

FRESHWATER PLANARIANS FROM COLOMBIA A REVISION OF FUHRMANN'S TYPES

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ABSTRACT

The type material of Colombian species of freshwater triclads (Fuhrmann, 1914) is revised and the original descriptions corrected and amplified. *Planaria polyorchis* is conspecific with *Dugesia festai* (Borelli). *Planaria longistriata* is a typical *Girardia* species of the *Dugesia* (*Girardia*) *tigrina* group, a group widespread in North and South America. *Planaria paramensis* and *P. cameliae* belong to a group of *Dugesia* species characterized particularly by their dorsal testes, and exemplified by a number of species in and around the Caribbean region.

INTRODUCTION

Revisionary work on aquatic planarians often is hampered by the inadequacies, according to modern criteria, of early species accounts and by the general unavailability of type material. It is important, therefore, when types are rediscovered, that they be reassessed and their status and location documented. In the present paper I report on the type material of freshwater planarians described from Colombia, South America, by Fuhrmann (1914), which types are now housed in the collections of the British Museum (Natural History). Our total knowledge concerning the Colombian paludicolan fauna is derived only from Fuhrmann's publication and in view of the resurgence of interest in the Dugesidae of northern Neotropica (Ball, 1971; Mitchell & Kawakatsu, 1972; Codreanu & Balcesco, 1973; Gourbault, 1979, in press) it is unfortunate that Fuhrmann's actual specimens should have remained unknown and unstudied for so long.

Accepting the principle that our task is not to name species but to know them I am presenting here corrections and amplifications to Fuhrmann's descriptions of the Colombian species so as to facilitate further monographic work on the Dugesidae. The original accounts lack histological information and the copulatory organs, so impor-

tant in planarian taxonomy, are occasionally misinterpreted because the particular specimen is curved, or for some other reason the sections are not true. In other respects Fuhrmann's descriptions, originally in French, are generally reliable and are repeated here only in summary.

SPECIES ACCOUNTS

Dugesia* (*Girardia*) *longistriata (Fuhrmann, 1914) (Figs. 1, 2)

Planaria longistriata Fuhrmann, 1914: 796.

Euplanaria longistriata: Kenk, 1930: 292.

Dugesia longistriata: Kenk, 1941: 7.

Type material. — British Museum (Natural History), 1928.1.5.16-18 and 1928.1.5.81-86, alcohol specimens (paratypes). BMNH 1928.1.4.245-257, slides as follows: 245-250 wholemounts; 251 oblique sagittal sections; 252-253 sagittal sections, copulatory apparatus not in the series; 254 sagittal sections (cf. Fuhrmann, 1914, fig. 4); 255-257 frontal sections (cf. Fuhrmann, 1914, fig. 5). All the available slides have been re-examined but the new description and figures are based primarily upon the wholemount 245, sagittal series 254, and frontal series 255-257. Slide 254 is difficult to interpret because it has at some time been damaged and repaired.

Redescription. — The external features are as described by Fuhrmann (1914: 796) and specimen 245 has been redrawn here as fig. 1. Living specimens are up to 18 mm long, very agile, and of a light ochre colour with many dark brown stripes. The ventral surface is pale and lacks stripes. The pharynx is pigmented, as in other New World Dugesidae, the pigment lying immediately beneath the outer musculature of the pharynx.

The testes are numerous, small, and occur in clusters ventrally situated throughout the body-length. There are three or four testicular follicles anterior to the ovaries, which latter occur ventrally

between the third and fourth intestinal diverticula. The vitellaria are found throughout the body, principally dorsally situated, and there are numerous pre-ovarial follicles. The oviducts arise from the outer lateral wall of each ovary, extending forwards a little way so that there is a sperm-filled tuba anterior to the ovary (Fuhrmann, 1914, fig. 6).

The penis consists of a stout muscular bulb and a short conical papilla extending into the male atrium. The vasa deferentia are said by Fuhrmann to extend to the gonopore, from where they recurve to the penis bulb. In fact the recurvature can be much less (fig. 2). There is no intrabulbar vesicle and the narrow ejaculatory duct, which opens at the tip of the papilla, is more ventrally than centrally located. The male atrium and the penis papilla are invested with a nucleate epithelium whereas that of the ejaculatory duct is infra-nucleate.

