

INSTITUT DES PARCS NATIONAUX
DU CONGO BELGE

INSTITUUT DER NATIONALE PARKEN
VAN BELGISCH CONGO

Exploration du Parc National de l'Upemba

MISSION G. F. DE WITTE

en collaboration avec

W. ADAM, A. JANSSENS, L. VAN MEEL et R. VERHEYEN (1946-1949).

FASCICULE 21

Exploratie van het Nationaal Upemba Park

ZENDING G. F. DE WITTE

met medewerking van

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AFLEVERING 21

TURBELLARIA TRICLADIDA

BY

ERNESTO MARCUS (São Paulo)



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INTRODUCTION

The President of the « Institut des Parcs Nationaux du Congo Belge », Professor V. VAN STRAELEN kindly intrusted me with the important collection of fresh-water and terrestrial Tricladids made by Dr. W. ADAM, member of the « Mission G. F. DE WITTE » in the National Upemba Park, Katanga, in 1946-1949. Mrs. EVELINE DU BOIS-REYMOND MARCUS has taken part in the study of the more than 1.300 limnic and almost 100 terrestrial worms, and has drawn the figures.

We have included one lot of 8 Paludicola from Pietermaritzburg (Natal) and 4 Terricola from Amani (East Usambara, Tanganyika Territory) in the present report. The first were collected by Drs. D. W. and R. F. EWER (Natal University, Pietermaritzburg), and the latter by Miss B. KEMP (Amani). She sent them to Professor Dr. C. F. A. PANTIN (Cambridge, England) who kindly handed them over to us. Also for bibliographic help we are indebted to Prof. PANTIN and Drs. EWER.

All the localities between [] are without the Park.

INTRODUCTION TO THE PALUDICOLA.

The first species of *Tricladida Paludicola* reported from Equatorial Africa are *Planaria venusta* and *P. brachycephala* collected in a tributary and a subtributary of the Ituri (BÖHMIG, 1897, pp. 12, 13). As the specimens were immature, they cannot be discussed. The following records are those of *Planaria neumanni* NEPPI (1904, p. 309; MEIXNER, 1928, p. 576, note 4) from South Kaffa (2.300 m), and *P. tanganyikæ* LAIDLAW (1906, p. 777) from Lake Tanganyika. *Planaria gonocephala* DUGÈS from Mt. Kenya (up to 4.000 m) was classified with reservation (BEAUCHAMP, 1913, p. 4). As will be shown in the discussion of *Dugesia gonocephala* (DUGÈS), the name of this species can really not be maintained for the specimens from Mt. Kenya. A little farther to the South, on the Kilimandjaro, *Planaria jeanneli* was found (l. c., p. 8), the description of which, referring to the openings of the ovovitelloducts, was corrected later on (BEAUCHAMP, 1939, p. 73). The short series of testes characterizes this species. Perhaps it belongs to *Curtisia* GRAFF (1916, p. 3213). It is true that the type of *Curtisia* has no bursa (HYMAN, 1951a, p. 160), but also species with bursa have been put in this genus (KENK, 1930, p. 290; MARCUS, 1946, p. 143). WESTBLAD (1952, p. 49) extends the conceit of *Curtisia* even farther.

Worms from Mt. Elgon (BEAUCHAMP, 1935, pp. 146-147) were all sexually immature, and therefore their classification as *Euplanaria gonocephala* cannot be considered as proven. The material from the caves of Tschetro-Saka and Yanapæ (Sankuru District, Belgian Congo) mentioned in the same paper was mature. Its determination as *Euplanaria gonocephala* is supported by the existence of inner longitudinal muscle fibres (BEAUCHAMP, 1936, p. 435) on the outer side of the pharynx, as such are characteristic for *Dugesia gonocephala* (UDE, 1908, p. 319; KENK, 1930a, p. 248). BEAUCHAMP (1939a, pp. 120-121; 1951b, pp. 96-97) reported further localities from the Belgian Congo for *gonocephala* situated in the northern (Bas-Uele; Bangala), western (Lukunga; Thysville and Matadi, Bas-Congo; N'Zobe, Shiloango), and eastern part (Territoire Kabare) of this country. He verified the same species in northern Angola (BEAUCHAMP, 1951a, pp. 80-81), and finally described *Dugesia congolensis* BEAUCHAMP (1951b, p. 90) from the region of Uvira on the north end of Lake Tanganyika.

In a recent paper BEAUCHAMP (1952, Bull. Soc. Zool. France, vol. LXXVII, pp. 362-370) describes *Dugesia lamottei* from French Guinea, recognizes part of the material of *Dugesia gonocephala* from Angola as a distinct species, *D. machadoi*, and reports the first Paludicola from Madagascar (*D. milloti* and *Dugesia* sp.).

LIST OF LOCALITIES (PALUDICOLA).

- 719 Bwalo, affl. g. Muye et sous-affl. dr. Lufira, 1.750 m, pH 6, temp. 20°, 13.IV.1948 : *Dugesia gonocephala* (DUGÈS).
- 721 Buye-Bala, affl. g. Muye et sous-affl. dr. Lufira, 1.750 m, pH 6, 14.IV.1948 : *Dugesia gonocephala* (DUGÈS).
- 726 Lubanga, tête de source (près de Buye-Bala), 1.750 m, pH 6, 14.IV.1948 : *Dugesia gonocephala* (DUGÈS) and *Dugesia ectophysa*, n. sp.
- 736 Katongo, affl. g. Mubale et sous-affl. g. Munte, 1.750 m, pH 5,5-6, temp. 19°; 15.IV.1948 : *Dugesia gonocephala* (DUGÈS).
- 752 Dipwa, affl. g. Kalumengongo et sous-affl. dr. Lualaba, 1.730-1.830 m, 18.IV.1948 : *Dugesia gonocephala* (DUGÈS).
- 794 Lubanga, affl. g. Muye, au-dessus des chutes, 1.500 m, pH 5,5-6, temp. 20°, 30.IV.1948 : *Dugesia ectophysa*, n. sp.
- 839 Luanana, affl. g. Kamesia et sous-affl. dr. Muye, 1.495 m, pH 6, temp. 20°, 3.V.1948 : *Dugesia ectophysa*, n. sp.
- 904 Lubanga, affl. g. Muye, en dessous des chutes, 1.320 m, pH 6-6,5, temp. 18,5°, 19.V.1948 : *Dugesia ectophysa*, n. sp.
- 919 Lupiala (riv.), affl. dr. Lufira, 1.470 m, pH 6, temp. 19°, 20.V.1948 : *Dugesia gonocephala* (DUGÈS) and *Dugesia ectophysa*, n. sp.
- 920 Kamesia, affl. dr. Muye et sous-affl. dr. Lufira, 1.550 m, 22.V.1948 : *Dugesia gonocephala* (DUGÈS) and *Dugesia ectophysa*, n. sp.
- 928 Kayumbwe, affl. g. Muye, cours inférieur, 1.350 m, pH 6, temp. 21°, 25.V.1948 : *Dugesia ectophysa*, n. sp.
- 978 Munoi, dans la Lupiala, ± 1.100 m, pH 6, temp. 19°, 4.VI.1948 : *Dugesia ectophysa*, n. sp.
- 1002 Kaswabilenga, rive dr. de la Lufira, 700 m, 9-19.VI.1948 : asexual worms in fission, indeterminable.
- 1081 [Masombwe, sur Grande-Kafwe, 1.120 m, pH 6,5, temp. 17°, 5-10.VII.1948] : asexual black worms that could not be classified.
- 1147 Kilwezi, affl. dr. Lufira, 700 m, 26.VII-14.IX.1948 (24.VII.1948, pH 6,5-7, temp. 23°) : asexual worms in fission, not determinable.
- 1290 Loie, affl. g. Lufira, 700-1.000 m, 17.VIII.1948 : asexual worms in fission, not identifiable.
- 1933 Kanonga, affl. dr. Fungwe, 750 m, II.1949 : asexual worms in fission, not determinable.
- 2107 Pelenge, affl. g., 1.250 m, pH 6,6, temp. 19,8°, 18.III.1949 : asexual, not classifiable worms in fission, and 2 immature *Dugesia gonocephala* (DUGÈS).

- 2332 Kaziba, riv. Lubanga, 1.150 m, pH 7, temp. 19,1°, 16-22.IV.1949 : one immature *Dugesia gonocephala* (DUGÈS) and many asexual worms in fission, indeterminate.
- 2371 Ganza, affl. dr. Lukoka, 860 m, pH 7,8, temp. 17°, 31.V.1949 : asexual worms in fission, indeterminate.
- 2375 Ganza, Kamandula, 860 m, pH 8,3, temp. 20,7°, 31.V.1949 : asexual worms in fission, not identifiable.
- 2433 Kabangey, affl. dr. Loie, 1.050 m, pH 6,7, temp. 20,8°, 6.VI.1949 : two immature specimens, not determinable.
- 2434 Loie, près de la Kabangey, 1.000 m, pH 7,6, temp. 18,1°, 6.VI.1949 : immature worms, indeterminate.
- 2472 Lukorami, affl. g. Lufira, 900 m, pH 7,9, temp. 18,5°, 13.VI.1949 : asexual worms in fission, not determinable.
- 2503 Mware, affl. g. Lufira, 950 m, pH 7,3, temp. 17,5°, 20.VI.1949 : *Dugesia astrocheta*, n. sp.
- 2520 Mware, affl. g. Lufira, 1.000 m, pH 7,8, temp. 23,8°, 24.VI.1949 : *Dugesia astrocheta*, n. sp.
- 2525 Difirinji, affl. g. Lufira, 750 m, pH 7,6, temp. 18° (eau stagnante), 27.VI.1949 : asexual worms in fission, not classifiable.
- 2573 Mware, affl. g. Lufira, 750 m, pH 7,7-8,6, temp. 23° (eau stagnante), 11.VII.1949 : immature worms, indeterminate.
- 2583 Kamusanga, affl. g. Lufira (en face du mont Sombwe), 700 m, pH 7,6, temp. 20,3°, 12.VII.1949 : one incomplete *Dugesia ectophysa*, n. sp.
- 2593 Lufira, rive dr. (au pied du mont Sombwe), 700 m, pH 8,4, temp. 21,8°, 13.VII.1949 : asexual worms in fission, not identifiable.
- 2599 Lukoka, affl. g. Lufira (embouchure), 750 m, pH 7,9, temp. 21,3°, 14.VII.1949 : one immature specimen of *Dugesia gonocephala* (DUGÈS). [Pietermaritzburg, Natal]. *Dugesia monomyoda*, n. sp.

***Dugesia gonocephala* (DUGÈS, 1830).**

(Fig. 1, 4-7.)

Material. — Mature specimens occur in samples 719, 721, 726, 736, 752, 919, 920, only immature ones in 2332 and 2599.

External characters. — The biggest ripe specimen is 18 mm long and 6 mm broad, the largest immature ones 18×4,5 and 14×6 mm. In a worm of 17 mm the pharynx extends from 7,5 to 10,5 mm; the mouth lies at 10 mm, the gonopore at 13 mm. The body has sharp borders, and is a little more convex on the back than on the ventral side. The anterior end is bluntly pointed, and the auricles are slightly produced. The sides are

nearly parallel till they converge towards the pointed tail. The eyes lie anterior to the auricles and as far separate one from the other as each from the tip and the margin.

The colour of the back is a yellowish brown with lighter grayish borders. In most worms the ventral side is lighter. Probably the yellow is due to the contents of the intestine. The back, except the rim, is stippled with black. These stipples can be just as dense on the ventral side or much scarcer. The animals are quite opaque. The tips of the auricles are in some cases dark brown or bright orange. The pigmentfree auricular sense organs are recognizable in the darker specimens. In the light ones there is hardly any difference between the pale colour of the margin and the pigmentfree spots. On the dorsal side the borders of the pharynx are surrounded by a little denser pigment that is often scarcer over the pharynx. Ventrally the nerve cords show as light lines, the mouth lies in a white area.

Internal characters. — The pigment is enclosed in ramified cells that lie chiefly in the submuscular parenchyma, but some of the ramifications penetrate the muscular layers, especially where the pigment forms the black stipples.

The outer musculature of the pharynx is arranged in three layers (fig. 5), the outer longitudinal (l), the annular (r), and the inner longitudinal (l), that is situated inside the insunk epithelial nuclei (n). The inner zone has a very thick inner annular and a thinner longitudinal layer.

The testes extend from 2,5 mm behind the tip almost to the hind end of the body. The very numerous and small follicles lie in about 8 rows one beside the other on each side between the intestine and the dorsal body wall. The efferent ducts (sperm ducts, HYMAN, 1945, p. 476, note) widen to form sperm-filled accessory, extra-bulbar seminal vesicles (spermiducal vesicles, e) at the level of the mouth. Beside the penial bulb they curve upward and forward, their wall becomes thickly muscular (z), and they pass through the penis bulb (q) and open into the intra-bulbar, principal, seminal vesicle (bulbar lumen, s). This vesicle is filled with pale, erythrophilous secretion and revested with a flat, nucleated epithelium. A small diaphragm (d) separates the vesicle from the ejaculatory duct (j) that proceeds straight to the tip of the conical penis papilla (p). The lining of the ejaculatory duct has intra-epithelial nuclei. The musculature of the whole penis is intermingled with strands of eosinophilous secretion that open into the entire course of the ejaculatory duct, especially immediately beyond (w) the diaphragm. This secretion is produced by extra-bulbar glands. The epithelium of the papilla and the male antrum (y) has for the most part insunk nuclei, only exceptionally one or the other nucleus is intra-epithelial.

The outermost part of the common antrum (a) has normal nuclei. The shape of its lumen varies with its functional phase. In a worm that

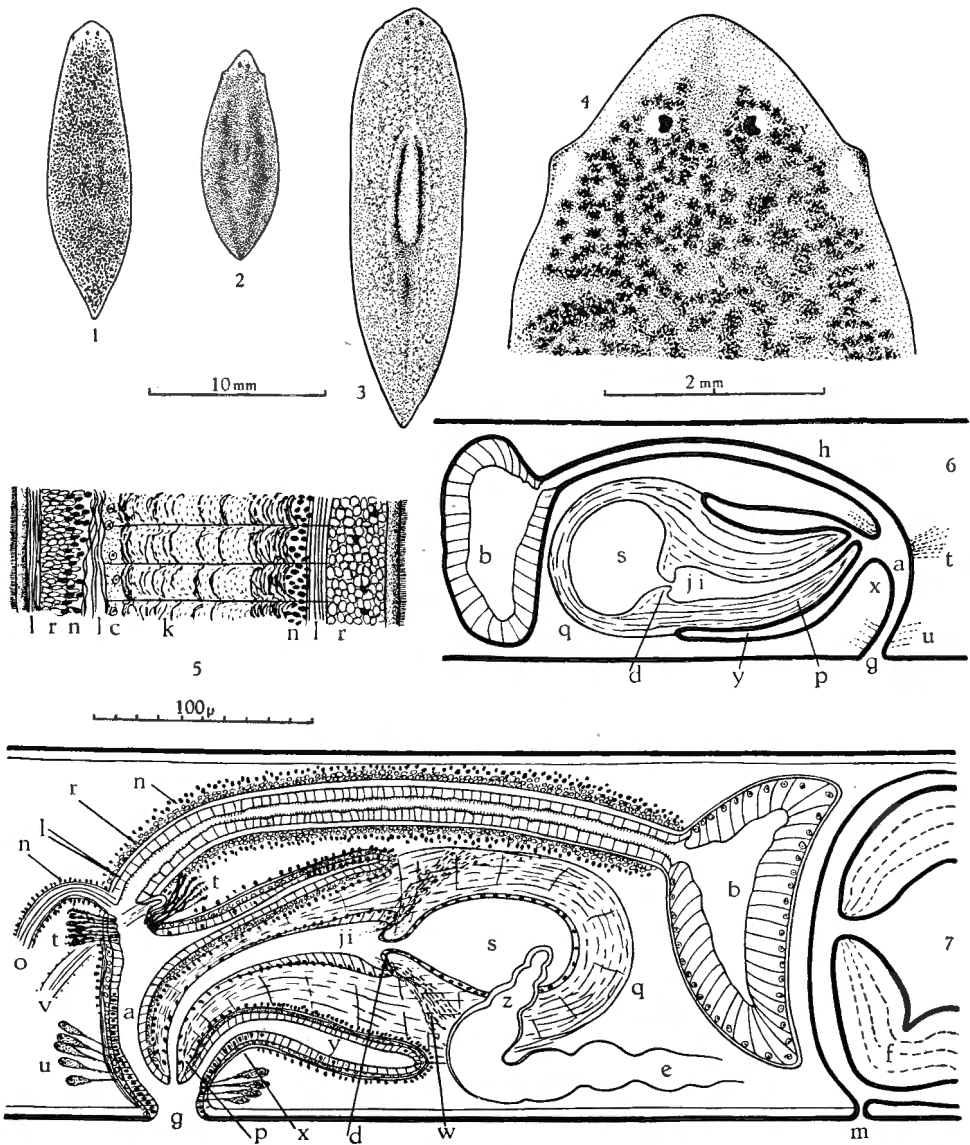


FIG. 1. — *Dugesia gonocephala* (DUGÈS), preserved worm.

FIG. 2. — *Dugesia astrocheta* n. sp., preserved worm.

FIG. 3. — *Dugesia ectophysa* n. sp., preserved worm.

FIG. 4-7. — *Dugesia gonocephala* (DUGÈS), preserved material
 4. Dorsal view of head. — 5. Sagittal section of part of pharynx. — 6. Diagram of copulatory organs with retracted penis. — 7. Combined sagittal section of copulatory organs with partly protruded penis.

a, common antrum; b, bursa; c, pharyngeal nerve plexus; d, diaphragm; e, accessory seminal or spermiducal vesicles; f, pharynx; g, gonopore; h, bursal canal; ji, ejaculatory duct; k, secretion of pharyngeal glands; l, longitudinal muscles; m, mouth; n, insunk nuclei; o, right ovovitelloduct; p, penis papilla; q, penis bulb; r, annular muscles; s, principal seminal vesicle; t, shell glands; u, cement glands; v, left ovovitelloduct; w, erythrophilous secretion of penis; x, fold between male and common antrum; y, male antrum; z, muscular ends of spermiducal vesicles.

presumably had recently freed an egg capsule (cocoon), the common antrum is very wide, and its walls form folds and pockets that do not exist in other animals. Like the whole copulatory apparatus that varies greatly in size and proportions according to the state of development of its parts, also the ventral fold (x) may be very high (fig. 6) or quite flat (fig. 7). That depends on the contraction or extension of the penis papilla, and produces either separation of the male (y) and common (a) antrum or an ample communication between them. Weakly erythrophil cement glands (u) open into the common antrum near the gonopore (g). In the common and male antrum the muscle layers continue those of the body wall; entally to the shell glands (t) the layers are altered in the bursal canal (h), the longitudinal fibres (l) are subepithelial and the annular ones (r) lie outside them.

