

TAXONOMICAL STUDIES ON *FRIDERICIA* (ENCHYTRAEIDAE, OLIGOCHAETA) ALONG THE CHANGJIANG (YANGTZE) BASIN

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Abstract Four terrestrial species of *Fridericia* along the Changjiang Basin are described. Among them, *Fridericia chongqingensis* sp. nov. is diagnosed by the much branched (13—19 twigs) peptonephridia, the midventral nephridial efferent ducts, the longer sperm funnel, the well-developed seminal vesicle, the presence of 2 (sometimes 3) sessile globular spermathecal diverticula, and one small accessory gland cell (brown *in vivo*) at each ectal orifice. While *Fridericia paroniana* Issel, 1904 and *F. maculata* Issel, 1904 are recorded from China for the first time.

Key words Enchytraeidae, Oligochaeta, *Fridericia*, new species, new record.

1 Introduction

Since Michaelsen (1889) erected the genus *Fridericia*, about 130 species in the genus have been described throughout the world (Nielsen & Christensen, 1959, 1961, 1963; Dózsa-Farkas *et al.*, 1985, 1992; Römbke & Dózsa-Farkas, 1996; Schmelz & Römbke, 1998). In China, only 8 species of the genus were known, among which, *F. bulbosa* (Rosa, 1887), *F. bulboides* Nielsen & Christensen, 1959, *F. carmichaeli* Stephensen, 1915, *F. callosa* (Eisen, 1878), *F. alba* Moor, 1895, were reported (Chen, 1959; Liang & Xie, 1992; Wang *et al.*, in press; Xie *et al.*, in press).

Recently, a faunal survey of enchytraeids was carried out along the Changjiang Basin. Among the collected specimens, 4 terrestrial species of *Fridericia*, including one new species and 2 new records in China, were observed and the descriptions are presented herein.

2 Material and methods

Worms were extracted by using the wet-funnel method (O'Connor, 1962) and fixed in 10% formalin. Observations were made on specimens both *in vivo* and after fixation. For preserved materials, whole worms or dissected specimens were stained in borax carmine or paracarmin and mounted in Canada balsam. Measurements in the descriptions are based on fixed specimens. Types of the new species are deposited in Specimen Room of Invertebrates, Institute of Hydrobiology, the Chinese Academy of Sciences.

3 Results

Fridericia chongqingensis sp. nov. (Fig. 1 A—E)

Description Body length 8—11.5 mm. Segments 44—73. Paleopidermal glands well-developed, arranged transversely, 3—4 rows per segment. Head pore in 0/1, large, longitudinally elongate. Dorsal pores from VII onwards. Chaetae straight, with distinct ental hooks, 100—104 μm in maximal length and ca. 7 μm in maximal width. Chaetae distribution: (1), 2, 3, 4, (5)—3, 4, 5: 2, 3, 4, 5, (6)—(1), 2, 3, 4. Clitellum in XII—1/2XIII, clitellar glands oblong, irregularly distributed, not interrupted dorsally and ventrally. Copulatory glands absent. Spermathecal pores midlateral of 4/5. Male pores midventral of XII. Both lateral and ventral chaetae of XII absent.

Brain oblong in dorsal view, convex anteriorly, truncate or round posteriorly, 130—136 μm long and 90—92 μm wide. Septal glands 3 pairs, all with ventral lobes. No secondary septal glands. Peptonephridia much branched (Fig. 1A), extending backwards to V, with 5—8 middle twigs (some divided into sub-twigs) and 8—11 terminal twigs (type c, *sensu*, Nielsen & Christensen, 1959). Chloragogen cells well-developed, from VI onwards, cylindrical, filled with golden-brown granules, 14 μm high and 8 μm wide. Chylus cells in XIV—XVII. Blood colorless. Dorsal vessel originating in XX—XXIII. Coelomic fluid containing many detached chaetae. Nucleated coelomocytes discoid, up to 20—40 μm in diameter, with regular outline, evenly granuated (type c, *sensu* Möller, 1970); anucleated corpuscles oval, up to 6—8 μm in diameter (Fig. 1C). 5 pairs preclitellar nephridia at 6/7—10/11, with efferent ducts arising from midventral of postseptale (Fig. 1B). Seminal vesicle large, occupying the whole of segments X—XII. Sperm funnel cylindrical, soft-bodied, 610—620 μm long, 150—158 μm wide, covered by pale, large, granular cells; collar narrower than funnel (97—100 μm) (Fig. 1E). Vasa deferentia confined to XII, much coiled irregularly. Penial bulbs semi-spherical in lateral view, 230—236 μm long, 110—115 μm wide and 93—95 μm high. No egg sacs. 1—2 mature egg at a time. Spermathecae in V, with a narrow ental duct (long ca. 15 μm). Two ental duct connecting with oesophagus respectively. Ampulla conical, 105—110 μm long and 128—132 μm wide; with 2 (sometimes 3 in some specimens from Nanning) sessile globular diverticula (58—60 μm in size) at the base of ampulla. Spermatozoa scattered in the lumen of ampulla and diverticula. Ectal duct 468—472 μm long and 23—25 μm wide. One small ectal gland cell (brown *in vivo*) attached at each ectal pore.

