TURBELLARIA

BY

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INTRODUCTION

The Belgian Hydrobiological Expedition (Mission K.E.A.) has brought together a collection of *Turbellaria*, which is highly interesting, though it contains only a small number of species. Its great value consists in the so-called *Microturbellaria*. Comparing the systematic groups of freshwater *Turbellaria*, two Orders, the *Rhabdocoela* and *Alloeocoela*, as they are called in textbooks (f. ex. HYMAN, 1951), belong to the *Microturbellaria*, one Suborder, the *Tricladida Paludicola*, to the *Macroturbellaria*. If a more specialized system is applied, f. ex. that of KARLING (1940, pp. 229-235), the limnic *Microturbellaria* belong to four different Orders, all *Macroturbellaria* of this biotope to one Section of a Suborder. Nevertheless the number (12) of species of *Microturbellaria* known from the Ethiopian Region (MARCUS, 1955, pp. 116-117; 1955*a*, pp. 7, 26) is the same as that of the *Macroturbellaria*. Only sufficiently described species are considered in this computation. The *Paludicola* belong to only two slightly different genera, the *Microturbellaria* to nine, five rhabdocoel and four alloeocoel genera. This proves how little of the probably rich microturbellarian fauna in the continental waters of the Ethiopian Region is known.

Without any doubt it is more difficult to collect and preserve *Microturbellaria* than *Paludicola*. But the former are much more attractive from morphological and zoogeographical points of view than the latter. On the whole *Microturbellaria* are much more auspicious for the results of an expedition than the rather uniform *Paludicola*, which mainly in tropical regions so often frustrate the collector's effort, when they belong to asexual strains, that can not be duly classified. Then only the Family can be established, and this unfortunately occurred also with 5 worms from Lake Albert in the present collection; one of them, an entirely black animal, is probably new. The immature *Planariidae* are given numbers 6 and 7 in order to continue the previously described Nos. 1-5 (MARCUS, 1955*a*, pp. 12-16).

The *Microturbellaria* were scrutinized to the utmost and sometimes denominated somewhat venturously aiming at the best possible presentation of the rare material.

After the above mentioned system of KARLING (1940) the present collection is listed as follows :

Order Archoophora, Suborder Macrostomida :

Macrostomum tuba (GRAFF, 1882) var. *verbekei*, var. nov.

Order Holocoela (Prolecithophora), Suborder Separata :

Plagiostomum lacustre BAYLIS, 1927.

Order Rhabdocoela (Neorhabdocoela), Suborder Dalyellioida :

Gieysztoria rubra (FUHRMANN, 1894).
Sergia mancala, spec. nov.
Vaillantiella caribumba, spec. nov.

Order Seriata, Suborder Tricladida, Section Paludicola :

Planariidae spec. 6.
Planariidae spec. 7.

Mrs. EVELINE DU BOIS-REYMOND MARCUS and I wish to express our thanks to Mr. J. VERBEKE, Entomologist of the Mission K.E.A., for having entrusted us with his collection.

TURBELLARIA

MACROSTOMIDA.

Macrostomum tuba (GRAFF) var. **verbekei**, var. nov.

(Figs. 1-4.)

The length is about 0,5 mm, the greatest breadth, in the middle of the body, 0,25 mm. The head is delimited by a slight constriction; the flat and broad caudal plate is distinctly set off from the body and slightly pointed at its posterior end. Such a caudal plate of preserved worms has no systematic weight.

The colour is yellowish gray, mainly on the back, where the rhabdites are dense. The black eyes stand close together. Other pigments are not present. The great quantity of colourless contents of the intestine makes the middle region of several specimens quite light, as it distends the body and so stretches the skin. Head and caudal plate are darker in these animals.

Subterminal cephalic glands (c) stain pink and contain fine granules of secretion, not rhabdites. Two pits flank this group of cells. The tufts of rhabdites stain orange, they are more numerous on the back than on the belly, and their number is also somewhat increased on the tail. They develop in subepidermal cells.

The mouth (k) is ventral and rather transverse than longitudinal. That may be due to preservation and contraction. It lies 60 μ behind the fore end in a 0,37 mm long sectioned worm. The pharynx (f) is a thin-walled tube with ciliated epithelium, the insunk nuclei of which are located between the muscle fibres. Pink staining glands open on the entrance of the pharynx. The pharynx ends in the anterior wall of the gut (i). The intestine has a high ciliated epithelium, as in other species of the genus; the lumen contains Ciliata and big shells of Diatoms. Backwards the gut extends to the beginning of the caudal plate.

The testes (t) are more or less globose sacs located beside the anterior end of the gut. The spermatogonia form one layer on the testicular wall. Thin efferent ducts (e) open united into the accessory seminal vesicle (v), a thin-walled organ situated under the posterior wall of the intestine (i). Through a constriction the sperms pass to the principal seminal vesicle (s) that is involved by spirally arranged muscle fibres. An intervesicular duct (z) with thick muscular

wall leads to the granule vesicle (q), the glands (r) of which enter it proximally. The base of the stylet (p) encloses the ectal end of the granule vesicle. The stylet is 0,11-0,132 mm long, entally 28-30 μ, ectally about 5 μ in diameter. It ends slightly inflated (fig. 4), and this expansion is not accompanied by a thickening of the wall. The orifice of the stylet was not seen with certainty, probably it is subterminal. The male pore (x) is located 20 μ from the hind end of a worm that was 0,37 mm long in the sections. The female aperture (w) is located 150 μ farther in front.

The ovaries (o) lie behind the testes and are, in the present material, not bigger than these. Their small size and only little lobulate outline indicate that the worms are in initial female phase. Notwithstanding the two oviducts already include together 2-3 growing ovocytes (u). The common oviduct (y) contains free alien sperms. The passage apparatus (h) consists of high cells filled with cyanophilous secretion, which surround the ental opening of the female antrum (a). The nuclei of the ciliated atrial epithelium are insunk and accompany the periphery of the female antrum. They can be distinguished from longish glands, that open into the antrum like in *Macrostomum retortum* PAPI (1951, p. 300 and fig. 15). The cement glands (g) encircle the female pore (w), their erythrophil secretion is discharged on the ventral surface. A vagina is not developed.

Occurrence. — Lake Kivu, Goma, northern shore of the lake (Sample 2105 *b*), 2.X.1953, among green algae *Cladophora*, 12 specimens.

Called in honour of Mr. J. VERBEKE, Entomologist of the Mission K.E.A.

DISCUSSION OF *MACROSTOMUM TUBA* var. *VERBEKEI*.

Only with reservation do we call the present material a variety of *M. tuba* (GRAFF, 1882). It differs from the latter mainly by the much shorter stylet with an only slightly swollen terminal bulb. Besides the rod tracks (LUTHER, 1905, pp. 8-9) are wanting, the ovaries are rather compact than lobulate (p. 42), and the passage apparatus between female antrum and common oviduct is unlike the figures that LUTHER gave for *tuba* (t. 4, figs. 41, 42). This last feature is difficult to evaluate, as the functional phase probably influences the morphological aspect. WEISE (1942, p. 175) found compact ovaries in young animals of *tuba*, and also the present worms are in the beginning of female maturity. One can agree with WEISE (l. c.) who assumes that OKUGAWA's figure 2 (1930, t. 3) shows compact ovaries with only slight indentations on the outer side. The importance of the shape of the ovaries for the systematics of *Macrostomum* (LUTHER, 1905, p. 48) was later restricted by LUTHER (1947, p. 10), who also found differences between living and preserved and contracted *M. hamatum* (p. 20). Presence or absence of rod tracks is not sufficient for specific separation.

