

STUDIES ON THE FAUNA OF CURAÇAO AND OTHER
CARIBBEAN ISLANDS: No. 44.

TURBELLARIA FROM CURAÇAO

by

ERNST MARCUS

(Departamento de Zoologia da Universidade de São Paulo)

A study of the several fresh and brackish-water springs on Curaçao, carried out by Dr. P. WAGENAAR HUMMELINCK, revealed (a) the common occurrence on that island of *Dugesia festai* (Borelli 1898), a species which until then had only been known from the South American mainland (nearest find: Ecuador!), and (b) a hitherto undescribed species of *Bothromesostoma*, which is probably more abundant than the single discovery of it in small rain-puddles suggests. No Turbellaria were collected in the few springs which were sampled on Bonaire and Aruba.

RHABDOCOELA (Neorhabdocoela)

Bothromesostoma pieti spec.nov.

Figs. 8-10

CURAÇAO. Piscadera Bay Club (Sta. 68), 10.X.1936; small puddle of rainwater on limestone plateau, $\frac{1}{4} \times \frac{1}{4} \times 1/10$ m, with a little plant decay, almost no algae, many *Eulimnadia*; water clear and colourless, 29-36°C, 40 mg Cl'/l, 190 mg HCO₃'/l, total hardness 8 German degr., pH 8.2-8.4. Same locality but another pool (Sta. 69), 10.X.1936; $1 \times \frac{1}{4} \times 1/20$ m, as before, 29-36°C, 60 mg Cl'/l, 310 mg HCO₃'/l, 12 Germ.°, pH 8.1-8.4. — A total of about 40 worms and 1 free yellowish-brown dormant egg 0.3 mm in length and 0.15 mm thick.

Material has been presented to the Rijksmuseum van Natuurlijke Historie, Leiden, the Zoölogisch Museum of Amsterdam and the U.S. National Museum.

The measurements of the biggest worm are: length 1.8, breadth 0.6, height 0.3 mm. The transverse section is trapezoid. The fore end is blunt with obliquely cut corners, the posterior end is pointed, the

ventral side flat and broader than the back, which bears two longitudinal ridges (Fig. 8), probably due to contraction at the moment of fixation.

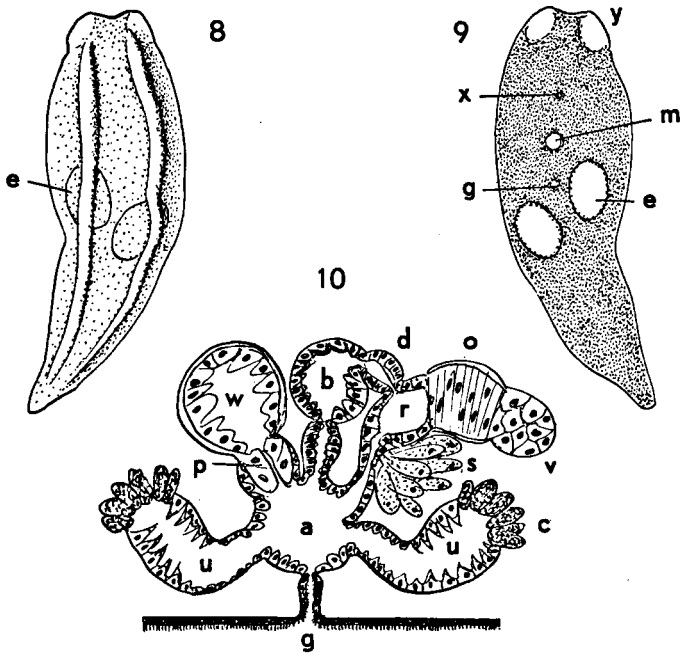


Fig. 8-10. *Bothromesostoma pieti* spec. nov. from Curaçao. — 8. Dorsal view of preserved worm. — 9. Ventral view of preserved worm. — 10. Copulatory organs; diagram reconstructed from transverse sections. — a — antrum; b — bursal vesicle; c — uterine glands; d — insemination canal; e — dormant egg; g — gonophore; m — mouth; o — oviduct; p — male copulatory organ; r — seminal receptacle; s — shell glands; u — uterus; v — ovary; w — bursal vesicle; x — ventral pit; y — pigment-free ocular area.

