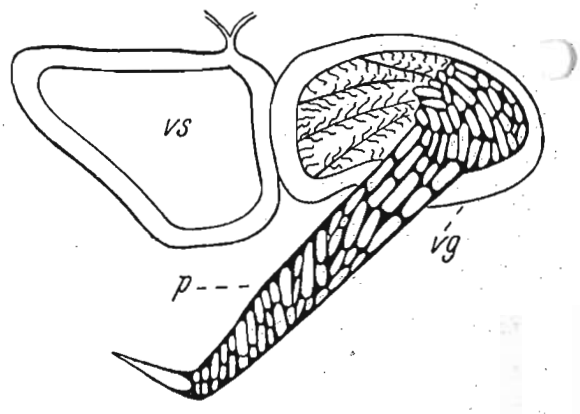

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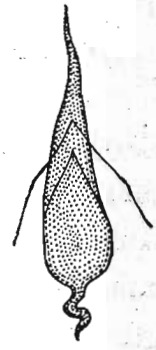

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Fig. 14. *M. ruebushi* var. *frigorophilum* mihi. Dorsal view of gross anatomy. 96 ×.
Fig. 15. *M. ruebushi* var. *frigorophilum* mihi. Gross anatomy of eye. 300 ×.
Fig. 16. *M. ruebushi* var. *frigorophilum* mihi. Male sex apparatus. 390 ×.
Fig. 17. *M. ruebushi* var. *frigorophilum* mihi. Penis-stilette. 300 ×.
Fig. 18. *M. ruebushi* var. *frigorophilum* mihi. Mature sperm-cell. 600 ×.

Macrostomum ruebushi var. *frigorophilum* mihi.

Macrostomum ruebushi var. *frigorophilum*[4] occurs abundantly in a large spring in Rockbridge County, Virginia. This springhead is large enough to maintain a constant low temperature throughout the year. The animals were taken in large masses of *Spirogyra* in which they live and were then cultured

[4] The numerous specimens from which this description is taken were made available to me through the kindness of Mr. Thomas Alphin of this laboratory.

in Petri dishes kept in a refrigerator for about two months without the loss of a single specimen. At the time this study was terminated many half-grown specimens could be seen in the culture.

The body shape (Fig. 14) of this animal resembles a long barge whose anterior end is not so abruptly truncated as the posterior end. There is a slightly narrowed mid-body region. The characteristic spatulation of the caudal region is distinctly lacking in this animal, however it performs the function of adhesion without the assistance of a pronounced adhesive disk. A characteristic area of fine epidermal granulation is found extending latero-caudal from the mouth. The animal is quite colorless. The average length of the worm is 1.6 mm. and the width is .4 mm.

The rhabdites are unusually numerous throughout the epidermis. They have the typical generic shape and are approximately .1 μ by 1.1 μ in dimension. They are found grouped in collections of seven and eight.

There are no spines, and the sensory hairs (Fig. 14, *sh*) are located in groups of two and three mostly at the extremities of the body. Those on the body-ends measure about 2 μ, while those on the body sides measure about 5 μ in length. The cilia over the body measure about 1.3 μ in length.

The shape of the brain ganglia follows to a degree the anterior limits of the granular area in the epidermis about the mouth. The eyes (Fig. 15) are made up of a pigmented cup supplied with a hyaline lens-like region connected to the "brain" by a slender neutral stalk.

The digestive system is composed of mouth, pharyngeal cavity, and enteron. The mouth (Fig. 14, *m*), an anterior, mid-ventral opening guarded by ciliated lips, is unusually long, and has fewer than the ordinary number of mucous glands surrounding it. Unless distended, the pharynx simplex is not discernable. The enteron (Fig. 14, *en*) conforms to the shape of the body, tapering from a broad origin and terminating just anterior to the common oviduct.

The excretory system (Fig. 14, *pn*) is composed of two main lateral stems which become quite small as they near either body extremity. These main branches cannot be visually followed for their entirety. The opening to the exterior has not been determined.

The male reproductive system is made up of testes, vasa deferentia, vesicula seminalis, vesicula granulorum, and penis stilette. The testes (Fig. 14, *t*) have muscular walls and are laterally located

in the posterior first-half of the body. A vas deferens (*vd*) extends from each testis, runs ventral to the ovary and joins in the mid-line, posterior to the female genital atrium, with the vas deferens of the opposite testis. There may or may not be a false vesicula seminalis formed at this point. The vesicula seminalis (Fig. 16, *vs*) is a distensable muscular-walled sack containing the mature sperm. This spermiary connects with the vesicula granulorum (Fig. 16, *vg*) by a sphincter which guard the entrance into that organ. The granulorum possesses the characteristic ciliated chambers which aid in driving the sperm and granular material to the male genital canal of the stilette. This stilette (Fig. 17, *pm*) is lined by bands of muscles which presumably aid in ejaculation. The stilette has a bend of almost a right angle at its sharpened termination and opening. As a general observation throughout the genus in those stilettes possessing a hooked end I have noticed that the bent point always extends ventrally toward the male opening. The average length of the stilette is 88 μ. The male gonopore is a simple, circular, epitheliated opening whose margin is ciliated. The diameter of the opening is 2.7 μ and it is located 32 μ from the posterior end of the body.