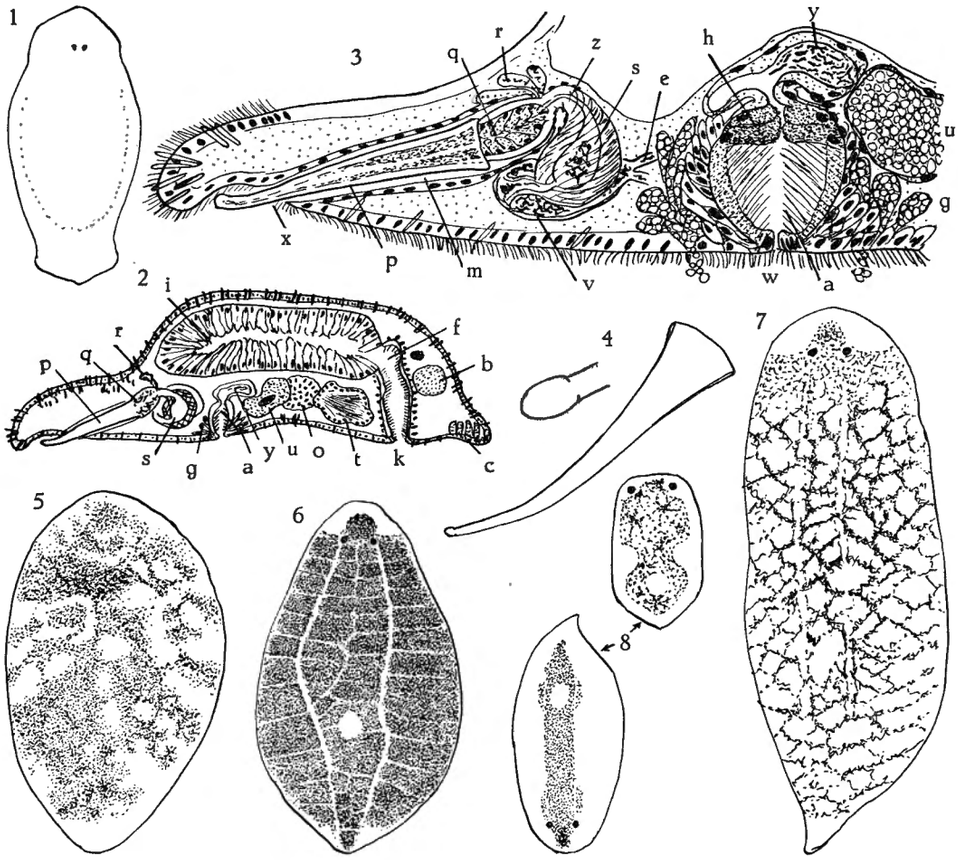

FIG. 1-4. — *Macrostomum tuba* var. *verbekei* n. var.

1. Preserved worm. — 2. Combined sagittal section. — 3. Combined section of copulatory organs. 4. Stylet and farther enlarged tip of same.

a : female antrum; b : brain; c : cephalic glands; e : efferent duct; f : pharynx; g : cement glands; h : passage apparatus; i : gut; k : mouth; m : male antrum; o : ovary; p : stylet; q : granule vesicle; r : granule glands; s : seminal vesicle; t : testis; u : growing ovocyte in oviduct; v : accessory seminal vesicle; w : female pore; x : male pore; y : common oviduct; z : intervesicular duct.

FIG. 5-8. — *Plagiostomum lacustre* BAYL.

5. Worm from Lake Tanganika, sample 5007. — 6. Worm from Lake Kivu, sample 2050. — 7. Worm from Lake Edward, sample 3046. — 8. Two worms from Lake Albert, sample 4022.

FERGUSON (1939, p. 68) was the first to distinguish the bulbar tip of the penial stylet of *M. tuba* (GRAFF, 1882) from that in *M. tuba* var. *gigas* OKUGAWA, 1930. The bulb of *tuba* is caused by expansion of the lumen, that of *gigas* by thickening of the wall. Therefore HYMAN called her material that had been described as *M. tuba* (1936, p. 14) *gigas* later on (1943, p. 324). Also Brazilian material was designated as *gigas* (MARCUS, 1946, p. 7). Figures of the stylet tip without thickened walls are the original figure of GRAFF (1882, t. 4, fig. 14) reproduced

by HYMAN (1943, fig. 13), and that in the « Süsswasserfauna » (GRAFF, 1909, fig. 160). The latter figure appears in the « Tierreich » too (GRAFF, 1913, fig. 58). Without wanting to affirm that GRAFF's figures are correct, we must stress that in African worms the slight terminal swelling is only due to a widening of the lumen. A drawing of RUHL (1927, fig. 13 A; also Zool. Anz., v. 72, p. 173) that was not made with systematic scope does not allow to recognize whether the bulb is caused by a widening of the lumen or a thickening of the wall, but the former is more likely.

LUTHER (1905, p. 4) has sectioned worms, probably from Trieste (ID., 1947, p. 27), that BÖHMIG had classified as *tuba* (GR.). Evidently the tip of the chitinous copulatory organ was lost in LUTHER's sections (GIEYSZTOR, 1930, p. 308; HYMAN, 1943, p. 322; LUTHER, 1947, p. 27). Nevertheless the mentioned authors and all the others that have studied *M. tuba* and var. *gigas* consider LUTHER's material as *M. tuba*.

GIEYSZTOR (1930, fig. 3) and WEISE (1942, fig. 40) have clearly drawn widening of the lumen as well as thickening of the wall in the terminal bulb, as PAPI (1951, p. 301) was right to stress. Therefore this detail is no longer of systematic value (STEINBÖCK, 1949, pp. 235-236; 1951, p. 140; PAPI, l. c.; FERGUSON, 1954, p. 142).

PAPI maintains var. *gigas* for populations with long and relatively straight stylet. As index is recommendable the relation between length and proximal (ental) diameter of the stylet, not the hitherto applied proportion between the lengths of granule vesicle and stylet, because the arched neck of the vesicle (HYMAN, 1943, p. 327) difficults measuring.

This index 1 : 5 isolates the present African population from all others. In materials from botanical gardens in North (Berlin), Middle (Marburg-Lahn), and South Germany (München) the ratio is 1 : 10 (WEISE, RUHL, GRAFF). These, together with such from the Lago Maggiore, 1 : 12 (STEINBÖCK, 1949, fig. 2, *a*), we consider as the typical form of *tuba* (GR.). The other records here considered are : Lake Biwa, ponds and rice fields in Middle Japan (OKUGAWA, 1930); ponds near Odessa (BEKLEMISCHEW, 1927, pp. 188, 202); Poland, Warszawa (GIEYSZTOR, 1930, aquaria); Italy, Pisa (PAPI, 1951, botanical garden and outdoors); New York (HYMAN, 1936, 1943, aquaria and tanks); Virginia and Tenessee (KEPNER and STIFF, 1932; FERGUSON, 1939, p. 59 : *M. bulbostylum* = *tuba*) in ponds, springs, small streams, and lakes; Brazil, in the neighbourhood of the city of São Paulo, and also in aquaria and tanks (MARCUS, 1946). Their stylet index is from 1 : 20 to 1 : 38. They must be designated as var. *gigas*, because the original material of this variety has an index a little higher than the mentioned minimum. PAPI is right to call *tuba* and its var. *gigas* thermophilous forms, and the same fits for var. *verbekei*.

