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Some Land Planarians from Caribbean Countries

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INTRODUCTION

The expression "Caribbean countries" as here used includes Yucatan, Central America, Panama and the Canal Zone, northern Colombia and Venezuela, the Venezuelan islands, Trinidad, and the chains of islands of the Lesser and Greater Antilles. The area has not been well collected for land planarians, although a considerable number have been reported from there. Von Graff (1899), in his massive monograph on the land planarians of the world, listed *Limacopsis terricola* and *Geoplana bogotensis* from Colombia, *Geoplana gollmeri* and *taenioides* from Venezuela, *G. gigantea*, *ehlersi*, and *kenneli* from Trinidad, and *Amblyplana cockerelli* from Jamaica. *Geoplana bogotensis* was redescribed, including an account of the sexual anatomy, by Busson (1903), but I was (Hyman, 1955) and still am of the opinion that Busson's material agreed poorly with the original description. It seems to me that the identity of *G. bogotensis* cannot be established unless the original specimen is sectioned. Busson (1903) also reported *Geoplana olivacea* F. Müller, a Brazilian species, from the vicinity of Bogota, Colombia, but C. Froehlich (1959) declared this a misidentification and renamed the species *G. bussoni*. *Geoplana kenneli* belongs to the genus *Kontikia* (C. Froehlich, 1955), and *Amblyplana cockerelli* belongs to *Microplana* (Prudhoe, 1949).

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Beauchamp (1912, 1913) reported land planarians from the leaf bases of epiphytic bromeliads in Costa Rica: *Geoplana picadoi*, *Rhynchodemus bromelicola*, and *R. costaricensis*. The last is to be transferred to the genus *Orthodemus* (Hyman, 1954).

The most extensive article on the region is that of Fuhrmann (1912) on the land planarians of Colombia. Fuhrmann's material contained 23 species, all new but one, *Geoplana bogotensis*, of which Fuhrmann agreed in general with Busson's description. The others were named *Geoplana mayori*, *cameliae*, *tamboensis*, *von Gunteni*, *ubaquensis*, *caucaensis*, *columbiana*, *bilineata*, *nigrocephala*, *bimbergi*, *becki*, *amagensis*, *multipunctata*, *meyerhansii*, *ortizi*, *gonzalezi*, and *guacensis*, *Pelmatoplana graffi*, *Rhynchodemus samperi*, *maculatus*, and *cameliae*, and *Amblyplana montoyae*. *Rhynchodemus samperi* definitely belongs in that genus, but the information furnished about *R. maculatus* and *cameliae* is inadequate to enable one to place them generically. Fuhrmann remarks of *cameliae* that a penis papilla was evident in the cleared specimen; this would definitely exclude the species from *Rhynchodemus*. Pantin (1953) suspects that *Amblyplana* is a synonym of *Othelosoma*, but Fuhrmann's figure of the copulatory apparatus of *Amblyplana montoyae* rather suggests the genus *Microplana*.

From time to time I have made small additions to the knowledge of Caribbean land planarians. In 1938 I reported *Geoplana multipunctata* Fuhrmann, 1912, and *Diporodemus yucatanii* from caves of Yucatan. Eudoxia Froehlich (1955) doubts my identification of *G. multipunctata*. The following year (1939) *Geoplana montana* and *Bipalium costaricensis* were described from mountainous regions of Costa Rica. From the Canal Zone, mainly Barro Colorado Island, I described (1941) *Geoplana cameliae* Fuhrmann, 1912, *G. aphalla* and *panamensis*, *Diporodemus plenus*, and *Desmorhynchus angustus*, later transferred to *Rhynchodemus*. Later (1955) I was able to give a more complete description of this species from Panama specimens, and in 1957 it was refound on Barro Colorado Island. In the same article (Hyman, 1957) I reported the finding of *Geoplana cameliae* Fuhrmann, 1912, from Trinidad.

In 1949 Prudhoe described *Geoplana gigantea* Graff, 1899, *G. vaginuloides* (Darwin, 1844), *G. sandersoni*, and *Rhynchodemus aripensis* from Trinidad, *Microplana haitensis* from Haiti, and *M. cockerelli* from Jamaica. Prudhoe based his identification of *G. vaginuloides* on color pattern, but Ernesto Marcus (1952) has shown that the color pattern of this species is highly variable. The copulatory apparatus of *G. vaginuloides*, distinguished by the excessively long penis papilla, was figured by Riester (1938) and Ernesto Marcus (1951) for specimens from the original locality. Prudhoe's figure differs so markedly from the concordant figures of Riester and

Marcus that one must doubt the correctness of Prudhoe's identification. It is further highly doubtful that the same species of land planarian could inhabit Trinidad and the coastal area of eastern Brazil. The description by Eveline Marcus (1953) of *Rhynchodemus graetzi* from Panama completes the list of land planarians known from Caribbean countries.

NUMBERING FOR ALL FIGURES

1, Eyes; 2, pharynx; 3, copulatory apparatus; 4, sperm duct; 5, penis; 6, penis papilla; 7, male antrum; 8, female antrum; 9, vagina; 10, common ovovitelline duct; 11, gonopore; 12, mouth; 13, ejaculatory duct; 14, seminal vesicle; 15, penis sheath.

