

***Fridericia liangi* sp. nov. (Enchytraeidae, Oligochaeta) from  
Changbaishan Mountain, China**

Author(s): Jing Chen and Zhicai Xie

Source: Proceedings of the Biological Society of Washington, 122(4):399-404,  
2009.

Published By: Biological Society of Washington

DOI: 10.2988/09-07.1

URL: <http://www.bioone.org/doi/full/10.2988/09-07.1>

---

BioOne ([www.bioone.org](http://www.bioone.org)) is an electronic aggregator of bioscience research content, and the online home to over 160 journals and books published by not-for-profit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Web site, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at [www.bioone.org/page/terms\\_of\\_use](http://www.bioone.org/page/terms_of_use).

Usage of BioOne content is strictly limited to personal, educational, and non-commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

***Fridericia liangi* sp. nov. (Enchytraeidae, Oligochaeta) from  
Changbaishan Mountain, China**

Jing Chen and Zhicai Xie\*

(JC, ZCX) State Key Laboratory of Freshwater Ecology and Biotechnology, Institute of Hydrobiology, Chinese Academy of Science, Wuhan, 430072, China, e-mail: zhcxie@ihb.ac.cn;  
(JC) College of Life and Science, Zao Zhuang University, Zaozhuang, 277160,  
e-mail: chj218.2000@163.com

*Abstract.*—We describe one new enchytraeid species, *Fridericia liangi* sp. nov., from Mt. Changbaishan, Jilin Province, northeastern China. It was collected from soils at the foot of Changbaishan Mountain and is distinguished from all known congeners by the following combination of characters: 1) no lateral chaetae, only ventral chaetae throughout, 2) a maximum of four chaetae in ventral preclitellar bundles, 3) one chaeta in ventral postclitellar bundles, 4) dorsal pores from VII on, 5) esophageal appendages unbranched, 6) coelomocytes without refractile vesicles, 7) clitellum girdle shaped, well developed, 8) no subneural glands, and 9) spermathecae simple.

---

The genus *Fridericia* Michaelsen, 1889 occurs worldwide, but most of the species are known from Central Europe (Nielsen & Christensen 1959, 1961, 1963; Rota & Healy 1999). The majority of *Fridericia* species are indifferent to moisture and are present in most woodland sites, including some quite dry ones, but some species are also found in wet soils (Graefe & Schmelz 1999). Since Michaelsen (1889) erected the genus, 203 nominal taxa (species and subspecies) have been assigned to *Fridericia*. Schmelz (2003), in a systematic revision of the genus, accepted 89 of 197 as valid; since then, five new species have been described (Dózsa-Farkas 2005, Schmelz & Collado 2005, Dózsa-Farkas & Cech 2006, Schlaghamerský 2007, Chen & Xie 2008), and one species has been revalidated (Rota et al. 2003). In China, only 13 species of the genus have been recorded (Wang et al. 1999, Xie et al. 1999, 2000, 2001; Chen & Xie 2008).

A series of studies has been carried out at Changbaishan Mountain (including Changbaishan Mountain Nature Reserve and hardwood forest) to investigate the structure of enchytraeid communities. In these investigations, some new enchytraeid species were found. In this paper we describe an additional new species of *Fridericia* from soil samples originating from the hardwood forest where the dominant tree is *Pinus sylvestris* var. *sylvestrififormis*. The soil was relatively dry and the humus was scarce, the litter being dominated by pine needles.

#### Material and Methods

Worms were collected from the field by taking soil samples and extracting them in the laboratory, using a standard hot/wet funnel-extracting device (O'Connor 1962, Healy & Rota 1992).

General size, color and behavior of the living specimens were recorded with a stereomicroscope. All other characters were studied with a light microscope

---

\* Corresponding author.

equipped with interference contrast optics. For the examination of the soft-bodied internal organs and surface structures, we gently pressed the living specimens between slide and coverslip in a drop of tap water. Some microscopic observations, including the body color, array and color of epidermal glands and details of internal organs, were also documented photographically *in vivo*. Drawings from whole mounts were made with the help of an Olympus drawing tube. The examined worms were preserved in 10% formalin or 70% alcohol. For additional taxonomic observations, some specimens were stained in paracarmine, dehydrated in an alcohol series, and mounted in Canada balsam. The type material of the new species is deposited in the Museum of Aquatic Organisms (MAO), Institute of Hydrobiology, The Chinese Academy of Science, China.