The bursa copulatrix is a sacciform organ lying anterior to the penis and the bursal canal curves over the atrium, bending sharply downwards to open into its roof as a wide sinuous duct above the gonopore. At the point where the bursal canal curves downwards, the two oviducts open into it separately from behind, and beneath these are numerous and extensive shell glands (fig. 2). The bursal canal is lined with a ciliated and nucleate epithelium overlain by thin layers of subepithelial circular muscles and outer longitudinal muscle fibres. The longitudinal muscles of the bursal canal may also extend part way over the bursa itself. The vaginal region of the bursal canal, between oviducts and atrium, and also the posterior wall of the atrium and walls of the gonopore, are characterized by a significant thickening of the inner circular muscle layer.

Remarks. — In my revision of the Dugesiidae (Ball, 1974) I made no assignment of *Planaria longistriata*. However, it clearly falls within the subgenus *Girardia* as therein defined. *Dugesia longistriata* may be distinguished from all other members of the *D. tigrina* group (see below) by its colour pattern, and by its short conical penis lacking a developed seminal vesicle.

Distribution. — This species was found in two quite distinct localities: (1) Laguna Ubaque, east slopes of the Cordillera Oriental (2112 m) at Paramo Cruz Verde (04°34'N 74°02'W) southeast of Bogotá. (2) Shores of Laguna Pedropalo (2000 m), east side of Sabana de Bogotá (04°43'N 74°10'W) northwest of Bogotá.

Dugesia (Girardia) paramensis (Fuhrmann, 1914) (Figs. 3, 4)

Planaria paramensis Fuhrmann, 1914: 798.

Euplanaria paramensis: Kenk, 1930: 292.

Dugesia paramensis: Kenk, 1941: 7.

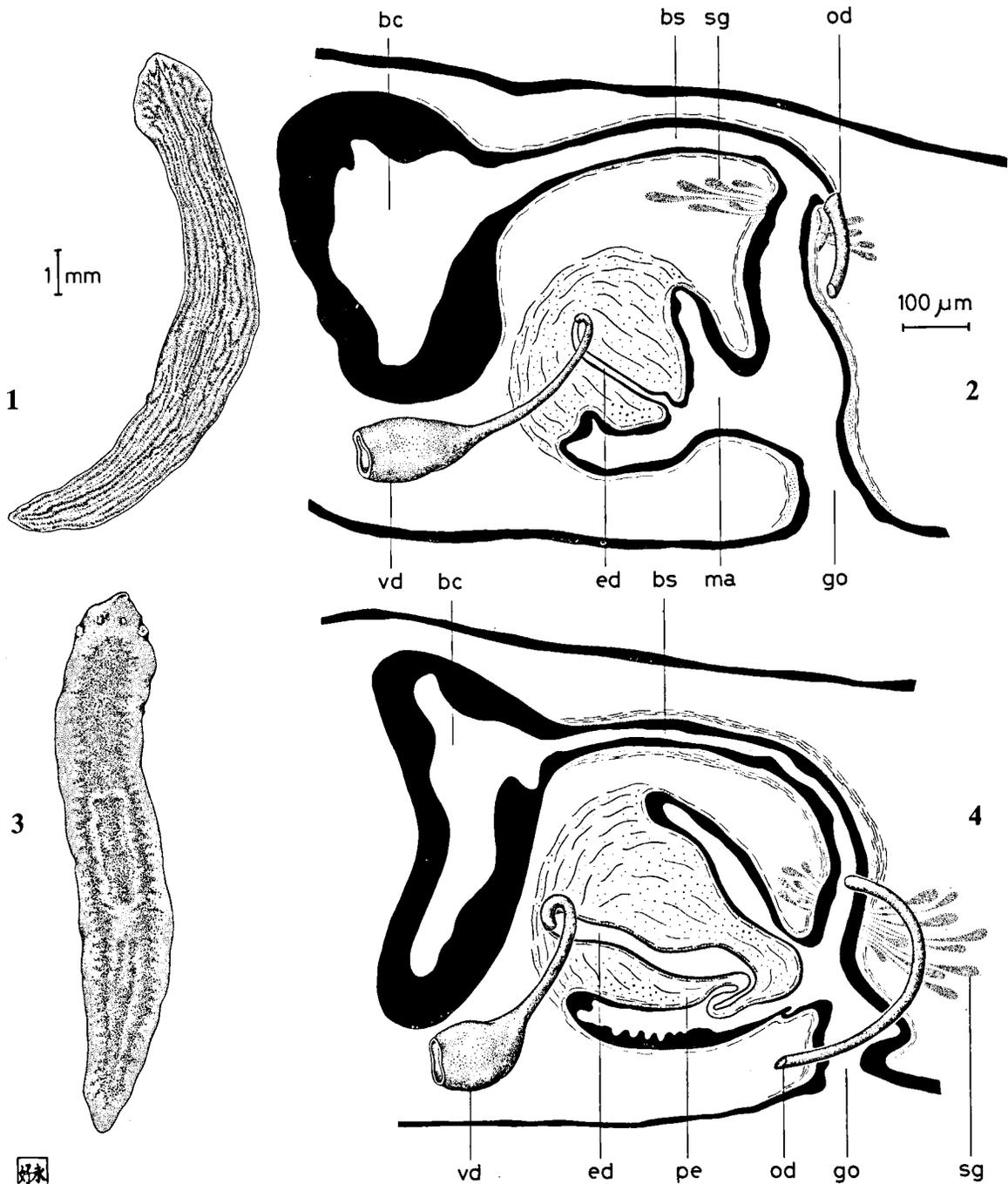
Dugesia (Girardia) paramensis: Ball, 1974: 377.