The cuticular copulatory organ of *Macrostomum longituba* PAPI (1953, p. 4) is slightly swollen at the tip like that of *tuba* var. *verbekei*, and its proportions are similar. But in *longituba* the tip is curved, and its wall is thickened terminally and on the convex side of the curve. HYMAN (1955, p. 2) classified a marine specimen from the coast of Venezuela as *Macrostomum tuba* (GRAFF).

HOLOCOELA, SEPARATA.

Plagiostomum lacustre BAYLIS, 1927.

(Figs. 5-12.)

The rich material consists of 161 worms, the biggest of which (sample 2050) is 2 mm long, 1 mm broad, and 0,8 mm high. Most of them are considerably smaller, viz. 0,35-1,5 mm long. The anterior end is bluntly rounded or truncate, the hind end pointed. Frequently the animals are slightly flattened in dorso-ventral or lateral direction.

Two black eyes lie near the anterior end, close to one another in most worms. All animals have a pigmented back and a light belly. The pigment is located in the parenchyma and is yellowish to rusty brown or gray to black. It is distributed in scarce or dense fine dots, scattered stars, or forms a net, blotches, or a longitudinal band (figs. 5-8). The anterior end, two stripes that correspond to the longitudinal dorsal nerves as in *P. evelinae* MARCUS (1946, p. 107), and a circular area in the posterior third have no pigment. The posterior light spot coincides with the position of the caudal pore of the excretory organs in *P. evelinae*. It is without pigment in BAYLIS' original material too, but the 3-4 pigmented transverse bands of the latter (BAYLIS, 1927, fig. 1, *a-d*) do not occur in the present worms. The pigment of the only specimen from Lake Tanganika of the Mission K.E.A. (fig. 5) is irregularly distributed. The worms of one population are of uniform colour pattern, f. ex., the 50 specimens from the northern shore of Lake Kivu (sample 2105) have a densely grayish black back. Where numerous samples from one lake are available, as from Lake Albert, nearly all patterns are represented, and evidently not related with the biotope, among swimming or bottom plants. The same holds true for Lake Edward. Only the narrow dorso-median band of brown pigment (fig. 8) was merely observed in 5 worms from Lake Albert (samples 4022, 4034*b*).

The ciliated epidermis without recognizable limits of its cells is provided with some blue staining glands. Some areas on the fore end, above the mouth, are characterized by insunk nuclei, absence of glands, and a dense subepidermal felt of nerves. Such evidently sensory patches were described for *Plagiostomum lapinum* and *P. remanei* (MARCUS, 1952, p. 65; 1954, p. 464). A concentrated frontal gland is not developed, but blue strands of secretion extend from cells (c) behind the brain (b) forwards on both sides and open around the mouth (m). Also *P. evelinae* has only oral, not frontal glands. The lateral ciliated pits of the latter (MARCUS, 1946, figs. 113, 115) are absent in *P. lacustre*, and the inner canals of the excretory system were not seen. The basilar membrane is thin, and so are the dermal muscle layers.

The eyes consist each of three retinal cells in a pigment cup. They lie in the anterior part of the brain (b). The three cells are directed forwards, the cup is not subdivided. Its pigment lies near that of the parenchyma. A ciliated furrow is not developed.

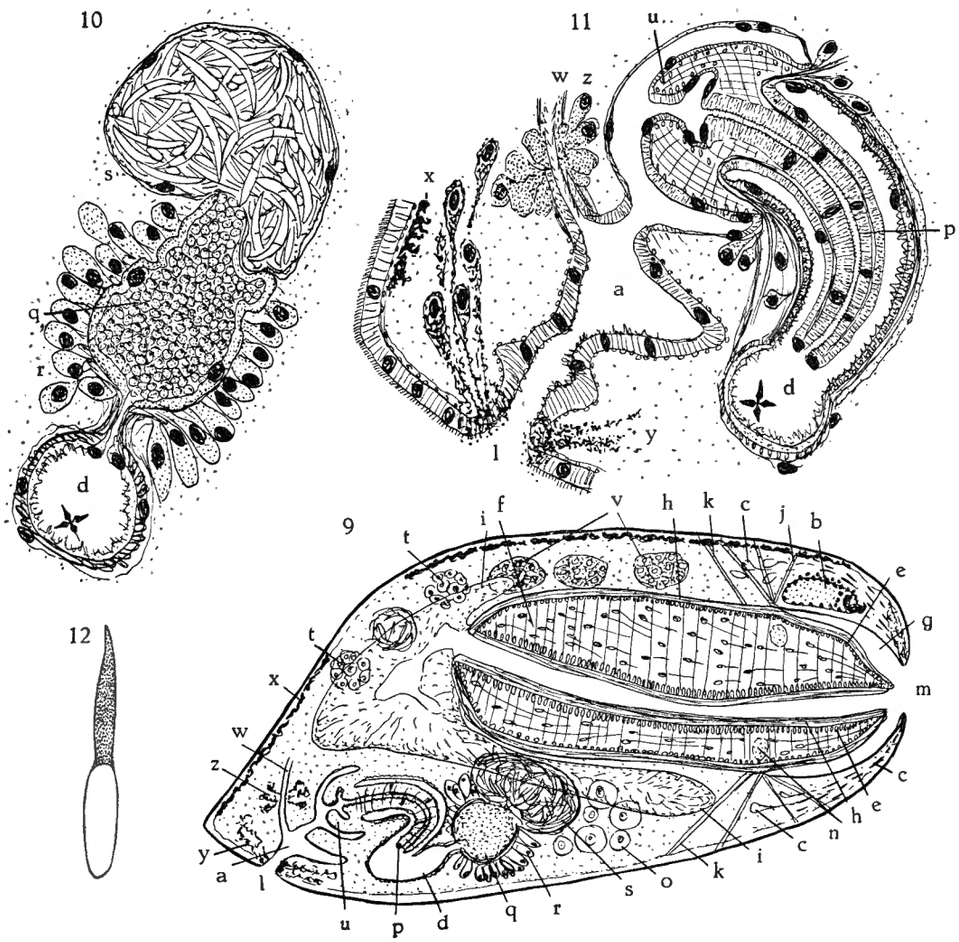

FIG. 9-12. — *Plagiostomum lacustre* BAYL.

9. Organization in median section. — 10. Sagittal section of seminal and granule vesicle. — 11. Sagittal section of penis and antrum, 0,1 mm from the former. — 12. Spermatozoon.
a : common antrum; b : brain; c : oral glands; d : distal sac; e : annular fibres of pharynx; f : pharynx; g : pharyngeal pouch; h : longitudinal fibres of pharynx; i : intestine; j : protractor of pharynx; k : retractor of pharynx; l : genital opening; m : mouth; n : nerve-ring of pharynx; o : ovary; p : penis; q : granule vesicle; r : granule glands; s : seminal vesicle; t : testes; u : penial sheath; v : vitellaria; w : common ovovitelloduct; x : parenchymal pigment; y : cement glands; z : shell glands.

The mouth (m) is antero-ventral and leads immediately into the pharyngeal pouch (g). This pouch surrounds approximately one third of the pharynx (f). It has a flat epithelium without cilia and glands. The protractors (j) and retractors (k) are attached to the inner border of the pouch. The pharynx is big, its proportion to the length of the body is from 1 : 2,5 to 1 : 1,7. The size of the pharynx is probably proportionally smaller in living animals. The pharynx doliiformis, a very consistent organ, contracts less than the rest of the

body in preserved *Provorticidae* (LUTHER, 1948, pp. 7, 20; MARCUS, 1951, p. 17), and the same was observed in *Plagiostomidae* (MARCUS, 1954, p. 464). The lumen of the pharynx is, in sections, a triangle with the point directed downwards, as in many other species of the genus (BRANDTNER, 1934, text-fig. 1). The longitudinal (h) and the annular (e) muscle fibres of the pharynx are disposed in the same order around the entire pharynx, not inverted. The inner annular muscles are stronger than the outer ones. The nerve-ring (n) is situated on the level of the insertion of the pharyngeal pouch.