The ventral surface looks more or less black, the dorsal side is light. Unpigmented ventral epidermal areas (Fig. 9, y) correspond to the eyes, which lie close to the ventral integument. This position makes it probable that the worms swim upside down. The dark belly and light back also suggest this, by analogy with the similarly coloured *Mesostomum productum* (O. Schmidt 1848) and *M. maculatum* Hofsten 1916, which are known to swim in this way. However, *Bothromesostoma evelinae* Marcus 1946, whose back is

black and its belly orange yellow, likewise swims upside down.

In the sections the pigment appears in the parenchyma of the ventral half of the body and also in the ventral epidermis. The dormant eggs (e) in the uteri are so voluminous that they extend to both the dorsal and the ventral surface, shining through the skin. The epidermis is about 10 micra thick, dorsally and ventrally. The cilia are short, and well preserved only at the anterior end, where they are 5 micra long. Rammites are not developed; the histological state does not allow of more than the verification of blue-staining glands in the fore end. The small ventral glandular sac (x) is perpendicular and ventral to the anterior border of the pharynx. It is about 50 μ deep, is ciliated, and surrounded with basophilous glands.

The pharynx lies anterior to the middle of the body; in a worm 1 mm long the mouth (m) is situated 0.36 mm from the tip. The diameter of the pharynx is 0.3 mm; no excretory pores or excretory beaker were found in seven series of sectioned worms. The pharyngeal pocket is shallow and surrounds at most half of the pharynx. The epithelium of the pocket looks cuticularized; the outer epithelium of the pharynx bears short, rigid cilia. The nuclei of this epithelium are concentrated at the border of the pocket. The oesophagus is nucleated, its epithelium has homogeneous plasma without granules. The form of the oesophagus varies with contraction. The following, anterior part of the intestine contains numerous granular clubs.

The gonopore lies 0.15 mm behind the mouth (Fig. 10, m). As is often the case in populations of mesostomines, no testes or efferent ducts are developed. A male vesicle (w) without sperm and glands lies behind the pharynx and is followed by a folded copulatory organ (p), which projects into the common antrum (a). To the right and a little behind, the canal of the bursa (b) opens into the antrum. The bursal canal is not distinctly demarcated from the empty vesicle. A duct (d), the insemination canal or ductus spermaticus, extends from the fundus of the copulatory bursa to the seminal receptacle (r). The latter is an empty dilatation of the oviduct (o) or germiduct, whose disc-like cells are as in other Mesostominae. The ovary (v) and the vitellaria are also typical. The latter are developed

along the whole length of the body, and extend from the dorsal to the ventral side. The vitelline ducts have not been seen. Two tubes, the uteri (u), run from the antrum (a) backwards. Their blind ends bear blue-staining glands (c) in young worms without dormant eggs. In older animals a total of up to 5 thick-shelled eggs (e) occurs. Acidophilous shell glands (s) open into the oviduct.

The species is named after PIETER WAGENAAR HUMMELINCK. The holotype, a slide with a series of sagittal and transverse sections, has been deposited in the Department of Zoology, Faculty of Philosophy, University of São Paulo.

In the discussion of *Bothromesostoma evelinae* MARCUS (1946, p. 97) 6 species were mentioned, one of which, *B. primitivum* Sabussowa 1929, does not belong to *Bothromesostoma*. The 4 species dealt with by GRAFF (1913, p. 286–291) have mouth and gonopore together in one and the same concavity of the skin; the sixth, *B. truncatum* Beklemishev 1921, has its ventral glandular pit in front of the brain.

B. pieti must be compared with 3 further species:

1) *Mesostoma macroprostatum* HYMAN (1939, p. 629), which belongs to *Bothromesostoma* or represents the type of a new genus (HYMAN 1955, p. 25); it has separate seminal and prostatic vesicles.

2) *B. evelinae*, which is dorsally dark, ventrally light; it has an excretion beaker, and its insemination canal runs between bursal canal and oviduct distally to the seminal receptacle.