The sperm-cell (Fig. 18) of this animal at maturity measures 52 μ by 7 μ. The cell's shape suggests an irregular spindle and possesses the normal complement of tail, body, feeler, and lateral setae. Chromatin granules are absent.

The female reproductive system contains ovaries, oviducts, a common oviduct, female accessory glands, female genital atrium, and female gonopore. The ovaries (Fig. 14, *ov*) are long, semi-lobed structures and occupy the dorso-lateral space between the body wall and enteron. They extend from the posterior extremity of the enteron to the testes. They become reduced and somewhat pointed at their origin. The oviducts (*od*) from the ovary of each side join in the mid-line and communicate with the common oviduct, which leads into the female genital atrium. There is a sphincter at the latter union. The female genital atrium is an internally ciliated spheroidal sack which may be distended by a mature egg awaiting oviposition. The female gonopore resembles the male gonopore except that it is usually about twice as large and is surrounded by a system of radiating accessory glands. Maturing eggs are arranged in a chain-like series in the oviducts (Fig. 14). There is considerable difference in size between the developing oöcytes and the mature egg found in the genital atrium.

Taxonomically, this animal is established as a new variety of *M. ruebushi* mihi because of the following differences:

(1) The stilette of this variety, while being of the same type as that of the type species, has three notable differences: (a) The stilette of *M. ruebushi* mihi has a constant indentation mid-way in the tube. This variety does not have this feature. (b) The peculiar hooked end of the stilette of *M. ruebushi* mihi is at an angle of 45°. The corresponding angle in this variety is 90°. (c) The stilettes of *M. ruebushi* mihi average 96 μ in length. Those of this variety average 88 μ.

(2) There is a sharp distinction between the body shapes in the two animals.

(3) *M. ruebushi* mihi hat the average body dimensions of 2.3 mm. by .8 mm. *M. ruebushi* var. *frigorophylum* mihi has the average dimensions of 1.6 mm. by .4 mm.

(4) The granular area in the epidermis near the mouth is chracateristic of *M. ruebushi* var. *frigorophylum* mihi and is not apparent in *M. ruebushi* mihi.

(5) The median side of the testes of *M. ruebushi* mihi are distinctly lobed. The testes of *M. ruebushi* var. *frigorophylum* mihi are only slightly indented.

(6) Mouth glands are present in *M. ruebushi* mihi and are absent to a great extent in *M. ruebushi* var. *frigorophylum* mihi.

(7) The eye of *M. ruebushi* mihi is sessile in its relation to the "brain", whereas in this form it is stalked.

(8) The granular material in the vesicula seminalis of *M. ruebushi* mihi is congregated into separate masses. This does not occur in *M. ruebushi* var. *frigorophylum.*

(9) The sperm-cells of *M. ruebushi* mihi lack setae, while those of *M. ruebushi* var. *frigorophylum* mihi possess two setae each.

(10) The sensory hairs of *M. ruebushi* mihi are less numerous than those of *M. ruebushi* var. *frigorophylum.*

Variety Diagnosis.

Macrostomum ruebushi var. *frigorophylum* new variety: Body-barge-shaped, distinct granular area near mouth, ciliated chambers in vesicula granulorum, eyes are embedded in brain tissues, sperm-cell is armed with setae, penis-stilette is a gradually reduced funnel with sharpened end at an angle of 90°, body length up to 1.6 mm.

Macrostomum ruebushi var. *granulophorum* mihi.

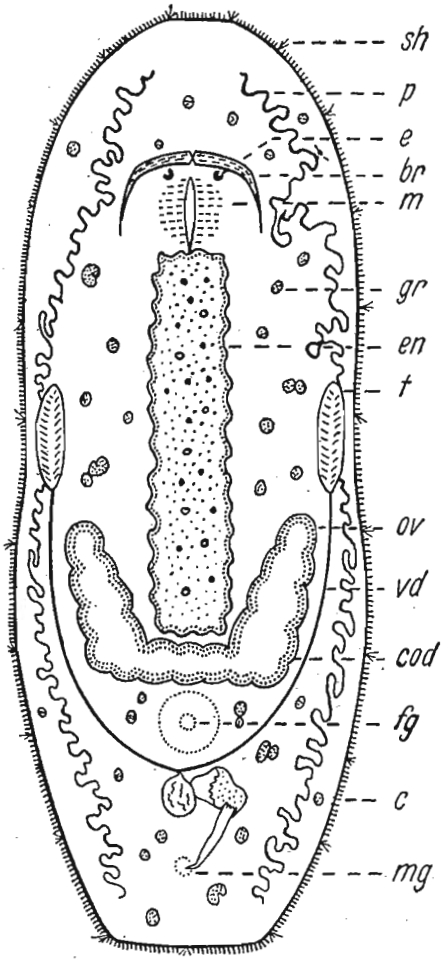
Macrostomum ruebushi var. *granulophorum* lives in the waters of the Yale Game Preserve, New Haven, Connecticut[5].

