On Two Fresh-Water Planarians from Chile

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The material of this article was presented by Dr. Patricio Sanchez of the Catholic University of Santiago, Chile, who found himself in need of identification of two species of fresh-water planarians on which he has been conducting experiments to be reported elsewhere. Dr. Sanchez provided photographs of the worms in life, several sets of serial sections of them, and preserved specimens, from which I have made additional series of sections. Dr. Sanchez had already correctly determined that both species belong to the genus Dugesia, family Planariidae, and I have established that one is a described, the other an undescribed, species.

The worms were fixed in 0.7 per cent sodium chloride saturated with mercuric chloride, a fixative very suitable for fresh-water triclads. Some series were stained with hematoxylin and eosin, others with Mallory's triple stain.

Symbols Used in Figures

1. Copulatory bursa; 2. bursal canal; 3. entrance of common ovovitelline duct; 4. eosinophilous glands; 5. penis bulb; 6. cyanophilous glands; 7. common antrum; 8. common gonopore; 9. spermiducal vesicle; 10. sperm duct; 11. enlarged part of sperm duct in penis papilla; 12. penis papilla; 13. lumen of penis papilla; 14. muscular thickening; 15. nuclei of muscle layer; 16. girdle of eosinophilous glands; 17. male antrum; 18. bulbar cavity.

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ORDER TRICLADIDA
SUBORDER PALUDICOLA
FAMILY PLANARIIDAE
Dugesia sanchezi, new species
Figures 1-3, 5-11

EXTERNAL CHARACTERS: The appearance of the species in life is shown in figures 1-3. The mobile head is triangular, with well-developed pointed auricles; behind the level of the auricles the moderately slender body remains of about the same width until the posterior body third where it tapers gradually to a pointed posterior end. The species may reach a length of 20 mm. when moving extended, but is generally shorter, about 15-18 mm. in length. As shown in figures 1 to 3 the color pattern is variable, and this variability is unrelated to locality or size, except that newly hatched specimens tend to be lighter. The general color is brown, varying to grayish or yellowish tints. A light, middorsal, longitudinal stripe is invariably present. Otherwise the color ranges from an evenly distributed granular type, as in figure 1, to types with oval light areas, limited to the lateral regions, as in figure 3, or spread over much of the dorsal surface, as in figure 2. The head is evenly pigmented but more translucent at the margins, and the posterior half of the auricles is of a lighter hue. The ventral surface is of an even, yellowish gray tint.

HISTOLOGY: The dorsal epidermis is much taller than the ventral and much more heavily provided with rhabdites. Beneath the epidermis is a well-developed basement membrane followed by the subepidermal musculature, mainly of longitudinal fibers, interspersed with pigment granules. The musculature appears about equally thick dorsally and ventrally and is underlain by a layer of rhabdite-forming cells, very thickly present dorsally, somewhat scanty ventrally. The pharynx did not present any special features.

REPRODUCTIVE SYSTEM: The ovaries occur in the usual anterior position, lying between the second and third intestinal diverticula in one set of longitudinal sections. The very numerous yolk glands occur throughout the body between the intestinal diverticula; one small mass is found directly anterior to each ovary. The numerous testes begin immediately behind the ovaries; they are ventrally located, close to the subepidermal musculature. As usual in the genus they extend throughout the body length in a lateral tract on each side below the intestinal diverticula. Generally two or three are seen on each side in every transverse section.
Figs. 1–3. Color variants of *Dugesia sancheni*, all from the Rio Mapocho. Actual lengths, 18, 15, and 15 mm. Photographs by P. Sanchez.

Fig. 4. *Dugesia chilla*, from Quebradas Cadillos and Cajon. Actual length, 24 mm. Photograph by P. Sanchez.
The copulatory complex is found as usual directly behind the pharynx. Sagittal views of the copulatory complex of three different specimens from different localities are shown in figures 5–7. The differences are not related to locality but to degree of contraction. The copulatory sac or bursa is large in all specimens, with some slight variation in size. It is lined with the usual tall bulging cells underlain by a slight fibrous investment. The bursal canal curves posteriorly above the male complex and is generally short, as in figure 5, somewhat longer in figure 6, in which all parts are more extended than in other sets of sections. In sections stained with Mallory the lining epithelium of the bursal canal is heavily fuchsinophilous; it is underlain by a moderately thick muscle layer here taking the blue stain. Distally the bursal canal widens and curves ventrally to join the male antrum. Just below the curve it receives from behind the short common ovovitelline duct accompanied by the usual trail of eosinophilous glands. The wall of the entire common antrum is heavily supplied with eosinophilous or fuchsinophilous glands, as shown in figure 5 from a series stained with Mallory. A few cyanophilous glands enter the posterior wall shortly below the entrance of the common ovovitelline duct. The lining epithelium of the common antrum consists of tall, slender, loose cells underlain by a muscle coat continuous with that of the bursal canal.