3) *B. pictum* BEKLEMISCHEV (1950, p. 26), which has light brownish-black pigment, forming 3 transverse stripes in younger animals. A deeper layer is blue, and this colour appears in adult worms as a pale spot in the region of the pharynx and the copulatory complex.

TRICLADIDA PALUDICOLA

Dugesia festai (Borelli 1898)

Figs. 11–22

CURAÇAO. Boca di Leeuw, Hato (Sta. 72), 13.X.1936; natural spring at limestone cliff, made more accessible and built in, rather slowly flowing, (2 ×) 1½ × 1¼ m, with clayish-mud, no vegetation (dark); water clear and colourless, 30°C, 210 mg Cl'/l, 280 mg HCO₃'/l, total hardness 16 Germ. degr., pH 7.5–7.7. Same locality (Sta. 72a), 29.VIII.1949; (5 ×) 3 × ¼ m, as before, 365 mg Cl'/l, 420 mg HCO₃'/l, 21 Germ.°, pH 7.1. — About 50 specimens, light brown with pointed heads.

Bron Cajoeda, Hato (Sta. 74a), 5.V.1949; overflowing basin of brick work near spring, $1 \times \frac{1}{2} \times \frac{1}{2}$ m, with dirt and leaf decay, some algae; water clear and almost colourless, 1130 mg Cl'/l, 335 HCO₃'/l, 49 Germ.° Same locality (Sta. 74b), 26.IX.1948. Same locality (Sta. 74c), 27.VIII.1955; puddles, $1/10 \times 1/10 \times 1/50$ m, 29–29½°C, 490 mg Cl'/l. — About 40 specimens, slender, black (ventrally as well) and with light pharynx. Some with light dorsal mid-line.

Bron Wandongo, Hato (Sta. 76), 6.X.1936; natural spring near limestone cliff, slowly flowing, (4 ×) $2 \times \frac{1}{2}$ m, with rock debris and sand, almost no vegetation; water clear and colourless, 28°C, 230 mg Cl'/l, 290 mg HCO₃'/l, 17 Germ.°, pH 7.1–7.3. Same locality, 9.X.1936. Same locality (Sta. 76A), 6.X.1936; turbulent pool near spring, (1 ×) $1 \times \frac{1}{2}$ m, with gravel and sand, very few algae, single *Chara* and *Najas*. Same locality (Sta. 76Aa), 11.X.1936; pH 7.2–7.4. Same locality (Sta. 76D), 27.VIII.1955; seepage, 28½°C, 250 mg Cl'/l. — About 100 specimens, some quite black with black pharynx, others black with light belly and pharynx, others brown. Some with light dorsal mid-line. Figs. 11–13.

Bron San Pedro, S. (Sta. 79), 22.X.1936; natural spring at limestone cliff, rather rapidly flowing, $1 \times 1/10$ m, with rock debris and sandy mud, few algae; water clear and colourless, 30°C, 360 mg Cl'/l, 400 mg HCO₃'/l, 21 Germ.°, pH 7.6–8.2? Same locality (Sta. 79C), 5.III.1955, muddy pool, $1 \times 1 \times 1/10$ m, with algae; 27°C, 460 mg Cl'/l. — About 30 specimens, slender, blackish and light brown. Some with light dorsal mid-line. Figs. 14–16.

Bron San Pedro, S., in Hofje (Sta. 395), 13.II.1949; natural spring, 5 m W of Sta. 79, rather rapidly flowing, $\frac{1}{2} \times 1/20$ m, with rock debris and sand, some leaf decay and algae; water clear and colourless, 405 mg Cl'/l, 335 mg HCO₃'/l, 18 Germ.°. Same locality (Sta. 395a), 5.III.1955; same data, 30°C, 460 mg Cl'/l. Same locality (Sta. 395A), 5.III.1955; small pool of dirty mud with very little water; polluted, probably about 500 mg Cl'/l. — About 40 specimens, some slender and brown, others with net of dark pigment interrupted by light dorsal mid-line. Figs. 20–22.