DESCRIPTIONS

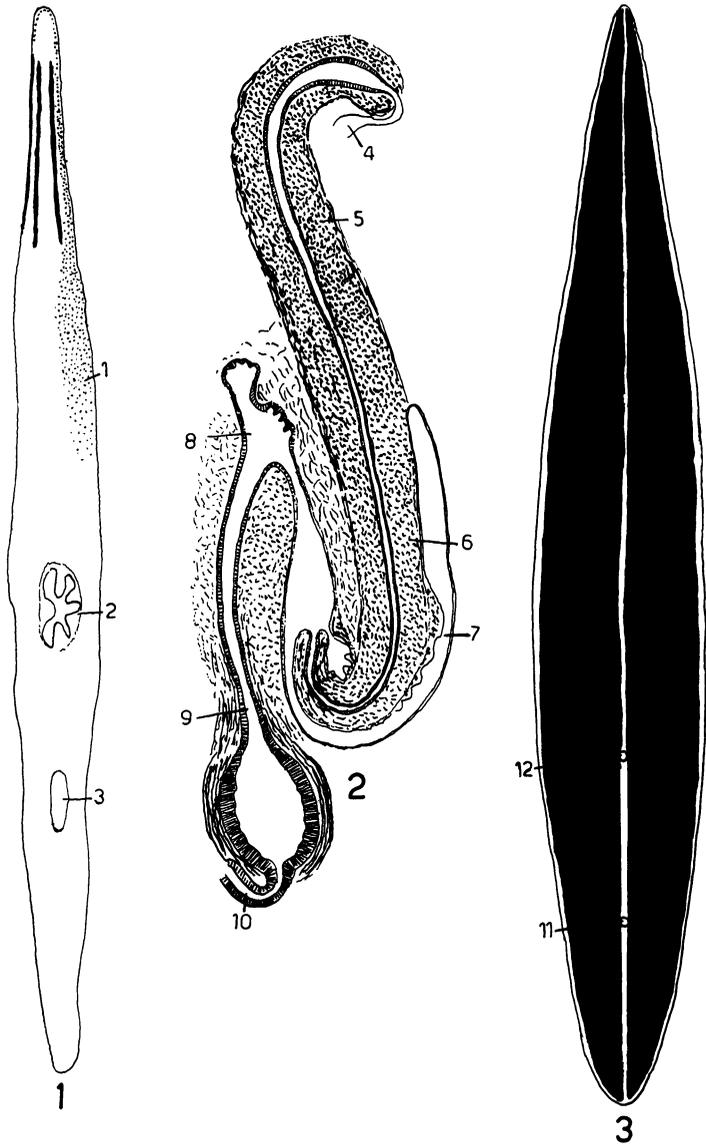
FAMILY GEOPLANIDAE

Geoplana gigantea Graff, 1899

Figures 1-2

The single specimen was collected in March, 1958, in rotten wood in the vicinity of Simla, tropical station of the New York Zoological Society in the hills of Trinidad, by Dr. Anne Alexander, who kindly presented me with the specimen. The species is probably limited to Trinidad, as the identity of the specimens from Venezuela mentioned by Graff cannot be established.

This is a very large species. The present specimen was stated to have been nearly 100 mm. long in life, when moving extended; preserved it was 70 mm. in length. Graff's largest specimen was nearly 200 mm. long. The form is elongated, narrowing to the extremities (fig. 1). The color of the original specimens was stated to have been a dirty yellow, with two dark longitudinal stripes. Graff (1899, pl. 6, fig. 23) depicts these stripes as extending the length of the animal but subsequent observers find them limited to the anterior fourth or less. My specimen was reported as mustard yellow, with four dark brown lines anteriorly, as shown in figure 1. The pair of outer lines along the margins apparently has not been previously noticed. The marginal band of eyes ceases some distance anterior to the pharynx as already noted by Prudhoe (1949); it extends around the anterior tip in approximately single file, then gradually widens until several rows deep, then ceases, with only a slight diminution of width (fig. 1). The relative positions of the pharynx and copulatory region are shown in figure 1. The pharynx appears to be of complicated ruffled form.



FIGS. 1, 2. *Geoplana gigantea*. 1. Dorsal view of entire worm. 2. Sagittal view of copulatory apparatus, anterior end above.

FIG. 3. *Geoplana mayori*, dorsal view of entire worm.

The copulatory region of the specimen was removed and sectioned sagittally. My findings, shown in figure 2, are in essential agreement with those of Prudhoe. The penis is exceptionally long and muscular, separated from the surrounding mesenchyme by a sheath of longitudinal fibers, whereas the interior seems to consist of mainly circular fibers that form a tangled web. The two sperm ducts approach the proximal end of the penis, enter its muscular sheath, and as they pass into the penis unite to form the long ejaculatory duct, which traverses the center of the penis to its tip (fig. 2). The initial widened part of the ejaculatory duct is considered by Prudhoe to constitute a prostatic gland, but I am unable to detect any histological difference here. The gonopore was not found on the sections.

The ovovitelline ducts as they approach the proximal end of the female apparatus unite to a common duct lined by a tall epithelium. This enters the proximal end of the vagina, an oval body with a muscular wall and a high glandular epithelium. This vaginal expansion soon narrows to a long duct with a low epithelial lining that runs anteriorly to open into the male antrum.

No testes were found in the part sectioned. According to Prudhoe they are located dorsally and arranged in four longitudinal rows that extend posteriorly to a level just behind the pharyngeal cavity.

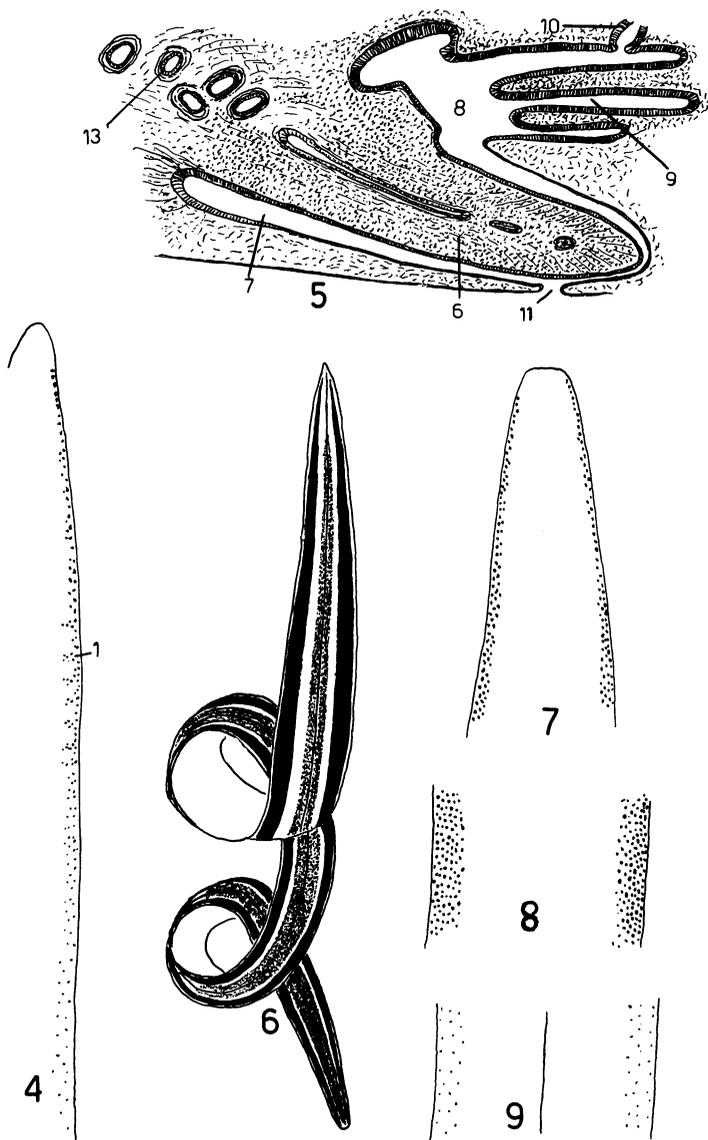
Geoplana mayori Fuhrmann, 1912

Figures 3-5

The single specimen was collected March 12, 1959, by Alan Solem in a forest at El Velo, Finca Lerida, Panama, at an elevation of 5650 feet.

Preserved, the worm is 65 mm. long and up to 8 mm. wide, with the mouth at 45 mm. from the anterior end, gonopore at 53 mm. The color pattern conforms to that of the original description. The dorsal surface is black except for a light middorsal stripe and light margins (fig. 3). According to Fuhrmann the light margin is bordered externally with blue, but this was not evident on my specimen. The three light stripes are stated in the original description to unite at the anterior tip, which is hence of light coloration, but in the present specimen the light stripes fade away on approaching the anterior tip which is dark.

The eye arrangement (fig. 4) differs altogether from that of the original description. The row begins well behind the anterior tip as a single file that soon widens to a band a few eyes wide that ceases well before the pharynx; here and there a wider group extends inward, as shown in the



FIGS. 4, 5. *Geoplana mayori*. 4. Eye arrangement. 5. Sagittal view of the copulatory apparatus, anterior end to left.