The sperm ducts are distended into the usual spermiducal vesicles packed with sperm as they proceed posteriorly along each side of the pharynx. As they reach the level of the penis bulb, each narrows to a slender duct that ascends vertically through the penis bulb, then curves posteriorly in the bulb, as shown in figure 5. The two ducts descend through the penis bulb into the base of the conical penis papilla where each enlarges. These enlargements continue for some distance in the penis papilla and finally without fusion enter separately a considerable cavity in the distal part of the penis papilla, and this exits into the male antrum by a narrowed opening. In figures 5–7 are shown different appearances of the penis papilla in three different sets of sagittal sections. Its shape varies according to degree of contraction, but the relations of the ejaculatory ducts inside are seen to be the same in all three sections. The penis papilla is greatly extended in figure 6, taking on a more elongated conical shape than in other series of sections. The penis papilla is not very muscular. It is clothed with a rather flat epithelium, under which the musculature is developed mainly at the base of the papilla. The penis bulb consists of the usual mesh of muscle fibers taking a curved course parallel-
ing the contours of the bulb. This mesh is filled as usual with cyanophylous gland conduits from gland cells located between the bulb and the copulatory bursa, as easily seen in sections stained with Mallory.

As the distinguishing feature of this species is the course of the ejaculatory ducts in the penis, it has been thought desirable to sketch this course as seen in transverse sections. Figures 8–11 show successive sections of a transverse series stained with Mallory. In figure 8, the narrowed ejaculatory ducts are seen descending through the penis bulb to enlarge in the base of the penis papilla. Figure 9 shows the base of the penis papilla containing the separate enlargements; on each side the ejaculatory duct ascends from the spermiducal vesicle. Figure 10, on a larger scale, passes through the penis papilla enclosed in the male antrum and containing the two enlarged ducts, still separate. Figure 11 passes through the descending female antrum at the level of the entrance of the ovovitelline ducts into the curvature of the bursal canal. These ducts are seen to unite at their entrance; hence the common duct is very short. Below, the distal end of the penis papilla is seen to contain a single cavity.

**Differential Diagnosis:** In 1954 Marcus listed the species of *Dugesia* known to occur in South America, including the Caribbean region. The number totaled 14, to which he added two new species. Subsequently I added a species from Trinidad, *Dugesia arimana* Hyman, 1957. There are, further, three species in the literature, referred to by Marcus, that might belong to *Dugesia*, but this cannot be decided because the sexual anatomy is unknown. Of these 20 species, only four come from Chile: *Dugesia chilla* and *rinconae* Marcus, 1954, *D. dimorpha* (Böhmig, 1902), and the unidentifiable "Planaria" similis Böhmig, 1902. In the course of the ejaculatory ducts through the penis, *D. sanchezi* differs from all other Chilean species and from all species of *Dugesia* known from South America except the form tentatively ascribed by Böhmig (1902) to *Dugesia dubia* (Borelli, 1895), renamed *D. anceps* by Kenk (1930) as the combination *Planaria dubia* is preoccupied. The differences in penial anatomy between Böhmig's specimen and Borelli's description are such that I suspect Böhmig's identification was mistaken. Further, Borelli's material of "dubia" came from Paraguay; Böhmig's specimen, from the Rio de la Plata near Buenos Aires. I am inclined to regard Böhmig's specimen as a geographic variant of *Dugesia sanchezi*. The course of the ejaculatory ducts through the penis is strikingly similar in the two forms. Böhmig's form differs from *D. sanchezi* in the smaller size of the copulatory bursa, but this is not important, the tendency of the testes to
spread dorsally, the separate entry of the ovovitelline ducts into the bursal canal, as also in Borelli's original description of *dubia*, and the narrowed tubular form of the ejaculatory duct in the penis papilla as contrasted with the rather large cavity here in *sanchezi*.

The possible identity of *Planaria dimorpha* Böhmig, 1902, with *D. sanchezi* had to be carefully considered, as Böhmig's species came from Chile. Dr. Sanchez informs me that he visited one of the two localities in which Böhmig found *dimorpha*, namely, Peña Blanca near Quilpué, but could not find any "Graben," and the smaller streams were dry at the time of his visit. Planarians taken from a larger water course in this vicinity proved to be typical *Dugesia sanchezi*. The course of the ejaculatory ducts in the penis of *dimorpha* differs altogether from that in *sanchezi*. Böhmig further describes and depicts a circle of eosinophilous glands opening through the sides of the penis papilla in *dimorpha*; this is positively absent in *D. sanchezi* and in fact is altogether unusual in fresh-water planarians.

**Holotype:** One set of sagittal serial sections deposited in the in-vertebrate section of the American Museum of Natural History; also other sections and some whole mounts.

**Ecology:** The species lives under stones in coastal hillside streams and brooks of central Chile. Although these streams run into the sea, they are not in the least brackish because of the steep slope. The worms undergo the usual transverse fission behind the pharynx, and both fragments regenerate. The stalked capsules, turning black a few hours after deposition, are readily found in nature attached to the under side of stones from the beginning of the warm season into the summer; they are also readily laid in laboratory cultures. Each hatches into several young in three to five weeks.