The vitellaries extend to the hind end. When fully developed, they occupy the whole height of the body. The ovovitelloducts with insunk nuclei accompany the ventral nerve cords and bend upward and inward a little behind the gonopore. They enter (o, v) the bursal canal immediately above the belt of strongly eosinophilic shell glands (t), one ovovitelloduct coming more from the dorsal side, the other more from the ventral side, so that they open asymmetrically. The bursal canal (h) does not run in the median line over the male copulatory organ, as it is drawn in our diagrams, but passes around it to the left side. The epithelium of the strongly muscular bursal canal has insunk nuclei, while these are intra-epithelial in the high cells of the ampulla (b), the muscle layer of which is thin.

In two samples (726, 919) there are egg capsules, their diameter is 1,5 mm and the length of the stalk 2 mm.

Among *Dugesia*-species with head « en fer de lance » *D. gonocephala* (DUGÈS) is characterized by 3 layers of external muscles of pharynx : outer longitudinal, annular and inner longitudinal fibres, the latter inward to the insunk epithelial nuclei. Male ducts unite within penial bulb; a small diaphragm between bulbar lumen and ejaculatory duct that runs in axis of conical penis papilla. Separation of male and common antrum as well as antral folds and pockets vary. Sequence of muscle layers of body wall continues in antrum but is altered in bursal canal entally to belt of shell glands. Ovovitelloducts open into canal of bursa without previous union. In present material epithelial nuclei of bursal canal are insunk, those of ampulla intra-epithelial.

DISCUSSION OF *DUGESIA GONOCEPHALA*.

Dugesia gonocephala (DUGÈS, 1830, p. 83, t. 2, f. 22) is the type of the genus *Dugesia* GIRARD (1850, p. 265), as was exposed by HYMAN (1939, pp. 264-265). The name *gonocephala* needs not be substituted by that of the fissiparous *subtentaculata* DRAPARNAUD (1801). The priority of the latter (ARNDT, 1922, p. 132, note 2; VANDEL, 1925, p. 503, note 2) is not quite certain,

as some morphological details differ in *subtentaculata* and *gonocephala* (BENAZZI, 1947, pp. 3-4). Moreover LEPORI (1948, p. 462) has shown that also *D. sicula* LEPORI, an evidently good species, occurs with strains reproducing exclusively by fission.

The separate openings of the ovovitelloducts into the bursal canal of *D. gonocephala* were correctly described and drawn by O. SCHMIDT (1859, p. 31, t. 4, f. 4), STOPPENBRINK (1905, p. 521, t. 25, f. 1, 2), and MEIXNER (1928, p. 575, note 3, f. 2), whereas UDE (1908, p. 346, t. 21, f. 8, 9), STEINMANN (1911, p. 214; 1913, p. 193, f. 86) and GRAFF (1912-1917, t. 55, f. 12) are wrong. The classification of the present worms, in which the nuclei of the bursal canal are insunk, is in contradiction with MEIXNER's statement (1928, p. 575, note 3 on p. 576), that the epithelium of this canal has always intra-epithelial nuclei in *gonocephala*. We know, however, that this character varies (MARCUS, 1946, p. 148) in *Dugesia tigrina* (GIRARD), and also the material of *D. astrocheta* described in the present paper is not uniform with respect to the normal or insunk nuclei of the bursal canal. Maybe MEIXNER is right to consider *Planaria wytegrensis* SABUSSOW (1907, p. 741) as identical with *Dugesia polychroa* (O. SCHMIDT) and not with *gonocephala*, but this question should be discussed by comparing the penis bulbs and the seminal vesicles, not the position of the nuclei in the bursal canal.

As a rule *D. gonocephala* is called a cosmopolitan species (LELOUP, 1944, p. 72, 75), or with VOIGT and THIENEMANN a preglacial aboriginal of the Holarctis (STANCOVIC, 1934, p. 185; BENAZZI, 1933, p. 302; 1949, p. 4). As the revision of the fresh water Tricladids that already STEINMANN claimed (1913, p. 201) has not yet been undertaken (HYMAN, 1951, p. 157), it is necessary to survey the fundaments of the general conception as to the distribution of *D. gonocephala*.

As far as I can see from the statements of VOIGT (1894, pp. 166, 173), THIENEMANN (1906, pp. 12-13; 1907, pp. 8-9; 1923, pp. 370, 394), UDE (1908, pp. 310, 348-351), VANDEL (1925, p. 499), WESENBERG-LUND (1937, p. 92), and others, *D. gonocephala* occurs in Europe, from the Mediterranean to Denmark and from Spain and France to Russia, while it is absent in Great Britain and Scandinavia. The records from North Africa (BEAUCHAMP, 1913, p. 7; 1920, p. 194; 1932a, p. 221; 1951, p. 251; VANDEL, 1925, p. 499, and others), ranging from Tunis and Algeria to Morocco and the Atlas, seem to be certain. Gomera, one of the Western islands of the Canaries, is a not yet confirmed locality (ARNDT, 1922, p. 139, note 1).

As the species does not occur in the Arctic region nor in the realms of the Notogæa and Neogæa, it is certainly not cosmopolitan. It is true that BRESSLAU (1933, p. 247) mentioned *D. gonocephala* from Brazil, but I do not know any study of sectioned planarians from Brazil that authenticates BRESSLAU's statement. The occurrence of *D. gonocephala* in Brazil or in any other part of the Neogæa is highly improbable (BEAUCHAMP, 1939, p. 63). Possibly BRESSLAU's mention is based on VEJDOVSKY's opinion (1895, pp. 209-

210), who considered *Planaria aurita* KENNEL (1888, pp. 464-468) from Trinidad a synonym of *gonocephala*. In fact, *D. aurita* and *D. gonocephala* are similar, but not identical.

The Nearctic sub-region too must be excluded from the map of *D. gonocephala*. STRINGER (1918, p. 356) listed it from Illinois and Michigan, but the respective classifications were not correct. WOODWORTH's record (1897, p. 6) for Illinois comes under *D. tigrina* (GIRARD), and PEARL's for Michigan, after KENK (1944, p. 13) under *Curtisia foremani* (GIRARD).

Looking through the Asiatic and tropical African records we must consider that *D. gonocephala* is not « la seule espèce à tête en fer de lance » (BEAUCHAMP, 1929a, p. 17). The admirable studies of BENAZZI and his school reveal many different « gonocephaloid » species occurring in Italy, that have up to recent times summarily been taken for *gonocephala*.

Since IJIMA ⁽¹⁾ (1887, p. 338, note) Japan appears in all lists of the distribution of *D. gonocephala*. The penis of these Japanese worms was said to liken that of *D. polychroa* (O. SCHMIDT, 1861, p. 92), a species perhaps identical with *D. lugubris* (O. SCHMIDT, 1861, p. 91), or very near to it (BENAZZI, 1938, p. 86, note 1). Figures of the penis of *polychroa* (SCHMIDT, 1861, t. 10, f. 5; IJIMA, 1884, t. 21, f. 5; BÖHMIG, 1909, f. 280) show the seminal vesicle ental to the penis bulb, separated from the bulbar lumen, and a terminal opening of the ejaculatory duct. In *D. gonocephala* the seminal vesicle is undivided and coincides with the bulbar lumen. The symmetrical penis papilla with an apical orifice of the male duct is the same in *gonocephala* and *polychroa*. It is strange to see that the figures of the so-called *gonocephala* from the Far East (IJIMA and KABURAKI, 1916, f. 13; KABURAKI, 1922, f. 5 on p. 16; Tu 1934, t. 3) all show a seminal vesicle (bulbar lumen) like *gonocephala*, not like *polychroa*, and the external opening of the ejaculatory duct on the underside of the penis, not on its tip. The descriptions mention this character precisely. It is known that the length of the penis and the width of the duct depend on the liquid of preservation (GELEI, 1928, p. 12), and that even if the same liquid is used (KENK, 1930, p. 157), a partial (BEAUCHAMP, 1929, f. 3 and 4) or total (KOMAREK, 1926, f. 7 on p. 22 and t. 1, f. 7) invagination of the papilla can produce extremely heterogeneous aspects. A central or excentric duct however and a corresponding symmetrical or asymmetrical papilla are anatomical details, as was correctly stated by LEPORI (1948, p. 467). Already VANDEL (1925, p. 500, note) noted the ventral orifice of the ejaculatory duct in the Japanese *gonocephala*. He called it an anomaly, but I consider it as incompatible with the diagnosis of *gonocephala*.

ARNDT (1922, pp. 138-139) did not find *D. gonocephala* in Southern, Central, and East Siberia. As he took the occurrence of the species in Japan

(1) I spell this name as it appears in Japanese periodicals.

for granted, he thought that the Ice Age had wiped out *gonocephala* in Siberia, and that the species had not yet re-colonized this region. BEAUCHAMP (1931, p. 462; 1932, p. 358) criticized this opinion. In the present conceit *gonocephala* is no longer considered as a European species that also occurs in Japan, so that the map of its distribution turns out less unintelligible.

The immature specimens from Coonoor (Nilgiris) that BEAUCHAMP (1930, p. 674) classified with interrogation as *Planaria gonocephala* remain entirely doubtful. Numerous mature worms of *gonocephala* were recorded from Java (BEAUCHAMP, 1929a, p. 16). They differ from typical *gonocephala* by the absence of the inner longitudinal muscles on the outer side of the pharynx (BEAUCHAMP, 1936, p. 435). In his paper on the Javanese *gonocephala* BEAUCHAMP refers to *Planaria mertoni* STEINMANN (1914, p. 111) as a neighbouring species. Later on (1939, p. 73) he calls it a form of *gonocephala*, because at this time he admits only three well defined types « grandes espèces » (1940, p. 8) of *Dugesia* (1939, p. 72). Certainly the species from the Kei Islands is nearer to *gonocephala* than to *lugubris*, but eyes, auricular sense organs, brain, intestinal diverticles, and common ovovitello-duct distinguish *mertoni* clearly from *gonocephala*. One might rather unite *Planaria hymani* SIVICKIS (1928, name on p. 360) with *gonocephala*, but in contrast with the excellent description of *mertoni* that of *hymanæ*, as it should be named, contains so few essential features, that one cannot give a definitive opinion as to the « état civil » (BEAUCHAMP, 1939, p. 71) of *D. hymanæ* (SIVICKIS). The species has less numerous anterior and more posterior intestinal diverticles than *D. gonocephala*.

BEAUCHAMP's material from Mt. Kenya (1913, p. 4) has a ventral, not terminal opening of the penis (p. 5, t. 1, f. 1); and the outer muscles of the pharynx (BEAUCHAMP, 1936, p. 435) are of the *polychroa* (IJIMA, 1884, p. 388), not of the *gonocephala* type (UDE, 1908, p. 319). It seems advisable not to classify such worms as *D. gonocephala*. Although the two mentioned characters occur in *D. neumanni* (NEPPI) too, this species cannot be united with the specimens from Mt. Kenya, because the bulbar lumen of both differs. BEAUCHAMP's *gonocephala* from Tschetro-Saka and Yanapæ (1935, p. 147) that are mentioned above in the Introduction to the Paludicola are not figured, so that the opening of the ejaculatory duct is not known. The pharyngeal muscle layers in these lots from the Belgian Congo agree with typical *gonocephala*. LAIDLAW (1906) was right to consider his *Planaria tanganyikæ* as an ordinary form that does not support the halolimnic character of the lake. It might be *gonocephala*, but the description and the figure are not sufficiently detailed to settle this question, nor does BAYLIS (1927, p. 380) give any further information. *Dugesia congolensis* BEAUCHAMP (1951b, p. 90) is certainly a valid species that differs from *gonocephala* by its common ovovitello-duct (pp. 92, 94).

Dugesia astrocheta sp. nov.

(Fig. 2, 8-13.)

Material. — Mature specimens occur in samples 2503 (holotype) and 2520.

External characters. — The biggest specimen is 13 mm long and 5 mm broad, with the pharynx from 6-8 mm, the mouth at 8 mm, and the gonopore at 10 mm. The length of the smallest mature worm is 8 mm, its breadth 2 mm, the mouth lies at 6 mm, and the gonopore at 7,2 mm. The worms are roundish and broad (fig. 8), with sharp borders, more pointed at the tail than at the tip, and have well marked auricles. The eyes lie about half way between the tip and the auricles, and as far one from the other as each from the border.

The colour of the back is a plain dark gray, nearly black; the ventral side is a little lighter. Around the eyes there are round light areas, and on the auricles lighter, almost reniform, spots. On the anterior margin the sensory furrow is without pigment.

The anterior limb of the gut extends beyond the eyes. It has 10-12 diverticles on each side. The posterior limbs have each 15-20 ramified diverticles on the outer side, and 10 or more small ones towards the mid-line. In all the clarified worms the gut contains masses of spongillid tissues and needles.

Internal characters. — The wall of the pharynx (fig. 10) consists of the following layers: a ciliated outer epithelium (cilia 3 μ , epithelium 3 μ); a thin basal membrane; longitudinal (8 μ) and annular (21 μ) muscle fibres; the insunk epithelial nuclei (n); a loose nerve plexus; outer eosinophilous (ek) and inner cyanophilous (ci) strands of secretion (60-100 μ); inner longitudinal (8 μ) and inner annular (30-50 μ) muscle fibres; and a quite flat inner epithelium. At the tip of the pharynx the nuclei of the inner epithelium are insunk and lie under the inner longitudinal muscles (l). Farther inward they come to lie among the annular fibres (r), and near the ental (anterior) end of the pharynx they are intra-epithelial.

In the biggest worm the dorsal testes are loosely scattered between the intestinal diverticles. They begin 3 mm from the tip and form two rows of 3-5 follicles that extend to the level of the gonopore. In a smaller sectioned specimen the follicles appear to touch one another and are more numerous; they begin 1,3 mm from the front and end 1 mm from the tail.

The male copulatory apparatus lies a little to the right of the median line and the bursal canal to the left. The male antrum (y) and the bursal canal (h) open side by side from the front into the common antrum (a). The hindmost muscular parts (z) of the spermiducal vesicles (e) enter the penial bulb and open into the round seminal vesicle (s). In most animals these muscular parts (z) enter the seminal vesicle from both sides, about

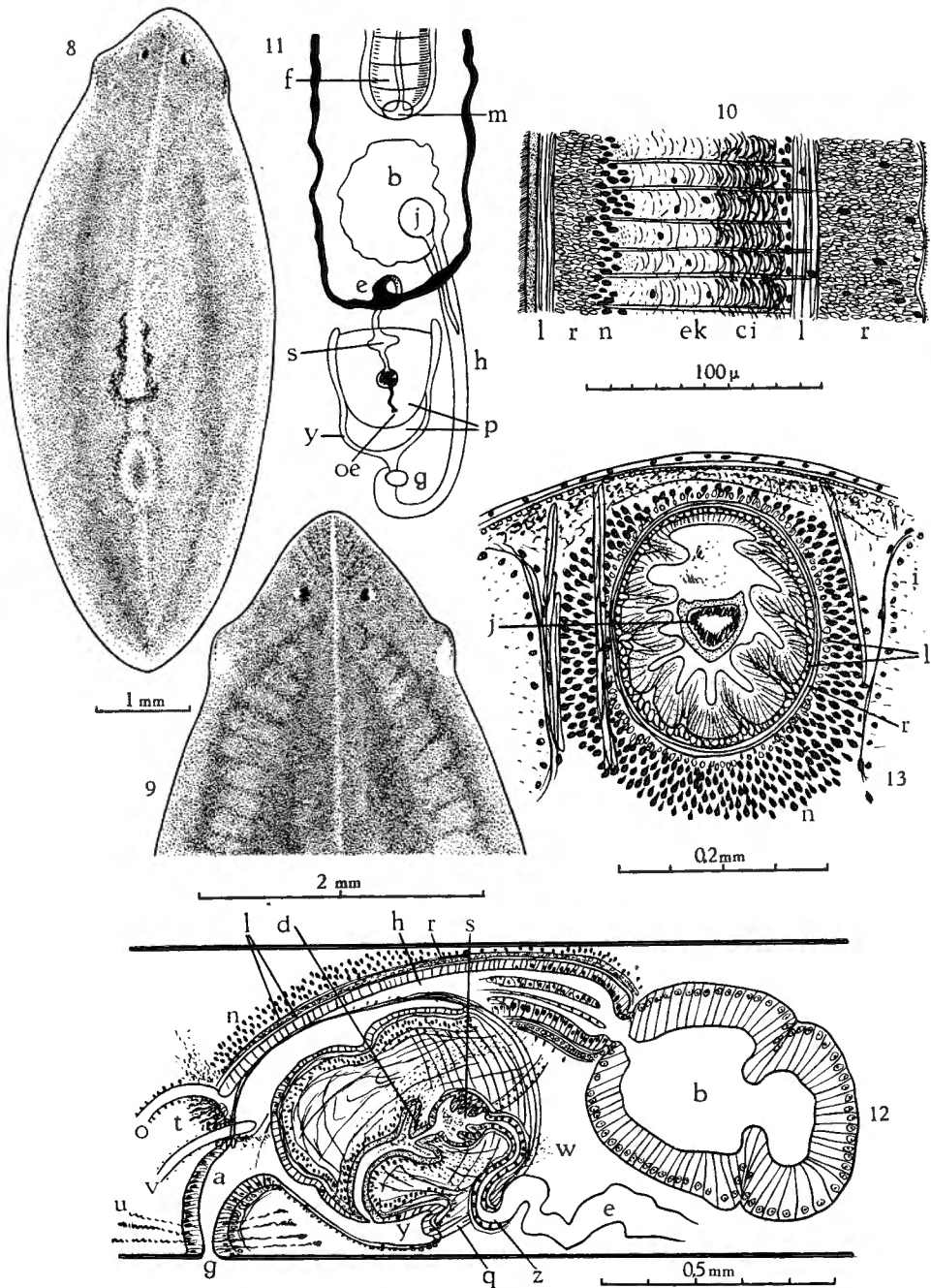


FIG. 8-13. — *Dugesia astrocheta* n. sp., preserved material.

0,15 mm apart from one another (fig. 12). In one specimen (fig. 11) however the efferent ducts from both sides unite ventrally to the penial bulb (p) and enter the seminal vesicle (s) as a common spermiducal vesicle (e). The seminal vesicle is lined with a high, folded epithelium, receives the secretion of cyanophilous glands and is separated from the ejaculatory duct by a diaphragm (d). Erythrophilous granular secretion (w) is emptied into the ejaculatory duct that bends downward and opens ventrally to the rounded, blunt tip of the penis papilla into the male antrum (y). On the papilla and in the male antrum the most nuclei are insunk, a few are intra-epithelial.

In the common antrum (a) the height of the epithelium increases and has mostly intra-epithelial nuclei. The common antrum receives the cement glands (u), the secretion of which is granular and eosinophilous. The muscle layers are as in the body wall with annular subepithelial and longitudinal parenchymatic fibres.

The ovaries lie 1 mm from the tip; the foremost vitellaries are on the same level. The ovovitelloducts with insunk nuclei from the beginning, the so-called tuba, run over the ventral nerve cords and enter the bursal canal immediately above the circle of eosinophilous shell glands (t) at slightly different levels (o, v). The ducts come from behind and both sides.