FIGS. 6-9. *Geoplana andina*. 6. Dorsal view of entire worm. 7-9. Eye arrangement at successive levels.

figure. Fuhrmann stated that *G. mayori* has the largest number of eyes of any land planarian known to him, although unfortunately he did not figure the eye pattern, and that eyes continue scantily to the posterior end. This discrepancy between the eye number and arrangement in the Colombian worms and the Panamanian specimen may represent a real geographic variation, but I cannot consider it sufficient grounds for erecting a new species.

The copulatory region was removed and sectioned sagittally. The copulatory apparatus, shown in sagittal view in figure 5, agrees reasonably well with that of the original description. The weakly muscular penis, of elongated conical form, extends beyond the gonopore. The convoluted ejaculatory duct, provided with a muscular coat of circular fibers, enters the penis base and, losing its muscular coat, proceeds as a straight tube along the middle of the penis papilla to its tip. The vagina, opening dorsally into the common antrum, is a considerable cavity lined by a high glandular epithelium thrown into more folds than shown in Fuhrmann's figure. The common ovovitelline duct, called vagina by Fuhrmann, enters the vagina dorsoposteriorly. No testes are present in the part sectioned, and sagittal sections are not suitable for verifying the vitelline network described by Fuhrmann. According to the original description the testes, relatively few in number, are located dorsally above the intestinal branches in the prepharyngeal part of the body.

The present specimen certainly bears considerable resemblance to *Geoplana taxiarcha* Ernesto Marcus, 1951, as noted by Marcus in the original description. The color pattern of *G. taxiarcha* is variable, resembling that of *G. mayori* in some specimens, with narrower black and wider yellow stripes in others. In the folded vaginal wall lined by a high glandular epithelium, the present specimen resembles *taxiarcha* more than it does Fuhrmann's figure of *mayori*; but *taxiarcha* differs from the latter in its smaller, more muscular, penis papilla and the non-convoluted ejaculatory duct. The eye arrangement of *taxiarcha* differs much from that of the present specimen. There seems little possibility that the present worm is identical with *taxiarcha*, but its identity with *mayori* is certainly open to some doubt.

***Geoplana andina*, new species**

Figures 6-10

Three specimens of this large handsome worm were presented by Dr. Eugene Kozloff, who had collected them on June 20, 1954, under logs in a forest at 1500 meters in elevation, at Bitace, Departamento del Valle, Colombia.

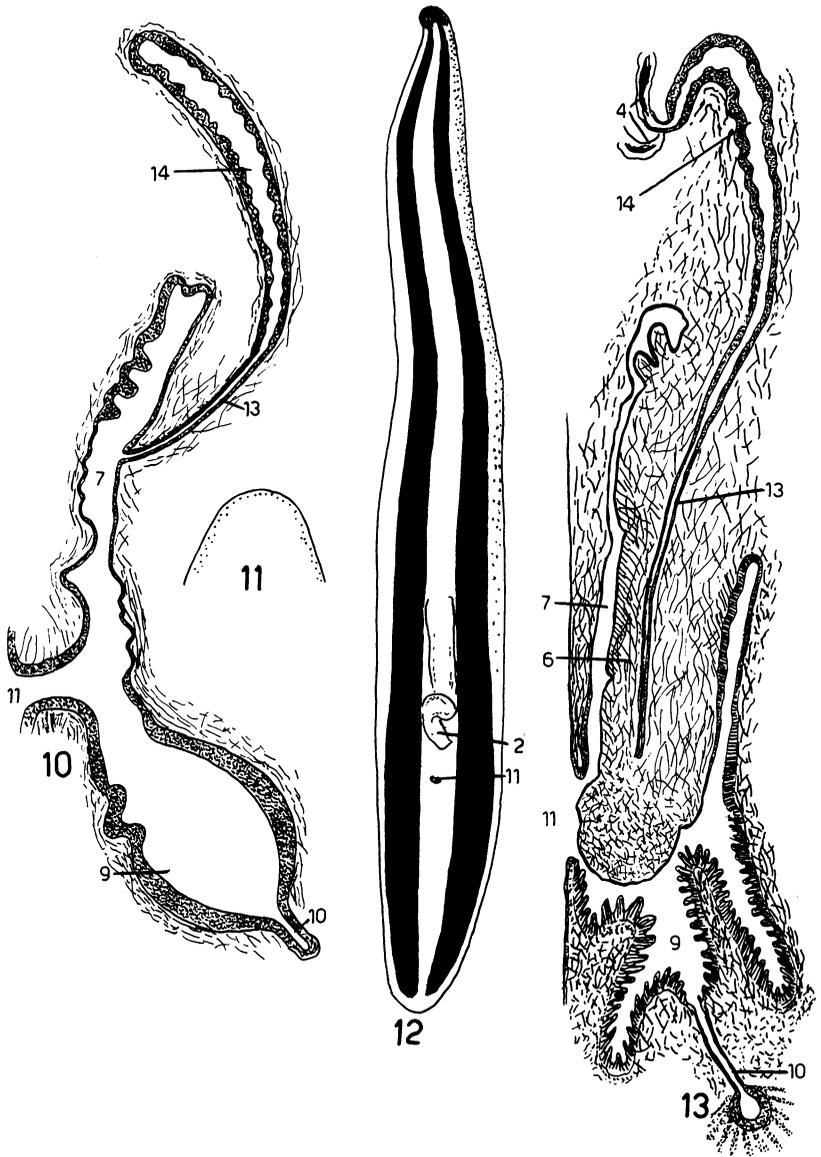


FIG. 10. *Geoplana andina*. Sagittal view of the copulatory apparatus, anterior end above.

FIGS. 11–13. *Geoplana bistriata*. 11. Eye arrangement on anterior tip. 12. Dorsal view of entire worm. 13. Sagittal view of the copulatory apparatus, anterior end above.

Preserved, the worms measure 150, 140, and 120 mm. in length, respectively, and about 11 mm. in width at the widest part. The form is typically geoplanid, broad and very flat in median regions, tapering to a pointed anterior and a less pointed posterior end (fig. 6). In the 150-mm. worm the mouth is located 100 mm. from the anterior end, the gonopore 40 mm. from the posterior end. In one specimen the pharynx is protruded and is seen to be of a complicated ruffled type. The color pattern, identical in the three specimens, of alternating dark and light longitudinal stripes (fig. 6), is of a type common in the genus. There is a middorsal dark but not black stripe containing a median black line; lateral to this stripe on each side occurs a yellowish stripe, followed by a conspicuous black stripe bordered by a yellow margin. The eye arrangement, studied in the smallest specimen, is depicted in figures 7 to 9. The eyes do not cross the anterior tip (fig. 7). Starting out single file, the eyes quickly increase to a band several eyes wide at a distance of 20 mm. from the anterior tip (fig. 8), there occupying the entire width of the black lateral stripe. This condition continues to about 50 mm. from the anterior end, from which level the eyes gradually decrease in number to the pattern shown in figure 9, 90 mm. from the anterior end, then rapidly disappear. No eyes could be discerned in the last 30–40 mm. of the worms. As is often the case, each eye in the black stripe is encircled with a pigmentless halo.