The limits between the cells of the gut (i) are distinct in several of our sectioned worms; digestion is, at least in part, intracellular. The height of the intestinal epithelium varies according to the digestive phase. One of the studied specimens had probably eaten an other Turbellarian.

The testes (t) are located before and behind the ovaries (o). The common vesicle has a thin epithelium with normal nuclei and a distinct constriction between an inner seminal vesicle (s) and an outer granule vesicle (q). The latter is surrounded by granule glands (r). A short muscular tube, KARLING's « Verbindungsgang » (1940, p. 88) unites the granule vesicle with the distal sac (d), that is surrounded by annular muscles. It lodges the inverted copulatory organ (p), the length of which varies. It may be straight or curved, but is not curled as in *Plagiostomum lemani*. Two nuclei lie at the tip of the penis, and some more in the penial epithelium. Numerous small glands enter the basis of the penis. The latter is separated by a penial sheath (u) from the male antrum. The epithelium of the male antrum is flat, that of the common antrum (a) high and folded. The sperms (fig. 12) correspond to those of the original material (BAYLIS, 1927, p. 384, fig. 4). They are 25 μ long and 3,5 μ thick. The head is 11-14 μ long.

The ovaries (o) are loose agglomerations at the level of the hind part of the pharynx. Precocious insemination was not seen, though alien sperms occur in various parts of the body. The vitellaries (v) begin short behind the brain and reach backwards to the distal sac. The ciliated ovovitelloduct (w), that has longitudinal muscles, receives the red shell glands (z) and enters the antrum (a) from the dorsal side as in the other species of the genus (BRANDTNER, 1934, p. 130). Cement glands (y) open around the genital pore (l).

OCCURRENCE OF *PLAGIOSTOMUM LACUSTRE*.

Lake Tanganika : Kirando, under stones, end of October (BAYLIS, 1927, p. 381).

Belgian Hydrobiological Expedition (Mission KEA).

LAKE TANGANIKA.

Sample.

5007 (13.VIII.1953), shore of the river Lukuga near its outflow from the lake (1 specimen).

LAKE KIVU.

Samples.

2050 (11.IV.1953), Shangugu, on the outflow of river Ruzizi from the lake (3 specimens).
2105 *a* (2.X.1953), Goma, northern shore of the lake, Km 202, among algae *Cladophora* (50 specimens).
2105 *b* (same date), same locality, among green algae (5 specimens).

LAKE EDWARD.

3046 *a* (14.VI.1953), Vitshumbi, southern shore of the lake, among *Potamogeton* (2 specimens).
3046 *a* (same date), same locality (4 specimens).
3046 *b* (same date), same locality, among *Pistia* (3 specimens).
3100 (23.I.1954), same locality, among *Vossia* (3 specimens).
3106 (25.I.1954), Kisaka, among pebbles covered with algae *Cladophora* (3 specimens).
3114 *a* (30.I.1954), Pilipili, among *Ceratophyllum* and *Najas* (8 specimens).
3118 *a* (5.II.1954), Ishango, Semliki, in the river near its outflow from the lake, 2 samples (together 11 specimens).
3124 *a*, Kasindi, northern shore of the lake, 2 samples from *Potamogeton*, and among *Najas* and *Potamogeton* (together 13 specimens).
552, lake, (2 specimens).

LAKE ALBERT.

4022 (26.VI.1953), 10 km from Kasenyi, among *Pistia* (4 specimens).
4034 *a* (30.VI.1953), shore of Kasenyi, southwestern part of the lake, among *Pistia* (1 specimen).
4034 *b* (same date), same locality (1 specimen).
4054 (13.XII.1953), Kasenyi, Bezaha, shore (19 specimens).
4086 *a* and *b* (16.II.1954), Mahagi Port, northern part of the lake, shore, among *Najas*. Four samples (together 28 specimens).

DISCUSSION OF FRESHWATER *PLAGIOSTOMIDAE*.

The present material of the Belgian Hydrobiological Expedition makes it possible to compare *P. lacustre* with the other limnic *Plagiostomidae*. The male copulatory organ is similar in all of them, that of the Eurasiatic *Plagiostomum lemani* FOREL and DU PLESSIS belongs to type H (KARLING, 1940, fig. 10 on p. 87), and those of the South American *P. evelinae* MARCUS and the Central African *P. lacustre* BAYLIS to the little less complicated type G (ibid.). The North American *Hydrolimax grisea* HALDEMAN, 1842, known by HYMAN'S rediscovery (1938), agrees with the other species in regard to the distal parts, while the seminal vesicle and the secondary granule vesicle (KARLING, p. 88) show a still farther going differentiation. The pharynges of *H. grisea, P. lacustre,* and *P. evelinae* belong to the variabilis intextus-type; *P. lemani* has a pharynx variabilis textus with inversion of the muscle layers at the border of the pharyngeal pouch (KARLING, pp. 77-79).

The *Plagiostomidae* are principally marine. *H. grisea* is known from New Jersey and the Eastern part of Pennsylvania (Delaware and Schuylkill river). Its occurrence in a restricted area neighbouring to the sea, as well as the extent of glaciation in North America, makes it probable that it is a young immigrant into freshwater.

P. lemani is vastly distributed in the Palearctis (MARCUS, 1946, p. 106). This fact and its occurrence in Lake Ochrida (BEAUCHAMP, 1934, p. 209), the « Baikal of the Balkan » (L. S. BERG), favour the opinion that it is an old inhabitant of continental waters. When the species was found in the Gulf of Finland and near Karlskrona, Sweden, some scientists were inclined to consider these occurrences as a preservation of marine habitat, and hence called *P. lemani* a newcomer to freshwater. The salinity of the mentioned localities does however not surpass 8 per mil, and this is the limit, up to which many limnic *Turbellaria* penetrate into brackish waters (REMANE, 1950, p. 10). *P. lemani* lives also in the Caspian Sea and thus shows to be euryhalinous. It may quite well be a preglacial inhabitant of freshwater (STEINBÖCK, 1932, pp. 234-245), and a more recent remigrant in the Baltic Sea.

P. evelinae is hitherto known from a very limited area in the basin of São Paulo near the river Tieté. It could and possibly can reach this region from the Atlantic through the river Parahyba. Swampy ponds that supply affluents of the latter and the Tieté communicate during rainy weeks on the narrow watershed between the Parahyba valley and the basin of São Paulo.

P. lacustre is known from the Central African rift valley only. Therefore it does not seem to belong to the « original freshwater fauna of Africa that must have been similar in its various parts » (WORTHINGTON, 1954, p. 71). *Phaenocora foliacea* BÖHMIG, known from the Cape Peninsula, East Transvaal (Limpopo system), Belgian Congo, Albert and Garamba National Parks, and Kenya, Lake Naivasha and Mount Elgon, might be such an old element of the African freshwater fauna. The numerous different localities where *P. lacustre* lives in the lakes of the rift valley show that it is euryoecous, not specialized for a determinate biotope. Its distribution from Lake Albert to Lake Tanganika makes it possible to imagine that it came through the White Nile before the Virunga (Mufumbiro) volcanoes seperated Lake Kivu from the White Nile system. But this is not the only possible explanation. The watershed between the sources of the Rukakara and other affluents of the Victorian Kagera and the Kalundara and others that flow to Lake Kivu is only few kilometers broad and consists partly of *Papyrus* swamps. Thus *P. lacustre* may have reached Lake Albert and Lake Edward through the White Nile and Lake Kivu through the Victoria Nile. As long as the *Turbellaria* of Lake Victoria are so little known as is shown by my list (MARCUS, 1955, pp. 116-117), one can not decide whether the historical or the still existing way from the Nilotic system to the Southern Lakes of the Central African rift valley was used by *P. lacustre*.