The bursal canal (h) from the shell glands inwards has three layers of muscle fibres, subepithelial and external longitudinal ones (l) separated by a thick layer of annular muscles (r). A characteristic feature of this species are deep longitudinal folds in the epithelium of the bursal canal, that produce a star-shaped lumen in cross-sections (fig. 13). The nuclei of this epithelium are partly insunk and form, together with those of the myoblasts, a thick mantle (n) around the canal. In one of the sectioned worms the whole canal has no intra-epithelial nuclei, in the other the number of these increases towards the ampulla, and at the anterior end all are intra-epithelial. The ample ampulla (b) has high cells. In one specimen it contains a sperm-mass surrounded by a capsule (j) that is globular in the ampulla and continues as a narrow stalk in the canal.

EXPLANATION OF THE FIGURES 8-13.

8. Dorsal view. — 9. Dorsal view of head. — 10. Sagittal section of part of pharynx. — 11. Copulatory organs of clarified worm in ventral view. — 12. Combined sagittal section of copulatory organs. — 13. Transverse section of bursal canal containing stalk of spermatophore.

a, common antrum; b, bursa; ci, cyanophilous pharyngeal secretion; d, diaphragm; e, accessory or spermiducal vesicles; ek, eosinophilous pharyngeal secretion; f, pharynx; g, gonopore; h, bursal canal; i, intestine; j, spermatophore; l, longitudinal muscles; m, mouth; n, insunk nuclei; o, right ovovitelloduct; oe, opening of ejaculatory duct; p, penis papilla; q, penis bulb; r, annular muscles; s, principal seminal vesicle; t, shell glands; u, cement glands; v, left ovovitelloduct; w, erythrophilous secretion of penis; y, male antrum; z, muscular ends of spermiducal vesicles.

Dugesia astrocheta, n. sp., has rounded, blunt tip of penis, ventrally to which ejaculatory duct opens. Bursal canal with deep longitudinal folds in epithelium, which produce star-shaped lumen in cross-section. The species belongs to « *gonocephala*-Artenkreis » (BENAZZI) and differs from related *Dugesia sicula* LEPORI by inner annular pharyngeal muscles much thicker (30-50 μ) than inner longitudinal ones (8 μ); distinct penial bulb; well developed epithelium of seminal vesicle; glands opening into ejaculatory duct; longitudinal, annular, and longitudinal muscles around bursal canal; and antral muscles disposed like in body wall.

DISCUSSION OF *DUGESIA ASTROCHETA*.

The new species belongs to the « Artenkreis » of *D. gonocephala* (DUGÈS) that was defined by BENAZZI (1949a, pp. 3-6). *D. astrocheta* does not occur in samples together with *gonocephala*, and even if they were found in the same locality later on, its morphological particularities make probable that it is reproductively isolated from *gonocephala*.

Within the *gonocephala* « Artenkreis » *D. sicula* LEPORI (1948) seems to be the nearest related species, because the male copulatory organ is similar and the bursal canal is in both species wide and provided with longitudinal folds lined with cylindrical cells, and surrounded by a thick coat of muscles. There are, however, important differences in pharynx (1), penial bulb (2), seminal vesicle (3), ejaculatory duct (4), bursal canal (5), and wall of antrum (6).

(1) The inner longitudinal muscle layer is much thinner than the annular one in *astrocheta*, equal to it in *sicula*. (2) A distinct bulb occurs in *astrocheta*, while it is not limited in *sicula*. (3) The epithelium of the vesicle is well developed in *astrocheta*, absent in *sicula*. (4) The glands that open into the ejaculatory duct in *astrocheta* are wanting in *sicula*. (5) The muscle layers are longitudinal, annular, and longitudinal in *astrocheta*, longitudinal, diagonal, and annular in *sicula*. (6) The sequence of the muscle layers in the wall of the bursal canal and that of the common antrum is different in *astrocheta* and the same in *sicula*.

Dugesia congolensis BEAUCHAMP (1951b, p. 90) has a common ovovitello-duct by which it differs from *D. astrocheta*.

D. astrocheta must also be compared with the « *gonocephala* » from the Far East, the classification of which is not accepted in the discussion of that species. To judge from KABURAKI's description (1922, p. 17) the musculature of the bursal canal is disposed like in the body wall in the Japanese species. This character differs from *astrocheta* as well as from *gonocephala*.

The bursal canal of BEAUCHAMP's material from Mount Kenya (1913, p. 5) is not different from European *gonocephala*, and therefore the former cannot be united with *astrocheta*, the epithelial folds and thick muscular

coating of which would have been noted by BEAUCHAMP. *Dugesia neumanni* (NEPPI) does not belong to the *gonocephala* « Artenkreis », due to the small number of intestinal diverticles, 6 on each side of the anterior limb, 7 on the outer side of each posterior branch; and the absence of a diaphragm between the seminal vesicle and the ejaculatory duct. The musculature of the pharynx and the bursal canal of *neumanni* agrees with that of *astrocheta*.

***Dugesia ectophysa* sp. nov.**

(Fig. 3, 14-17.)

Material. — Samples 726, 794, 839 (holotype), 904, 919, 920, 928, 978, and 2583 contain one to three mature specimens each, all together 15 among a total of about 290.

External characters. — The biggest worm measures 24 mm in length and 6 mm in breadth. Its pharynx occupies from 8-14 mm, and the mouth lies at 13, the gonopore at 16 mm. The broad and flat animals are a little more pointed at the hind end than at the rather blunt anterior end (fig. 14). The auricles are inconspicuous. The eyes lie in front of them, one as far from the other as each from the tip and the margin. In some worms there are accessory eyes.

The back is grayish brown with lighter borders and appears homogeneous with low power. As the pigment is located in the parenchyma, the dark hue is interrupted by the intestinal diverticles, and the animal is mottled with white stipples that accompany the ramifications of the gut. The borders of the pharynx are marked by more concentrated pigmentation. The pharynx itself is colourless. The ventral side is nearly without pigment, except a black halo around the gonopore in mature specimens.

The anterior limb of the gut has about 10-14 diverticles on each side, the posterior branches have 15-20 on their outer sides and about 10 small ones on their inner sides in immature specimens, that are sufficiently transparent to reveal them. Often the anterior limb is so twisted and has so strong contractions, that it is difficult to distinguish the main branch from the lateral diverticles. This gives a characteristic diffuse aspect to the anterior gut. The posterior limbs are better recognizable, especially where they flank the pharynx.

Internal characters. — The structure of the pharynx differs from that in *gonocephala* in some details. The wall consists of ciliated outer epithelium (cilia 4 μ , epithelium 5 μ) with insunk nuclei (fig. 16, n) and a 1,5 μ thick basal membrane, two or three layers (l) of longitudinal fibres (6 μ), a 25 μ thick layer of annular muscles (r) that is partly occupied by the insunk epithelial nuclei (n), and a third, irregular longitudinal layer (l), about 12 μ , a likewise irregular nerve plexus (c), the ducts of cyanophilous and erythrophilous pharyngeal glands (k), the inner longitudinal muscles

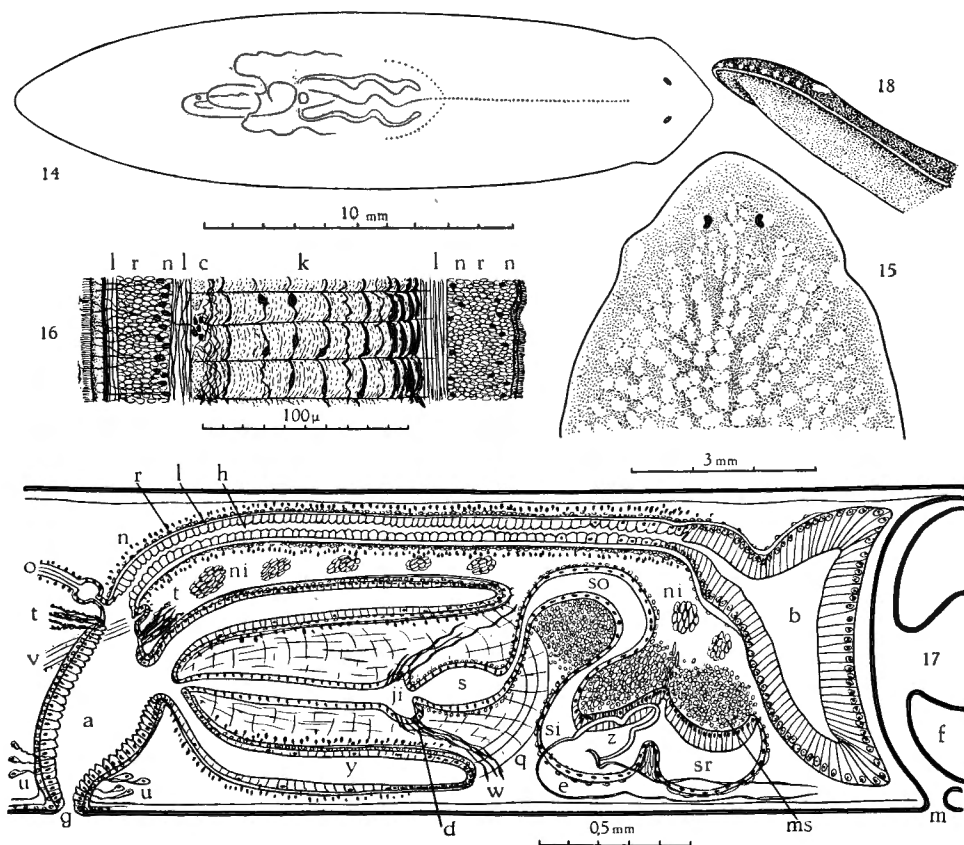


FIG. 14-18. — *Dugesia cctophysa* n. sp. preserved material.

14. Ventral view of clarified specimen. — 15. Dorsal view of head. — 16. Sagittal section of part of pharynx. — 17. Combined sagittal section of copulatory organs. — 18. Lateral view of head of worm from sample [1081], with sensorial spots; not classified species.

a, common antrum; b, bursa; c, pharyngeal nerve plexus; d, diaphragm; e, accessory seminal or spermiducal vesicles; f, pharynx; g, gonopore; h, bursal canal; ji, ejaculatory duct; k, secretion of pharyngeal glands; l, longitudinal muscles; m, mouth; ms, muscles of seminal vesicle; n, insunk nuclei; ni, parenchymal transverse muscles; o, right ovovitelloduct; q, penis bulb; r, annular muscles; s, principal seminal vesicle; si, extrabulbar seminal vesicle; so, posterior section of « si »; sr, anterior pouch of seminal vesicle; t, shell glands; u, cement glands; v, left ovovitelloduct; w, erythrophilous secretion of penis; y, male antrum; z, muscular ends of spermiducal vesicles.

(l, ca. 10 μ), the inner annular layer (r) of ca. 30 μ , in which the nuclei (n) of the thin inner epithelium (3 μ) with short cilia (3 μ) are scattered. Some strands of cyanophilic secretion open on the outer surface of the pharynx, the rest of the gland secretion is emptied on the border.

In the region of the copulatory organs the dorso-ventral and transverse parenchymal muscles (ni) are extremely strong developed.

Although the 2 sectioned specimens are in very different phases, the distance from mouth to gonopore is the same in both (2,9 mm). One worm quite in the beginning of maturity has a 1,5 mm long copulatory apparatus measured from bursa (b) to gonopore (g). The other is fully developed and its measure is 2,5 mm. In both the disposition of the efferent ducts (e) and seminal vesicle (s) is completely alike, as well as the wide connection of bursal ampulla (b) and canal (h). The younger animal has less numerous insunk and more intra-epithelial nuclei in the male antrum and on the penis papilla.

The dorsal testes extend from about 3 mm behind the tip nearly to the hind end, in rows of 5-10 follicles on each side. The efferent ducts form accessory seminal or spermiducal vesicles (e) close behind the mouth (m), that turn to the middle and enter the seminal vesicle through a muscular tube (z). The seminal vesicle lies outside the penial bulb (q). It has an enormous layer of crossing muscle fibres (ms), that covers the dorsal side of its anterior part (si), and the ventral side in its posterior section (so), with which it enters the penial bulb. The seminal vesicle is lined with a cylindrical nucleated epithelium that is very high on the dorsal side of the anterior part. From the level of the entering efferent ducts an unpaired pouch (sr) built like the vesicle itself (si) extends rostrally till to the bursa. It is separated from the vesicle by a strong constriction.

Inside the bulb the most posterior part of the vesicle (s) is closed by a diaphragm (d) that limits it against the following narrower section, the ejaculatory duct (ji), which receives eosinophil granular secretion (w). The male canal runs straight through the penis papilla and opens on its tip, a little to the ventral side, so that the dorsal part of the papilla is thicker than the ventral.

The male antrum (y) has a low epithelium with some intra-epithelial and some insunk nuclei. The common antrum (a) has high, villous cells with intra-epithelial nuclei. The muscle layers of the antra are the same as in the skin. They are altered in the bursal canal (h), from the belt of shell glands (t) inward. The bursal canal runs on the left side of the male organ, widens gradually at its ental end, and opens into the ampulla (b), the high epithelium of which is sharply limited against the low of the canal.

The ovovitelloducts (o, v) have insunk nuclei. They bend upward and enter the bursal canal separately above the shell glands at slightly different levels coming from both sides and from behind. Around the gonopore (g) some feebly eosinophil cement glands (u) open into the common antrum.

Dugesia ectophysa, n. sp., up to 24 mm long, broad, flat, with inconspicuous auricles has 3 layers of outer pharyngeal muscles, the details of which (fig. 16) differ from those of *gonocephala* (fig. 5). Spermiducal vesicles enter seminal vesicle through muscular tubes. Seminal vesicle lies outside penial bulb, is partially covered by mighty layer of crossing muscles and has an anterior pouch. Intra-bulbar seminal vesicle separated from ejaculatory duct by small diaphragm. Although male organ differs less from *lugubris* than from *gonocephala* and *tigrina* type, *Dugesia ectophysa* cannot be approached to any of these or other types occurring in *Dugesia*.

DISCUSSION OF *DUGESIA ECTOPHYSA*.

The female apparatus of the present species belongs to the most common type of the *Planariidae* (MEIXNER, 1928, p. 573, f. 2), that occurs in all zoogeographical realms. The male organ, however, is very singular, though the diaphragm (fig. 17, d) likens that of *gonocephala*, *congolensis*, *astrocheta*, and others. In his review of the planarian taxonomy KENK (1930, p. 154) did not discuss the principal seminal vesicle, that as a rule is treated together with the penis bulb. In *D. ectophysa* this vesicle is not only represented by the bulbar lumen, but shows peculiar structures outside the bulb too. These are not like the disposition in *lugubris* and *polychroa*, where the bulb is divided in two successive, nearly spherical masses separated by a constriction. The corresponding bulbar lumen consists of two ample cavities united by a canal. It is true that *D. ectophysa* differs less from the *lugubris*-type than from the two others of BEAUCHAMP's synopsis (1939, p. 72), the *gonocephala*- and the *tigrina*-type (ibid., f. 5). The latter is American, though not simply « dugesian » (HYMAN, 1939, p. 265). There exist more than these three types, viz. the simple ones of *D. neumannii* (NEPPI, 1904, p. 309), *D. glandulosa* (KENK, 1930, p. 292; WEISS, 1910, p. 544; perhaps re-described as *annandalei* KABURAKI, see BEAUCHAMP, 1939, p. 74; 1940, p. 9), and *D. seclusa* (BEAUCHAMP, 1940a, p. 313), as well as some complicated types of South West Australian species (WEISS, l. c.). *D. ectophysa* cannot be approached to any of these types.

COMPARATIVE REMARKS ON THE PALUDICOLA.

The three classifiable species contained in the present material are all typical *Dugesia*. They differ considerably by colour and size, so that they can easily be distinguished already with low power (fig. 1-3). It was surprising to find that these external differences correspond to such in the anatomy of the reproductive organs.

The young and the mature *Dugesia gonocephala* are of very different sizes, and all distinctly stippled, also on the ventral side; only the density of their spots varies. All worms are quite opaque, and their anatomy is

not detectable even in clarified state. The specimens have nearly constant proportions of prepharyngeal and postpharyngeal length, so that one may presume that all originate from eggs.

The small *Dugesia astrocheta* are generally broad and roundish. Their colour is plain and dark on the back. The intestine does not show.

The worms of *Dugesia ectophysa* are long, broad, and rather flat, and plain with a lighter ventral side and visible intestine. Mature worms have a dark halo around the gonopore. The sizes vary considerably, but only the biggest, more than 20 mm long animals are mature. The mature specimens make up a very low percentage of the populations.

The asexual lots are indeterminable, except a few stippled *Dugesia gonocephala*, because they are plain as *Dugesia astrocheta* and *D. ectophysa*. Their shape is varied, due to fission or different age. In some cases the different shape of the auricles suggests even the possibility of further species. Anterior sensorial spots (fig. 18) were most distinct in the black asexual worms of sample 1081. After KENK (1930a, p. 248-249) they are not specific, but occur in many species of *Dugesia*. We have noted vestigial sensory spots also in *Dugesia gonocephala* (sample 2599), *D. ectophysa* (sample 904), and *D. monomyoda* (fig. 20) from Pietermaritzburg; BEAUCHAMP (1951b, p. 97) found distinct spots in some specimens of *D. gonocephala* (DUGÈS).

In the Upemba Park all mature *Dugesia gonocephala* were caught in april and may, in altitudes from 1470 to 1830 m, while the amplitude of *Dugesia ectophysa* is much wider (700-1.750 m). The few classifiable immature *Dugesia gonocephala* were obtained at 700, 1.150 and 1.250 m. Also the pH 5,5-6 of the localities where mature *gonocephala* were collected differs from the one available datum (pH 7,9) for immature specimens.

Dugesia astrocheta comes from two neighbouring localities with slightly different pH (7,3 and 7,8). The two lots were caught in the same week, so that the considerable diversity of the temperature at the two places, 17,5° and 23,8°, must be due to different exposition to the sun. The two other species, although verified in a greater number of collecting stations, have a smaller thermic range than *Dugesia astrocheta*, viz. mature worms of *gonocephala* only from 19° to 20°, and *ectophysa* from 18,5° to 23°.

As mature worms of *Dugesia ectophysa* were obtained in april, may and june, and this species surpasses mature specimens of *gonocephala* in amplitude of height, temperature and pH (5,5-7,6), it proves to be more euryoecous in the Upemba Park than *gonocephala*.

Fission is frequent among the tropical Dugesias. Dividing populations were obtained in february, april, may, and june. Neither altitude nor temperature seems to be correlated with asexual reproduction. However the list of localities shows that doubtless fission was only found in alkaline waters (pH 7,6-8,4).

Dugesia monomyoda sp. nov.

(Fig. 19-23.)

Material. — 8 specimens from [Pietermaritzburg, Natal], collected by Drs. D. W. and R. F. EWER (holotype : in the Collection of the Institut des Parcs Nationaux du Congo Belge).

External characters. — The largest worm is 14 mm long and 2 mm broad. Its eyes lie at 0,5 mm from the tip, the ovaries (ov) at 1,3 mm, the testes (te) begin at 1,4 mm, the pharynx (f) at 5 mm. The mouth (m) lies at the hind end of the pharynx at 7 mm, the gonopore at 9 mm, the hindmost testes extend to 10 mm.

