CYMBELLA ORIENTALIS SP. NOV.,
A FRESHWATER DIATOM FROM THE FAR EAST

J. H. Lee, T. Gotoh* & J. Chung

Department of Biology, College of Natural Science,
Kyungpook National University, Taegu 702-701, Korea

*Department of Biology, Kinki University School of Medicine,
Osaka-Sayama, Osaka 589, Japan

Cymbella orientalis Lee, sp. nov., collected from the Kwangchun River, Kyungsang Pukdo, Korea, is formally described. The new taxon is characterized by its dorsal unilateral central area and areolar structure with flaps. C. orientalis is an attached freshwater species found in springs, lakes and the lower course of rivers. It was recorded from several localities within the Far East: Okinawa and Kikai Islands in the Ryukyu Islands, Tsushima Island in Japan, Beijing and Shandong in China, and Taiwan.

INTRODUCTION

A total of 657 taxa are listed for the genus Cymbella C. A. Ag. by VanLandingham (1969). Of these taxa, 39 recent and fossil diatoms were described from the Far East (China, Korea and Japan) by Reichelt in Kuntze (1898), Okuno (1959), Skvortzow (1928, 1929a,b, 1930, 1936a,b, 1937a,b,c, 1938a,b,c,d, 1946) and Voigt (1943). Furthermore, Skvortzow & Noda (1971) described 8 new taxa of Cymbella from Japan and China. Most of these 47 taxa described from the Far East are restricted in distribution to their type locality; however, several are widely distributed within the Far East and a few are even more widely distributed.

In a recent investigation of the diatoms of Korea, we found a Cymbella previously reported from the Ryukyu Islands: Okinawa (Nakai 1987) and Kikai Island (Tanaka 1989). While it was identified as Gomphonema angustatum (Kütz.) Rabh. by Nakai (1987) and as Cymbella subzwarensis Foged by Tanaka (1989), considerable doubt characterized these identifications. In the present paper, this taxon is described as a new species, Cymbella orientalis, and its characteristics are discussed in detail.

MATERIAL AND METHODS

Samples containing Cymbella orientalis were collected from the lower course of the Kwangchun River, Ulchín County, Kyungsang Pukdo, Korea on 19 May and 2 August 1991. Water temperature was 18-21°C, pH 6.9-7.6, and electrical conductivity 55-112 μS cm⁻¹. Furthermore, two samples collected from the following localities were examined: the estuary of the Nita-gawa River, Tsushima Island, Japan, collected on 22 May 1980 by T. Yoshida and a spring at Amesoko, Okinawa Island, Japan, collected on 7 April 1982 by S. Nakai.

Samples were cleaned with the permanganate method (Hendey 1974) and mounted in Pleurax. Slides were examined with a Nikon Apophoto microscope. For scanning electron microscopy, the
cleaned material was dehydrated in ethanol, then a drop of the suspension was air-dried on stubs, sputter-coated with Au, and examined with a Hitachi S-450 SEM at Kinki University.

Terminology used is that suggested by Anonymous (1975), Ross et al. (1979), Mann (1981) and Krammer (1982).

RESULTS AND DISCUSSION

*Cymbella orientalis* Lee, sp. nov. (Figs 1-6)

**Synonyms:** *Cymbella sinica* Skv. *sensu* Voigt (pro parte), *Notes Bot. Chin., Univ. l'Aurore Changhi* 5: 29, pl. 2, fig. 6, 1943.


Valves weakly dorsi-ventral with the dorsal margin lanceolate, ventral margin slightly convex, apices narrowly rounded or only slightly rostrate. Outer raphe fissure somewhat eccentric, slightly flexed toward the dorsal margin of the valve. Distal raphe fissures hooked dorsally at an angle of about 45°. Inner raphe fissure linear, lying for the most part in the centre of the axial area. Axial area fairly broad and linear, widening slightly at the central area. Central area unilateral and transversely rectangular, formed by foreshortening of the median dorsal stria. Striae weakly radiate throughout most of the valve, parallel elsewhere, punctate-lineate. Puncta distinct, ca. 25 in 10 μm. Valves 17.5-46 μm long, 5.5-8.5 μm broad. Striae 10-12 in 10 μm on the ventral side, 11-12 in 10 μm on the dorsal side.