Type material. — British Museum (Natural History), 1928.1.5.87-88, alcohol specimens. BMNH 1928.1.4.258-270, slides as follows: 258-260 wholemounts; 261-264 sagittal sections (cf. Fuhrmann, 1914, fig. 9); 265-268 frontal sections (cf. Fuhrmann, 1914, fig. 10); 269-270 frontal sections. All the available slides have been re-examined but the redescription and new figures are based primarily upon the two series 261-264 and 265-268.

Redescription. — The external features are as described by Fuhrmann (1914: 798) and specimen 258, which shows a supernumerary eye, has been redrawn here as fig. 3. Living specimens are up to 20 × 2 mm, jet-black dorsally and dark grey ventrally. The pharynx is pigmented.

The testes are large, discrete, and numerous follicles dorsally situated throughout the body-length. The first of the testes are immediately adjacent (lateral) to the ovaries, or may be anterior to them. The vitellaria occur throughout the body but are more extensive in the ventral half, and there are some pre-ovarial follicles. The oviducts show no special peculiarities and enter the bursal canal separately above the shell glands, in the usual way.

The copulatory complex is shown in fig. 4, and this may be compared with the fig. 9 of Fuhrmann which is a drawing of the same specimen. The penis consists of a stout muscular bulb and an elongate conical papilla. The vasa deferentia extend along the sides of the pharynx and open into the penis bulb with varying degrees of recurvature (fig. 4; Fuhrmann, 1914, fig. 10), to form a bifid seminal vesicle. The wide ejaculatory duct opens almost at the tip of the penis; Fuhrmann (1914, fig. 9) believed that it opened subterminally but he failed to notice the recurva-



Figs. 1-4. Colombian freshwater triclads of Fuhrmann, 1914, redrawn from the type material. 1, *Dugesia longistriata*, BMNH 1928.1.4.245, external features drawn from a wholmount; 2, *D. longistriata*, BMNH 1928.1.4.254, sagittal section of the copulatory apparatus viewed from the left side; 3, *D. paramensis*, BMNH 1928.1.4.258, external features drawn from a wholmount (same scale as fig. 1); 4, *D. paramensis*, BMNH 1928.1.4.262, sagittal section of the copulatory apparatus viewed from the left side (same scale as fig. 2).
 Abbreviations: bc = bursa copulatrix; bs = bursal canal; ed = ejaculatory duct; go = gonopore; ma = male atrium; od = oviduct; pe = penis; sg = shell glands; vd = vas deferens.

ture of the tip of the papilla in his specimen (cf. fig. 4). The male atrium is lined with a tall nucleate epithelium, the penis papilla with a flat epithelium that is partially or completely infranucleate; the ejaculatory duct is infranucleate.