The Semliki Rapids between Lake Albert and Lake Edward do not constitute a barrier, even in upstream direction for a *Plagiostomum* that occurs also under

stones (BAYLIS, 1927, p. 380; sample 3106 of the present material), as the worms can creep gliding from one cavity under a stone to the next without swimming free. The animals and still more the cocoons on their substratum can be transported by the Ruzizi Waterfalls from the Kivu to the Tanganika. As an euryoecous species *P. lacustre*, that was already found at the Lukuga outflow (sample 5007 of the present material), may penetrate into the Congo.

The colour pattern from the Southern part of Lake Tanganika (Kirango) described by BAYLIS (p. 381, fig. 1, *a-d*) was not found again in the more Northern areas studied by the Belgian Hydrobiological Expedition. But further signs of a beginning formation of subspecies or geographical races can not be seen within the thousand kilometers long area inhabited by *P. lacustre*. In the much vaster area occupied by the Palearctic *P. lemani* no subspecific unities could be verified either. This may, at least in part, be due to the subtlety of the specific characters in the genus *Plagiostomum* (KARLING, 1940, p. 97).

RHABDOCOELA, DALYELLIOIDA.

Gieysztoria rubra (FUHRMANN, 1894).

(Figs. 13-15.)

Gieysztoria rubra LUTHER, 1955, pp. 202-208.

The length of the single specimen is about 0,4 mm, the greatest diameter about 0,22 mm. The head is blunt, the tail pointed. The limits of the epidermal cells are distinct; rhabdites and cilia can not be recognized. The parenchyma is a very loose tissue, as it characteristic for this species (l. c., p. 202).

The pharynx (f) that is irregularly contracted in the present specimen is about 0,1 mm long. The cells of the intestine (i) contain shells of Diatoms.

One of the testes lies farther in front than the other; such different positions are known in *Gieysztoria* and other *Dalyelliidae* (l. c., pp. 44-45). The testes are voluminous, but contain only spermatogonia and spermatocytes, no ripe spermatozoa. There are some mature sperms in the small seminal vesicle (s). The high epithelium of the granule vesicle (q) stores no secretion, as the worm is not in active male phase.

The cuticular organ consists of two fibrous rings (k, m) and 20-24 spines (j) of equal length, which are of the uniformly cuspidate type (l. c., p. 204). The dorsal interruption of the rings can be presumed to be present, but was not verified with certainty in the sections. The length of the basilar openings (p) of the spines is less than one third of their entire length. The inner fibrous walls (h) of the spines attain the proximal ring (k). These bridges are numerous and principally central. A few farther peripherical fibres (n) that are not bases of spines but proceed from the distal ring (m) extend to the proximal one. These fibres are the first to appear when the cuticular organ is focalized.

Also the female organs agree with LUTHER's text and drawings (fig. 32, H, I).

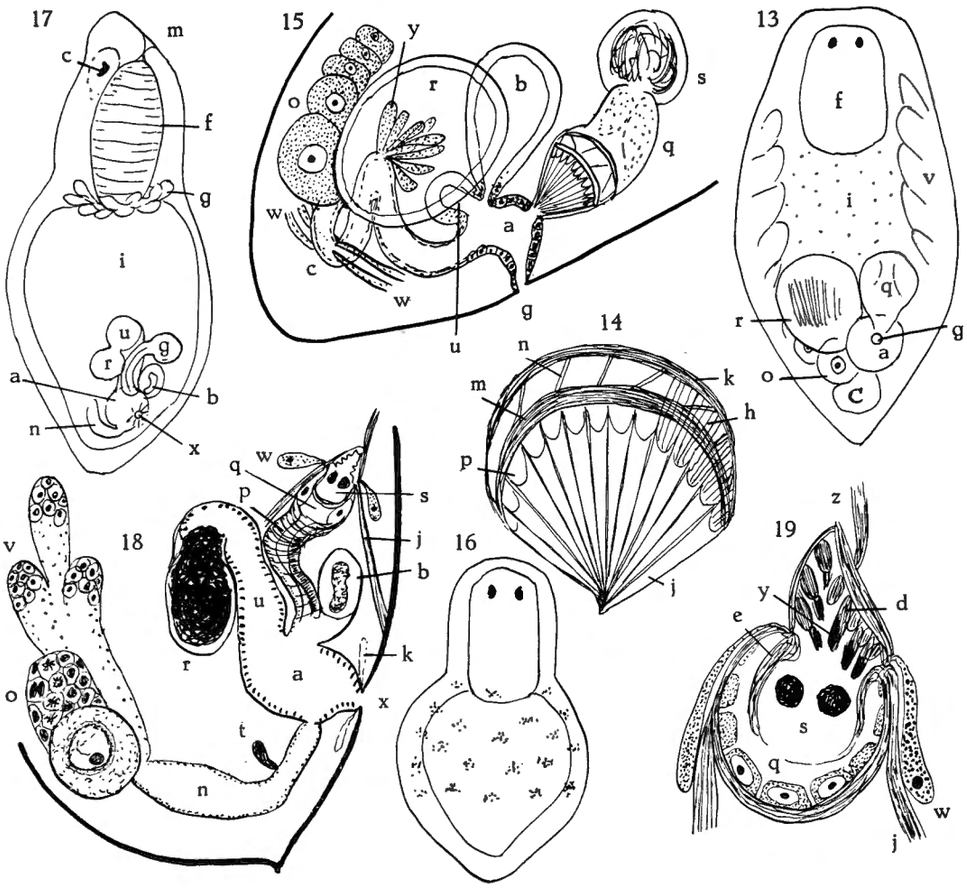

FIG. 13-15. — *Gieysztoria rubra* (FUHRM.).

13. Aspect of preserved worm. — 14. Diagram of reproductive organs. — 15. Male cuticular organ, from sections.

a : common antrum; b : bursa copulatrix; c : ductus communis; f : pharynx; g : genital pore; h : bases of spines; i : intestine; j : spines of cuticular organ; k : proximal ring of cuticular organ; m : distal ring of cuticular organ; n : fibres from distal to proximal ring; o : ovary; p : outer openings of cuticular spines; q : granule vesicle; r : receptaculum seminis; s : seminal vesicle; u : uterus; v : vitellaria; w : vitelloducts; y : shell glands.

FIG. 16-19. — *Sergia mancala* n. sp.

16. Dorsal aspect of preserved worm. — 17. Lateral view of clarified worm. — 18. Diagram of reproductive organs. — 19. Oblique section of male bulb.

a : genital antrum; b : bursa copulatrix; c : eye; d : peg-shaped cells; e : fold of bulb; f : pharynx; g : oesophageal cells; i : intestine; j : protractor of bulb; k : cement glands; m : mouth; n : ovovitelloduct; o : ovary; p : male genital canal; q : granule vesicle; r : receptaculum seminis; s : seminal vesicle; t : shell gland; u : uterus; v : vitellarium; w : granule glands; x : genital pore; y : strands of secretion; z : retractor of bulb.

