

On some rare and new species of rotifers (Digononta, Bdelloida; Monogononta, Ploima and Flosculariaceae) in the Kaw River estuary (French Guiana)

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ABSTRACT

The rotifer fauna of the Kaw River estuary (French Guiana) was investigated during the dry season/low water period (November 1998 and 2001) and the rainy season/flood period (June 1999) at three different stations (estuary, mud flat and mangrove creek). One hundred and eight taxa were identified, including three new species described herein, *Dissotrocha guyanensis* n. sp. bearing three pairs of dorsal thorns on the trunk and two long (40-50 µm) spurs on the foot; *Epiphanes desmeti* n. sp. a typical *Epiphanes* species with 10-12 (14?) uncinial teeth); and *Floscularia curvicornis* n. sp. bearing two long and curled ventral tentacles. *Synchaeta arcifera* Xu, 1998, is recorded from South America for the first time. Some remarks about *Testudinella haueriensis* Gillard, 1967 are also included.

KEY WORDS

Rotifera,
Dissotrocha,
Epiphanes,
Floscularia,
Testudinella,
Synchaeta,
French Guiana,
new species.

RÉSUMÉ

Rotifères rares et nouveaux (Digononta, Bdelloida; Monogononta, Ploima et Flosculariaceae), de l'estuaire de la rivière de Kaw (Guyane française).

La faune rotiférienne de la rivière de Kaw (Guyane française) a été étudiée durant les saisons sèche (novembre 1998 et 2001, période d'étiage) et humide (juin 1999, période de crue), dans trois stations différentes (estuaire, vasière et mangrove). Cent huit taxons ont été recensés dont trois espèces, nouvelles pour la science, sont décrites ici : *Dissotrocha guyanensis*

MOTS CLÉS

Rotifera,
Disotrocha,
Epiphanes,
Floscularia,
Testudinella,
Synchaeta,
 Guyane française,
 espèces nouvelles.

n. sp. présentant trois paires d'épines dorsales sur le tronc et deux longs éperons (40-50 μm) sur le pied; *Epiphanes desmeti* n. sp. typique du genre *Epiphanes* avec un uncus à 10-12 (14?) dents; et *Floscularia curvicornis* n. sp. présentant deux longs tentacules ventraux enroulés. Une espèce est nouvellement mentionnée pour l'Amérique: *Synchaeta arcifera* Xu, 1998. Par ailleurs, l'espèce *Testudinella haueriensis* Gillard, 1967 fait l'objet de remarques d'ordre systématique.

INTRODUCTION

The rotifer fauna of the Neotropics is now relatively well known, with many species having been recorded by Koste and Jose de Paggi (Koste & Jose de Paggi 1982; Jose de Paggi & Koste 1995). Most studies have, however, focused on the central and southern countries of South America, with the northern regions (except for Venezuela, Michelangelli *et al.* 1980; Zoppi De Roa *et al.* 1993) remaining largely unexplored to date.

The rotifer fauna of French Guiana has been studied by Pourriot (1996, 1997) and Segers & Pourriot (1997), specifically in the large reservoir of Petit-Saut. Starting in 1998, within the framework of the "Programme national des écosystèmes côtiers" (PNEC-GUYANE), a study has been conducted focusing on the zooplankton community (which is absent from or only briefly mentioned in most studies on mangrove ecosystems) of the

Kaw River estuary of French Guiana. Prepared in conjunction with a separate study on Neotropical Rotifera (Rougier *et al.* 2005), this paper is based on the identification of several new taxa whose morphology, distribution and ecology are described.

SITE AND METHODS

Plankton samplings were carried out in the Kaw River estuary (French Guiana) during the dry season/low water period (November 1998 and 2001) and during the rainy season/flood period (June 1999) at three different stations: estuary (E), mud flat (V) and mangrove swamp (M) (see Fig. 1). Samples were collected with a submerged pump located 1 m below the surface. The pumped-up water flows through two filtering nets, the first with a 150 μm mesh size (for mesozooplankton capture) and the second with a 40 μm mesh size (for microzooplankton capture, including rotifers). The animals were preserved in a neutral formalin solution (4%).

The type material of the new taxa is deposited in the Muséum national d'Histoire naturelle, Paris (MNHN).

The identification of rotifers was carried out using the classification criteria of De Beauchamp (1955), Gillard (1967), Koste (1972, 1978, 1996), Koste & Jose de Paggi (1982), Berzins (1982a, b), Brandorff *et al.* (1982), Koste *et al.* (1983), De Smet (1988, 1989), Nogrady & Pourriot (1995), Segers (1995, 1997), De Smet & Pourriot (1997), Hollowday (2002).

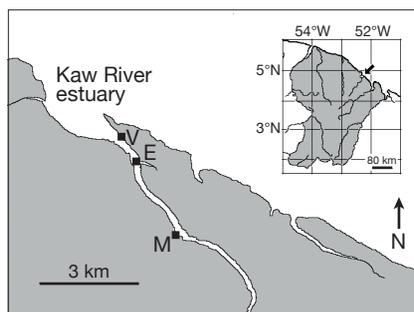


FIG. 1. — Location of the three sampling stations of the Kaw River estuary (French Guiana). Abbreviations: E, estuary; M, mangrove creek; V, mud flat.