The colour is a plain brown on the back, that varies from pinkish brown to almost olivaceous, and is paler towards the sides. The ventral side is lighter. The worms are slender with a quite round (fig. 20) or a little pointed (fig. 19) fore end, prominent auricles, and a tapering tail. The auricular sense organs mark as big white semicircular areas, and the anterior border is surrounded by small, roundish, light spots, the sensorial pits.

The anterior limb of the gut surpasses the eyes. It has about 20 diverticles on each side. The posterior limbs have 30 or even more each on the outside, while their diverticles towards the mid line are very small; there are certainly more than 30 on one side between the gonopore and the hind end.

Internal characters. — In the parenchyma a strong layer of transverse muscle fibres (fig. 23, ni) is remarkable; it runs below the intestinal diverticles and separates the efferent ducts and ovovitelloducts from the ventral nerve cords. The pharynx wall (fig. 21) is constituted of a thin, ciliated outer epithelium (cilia 3 μ ; epithelium 3 μ); a single layer of longitudinal (3 μ) and one of annular muscles (3 μ); the insunk epithelial nuclei intermingled with the nerve plexus (14 μ); erythrophilous and cyanophilous gland secretion (ca. 100 μ); a single layer of inner longitudinal muscles (8 μ) and thick inner annular muscles (30 μ). The inner epithelium (5-20 μ) has normal nuclei for the most part of the length of the pharynx. Only near the tip the nuclei are insunk and lie between the annular muscles. The glands open on the border of the pharynx.

The dorsal testes (te) lie in a nearly single row. Behind the pharynx the efferent ducts are widened by masses of sperm. They bend inward and upward 1,5 mm behind the mouth and enter the penial bulb (q) forming paired spermiducal vesicles (e) that are lined with flat epithelium, but are not strongly muscular. The spermiducal vesicles unite in the principal seminal vesicle (s) with high epithelium that contains cyanophilous secretion (cy). The vesicle is separated from the ejaculatory duct (ji) by a diaphragm (d). The whole length of the duct receives masses of eosinophil

secretion (w) from extrabulbar glands. The duct opens on the tip of the papilla. The penis papilla is covered with normal epithelium that also lines the male antrum (y). The latter is broadly connected with the common antrum (a).

The vitellaries begin at the level of the ovaries (ov) 1,3 mm from the tip of the body. The ovovitelloducts run above the ventral nerve cords and the transverse muscle layer (ni). The nuclei of their epithelium are insunk except in the most ectal part. The ducts enter the bursal canal (h) entally to the circle of outlets of the shell glands (t), that limits the bursal canal against the antrum. The ovovitelloducts do not enter at symmetrical points from both sides, but one (o) higher and farther behind, the other (v) lower and more in front.

The common antrum (a) has normal nuclei and subepidermal annular muscles. The cement glands (u) are sparsely developed in the sectioned worm. The ciliated bursal canal (h) has normal nuclei, a thin mantle of longitudinal (l) and a ventrally thick coat of annular (r) muscles; in some places there is an outer layer of scattered longitudinal fibres. The canal runs to the left of the mid-line. The vacuolized cells of the ampulla (b) include eosinophilous granules.

The pharynx pocket and the intestine contain the well known astomatous Ciliate *Sieboldiellina planariarum* (SIEBOLD). This species was described by BÜTSCHLI (1888-1889, p. 1717, t. 65, f. 2), CÉPÈDE (1910, p. 563, f. 39), BISHOP (1926, pp. 187-194, t. 8), and many others. It occurs in the digestive tract of many Paludicola (GRAFF, 1903, p. 62) and occasionally also in the bursa (STEINBÖCK, 1924, p. 493; BEAUCHAMP, 1932, p. 331). The last two observers refer to *Dugesia gonocephala* (DUGÈS).

Dugesia monomyoda, n. sp., has a plain brown back, prominent auricles with big, white semicircular areas, and tapering tail. Anterior border surrounded by sensorial pits. Fore limb of gut surpasses eyes; about 20 diverticles on each side; posterior limbs each with 30 or more lateral and still more numerous small medial ones. Thus number of gut-diverticles greater than in *gonocephala*. As in the latter, transverse muscles between genital ducts and nerve cords, absent in *astrocheta* and *ectophysa*. Pharynx with 2 thin layers of muscles. Diaphragm between seminal vesicle and ejaculatory duct that receives eosinophil secretion of extra-bulbar glands on its whole length. The astomatous Ciliate *Sieboldiellina planariarum* (SIEBOLD) in pharynx-pocket and intestine.

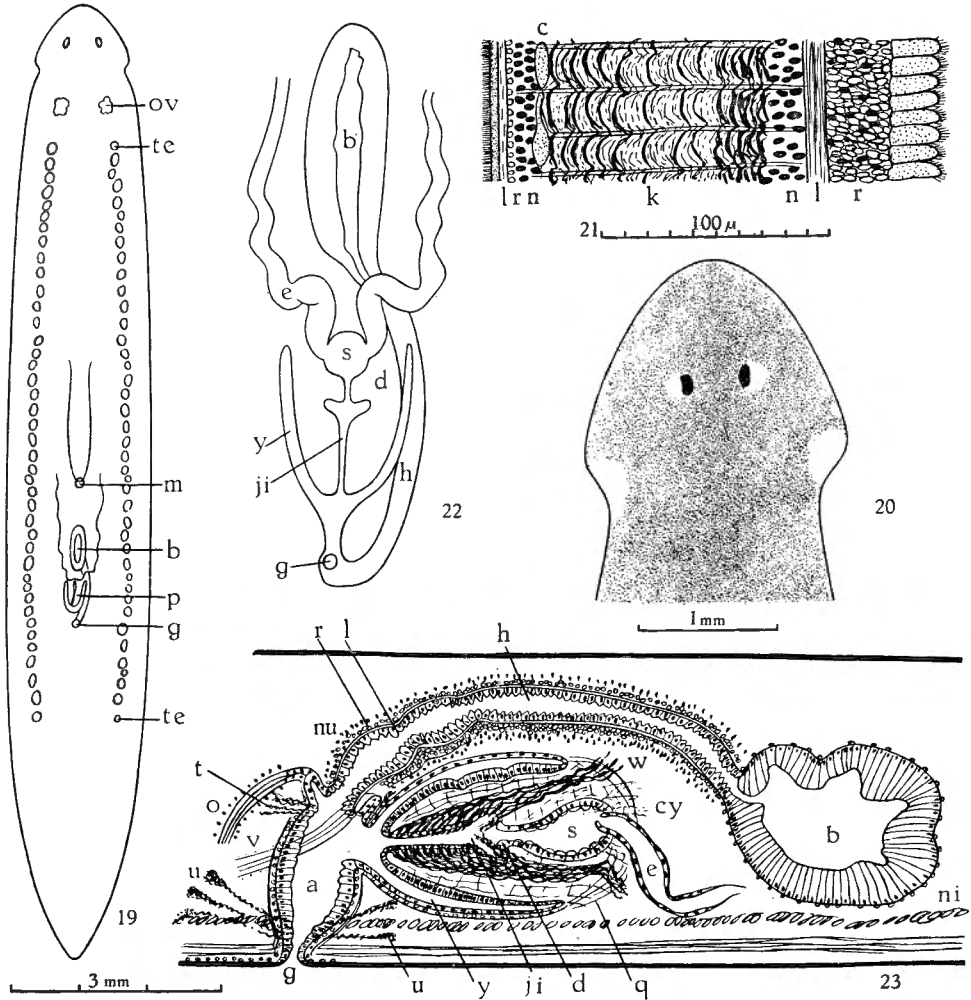


FIG. 19-23. — *Dugesia monomyoda* n. sp., preserved material.

19. Diagram of clarified worm. — 20. Dorsal view of head of other specimen. — 21. Sagittal section of part of pharynx. — 22. Ventral view of copulatory organs. — 23. Combined sagittal section of copulatory organs.

a, common antrum; b, bursa; c, pharyngeal nerve plexus; cy, cyanophilous secretion of seminal vesicle; d, diaphragm; e, accessory seminal or spermiducal vesicles; f, pharynx; g, gonopore; h, bursal canal; ji, ejaculatory duct; k, secretion of pharyngeal glands; l, longitudinal muscles; m, mouth; n, insunk nuclei; ni, parenchymatic transverse muscles; nu, myoblast nuclei; o, right ovovitelloduct; ov, ovaries; p, penis papilla; q, penis bulb; r, annular muscles; s, principal seminal vesicle; t, shell glands; te, testes; u, cement glands; v, left ovovitelloduct; w, erythrophilous secretion of penis; y, male antrum.

DISCUSSION OF *DUGESIA MONOMYODA*.

The copulatory apparatus of the present species resembles that of *Dugesia gonocephala* (DUGÈS). The absence of the inner layer of longitudinal muscles in the outer wall of the pharynx as well as the more numerous intestinal diverticles distinguish *monomyoda* from *gonocephala*. The number of outer pharyngeal muscle layers, not their thickness, agrees in *monomyoda* and *astrocheta* (fig. 10), but the bursal canal and penis papilla differ. *Dugesia ectophysa* (fig. 17) and *D. neumanni* (NEPPI) are species farther distant from the *gonocephala*-group, as is shown by the extra-bulbar seminal vesicle (*ectophysa*) and the absence of a diaphragm in the penis (*neumanni*). Moreover the latter species has three muscle layers around the bursal canal, a ventral opening of the ejaculatory duct, and more than 1,000 testicular follicles. *Dugesia congolensis* BEAUCHAMP (1951*b*, p. 90) differs from *D. monomyoda* by the pharynx that is like in *gonocephala* (p. 91), and the common ovovitelloduct.

The transverse muscles between the genital ducts and the nerve cords present in *monomyoda* occur in *gonocephala* too, but are absent in *astrocheta* and *ectophysa*.

In 5 of her 6 Southwest Australian planarians WEISS described sensorial pits or spots (1910, p. 543, etc., 567-569), the position of which corresponds to that of the sensorial border in the Terricola (GRAFF, 1912-1917, p. 2905). To these spots WEISS attributes (p. 599) some taxonomic significance, and in fact BEAUCHAMP (1929*a*, p. 421) classified immature worms from Buitenzorg as *Planaria pinguis* WEISS, 1910, due to their accordant four sensorial spots on each side of the head. In *Dugesia cretica* (MEIXNER, 1928), KENK (1930*a*, p. 248) and BEAUCHAMP (1936, p. 434) found such spots, but their number may differ on both sides (KENK), and moreover they also occur in many other species of *Dugesia* (KENK, 1930*a*, p. 249; BEAUCHAMP, 1951*b*, pp. 95, 97). Therefore they are of little systematical value, and their presence in *Dugesia monomyoda* cannot be used as a disjunctive character.

INTRODUCTION TO THE TERRICOLA.

The land planarians have much more numerous records from Africa than the Paludicola. The vast region of the Congo-system however is wholly unknown, as the following catalogue of hitherto published African species shows. The list is arranged alphabetically by the original generic and specific names, and indicates the changes in nomenclature. Synonymy is specially difficult in the *Rhynchodemidæ* GRAFF, 1896, to which the bulk of African Terricola belongs.

GRAFF (1899, pp. 76, 84, 285) distinguished two groups of species within the genus *Rhynchodemus* LEIDY, 1851, viz. *Rhynchodemus* (a) and *Rhyncho-*

demus (b), with different cutaneous and parenchymatic muscles. BENDL's two principal types of male copulatory organs (1908, p. 550) suit to GRAFF's groups. HEINZEL (1929, p. 456, 460) applied the name *Rhynchodemus* LEIDY, 1851, to group (a) that includes *Rhynchodemus terrestris* (O. F. MÜLLER, 1774), and introduced the new genus *Desmorhynchus* for group (b). The corresponding subfamilies were established as *Rhynchodeminae* (HEINZEL, 1929, p. 455) and *Desmorhynchinae* (p. 458).

The type species of *Rhynchodemus*, *Rh. sylvaticus* (LEIDY, 1851) was not considered in HEINZEL's system. As HYMAN (1943, p. 3) proved, this type belongs to group (b); therefore *Desmorhynchus* HEINZEL becomes a synonym of *Rhynchodemus* LEIDY, and *Desmorhynchinae* HEINZEL (*Dolichoplaninae* HYMAN) must be substituted by *Rhynchodeminae* CORRÊA (1947, p. 59; PRUDHOE, 1949, p. 427).

HYMAN thought that *Rhynchodemus* group (a) could be called *Geodesmus* MECZNIKOW, 1866, and consequently introduced (1943, p. 13) *Geodesminae* for the *Rhynchodeminae* HEINZEL. However PANTIN (1950, p. 34) verified that *Geodesmus bilineatus* MECZNIKOW, 1866, is congeneric with *Rhynchodemus sylvaticus* (LEIDY, 1851). Therefore also *Geodesmus* is a synonym of *Rhynchodemus* group (b).

Rhynchodemus group (a) has to be called *Microplana* VEJDOVSKY, 1890, as was shown by PANTIN (1953). Already SCHNEIDER (1935) evidenced that *Microplana humicola* VEJDOVSKY is congeneric with HEINZEL's type of *Rhynchodemus*, *Rh. terrestris* (O. F. MÜLLER). HEINZEL's *Rhynchodeminae* and HYMAN's *Geodesminae* are now *Microplaninae* PANTIN, 1952. Moreover PANTIN (1953) found the co-types of *Othelosoma symondsi* GRAY (1869, p. 241) recognizable and with generic characters of *Artiocotylus* GRAFF (1896, p. 69). Therefore the latter genus becomes a synonym of *Othelosoma*. HEINZEL (1929, pp. 456-457) abolished the genus *Amblyplana* GRAFF (1896, p. 72) and distributed its species onto *Rhynchodemus* group (a), now *Microplana*, and *Artiocotylus*, now *Othelosoma*.

LIST OF AFRICAN SPECIES.

1. *Amblyplana aberana* MELL (1904, p. 476). Abera (Djamdjam, South Abyssinia). After HEINZEL (1929, p. 456) a *Rhynchodemus* group (a) = *Microplana*.
2. *Amblyplana caffra* JAMESON (1907, p. 33). Pietermaritzburg (Natal). After HEINZEL (1929, p. 451, 457) an *Artiocotylus* = *Othelosoma*.
3. *Amblyplana capensis* GRAFF (1899, p. 512). Cape Colony.
4. *Amblyplana cylindrica* BEAUCHAMP (1913, p. 11). Mount Kenya up to 3.470 m. After HEINZEL (1929, p. 451, 457) an *Artiocotylus* = *Othelosoma*.
5. *Amblyplana ehrenbergi* GRAFF (1899, p. 511). Cameroons.

6. *Amblyplana flavescens* JAMESON (1907, p. 36). Pietermaritzburg (Natal). After HEINZEL (1929, p. 451, 457) an *Artiocotylus* = *Othelosoma*.
7. *Amblyplana hepaticarum* JAMESON (1907, p. 38). Pietermaritzburg (Natal). After HEINZEL (1929, p. 451, 457) an *Artiocotylus* = *Othelosoma*.
8. *Amblyplana knysnensis* GRAFF (1899, p. 509). Cape Colony.
9. *Amblyplana natalensis* JAMESON (1907, p. 28). Pietermaritzburg (Natal). After HEINZEL (1929, p. 456) a *Rhynchodemus* group (a) = *Microplana*.
10. *Amblyplana neumanni* MELL (1904, p. 480). Abera (Djamdjam, South Abyssinia). After HEINZEL (1929, p. 456) a *Rhynchodemus* group (a) = *Microplana*.
11. *Amblyplana nigrescens* MELL (1904, p. 472). Gardula (South West Abyssinia). HEINZEL thought (1929, pp. 457-458) that this species could perhaps preserve the original generic name. But as PANTIN (1953) referred *Rhynchodemus flavus* MOSELEY to *Othelosoma*, and *Rhynchodemus fuscus* MOSELEY, the second species mentioned in the first description of *Amblyplana*, is not identifiable or is also an *Othelosoma*, HEINZEL's idea is not realizable (BEAUCHAMP, 1930a, p. 738, note 1). Moreover MELL's figure (t. 17, f. 3) shows as particularity only diverticles in the ductus vaginalis. After FREISLING (1935, p. 18) the species belongs to *Artiocotylus* = *Othelosoma*.
12. *Amblyplana notabilis* GRAFF (1899, p. 509). Cameroons. After HEINZEL (1929, p. 449-451) an *Artiocotylus* = *Othelosoma*.
13. *Artiocotylus notabilis* var. *angolensis* BEAUCHAMP (1951a, p. 81). Northern Angola. Should be considered as a distinct species (see discussion of *Othelosoma pugum*, n. sp.).
14. *Amblyplana tetractadea* WILCZYNSKI (1923, p. 255). At the foot of Mount Kilimandjaro. With paired anterior intestine. Genital organs unknown. BRESSLAU (1933, p. 253) called it *Rhynchodemus*.
15. *Amblyplana viridis* JAMESON (1907, p. 31). Pietermaritzburg (Natal). After HEINZEL (1929, p. 456) a *Rhynchodemus* group (a) = *Microplana*.
16. *Amblyplana zenkeri* GRAFF (1899, p. 509). Cameroons.
17. *Artiocotylus cherangani* BEAUCHAMP (1936, p. 144). Kenya Colony. With only one bursal-antral connection (BEAUCHAMP, 1951a, p. 82, note) and therefore a *Microplana*.
18. *Artiocotylus macrothylax* BEAUCHAMP (1936, p. 141). Kenya Colony. After PANTIN (1953) *Artiocotylus* is a synonym of *Othelosoma*.
19. *Artiocotylus speciosus* GRAFF (1896, p. 70; 1896a, pp. 81-82; 1899, p. 481). Cape Colony. = *Othelosoma*.
20. *Bipalium kewense* MOSELEY, 1878, was reported for the first time from Africa (Cape Colony) by TRIMEN (1887, p. 548) and later from Pietermaritzburg (Natal) by JAMESON (1907, p. 28).

21. *Dolichoplana conradti* GRAFF (1899, p. 536). Togo.
22. *Geoplana* spec.? GRAFF (1899, p. 254). Zambezi. A quite doubtful fragment.
23. *Othelosoma symondsi* GRAY (1869, p. 241), Gabon, French Equatorial Africa. Re-examined by PANTIN (1953).
24. *Pelmatoplana buettneri* GRAFF (1899, p. 395). Togo.
25. *Platydemus africanus* GRAFF (1899, p. 521). Cape Colony. After FREISLING (1935, p. 12) an *Artiocotylus* = *Othelosoma*.
26. *Platydemus montanus* MELL. (1904, p. 484). Abera (Djamdjam, South Abyssinia). Only incipient male organs are known.
27. *Rhynchodemus flavus* MOSELEY (1877, p. 286). Cape Colony. GRAFF (1896, p. 72; 1899, p. 511) referred this species to *Amblyplana*, PANTIN (1953) to *Othelosoma*.
28. *Rhynchodemus fuscus* MOSELEY (1877, p. 286). Cape Colony. GRAFF (1896, p. 72; 1899, p. 508) referred this species to *Amblyplana*, FREISLING (1935, p. 9) to *Artiocotylus* = *Othelosoma*, but FREISLING sectioned GRAFF'S, not the original, material, that cannot be defined (PANTIN, 1953).
29. *Rhynchodemus purpureus* BENDL (1908, p. 535). Abyssinia. After HEINZEL (1929, p. 456) a *Rhynchodemus* group (a) = *Microplana*.