Transverse sections through the prepharyngeal region showed typical histology. The subepidermal musculature consists of an outer circular layer and an inner longitudinal layer, about twice the width of the circular layer ventrally, about the same width dorsally. Diagonal fibers between the circular and longitudinal layers presumably exist but were not clearly discerned; if present, this diagonal layer must be rather narrow. Ventrally the longitudinal fibers are arranged in bundles, as usual in the genus, but dorsally lack definite arrangement. The eosinophilous adhesive marginal glands are conspicuous in the sections.

The copulatory region of the smallest specimen was removed and sectioned sagittally. The peculiarities of the male apparatus led me to suspect immaturity; hence the copulatory apparatus of a larger specimen was removed and sectioned. As the copulatory apparatus agrees in both series, sexual maturity may be assumed. The copulatory apparatus, shown in median sagittal view in figure 10, is not set off from the surrounding mesenchyme. The lining epithelium appears wanting everywhere, no doubt as a result of faulty fixation, and is probably represented by purplish strands in the various lumina (not shown in the figure). The wall shown in the figure is of muscular nature, seemingly

composed of a web of fibers of varied thickness. The sperm ducts, approaching the male apparatus from in front, enter the proximal end of a long sinuous seminal vesicle with a moderately thick muscular wall. The vesicle narrows to a non-muscular duct that curves ventrally and enters the middle of the roof of the male antrum. The male antrum is an elongated cavity without any trace of a penis papilla; it extends blindly some distance anterior to the entrance of the ejaculatory duct and there has a muscular wall. Distal to the entrance of the duct the wall is thin. The female apparatus consists of a large oval vagina with thick muscular wall that is oriented obliquely dorsally and receives the common ovovitellic duct into its proximal end.

No sperm were evident anywhere in the sections of the smaller specimens but were seen in the sperm ducts of the larger one. No testes could be found in transverse sections of a short prepharyngeal piece. Either the testes have a very limited distribution, or the specimen was spent.

Geoplana andina differs from other members of the genus in the peculiarities of the male apparatus.

HOLOTYPE: One whole worm in alcohol deposited in the Department of Living Invertebrates of the American Museum of Natural History; also one set of sagittal sections of the copulatory apparatus.

***Geoplana bistrriata*, new species**

Figures 11–13

Three specimens were sent by Alan Solem, who had collected them March 8 and 12, 1959, one in a forest at 5650 feet at El Velo, Finca Lerida, Panama, and the other two 1 mile below Cerno Punta, Chiriqui, Panama, at 5900 feet.

Preserved, the three worms are 55, 65, and 70 mm. long, respectively, with the mouth at 35, 37, and 42 mm. from the anterior end, and the gonopore 45, 48, and 50 mm. from the anterior end. They are about 9 mm. wide through the mouth region. The color pattern consists of two conspicuous, black, lateral, longitudinal stripes on a light brown or yellowish ground (fig. 11). The stripes continue to the ends. The black stripes meet at the anterior end, making a blackish head, but are separate at the posterior end, not, however, reaching the tip which is yellow. The band of eyes encircles the anterior tip, single file (fig. 12), but soon widens to occupy the width of the yellowish marginal stripe (fig. 11), and dies away at the level of the middle of the pharynx. The pharynx is of the simple tubular type (fig. 11).

Transverse sections of the prepharyngeal region show that the worm

is much flattened dorsoventrally. Dorsal and ventral surfaces are virtually straight and parallel. Because of poor fixation, histological details cannot be reported. The epidermis is wanting over considerable areas, and the subepidermal muscle layers are disorganized. Eosinophilous marginal glands appear to be wanting. A single, somewhat large testis, dorsally located, is present on each side of each transverse section. Evidently the testes are limited to the prepharyngeal region.

The appropriate postpharyngeal region was removed from one worm and sectioned sagittally. A sagittal view of the copulatory apparatus, constructed from these sections, is shown in figure 13. The sperm ducts enter separately the proximal end of a long, sinuous, seminal vesicle with a moderately thick muscular wall. The vesicle takes a short forward course, then curves posteriorly, and with diminishing thickness of wall continues as a straight ejaculatory duct along the length of the penis papilla, in which it is located somewhat ventrally. The long penis papilla nearly fills the male antrum. Its interior consists of a web of muscle fibers, not definitely arranged in layers. Its distal end occupies the widely open gonopore. The vagina has greatly folded walls clothed with a tall glandular epithelium thrown into waves and not underlain by definite muscle layers. The common ovovitelline duct, accompanied by the usual long strands of eosinophilous glands, narrows as it approaches the vagina into which it opens at about its middle.

In shape, size, and color pattern, this species appears identical with *Geoplana gabriellae* Eveline Marcus, 1951, from Peru, but the considerable differences in the copulatory apparatuses establish the two species as distinct. This is another example of the impossibility of identifying land planarians on the basis of color pattern alone. It is more difficult to decide about *Geoplana bilineata* Fuhrmann, 1912, Colombia, because of the inadequate nature of the original description; but this appears to be a smaller species, sexually mature at 26 mm. It is also slender, with sides parallel for most of their length, and the dark stripes do not meet anteriorly. The eye arrangement also differs from that of the present species, in that the eyes enter the black bands and continue to the posterior end. On these grounds I consider the present species distinct from *G. bilineata*.

HOLOTYPE: One worm in alcohol, deposited in the Chicago Natural History Museum.