Unless otherwise specified in the descriptions, measurements refer to mature live specimens. Abbreviations used in the figures and photographs are: co, collar of sperm funnel; dv, dorsal vessel; ecd, spermathecal ectal duct; end, spermathecal ental duct; i, intestine; pg, pharyngeal glands; sa, spermathecal ampulla; s, spermatozoa; sf, body of sperm funnel; vc, ventral chaetae; vd, vas deferens.

*Fridericia liangi*, new species

Fig. 1 A–G

*Holotype*.—Fully mature, whole-mounted specimen, stained, JLO20080001.

*Type locality*.—Hardwood forest, Mt. Changbaishan, Jilin Province (42°15'45"N, 128°4'16"E, 705 m above sea level), dark brown forest soil under roots of Scots pine (*Pinus sylvestris* var. *sylvestrifomis*), 24 Jun 2008, coll. J. Cheng and J. Xiong.

*Paratypes*.—JLO20080002–4, three whole mounted fully mature specimens collected from the same locality and date as the holotype.

*Other material examined*.—15 mature specimens also from the type locality were

examined *in vivo*, seven were preserved in 10% formalin and the others in 70% alcohol.

*Etymology*.—The new species is named for our colleague Yanling Liang, one of the most important contributors to the knowledge of Oligochaeta in the last century.

*Description*.—Thin worms, slow movements. Transparent, pale in color (Fig. 1A). Length 8–9 mm. Diameter 0.27–0.32 mm. Segment number of specimens with clitellum 38–44 (holotype 40). Dorsal pores from VII. Epidermal glands pale, one row per segment at chaetal level, cells rectangular. Chaetae straight, simple-pointed, with distinct ental hook, those in middle of bundle shorter than outer ones; 35–45  $\mu$ m long and 4–5  $\mu$ m wide (Fig. 1E–G). Chaetal formula: 0-0: 2, 3(4)-1. No lateral bundles, ventral chaetae present in all segments from II onwards, except XII; usually 2 or 3, rarely 1 or 4 in preclitellar bundles; 1 chaeta in postclitellar bundles. Clitellum girdle-shaped, well developed but not much elevated; granulocytes small, arranged irregularly and interspersed with large hyalocytes or some specimens with absent glands in mid-dorsal part.

Brain rounded or truncate posteriorly, lateral margins converging anteriorly, ca. 175  $\mu$ m long and 75  $\mu$ m wide (Fig. 1D). Esophageal appendages short, stout, unbranched, extending to V. Three pairs of pharyngeal glands in 4/5, 5/6 and 6/7, respectively, all separated dorsally, sometimes the first pair connected dorsally, all with long and large ventral lobes (Fig. 1A). No intestinal appendages. No thickened septa. Gradual transition from esophagus to intestine. Chloragogen cells cover the gut from segment V on backwards (Fig. 1A). Dorsal blood vessel originating from XV–XVI. Five preclitellar pairs of nephridia, from 6/7 to 10/11, anteseptale almost as long as 0.50 postseptale, medial rise of efferent duct. Coelomocytes numerous. Mucocytes ovoid to spherical, without refractile vesicles, ca. 30–