The shape of the animal (Fig. 19) is at variance with the usual generic shape found in *Macrostomum*. The anterior is rounded and the posterior is truncated and lacks a definite tail region. The body is broadened in both anterior and posterior regions. There is

[5] Dr. T. K. RUEBUSH of the Osborne Zoological Laboratory kindly supplied the material for this study.

a slightly narrowed mid-body region. The animal is colorless except for the occurrence of granular cells (Fig. 19) found in the epidermis. They are quite numerous and measure up to 51 μ in diameter. The color of these cells is light brown. Many of them are bilobed. The average body length is 1 mm.

Rhabdites are not very numerous in the epidermis. They are elaborated in sub-dermal adenal cells (Fig. 20) whose ducts



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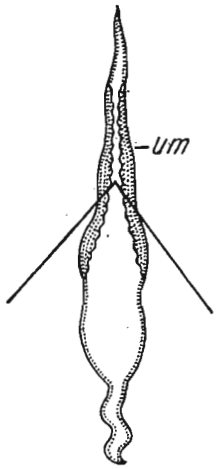

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Fig. 19. *M. ruebushi* var. *granulophorum* mihi. Dorsal view of gross anatomy.
Fig. 20. *M. ruebushi* var. *granulophorum* mihi. Rhabdite gland-cell. 750 ×.
Fig. 21. *M. ruebushi* var. *granulophorum* mihi. Ventral view of penis-stilette. 420 ×.
Fig. 22. *M. ruebushi* var. *granulophorum* mihi. Mature sperm-cell. 750 ×.
Fig. 23. *M. ruebushi* var. *granulophorum* mihi. Spermatogonial chromosomes. 1500 ×.

lead to the surface. There are no spines and the sensory hair tufts are few in number. The body surface is entirely ciliated.

The nervous system, with its "brain", which is made up of two ganglia (Fig. 19) joined in a narrow commissure and lateral extensions, is typical. The eyes (Fig. 19) are small, black, and are not embedded in the brain tissue, but occupy a position dorso-posterior to it.

The mouth (Fig. 19) is large and well provided with radiating

streamers of glands. There is a simple pharyngeal cavity leading into a rather small rod-like enteron.

The excretory system (Fig. 19) is of the usual tubular type, coursing laterally in two main branches which give off subordinate stems supplied with flame-cells at their termination. The external opening has not been determined.

The testes (Fig. 19) are small, smooth-walled, and are located in the mid-body region which is an inordinate position for these structures. Their vasa deferentia, as a constant generic feature, descend, one on either side, to unite and empty into the vesicula seminalis in the mid-line of the body. The vesicula seminalis (Fig. 19) is situated slightly dorsal to the granulorum and stilette. The granulorum has its granular material massed into a pavement-block arrangement around the walls of this structure. The granular material extends into the basal part of the stilette. Ciliated chambers are present in the granulorum. The penis-stilette (Fig. 21) is an irregularly reduced funnel with a pointed end hooked into a right hand bend. The opening is terminal and is toward the posterior. The base is wide and crenated. The stilette averages 99 μ in length.

The sperm-cell (Fig. 22) at maturity, as found in the seminalis, is of a long oblanceolate form. The body of the cell is gradually reduced anteriorly to become the feeler. A pair of undulating membranes (Fig. 22, *um*) line the sides of the cell in this region. The tail is short and curled. Two setae are present. Chromatin material is not visible in this sperm-cell.

The female sexual system contains the ovaries, oviducts, common oviduct, genital atrium, and gonopore. The oviducts and ovaries (Fig. 19, *ov*) are much broader than the average. The walls of the genital atrium are heavily ciliated.

A spermatogonial metaphase was studied to determine the chromosome morphology. There is a large, slightly bent pair, a medium-sized V-shaped pair, and a small pair with a bend in opposite direction.

This animal is accorded the taxonomic position of a variety beause of the following facts which show its relation to *M. ruebushi* mihi:

(1) The body shapes of *M. ruebushi* mihi and *M. ruebushi* var. *granulophorum* mihi have nothing in common.

(2) *M. ruebushi* mihi measures 2.3 mm. by .8 mm., while *M. ruebushi* var. *granulophorum* mihi measures 1 mm. by .3 mm. on the average.