The bursa copulatrix lies anterior to the penis and from it the bursal canal curves smoothly over the atrium into which it opens above the gonopore. The bursal canal is lined with a ciliated infranucleate cuboidal epithelium overlain by thick layers of inner circular and outer longitudinal muscle fibres. There is some slight intermingling between these two muscle layers.

Remarks. — In some specimens of this species there are two pharynges, one in front of the other, which Fuhrmann takes to indicate a special form of asexual reproduction. This is discussed fully in his paper (Fuhrmann, 1914: 801). *Dugesia paramensis* may be distinguished from the other *Girardia* species with dorsal testes (table I) by its large conical penis papilla, undivided atrium, and lack of an expanded seminal vesicle.

Distribution. — This species was found in a stream on the east slopes of the Cordillera Oriental (3200 m) at Paramo Cruz Verde (04°34'N 74°02'W), southeast of Bogotá.

***Dugesia polyorchis* (Fuhrmann, 1914)**

Planaria polyorchis Fuhrmann, 1914: 802.

Dugesia polyorchis: Kenk, 1941: 7.

Dugesia (Girardia) polyorchis: Ball, 1974: 376.

Type material. — British Museum (Natural History), 1928.1.4.271-272, frontal sections on two slides.

Remarks. — This species was discovered by Fuhrmann among a sample of *Dugesia paramensis*. Since only one specimen was available for study, and since this was sectioned before it was recognized as new, a satisfactory description was not possible, neither then nor now. Fuhrmann's description is accurate as far as it goes but the sections do not show all of the copulatory apparatus and thus the affinities of the species are difficult to assess. It seems to me, however, that everything that can be discerned from the slides is consistent with the specimen being *Dugesia*

festai (Borelli, 1898), and I propose that Fuhrmann's species be considered as conspecific with the latter (cf. Kenk, 1974: 27). *Dugesia festai* is a species apparently widespread in the Andes of Ecuador and Peru, extending also into Venezuela and Curaçao. It has been recorded from Colombia by Mitchell & Kawakatsu (1973: 658).

***Dugesia (Girardia) cameliae* (Fuhrmann, 1914) (Figs. 5-8)**

Planaria cameliae Fuhrmann, 1914: 802.

Planaria camaliae Fuhrmann, 1914: 802, lapsus calami.

Euplanaria cameliae: Kenk, 1930: 292.

Dugesia cameliae: Kenk, 1941: 7.

Dugesia cameria: Mitchell & Kawakatsu, 1973: 658, lapsus calami.