LIST OF LOCALITIES (TERRIGOLA).

- 408 Kamitunu, affl. g. Lusinga et sous-affl. dr. Lufwa. Savane avec quelques arbres et affleurement rocheux, 1.800 m, 10.III.1948 : one *Othelosoma*-like immature worm.
- 454 Lusinga, tête de source, 1.760 m, 12.III.1948 : one *Othelosoma*-like immature worm.
- 458 Lusinga, savane brûlée autour de la mare, 1.700 m, 13.III.1948 : one *Othelosoma*-like immature worm.
- 467 [Dipidi, affl. dr. Lufwa et sous-affl. dr. Lufira, tête de source, 1.700 m, 15.III.1948] : one brown *Rhynchodemus*-like immature worm.
- 500 Riv. Lufwa, galerie forestière, 1.810 m, 16.III.1948 : one *Othelosoma*-like immature worm.
- 519 Mukana, forêt marécageuse, 1.810 m, 18.III.1948 : *Microplana harea* n. sp., and *Othelosoma pugum*, n. sp.
- 562 Buye-Bala, affl. g. Muye et sous-affl. dr. Lufira, 1.750 m, 26.III.1948 : *Rhynchodemus hectori* var. *marfa* n. var., and *Othelosoma*-like immature worms.
- 574 Buye-Bala, petite mare à droite, 1.750 m, pH 5; 29.III.1948 : *Rhynchodemus hectori* var. *marfa* n. var.

- 575 Buye-Bala, petite mare à droite, 1.750 m, pH 5, 29.III.1948 : one *Othelosoma*-like immature worm.
- 576 Buye-Bala, confl. g., deuxième bosquet, 1.750 m, 30.III.1948 : two *Othelosoma*-like immature worms.
- 601 Buye-Bala, petit bois derrière la mare, 1.750 m, 31.III.1948 : *Rhynchodemus hectori* var. *marfa*, n. var., and two *Othelosoma*-like immature, reddish brown worms; up to 45 mm long.
- 649 Buye-Bala, savane herbeuse, 1.750 m, 31.III.1948 : two *Microplana*-like immature worms, gray with black mid-line, and 12 *Othelosoma*-like immature worms, up to 45 mm long and reddish brown with 3 darker stripes.
- 668 Diatoka, mare près tête de source Bungushi (affl. g. Kalumengongo, entre têtes de source Mubale et Munte). Au-dessus des arbustes autour de la mare, 1.750-1.780 m, 7.IV.1948 : one *Othelosoma*-like immature worm.
- 699 Mukelengia, affl. g. Kalumengongo et sous-affl. dr. Lualaba, galerie forestière, 1.750 m, 12-13.IV.1948 : two *Othelosoma*-like immature worms with 3 dark stripes, up to 45 mm long.
- 754 [Manda, affl. Kalumengongo et sous-affl. dr. Lualaba, galerie forestière, 1.715 m, 18.IV.1948] : two *Othelosoma*-like immature worms.
- 760 [Manda, plateau avec affleurement rocheux, 1.750 m, 20.IV.1948] : one *Othelosoma*-like immature worm.
- 815 Kabwe, rive dr. Muye, affl. dr. Lufira, galerie forestière, 1.320 m, 26.IV-26.V.1948 : *Othelosoma polecatum* sp. n., and other immature *Othelosoma*-like worms with dark mid-line.
- 970 Munoi, bif. riv. Lupiala, affl. dr. Lufira, 890 m : four *Othelosoma*-like immature worms with 3 dark dorsal stripes.
- 1002 Kaswabilenga, rive dr. Lufira, 700 m, 9-19.VI.1948 : *Rhynchodemus hectori* var. *marfa* n. var., and two *Othelosoma*-like immature worms with blackish back and lighter belly.
- 1377 Entre la Buye-Bala et la Katongo, autour d'un étang à nénuphars, à sec, 1.750 m, 28.IX.1948 : *Othelosoma conyum* n. sp.
- 1725 Mabwe, rive Est du lac Upemba, forêt katangaise, 585 m, 3.I.1949 : five *Microplana*-like light yellow immature worms.
- 1903 Kanonga, galerie forestière le long de la Fungwe, 675 m, 8.II.1949 : two *Othelosoma*-like immature worms.
- 2055 Pelenge, galerie forestière, 1.250 m, 7-20.III.1949 : two *Othelosoma*-like immature worms with 3 dark dorsal stripes.
- 2095 Pelenge, galerie forestière, 1.250 m, 7-20.III.1949 : a big (62 mm) *Microplana*-like immature worm with black mid-line flanked by two light stripes.

2331 Kaziba, Lubanga, affl. dr. Senze et sous-affl. dr. Lufira, galerie forestière, 1.150 m, 16-22.IV.1949 : three fragments of a Microplanine.

[Amani, East Usambara, Tanganyika Territory]. *Othelosoma voleum* n. sp.

Microplana harea sp. nov.

(Fig. 24-29.)

Material. — One mature specimen in sample 519 (holotype).

External characters. — The worm is 15 mm long and 1,2 mm broad. The body is dorso-ventrally flattened, without sharp borders, successively narrowed to the round anterior end and suddenly pointed to the posterior. The mouth lies at 7,5 mm, the gonopore at 11,5 mm from the fore end.

The back is dark gray with a fine, partially faded black middle stripe that begins behind the head and reaches the caudal tip (fig. 24). A light area lies between the small eyes that are very near the anterior end (fig. 25) and situated close to the external surface. The colour of the back passes gradually to the ventral side that is light and only anteriorly somewhat darker. The creeping sole is not lighter than the rest, it occupies about half the breadth of the ventral side, but is narrower towards the anterior end.

Internal characters. — The height of the dorsal epidermis, that is rich in glands, is about 28 μ , that of the ventral half (h) with few glands (u) 11 μ . The nuclei of the sole (k) are insunk, the glands not concentrated as in *M. terrestris* (PANTIN, 1950, p. 28). The annular (z) and longitudinal muscles (y) of the body wall form single layers. Then follow the cutaneous nerve plexus (c), the thick bundles of parenchymal muscles (j) and the ventral nerve cords (n).

The anterior branch of the intestine has about 6-8 diverticles per millimeter, a number that corresponds to preserved material of other species of the genus (GRAFF, 1899, p. 112), and terminates ca. 0,5 mm behind the fore end. Behind the pharynx the two posterior rami of the intestine (i) are united by broad anastomoses (a). These are interrupted by a few parenchymal pillars (x), each about 250 μ long. Also behind the copulatory organs (s, b) the two posterior limbs of the gut are confluent, this broad connection (a) is about 850 μ long. Only in the hindmost region of the body the two posterior intestinal branches are separate (x).

The ventro-lateral testes (t) begin 1,9 mm behind the fore end and extend backward to the level of the copulatory organs. They lie in the septa of the intestinal diverticles (w) but not in all of them. The efferent ducts (d) are slightly swollen and strongly muscular in their ectal course but do not form seminal vesicles. They bend dorsally, pierce the muscle wall of the penis bulb and open independently into its lumen as separate tubes (fig. 28).

The male copulatory organ is nearly globular, with a slightly lengthened papilla that projects into the antrum (m). The lumen of the penis is a seminal vesicle (s) lined with a folded glandular epithelium that stores differently staining secretion. From the point where the female canal (f) joins the antrum (m) a perpendicular canal, the common antrum, descends to the gonopore (g) that is broader than long.

The ovaries lie 1,6 mm behind the fore end; the vitellaria attain the caudal end. As in most other species sperms are collected in the tuba or seminal receptacle of each ovary. The ovovitelline ducts (o) proceed laterally to the efferent ducts. They bend inward at the level of the gonopore, unite and form a common ovovitelloduct (f). This terminal duct probably receives the shell glands that are not recognizable and functions also as ectal (distal) part of the bursal canal. The ental (proximal) part of the latter (b) is a genito-intestinal duct. It connects the point where the ovovitelline ducts (o) unite with the broad post-copulatory intestinal anastomosis (a). A bursal ampulla is not developed.

Microplana harea n. sp., is 15 mm long, has a dark gray back with a fine black middle stripe that begins behind head and reaches caudal tip. Creeping sole as light as rest of belly. Male copulatory organ nearly globular. Anterior limb of gut tricladean, not double as in « *Amblyplana* » *tetracladea* WILCZYNSKI; posterior ones with broad anastomoses as in *tetracladea* and *Microplana purpurea* (BENDL). As in the latter, bursal ampulla substituted by genito-intestinal duct. Colour, position of pharynx, and absence of separate male antrum distinguish *harea* from *purpurea*.

DISCUSSION OF MICROPLANA HAREA.

The new species must be compared primarily with *Amblyplana tetracladea* WILCZYNSKI (n° 13 of our list) and with n° 29, *Microplana purpurea* (BENDL). In both the posterior branches of the intestine are connected by numerous anastomoses like in the present species. In *M. purpurea* STEINBÖCK (1924, p. 499, f. 19) discovered this particularity. The anterior ramus of the gut is typically tricladean in *purpurea* and *harea*, while it is partly divided in two in *tetracladea*. The pharynx lying in the anterior third of the body distinguishes *purpurea* and *tetracladea* from *harea*, where it lies in the middle.

As far as can be judged without knowing the reproductive organs of *tetracladea*, this species, *M. purpurea*, and *M. harea* seem to constitute a natural group. *M. purpurea* was hitherto the only known Ethiopian *Microplana* in which the bursal ampulla is suppressed and substituted by a genito-intestinal duct (MEIXNER, 1921, p. 371; STEINBÖCK, 1924, p. 486, f. 14). The colour, the anterior pharynx, and the penis sheath that produces a broad division between the male and the common antrum, separate *purpurea* from *harea*.

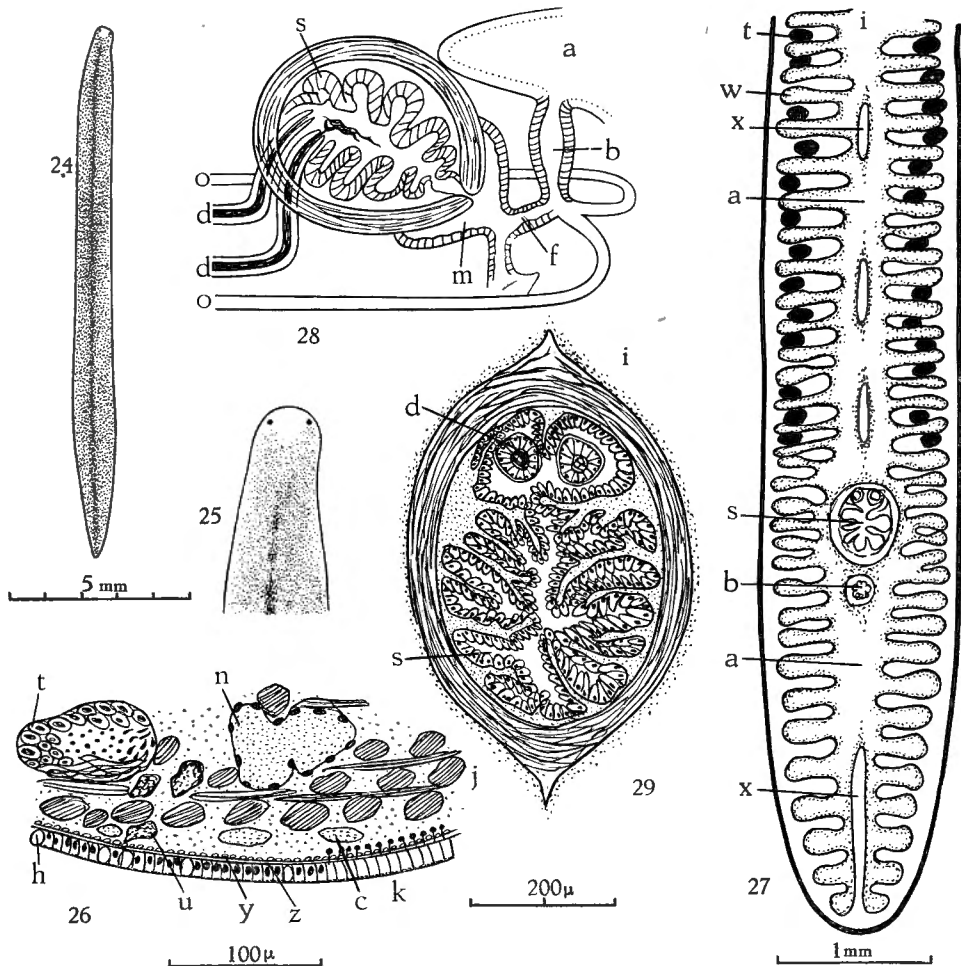


FIG. 24-29. — *Microplana harea* n. sp., preserved material.

24. Dorsal view. — 25. Head of same worm. — 26. Ventro-lateral part of transverse section. — 27. Horizontal section of hind part. — 28. Diagram of copulatory organs. — 29. Horizontal section of penis.

a, anastomoses of intestine; b, bursal canal; c, cutaneous nerve plexus; d, efferent ducts; f, common ovovitelline duct; g, gonopore; h, epidermis; i, intestine; j, longitudinal parenchymal muscles; k, creeping sole; m, antrum; n, ventral nerve cord; o, ovovitelline ducts; s, seminal vesicle; t, testes; u, skin gland; w, diverticle of intestine; x, parenchymal pillars; y, longitudinal subepidermal muscles; z, circular subepidermal muscles.

Two species from Madagascar, *Amblyplana tristriata* GEBÄ (1909, p. 390) and *A. mediotriata* GEBÄ (1909, p. 393), as well as *A. trifuscolineata* KABURAKI (1920, p. 147) from Mauritius, belong to *Microplana* of MEIXNER's type A (1928, p. 591-592) with genito-intestinal communication. But they all differ from *M. harea* by the considerable distance between the more ectal genito-intestinal duct and the more ental uniting point of the ovovitelloducts.

Those Ethiopian *Rhynchodemidæ*, the copulatory organs of which are not known, differ from the present species by their colour patterns.

***Othelosoma pugum* sp. nov.**

(Fig. 30-41.)

Material. — 10 worms in sample 519 (holotype), five of which are mature.

External characters. — The animals are 6,5-27 mm long and up to 1,8 mm in diameter. The mature specimens are from 11 to 21 mm in length. The anterior end of the body is quite blunt, and the round end of the creeping sole reaches the tip in strongly contracted worms. Dorsal to it there is a small flattening that contains the two small eyes. The sides of the body show some transverse folds chiefly in the anterior part, that are due to contraction, probably of the retractor (r). The diameter of the nearly cylindrical worms diminishes gradually towards the tail that is a little pointed. In a 21 mm long animal the mouth lies at 12 mm from the fore end, the gonopore at 17 mm. For a 19 mm long worm these indications are 8,5 and 13 mm, for one of 14 mm, 6 and 11 mm.

The colour of the back is a light reddish brown that fades out on the sides. The anterior tip of the body is light and surrounded by a ring of darker brown colour. From this goes out a narrow, dark brown mid-line without distinct borders, that runs along the whole length to the tip of the tail. This dark mid-line is flanked by two stripes very little lighter than the sides of the back, followed by two slightly darker ones, so that one might speak of 3 dark stripes, the median darker than the lateral ones. They unite on the tail (fig. 35). The ventral side is light yellow, the still lighter creeping sole occupies about one third of the breadth. One worm, the only well preserved specimen, is much lighter than the rest, but does not show further differences.

Internal characters. — The epidermal epithelium is 28 μ high on the back and 15 μ on the creeping sole (k) that is ciliated and has normal nuclei. The light spot on the anterior end (fig. 31, 33, 36) surrounds the sensory groove (g). It has a flatter epithelium than the rest of the skin and no pigment. In strongly contracted specimens it is entirely tucked away into a deep fold that prolongs the sensory pit. The eyes (e) have 0,15 mm deep pigment cups that are 80 μ in diameter.

The subepidermal muscles consist of one layer of strong circular and another of even stronger longitudinal fibres. The latter seem to form bundles in some places (fig. 39, f), as GRAFF has already described and drawn such for *Artiocotylus speciosus* (1899, p. 76, t. 55, f. 7, hml). They are extremely thin in the region of the creeping sole (k). The retractor (r) of the anterior end is developed as PANTIN (1953) described it for *O. symondsi* GRAY. As in this species the retractor takes origin far behind the ovaries (v), at 3,5 mm behind the anterior tip in a 19 mm long worm. The fibres (q) of the retractor come from several septa between the intestinal diverticles (h). The retractor is inserted on and ventrally to the sensory groove (g), however the muscle fibres end united already in the parenchyma 0,3 mm behind the pit.

Inwards to the subepidermal muscle layers lies a thick parenchyma constituted chiefly of gland cells (z) mingled with the cutaneous nerve plexus (l). It is followed by parenchymal muscles that are also strongly developed. Especially ventro-laterally they form compact masses (u), between which the nerve cords (n) run. Dorsally to these and ventrally to the gut (i) there is a transverse plate of muscles (j).

The short pharynx is connected with the gut by an esophageal tube. The intestinal diverticles (h) are narrow, 6-12 were counted on one millimeter length. The anterior ramus ends 0,5 mm from the tip of the body. As far as the gut was sectioned horizontally, till 2,8 mm behind the gonopore, no anastomoses or cross branches between the main posterior branches were seen.

The big testes (t) are numerous, and most of them lie ventro-laterally between the parenchymal longitudinal muscles (u) and the intestine (i), the hindmost near the anterior end of the penis bulb. The winding efferent ducts (d) form accessory seminal vesicles filled with sperm, approach the gonopore, bend forward and continue with highly muscular and sinuous end pieces. These pierce the muscle wall of the penis bulb independently and enter the ental end of the curled seminal vesicle (s) from behind. The whole male copulatory organ is 1,5-2 mm long. Its muscle wall is 0,2 mm thick in a 21 mm long worm and consists of a compact mass of fibres, in which the three layers, « Muscularis, Eigenmuskulatur, äussere Muskelhülle » (GRAFF, 1899, p. 170-171) are not distinguishable. The lumen of the seminal vesicle is 0,15 mm wide and lined with a folded epithelium that forms a network of longitudinal ridges. These probably store granular secretion, but the state of preservation is not sufficient for all histological details. The inner epithelium of the male organ continues as smooth lining of the ejaculatory duct (m). This duct proceeds through the ectal part of the male organ, the downward bent penis papilla that ends with a long slender tip, about 50 μ in diameter and 120-200 μ in length. The papilla is covered with a flat epithelium. Its strong circular muscles continue those of the antrum (a), but the high (60 μ) epithelium of the latter is ciliated.