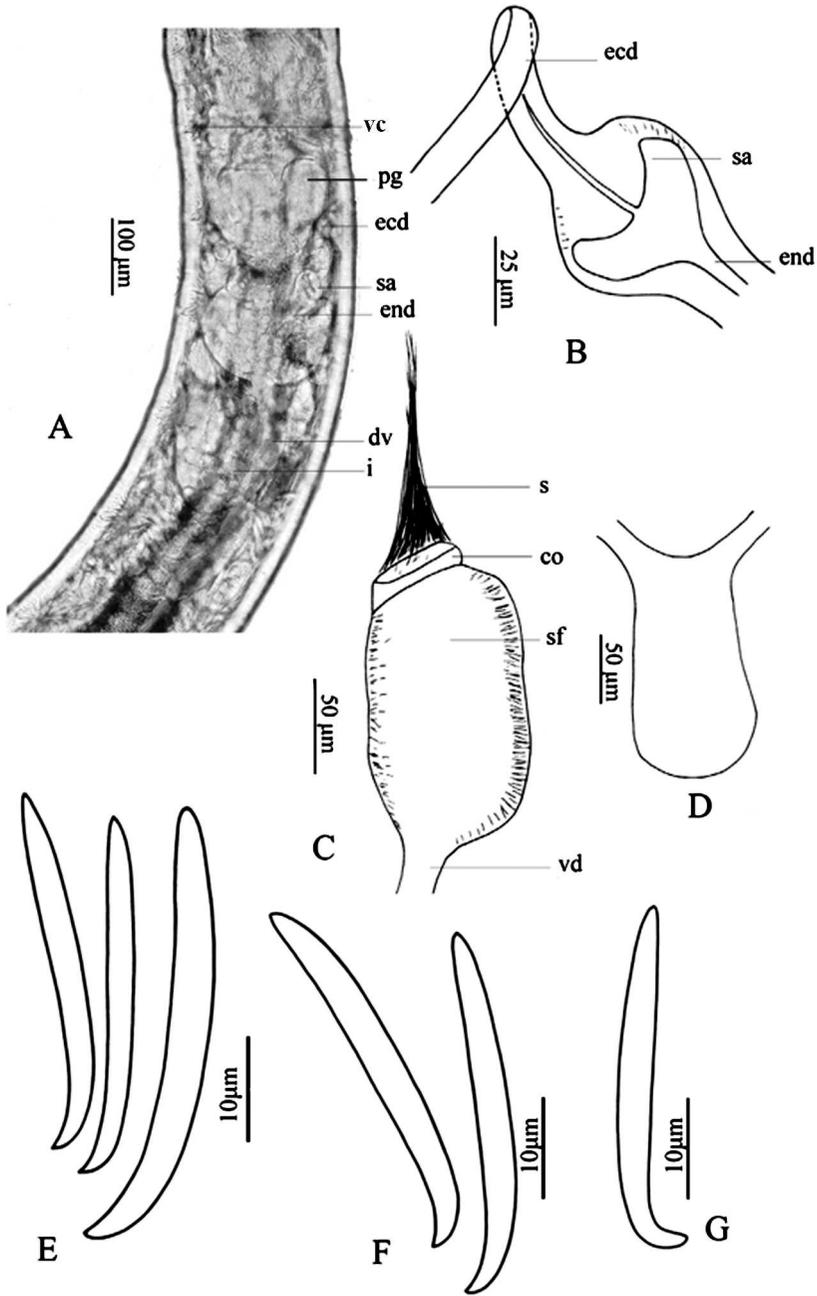


Fig. 1. *Fridericia liangi*. A, segments IV–IX, dorsal view; B, spermatheca; C, sperm funnel; D, brain; E, chaetae in VI; F, chaetae in X; G, chaeta in XIII.

40 µm in diameter. Lenticytes scarce. Chylus cells in XII–XIII, occupying two segments. Subneural glands absent. Seminal vesicle small or absent.

Sperm funnels conical to cylindrical, small, ca. 100 µm wide and 150 µm long. Sperm funnel collar of the same width as maximum diameter of the funnel body

Table 1.—Comparison of taxonomic features among four allied species of *Fridericia*.

Characters	<i>F. liangi</i>	<i>F. unisetosa</i>	<i>F. paraunisetosa</i>	<i>F. silvestris</i>
Body length (mm)	8–9	6.5–7.3	5.0–7.8	17–18
Segment number	32–46	37–55	37–55	over 60
Clitellum	girdle-shaped, glands irregularly arranged	interrupted dorsally, glands irregularly arranged	interrupted dorsally and ventrally, glands irregularly arranged	
Chaetal formula	0-0: 2, 3(4)-1	0-0: 1-1	0-0: 1-1	
Epidermal glands	pale in color, 1–2 rows	brown in color, 3–4 rows	brown in color, 3–4 rows	?
Dorsal pores	VII	VII	XIII	
Oesophageal appendages	unbranched	unbranched	unbranched	3–4 elongate branches
Origin of dorsal vessel	XV–XVI	XV–XVII	XIV–XVII	XIII–XIV or XVII
Seminal vesicle	small or absent	large, extending to X–XII	large, extending to X–XII	?
Sperm funnel (length : width)	3:2	2	3:2	?
Spermathecal ectal glands	absent	absent	absent	?
Spermathecal diverticula	absent	absent	6–8 variously sized	?
Chylus cells	XII–XIII	XII–XIII	XI–XV	1/2X–XII
Subneural glands	absent	absent	absent	?
Reference	Text	Xie et al. 2000	Xie et al. 2000	Schmelz 2003

(Fig. 1C). Spermatozoa very long, longer than local body diameter. Vas deferens forming loose loops in XII. Male copulatory organs small, ca. 100  $\mu\text{m}$  long and 75  $\mu\text{m}$  high. Bursal slits I-shaped.