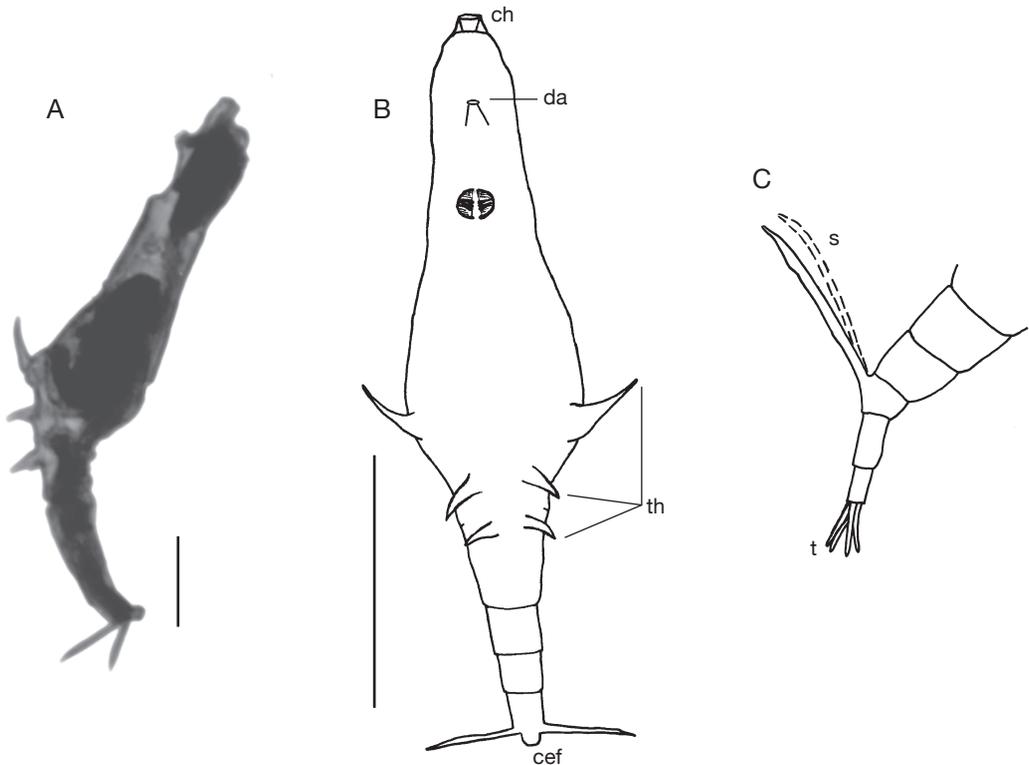


FIG. 2. — *Dissotrocha guyanensis* n. sp.: **A**, lateral view; **B**, dorsal view; **C**, lateral view of foot end. Abbreviations: **cef**, contracted end of the foot; **ch**, contracted head; **da**, dorsal antenna; **s**, spurs; **t**, toes; **th**, thorns. Scale bars: A, 50 μ m; B, 100 μ m.

SYSTEMATICS

Family PHILODINIDAE Ehrenberg, 1838
Genus *Dissotrocha* Bryce, 1910

Dissotrocha guyanensis n. sp.
(Fig. 2)

TYPE LOCALITY. — Kaw River estuary (French Guiana), mud flat station (V).

TYPE MATERIAL. — Holotype: ♀ mounted on a slide (MNHN AM 871); paratypes: 3 ♀♀ mounted on slides (MNHN AM 875).

DIAGNOSIS. — Among the bdelloids, *D. guyanensis* n. sp. is easily distinguished due to the presence of four toes and three pairs of strong dorsal thorns. Two of the pairs are located at the end of the second pseudosegment of the trunk (the first one being more lateral), and the third is situated at the third pseudosegment of the trunk. The foot bears two acutely pointed, long spurs. The rami have

three median big teeth with many minor teeth.

MEASUREMENTS (in μ m). — Total length 280-330, spur length 40-50.

OCCURRENCE. — Encountered at the three stations of the Kaw River (Fig. 1), in the wet season, during the spring and neap tides, and in the dry season.

DESCRIPTION

The anterior part, especially the corona, is inconspicuous in the preserved state, except for the dorsal antenna, which is slightly protruding in lateral view. The trunk is composed of three pseudosegments. The second pseudosegment is the widest, and the third is the narrowest. The posterior part of the body bears three pairs of spines: the first pair is the biggest and appears dorso-laterally on the larger part of the second pseudosegment, pointing forward. The two others are on the second and the third segment, respectively, and both point backward.