**Localities:** The species has been taken in a number of streams as follows:

- Rio Mapocho, in the vicinity of the town of Talagante, province of Santiago.
- Estero El Cobre, in the vicinity of the town of Nogales, province of Valparaiso.
- Estero Catapilco where it opens into La Laguna, at the village of the same name, near the beach of Maitencillo, on the boundary between the provinces of Valparaíso and Aconcagua.
- Estero Guallilemu, upstream from its end in the proximity of the seminary at Punta de Talca, near the southern boundary of the province of Valparaíso.
- Estero Reñaca, near its mouth at the sea resort of the same name, south of Concón, province of Valparaíso.
- Estero Limache, downstream from the town of that name, province of Valparaíso; near one of Böhmig's localities.
Quebrada El Tigre, upstream from the Tranque de Cachagua, at the beach of the latter name, immediately south of Zapallar, province of Aconcagua.

Dr. Sanchez considers that the Rio Mapocho might be designated the type locality, as this stream is apt to be more constant and permanent than the others.

*Dugesia chilla* Marcus, 1954

Figures 4, 12

Although Marcus has given his usual excellent description of this species, his specimens were obviously contracted. I am hence able to supplement his description from sections of uncontracted specimens and with natural history notes furnished by Dr. Sanchez.

**EXTERNAL CHARACTERS:** The appearance of the species in life is shown in figure 4. It is longer and more slender than the preceding species, reaching a length of 25 mm., flexible and active, with a larger and narrower head, and longer and narrower, very flexible auricles. The color is a dark even brownish or bluish black, with lighter auricles, whitish on their posterior half. The posterior end is not quite so pointed as in *D. sanchezi*. The ventral surface is a light bluish gray. The white areas around the eyes are notably smaller than in *D. sanchezi*.

**REPRODUCTIVE SYSTEM:** A sagittal view of the copulatory complex is shown in figure 12, which may be compared with Marcus’ figure 70. Clearly the latter is strongly contracted. The moniliform appearance of the bursal canal in Marcus’ figure is the result of contraction and is wanting in the relaxed specimens, as in my figure 12. The bursal canal is well provided with a layer of circular and longitudinal muscles, outside of which are seen the nuclei belonging to the muscles. Distally the bursal canal makes a pronounced downward curve and receives into its posterior wall the common ovovitelline duct. Peculiar to the species is the thick girdle of eosinophilous glands entering the canal, now female antrum, just below the entrance of the common ovovitelline duct. Owing to the contraction, these structures are displaced dorsally in Marcus’ material. The short female antrum is joined from in front by the male antrum to form the common antrum that exits below by the common gonopore. The entire antral wall is entered thickly by glands, not shown in my figure, which are eosinophilous, not cyanophilous as stated by Marcus. I believe the antral glands are usually eosinophilous in paludicolous triclads.

The penis of this species is remarkable for its globular shape, with practically no papilla. It, too, is strongly contracted in Marcus’ ma-
Figs. 9–11. Dugesia sanchezii. 9. Section posterior to that shown in figure 8. 10. Section posterior to that shown in figure 9. 11. Section posterior to that shown in figure 10.

Fig. 12. Dugesia chilla, sagittal view of the copulatory complex of specimen from Quebradas Cadillos and Cajon, Mallory's triple stain.
terial as may be seen by a comparison of his figure 70 with my figure 12. The rounded penis bulb, consisting as usual of a mesh of muscle fibers paralleling its contours and containing cyanophilous gland material, surrounds a large lumen which I call "bulbar cavity" but which is usually termed "seminal vesicle." The sperm ducts open separately, one from each side, into this cavity. The lining of the bulbar cavity is glandular, and I find it eosinophilous, not cyanophilous as stated by Marcus. Marcus finds the distal ends of the sperm ducts at their entry into the bulbar lumen provided with a glandular eosinophilous epithelium, but in my sections stained with Mallory the entire course of the sperm ducts through the penis bulb is furnished with a strongly eosinophilous epithelium. The lining epithelium of the male antrum is likewise eosinophilous.

Ecology: This species lives in the same type of coastal stream descending the hills as the preceding species, and in fact both species are found living together in some of the streams. Dugesia chilla is less adaptable to laboratory conditions than D. sanchezi and often survived poorly. When in the asexual state the species undergoes the usual transverse fission behind the pharynx that is typical of the genus Dugesia. It also reproduces sexually from spring through summer, attaching the stalked capsules to the under sides of stones. The capsules turn black some hours after deposition and hatch into several young in three to five weeks.

Localities: The species occurs in several streams in central Chile as well as in the localities in southern Chile given by Marcus. The localities in central Chile are as follows:

Estero Guallilemu, as described for D. sanchezi.
Quebrada El Tigre, as described for D. sanchezi.
Quebradas Cadillos and Cajon, two short small brooks that arise from separate springs, run down hill, and unite before ending at the beach of Zapallar, province of Aconcagua.

References Cited

Böhmig, Ludwig

Borelli, Alfredo

Hyman, Libbie H.
1957. A few turbellarians from Trinidad and the Canal Zone, with corrective remarks. Amer. Mus. Novitates, no. 1862, 8 pp., 6 text figs.
KENK, ROMAN

MARCUS, ERNESTO