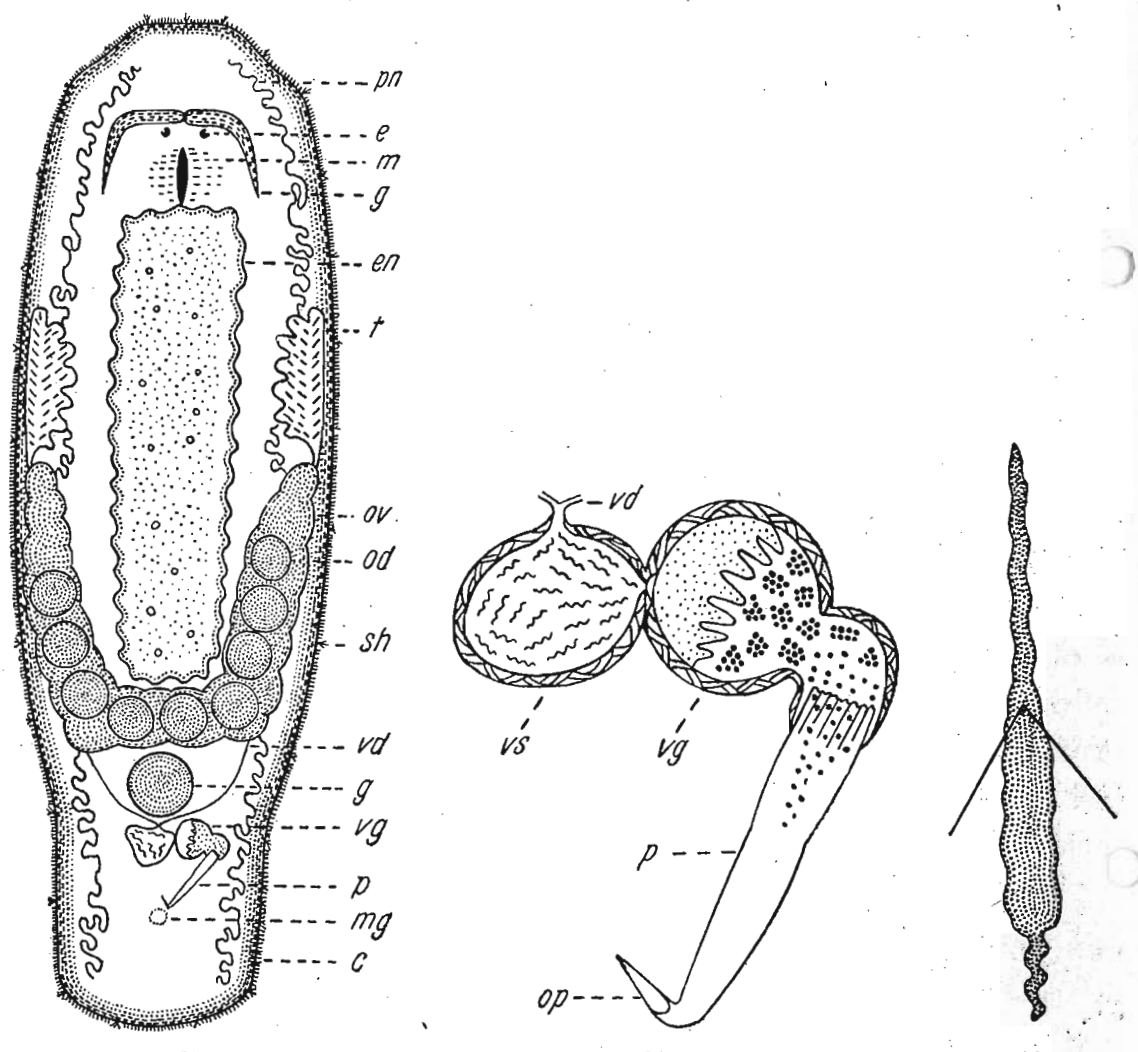
(3) The morphology and position of the testes in the two animale is different.

(4) *M. ruebushi* mihi is free of granular cell inclusions in the mesenchyme as displayed by *M. ruebushi* var. *granulophorum* mihi.

(5) The granular material in the granulorum of *M. ruebushi* var. *granulophorum* mihi is massed and confined to the walls of that structure, while this is not the case in *M. ruebushi* mihi.

(6) The sperm-morphology in the two animals is distinctly different.

(7) The stilette-morphology in the two animals differs; one is obliquely truncated, while the other is truncated at right angles.



24. 25. 26.

Fig. 24. *M. ruebushi* var. *recurvostylum* mihi. Dorsal view of gross anatomy. 100 ×.
Fig. 25. *M. ruebushi* var. *recurvostylum* mihi. Male sex apparatus. Stilette drawn to show opening. 360 ×.
Fig. 26. *M. ruebushi* var. *recurvostylum* mihi. Mature sperm-cell. 1000 ×.

Variety Diagnosis.

Macrostomum ruebushi var. *granulophorum* new variety: Body boat-shaped, anteriorly rounded, posteriorly truncated, spatulate tail lacking, epidermis impregnated with lobate granular cells, rhabdites comparatively few, sensory hairs, cilia present, no spines, testes small, smooth-walled, granular material massed in platelets in vesicula granulorum, ciliated chambers present in granulorum, penis-stilette is basally crenated funnel with sharp end bent at right angles to main axis of genital canal, opening terminal, length 99 μ, sperm-cells elongate, oblanceolate, with a pair of latero-posterior setae

plus lateral undulant membranes, ovaries, oviducts very broad, chromosome number $n = 3$, $2n = 6$, body length up to 1 mm.

Paratype: U.S.N.M. No. 20465.

Macrostomum ruebushi var. *recurvostylum* mihi.

Macrostomum ruebushi var. *recurvostylum* mihi was taken from the Yale Game Preserve waters, New Haven, Connecticut[6].

This animal is colorless except for that color supplied by the enteric contents. The body has two blunted ends and lacks the generic spatulation of the caudal region. With the exception of this caudal region the body-shape resembles that of *M. bulbostylum* mihi. The average length is 2.3 mm., while the width averages .8 mm.

Rhabdites are elaborated in the epidermis in spheroidal cells containing a conspicuous nucleus and from two to four developing rhabdites. The rhabdites are not as sharply pointed as in some species. They lie in groups of from 7 to 10 and are oriented at an angle just under the surface. A few project just beyond the epidermis.