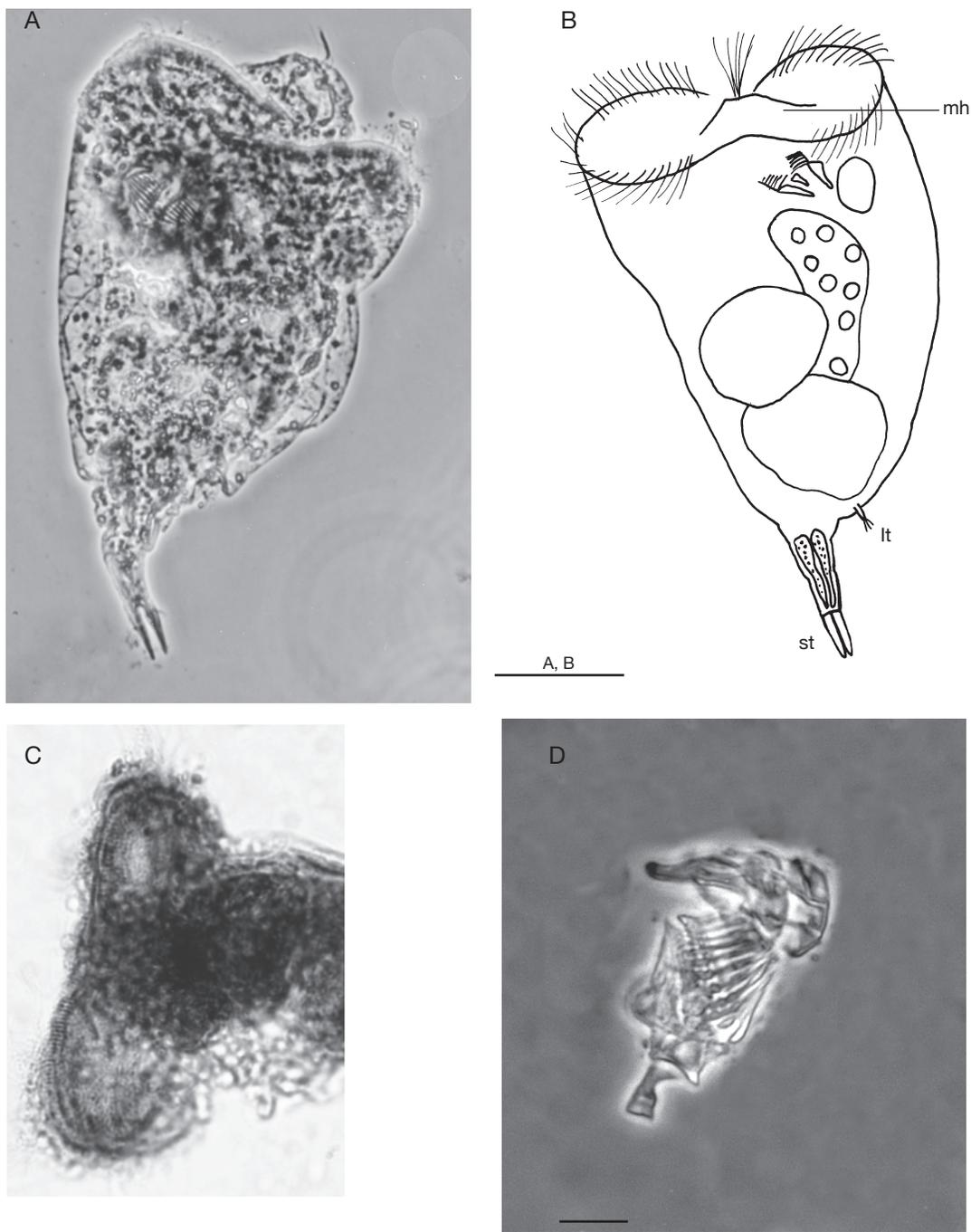


FIG. 3. — *Epiphanes desmeti* n. sp.: **A**, dorsal view; **B**, ventral view; **C**, corona; **D**, trophi. Abbreviations: **lt**, lateral tentacles; **mh**, medial hump; **st**, stout toes. Scale bars: A, B, 50 μ m; D, 10 μ m.

DISCUSSION

The French Guianan form undoubtedly belongs to the genus *Dissotrocha* in view of its four toes, long spurs and viviparity (Donner 1965). To date, two species with very long toes, *D. aculeata* (Ehrenberg, 1832) and *D. hertzogi* Hauer, 1939, have been recognized as belonging to the genus.

Although *D. aculeata* shows great variability (Berzins 1982a), the French Guianan taxon cannot be related to this group. Indeed, some of the characters appear more related to *D. hertzogi*, and particularly to *D. hertzogi aculeata* Koste, 1996 from S Africa. The foot of *D. guyanensis* n. sp. has five articles as in *D. hertzogi* (three in *D. aculeata*), the third bearing two long spurs. Although not as long as those of *D. hertzogi* (40-50 µm versus 80-90 µm), these spurs are likewise straight, equally wide from the base to the tip, and acutely pointed. The distal point is about 1/5 the length of the entire spur. This shape is very different from that of *D. aculeata*, which is curved with an enlarged basis. In addition, the number and position of the thorns are characteristic: the posterior part of the body only bears three pairs of spines, whereas in *D. aculeata* the spines are spread out all over the trunk.

These characters seem sufficient to distinguish a new species.