Bron San Pedro, N. (Sta. 80), 22.X.1936; natural spring at limestone cliff, overflowing pool, $1 \times 1 \times \frac{1}{2}$ m, with rock debris and some leaf decay, almost no algae; water clear and colourless, about 30°C, about 460 mg Cl'/l. Same locality (Sta. 80Aa), 13.II.1949; wet mud with percolating water, leaf decay of *Coccoloba uvifera*, water clear and colourless, 495 mg Cl'/l. Same locality (Sta. 80Ab), 11.III.1949; wet mud in basin of sinter deposits, $1/5 \times 1/10$ m; about 500 mg Cl'/l. — About 40 specimens, slender, brown, spotted, with light dorsal mid-line, light belly and pharynx. Figs. 10–12.

Material has been presented to the Rijksmuseum van Natuurlijke Historie, Leiden, the Zoologisch Museum of Amsterdam, the British Museum (N.H.) and the U.S. National Museum.

Of the about 300 specimens – preserved with alcohol, formaline or Bouin's fluid – 21 series were sectioned. The biggest worm is 10 mm long and 1.8 mm broad, but they are usually smaller.

Even at a length of as little as 4 mm the reproductive organs begin to appear. On the other hand, larger animals may be immature. Generally speaking the number of mature worms is very small; only in three of them were vitellaria seen. No univocal signs

of fission were observed. In an animal 8 mm long the mouth lies 5 mm, the gonopore 5.6 mm behind the tip.

The head is triangular, more or less elongated, always pointed, and always with distinct auricles, the latter in most cases having white areas which are frequently rather large. The eyes lie on a level with the anterior border of the auricles, generally nearer to the middle than to the sides. The colour varies very much. The back may be black or quite light brownish. The ventral side and the pharynx are black, grey or white. A light dorsal mid-line, sometimes flanked by two dark lines, occurs; and worms with a net of dark pigment over the light ground colour are also found. Though a certain colour pattern predominates in a given sample, there is no correlation with locality.

The structure of skin, muscles and parenchyma shows no specific characters. The pharynx agrees with Beauchamp's description (1939, p. 66). About one tenth of its height is occupied by the outer and inner epithelia together; one tenth by the outer longitudinal and annular muscles; five tenths by the parenchyma with its glands; one tenth by the inner longitudinal, and two tenths by the inner annular muscles. The gut contains oligochaetes and parts of such.

The testes are ventral. In one older worm some of them occupy nearly the entire height, extending from the ventral to the dorsal side. In one young animal they are dorsal for a certain distance, without any recognizable mechanical reason. The male copulatory organ is weakly developed. The musculature of the bulb is inconspicuous, that of the papilla a little stronger. The bulbar lumen which receives the secretion of blue-staining glands is a simple round cavity (Figs. 16, 17, 21), or is tripartite with two proximal lumina united in a distal one (Figs. 11, 14, 18, 22). The papilla projects, in more or less pointed form, into the antrum (Figs. 13, 19), or ends in a knob separated from the base by an annular furrow (Figs. 15, 19, 22). In other cases the papilla is so much contracted that a thickened ring surrounds a tiny projection (Figs. 11, 14, 21), or even this last may be withdrawn, so that the ejaculatory duct opens in the centre of the tumid ring (Fig. 20). Such contracted copulatory organs show the muscles best. The penial epithelium is normal, not depressed. The efferent ducts are dilated and thin-walled where they approach