***Geoplana quinquestriata*, new species**

Figure 14

The single specimen was collected January 26, 1959, by Alan Solem

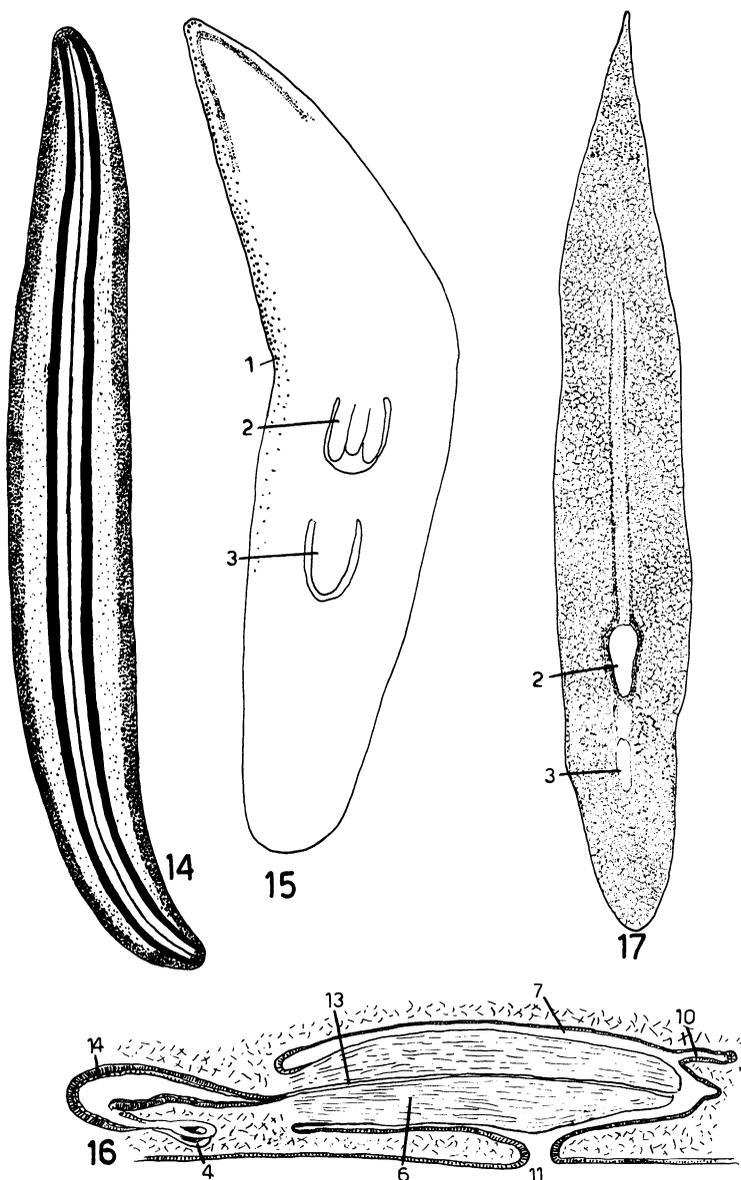


FIG. 14. *Geoplana quinquestriata*, dorsal view of entire worm.

FIGS. 15, 16. *Geoplana fusca*. 15. Dorsal view of entire worm. 16. Sagittal view of the copulatory apparatus, anterior end to left.

FIG. 17. *Geoplana fuhrmanni*, dorsal view of entire worm.

on Barro Colorado Island in the Canal Zone.

The preserved worm is 55 mm. long and about 5 mm. wide at the widest part. It is typically geoplanid in shape, broad and flat at the middle, tapering to rounded ends. The color pattern consists of five dark stripes on a lighter ground (fig. 14). There is a median black line, bordered on each side by the lighter, yellowish ground color. This is followed by a black stripe on each side, bordered laterally by lighter ground color, about twice the width of the black stripes. There follows a dark but not black, rather gray, marginal band. The lateral stripes do not fuse at their ends. The two ends are dark, being encircled by the marginal bands.

The eyes occur in a single file around the anterior end and continue as an irregular single file for several millimeters along the sides of the anterior end. They then enter the dark marginal band and become undetectable but seem to continue as a rather narrow band that ceases before the level of the pharynx.

The mouth is located at about 30 mm. from the anterior end; the pharynx is of simple tubular form.

Despite its considerable size, the worm appeared to be in an asexual state when examined in a cleared state. Nevertheless the postpharyngeal region was removed and sectioned sagittally. The sections showed a complete absence of sexual development; hence it is impossible to complete the description. Transverse sections are nearly straight ventrally, slightly convex dorsally. Dorsally the epidermis is about twice as thick as ventrally and heavily packed with rhabdites, the formative cells of which, staining almost black, form the usual zone in the dorsal mesenchyme internal to the subepidermal musculature. The latter is not well preserved but shows the usual outer circular and inner longitudinal layers. The arrangement of the latter into bundles is evident despite poor preservation. Marginal adhesive glands are not discernible.

Of several five-striated geoplanas in the literature, the present specimen most nearly resembles in external features *G. marginata* F. Müller, 1856, excellently redescribed with a colored figure of the color pattern by Ernesto Marcus (1951), also by Riester (1938). As often in striped geoplanas, the striped pattern of *G. marginata* is subject to some variation, but commonly the marginal stripes are darker than the others and of about the same width as the lateral stripes, thus leaving a broad marginal band of ground color in which the eyes are readily visible; whereas in the present species the broad and less dark marginal band extends nearly to the margin.

HOLOTYPE: Whole mount, minus pieces removed for sectioning, de-

posited in the Chicago Natural History Museum.

Geoplana fusca, new species

Figures 15–16

The single specimen was collected by Alan Solem, March 8, 1959, at 5500 feet in elevation, 2 miles below Cerro Punta, Chiriqui, Panama.

Preserved, the worm measures 20 mm. in length and 3.5 mm. in width across the widest part. It is broad and flat, tapering but slightly to the broadly rounded posterior end, more abruptly to the narrowed anterior end (fig. 15). The color is a uniform grayish brown, with a slightly darker short marginal band at the anterior end, noticed only after clearing. The eyes, shown on one side in figure 15, occur single file around the anterior end, but soon the band of eyes widens to about two eyes deep and from this band eyes frequently extend medially. At about the level of the pharynx the eyes diminish in number and frequency and cease altogether at about the level of the gonopore. The pharynx, beginning at about 9 mm. from the anterior tip, is of complicated folded form. The gonopore is located at 12 mm. from the anterior tip.

Transverse sections through the prepharyngeal region show that the worm is much flattened dorsoventrally. Dorsal and ventral surfaces are nearly straight and parallel. The epidermis and the subepidermal longitudinal muscle bundles are about equally thick dorsally and ventrally. Rhabdites are concentrated in the lateral dorsal and marginal epidermis, being so thick here as to appear as a dark band. The ventral epidermis is thickly penetrated by slime glands, long sinuous bodies staining black with haematoxylin. Marginal adhesive glands were not in evidence.

The body region containing the copulatory apparatus was removed and sectioned sagittally. A sagittal view of the apparatus is given in figure 16. The rather large testes are dorsally situated above and between the intestinal branches; one or two are present on each side in transverse sections. They form a lateral band on each side, extending posteriorly to the level of the penis. They contain but few sperm, being mostly in stages of spermatogenesis, an indication that the specimen may not be fully mature. The sperm ducts are separate to their entrance into the proximal end of the seminal vesicle. The latter is a tubular body with a layer of circular muscles subtending the lining of cuboidal epithelium. The seminal vesicle turns posteriorly and gradually diminishes in diameter as it enters the base of the penis papilla, where it becomes a narrow ejaculatory duct passing along the center of the penis papilla to the distal end of the latter. The penis papilla is an elongated body of weak muscu-

larity except for a layer of circular muscles just beneath the covering cuboidal epithelium. The female system is reduced to the lowest possible state, consisting of a short tube extending back from the dorsoposterior region of the antrum and receiving the ovovitelline duct. It is impossible to say whether this slightly developed female system represents a state of sexual immaturity or not, but the presence of sperm in the sperm ducts (fig. 16) is indicative of maturity.

As a copulatory apparatus of this type is common in South American geoplanas, specific diagnosis of *G. fusca* must rest on the combination of the details of this apparatus with color and eye arrangement.

HOLOTYPE: Whole mount of worm minus pieces removed for sectioning, plus serial sagittal sections of the copulatory region (three slides) plus one slide of transverse sections of the prepharyngeal region, deposited in the Chicago Natural History Museum.

***Geoplana fuhrmanni*, new species**

Figures 17–18

Geoplana cameliae, HYMAN, 1941.

Geoplana cameliae, HYMAN, 1957.

Two specimens were presented by Alan Solem: one collected January 23, 1959, on Barro Colorado Island in the Canal Zone, the other, smaller worm March 10, 1959, below El Volcan, Chiriqui, Panama, at 2750 feet in elevation, in a coffee grove.