Family EPIPHANIDAE Bartos, 1959

Genus *Epiphanes* Ehrenberg, 1832

Epiphanes desmeti n. sp.

(Fig. 3)

TYPE LOCALITY. — Kaw River (French Guiana), estuary station (E).

TYPE MATERIAL. — Holotype: ♀ mounted on a slide (MNHN AM 874); paratypes: 10 ♀♀ preserved in an Eppendorf tube (MNHN AM 870).

DIAGNOSIS. — Small species with a conical body that is prolonged by a foot having two equal toes. The trophi are of the malleate type with 10 to 14 teeth in the uncus. The three first teeth have a jointed base.

MEASUREMENTS (in µm). — Length of the body 140 to 200; foot 31.2-36.4; toes 15.6-18.2; unci length 20.8.

TABLE 1. — Size range of tropical taxa of *Epiphanes* Ehrenberg, 1832 (length in µm). Abbreviation: DRC, Democratic Republic of Congo.

	<i>E. desmeti</i> n. sp.	<i>Epiphanes</i> sp. (De Smet 1989)	<i>Veltae</i> <i>mesembrinus</i>
Locality	Guiana	DRC	Madagascar
Body	148-200	150-193	255-260
Foot	31.2-36.4	47	?
Toes	15.6-18.2	16-17	25-28

OCCURRENCE. — This species was encountered at very low numbers at the three sampling stations (Fig. 1), during spring tide as well as during neap tide. The African specimens of *E. desmeti* n. sp., collected by De Smet in a small, polluted pond ("manioc retting, washing and bathing"), apparently show a predilection for organically loaded water, which is also the case in French Guiana. *Epiphanes desmeti* n. sp. could be a tropical vicariant of *E. senta* (O. F. Müller, 1773).

DESCRIPTION

Conical body with an enlarged anterior part (112 µm) that progressively tapers towards the foot. The foot is composed of three segments, the third being the longest. Two equal toes are almost as long as the last foot segment. The integument is soft. Despite the absence of a true lorica, some specimens were fully extended in the preserved condition. The stout toes are equally long, elongate-conical. Two lateral tentacles are located just above the first foot pseudosegment. The corona is composed of two parts that appear spiral when spread out, with a medial hump bearing a frontal tentacle or sensory seta. The mastax (trophi malleate) relates to the genus *Epiphanes*. The unci have 10 to 12 teeth, with the first three fused at their base as figured by De Smet (1988, 1989).

DISCUSSION

To our knowledge, De Smet (1988, 1989) provides the only description of a very similar specimen from Kiyendi in the Bas-Zaïre (now Democratic Republic of Congo), but with 14 teeth in the uncus. According to the mastax type, the author ranks it without any doubt in the genus *Epiphanes*. All other species of similar morphology (conical body with short foot and toes) have less than seven uncus