The ovary (o) is dorso-caudal, slightly slanting to the right side, between the vitelloducts (w). The vitellaria (v) are papillary with numerous multiplication zones. The very ample receptaculum seminis (r) contains alien sperm. The ductus communis (c) receives the secretion of a big tuft of shell glands (y), before it attains the uterus (u), in the present specimen a small, empty pouch. Between uterus and male canal lies a voluminous bursa (b), that contains a plug of indistinct material, probably degenerated cells. The cement glands are hardly developed.

Occurrence. — Lake Edward, Vitshumbi, southern shore of the lake (sample 3046 *a*), 14.VI.1953. One specimen together with 4 *Plagiostomum lacustre* BAYL.

Further distribution. — According to LUTHER's pondered synonymy *Gieysztoria rubra* has been reported from Northern, Eastern, Central and Southern Europe and from Brazil, in and near the city of São Paulo.

DISCUSSION OF *GIEYSZTORIA RUBRA*.

Of the big Family *Dalyelliidae* only one Ethiopian species, *Gieysztoria quadridens* (BÖHMIG, 1897, p. 10) from Lake Victoria, Bukoba, was described. This description, as well as material from British East Africa registered as « *Dalyellia*-sp. » (BEAUCHAMP, 1935, p. 151) shows how difficult the analysis of single preserved specimens of this family is. *G. quadridens* with a cuticular organ composed of four simple short spines remains a « species inquirenda ». It is interesting that LUTHER (1955, p. 228) with his vast knowledge of the *Dalyelliidae* succeeded to understand from BÖHMIG's description that *G. quadridens* is probably related to *G. rubra*. This is consistent with WORTHINGTON's « Victorian Region » (1954, p. 70) that includes Lake Edward.

Sergia mancala, spec. nov.

(Figs. 16-19.)

The length of the worm is 0,5 mm, its greatest diameter, in the middle, 0,3 mm. The body is rounded in front, cylindrical in the anterior third, that contains the pharynx, then widens suddenly, diminishes successively backwards, and ends with a short tail. The colour is yellowish, powdered with spots of black pigment located in the parenchyma. The black eyes (c) lie over the fore end of the pharynx (f), and their pigment cups open outwards.

The epidermis is thin; rhabdites and cilia are not preserved. The mouth (m) is subterminal, the pharynx long and relatively slender, as LUTHER found it (1955, p. 269) in *Sergia sergia* (BEKLEMISCHEV, 1918). Of histological details of the pharynx an inner sphincter is remarkable; the number of the muscles could not be counted. The oesophageal cells (g) between pharynx and intestine (i) are like those of BEKLEMISCHEV's figure 8. They may be the insunk

cells of the inner pharyngeal epithelium (MARCUS, 1946, fig. 31, *e*), the so-called « Kropfzellen » (LUTHER, 1955, pp. 17, 269), or glands (MARCUS, 1946, fig. 31, *s*). The gut contains Diatoms.

The testes were missing, probably reduced. The copulatory organ (figs. 18, 19) is located near to the ventral wall of the body. This male organ resembles that of *Sergia sergia* (BEKL.) in some traces, among which the absence of cuticular elements in the genital canal is by far the most important. The seminal vesicle (s) is conical. Ectally it juts into the granule vesicle (q) that therewith becomes cup-shaped. The point of the cone contains peg-shaped cells (d) that project into the lumen. Their nuclei could not be found within the cells, possibly they lie beyond the musculature of the bulb. Distally converging strands of basophil secretion (y) cap these cells. Perhaps these strands correspond to those drawn in all figures of the male bulb of *Sergia sergia* (BEKLEMISCHEV, 1918, fig. 9; NASONOV, 1926, t. 2, figs. 11, 12; LUTHER, 1955, fig. 51, H, I, sekr.). But LUTHER noted (p. 269) that the secretion of *S. sergia* does not stain, and moreover that it is produced in two lateral diverticula of the bulb, which lie ectally to the seminal vesicle. Hence the comparison between the two species is rather vague in regard to this secretion. Two blue-staining globules lie in the seminal vesicle. LUTHER (l. c.) found them in *S. sergia* too and called them sperm-balls. Maybe the basophilous secretion agglutinates the spermatozoa. The external furrow and the internal incomplete muscular fold (e) between seminal and granule vesicle can not be compared with structures of *S. sergia*, though they are frequent in other *Dalyelliidae* (LUTHER, 1955, p. 46). Like in these the granule glands (w) are attached in the furrow. Also in *S. sergia* they open into the ental part of the granule vesicle (BEKLEMISCHEV, 1927*a*, p. 122, note 1; LUTHER, 1955, fig. 52, D, ks.). NASONOV (1926, p. 871, t. 2, fig. 12, *h*) did not see the granule glands of *S. sergia*. A wreath of 12 big cells with distinct limits lines the granule vesicle (q); NASONOV (l. c.) found four, LUTHER (p. 269) a high epithelium without visible limits. The retractors (z) and protractors (j) of the bulb are strong. Like in *S. sergia* the male genital canal (p) does not contain a cuticular apparatus. It differs from this species by much stronger developed musculature, and opens into the antrum (a) farther distant from the genital pore (x) than in *Sergia sergia*. There are no nuclei in the epithelium of the male canal.

The ovary (o) has a strange aspect. One big ovocyte and an ental lump of small cells with their nuclei in different phases of division form the organ. These cells are very numerous and not disposed like the germ-cells of a regular germarium of the *Dalyelliidae*. Maybe this ovary consists of an abnormal germzone and only one growing ovocyte. The vitellaria (v) contain several multiplication zones, they are papillary as in *Sergia sergia*. Germarium and vitellaria meet in the posteror region of the body, and from there the ovovitelloduct (n) curves forward and towards the ventral side. One shell gland (t) was seen on this duct. A rostral diverticulum of the antrum (a) is the bursa (b), a tubate, muscular organ, the lumen of which contains a plug of secretion. The nuclei

of the atrial epithelium are more distinct than those of the ovovitelloduct. An ample dorsal dilatation of the antrum is the uterus (u), also with a well nucleated epithelium. We consider as receptaculum seminis (r) an inner pouch of the uterus. In the total animal (fig. 17) and in the sections there is a broad communication between uterus and receptaculum. The latter contains a bulk of blue-staining matter, perhaps alien sperms involved in secretion of the peg-shaped cells. Some cement glands (k) occur around the genital pore (x).

Occurrence. — Lake Albert, Kasenyi, southwestern part of the lake (sample 3021 *b*), 26.VI.1953, in a depth of 2-3 m, one specimen.

DISCUSSION OF *SERGIA MANCALA*.

The designation of the present single, not very well preserved specimen with generical and specific name is intended to simplify future discussion. If this worm had been gathered at a locality from where further collections were soon to be expected, it would have been listed as « *Dalyelliidae*-spec. ». But *Turbellaria* from Lake Albert are extremely rare. Since BÖHMIG (1897, pp. 12, 13) described two immature Planariids from the Ituri District, Belgian Congo, not a single Turbellarian was mentioned from this region.