Holotype: Slide number LJ 101, Flora of Korea Herbarium, University of Kyungpooknensis (KNU), Korea.
Type locality: Kwangchun River, Ulchin County, Kyungsang Pukdo, Korea, 37°04' N, 129°24' E.

Etymology of name: *orientalis* = oriental; indicating its distribution within the Far East.

Light micrographs of *Cymbella orientalis* are shown in Figs 1-14. Substantial variation in the dimensions of the valve and its outline were observed in both the holotype (Figs 1-6) and paratype slides (Figs 8-14).

SEM observations

Externally, the terminal raphe fissures are hooked toward the dorsal margin of the valve and occupy a relatively broad hyaline area at the valve apices (Figs 15, 17, 18). The apical pore fields are situated on the valve margin and mantle, but are not sharply differentiated from the striae (Figs 24-27). The transapical striae extend to the valve mantle and consist externally of simple, rounded...
Figs 1-14. Cymbella orientalis, LM. Scale bar = 10 μm. Figs 1-6. Specimens from holotype slide, Kwangchun River, Korea. Fig. 7. Specimen from Nita-gawa River, Tsushima Island, Japan. Figs 8-14. Specimens from paratype slides, Okinawa Island, Japan.
foramina (Figs 16, 23). On the ventral side of the central area, some of the foramina appear larger than the others, but they are clearly not stigmata (Figs 16, 21).

Internally, the distal raphe fissures terminate as helictoglossae (Figs 19, 22). The pores of the apical pore field are connected with a costal system, varying from the other fine structure of the valve. Each apical pore field extends from the valve apex to the third or fourth alveolus; therefore, some of the pores partially cover the alveoli, but this occurs only on the valve margin and mantle (Fig. 22). Areolae are covered by flaps, which extend out from areola walls forming very narrow rounded slits (Figs 20, 21). Intercostae are sometimes interrupted; in such cases they resemble two small pegs (Fig. 20).

The epicingulum is composed of a valvocopula (Figs 24-27) and connecting bands (Figs 30, 31). The valvocopula is composed of two open bands, one being much longer than the other. The shorter band is ca. 1/13 to 1/20 of the valve circumference and is positioned at only one apex, where it is overlapped by both ends of the long band (Figs 24, 25, 31). A single row of puncta ornaments the advalvar portion of the long band. This puncta row is interrupted at the apex opposite the one occupied by the short band (Figs 26, 27, 30) and at mid-valve, dorsal to the central nodule (Fig. 28). The absolute number and structure of connecting bands were not determined.

Comparisons with related species

Cymbella orientalis resembles a number of poorly described taxa in general valve outline and construction, but differs by possession of a unique suite of characters. C. orientalis differs from C. raytonensis Cholnoky (1955), C. amphicephala var. variostriata Foged (1955) and C. incerta var. africana Cholnoky (1957) by its unilateral central area. C. subaequalis Grun. (cf. Krammer & Lange-Bertalot 1986) is similar in the shape of its raphe to C. orientalis, but has a differently shaped central area, accompanied by radiate striae at the apices, which consist of much denser puncta (30-32 in 10 μm).

Cymbella subzewarensis, described from Afghanistan by Foged (1959), is similar to C. orientalis. However, it can easily be differentiated from the latter by the ventral deflection of its terminal raphe fissures. In this same paper, Foged (loc. cit., pl. 11, fig. 5) illustrated a diatom, “C. subzewarensis forma”, but without giving it formal taxonomic status. It is doubtful whether or not this taxon should be included in C. subzewarensis, since it differs from the nominate form in the direction of its terminal raphe fissures. While this unnamed taxon is very similar to C. orientalis, it can be differentiated by the more distant position of its proximal raphe ends and the strongly radiate arrangement of striae at the apices.

The apparently rare taxon Cymbella sinica, described from Chengdu in China by Skvortzow (1938c), appears to be most closely related to C. orientalis. Since three illustrations were included in the original description and none designated as the holotype, it is not clear which is the type and there exist differences between them in the shape of the raphe and axial area. One figure differs from the rest in its more strongly curved raphe and broader axial area. In any case, C. sinica is an independent taxon characterized by a simple filiform raphe, indistinctly lineate-punctate striae and much denser dorsal striae (15 in 10 μm).