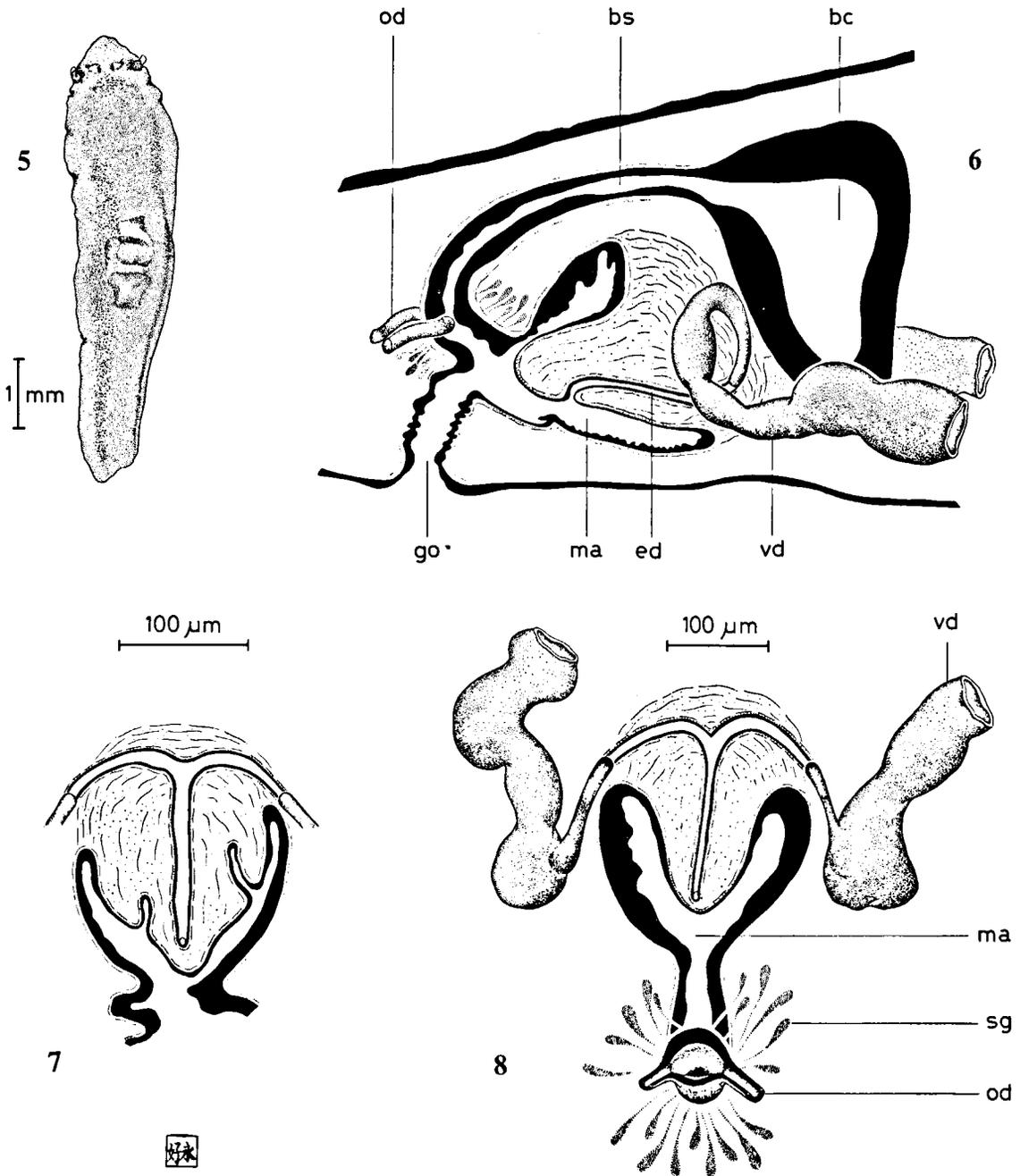
Dugesia cameriae: Kawakatsu, Hauser & Friedrich, 1976: 215, lapsus calami.

Type material. — British Museum (Natural History), 1928.1.5.89-100, alcohol specimens. BMNH 1928.1.4.273-290 slides as follows: 273-276 wholemounts; 277 frontal sections; 278 frontal sections; 279-280 sagittal sections (cf. Fuhrmann, 1914: fig. 13); 281 frontal sections; 282 frontal sections; 283-285 sagittal sections of poor quality; 286 frontal sections; 287-288 sagittal sections of poor quality; 289-290 frontal sections of poor quality. All the available slides have been re-examined but the redescription and new figures are based primarily on the three series 279-280, 281, and 286.

Description. — The external features are as described by Fuhrmann (1914: 803). Living specimens are up to 17 mm long and 1 mm wide and have a markedly triangular head with prominent auricles (fig. 5; Fuhrmann, 1914, fig. 11). The dorsal surface is dark brown or black and the ventral surface is pale. As in the other species the pharynx is pigmented.

The testes are numerous follicles situated dorsally and throughout the bodylength, beginning just behind the ovaries. The vitellaria occur throughout the body, predominantly in the ventral half, and there are some pre-ovarial follicles. The oviducts show no special peculiarities and enter the bursal canal widely separated above the zone of the shell glands, in the usual way.