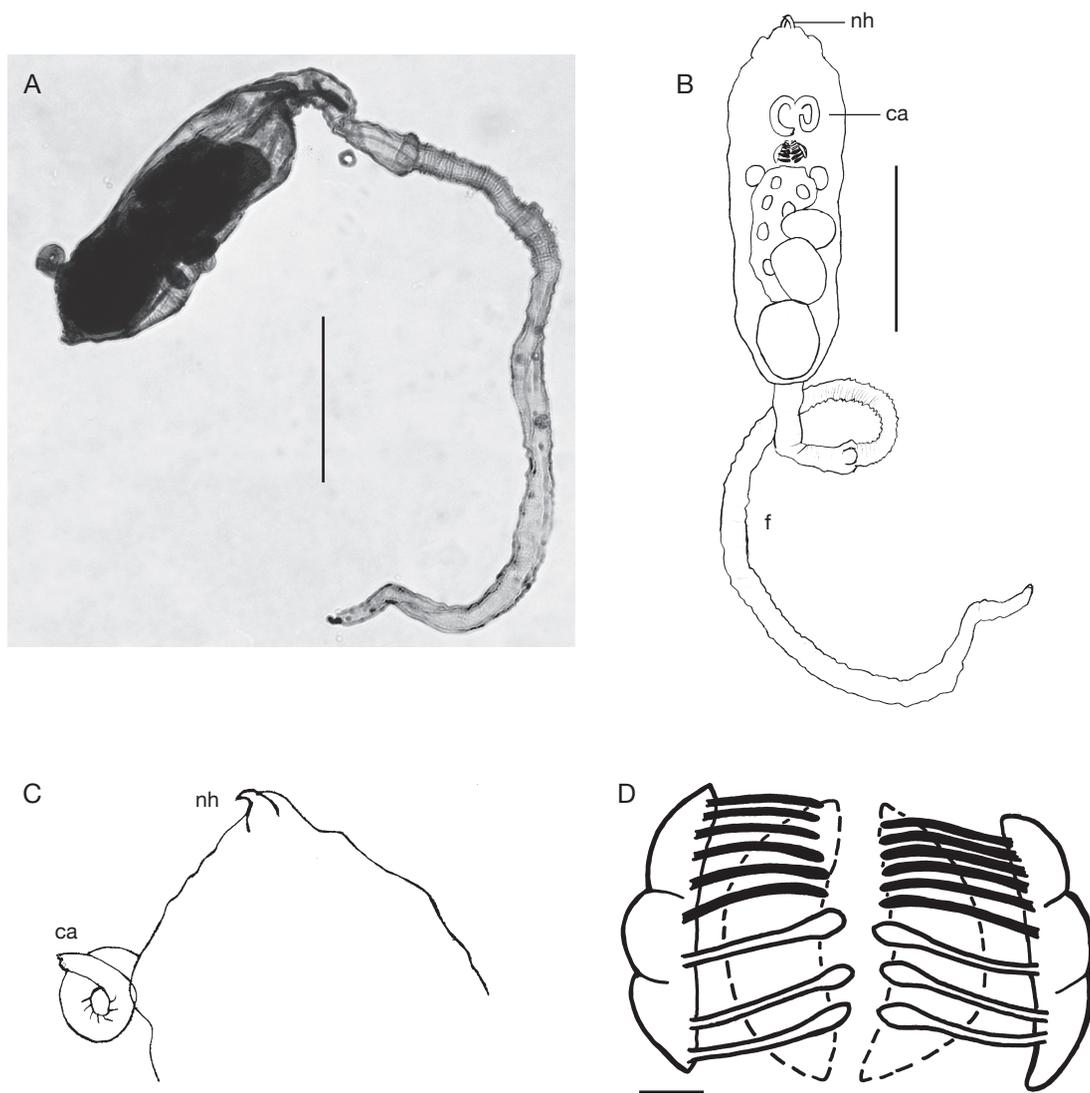


FIG. 4. — *Floscularia curvicornis* n. sp.: **A**, lateral view; **B**, ventral view; **C**, head; **D**, trophi. Abbreviations: **ca**, curled antenna; **f**, foot; **nh**, neck hooks. Scale bars: A, B, 50 μ m; D, 10 μ m.

teeth (Koste 1978). Berzins (1982b) described under *Veltae mesembrinus*, an “odd-looking” form of *Epiphanes* from Madagascar, which differs from our species by its larger size, longer and asymmetrical toes (as shown in Table 1), and with the first foot pseudosegment being the longest (versus the third one here).

Family FLOSCULARIIDAE Harring, 1913
Genus *Floscularia* Cuvier, 1798

Floscularia curvicornis n. sp.
(Fig. 4)

TYPE LOCALITY. — Kaw River estuary (French Guiana), mangrove swamp station (M).

TYPE MATERIAL. — Holotype mounted on slide (MNHN AM 868); paratype mounted on slide (MNHN AM 869).

OTHER MATERIAL EXAMINED. — Same locality, 1 specimen photographed.

DIAGNOSIS. — The species is characterised by two long and curled ventral tentacles, a morphological character not seen in other species to date.

MEASUREMENTS (in μm). — Trunk length 185-300, trunk width 80, foot length up to 600, ventral tentacles length 50-60.

OCCURRENCE. — Mangrove swamp station (M, Fig. 1) during spring tide (outflow).

DESCRIPTION

The divided corona (four lobes) and the presence of two small neck hooks are evidence that it belongs to the genus *Floscularia* Cuvier, 1798 (see Segers 1997).

A sheath, usually present in all members of the genus (Koste 1972; Segers 1997; Fontaneto *et al.* 2003) was not seen. The foot is very long (400-600 μm), more than twice the length of the trunk. On the contracted individual, a small dorsal antenna is situated at the base of the hooks. A specific character is the presence of two long, lumbar and curled antennas, widely separated at their base (= ventral tentacles "apically" displaced). There is no apical cuticular wing-like structure as in *F. noodti* (Koste, 1972).

Unci formula: three big teeth followed by approximately six thinner teeth.

Family TESTUDINELLIDAE Bartos, 1959

Genus *Testudinella* Bory de Saint-Vincent, 1826

Testudinella haueriensis Gillard, 1967

(Fig. 5)

TYPE MATERIAL. — Because of the loss of type specimens (no trace of holotype in Belgium after extensive searching by Segers) and with the original descriptions limited to morphology, a neotype is here designated: ♀ from French Guiana, mounted on slide (AM 872).

OTHER MATERIAL EXAMINED. — 6 specimens preserved in an Eppendorf tube (AM 873).



FIG. 5. — *Testudinella haueriensis* Gillard, 1967. Scale bar: 50 μm .

DIAGNOSIS. — The large Guianan specimens of *T. haueriensis* are characterised both by a strong spine at the middle of the anterior aperture and by ramified gastric glands and, to a lesser degree, vitellogen.

MEASUREMENTS OF GUIANAN SPECIMENS (in μm). — Total body length 280-335 (anterior spine included), body width 215-235, frontal spine length 31-44.

OCCURRENCE. — Estuary station (E, Fig. 1) during the spring tide (outflow), and sporadically in a sample from the mangrove swamp (M, Fig. 1) (neap tide, inflow) and at the mud flat station (V, Fig. 1) (neap tide and spring tide).