Spermathecal ectal glands absent. Ectal duct ca. 15–20  $\mu\text{m}$  wide, longer than body diameter at V, proximally widened and barely projecting into ampulla. Ampullae simple, without diverticula, distal part 3–4 times as wide as ectal duct. Proximal part of ampulla forming an ental duct, tubular, slightly narrower than distal part. The two ental ducts separately connect to esophagus laterally (Fig. 1B).

*Remarks.*—Among the group of species without spermathecal diverticula, *Fridericia liangi* is chiefly distinguished by the following characters combined: 1) no lateral chaetae, only ventral chaetae throughout, 2) a maximum of three or four chaetae in ventral preclitellar bundles, 3) one chaeta in ventral postclitellar bundles, 4) dorsal pores from VII onwards, 5) esophageal appendages unbranched, 6) coelomocytes without refractile vesicles, 7) clitellum girdle shaped, well developed, 8) no subneural glands, and 9) spermathecae simple.

A remarkable character in the new species is the presence of only ventral chaetae. So far, the *Fridericia* group without lateral chaetae consisted of two valid species: *F. unisetosa* Xie, Liang, & Wang, 2000, *F. paraunisetosa* Xie, Liang, & Wang, 2000, and one nomen dubium species, *F. silvestris* Leidy, 1882. The new species is smaller than *F. silvestris* (body length ca. 17–18 mm, over 60 segments; Leidy 1882) and not as thick as *F. unisetosa* and *F. paraunisetosa*. *Fridericia liangi* can easily be distinguished from *F. unisetosa* and *F. paraunisetosa* by the chaetal pattern in each bundle. *Fridericia unisetosa* is further distinguished by: body color and epidermal glands brown; clitellum glands absent in mid-dorsal part; mucocytes with some refractile vesicles; and seminal vesicle developed. *Fridericia*

*paraunistosa* has body color and epidermal glands brown; dorsal pores from XIII onwards; clitellum glands absent in mid-dorsal and mid-ventral parts; mucocytes with some refractile vesicles; spermathecal ampullae each with 6–8 variously sized diverticula; and seminal vesicle developed. Similarities and differences among the above species are summarized in Table 1.

The species *Fridericia silvestris* was not clearly described in many characters, such as the origin of the blood vessel or the reproductive organs (Leidy 1882, Moore 1895, Cernovitov 1933), and was designated as nomen dubium (Schmelz 2003). Even if based on the poor and partly inconsistent morphological accounts, the following features demonstrate that *F. silvestris* is a different species: large body size, high segment number, thickening of the cuticle and preclitellar septa, branched esophageal appendages.

*Distribution and habitat.*—*Fridericia liangi* is only known from the type locality at the foot of Mt. Changbaishan, where the forest is dominated by Scots pine (*Pinus sylvestris* var. *sylvestrifomis*). Compared to the higher regions of the mountain, the type locality is with poor humus on dark brown forest acid soil, relatively low soil moisture, organic matter, carbon content, nitrogen and phosphorus content, and higher soil potassium and calcium content. In the locality, some other enchytraeids, such as *Henlea perpusilla* Friend, 1911 and *Fridericia bretscheri* Southern, 1907 coexist with the *Fridericia liangi*.

#### Acknowledgments

We are greatly indebted to Mr. Guahua Dai of National research station of Changbaishan Mountain Forest ecosystems and Mr. Ji Ye of the Institute of Applied Ecology, Chinese Academy of Science, for their help in the field investigation. This work was financially

supported by State High-Tech Development Project (2005AA60101005), the Development Plan of the state Key Fundamental Research of China (Grant No. 2007CB109205), the Knowledge Innovation Program of the Chinese Academy of Sciences (Grant No. KSCX2-YW-Z-0933), and the National Natural Science Foundation of China (No. 30370250).