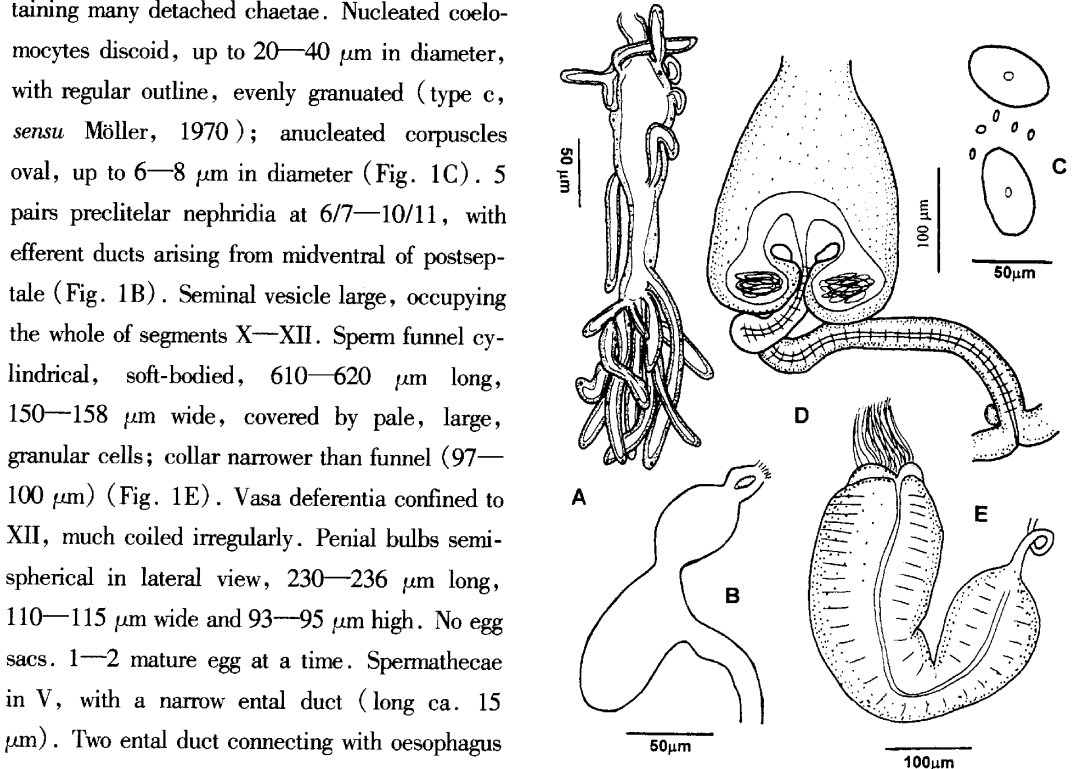


Fig. 1 *Fridericia chongqingensis* sp. nov.

A. Peptonephridium; B. Nephridium in 15/16;

C. Coelomocytes; D. Spermathecae; E. Sperm funnel.

of ampulla. Spermatozoa scattered in the lumen of ampulla and diverticula. Ectal duct 468—472 μm long and 23—25 μm wide. One small ectal gland cell (brown *in vivo*) attached at each ectal pore.

Type material Holotype, Whole mounted specimen, Mt. Baoding, Chongqing City, China, bam-

boo root. Moist, loose, brown soil with coarse mineral particles. November, 1997. Paratypes, 5 whole mounts and one dissected specimen, time and locality same as holotype.

Other material examined 20 specimens also from type locality; 5 specimens from soil of pine forests, Chongqing City, China (November, 1997); 6 from soil of Nanhu Park, Nanning City, Guangxi Zhuang Autonomous Region (September, 1995).

Etymology Named "*chongqingensis*" from the type locality.