The larger specimen, made the basis of the present study, was 45 mm. long by 6 mm. wide through the widest part. The smaller worm was 35 mm. long by 4–5 mm. wide. The form is typically geoplanid (fig. 17), tapering anteriorly to a rather pointed end, posteriorly to a rounded one. The pointed anterior end appears characteristic of the species. The color, illustrated in Hyman (1941, figs. 8, 9), is medium brown, mottled and spotted with darker brown to black markings. A middorsal light band, extending from the copulatory region forward and dying away some distance from the anterior tip, is generally present. It was seen in the larger specimen after clearing (fig. 17) but was wanting in the smaller worm. The eye arrangement was previously depicted (Hyman, 1941, figs. 7, 8; 1957, fig. 7). The band of eyes begins single file around the anterior tip, gradually widens, reaching a maximum width well anterior to the pharynx, and then gradually diminishes in width and numbers to the posterior end. As usual the eyes occupy the light areas between the

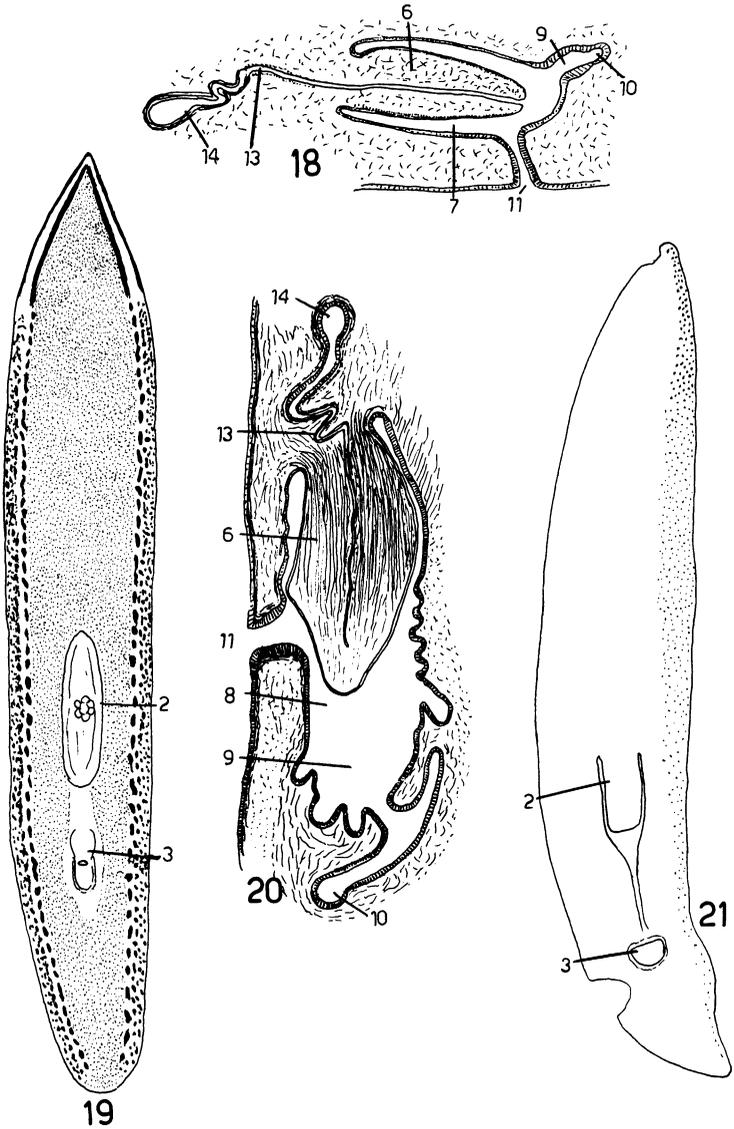


FIG. 18. *Geoplana fuhrmanni*, sagittal view of the copulatory apparatus, anterior end to left.

FIGS. 19, 20. *Geoplana chiriquii*. 19. Dorsal view of entire worm. 20. Sagittal view of the copulatory apparatus, anterior end above.

FIG. 21. *Geoplana alterfusca*, dorsal view of entire worm.

darker markings (Hyman, 1941, fig. 8). The pharynx, previously depicted as of simple cylindrical shape, was seen to be distally folded in the larger present worm; it could not be clearly made out in the smaller specimen. In the former its root occurs at 32 mm. from the anterior end. The gonopore is situated 40 and 27 mm. from the anterior end in the two worms.

Transverse sections through the prepharyngeal region of the larger worm are flat below, convex above. The dorsal epidermis is thickly beset with rhabdites, a condition that continues around the margins. Marginal adhesive glands are not in evidence. The subepidermal longitudinal muscle bundles are about equally thick dorsally and ventrally. One or two small testes occur on each side, dorsally located. They are mostly in the spermatogonial stage, but sperm are seen in some of them.

The copulatory region of the larger worm was removed and sectioned sagittally. A sagittal view of the apparatus is given in figure 18. The apparatus is seen to be of the same simple type shown in figures 5 and 16. The sperm ducts enter the proximal end of the seminal vesicle, an oval body provided with a layer of circular muscles, and continuous distally with a convoluted ejaculatory duct that at first is also provided with circular muscles. The convolutions and muscle layer soon disappear, and the duct then enters the base of the weakly muscular penis papilla in which it pursues a straight course to the tip. The penis papilla is of elongated conical form without definite musculature except for a thin stratum of circular fibers just beneath the covering epithelium. The male antrum is lined with a low cuboidal epithelium, which increases posteriorly to a columnar form lining the common antrum and the duct leading to the gonopore. The female part of the apparatus is of the simplest possible type, consisting of a short, funnel-like tube lined with a columnar epithelium and receiving the common ovovitelline duct into its proximal end.

This is the species formerly identified (Hyman, 1941, 1957) as *Geoplana cameliae* Fuhrmann, 1912. Differences from Fuhrmann's description were ascribed to sexual immaturity. But the larger of the present specimens must be regarded as almost mature. Its copulatory apparatus does not differ essentially from that of a specimen previously regarded as immature (Hyman, 1957, fig. 6). The present specimens and those I previously ascribed to *G. cameliae* differ from the original description in the more posterior position of the pharynx and copulatory apparatus, the more complex pharynx, the continuation of the band of eyes to the posterior end, the location of the seminal vesicle somewhat anterior to the penis base, the lack of prostatic glands entering the seminal vesicle, and the absence of little glandular papillae on the penis. On these grounds I

consider the present and previous specimens as distinct from *G. cameliae* and name them *G. fuhrmanni*.

HOLOTYPE: Larger worm mounted entire minus portions removed for sectioning, plus sagittal series (three slides) plus one slide of transverse sections through the prepharyngeal region, deposited in the Chicago Natural History Museum.

***Geoplana chiriquii*, new species**

Figures 19–20

The single specimen was collected by Alan Solem March 10, 1959, below El Volcan, Chiriqui, Panama, at 2750 feet in elevation, in a coffee grove.