Only thanks to LUTHER's grand Monograph of the *Dalyelliidae* (1955) we could try to classify the rare and valuable animal. Decisive was the absence of a cuticular apparatus in the male copulatory organ (l. c., p. 50). The uncertain (BEKLEMISCHEV, 1927*a*, p. 125; LUTHER, 1955, p. 323) *Dalyellia inermis* GRAFF (1911, p. 352, t. 3, figs. 1-3) has a cuticular lining in the ejaculatory duct. The unrecognizable testes of the present specimen of *Sergia mancala* are nothing specially remarkable. Their reduction is known to occur on the height of female maturation (LUTHER, 1955, pp. 43, 44). The absence of a cuticular copulatory organ however must be commented. In *Provorticidae* that belong to the same Section as the *Dalyelliidae* the loss of this organ after copulation was observed (MARCUS, 1951, pp. 18, 20). In this case all male efferent organs, ducts, seminal and granule vesicle, had vanished, while they are complete in the present worm. In a Typhloplanid, *Brinkmanniella augusti* MARCUS (1951, p. 22), the cuticular stylet is the last male organ to subsist. Therefore we think that the absence of a cuticular organ in the present case is a permanent feature and suggests a denomination.

It would certainly be untimely to discuss zoogeographic relations, so much the more as *Sergia sergia* (BEKLEMISCHEV, 1918) was only found in few localities in Russia and Finland (LUTHER, 1955, p. 271).

Vaillantiella caribumba, spec. nov.
(Figs. 20-23.)

The length of the single available worm is 0,6 mm, the breadth 0,5 mm, the height 0,35 mm. The greatest breadth lies in the middle. The anterior end is narrowed, obtuse, without any auricles. The rear of the body bears a short, pointed tail that is bent upwards.

The mouth is subterminal. When the animal was preserved, it evidently contracted very much and even partly expelled the wall of the gut through the mouth. Coloured elements are only the two small black eyes and some pigment in the parenchyma. The limits between the epidermal cells are distinct. The posterior end shows voluminous glands (i), the granular erythrophilous secretion of which enters the caudal, probably adhesive papillae. The parenchyma is not specially dense; on the back it contains pigment cells between the vitellaria and the skin.

The pharynx is conspicuous. Its relative length however, that is more than one third of that of the body, may be due to its consistence that prevents shrinkage. The intestine has an epithelial wall; it contains unicellular organisms, part of which lies within vacuoles of the gut-cells.

The testes are asymmetrical, one, probably the right one, lies ventrally between intestine and male copulatory organ, the other farther behind, a little in front of the tail. The former was measured, it is 270 μ broad, about 80 μ long, and 40 μ high. The ample seminal vesicle (s) is spherical. A girdle of cyanophilous glands (k) separates the seminal and granule vesicle (q). Part of the secretion of the latter was probably forced into the seminal vesicle due to violent contraction during preservation.

Five spines provided with basal muscles (m) are located beside the outlet of the male genital canal, an antero-dorsal one (j) that is slender, curved, crotchety, and 70 μ long; a postero-dorsal, nearly straight and 95 μ long one (p); two antero-ventral ones (t) on a common socket (h) are parallel, 40 μ long, and end with a hook. A small, rather broad spine (v) lies nearest to the antrum. Some cuticular connections at the bases of the spines seem to exist, but are indistinct and were therefore not drawn. The male canal narrows towards the genital opening (g).

The ovary (o) contains several growing ovocytes. The strongly lobate vitellaria are located over the intestine. The ductus communis (c) receives the outlet of the vitelloduct (w), that (d) of the receptaculum seminis (r), and the shell glands (y). The duct (d) of the receptaculum shows no lumen in the sectioned worm, but consists of a pile of flat cells. The receptaculum lies to the left of the ovary.

The bursa (b) is bent forwards and ventrally. With its surrounding glands and a cuticular spine (e) it looks more like a stimulative organ of the *Polycystididae* than a bursa copulatrix. A high-celled duct (n) connects the bursa with the antrum (a) that is histologically similar to this duct. The ductus commu-

nis (c) enters a spacious uterus (u) which opens into the antrum from behind. The cement glands (z) around the genital pore (g) are distinct, but not specially strong.

Occurrence. — Lake Albert, Mahagi Port, northwestern shore of the lake (sample 4086 *a*), 16.II.1954, among *Najas* one specimen together with one *Plagiostomum lacustre* BAYLIS.

DISCUSSION OF *VAILLANTIELLA CARIBUMBA*.

The generic classification of the here described species is certain in our opinion. Differences between *Vaillantiella algerica* LUTHER (1955, p. 303) and *V. caribumba* are principally the details of the cuticular male organs and the bursa. Further distinguishing features, as the auricles of the head, the terminal mouth, and the small pharynx of *algerica* may have been accentuated by different preservation. The pervious duct of the receptaculum seminis, not filled with flat cells, may be functional (LUTHER, 1955, p. 72), and so possibly the mighty cement glands are too. The different number and connections of the cuticular spines furnish good specific characters. The bursa of *caribumba*, it is true, differs widely from that of *algerica*. The latter has a cuticular clasp at its entrance, but no glands around it. It is a rather shallow dilatation of the atrium.

The occurrence of a species in Lake Albert, that is related with a member of the « fauna hygropetrica » from Algeria, is unexpected but not inexplicable. First of all one will think of the thick-shelled eggs of the *Dalyelliidae* which can remain alive, when the pond or brooklet, where they have been freed, dries up. It is possible that aquatic birds transport particles of mud containing eggs of *Dalyelliidae* on their feet. The mighty developed cement glands of the Algerian species suggested the possibility of an encystment during dry periods (LUTHER, 1955, p. 307, note 1). Such sticky mucous cysts can probably not withstand a transport by wind and birds. But also a passive distribution of the eggs is not a convincing explanation for the occurrences of *Vaillantiella*. If such transportation were not only quite exceptional, it would have brought about a much more uniform universal fauna of *Dalyelliidae* than actually exists. More than many other freshwater animals the *Dalyelliidae* are rich in endemisms, f. ex., in Brazil (LUTHER, 1955, pp. 86-87), and specially isolated by the morphological characters of the cuticular copulatory organs. Also ecological specialization is known for several species (l. c.).

Rather than the factors existing to-day we suppose that historical ones have provided the communication between *Vaillantiella algerica* and *caribumba*. Possibly these species have originated from a common ancestor during one of the pluvial periods in Africa, which were more or less contemporaneous with the temperate glacial periods in the Holarctic Region. During an early pluvial