This species is not supplied with epidermal spines. The sensory hairs are located on both ends and the sides of the animal. Those on the ends are shorter than the lateral ones. The latter are about 27 μ in length and are arranged in tufts. The entire body surface is ciliated.

The eyes are quite small. Their pigmented cup measures 32 μ by 16 μ. The visual organs do not appear to be embedded in the brain tissue. The "brain" is typical in shape.

The mouth is supplied with a normal complement of mucous glands which radiate from its ciliated lips. Single gland-cells of this system extend as far laterally as the anterior portion of the enteron. The contents of these flask-shaped cells are granular in character.

The excretory system is made up of a pair of laterally disposed tubules of small caliber which wind sinuously for the length of the body. Branches containing flame cells are given off from these two main stems. The external opening has not been determined.

The testes (Fig. 24) are located in the posterior first half of the body. They are peculiar in structure in that the median side of each testis is distinctly indented. This feature is more pro-

[6] The material used in this study came to me through the kindness of Dr. K. T. Ruebush, Yale University.

nounced here than in any of the other *Macrostomum* studied. The vasa deferentia (Fig. 24) extend posteriorly ventral to the ovaries and oviducts and enter, as they join, into the vesicula seminalis just posterior to the female genital atrium. The walls of the vesicula seminalis (Fig. 25) are characteristically supplied with interlacing muscles. There is a sphincter between this structure and the vesicula granulorum (*vg*) with which it is intimately connected, since the muscular walls of the one are continuous with those of the other. Ciliation was not observed in the median portion of the granulorum. There is a row of pit-like depressions in evidence which may represent a phase in granular material formation. The granular material is arranged in small separate masses. The penis-stilette (Fig. 25) has an angular bend of about 45° which draws the poin backwards towards the chief axial line of the tube. There is a slight indentation half-way in the length of the tube. The opening of the stilette, located in the hooked end, is always pointed ventrally toward the ciliated male gonopore (Fig. 24), which is located in the mid-line of the body. The stilette is 96 μ long.

The structure of the mature sperm-cell (Fig. 26) is unique in that the feeler portion is almost as wide as the body of the cell. Two setae are present. There are no chromatin granules observable in this cell. The cell measures 56 μ in length.

The ovaries are partially lobed structures located laterally and extending anteriorly to the tip end of the testes. The developing oöcytes (Fig. 24) in the oviducts maintain their spherical form to an unusual degree. The two oviducts join in the mid-line and connect with the common oviduct which opens into the female genital atrium. The atrium is the usual ciliated structure which assumes a spherical shape with the arrival of the mature egg into its lumen. The female gonopore has heavily ciliated margins and is ventrally situated in the posterior mid-line of the body.

Taxonomically, *M. ruebushi* var. *recurvostylum* mihi resembles the type species. *M. ruebushi* mihi in that the penis-stilette of the variety is of the same pattern as that of the species, since it too has a sharply pointed and curved ending with a terminal opening. However, they differ in these respects:

(1) The stilette of *M. ruebushi* var. *recurvostylum* mihi has a mid-tube indentation and a unique recurved terminus. *M. ruebushi* mihi does not possess these features.

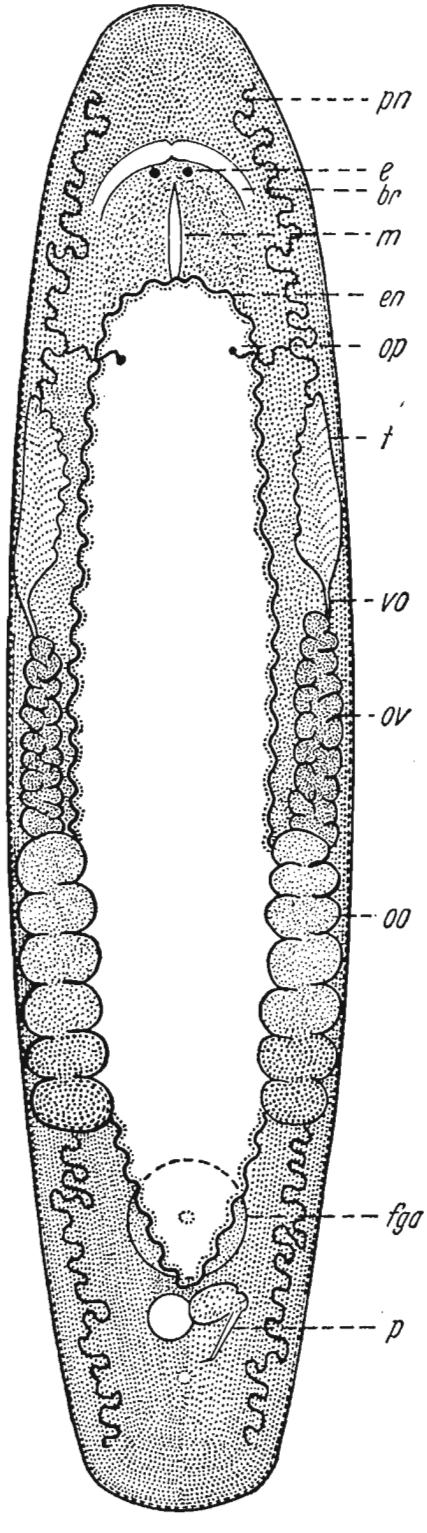
(2) In *M. ruebushi* var. *recurvostylum* mihi the vesicula granulorum is distinctly divided into two parts—one which is concerned with the retention of sperm-cells and granular material and one which serves as an origin for the penis-stilette. This division is not found in *M. ruebushi* mihi.