Preserved, the worm measures 40 mm. in length and 6 mm. in width through the widest part. It is broad and flat, with sides nearly parallel for much of the length, then narrowing rather abruptly to the pointed anterior end, more gradually to the rounded posterior end (fig. 19). The color pattern consists of lateral black markings on a grayish brown ground. At the anterior end a pair of narrow black lateral stripes accompanied by a narrow black margin extend for about 6 mm. from the anterior tip. This pattern is continued to the posterior end by a marginal zone composed of black dashes and dots (fig. 19). The eye arrangement is similar to that of *G. fuhrmanni* (Hyman, 1957, fig. 5). The row begins one to two eyes wide at the anterior tip and extends at this width to about the end of the black margin, then rapidly increases in number and width to occupy the entire width of the marginal markings as far as the root of the pharynx, behind which the eyes gradually decrease in number to the posterior end, becoming very scanty. As usual the eyes occupy the light areas between the black markings. The mouth is located 22 mm. from the anterior tip, the gonopore 8 mm. behind the mouth. The pharynx, slightly protruded from the mouth, shows lobulations indicative of a ruffled shape.

Transverse sections were made of a short prepharyngeal region. These are broad and flat, slightly convex above. The dorsal epidermis, packed solid with rhabdites as usual, is slightly thicker than the ventral epidermis which appears devoid of rhabdites and shows columnar epidermal cells. The subepidermal longitudinal muscle layer is rather narrow and about equally wide dorsally and ventrally. The sections show on one or both sides one or two large oval testes situated directly above the digestive diverticula.

The copulatory region was removed and sectioned sagittally. A median sagittal view of the copulatory apparatus is given in figure 20. It is strikingly similar to that of the worm here called *G. mayori* (fig. 5). The sperm ducts enter a tubular seminal vesicle, lined by a cuboidal epithelium subtended by a mostly circular muscle layer. From the seminal vesicle the sinuous ejaculatory duct proceeds into the base of the penis papilla, gradually decreasing in diameter and losing its muscular coat. The rather large penis papilla, clothed with a cuboidal epithelium, lacks definite muscular coats but is permeated with muscle fibers running mostly in a longitudinal direction. The large vagina, lined with a columnar epithelium, has greatly folded walls, especially laterally, hence not appearing in a median section. The common ovovitelline duct enters the vagina posteriorly. The common antrum leading to the gonopore is lined with an especially tall epithelium.

In view of the similarity of the copulatory apparatuses, distinction of *G. chiriquii* from *G. mayori* must rest upon differences of color pattern and eye arrangement.

HOLOTYPE: Whole mount of worm minus pieces removed for sectioning plus serial sagittal sections of the copulatory apparatus (seven slides) deposited in the Chicago Natural History Museum.

***Geoplana alterfusca*, new species**

Figures 21-22

The single specimen was collected by Alan Solem February 24, 1959, in a log in woods behind the Club Campestre, El Valle, Cocle, Panama.

The preserved worm is 33 mm. long and 5 mm. wide through the widest part. The form is broadly elongated and flat, widest at the middle, tapering to blunt ends. The anterior tip and the posterior end have suffered some damage. The pharynx, of simple cylindrical form, begins 21 mm. behind the anterior end, and the copulatory apparatus is located at 25 mm. (fig. 21). The color is a uniform grayish brown. The eye arrangement is depicted in figure 21; the band of eyes increases in number of eyes and width to a level well before the pharynx, then gradually declines to the posterior end.

The copulatory region was removed and sectioned sagittally. Transverse sections were not prepared. In the sagittal series, the dorsal epidermis is packed with rhabdites as usual, whereas these bodies are scanty in the ventral epidermis. The longitudinal muscle layer beneath the epidermis appears of about equal width dorsally and ventrally, or possibly

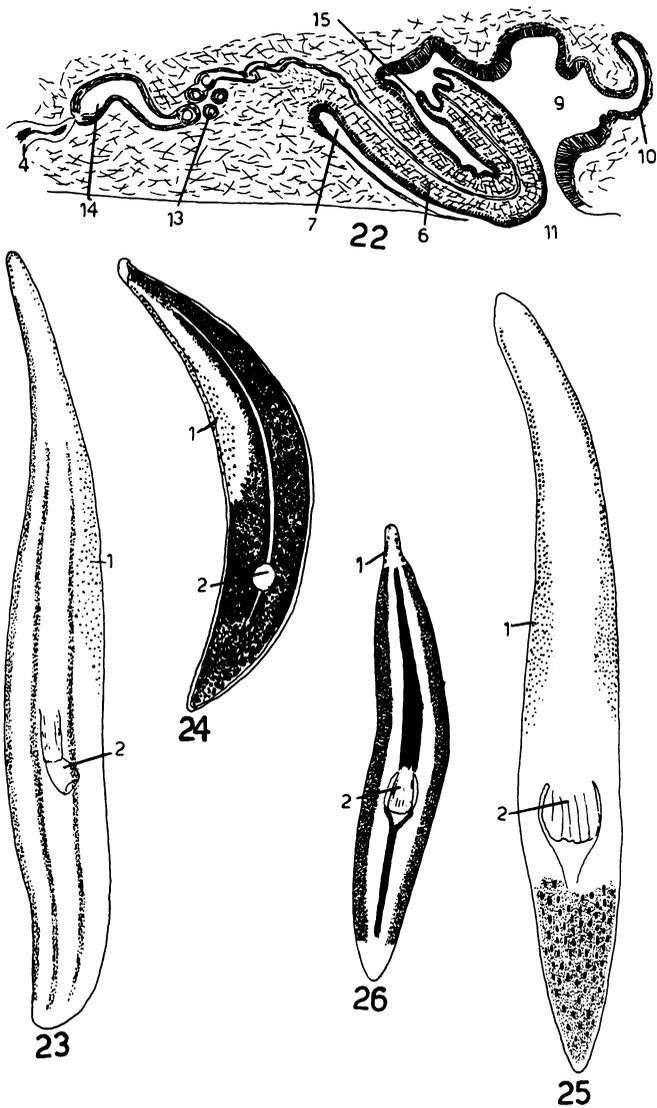


FIG. 22. *Geoplana alterfusca*, sagittal view of the copulatory apparatus, anterior end to left.

FIGS. 23-26. Unidentifiable geoplanas. 23. *Geoplana* A. 24. *Geoplana* B. 25. *Geoplana* C. 26. *Geoplana* D.

thicker dorsally but this is uncertain because of the considerable damage to the ventral body wall. No testes are present in the region sectioned, hence as in related species they are presumably limited to the prepharyngeal region.

A sagittal view of the copulatory apparatus is given in figure 22. The sperm ducts enter separately the proximal end of the sinuous seminal vesicle which is provided with a coat of circular muscle fibers. The vesicle narrows posteriorly, becoming an ejaculatory duct, which after a number of convolutions proceeds more or less directly into the base of the penis papilla. Along its course the ejaculatory duct is provided with a muscular coat which thins as the duct nears the penis papilla. The latter is of elongate, cylindroid form and has the peculiarity of terminating in a small papilla surrounded by a sheath. The rather weak musculature of the penis papilla consists of a thin layer of circular fibers beneath the covering epidermis and a loose web of fibers in the interior. The penis papilla lies in a considerable space lined dorsally and posteriorly by a tall, heavily staining epithelium, probably of a glandular nature, underlain by a thin musculature. The posterior part of this space constitutes the vagina, entered posteriorly and from above by the common ovovitelline duct.