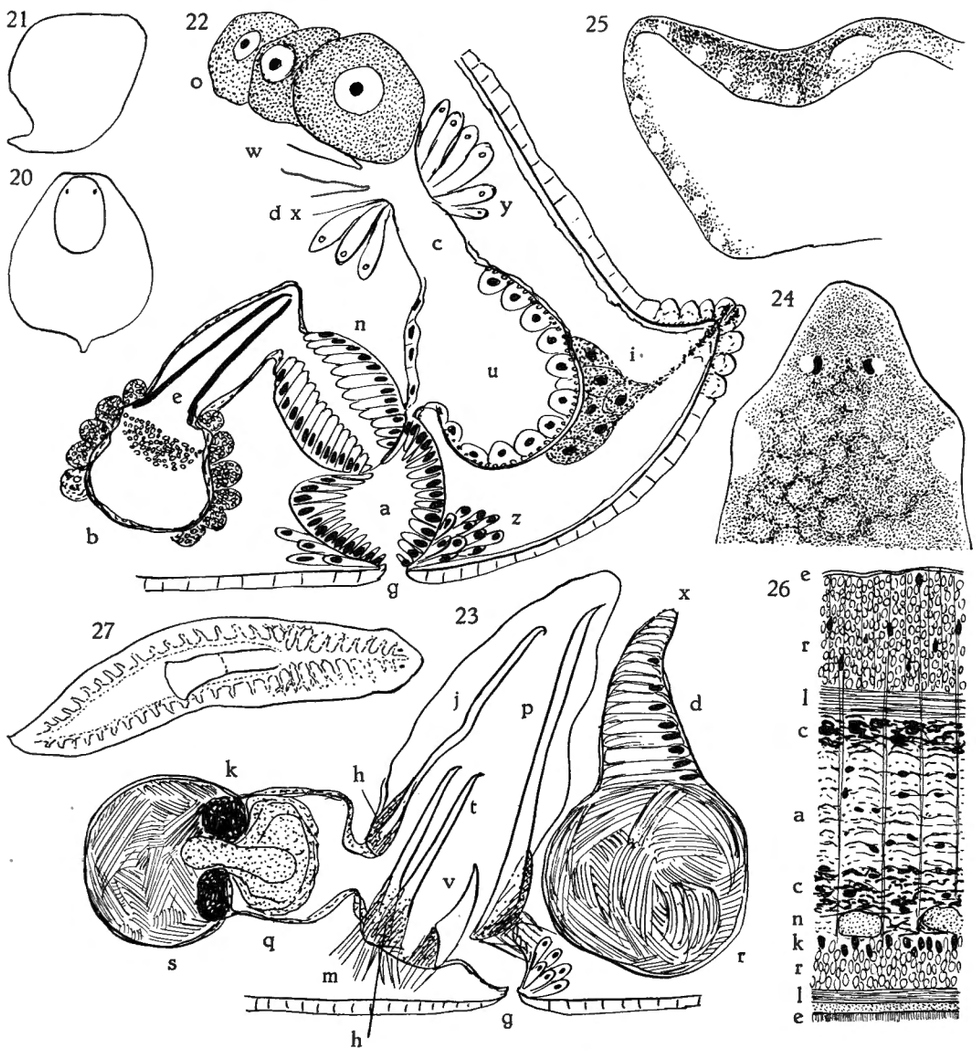

FIG. 20-23. — *Vaillantiella caribumba* n. sp.

20. Dorsal view of preserved worm. — 21. Side view of same. — 22. Reconstruction of reproductive organs of right side; the cross indicates the duct (d) of the receptaculum seminis. — 23. Reconstruction of reproductive organs of left side.

a : antrum; b : bursa; c : ductus communis; d : duct of receptaculum seminis; e : spine of bursa; g : genital pore; h : socket of spine; i : adhesive glands; j : antero-dorsal spine; k : cyanophilous region of granule glands; m : muscles of spines; n : bursa canal; o : ovary; p : postero-dorsal spine; q : granule vesicle; r : receptaculum seminis; s : seminal vesicle; t : antero-ventral spine; u : uterus; v : postero-ventral spine; w : vitelloduct; y : shell glands; z : cement glands.

FIG. 24-26. — *Planariidae* sp. 6.

24. Head of preserved worm. — 25. Ventral view of same. — 26. Transverse section of pharynx.

a : eosinophilous strands; c : cyanophilous strands; e : epithelia; k : nuclei of outer epithelium; l : longitudinal muscle fibres; n : nerve plexus; r : annular muscle fibres.

FIG. 27. — *Planariidae* sp. 7. Aspect of clarified worm.

period a substantial part of the Sudan plain was inundated (WORTHINGTON, 1954, p. 71). Rivers flowed through the Sahara, that contained important lakes, the faunistic evidences of which, crocodiles, Ethiopian fishes, and shrimps, are to-day seen in the waters of the Mountains of Ahaggar, of Tassili n'Adjer, and northwards to the Algerian and Tunesian Shotts.

TRICLADIDA PALUDICOLA.

PLANARIIDAE sp. WITHOUT REPRODUCTIVE ORGANS.

Planariidae sp. 6.

(Figs. 24-26.)

The immature worms are 10-12 mm long and 1,5 mm broad. The anterior end is blunt, the auricles are slightly produced.

The back is grayish brown with little lighter round spots; the ventral side is light. The eyes stand nearer together than to the borders, and in front of the line that unites the anterior ends of the auricles. The diameter of the eyes is about 120 μ. One specimen with much smaller eyes, 90 μ in diameter, probably had regenerated its fore end recently, possibly after fission. The auricles bear al large white spot, and on the margin of the head there is a row of 12 light sensorial spots.

The white pharynx extends from 5 to 7,5 mm of the body length. Its two outer muscle layers (l, r) are 25 μ thick together. The inner annular layer (r) measures 45 μ. The nerve plexus (n) lies near the outer muscle layer. The glandular secretion consists of outer cyanophilous (c), inner cyanophilous (c), and intermediate erythrophilous strands (e).

Occurrence. — Near Lake Edward, Rivière Duka (Kisaka), 29.V.1953, one stones (sample 565), 4 specimens.

DISCUSSION OF *PLANARIIDAE* p. 6.

The light sensorial spots do not furnish a specific character; they occur f. ex. in sp. 3 (MARCUS, 1955*a*, p. 13), the auricles of which are less developed than in sp. 6. The disposition of the pharyngeal glands in the latter does not occur in any of the Ethiopian *Planariidae* (l. c., pp. 12-18), the pharynx of which is known from sections.

Planariidae sp. 7.

(Fig. 27.)

The entirely velvety black worm of 3,2 mm length seems to be rather young. Its breadth is 0,7 mm. The triangular head is limited by the rounded auricles. Neither these nor the halos of the eyes are colourless; also the pharynx is quite

black. No other worm of the present collection that contains 181 Turbellarians shows such a uniform colouration, hence it does not seem to be produced by preservation.

The 0,75 mm long pharynx begins 1,15 mm from the tip of the body. It is in part protruded from the mouth in the present specimen. The ramifications of the gut are about 9 pairs on the anterior branch and 15-18 on the outer side of the posterior limbs. Whether these have diverticles on their inner side could not be recognized. Pharynx and gut contain swallowed food, evidently yolk of eggs and a few nuclei.

The layers of the pharynx are very thin and not well differentiated. This shows too that the specimen is young. Two outer muscle layers, a nerve plexus, cyanophilous glands, and two inner muscle layers could be distinguished.

Occurrence. — Ituri, bassin Congo (sample 1146), rivière Nyamasole (près Bogoro), 11.XI.1953, one specimen.

DISCUSSION OF *PLANARIIDAE* sp. 7.

Though it is probable that the black colour of the entire worm is a specific feature, the single young specimen can not be sufficiently analyzed.

SUMMARY.

The valuable material of the Belgian Hydrobiological Expedition consists of Microturbellarians, whose collection and preservation is notoriously difficult.

Macrostomum tuba var. *verbekei*, var. nov., differs from *tuba* (GRAFF) mainly by a short stylet with only slightly swollen terminal bulb. *Plagiostomum lacustre* BAYLIS was taken in all lakes, where the Expedition worked, with colour patterns different from the original material. Geographical subspecies however cannot be distinguished within its thousand kilometers long range. A tentative explanation of the distribution of this species is given. *Gieysztoria rubra* (FUHRMANN) was collected in Lake Edward; *G. quadridens* (BÖHMIG) from Lake Victoria is probably related to *rubra* (LUTHER, 1955). *Sergia mancala*, sp. n., has been named more with the intention to simplify future discussion, than with the conviction of stating something definitive. The generic classification of *Vaillantiella caribumba*, sp. n., is considered as certain. The occurrence in Lake Albert of a *Vaillantiella*, whose only relative is known from Algeria, might be a trace of the early pluvial period, during which a substantial part of the Sudan plain was inundated.

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