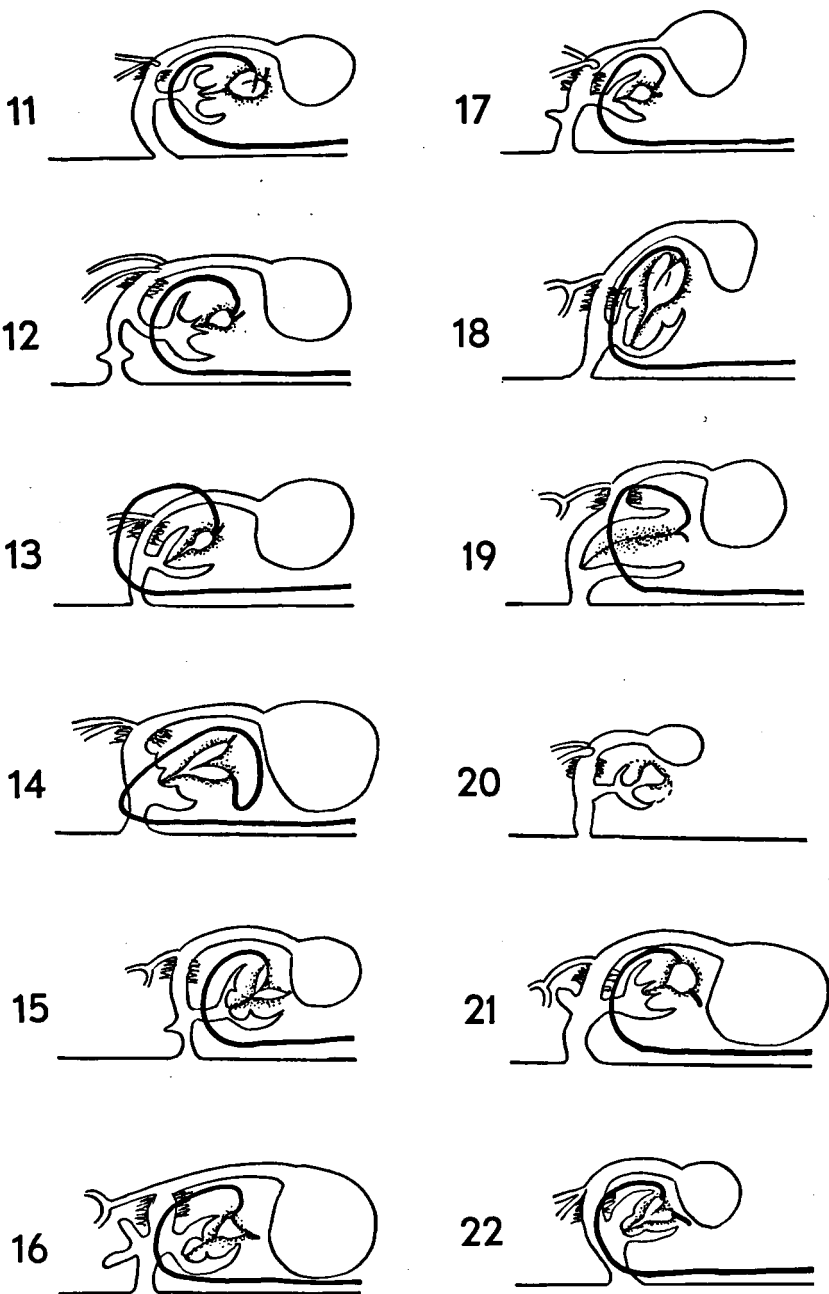


Fig. 11-22. *Dugesia festai* (Borelli) from Curaçao. — Diagram of the copulatory organs of twelve specimens from the spring of Wandongo, Hato: fig. 11-13 (station 76), and the springs of San Pedro: fig. 14-16 (sta. 79), 17-19 (sta. 80), 20-22 (sta. 395).

the copulatory complex, and become muscular shortly before entering the bulb from both sides. The male antrum varies in length and is more or less separated by a fold from the common antrum. In extreme cases (Figs. 12, 15) the distance of separation is long, or, on the contrary (Fig. 19), the bursal canal enters the antrum over the base of the penial papilla. The muscles and glands of the male copulatory organ and antrum agree with Beauchamp's description (1939, p. 66).

The boundary between antrum and bursal canal is characterized by a change in the epithelium. That of the bursal canal is ciliated and of uniform height, that of the antrum is not ciliated and is villiform, owing to the different height of its cells. The shell glands open into the uppermost, non-ciliated part. The ovovitelline ducts enter the antrum at the boundary mentioned. Their point of entry is highly variable. They enter either from both sides (Figs. 11, 17), or separately from behind (Figs. 12, 22), or they unite in a common ovovitelline duct of different length before entering (Figs. 15, 18, 21). Generally the bursal canal is evenly curved, and the shell gland-bearing part of the antrum continues the curve (Fig. 15), but in a few cases the canal forms an angle with the antrum (Fig. 16). The ciliated epithelium of the bursal canal has normal nuclei and contains fine pink granules of secretion produced by subepidermal glands. The muscles of the canal are interwoven annular and longitudinal fibres. The vesicle of the bursa is spherical, or is somewhat deformed by the neighbouring pharynx or penis. Its size varies according to age; its epithelium is, as usual, of different height and contains vacuoles.