(3) The structure of the testes differs in the two worms.

(4) The sperm-cell of *M. ruebushi* var. *recurvostylum* has two lateral setae which are not present in the sperm-cells of *M. ruebushi* mihi.

Variety Diagnosis.

Macrostomum ruebushi var. *recurvostylum* new variety: Body shape resembles *M. bulbostylum* mihi, spatulate tail not pronounced, colorless, epi-



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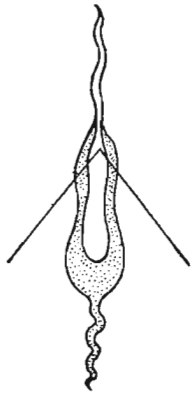

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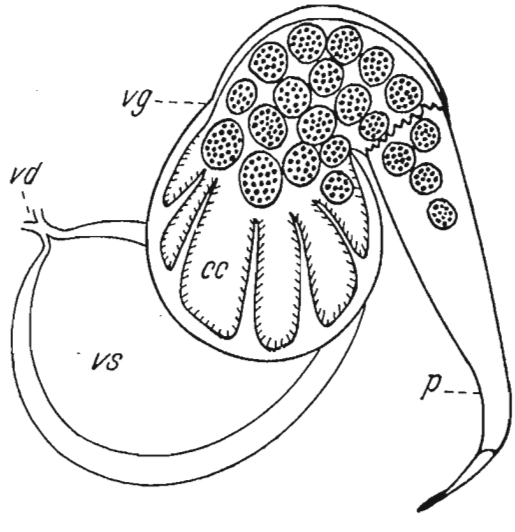

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Fig. 27. *M. ruebushi* var. *shenandoahensis* mihi. Dorsal view of gross anatomy. 70 ×.
Fig. 28. *M. ruebushi* var. *shenandoahensis* mihi. Mature sperm-cell. 750 ×.
Fig. 29. *M. ruebushi* var. *shenandoahensis* mihi. Diploid chromosomes. 1500 ×.
Fig. 30. *M. ruebushi* var. *shenandoahensis* mihi. Male sex apparatus. 375 ×.

dermal processes include blunted rhabdites, sensory hairs and cilia, spines absent, testes have deeply indented median walls, penis-stilette is an irregular funnel with sharpened point recurved toward axis of genital canal (length 96 μ), sperm-cells have unusually wide feeler and two latero-posterior setae (56 μ long), body measures 2.3 mm. in length.

Macrostomum ruebushi var. *shenandoahensis* mihi.

Macrostomum ruebushi var. *shenandoahensis* mihi may be collected from the spring streams of New Market, Virginia, and from the streams of Sugar Hollow, Albemarle County, Virginia.

This form measures up to 2 mm. in length. The animal (Fig. 27) has a typical *Macrostomum* shape except that the spatulation in the posterior region is not pronounced.

The entire external surface of the colorless body is ciliated. Sensory hair tufts are supplied both laterally and at the extremities of the body. Spines are lacking. There are paired latero-dorsal openings to the main stems of the excretory system just anterior to the testes.

The mouth, pharynx, and enteron are regular in structure. The flagellated enteron extends posteriorly so that its end rests dorsal to the female genital atrium.

The pigmented spherules composing the pigment-cup of the eye are unusually small. The visual structures are located dorso-posterior to the "brain" which has the regular bi-ganglionic composition.

The testes are elongate sac-like organs with smooth lateral walls and indented mesial walls. The vasa deferentia empty into the vesicula seminalis just posterior to the enteron and to the left of the mid-line of the body. The vesicula seminalis has unusually thick walls. The ductus ejaculatorius, connecting the vesicula seminalis and vesicula granulorum, has several ciliated chambers at its entry into the granulorum. There is a high degree of ciliary action within these chambers. The granules, supplied to the vesicula granulorum, are closely packed into spheroidal masses within that part of the granulorum nearest the base of the penis-stilette. These granular masses are continued into the male genital canal of the stilette.

The mature sperm-cells (Fig. 28), as studied from the vesicula seminalis and vesicula granulorum, measure about 45 μ in length and have two lateral setae. The cell may be divided into a feeler, a mid-body region containing highly undulating walls, and a fine curling "tail". Chromatin material was not observable in this cell.

The penis-stilette (Fig. 30) is a funnel with a crenate base which is slightly obliquely truncated. The curved and pointed termination has a small distal lip. The opening is terminal.

The female reproductive system is composed of organs whose features are regular, with the exception of the unusually large oöcytes which are to be found in the oviducts and the female genital atrium.

The 2 *n* number of chromosomes (Fig. 29) is 6 and the *n* number is 3 in this variety.

Taxonomically, this form is placed as a variety of *M. ruebushi* mihi because of the similarity of the penis-stilettes of the two animals.

Variety Diagnosis.