The ovaries (v) are 1,4-1,75 mm from the tip in sections, where they lie over the outer borders of the nerve cords (n). In one of the specimens one ovary is bilobed, so that a kind of parovarium is present (GRAFF, 1912-1917, p. 2996). The oviducal tubæ contain sperms. The vitellaria begin behind the ovaries and are connected with the ovovitelline ducts by long epithelial tubes. The ovovitelloducts (o) have normal, intra-epithelial nuclei along their whole course. A short distance behind the gonopore the ovovitelline ducts turn to the middle and enter the canalis anonymus (c) together with BEAUCHAMP's canal (y). Shell glands are not recognizable. The ampulla of the seminal bursa (b) is surrounded by parenchymal muscles that are interrupted in the areas where the intestine touches the bursa. The bursal orifices of the ductus vaginalis (w) and BEAUCHAMP's canal (y) are united. The latter forms a loop before it joins the ovovitelline ducts (o) and the canalis anonymus (c). The ductus vaginalis is constricted by a strong sphincter (x) approximately in its middle. A similar although longer and more ectal ring of muscles occurs in the vaginal duct of *O. cafferum* (JAMESON, 1907, p. 35, f. 9, 14, m.u.s.). The ductus vaginalis and the canalis anonymus of *O. pugum* open side by side on the same level into the antrum at a little distance from the gonopore.

Othelosoma pugum n. sp., is up to 27 mm long, light reddish brown with 3 dark stripes on the back and light yellow ventral side with a still lighter creeping sole, about one third of the breadth. Anterior retractor like in *O. symondsi* GRAY described by PANTIN. Male copulatory organ 1,5-2 mm long, surrounded by compact mass of muscle fibres. Ovovitelline ducts enter canalis anonymus together with BEAUCHAMP's canal. Parenchymatic muscles around ampulla of bursa interrupted where intestine touches bursa. Bursal orifices of ductus vaginalis and BEAUCHAMP's canal united. The latter forms a loop. Ductus vaginalis with sphincter in its middle and opening side by side with canalis anonymus on same level into antrum near gonopore.

DISCUSSION OF *OTHELOSOMA PUGUM*.

The following species of *Othelosoma* differ from *O. pugum* by the antral entrance of the ductus vaginalis farther ental than that of the ductus anonymus : *cafferum* (JAMESON), *flavescens* (JAMESON), *notabile* (GRAFF) and *symondsi* GRAY. The same holds true for *O. cylindricum* (BEAUCHAMP), where the bursal opening of the ductus vaginalis is dorsal, and one lobe of the bursa is connected with the intestine (BEAUCHAMP, 1930a, p. 732). Such a communication exists also in *O. angolense* (BEAUCHAMP). This character, the smaller and softer penis, and the shortness of BEAUCHAMP's canal separate *angolense* from *pugum*. *O. angolense* cannot be considered as a variety of *O. notabile* (GRAFF), as it has a genito-intestinal communication, a different topography of the antral orifices of the 2 female ducts, a very long canalis anonymus, and further differences in the female canals.

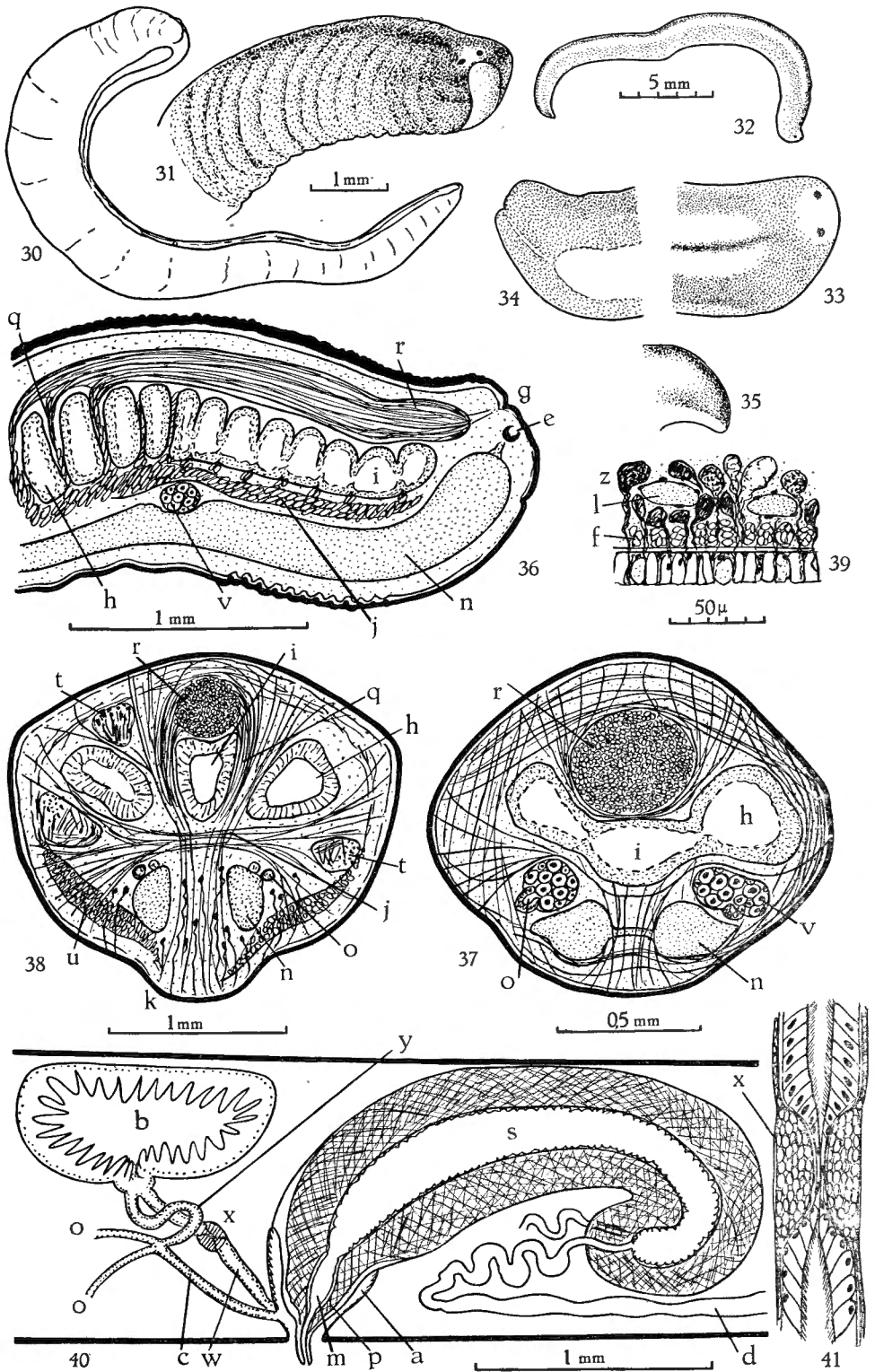


FIG. 30-41. — *Othelosoma pugum* n. sp., preserved material.

The latter open together and far entally in *O. africanum* (GRAFF), drawn by FREISLING (1935, f. 3). The ductus vaginalis of *O. hepaticarum* (JAMESON) has no sphincter; that of *O. macrothylax* (BEAUCHAMP) is paired; that of *O. nigrescens* (MELL) is provided with numerous diverticles in its ectal part.

O. speciosum (GRAFF) is a broad, ventrally flat species without stripes. There is a commun ovovitello-duct or glandular duct between the point where the ovovitello-ducts unite and the outer opening of BEAUCHAMP's canal.

Among the species, the copulatory organs of which are not known, none has a colour pattern like that of *O. pugum*. *O. flavum* (MOSELEY) f. ex. is light yellow with a jet black dorsal line, and *O. (?) fuscum* (MOSELEY) is flesh coloured (GRAFF, preserved : bright yellow) with a pair of broad bands of mottled brown that leave between them a narrow light stripe. The material that GRAFF identified with MOSELEY's species (n° 28 of our list) has a bursa seminalis much larger than the penis.

Othelosoma conyum sp. nov.

(Fig. 42-47.)

Material. — 3 mature worms are contained in sample 1377 (holotype).

External characters. — The length of the present specimens is 22, 25 and 26 mm, the diameter about 1,4 mm. The mouth of the 25 mm long worm lies before the middle, at 11 mm, the gonopore at 15 mm. The shape of the nearly cylindrical body, that is contracted and bluntly rounded in front (fig. 42) and gradually tapering towards the hind end, is the same as in the preceding species.

The back is rusty brown and becomes gradually lighter towards the ventral side that is light with a white creeping sole. The sole occupies one third or more, up to half the breadth of the belly. The anterior end of the back is a little darker than the rest of the dorsal side and gives origin to an almost black mid-line that ends on the tail and is flanked by two lighter bands separated from the sides by a line of deeper shade (fig. 43).

EXPLANATION OF THE FIGURES 30-41.

30. Strongly contracted worm. — 31. Anterior end of same. — 32. The lightest worm of the lot 519. — 33. Anterior end of same in dorsal view. — 34. The same in ventral view. — 35. Tail of same. — 36. Paramedian section of anterior end. — 37. Transverse section on level of ovaries. — 38. Transverse section on level of origin of retractor. — 39. Transverse section of ventro-lateral skin. — 40. Diagram of copulatory organs. — 41. Longitudinal section of vaginal duct.

a, antrum; b, bursa seminalis; c, canalis anonymus; d, efferent ducts; e eye; f, longitudinal cutaneous muscles; g, sensory groove; h, intestinal diverticles; i, intestine; j, transverse parenchymal muscles; k, creeping sole; l, cutaneous nerve plexus; m, ductus ejaculatorius; n, ventral nerve cords; o, ovovitello-ducts; p, penis papilla; q, origin of retractor; r, retractor; s, seminal vesicle; t, testes; u, longitudinal parenchymal muscles; v, ovaries; w, ductus vaginalis; y, Beauchamp's canal; z, skin glands.

Internal characters. — The creeping sole is ciliated, has normal nuclei, and cyanophilous glands (k) on its whole length. The subepidermal longitudinal muscles are united to form groups of 2-5 fibres each, as in *O. speciosum* (GRAFF) and *O. pugum*. These muscles are single over the creeping sole. The parenchymal longitudinal bundles (l) are conspicuous, all around the worm, and especially strong in the ventro-lateral region. The transverse parenchymal muscles (j) are well developed. The retractor (m) takes its origin between the intestinal diverticles (i) about 3 mm from the anterior end. This muscle is as strong and concentrated and ends in the parenchyma as in *O. pugum*, but nearer to the sensory pit (h), viz. 30 μ behind it. The topography of the pit in relation to the other cephalic organs is drawn in fig. 44. The dorsal fold (f) of the skin evidently originates by the contraction of the retractor, but the fibres of the latter do not insert on the inner border of this fold. What GRAFF (1899, pp. 17, 79, 81) described as retractor in *Amblyplana* is not so concentrated. He speaks (1912-1917, p. 2755) of « heaped longitudinal bundles », and perhaps only in *Othelosoma notabile* (1899, t. 54, f. 1-3, R) it seems to be comparable with the retractor of the species of *Othelosoma* described in the present paper, *O. cylindricum* BEAUCHAMP (1913, p. 12), and *O. symondsi* GRAY (PANTIN, 1953).

The testes (t) begin 2,2 mm behind the tip. They are very numerous and distinctly ventral, lying between the nerve cords (z) and the floor of the gut (i), approaching the median plane in an uncommon way (fig. 45). Backward they attain the beginning of the copulatory complex. The sinuous efferent ducts (d) have muscular walls and are dilated by sperms. The ducts turn forward and pierce the muscle wall of the penial bulb (r). They converge to the ental end of the seminal vesicle (s), the inner diameter of which is about 80 μ . The whole male organ is 1,5 mm in length and 0,5 mm in diameter. As in *O. pugum* the thick muscle wall of the penial bulb is uniform and constituted by chiefly circular fibres. On the dorsal side a narrow layer of longitudinal fibres, GRAFF's outer muscular tunic, is developed. The epithelium of the seminal vesicle contains pink secretion, is folded entally, and becomes smooth towards the penis papilla. At the

EXPLANATION OF THE FIGURES 42-47.

42. Head. — 43. Colour pattern of back. — 44. Diagram of anterior end. — 45. Transverse section in front of copulatory organs. — 46. Diagram of copulatory organs. — 47. Female ducts, enlarged.

a, male antrum; b, bursa seminalis; c, canalis anonymus; d, efferent ducts; e, eye; f, antero-dorsal fold; g, gonopore; h, sensory pit; i, intestine; j, transverse parenchymal muscles; k, glands of creeping sole; l, longitudinal parenchymal muscles; m, retractor muscle; n, common ovovitelloduct; o, ovovitelline ducts; p, penis papilla; q, common antrum; r, penial bulb; s, seminal vesicle; t, testes; u, sphincter of male antrum; v, ovary; w, ductus vaginalis; x, sphincter of ductus vaginalis; y, Beauchamp's canal; z, ventral nerve cord.

base of this papilla the ejaculatory duct is widened. The penis papilla is an about 250 μ long organ that bends to the ventral side and projects into the male antrum (a). The latter is separated from the common antrum (q) by a strong sphincter (u). Measured from this muscle to the gonopore (g) the common antrum is 0,5 mm high. The species seems to be slightly protandrous.

The ovaries (v) lie 1,5-1,8 mm behind the tip. The female gonads are young, but the tubules (« Dottertrichter ») that connect the vitellaries with the ovovitelline ducts are already developed. The ducts (o) unite and give origin to a 0,1 mm long common ovovitelloduct (n). The latter receives the curved BEAUCHAMP's canal (y) from the dorsal side; the length of this canal is about 0,3 mm. The canalis anonymus (c) is also bent and 0,15 mm long. The distance between its antral opening and the gonopore (g) is 0,35 mm. The antral opening of the ductus vaginalis (w) is 90 μ apart from that of the canalis anonymus and 0,4 mm from the gonopore. The ectal 0,1 mm long part of the ductus vaginalis is surrounded by a sphincter (x), then follows an ental part (0,18 mm) till to the bursa (b), where the openings of the ductus vaginalis and BEAUCHAMP's canal lie independently one beside the other. The bursa is 1,4 mm long, 0,7 mm high, and lined with an epithelium that is typically high on the ventral wall, flat on the dorsal side. The bursal lumen is full of sperm and granular secretion that form a compact mass.

Othelosoma conyum n. sp., is up to 26 mm long, rusty brown with 3 dark dorsal stripes and white creeping sole up to half the breadth. Retractor ends nearer to sensory pit than in *O. pugum*. Uniform, chiefly circular muscles around 1,5 mm long male organ. On dorsal side of latter a narrow outer muscular tunic. Ejaculatory duct widened at base of ventrally bent penis papilla. Sphincter between male and common antrum. Common ovovitelloduct receives BEAUCHAMP's canal. Ductus vaginalis with 0,1 mm long ectal sphincter opens into antrum 90 μ apart from canalis anonymus. Bursal openings of ductus vaginalis and BEAUCHAMP's canal independent one beside the other. Ventral wall of bursa with high epithelium, dorsal wall flat.

DISCUSSION OF *OTHELOSOMA CONYUM*.

The fundamental plan of the copulatory organs in *O. conyum* agrees with various African species. *O. caffrum* (JAMESON) differs by the uniting of the bursal orifices of the two female canals and by the long ectal dilatation of the ductus vaginalis, the « stalk of the uterus » in JAMESON's terminology. This ductus has no sphincter in *O. hepaticarum* (JAMESON), and its BEAUCHAMP's canal is shorter than the canalis anonymus. Also *O. notabile* (GRAFF) has no sphincter around the ductus vaginalis, and the canalis anonymus of this species runs horizontally (HEINZEL, 1929, p. 450, f. 1, drg) or nearly so (GRAFF, 1899, f. 56 on p. 206). United bursal openings of ductus

vaginalis and BEAUCHAMP's canal occur in *O. pugum*, *O. speciosum* (GRAFF), and *O. symondsi* GRAY, re-examined by PANTIN (1953). Furthermore the sphincter lies in the middle of the ductus vaginalis of *O. pugum*, and there is no common ovovitelline duct. BEAUCHAMP's canal is very short in *O. speciosum*, while it is even longer than the canalis anonymus in *O. conyum*.

***Othelosoma polecatum* sp. nov.**

(Fig. 48-50.)

Material. — 2 mature worms in sample 815 (holotype), that had been dried out but allowed for sectioning and a general description, though not for many details.

External characters. — The worms are 18 mm long, but this measurement was certainly much bigger before they had dried. Their diameter is 1,2 mm. The shape likens that of the other present *Othelosoma*-species, blunt in front and pointed at the hind end, with a slightly prominent, narrow creeping sole. On the tip a white spot around the small cup-shaped eyes is a little depressed, possibly due to the drying. The surrounding rim is yellowish black. The rest of the body is dark yellow except the light creeping sole. On the dorsal side there are 4 black stripes, the median ones connected by a finely stippled area, the outer ones with distinct borders. The stippled zone together with the 2 median stripes is as broad as one of the yellow intervals and a lateral black stripe. The four black streaks unite on the tip of the tail. The mouth lies 7 mm behind the anterior end, the gonopore at 10 mm.

Internal characters. — The black pigment (z) is situated in the parenchyma (fig. 49). The subepidermal longitudinal muscles form small groups like in *O. pugum*. The retractor of the anterior end (fig. 49, m) is distinct and circular in cross section. It originates from the intestinal septa at about 2 mm from the tip. Its topographic relation to the ovaries was not seen. The parenchymal longitudinal bundles (l) form a thick layer, and also the transverse ones (j) are strongly developed.

The small testes begin near the origin of the retractor. They lie singly close to the nerve cords as in *O. conyum*. The efferent ducts (d) enter the 1,1 mm long and slender (0,2 mm) penial bulb (u), that is built of crossing muscle fibres. Its ectal half is surrounded by the male antrum (a) that is constricted from the commun antrum (q). In the pointed penis papilla the male duct forms a small seminal vesicle (s).