DISCUSSION

Testudinella haueriensis was described in terms of morphological criteria by Gillard from the Maica Lake within the Amazon watershed. A similar species (or the same?), but larger, was observed by Koste (1972) and Koste *et al.* (1983) at the same location and was considered to be a subspecies named *T. mucronata haueriensis* (Gillard, 1967). Unfortunately, none of these reports gives any indication about their anatomy. Nevertheless, referring to the catalogue of the Academy of Natural Sciences of Philadelphia (ANSP) Rotifer Collection, established by Jersabek *et al.* (2003), the specimen collected in Florida and mounted by Myers under the No. ANSP 36 possesses very ramified gastric glands and vitellogen.

A similar giant (350 μm) form from the Ivory Coast, but lacking a frontal spine, was described as *T. dendradena* by De Beauchamp (1955). This author, however, discovered after the publication of his note that this *Testudinella* had already been described and

TABLE 2. — Characteristics of six tropical geographical forms of *Testudinella* Bory de Saint-Vincent, 1826. *, without anterior spine.

	Body length* (μm)	Body width (μm)	Anterior median dorsal spine (μm)	Ramified glands
<i>T. haueriensis</i> Gillard, 1967	260	222	28	?
<i>T. haueriensis</i> (from Panama, Haring 1915)	300	275	40	yes
<i>T. haueriensis</i> (from Guiana)	250-300	215-235	31-44	yes
<i>T. mucronata haueriensis</i> Koste, 1983	316-500	240-360	36	?
<i>T. (Pterodina) "trilobata"</i> Rousselet, 1901	320-350	\approx 300	0	yes
<i>T. dendradena</i> De Beauchamp, 1955	350	\approx 320	0	yes

figured by C. F. Rousselet (in an addition to the note of Kirkman [1901], on rotifers from Natal) under the name *T. (Pterodina) "trilobata"*, which was inappropriate according to Haring (1915). In his revision of 1978, Koste considers these last two forms as subspecies of *T. patina*, even though the anatomy of *T. patina* differs (De Beauchamp 1955). Finally, a succinct description of a form similar to the previous species was made by Daday (*in* De Beauchamp 1955) from rotifers of Paraguay, under the name *T. (Pterodina) mucronata* Gosse, 1886. All these reports are confusing in the systematics of *Testudinella*, especially between the *patina* and *mucronata* groups. Nevertheless, De Smet (2005) observes notable differences in the morphology of the trophi (SEM) between *T. haueriensis* and *T. mucronata* that also justifies the distinction of the two species.

Reviewing the *Testudinella* literature, we can make the following observations: based on its size (<150 μm) and anatomy, *T. mucronata* can be linked to the *patina* group (as done by Koste 1978); further, the two species *T. mucronata* and *T. patina* have been observed cohabiting (Hudson & Gosse 1886), and they are both cosmopolitan and common in temperate freshwaters. They differ by the presence/absence of a medio-anterior frontal spine.

The group of tropical forms, all of large size (> 250 μm), seem to be heterogeneous (as shown in Table 2). The so-called *T. "trilobata"* of Rousselet (Kirkman 1901) and *T. dendradena* De Beauchamp, 1955 show the same peculiar anatomy, with ramified gastric glands and vitellogen, and with no anterior spine. On the other hand, *T. haueriensis* (Gillard 1967) and the giant form described by Koste (1972) possess a dorsal mucron, but the structure of the

gastric glands and vitellogen are unknown. Haring (1915) described, from the Black Swamp in Panama, a ramified vitellogen form with a long and slender spine on the dorsal margin of the anterior median lobe, and noted the presence of the same in Guatemala (Juday collection) and Paraguay (Daday 1905). The French Guianan specimens accord perfectly with the description of Haring. The distribution of all of these ramified vitellogen and gastric gland forms seems to be exclusively tropical.

Therefore, the problem is to decide whether the larger size, presence of a medio-antero-dorsal mucron, and morphology of the gastric glands and vitellogen are valuable specific criteria. As anatomic characters can be considered for other families (Pourriot 1989), why not here? It thus appears to be necessary to examine both morphology and anatomy to identify the genus *Testudinella*.

Family SYNCHAETIDAE Remane, 1933
Genus *Synchaeta* Ehrenberg, 1832

Synchaeta arcifera Xu, 1998
(Fig. 6)

MATERIAL EXAMINED. — 10 ♀♀ in an Eppendorf tube (MNHN AM 867); 6 ♀♀ in an Eppendorf tube (laboratory Écosystèmes lagunaires, University Montpellier II).

DIAGNOSIS. — Easily distinguished from the other members of the genus by the conical and acute dorsal extension of the integument and by the two dorsal horn-like appendages. Contracted animals take the shape of a crescent.