Macrostomum ruebushi var. *shenandoahensis* new variety: Body shape typical of *Macrostomum*, colorless, epidermal ciliation includes sensory hairs and cilia, pigment spherules of eye very small, vesicula granulorum has ciliated chambers, sperm-cells have two setae and lack chromatic granules, penis-stilette is a funnel with obliquely truncated base and a terminus with small lip beyond opening, 2 *n* number of chromosomes is 6, *n* number is 3, body length up to 2 mm.

Paratype: U.S.N.M. No's. 20446, 20470, and 20471.

Macrostomum ruebushi var. *truncatum* mihi.

Macrostomum ruebushi truncatum mihi lives in the waters of an extensive swamp at Gilbert, Virginia (Albemarle County). The water in this habitat is clear and cold, since the swamp is springfed. This animal has been collected from this place throughout the year, with the exception of the summer.

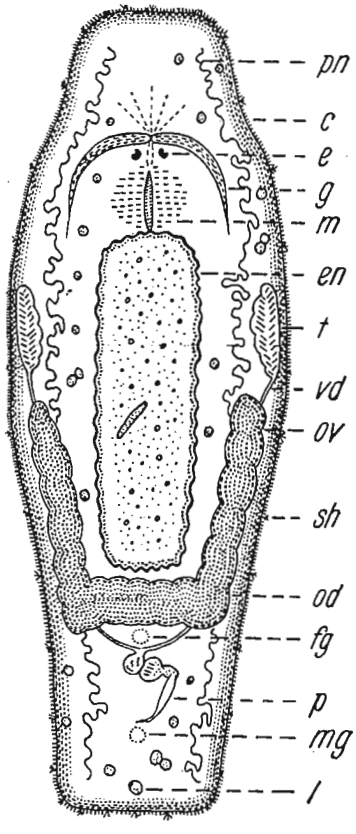
The body is extremely truncated at both extremities. The mid-body is widest. The average dimension for this variety is 1 mm. by .3 mm. The body is colorless except for the enteric content and for the presence of numerous epidermal cell-like inclusions (Fig. 31) which are of a yellow-green-brown hue. They range up to 68 μ in diameter and are finely granular in appearance. They occur singly or in groups. Such inclusion cells are more pronounced in *M. ruebushi* var. *granulophorum* mihi.

Rhabdites which measure 1.6 μ by 12 μ are evenly distributed within the epidermis in groups of seven, eight, and ten. There are no spinous processes and the sensory hairs (Fig. 31, *sh*) are about 16 μ in length and are more numerous at the extremities. The entire body surface is ciliated. The length of the cilia (*c*) is below the average for *Macrostomum*.

There is agreement here with the observation that the brain width in *Macrostomum* is directly proportional to the width of the

body. The rather wide "brain" (Fig. 31, *br*) in this animal has quite a narrow commissure. "Rhabditenstrassen" extend below and above the commissures. The eyes are typically shaped and are not embedded in the brain substance.

The digestive system is composed of mouth, pharynx simplex, enteron, and mucous glands (Fig. 31) and has but one significant



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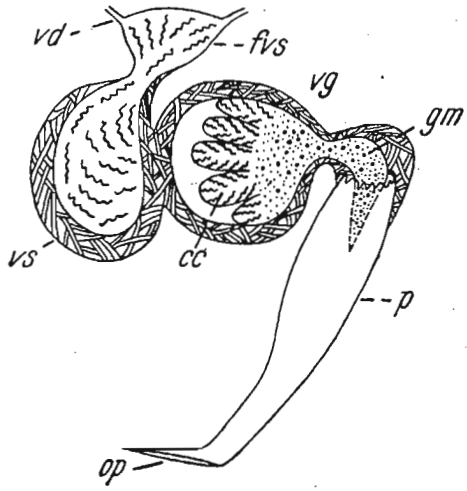

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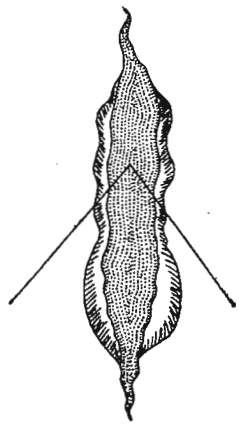

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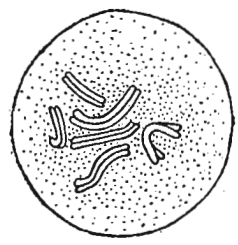

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Fig. 31. *M. ruebushi* var. *truncatum* mihi. Dorsal view of gross anatomy. 75 ×.
Fig. 32. *M. ruebushi* var. *truncatum* mihi. Male sex apparatus. Penis-stilette drawn to show opening. 420 ×.
Fig. 33. *M. ruebushi* var. *truncatum* mihi. Mature sperm-cell. 600 ×.
Fig. 34. *M. ruebushi* var. *truncatum* mihi. Somatic chromosomes. 2400 ×

deviation from the normal and that is that the mucous glands are supplied with granules about 1 μ in length, which are roughly semi-lunar in shape instead of the usual spherical shape. The enteron (Fig. 31, *en*) is typical in its morphology.