The ovovitelloducts (o) accompany the ventral nerve cords. Near the gonopore (g) they bend upwards and inwards and unite in a common ovovitelloduct (n) that is 25 μ long and 20 μ in diameter. It opens into the canalis anonymus (c), 120 μ long and 40 μ wide, that ends in the middle of the posterior wall of the common antrum (q). The canalis anonymus

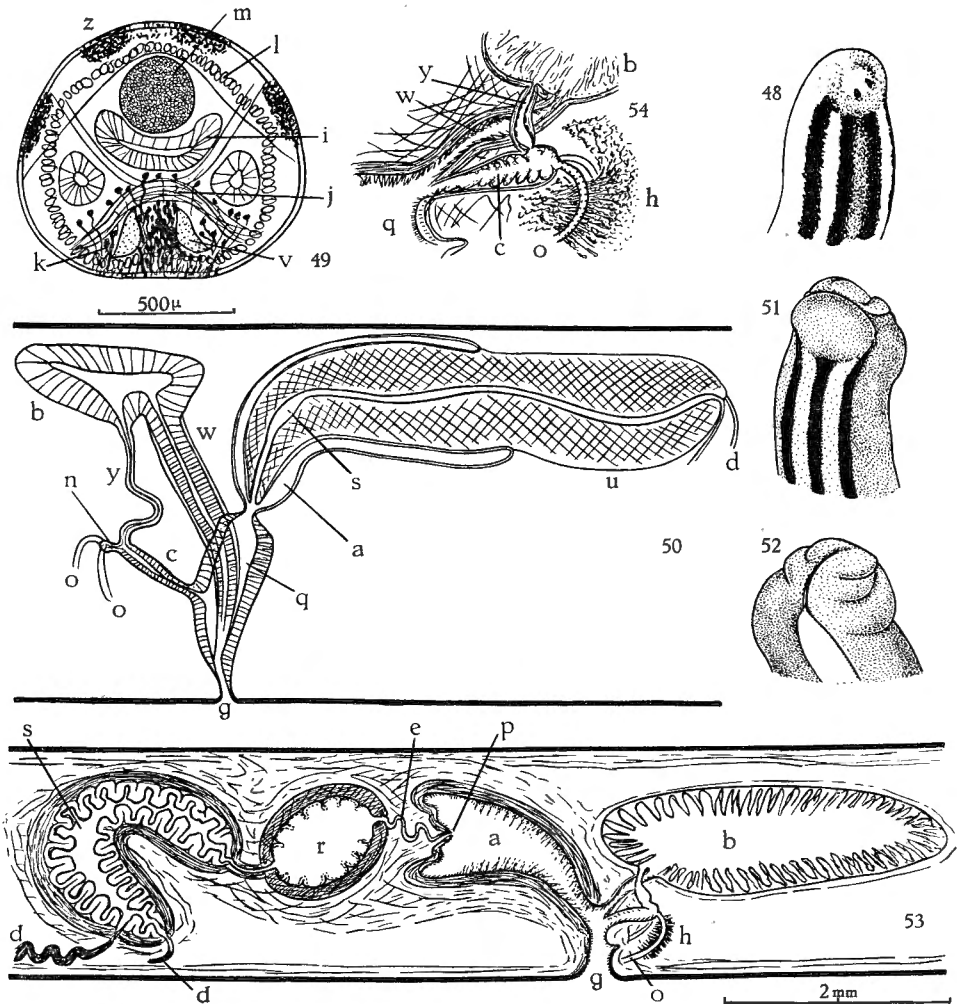


FIG. 48-50. — *Othelosoma polecatum* n. sp., preserved material.

48. Anterior end. — 49. Transverse section of anterior region. — 50. Diagram of copulatory organs.

FIG. 51-54. — *Othelosoma voleum* n. sp., preserved material.

51. Head in dorsal view. — 52. Same in ventral view. — 53. Diagram of copulatory organs — 54. Female ducts, enlarged.

a, male antrum; b, bursa seminalis; c, canalis anonymus; d, efferent ducts; e, ejaculatory duct; g, gonopore; h, shell glands; i, intestine; j, transverse parenchymal muscles; k, glands of creeping sole; l, longitudinal parenchymal muscles; m, retractor muscle; n, common ovovitelloduct; o, ovovitelloduct; p, penis papilla; q, common antrum; r, granule vesicle; s, seminal vesicle; u, penial bulb; v, ventral nerve cords; w, ductus vaginalis; y, Beauchamp's canal; z, pigment stripes.

receives also the BEAUCHAMP's canal (y), that is winding, about 0,3 mm long, and 25 μ in diameter. It comes from the 0,35 mm long bursa seminalis (b). The antral orifice of the ductus vaginalis (w) lies near the gonopore (g). This duct is 60-70 μ wide, with a folded epithelium and a rather thick muscle layer over its whole length (0,6 mm). The opening into the bursa is separate from and in front of that of the BEAUCHAMP's canal.

Othelosoma polecatum n. sp., is dark yellow with a light creeping sole and 4 dorsal black stripes that unite on tip of tail. Retractor distinct. Thick layer of parenchymal longitudinal muscles, also the transverse ones strong. Crossing fibres around long and slender male organ, the small seminal vesicle of which lies in pointed papilla. Constriction between male and common antrum. Ovovitelline ducts form common ovovitelloduct that opens together with winding BEAUCHAMP's canal into canalis anonymus. Latter enters antrum in middle of posterior antral wall. Antral opening of ductus vaginalis near gonopore. This duct with folded epithelium and thick muscle layer. Its bursal opening separate from and in front of that of BEAUCHAMP's canal.

DISCUSSION OF *OTHELOSOMA POLECATUM*.

Most African species of *Othelosoma* have a dark middle stripe, only in two the middle is light and the dark stripes are paired as in *O. polecatum*. These are *notabile* (GRAFF) re-examined by HEINZEL (1929, pp. 449-451) and *angolense* (BEAUCHAMP, 1951a, p. 81). In *notabile* the ductus vaginalis and the canalis anonymus open on the same level, and the common ovovitelloduct is longer than the canalis anonymus. In *angolense*, in which the ductus vaginalis resembles that of *polecatum*, there is no common ovovitelloduct, and the BEAUCHAMP's canal is much shorter than the canalis anonymus.

Othelosoma voleum sp. nov.

(Fig. 51-54.)

Material. — [Amani, East Usambara, Tanganyika Territory] (holotype : in the Collection of the Institut des Parcs Nationaux du Congo Belge). The collector, Miss B. KEMP, wrote (5.VI.1952) to Prof. C. PANTIN : « living in fissures in the bark of forest trees, and were only obvious in the rainy season as far as I know ».

External characters. — The four present worms, one without head, are 40-50 mm long, 2,8 mm broad, and 2,4 mm high. The strongly contracted anterior region, the cylindrical body, and the tapering hind end are similar to the other species of the genus described here. The creeping sole occupies up to one third of the ventral breadth. One worm (50 mm long) shows the mouth at 22 mm from the anterior end, the gonopore at 39 mm; another specimen (47 mm) at 20 mm and 36 mm.

The colour of the living worms, described as «mustard yellow» by Miss KEMP, was fairly well preserved, as is the rule in formalin.

This ground colour sometimes touches the light creeping sole, in other worms it fades out ventro-laterally. Three sharp black stripes of equal breadth (0,24 mm) run along the back. In two specimens the ground colour is lighter between the streaks than on the sides. The distances between the dark stripes are 0,48 mm.

Internal characters. — The epidermal epithelium of the back is 70 μ high in the anterior part and 30-40 μ in the middle of the body. On the belly it is only 15 μ , with 8 μ long cilia on the creeping sole. The nuclei of the latter seem to be intra-epithelial. Glands and rhabdites are abundant on the dorsal side; also the whole creeping sole is pierced by glandular secretion. The black granules that form the dorsal stripes lie in the parenchyma. The pigment cup of the eyes is 0,25 mm long, its ectal diameter is 0,15 mm. The connection of the united ventral nerve cords with the sensory pit and the end of the retractor in the parenchyma between the eyes correspond to the diagram of *O. conyrum* (fig. 44). The origin of the retractor lies far behind the ovaries. The layer of the circular subepidermal muscles is stronger than the longitudinal. The parenchymal longitudinal muscles of the ventro-lateral group (u in fig. 38) are strong, the transverse ones less distinct.

The small ventro-lateral testes are rather scarce. They begin farther backward than 6 mm and are wanting already 3 mm in front of the male apparatus. They were seen in sections 5 mm anterior to the mouth. The efferent ducts (d) are thick and full of sperm already 7 mm in front of the gonopore. They open independently and about 0,45 mm apart from one another into the 1,5 mm long, U-shaped seminal vesicle (s). The epithelium of the vesicle forms deep and regular folds. The cells have basal nuclei and are 30-40 μ high. A coarse layer of muscles of equal height surrounds the vesicle and is embedded in an up to 50 μ thick loose mass of muscular tissue that continues around the male antrum (a). A ciliated duct connects the seminal vesicle with the granule vesicle (r), the larger diameter of which is 0,7 mm. Its flat epithelium has long cilia and is a little folded. Its muscular coat is about 0,1 mm thick. Also the following sinuous ejaculatory duct (e) has its own subepithelial muscles. This duct is 80 μ in diameter and 0,7 mm long from its origin to its end on a small conical penis papilla (p). The latter projects into the male antrum (a), a wide and 2,1 mm long cavity with a slightly folded flat epithelium bearing 14 μ long cilia. Towards the ectal end of the antrum this epithelium becomes more and more villous. The muscularis of the male antrum is 30-50 μ thick, the loose outer muscle layer attains 0,1 mm. The common antrum has a smoother epithelium, thinner muscles, and some diverticles near the gonopore (g) that are not drawn in figure 53. They resemble those of *Othelosoma nigrescens* (MELL, 1904, t. 17, f. 3).

The ovaries lie 3,5 mm behind the tip. The vitellaria begin at this level and surround the gut on all sides. Where the ovovitelline ducts (o) bend upwards and inwards they receive the secretion of the shell glands (h) and become glandular ducts. Their outermost parts have no glands and open into the wide canalis anonymus (c). BEAUCHAMP's canal (y) enters the latter from the dorsal side. The canalis anonymus ends in the common antrum (q) about 0,25 mm from the gonopore (g) and 0,2 mm sideways from the ductus vaginalis (w). The antral opening of the duct is 0,3 mm distant from the gonopore. Its length is 0,42 mm, and the muscular coat is uniform without a special sphincter. The cilia of the ductus vaginalis are directed towards the bursa in the ental, and outwards in the ectal half. The bursa (b) is 3 mm long, lined with a high epithelium, and surrounded by loose muscles. The whole copulatory complex from the anterior end of the seminal vesicle to the caudal tip of the bursa is 8 mm long.

Othelosoma voleum n. sp., up to 50 mm in length is mustard yellow with 3 black stripes and a light creeping sole up to one third of ventral breadth. Retractor originates far behind ovaries. A U-shaped muscous seminal vesicle with folded epithelium receives efferent ducts and is connected by ciliated duct with ciliated granule vesicle. Sinuous ejaculatory duct ends on small penis papilla projected into wide and 2,1 mm long male antrum. Common antrum with diverticles near gonopore. Ovovitellocanals open into wide canalis anonymus together with BEAUCHAMP's canal. Bursal opening of latter separate from that of ductus vaginalis. Antral openings of ductus vaginalis and canalis anonymus separate. Whole copulatory complex 8 mm long. South Indian species (BEAUCHAMP, 1930a) morphologically less distant from *O. voleum* than hitherto known African ones.

DISCUSSION OF *OTHELOSOMA VOLEUM*.

The copulatory apparatus of this species differs greatly from all other known African *Othelosoma*, nor can it be presumed that any of the formerly described, not sectioned, species is identical with it, as their colour patterns are all different. Among BEAUCHAMP's South Indian *Othelosoma* (1930a) the lengthening and differentiation of the male organ is a general phenomenon (p. 704). Chiefly *O. retractile* (BEAUCHAMP, 1930a, p. 706) and *O. torquatum* (BEAUCHAMP, 1930a, p. 716) are related with *O. voleum*. They have a communication between the small bursal ampulla and the intestine and further minor differences. Notwithstanding they are morphologically less distant from *O. voleum* than the hitherto known African species. It is interesting to note one case more of Oriental-Ethiopian relations, and it is by no means surprising that this happens with a species found East to the zone of the great African graben.

Rhynchodemus hectori var. **marfa** var. nov.

(Fig. 55-61.)

Material. — Samples 562, 574, 601 (holotype) and 1002 contain mature worms.

External characters. — The present worms are up to 22 mm long and 1 mm thick. Many of them are curled up in front. The anterior end is slender, beak-shaped, and ventrally concave. At about 2 mm from the tip the body widens suddenly and becomes cylindrical. Behind the gonopore the diameter of the body diminishes gradually towards the posterior pointed tip. The length of the region before the eyes (e) varies from 0,4-0,8 mm. The creeping sole (k) begins as a narrow furrow, widens at the level of 2 mm, and then occupies one fourth to half of the breadth, varying at different levels of the same individual, and corresponding to the filling of the intestine in various animals. The pharynx (f) is about 0,7 mm long and lies 8-9 mm from the tip, the mouth at 9 mm, the gonopore at 11-12 mm. Several specimens show stages of anterior and posterior regeneration; in one worm even the very small eyes are evidently regenerated. GRAFF's observations (1899, p. 502) on the closely related *Rhynchodemus schmardai* obviously also refer to regeneration.

The back is brown (samples 574, 601), blackish gray (sample 1002), or nearly cream coloured (the single worm of sample 562), without stripes. The colour of the dorsal side appears also on the two anterior millimeters of the ventral side, the rest of which is grayish white without distinct limits of the sole. The sensory furrow (g) is set off as a light edge of the anterior end.

Internal characters. — The nuclei of the creeping sole (k) are insunk, and its numerous cyanophil glands (y) open on the whole length of the sole (fig. 60, 61). Especially in the anterior region the glands penetrate deeply into the parenchyma. The cutaneous glands outside the sole are less conspicuous (fig. 59). The longitudinal bundles of the subepidermal muscles (x) are strongest developed ventro-laterally (fig. 60). The transverse parenchymal muscles (j) form mighty bundles.

The testes begin already at the level where the body widens, about 2 mm behind the tip. One or two pairs lie in front of the ovaries. Backwards the testes extend (fig. 61, t) beyond the copulatory organs. As a rule the testes are disposed in a single row on each side, but occasionally two occur on the same level, one above the other. The efferent ducts (d) pierce the musculature (b) of the male organ from below and open into the ental part of the ciliated seminal vesicle (s). The more ventral or more dorsal position of this vesicle may depend on the contraction of the outer muscles (b) of the male organ. A winding ejaculatory duct (r) surrounded by glands of eosinophil, finely granular secretion passes to the male antrum (a) without forming a penis papilla. The folded wall of the antrum consists of a high

ciliated epithelium, 3-4 layers of circular (u), and one stratum of longitudinal muscles (m). The nuclei of these fibres do not accompany them, but lie in the loose muscular and glandular tissue that covers the subepithelial antral muscles. This tissue is surrounded by a tunic of longitudinal muscles (b) that does not extend on to the female part of the copulatory complex. The communication between the male antrum and the gonopore (p) is so short that in one specimen the male and female pores are separated by a dorsal muscle fold. Thus results an aspect resembling the figure of *Rhynchodemus vej dovskyi* GRAFF (1899, f. 51 on p. 200).

Also the ovaries lie at the level of the anterior widening at about 2 mm, and the vitellaria begin a little farther in front (1,8 mm from the tip). The vitellaries extend to the posterior region of the body (fig. 60, v). The uniting ovovitelline ducts (o) form the common ovovitelloduct (c) that is 0,2 mm long. Its ectal continuation, the glandular duct (h), is a little shorter (0,15 mm). The shell glands (w) spread far into the parenchyma. The female antrum (q) is about 0,4 mm long and 0,15 mm wide. Its epithelium is similar to that of the male antrum, only the basal position of the nuclei is characteristic.

Rhynchodemus hectori var. *marfa* n. var., first safe representative of true *Rhynchodemus* in Africa, differs little from South American *Rh. hectori* GRAFF. Back without stripes; not 7 but 1-2 pairs of testes in front of ovaries; more ventral seminal vesicle; absence of penis papilla; and lower epithelium of female antrum. These differences may partly be functional. Glands distributed over whole creeping sole without anterior concentration.

DISCUSSION OF *RHYNCHODEMUS HECTORI* var. *MARFA*.

Various species of middle sized *Rhynchodemus* with spacious male antrum are very similar in their copulatory organs, although contraction of some muscles may produce different aspects. The colour pattern varies within certain limits as is shown in the lots of the present collection. Only further investigation of the not yet sectioned species of GRAFF's monograph (1899) can help us to recognize the morphological and zoogeographical relations. The studies of BENDL (1908), HEINZEL (1929) and FREISLING (1935) in this sense are already extremely useful.

HEINZEL (1929, pp. 433-436) verified that *Rh. hectori* GRAFF (1897, p. 3; 1899, p. 502) from Argentine and *Rh. samperi* FUHRMANN (1914, p. 786) from Colombia can hardly be separated. They are subspecies with different colour patterns, different distribution of the shell glands, and a resulting shorter (*hectori*) and longer (*samperi*) glandular duct. In *Rh. vej dovskyi* GRAFF (1899, p. 492), *Rh. ochroleucus* GRAFF (1899, p. 491), and *Rh. schmardai* GRAFF (1899, p. 502) we have to discuss related oriental species, to which *Rh. hectori* var. *inopinata* BEAUCHAMP (1930, p. 81) must be added. *Rh. vej dovskyi* is characterized chiefly by the female antrum that is nearly as

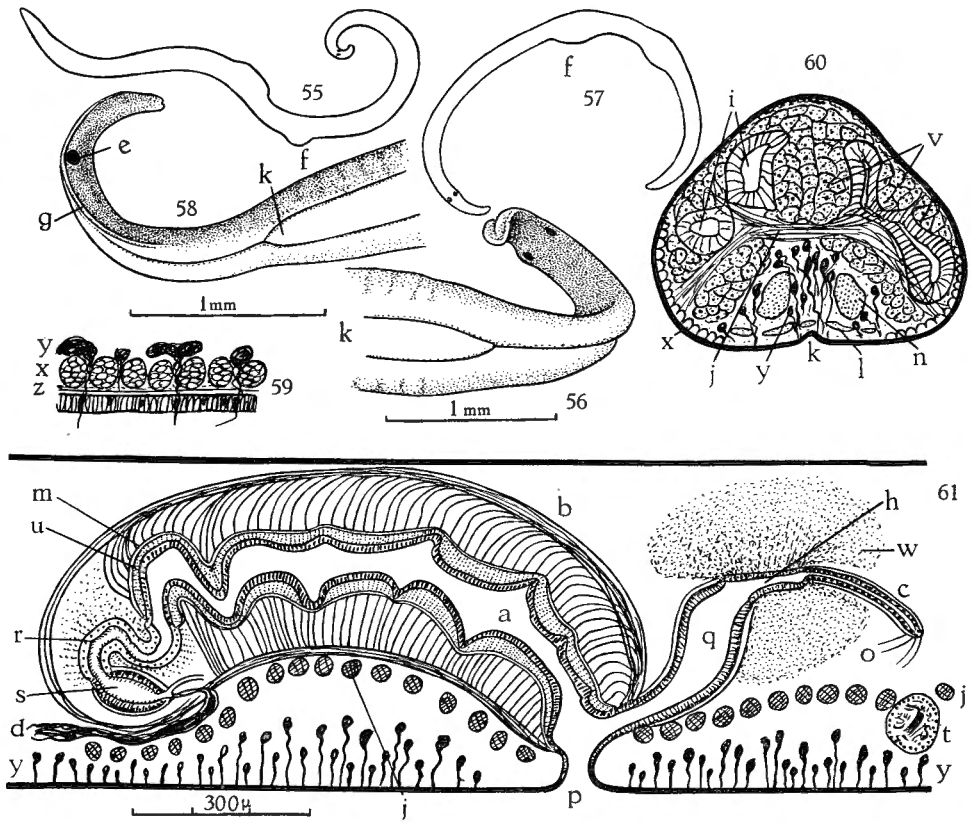


FIG. 55-61. — *Rhynchodemus hectori* GRAFF var. *marfa* n. var., preserved material.