The copulatory apparatus of this species is not very distinctive except for the small papilla and its sheath at the distal end of the penis. Report of a similar condition was found only for *Geoplana rezendei* Schirch, 1929, redescribed with figures of the copulatory apparatus by Riester (1938) and Ernesto Marcus (1951). But *G. rezendei* is a striped worm with scarcely any female antrum and is clearly different from the present species.

HOLOTYPE: Whole mount of the worm minus piece removed for sectioning plus serial sagittal sections of the copulatory apparatus (six slides) deposited in the Chicago Natural History Museum.

UNIDENTIFIABLE GEOPLANIDAE

Figures 23–26

Three specimens, collected in March, 1958, near Simla in the hills of Trinidad, and kindly presented by Dr. Anne Alexander, were found to be juveniles and hence cannot be given a proper taxonomic description. They are designated as *Geoplana* A, B, and C. A fourth juvenile specimen, collected by Alan Solem March 21, 1959, at Almirante, Bocas del Toro, Panama, is designated *Geoplana* D.

GEOPLANA A (FIG. 23): The preserved specimen is 20 mm. long, of typical geoplanid shape. It has four narrow, dark, longitudinal stripes,

lateral and marginal on a yellow ground. The marginal stripes run the body length, except for the tips; the lateral stripes begin some distance behind the anterior tip. The eye pattern is shown on the right side of figure 23. The anterior end is bordered by a single file of eyes. The band of eyes then widens, soon occupying the entire width between the lateral and marginal stripes, then abruptly ceases well anterior to the level of the pharynx. The pharynx is of simple cylindrical form. Although no evidence of sexual maturity could be discerned in the cleared worm, the postpharyngeal region was removed and sectioned; it was found devoid of any part of the reproductive system. The prepharyngeal part, mounted whole, is deposited in the Department of Living Invertebrates, the American Museum of Natural History.

GEOPLANA B (FIG. 24): The preserved worm, 13 mm. long and 1.5 mm. wide at the widest part, appeared of dirty black coloration. Closer examination showed a narrow, light, middorsal line and narrow light margins. The middorsal line stops well short of the body tips and is widened around the pharynx, which was discernible only as a circular light area. The wide black bands were found on magnification not to be uniformly black but to consist of spots and granules. The eye pattern is shown on the left side in figure 24. It is similar to that of the preceding species. Damage to the anterior tip prevented my determining the eye arrangement here. The worm mounted whole is deposited as for *Geoplana* A.

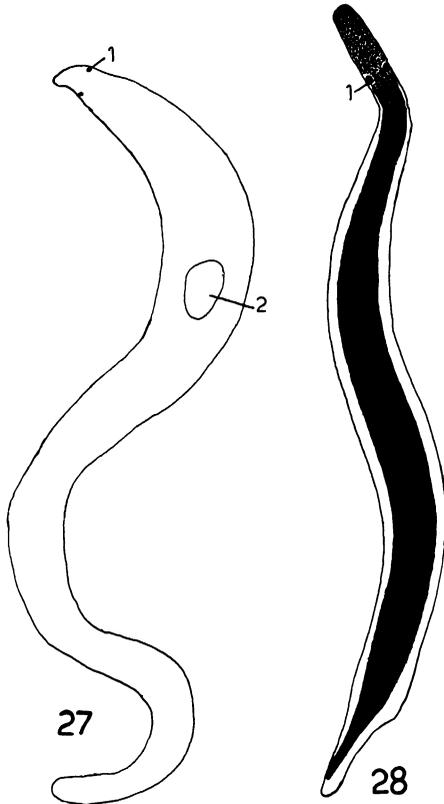
GEOPLANA C (FIG. 25): The preserved worm, 22 mm. long and 2.5 mm. wide through the pharyngeal region, is of typical geoplanid shape. The coloration, shown posteriorly in figure 25, consists of dark brown ovals on a lighter ground; curiously the long axis of the ovals parallels the anteroposterior body axis. The eye pattern, shown in the figure, is similar to that of species A and B except that the anterior tip is quite free from eyes. The pharynx, well seen in the cleared specimen, is longitudinally plaited. The worm mounted whole is deposited as for species A and B.

GEOPLANA D (FIG. 26): The small specimen, 6 mm. long, has three dark longitudinal stripes on an orange-brown ground. All three stripes stop short of the body ends. The median stripe, blacker than the others, ceases over the pharynx but begins again in narrower form behind this organ. The marginal stripes, scarcely black, are of uniform width throughout their course and extend quite to the margins. The eyes are arranged in single file around the anterior end and seem to cease at a level about halfway between the anterior tip and the pharynx but were difficult to follow because of the dark color of the marginal bands in which they are embedded. The pharynx is of simple cylindrical shape. The worm, mounted whole, is deposited as for the preceding species.

FAMILY RHYNCHODEMIDAE

Rhynchodemus angustus (Hyman, 1941)

This is evidently the most common land planarian in Panama and the Canal Zone. The Solem material contains 14 specimens, collected in Panama in March, 1959, from six different localities, at elevations ranging from 5500 to 7100 feet. The localities are: El Velo, Finca Lerida, two worms; 1 mile below Cerro Punta, Chiriqui, two worms; 2 miles below Cerro Punta, one worm; 1 mile above Cerro Punta, three worms; 2 miles above Cerro Punta, three worms; Casida Alta, Finca Lerida, Chiriqui, Panama, three worms. The specimens have been returned to the Chicago Natural History Museum.



FIGS. 27, 28. Unidentifiable rhynchodemids. 27. Rhynchodemid A. 28. Rhynchodemid B.

UNIDENTIFIABLE RHYNCHODEMIDAE

Figures 27-28

The material collected in Panama by Solem contains two immature rhyngodemids, considered unidentifiable. As even the genera of the Rhyngodemidae cannot be determined without the aid of sections, these are referred to as rhyngodemid A and B. The specimens in alcohol have been returned to the Chicago Natural History Museum.

RHYNCHODEMID A (FIG. 27): Because of coiling, the length could not be determined exactly but is estimated at about 30 mm. The pair of eyes marks the posterior limit of the short, pointed, anterior tip, behind which the body widens to about the level of the pharynx, then gradually narrows to the rounded posterior tip. The far anterior position of the pharynx, located at about one-fourth of the body length from the anterior end, is notable. The color is a uniform dull yellow. The worm was collected March 18, 1959, on a trail below Casita Alta, Finca Lerida, Boquete, Chiriqui, Panama, under a log.

RHYNCHODEMID B (FIG. 28): The worm is 25 mm. long, slender, with a considerable length of head anterior to the pair of large eyes. The shape of the posterior end suggests regeneration of a lost tail. The dorsal surface is black, with a wide yellow margin on each side, fading away at the level of the eyes, leaving the head uniformly dark. The ventral surface is of a dull brownish hue, except for the white creeping sole occupying its middle third. The pharynx, not shown in the figure, is located about 15 mm. from the anterior end. The large eyes and elongated head suggest the genus *Rhyngodemus*.

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