The excretory system (Fig. 31, *pn*) is made up of convoluting lateral tubules which send branches into all parts of the parenchyma. Flame cells are located at the distal extremities of the smaller branches. The external opening to this system has not been determined.

The testes (Fig. 31, *t*) are smaller than average size and have a smooth lateral and an indented median wall. The vas deferens (*vd*) from each side joins usually to produce a distension of the forepart of the seminalis known as the false vesicula seminalis (Fig. 32, *fvs*). The musculature in the walls of this part of the seminalis is weakly developed in order to provide for an unusual supply of sperm which causes the distension. Ciliated chambers are distinctly present in the granulorum (*vg*). Granular material is massed in the neck-line portion of the granulorum from whence the stilette originates. This granular material extends in a V-shaped crypt into the basal region of the stilette. The penis-stilette (*p*) has a rather narrow crenated base, a wider middle portion and presents a gradual curve from the base to the hooked and sharply pointed end in which the opening is located. As usual the point of the stilette is directed toward the ciliated mid-ventral male gonopore. The stilette measures 72 μ in length.

The sperm-cell of this animal at maturity measures 57 μ in length, which is above the average for the genus. It has a very short feeler, a large body, and a short tail. The body of the cell is lined by lateral undulating membranes. Setae are present. Chromatin material was not observed in the cell (Fig. 33).

The female reproductive system is of the type characteristic of the genus.

The chromosome morphology was studied from a somatic metaphase (Fig. 34) involving six pairs of chromosomes. There is a small pair with hooked ends, a large J-shaped pair, and a large pair with a pair of opposite bends.

A tabulation involving the varietal differences between *M. ruebushi* mihi and *M. ruebushi* var. *truncatum* is given below:

(1) The body shape of the two animals, while of the same type, differ in particulars.

(2) *M. ruebushi* mihi measures 2.3 mm. by .8 mm. *M. ruebushi* var. *truncatum* mihi measures 1 mm. by .3 mm. The stilette of the former measures 96 μ, while that of the latter measures 72 μ.

(3) Epidermal granular inclusions are present in *M. ruebushi* var. *truncatum* mihi and absent in *M. ruebushi* mihi.

(4) The sperm-cell morphology is distinct in each case.

(5) The granular material in the granulorum of *M. ruebushi* mihi is massed, while that of *M. ruebushi* var. *truncatum* mihi is dispersed.

(6) The stilettes are alike in that the opening is terminal in a hook. The stilette of *M. ruebushi* mihi is deeply crenated, while the stilette of *M. ruebushi* var. *truncatum* mihi is weakly crenated.

This variety so closely resembles *M. ruebushi* var. *granulophorum* mihi that a second tabulation must be given to show how these two varieties differ:

(1) The funnel of the stilette in *M. ruebushi* var. *granulophorum* mihi is more irregular than in *M. ruebushi* var. *truncatum* mihi.

(2) The basal part of the stilette is more deeply crenated in *M. ruebushi* var. *granulopohrum* mihi than in *M. ruebushi* var. *truncatum* mihi.

(3) The undulating membranes of the sperm-cells are less extended in *M. ruebushi* var. *granulophorum* mihi than in *M. ruebushi* var. *truncatum* mihi.

(4) The contours of the bodies of the two differ.

Variety Diagnosis.

Macrostomum ruebushi var. *truncatum* new variety: Body barge-shaped, oblong, epidermal yellow-green cell-like inclusions are present, "Rhabditenstrassen" present, sperm-cells have paired lateral undulating membranes and two setae, ciliated chambers in vesicula granulorum, penis-stilette has narro· weakly crenate base, a wider middle portion and a hooked and sharply pointed end, chromosome morphology is peculiar to this species, body length up to 1 mm.

Über Nahrungserwerb und Darmverlauf bei Nucula.

Von Dr. H. Caspers.

(Aus der Biologischen Anstalt auf Helgoland.)

(Mit 4 Abbildungen.)

Eingeg. 7. November 1939.

Bei ökologischen Untersuchungen über die Bodentierwelt der Helgoländer Tiefen Rinne wurde für dieses Gebiet eine eigene Biocönose, die *Nucula nucleus*-Gemeinschaft, festgestellt (Caspers, 1938). Die namengebende Muschel findet sich außerdem noch auf der Helgoländer Austernbank[1]. In den übrigen Gebieten der südlichen Nordsee wird diese Art durch *Nucula nitida* Sow. ersetzt.

Für die Deutung des Verbreitungsbildes und der Stellung innerhalb der Lebensgemeinschaft war eine bessere Kenntnis der Ökologie der beiden *Nucula*-Arten notwendig. In der Biocönose der Tiefen Rinne ist *N. nucleus* L. als Leitform erster Ordnung überall vertreten, doch steht ihre Häufigkeit im umgekehrten Verhältnis zu der von *Chione ovata* (Penn.) (Leitform zweiter Ordnung), so daß also in den Zentralgebieten, wo *Nucula* am häufigsten ist, *Chione* fast ganz fehlt. Als Ursache für das Entstehen dieses ökologisch bedeutungsvollen Verbreitungsbildes war

[1] Vgl. Caspers, Die Lebensgemeinschaft der Helgoländer Austernbank. Helgol. wiss. Meeresunters. (Erscheint demnächst.)