MEASUREMENTS (in μm). — Body length \approx 150 (more or less contracted animals). Trophi: total length 66,

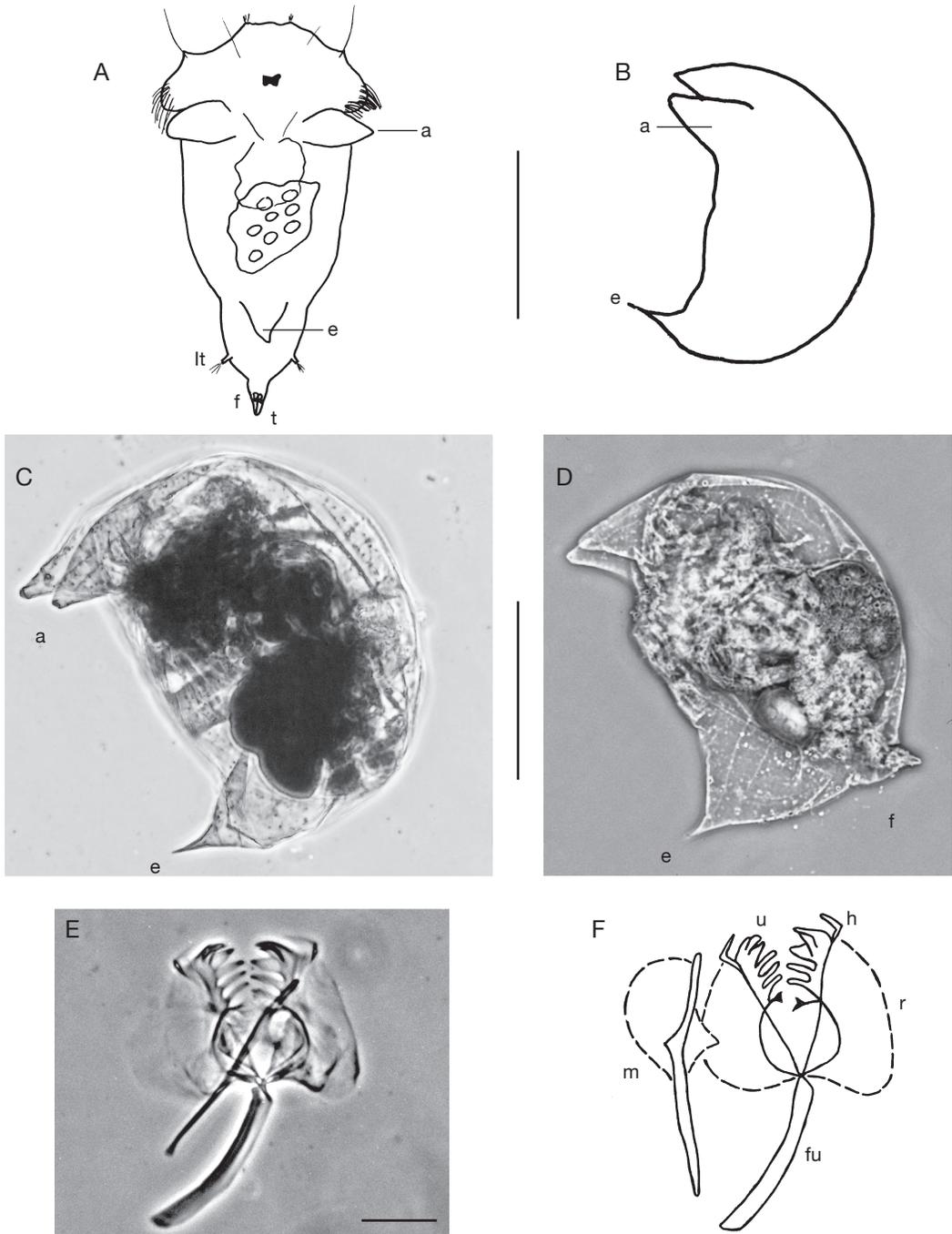


FIG. 6. — *Synchaeta arcifera* Xu, 1998: **A**, dorsal view; **B**, **C**, contracted specimens, lateral view; **D**, specimen with extruded foot; **E**, trophi, dorsal view. Abbreviations: **a**, horn-like appendage; **e**, conical extension of the integument; **f**, foot; **fu**, fulcrum; **h**, hook; **lt**, lateral tentacle; **m**, manubrium; **r**, ramus; **t**, toe; **u**, uncus. Scale bars: A-D, 50 μ m; E, 15 μ m.

TABLE 3. — Characteristics of four species of *Synchaeta* Ehrenberg, 1832 with horn-like appendages.

	Appendices under auricles	Red eyes	Foot toes	Body length (µm)	Conical extension	Contracted form
<i>S. arcifera</i> Xu, 1998	2 "horn-like", curved forward, dorsal	double	present, 2 small toes	91-150	dorsal	crescent
<i>S. bicornis</i> Smith, 1904	2 "horn-like", curved forward, dorsal	double	present, 2 small toes	200-300	without	
<i>S. fennica</i> Rousselet, 1909	2, large, lateral	double	present, 2 small toes	200-300	without	
<i>S. bacillifera</i> Smirnov, 1933	2, dorsal	single	present, 2 small toes	250-300	without	

fulcrum 35, manubrium 44, ramus 16, uncus 14. Subitaneous egg with thin shell and short spines: 42 × 39.