55. Worm of sample 601. — 56. Anterior end of same. — 57. Worm of sample 1002 — 58. Anterior end of same. — 59. Transverse section of skin — 60. Transverse section of body behind copulatory organs. — 61. Diagram of copulatory organs.

a, male antrum; b, outer muscles of male organ; c, common ovovitelline duct; d, efferent ducts; e, eye; f, pharynx; g, sensory furrow; h, glandular duct; i, intestinal diverticles; j, transverse parenchymal muscles; k, creeping sole; l, cutaneous nerve plexus; m, inner longitudinal muscles of male organ; n, ventral nerve cords; o, ovovitelline ducts; p, gonopore; q, female antrum; r, ejaculatory duct; s, seminal vesicle; t, testis; u, inner circular muscles of male organ; v, vitellaries; w, shell glands; x, longitudinal subepidermal muscles; y, skin glands; z, circular subepidermal muscles.

long as the male part. Also *Rh. ochroleucus* can be separated as a species by the absence of a seminal vesicle (HEINZEL, 1929, p. 441, t. 11, f. 6). *Rh. schmardai* however, the copulatory apparatus of which was studied by BENDL (1908, p. 545), is very near *hectori* and *samperi*. The common ovovitelline duct (« Eiergang ») of *schmardai* runs ventro-dorsally, not caudo-rostrally, and its shell glands are less concentrated than those of *hectori*. It may be emphasized that the extension of the outer muscle layer on to the female part of the antrum in BENDL's figure (t. 31, f. 1) was corrected by HEINZEL (1929, p. 435). On the other hand we have no precise indications as to the position of the gonads in *schmardai*. The testes are very numerous and the ovaries lie 6 mm behind the anterior end. As the length of the worm is not mentioned, the indication for the ovaries is useless, and the position of the testes is not related to that of the ovaries.

BEAUCHAMP (1930, p. 81) has courageously classified two worms from Sumatra as « variety » of *hectori*. His is a one-striped form, while typical *hectori* has two stripes (GRAFF, 1899, p. 503, t. 18, f. 19). Except the absence of a seminal vesicle the copulatory organs of var. *inopinata* are very similar to those of *hectori*. As BEAUCHAMP observed (p. 83), the ventral muscles of the male antrum are strongly contracted in the sectioned worm, but this is not a structural difference. The absence of the testes behind the level of the gonopore is more significant in var. *inopinata*. This may be conditioned by the developmental state. Recently we have, admitting merely functional diversities, classified worms as *Rhynchodemus pellucidus* GRAFF (MARCUS, 1952), although they had more testes than the original material. But in the mentioned case we united specimens from localities about 500 km apart. The absence of a seminal vesicle and of posterior testes might justify specific separation of var. *inopinata*. The African material has a seminal vesicle and testes like *hectori* and *samperi* beginning before the ovaries and ending behind the copulatory organs (fig. 61, t). There are 7 pre-ovarian pairs in both the South American forms, and 1-2 in the present worms. We mention this because the colour as the only base for a separation even of a variety might in future perhaps prove to be insufficient, if *Rhynchodemus stenopus* GRAFF (1899, p. 495) is studied anatomically. This species is stouter than *hectori* and widely separated from it in GRAFF's key (1899, p. 552-553), but its colour likens that of our African variety. As *Rh. stenopus* was found in Venezuela and Argentine little is won zoogeographically with its possible systematical approximation to our form.

For the classification of the species of the genus *Rhynchodemus* LEIDY, the copulatory organs of which are extremely simplified, our taxonomic criteria are perhaps not sufficiently detailed. The proboscidiform anterior end (LEIDY, 1851), the « cephalic hood, a highly organized structure » (PANTIN, 1953), deserves special attention. HYMAN's modern descriptions (1943, pp. 5, 7) show that *Rhynchodemus sylvaticus* (LEIDY) and *Rh. americanus* HYMAN differ with regard to the sensory tracts and the distance between

the ventral nerve cords. PANTIN (1950, p. 28) discovered a concentration of glands at the beginning of the creeping sole in *Rh. bilineatus* (MECZNIKOW), and the same concentration of glands seems to occur in *Rh. americanus* HYMAN (1943, f. 11). Also *Rh. piptus* MARCUS (1952, f. 134) has this type of sole glands, while in *Rh. pellucidus* GRAFF and *Rh. hectori* var. *marfa* they are distributed over the whole sole without anterior accumulation.

The latter form cannot in the present state of our knowledge be separated from *hectori* as a species. We apply the vague term « variety » to point out the aberrant colour pattern, the small number of pre-ovarian testes, the more ventral seminal vesicle, the absence of a penis papilla, and the less high epithelium of the female antrum. These differences may partly be functional.

Neither asexual reproduction nor passive distribution can be presumed for *Rh. hectori* to make the small differences between the South American, African, and Malayan representatives of perhaps one species more intelligible. The zoogeographical problem continues on open question.

ZOOGEOGRAPHICAL REMARKS.

GRAFF's phylogenetic considerations on the Terricola (1899, p. 283) and the corresponding system of the Suborder (1912-1917, pp. 3221-3230) are obsolete. Principally MEIXNER (1928, p. 591-601) established the natural system in a nearly inverse order. Nearest to the Maricola and therefore most primitive are the *Rhynchodemidæ*, the only family of the Terricola that occurs in all zoogeographical regions (GRAFF, 1899, pp. 272-273), except in the Arctic and Antarctic. The distribution of a primitive taxonomic unit is always of great interest. The more or less correct morphological analysis of the Rhynchodemids is accountable for the understanding of the future zoogeographic map of the Terricola.

To judge by the subepidermal muscles, the male organ, and the bursa, the subfamily *Microplaninæ* is more primitive than the *Rhynchodeminae*. The *Microplaninæ* occur in the Arctogæic and Neogæic realm, and their distribution can, after my opinion, only in part be understood with the present topography of land and sea as basis.

The species of *Microplana* with well developed, closed bursa seminalis form a natural group, the *aberana*-group, that corresponds to the first section of MEIXNER's type A (1928, p. 591). These most primitive *Microplaninæ* are known from Africa, Europe, and Central America. The Ethiopian species are : *M. aberana* (MELL), *M. cherangani* (BEAUCHAMP), *M. natalensis* (JAMESON), *M. neumanni* (MELL), and *M. viridis* (JAMESON). From Europe we know : *M. scharffi* (GRAFF), Ireland; *M. howesi* (SCHARFF), Southern France; and *M. styriaca* (FREISLING), Styria. PRUDHOE (1949, p. 428) placed the Central American species *M. costaricensis* (BEAUCHAMP)

among « the forms that cannot yet be classified with any degree of certainty ». But I think it is securely a *Microplana*, although the muscles are not described. Such an enormous penis papilla as that of *M. costaricensis* is not known from any *Rhynchodemus*. BEAUCHAMP (1913a, p. 42-44) compares his species with *Rhynchodemus scharffi* GRAFF, a sure *Microplana*, included in the *aberana*-group here. After HEINZEL (1929, p. 446) *M. scharffi* seems to belong to the following group. Considering the state of exploration and the extension of Africa and Europe, the first with 5 species against 2 or 3 from the latter, Africa may be assumed to represent the centre of origin of the most primitive *Microplaninae*.

Only in the Middle Pliocene the regional character of the Mammalian fauna in the Eastern Arctogæa, the Ethiopian, Oriental, and Palæarctic region, became distinct (MARCUS, 1933, pp. 152-153). In the Pliocene Japan and the continent as well as Asia and the Nearctic were still connected. The Mediterranean bridges from Tunis over Sicily to South Italy and that over Gibraltar were even Pleistocene. The distribution of the *aberana*-group in Africa and Europe can therefore easily be understood. It is advisable not to extend the zoogeographical interpretation to the one species of this group which is known from outside the map that can be explained with post-Oligocene connections.

The second section of MEIXNER's type A, the *terrestris*-group of *Microplana*, provided with a bursal-intestinal connection, is not fundamentally separated from the *aberana*-group. *M. scharffi* f. ex., seems to possess such a communication, and also among the relatively uniform African *Othelosoma* two species, *O. cylindricum* (BEAUCHAMP) and *O. angolense* (BEAUCHAMP), have a bursal-intestinal duct (BEAUCHAMP, 1930a, p. 732).

The following species belong to the *terrestris*-group of *Microplana* : *purpurea* (BENDL), Abyssinia; *harea* n. sp., Belgian Congo; *mediostrata* (GEBÄ) and *tristriata* (GEBÄ), Comoro Islands; *trifuscolineata* (KABURAKI), Mauritius; the European *britannica* (PERCIVAL), *henrici* (BENDL), *humicola* VEJDOVSKY, *monacensis* (HEINZEL), *peneckeii* (MEIXNER), *pyrenaica* (GRAFF), *terrestris* (O. F. MÜLLER); the Turkish *hovassei* (BEAUCHAMP) and *decennii* (BATTALGAZI); *uniductus* (BEAUCHAMP), South India; *unilineata* (FRIEB), Korea; *cockerelli* (GRAFF), Jamaica; and *montoyæ* (FUHRMANN), Colombia (should be *montoyai*).

Some species, the copulatory organs of which are not known, as *M. albicollis* (GRAFF) and *M. richardi* (BENDL), or *M. carli* (FUHRMANN) described from unfavourable material (MEIXNER, 1921, p. 356) cannot be attributed to a determinate group of *Microplana*. After HEINZEL (1929, p. 456) *Amblyplana teres* GRAFF from Ceylon is a *Microplana*. I do not know any description of the female copulatory organs of this species, but HEINZEL had GRAFF's collection at his disposal (1929, p. 426). To which group *M. teres* belongs cannot be indicated; as a *Microplana* from Ceylon it might be either of the *terrestris*- or rather of the transitory group, that is dis-

cussed later on. *Microplana ruteocephala* KABURAKI (1922a, p. 46) from Middle Japan has the characteristic head-shape of the *Microplaninæ*, but it cannot be attributed to any of the genera. The same holds true for *Rhynchodemus atrocyaneus* WALTON, a certainly endemic North American Microplanine. The endemicity of *Microplana terrestris* (O. F. MÜLLER) in North America may be questioned.

GISLÉN's instructive paper (1944) on the ecology of *Microplana terrestris* considers also the historical aspect of the distribution of the *Rhynchodemidæ* in Europe. Most of the species occur more or less exclusively in the Western and Southern part of the continent and therefore seem to have survived the Ice Age in places left free by glaciers (pp. 667-668). Only *M. terrestris* and perhaps *M. humicola* have shown a greater ability for spreading from their West European shelters to Central Europe in post-glacial times.

The occurrence of the *terrestris*-group on the Comoro Islands and on Mauritius requires the supposition of Mesozoic age for *Microplana*. The colonization of these islands must have succeeded in Cretaceous or even earlier times. The distribution of the group in Eurasia and America can be explained by the Tertiary Bering bridge. Also the map of *Diporodemus* and *Incapora* can be understood in this way. *Rhynchodemus attemsi* BENDL (1909, p. 56) from Yugoslavia has a bursal-cutaneous canal (BEAUCHAMP, 1937, p. 365), and must therefore be removed to *Diporodemus* HYMAN. Besides the South Indian *Rhynchodemus musculosus* BEAUCHAMP (1930a, p. 724) shows the same fundamental features of the copulatory organs as *Diporodemus indigenus* HYMAN (1943, p. 15) from the Central United States. *Rhynchodemus anamallensis* BEAUCHAMP (1930a, p. 703), also from South India, is closely related with the Peruvian genus *Incapora* DU BOIS-REYMOND MARCUS. It is known that the Ice Age wiped out many North American pre-Pleistocene animals or forced them southwards at least to the Sonoran subregion, where most of the Nearctic endemisms live (MARCUS, 1933, pp. 156-157). In North Eastern Siberia nobody will expect *Turbellaria Terricola* under the present climatic conditions. Therefore the Bering distribution of the *Microplaninæ* is sufficiently supported by Korea (*uni-lineata*) and Middle Japan (*ruteocephala*) in Asia, and Illinois and Ohio (*atrocyaneus* and *indigenus*) in the Nearctic. This type of distribution has innumerable parallels (MARCUS, 1933, pp. 153-154).

Othelosoma has taken its origin from *Microplana*. The spacious bursa seminalis of the African *Othelosoma* favours the idea of an origin from the *aberana*-group. The powerful retractor of several African *Othelosoma*-species occurs also in the *terrestris*-group of *Microplana* f. ex., in *M. mediotriata* (GEBÄ) and *M. tristriata* (GEBÄ), both from the Comoro Islands. Likewise *Microplana graffi* (GEBÄ) has a retractor. It was described from the Comoro Islands too and belongs to the third group of *Microplana* discussed in the following. On the other hand three *Othelosoma*-species from

the Cape Colony, *O. fuscum* (MOSELEY) *O. africanum* (GRAFF) and *O. speciosum* (GRAFF), have no retractor. Therefore it seems that this biologically very interesting muscle (PANTIN) has had an independent parallel development in *Othelosoma* and *Microplana*. After the present system six South Indian species (BEAUCHAMP, 1930a) must be included in *Othelosoma*: *O. retractile*, *O. sholanum*, *O. kukkal*, *O. torquatum*, *O. gravelyi*, and *O. hirudineum*. The reduction of the bursa from the African to the Indian *Othelosoma* is similar and even more pronounced than the same process from the *aberana*- to the *terrestris*-group of *Microplana*. A certain relation between one of our African and the Indian *Othelosoma* is mentioned in the discussion of *O. voleum*. The Ethiopian and Indian region have been connected till to the latest Pliocene; the interruption of Bab el Mandeb is even Pleistocene. The age of *Othelosoma* cannot be determined with certainty. MELL (1903) reported species of *Rhynchodemus* and *Amblyplana* from Madagascar without their copulatory organs, so that their generic position is not known. If they are not *Othelosoma*, this genus might have originated in Africa after the Miocene separation of Madagascar from the continent.

A very specialized group of *Microplana* comprises the species with rhynchodemid female organs. These are: *M. graffi* (GEBE), Comoro Islands; *M. voeltzkowi* (MELL) ⁽¹⁾, Nossi Bé near Madagascar; *M. ceylonica* (GRAFF), Rodriguez (KABURAKI), Ceylon (GRAFF); *M. thwaitesi* (MOSELEY), Ceylon; *M. atropurpurea* (GRAFF), Palau Islands; *M. haitiensis* (PRUDHOE), Haiti; and a species collected by the Lund University Expedition in Chile at Lat. 41° S. *M. atropurpurea* deserves special attention, because also its male apparatus is rhynchodemid (HYMAN, 1940, p. 350). The subfamily *Rhynchodeminae* can be derived from this group that we call the « transitory group ». This group is not yet known from Africa. Nevertheless its absence in higher latitudes seems to suggest a distribution that was possible by a terrestrial continuity in lower latitudes. The connection between Africa and South America till to the Lower Cretaceous and perhaps later on in the Oligocene (WITTMANN, 1935) would offer such a route of distribution. WEGENER's theory or hypothesis of Continental Drift cannot be proved by the hitherto known distribution of the Terricola, but the recent maps of their distribution become more intelligible with this theory.

The origin of *Rhynchodemus* from the transitory group of *Microplana* may be presumed in the Oriental region, where many species still live. *Rh. nematopsis* (BEAUCHAMP, 1930, p. 84) and *Rh. oahuensis* HYMAN must be added to HEINZEL's inventory (1929, p. 459). Several other *Rhynchodemus*-species are known from Central and South America (PRUDHOE, 1949, p. 428). *Rh. maculatus* FUHRMANN (1914, p. 788) that PRUDHOE mentions as *Geodesmus*, today *Microplana*, does certainly not belong to *Microplana*; probably it is a

(1) If *Amblyplana voeltzkowi* GEBE (1909, p. 396) is recognized as a *Microplana*, as is probable, it must receive a new name.

Rhynchodemus with the typical cephalic hood (PANTIN). Also *Rhynchodemus cameliae* FUHRMANN (1914, p. 789) seems to be a *Rhynchodemus*. *Rh. piptus* MARCUS (1952) has to be added to PRUDHOE's list. The African *Rhynchodemus* described in the present paper is a zoogeographical link between the Oriental and the Neogæic species. It seems once more necessary to recur to an Atlantic connection in lower latitudes to explain the distribution of the closely related southern *Rhynchodemus*. The occurrence of the few Holarctic species can be understood with the Tertiary Bering bridge. Three species are Palæarctic : *Rh. bilineatus* (MECZNIKOW) in many European greenhouses and on flower pots (ARNDT, 1934), in Belgium (ADAM and LELOUP, 1941), England and Wales (PANTIN, 1950) in the open; *Rh. diorchis* FUHRMANN (Switzerland); and *Rh. ijimai* KABURAKI (Middle Japan). Two species are Nearctic : *Rh. sylvaticus* (LEIDY) and *Rh. americanus* HYMAN, both from the United States.

The distribution of *Dolichoplana* is similar to that of *Rhynchodemus* with still less penetration into the Holarctis. Also in *Dolichoplana* an African link between the Oriental region and the Neogæa is known, *D. conradti* GRAFF, from Togo. DIVA CORRÊA (1947, pp. 61-63) has discussed the distribution of *Dolichoplana* and mentioned Mesozoic parallels to its Atlantic occurrence. As was said above, even a second Oligocene connection has been assumed.

A high age of the *Rhynchodeminae* must be inferred from their spreading into the Notogæa, where several species of *Cotyloplana* and *Platydemus* occur. *Cotyloplana* was considered as a separate family in BRESSLAU's synopsis (1933, p. 283), but evidently belongs to the *Rhynchodemidae* (BEAUCHAMP, 1933, p. 117; 1939b, p. 334).

The *Bipaliidae* and *Geoplanidae* arose from the *Rhynchodemidae*, probably from the *Microplaninae*. The *Bipaliidae* are principally Oriental and extend from this region West till Madagascar and North into the Eastern border of the Palæarctis. The *Geoplanidae* occur in the same parts of the world and further in the Notogæa and Neogæa. The explanation of their distribution will be extremely difficult. Future studies of this family should try to distinguish between older and younger types, specially within the vast genus *Geoplana*. *Pelmatoplana* is more primitive than *Geoplana*. The three most Northern *Geoplanidae*, the Japanese *Geoplana lapidicola* STIMPSON, *G. bimaculata* KABURAKI, and *Artioposthia japonica* KABURAKI, seem to be *Pelmatoplana* (MEIXNER, 1930, p. 3412). The most Northern endemic American *Geoplanid* is *Geoplana mexicana* HYMAN. It is a small worm with a single row of eyes, with ventral testes, and a distinct, although short, penis papilla. These characters are rather old than modern. The few available facts are neither sufficient for the establishment nor for the rejection of the Bering bridge as a way of distribution in *Geoplanids*. It is too early to subscribe HARRISON's opinion (1928) : « The total absence of *Geo-*

plana and the general paucity of land planarians in Holarctica appear to preclude the possibility of Northern migration routes » (quoted from WITTMANN, 1934, p. 266).

The parenchymatic Terricola cannot be dissected as can the earth worms. They must be microtomed, and as many of them are big, their sections require dozens of slides. For that reason the taxonomy of the Terricola has not yet attained the same degree of security as that of the earth worms, and consequently the present outlines of the zoogeography of the *Rhynchodemidæ* must be considered as preliminar and tentative.

ADDENDUM.

BEAUCHAMP's species (1952) mentioned in the Introduction to the Paludicola of the present paper (p. 4) differ from those described here : *lamottei* by a thickening of the ventral wall of the antrum that evidently unites the worms during copulation; *machadoi* by an antral pouch on one or both sides; and *milloti* by prominent auricles.

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