The copulatory complex is shown in figs. 6-8; fig. 6 being of the same specimen from which Fuhrmann drew his fig. 13. The penis consists of a stout muscular bulb and a rather asymmetric papilla projecting into the atrium. In one specimen the penis is contracted such that prominent folds are present (fig. 7). The vasa deferentia



Figs. 5-8. Colombian freshwater triclad of Fuhrmann, 1914, redrawn from the type material. 5, *Dugesia cameliae*, BMNH 1928.1.4.273, external features drawn from a wholemount; 6, *D. cameliae*, BMNH 1928.1.4.279-280, sagittal section of the copulatory apparatus viewed from the right side (same scale as fig. 8); 7, *D. cameliae*, BMNH 1928.1.4.286, frontal section through the penis viewed from above; 8, *D. cameliae*, BMNH 1928.1.4.281, frontal section through the copulatory apparatus viewed from above. Abbreviations: as in figs 1-4.

recurve before entering the penis bulb (figs. 6 & 8) and within the bulb they unite, without enlargement, to form an ejaculatory duct that opens ventrally subterminally (fig. 6). The atrium is intermediate between the totally divided condition of *Dugesia arimana* from Trinidad (Ball, 1971, fig. 3) and the uniform condition of most other *Dugesia* (*Girardia*) species. The epithelium of the atrium is nucleate and that of the penis and ejaculatory duct is infranucleate.

The bursa copulatrix lies anterior to the penis and from it the bursal canal curves smoothly over the atrium towards the gonopore. The epithelium of the bursal canal is infranucleate and is overlain by a thick musculature of inner circular and outer longitudinal fibres. There is some intermingling of the layers of musculature. In many of the slides spermatophores were present in the bursa copulatrix.

Remarks. — In my revision of the Dugesiidae (Ball, 1974) I made no assignment of *Planaria cameliae*. However, it clearly falls within the subgenus *Girardia* as therein defined. Of the *Girardia* species with dorsal testes (table I) *Dugesia cameliae* is most similar to *D. miltgeni* in its markedly ventral subterminal opening of the ejaculatory duct, and in the histological structure of the copulatory apparatus. The penis of the Colombian species is more pointed, however, and the vasa deferentia recurve before entering it.

Distribution. — According to Fuhrmann (1914: 802) this species was found in rivers close to the city of Medellin (06°15'N 75°36'W) in the Cordillera Central (1540-1820 m). Guaca presumably refers to the Rio Guaca (06°15'N 75°52'W); I have been unable to trace Cafetal La Camelia.

SYSTEMATIC RELATIONSHIPS OF THE COLOMBIAN SPECIES

Freshwater planarians of the family Dugesiidae occur throughout the New World (Ball, 1974, 1975). Most of the New World forms belong to the genus *Dugesia*, subgenus *Girardia*, and at present there are some 30 valid species known; five from continental North America, one from

Tahiti (Gourbault, 1978), and 24 from Central and South America, including some of the Caribbean islands. One or two species have wide distributions, but most are known from but one or a few localities.

In discussing the South American species, Ev. Marcus (1953) commented on the very small differences between them, which makes the unravelling of their taxonomic relationships difficult. But in the last 25 years many more species have been described and some patterns in variation begin to appear.

The difficulties at the species level notwithstanding, it is possible to divide the species on the basis of two clear characters, the distribution of the testes and the course of the bursal canal. It must be admitted, however, that the two characters are not completely congruent and the respective groups made are not quite disjoint.

The question as to the reliability of the position of the testes as a taxonomic character has often been debated (De Beauchamp, 1939; Ball, 1971; Kenk, 1975). Dugesiidae of the *Dugesia gonocephala* group, the subgenus *Dugesia* Ball, 1974, distributed throughout the Old World, are characterized by their numerous dorsal testes. Until recently most *Girardia* species differed in their numerous closely packed ventrally situated testes, and dorsal follicles were the exception rather than the rule. With more recent work, however, it has now become clear that no less than 14 out of the 30 species have dorsal testes (table I). Moreover, it is noteworthy that all but one of these species have what I have called a smoothly curved bursal canal.