Remarks Regarding the general morphological characters, the new species is closely related to *F. multisegmentata* Wang *et al.*, *F. perrieri* (Vejdovsky, 1877) and *F. agricola* Moore, 1895. However, besides in addition to the much branched peptonephridia and the presence of ectal gland cell at spermathecal pore, the new species also differs from *F. multisegmentata* by the less body length, the midventral nephridial efferent ducts, the more anterior origin of dorsal vessel and the longer sperm funnel; from *F. perrieri* by the fewer chaetae per bundle, the more posterior origin of dorsal vessel, the longer sperm funnel, the well-developed seminal vesicle and the morphology of spermatheca; from *F. agricola* by the more chaetae per bundle, the truncated brain and the midventral nephridial efferent ducts. The details of difference among them are given in Tab. 1.

Tab. 1 Comparison of *Fridericia chongqingensis* sp. nov. with allied species

	<i>F. chongqingensis</i> sp. nov.	<i>F. multisegmentata</i> Wang <i>et al.</i> , 1999	<i>F. perrieri</i> (Vejdovsky, 1877)	<i>F. agricola</i> Moore, 1895
Length (mm)	8 - 11.5	20 - 28	10 - 25	20 - 25
Segments	44 - 73	73 - 80	33 - 64	65 - 72
Chaetae/bundle	2 - 5(6)	2 - 4	4 - 8	2 - 4(5)
Clitellum	XII - 1/2XIII	XII - XIII	XI - 1/2XIII	XII - 1/2XIII
Posterior of brain	truncated	truncated	round	round
Peptonephridia	13 - 19 branches	ca. 11 branched	branched	5 - 7 branches
Origin of dorsal vessel	XX - XXIII	XXV - XXVI	XVI - XXI	?
Efferent duct of nephridia	midventral	terminal	ventral	ventral
Sperm funnel (length: width)	4 - 4.5:1	2.2:1	2.5 - 3:1	4.5 - 1
Seminal vesicle	well developed	well developed	poorly developed or absent	well developed
Spermathecae	lumen of ampulla and 2 diverticula inseparable; with one ectal glands (brown <i>in vivo</i>)	lumen of ampulla and 2 diverticula inseparable; no ectal glands	lumen of ampulla and 2 diverticula separable; canal of ectal duct coiled before reaching ampulla; no ectal glands	lumen of ampulla and 2 diverticula separable; no ectal glands
Distribution	China	China	Europe, Africa	USA, Brazil

Fridericia bulbosa (Rosa, 1887) (Fig. 2A, B)

Neoenchytraeus bulbosus Rosa, 1887:2.

Fridericia bulbosa Nielsen & Christensen, 1959: 72, Fig. 71; Chen, 1959: 18, Fig. 27; Healy, 1979: 55; Möller, 1971: 147, Fig. 7; Rota, 1994a: 250 - 251; Rota, 1995: 204.

Description Body length 9 - 10 mm. Segments 49 - 54. Epidermal glands 1 - 3 rows in one seg-

ment. Chaetae 2 per bundle throughout. Clitellum in XII - 1/2XIII, the gland cells scattered. Peptonephridia commencing as wide tube and gradually tapering in IV - V, with 2 - 3 terminal or subterminal branches. Chylus cells in XIV - XVI. Dorsal vessel originating in XVI - XVII. Coelomocytes: nucleated type *a*, up to 25 - 30 μm long; anucleate 4 - 8 μm . Seminal vesicles absent. Sperm funnel 1.5 - 2 times longer than wide, with collar narrower than the funnel (Fig. 2B). No egg sacs. Only one mature egg. Spermathecae confined to V, through an ental duct communicating with the dorso-lateral part of oesophagus. Ampulla onion-shaped, without diverticula. Ectal duct stout, with one medium-sized ectal gland at the ectal orifice (Fig. 2A).

Locality Bamboo forest in Chongqing City (November, 1997).

Remarks The characters of our specimens conform to the descriptions given by Rosa (1887) and Nielsen & Christensen (1959). Critical characters for identification are: small body size, chaetae usually 2 per bundle, peptonephridia short, unbranched or with 2 - 3 terminal or subterminal branches, nucleated coelomocytes without granulation, long spermathecal ectal ducts, ectal gland medium-sized. In morphological characters, *Fridericia bulbosa* is most close to *Fridericia bulboides* Nielsen & Christensen 1959, but, it is easily distinguished from *bulboides* by the presence of only 2 chaetae in the preclitellar region (4 in *bulboides*), short and with 2 - 3 terminal or subterminal branches of peptoniphridia (slend and unbranched in *bulboides*) and one medium-sized ectal gland at ectal orifice.

Geographic distribution Denmark, Armenia, America, Ireland, Germany, Italy, Tunisia, Algeria, China.