Figs 15-22. Cymbella orientalis, SEM. Scale bars = 5 μm (Figs 15-19) or 1 μm (Figs 20-22). Fig. 15. External view of valve. Fig. 16. External view of valve centre showing proximal raphe ends and arrangement of foramina. Note that some foramina are larger than others. Figs 17, 18. External view of valve apices showing dorsally hooked terminal raphe fissures. Fig. 19. Internal view of valve. Fig. 20. Internal view showing areolae with flaps (large arrowhead), intercostae (arrow) and openings (small arrowhead). Fig. 21. Internal view of valve centre showing alveoli; note absence of stigmata. Fig. 22. Internal view of valve apex showing helictoglossa, alveoli and apical pore field.
Voigt (1943) reported *C. sinica* from Beijing and Shandong. His figure shows a complex raphe and much coarser and clearly punctate striae; these characters match those of *C. orientalis*. Although Voigt expanded the range of variation of *C. sinica*, especially with regard to striae density (12-15 in 10 μm), it is doubtful that he had observed intermediate forms between *C. sinica* and *C. orientalis*. A thorough examination of our material yielded no intermediate forms between these two taxa. Thus, we suggest that Voigt’s specimens can be identified as *C. orientalis*.

*Cymbella sinica* var. *nipponica* Skvortzow (1938d) differs from *C. orientalis* by the relatively more pronounced dorsi-ventral outline of its valves and the eccentric position of its simple filiform raphe. Finally, *C. gonzalvesii* Sarode & Kamat (1984) is somewhat similar to *C. orientalis*. However, it appears to be more closely related to *C. sinica* because of the eccentric position of its raphe and denser striae (14-16 in 10 μm).

ECOLOGY AND DISTRIBUTION

In this study, *Cymbella orientalis* was found as an attached form in springs, lakes and the lower course of rivers at a pH of 6.4-7.6 and conductivities of 55-112 μS cm⁻¹. *C. orientalis* was also found in a sample collected from the estuary of the Nita-gawa River. However, it is uncertain whether this taxon can tolerate saline waters as no living cells were observed in the sample.
Cymbella orientalis is known from the following localities (see Fig. 32): Kwangchun River, 37°04′N, 129°09′-129°25′E, Ulchin County, Kyungsang Pukdo, Korea; Nita-gawa River, 34°32′N, 129°20′E, Tsushima Island, Japan; a spring at Amesoko, 26°40′N, 127°59′E, Okinawa Island, Japan (Nakai 1987); a spring at Kamikatetsu, 28°27′N, 129°56′E, Kikai Island, Japan (Tanaka 1989); a lake in Taiwan (T. Watanabe, pers. comm.); a park at Chasse in Beijing, ca. 39°55′N, 116°24′E, and Loutung near Jinan, Shandong (not clear from notes on locality), China (Voigt 1943).

The known distribution of C. orientalis falls within 24-40°N latitude (subtropical to temperate climate zones) and is apparently restricted to the Far East. It is intriguing that C. orientalis should be restricted to the Far East but not found on the mainland of Japan, which is geographically close and has similar environmental and climatic conditions. Further study of C. orientalis and its ecological preferences are necessary to better understand its pattern of distribution.

ACKNOWLEDGEMENTS

We thank Mr D. H. Han of Kyungpook National University for assistance in collecting samples, Dr S. Nakai and Mr T. Yoshida for providing materials, and Dr T. Watanabe for distributional information. We also acknowledge Mr H. Komiya, Y. Horiuchi and K. Okumoto of Kinki University School of Medicine for their assistance in the use of the SEM. Special thanks are due to Dr M. J. Sullivan for improving the present manuscript.
REFERENCES


SKVORTZOW, B. W. & NODA, M. (1971). On recent and fossil freshwater diatoms from Japan II. Science Reports of Niigata University, Ser. D (Biology), 8, 13-27


SKVORTZOW, B. W. (1971). On recent and fossil freshwater diatoms from Japan II. Science Reports of Niigata University, Ser. D (Biology), 8, 13-27