OCCURRENCE. — Estuary station (E, Fig. 1), mud flat station (V, Fig. 1), mangrove swamp station (M, Fig. 1).

DESCRIPTION

Generally, contracted females appear crescent-shaped with three dorsal conical points: two located in the front part of the animal and the third in the hind part. In some rare extended specimens, the paired horn-like appendages (L = 36 µm, W max = 13 µm) are located below the ciliated auricles and can be pointing forward as in *S. bicornis* Smith, 1904. The third point of the crescent is made by a basal, globular appendage tapering conically and strongly. In some animals, the small globular foot was extruded ventrally to this postero-dorsal appendage (see Fig. 6D). The foot has two tiny pedal glands (2.5 µm) and terminates with two small appressed toes (L = 5 µm).

The head, with a ciliated corona, was mostly retracted, but apparently convex judging from three more or less extended specimens. The species has a double cerebral eye and tubular lateral tentacles located below the third part of the trunk, as in *S. bacillifera* Smirnov, 1933.

Trophi: virgate of the Synchaetidae type; mastax large, conical, filling about one third of the anterior part of the body. Unci composed of a well separated hook preceding three teeth joined into a small plate, followed by three (left uncus) or two (right uncus) distinctly separated teeth. A last and small tooth of each uncus looks like a ginkgo leaf.

DISCUSSION

The crescent shape of fixed animals, the acute postero-dorsal appendage, and the ginkgo leaf-shaped tooth of both unci agree with the description of *S. arcifera* by Xu Youqin (1998) in a succinct Chinese publication, although his description differs particularly by the absence of the foot and toes. Xu clearly states (p. 167) that "no foot and toes can be observed whether living or in formalin": that is not the case in our specimens. This *Synchaeta* needs careful comparison with *S. bicornis*, *S. fennica* Rousselet, 1909 and *S. bacillifera*, species with horn-like appendages (as shown in Table 3).

REMARKS

In view of the scarcity of *S. arcifera* and of the very succinct and probably incomplete original description, it seemed useful to deposit specimens of Guianan animals and to describe anew this very rare species.

REMARKS ON SPECIES ECOLOGY

Of the five species described in this paper, only *Synchaeta arcifera*, a true planktonic species, was encountered during both the wet season (in 4 samples/18) and the dry season (in 20 samples/32, with a highest density of 12 ind./l).

The genus *Synchaeta* is widespread in fresh, brackish and sea water (Ruttner-Kolisko 1974), with at least half of its 34 species occurring in marine/brackish waters (Hollowday 2002). Some of them are euryhaline and show varying tolerance limits

to salinity, as described for a Mediterranean lagoon (Rougier *et al.* 2000). In the Kaw River estuary, the conductivity varies between 25 and 40 mS during the dry season, and between 0.1 and 6 mS during the wet season, with the temperatures being similar between the two periods (27-30°C). During the dry season, a coastal type plankton develops with rotifers (*Synchaeta arcifera*, *S. vorax* Rousselet, 1902, *S. cecilia* Rousselet, 1902, *S. neapolitana* Rousselet, 1902, *Trichocerca marina* Daday, 1890), tintinnids ciliates (*Tintinnopsis* spp. and *Codonellopsis* sp.) and copepods (*Paracalanus crassirostris* Dahl, 1894, *Oithona hebes* Giesbrecht, 1891). The phytoplankton is mainly composed of Bacillariophyceae and Dinophyceae. During the wet season, *S. arcifera* was the only member of Synchaetidae encountered, except once when it was accompanied by *S. cecilia*.

Unlike *S. arcifera*, the four other species described from the Kaw estuary, *Dissotrocha guyanensis* n. sp., *Epiphanes desmeti* n. sp., *Floscularia curvicornis* n. sp. and *Testudinella haueriensis*, were encountered only during the rainy season, suggesting that they were probably carried away with the freshwater flow. Like *Synchaeta*, *Epiphanes desmeti* n. sp. is planktonic, while the three others are tychoplanktonic. These species were accompanied by other rotifers (*Bdelloida* Hudson, 1884, *Colurellidae* Bartos, 1959, *Lecanidae* Bartos, 1959, *Trichocercidae* Remane, 1933, *Notommatidae* Remane, 1933, etc.), cladocerans (*Chydoridae* Dubowski & Grochowski, 1894, *Macrothricidae* Norman & Brady, 1867, *Ilyocryptidae* Smirnov, 1976, *Sididae* Baird, 1850), and some copepods. The densities of this continental plankton type were very low (8-10 ind./l, about 50 times lower than the density observed during the dry season). The phytoplankton was dominated by the Chlorophyceae (> 80%).

CONCLUSION

There is no question that our present knowledge of the Kaw River estuary rotifers is incomplete: 1) only three stations have been studied systematically; and 2) due to the considerable load of particles in suspension, it was very difficult to make an exhaustive analysis of the samples. Nevertheless, the sam-

ples collected during the two seasons (wet and dry, 1998-2001) have already permitted the discovery of five species of particular interest. Four of them are new for the fauna of South America, underlining the specificity of this fauna (endemism).

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