The type species of the subgenus, *Dugesia* (*Girardia*) *tigrina*, and the species most widely distributed, possesses a bursal canal that curves over the copulatory apparatus and then bends sharply downwards at the point of entry of the oviducts (Ball, 1971, figs. 5 & 7). This character is present and constant in many related species such as *Dugesia longistriata* (fig. 2). The alternative condition is a smooth, uninterrupted, downward curvature of the bursal canal (figs. 4 & 6). With one exception there is a correlation between the presence of dorsal testes and the smooth condition of the bursal canal (table I). It is also note-

TABLE I
List of *Girardia* species with dorsal testes.

Species	Atrium ¹	Bursal canal ¹	Distribution	Source of data
1 <i>andina</i>	uniform	smooth	Andes, Argentina	Type material
2 <i>chilla</i>	(un)divided ²	angled/smooth ²	Central & Southern Chile	Marcus, 1954; Hyman, 1959
3 <i>arizonensis</i>	divided	smooth ³	Arizona, USA	Kenk, 1975
4 <i>arimana</i>	divided	smooth	Trinidad/S. Vincent Venezuela	Ball, 1971; Kawakatsu et al., 1976
5 <i>miltgeni</i>	divided	smooth	Guadeloupe	Gourbalt, in press
6 <i>antillana</i>	uniform	smooth	Puerto Rico	Kenk, 1941
7 <i>cubana</i>	uniform	smooth	Cuba	Codreanu & Balcesco, 1973
8 <i>barbarae</i>	uniform	smooth	Mexico	Mitchell & Kawakatsu, 1972
9 <i>typhlomexicana</i>	uniform	smooth	Mexico	Mitchell & Kawakatsu, 1972
10 <i>mckenzei</i>	uniform	smooth	Mexico	Mitchell & Kawakatsu, 1973
11 <i>cameliae</i>	± uniform	smooth	Colombia	Type material
12 <i>paramensis</i>	uniform	smooth	Colombia	Type material
13 <i>veneranda</i>	uniform	smooth	Brasil	Martins, 1970
14 <i>hypoglauca</i>	divided	angled	Brasil	Marcus, 1946

¹ For an explanation of these characters see the main text.

² Marcus (1954) shows the bursal canal as angled and the atrium divided; Hyman (1959) gives the alternatives.

³ The bursal canal is sinuous and approaches the angled condition (Kenk, 1975, fig. 5).

worthy that no less than 10 of the species listed in table I (3-12) originate from a geographical area embracing Mexico and contiguous U.S.A., Central America, the Caribbean, and northern South America.

Of the Colombian species redescribed here, *Dugesia longistriata* and *D. festai* (= *polyorchis*) belong clearly with the *tigrina*-group. The two other species, *D. cameliae* and *D. paramensis*, are members of a large subgroup that appears to have its centre of diversification in the Central American and Caribbean area. This group shows even further diversification in that certain of the species,

D. arizonensis, *D. arimana*, and *D. miltgeni* have a clearly divided atrium that is unusual in the *Girardia* species. The evolutionary history of all these forms may be expected to be clarified by the material collected on the University of Amsterdam Expeditions to the West Indian Islands by Professor Dr. J. H. Stock and Dr. L. Botosaneanu, and which will form the subject matter of a future report. The relationships of certain more southern forms, *D. andina*, *D. chilla*, *D. veneranda*, and *D. hypoglauca* (table I) to the Caribbean group must await further assessment (cf. Ball, 1971; Kawakatsu et al., 1976).

ACKNOWLEDGEMENTS

I am grateful to both Mr. S. Prudhoe and Dr. D. I. Gibson for their hospitality during my visit to the British Museum (Natural History), and to them and the Trustees of the BMNH for lending me the specimens for further study. My

visit to the Museum was made while I was the recipient of Operating Grant A0016 of the National Research Council of Canada. I am also grateful to my wife, Maria Tran Thi Vinh-Hao, for preparing the figures.

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