#### Literature Cited

- Cernovitov, L. 1933. Revision der Enchytraeiden-Gattung *Distichopus* Leidy.—Zoologischer Anzeiger 104:73–76.
- Chen, J., & Z. C. Xie. 2008. *Fridericia dianchiensis* sp. nov. (Enchytraeidae, Oligochaeta) from Yunnan Province, China.—Proceedings of the Biological Society of Washington 121(2):283–288.
- Dózsa-Farkas, K. 2005. *Fridericia eiseni* sp. n., a new enchytraeid species close to *Fridericia ratzeli* (Eisen, 1872).—Proceedings of the Estonian Academy Science Biology Ecology 54(4):279–291.
- , & G. Cech. 2006. Description of a new *Fridericia* species (Oligochaeta: Enchytraeidae) and its molecular comparison with two morphologically similar species by PCR-RFLP.—Zootaxa 1310:53–68.
- Graefe, U., & R. M. Schmelz. 1999. Indicator values, strategy types and life forms of terrestrial Enchytraeidae and other microannelids. Pp. 59–67 in R. M. Schmelz and K. Sühlo, eds., Newsletter on Enchytraeidae No. 6. Proceedings of the 3rd International Symposium on Enchytraeidae, Osnabrück, Germany, 3–4 July 1998.
- Healy, B., & E. Rota. 1992. Methods for collecting Enchytraeidae during expeditions.—Soil Biology & Biochemistry 24:1279–1281.
- Leidy, J. 1882. On *Enchytraeus*, *Distichopus* and their parasites.—Proceedings of the Academy of Natural Sciences of Philadelphia 1882:145–149.
- Michaelsen, W. 1889. Synopsis der Enchytraeiden.—Abhandlungen aus dem Gebiete der Naturwissenschaften, Naturwissenschaftlichen Verein in Hamburg 11:1–59.
- Moore, J. P. 1895. The characters of the enchytraeid genus *Distichopus*.—American Naturalist 29: 753–756.
- Nielsen, C. O., & B. Christensen. 1959. The Enchytraeidae, critical revision and taxonomy of European species.—Natura Jutlandica 8–9:1–160.
- , & ———. 1961. The Enchytraeidae, critical revision and taxonomy of European species. Supplement 1.—Natura Jutlandica 10:1–23.

- , & ———. 1963. The Enchytraeidae, critical revision and taxonomy of European species. Supplement 2.—*Natura Jutlandica* 10:1–19.
- O'Connor, F. B. 1962. The extraction of Enchytraeidae from soil. Pp. 279–285 in P. W. Murphy, ed., *Progress in Soil Zoology*. Butterworths, London, 398 pp.
- Rota, E., & B. Healy. 1999. A taxonomic study of some Swedish Enchytraeidae (Oligochaeta), with descriptions of four new species and notes on the genus *Fridericia*.—*Journal of Natural History* 33:29–64.
- , N. T. Zaleskaja, N. S. Rodionova, & V. N. Petushkov. 2003. Redescription of *Fridericia heliota* (Annelida, Clitellata: Enchytraeidae), a luminous worm from the Siberian taiga, with a review of bioluminescence in the Oligochaeta.—*The Journal of Zoology*, London 260:291–299.
- Schlaghamerský, J. 2007. *Fridericia brunensis* sp. n. (Clitellata: Enchytraeidae) - a new European enchytraeid species similar to *F. monochaeta* Rota, 1995. In J. Schlaghamerský, ed., *Newsletter of Enchytraeidae* No. 10: Proceedings of the 7th International Symposium on Enchytraeidae. Brno, Czech Republic, 25–28 May 2006.—*Folia Facultatis scientiarum naturalium Universitatis Masarykianae Brunensis*, *Biologia* 110:53–65.
- Schmelz, R. M. 2003. Taxonomy of *Fridericia* (Oligochaeta, Enchytraeidae). Revision of species with morphological and biochemical methods. *Abhandlungen des Naturwissenschaftlichen Vereins in Hamburg*, (NF) 38. Goecke & Evers, Keltern, Germany, 415 pp.
- , & R. Collado. 2005. *Fridericia larix* sp. nov. (Enchytraeidae, Oligochaeta) from Irish soils.—*Organisms, Diversity and Evolution* 5(1):85–88.
- Wang, H. Z., Z. C. Xie, & Y. L. Liang. 1999. Records of Enchytraeidae (Clitellata) from the People's Republic of China. In B. M. Healy, T. B. Reynoldson and K. A. Coates, eds., *Aquatic Oligochaetes*.—*Hydrobiologia* 406:57–66.
- Xie, Z. C., Y. L. Liang, & H. Z. Wang. 1999. Taxonomical studies on *Fridericia* (Enchytraeidae, Oligochaeta) along the Changjiang (Yangtze) Basin.—*Acta Hydrobiologica Sinica* 23(suppl.):158–163.
- , ———, & ———. 2000. Two new species of *Fridericia* (Enchytraeidae, Oligochaeta) from Changbaishan Mountain, Jilin Province, China.—*Species Diversity* 5:53–58.
- , ———, & ———. 2001. *Fridericia nannin-gensis*, a new terrestrial enchytraeid species (Oligochaeta) from southwestern China.—*Proceedings of the Biological Society of Washington* 114:275–279.