***Fridericia paroniana* Issel, 1904 (Fig. 2C, D)**

Fridericia paroniana Issel, 1904: 31-39; Nielsen & Christensen, 1959: 76, Fig. 74; Rota, 1995: 214.

Description Body length 5-8 mm. Segments 35-46. Epidermal glands arranged in 3-5 transverse rows per segment. Chaetae with distinct ental hook, 2 (rarely 4) per bundle, 40-60 μm long. Clitellum in XII-1/2 XIII, gland cells scattered. Brain much convex anteriorly, truncate posteriorly. Peptonephridia with 1-2 terminal or subterminal branches. Chylus cells in XIV-XVI. Nephridia from 6/7 onwards, with 5 pairs in front of clitellum, with efferent duct originating midventrally. Blood colorless. Dorsal vessel originating in XXII-XXIV. Coelomocytes: nucleated type *a*, ca. 30 μm ; anucleate large, ca. 11 μm . Seminal vesicle poorly developed. Sperm funnel 2-3 times longer than wide, with narrower collar (Fig. 2D). Spermathecae one pair, small, each with conical or cylindrical ampulla and two global, almost sessile diverticula. Two ental duct communicating separately with oesophagus in V. With one small, sessile gland at the orifice (Fig. 2C).

Locality Bamboo forest of Chongqing City (November, 1997).

Remarks The morphological characters of our specimens agree closely with the description of *Fridericia paroniana* Issel, 1904 from Europe, except some differences which are considered to be infraspecific variations. *Fridericia paroniana* much resembles *Fridericia maculata* Issel, 1904 in the number of chaetae, the few branched peptonephridia, the poor developed seminal vesicle and the spermathecae. However, it is distinguishable from *maculata* by the absence of brown epidermal glands, the well-developed accessory glands at spermathecal pore, the indistinct connection between seminal chambers of two diverticula

and the shorter diverticula.

Geographical distribution Denmark, Ireland, Austria, Italy, Morocco, Algeria, new for China.

***Fridericia maculata* Issel, 1904 (Fig. 2E)**

Fridericia maculata Issel, 1904: 31—39; Nielsen & Christensen, 1959: 79, Fig. 76; Rota, 1995: 210.

Description Body length 7.8—9.0 mm. Segments 37—38. Epidermal gland cells brown and 2—3 rows per segment. Chaetae with distinct ental hook, 2 (rarely 4) per bundle and 50—60 μm in maximal length. Clitellum in XII—1/2XIII, gland cells scattered. Peptonephridia without or with 2—4 short terminal or subterminal branches, often bent at mid-length at a right angle. Chylus cells in XIV—XVI. Nephridia from 6/7 onwards, 5 pairs in front of clitellum, with efferent duct originating midventrally. Dorsal vessel originating in XXII—XXIV. Coelomocytes: nucleated somewhat granular, with small nucleus; anucleate very small. Seminal vesicle poorly developed. Sperm funnel ca. 2 times as long as wide. Spermatheca small, with conical or cylindrical ampulla and two almost cylindrical diverticula, diverticula often bent towards ectal duct. Ectal duct short, with one small sessile gland at orifice (Fig. 2E).

Locality Bamboo forest of Chongqing City (November, 1997).

Geographic distribution Denmark, Italy, western Anotolia, new for China.

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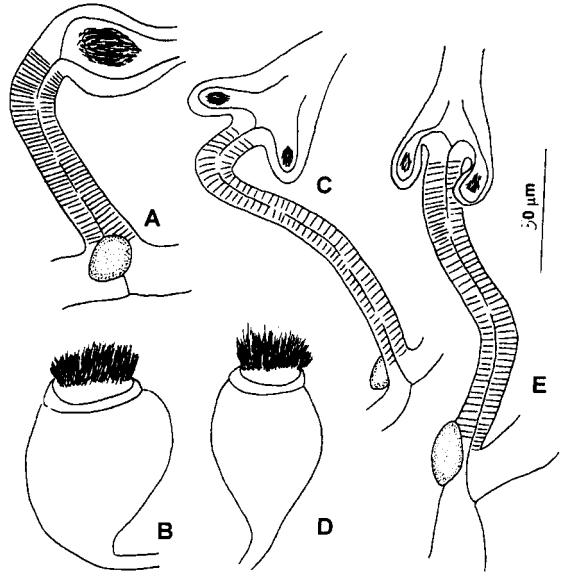


Fig. 2 *Fridericia bulbosa* (Rosa, 1887);

A. Spermatheca; B. Sperm funnel.

C, D. *Fridericia paroniana* Issel, 1904. C. Spermatheca; D. Sperm funnel. E. *Fridericia maculata* Issel, 1904. E. Spermatheca.

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