Further distribution: Colombia; Ecuador, up to 3,900 m.; Peru, up to 4,650 m.; Lake Titicaca, to depths of 56 m.; Bolivia, La Paz.

The present material cannot be identified with any of the Caribbean species hitherto described. In *D. aurita* (KENNEL 1888, p. 464) from Trinidad the ovovitelline ducts open very ventrally to the usual point. *D. antillana* KENK (1941, p. 1) from Puerto Rico is peculiar in exhibiting two blind tubes which extend from the ejaculatory duct into the tissues of the penis papilla. *D. arimana* HYMAN (1957, p. 2) from Trinidad has the same point of entry of the

ovovitelline ducts as *aurita*. The copulatory complex of *arimana* is short and high, owing to strong contraction of the penis papilla. If the latter were protruded as in *aurita* (l.c. table 19 fig. 21), the antrum would become long and low. As a result the outer opening of the bursal canal and the entry of the ovovitelline ducts would be nearer the gonopore. The two species resemble each other in a quite uncommon character. Both were collected in the Arima River. One sexual worm of the second species was obtained; its testes were dorsal, in contrary to the ventral ones in *aurita*. I agree with KENK (1944, p. 20) and HYMAN in considering the position of the testis as a reliable specific character in *Dugesia*. But it is necessary to bear in mind the worm of the preceding description, with ventral as well as dorsal testes; the fully mature male phases with dorso-ventral testes (KENK 1941, p. 3); and the displacement of testes from their original ventral position by the progressive growth of the yolk glands in certain species (BEAUCHAMP 1939, p. 66). These facts make it necessary to verify the position of the testes in several worms and to correlate it with the stage of male and female maturity.

I have given the general distribution of *Dugesia festai* according to DU BOIS-REYMOND MARCUS (1953, p. 65). The above-mentioned *Planaria aurita* Kennel must be definitely excluded from the synonymy of *D. festai*, owing to the peculiar type of entrance of its ovovitelline ducts. *Euplanaria aurita* BEAUCHAMP (1939, p. 62 ff.) is *festai*, not *aurita* Kennel, from which it differs in the entry of the ovovitelline ducts.

The gap between Curaçao and Ecuador (hitherto the northernmost location of occurrence of *festai*) is somewhat bridged by *D. longistriata* (FUHRMANN 1914, p. 796). This species has been found on both sides of the east Andean watershed, between the systems of the Magdalena and Orinoco. It is said to be peculiar in possessing an irregularly or posteriorly bilobed bursal vesicle. And in the original description of *Planaria festae* the shape of the bursa was also indicated as irregular (BORELLI 1898, p. 4). The east Andean *Dugesia polyorchis* (FUHRMANN 1914, p. 802), the description and, in particular, the illustrations of which are sketchy, may be the same species too. Its bursal vesicle is simple.

All descriptions of *festai* refer to preserved material, perhaps with the exception of some observations which BORELLI obtained from Dr. FESTA. Nevertheless, it can be stated that asexual reproduction is rare or does not occur at all in *festai* (BEAUCHAMP 1939, p. 69). The shape and proportions of fragments resulting from fission are peculiar (HYMAN 1925, p. 56–58), and would certainly have been noted in the several big populations which have been examined. But, on the contrary, sexually mature individuals of *D. dorotocephala* Woodworth 1897 have only seldom been found in nature (KENK 1944, p. 21). Apart from recording this difference, which is probably not of specific value, I agree with BEAUCHAMP, who united his material from Lake Titicaca and from La Paz in *dorotocephala*.

A faunistic note like the present one is not the place in which to arrive at far-reaching taxonomic and zoogeographic conclusions, and so I use the younger name until North American authorities have given their opinion.

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