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ON PLEISTOCENE AMPHORA THUMENSIS (MAYER) KRIEGER  
(BACILLARIOPHYCEAE)

KACZMARSKA, I.: On Pleistocene *Amphora thumensis* (Mayer) Krieger (Bacillariophyceae), Acta Palaeont. Polonica, 26, 3/4, 364-369. April 1982 (1981).

Light and scanning electron microscope study of the Eemian frustules of the diatom most frequently identified as *Cymbella thumensis* (Mayer) Hustedt confirms its assignment to the genus *Amphora*. According to the principles of the ICBN (1981) it should be named *A. thumensis* (Mayer) Krieger.

**Key words:** Diatomeae, Eemian, morphology, taxonomy, Poland.

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## INTRODUCTION

The ambiguous systematic position of the diatom usually recognized as *Cymbella thumensis* (Mayer) Hustedt (1945), or as *Cymbella parvula* Krasske (1933) necessitated a revision of its generic assignment.

The investigation were based on the Eemian material from Imbramowice near Wrocław (Kaczmarska 1976). Miller's method (1969) was used to prepare the frustules for observations with an JEOL SM-35 and Philips SEM-501-B scanning electron microscope. The collection is housed in the Department of Phycology of the Institute of Botany of the Polish Academy of Sciences.

*Acknowledgements.*—I am grateful to Prof. W. Kilariski, who made available and operated the SEM at the Institute of Zoology of the Jagiellonian University in Cracow, and to Mr C.C.A.H. Van der Donk for facilitating the use of the PSEM-501-B exhibited during the 3<sup>rd</sup> Conference on "The Application of Philips Electron Microscopes for Research in Biology, Medicine and Technology" (November 1979, Zakopane). Thanks are also due to dr. J. C. Kingston from the Bowling Green State University for drawing my attention to the fact that the diatom found at Imbramowice is identical with that found in contemporary sediments of Lake Michigan in the USA which he identified as *Amphora thumensis* (Mayer) Cl. I wish also to thank Prof J. Siemińska who suggested publishing these observations, and for her critical reading of the manuscript.

## PREVIOUS INVESTIGATIONS

The taxon was first described as *Amphora coffeiformis* (Agardh) var. *thumensis* by Mayer (1919) and later was identified by Krieger (1929) as an independent species *Amphora thumensis*. Krieger's paper, however, has been forgotten, and has not even been listed in the VanLandingham's catalogue (1969). Cleve-Euler (1932) tentatively assigned this diatom as a separate species to the genus *Amphora*. Jousé (1936) noticed a similarity between the species under discussion and *Cymbella parvula* (Krasske, 1933); since no differences were observed between these taxa, she considered them as synonyms. Hustedt (1945) claimed that the diatom discussed should be classed within *Cymbella* on the strength of detailed observations of complete frustules in various positions, and he was the first to use the specific name in the combination: *Cymbella thumensis* (Mayer) Hustedt. In his opinion *C. parvula* was a junior synonym of *C. thumensis*. Hustedt's combination has been commonly accepted by diatomologists (VanLandingham 1969).

The genera *Cymbella* and *Amphora* are very similar in numerous details of the valve structure. However, they differ in the structure of complete frustules. In contrast to *Cymbella*, *Amphora* displays frustules showing a curved perivalvar axis from the side of their well-developed girdle bands. This accounts for the fact that the *Amphora* frustules, as seen on the preparation slide, accumulate on the girdle bands rather than on the valves. When a frustule lies on the dorsal part of the girdle band, the raphes are visible simultaneously and the frustules are more or less ellipsoidal in this position. In the same position, the *Cymbella* frustules are rectangular and the raphes are not visible. Complete frustules of the species investigated are relatively rarely found in a position that allows one to define whether it belongs to *Amphora* or to *Cymbella*. In the fossil material this is still more difficult, since the frustules break up in the course of maceration of samples.

The profile of Eemian deposits at Imbramowice initially yielded only one complete frustule (Kaczmarska 1977; pl. 24: 5); this diatom being identified as *C. thumensis*. Later on, other valves were found there together with some complete frustules.

## DESCRIPTION

Genus *Amphora* Ehrenberg ex Kützing 1844  
*Amphora thumensis* (Mayer, 1919) Krieger, 1929  
 (pls 36, 37)

1919. *Amphora coffeiformis* Agardh var. *thumensis* Mayer: 208, pl. 9: 68, 69.  
 1929. *Amphora thumensis* (Mayer); Krieger: 280, pl. 2: 22, 23.  
 1932. *Amphora* ? *thumensis* (Mayer); Cleve-Euler: 133, fig. 373a, b.  
 1933. *Cymbella parvula* Krasske: 92, pl. 2: 3.  
 1945. *Cymbella thumensis* (Mayer); Hustedt: 938.

**Material.**—Over a hundred well preserved valves, and over a dozen complete frustules.

Dimensions (in  $\mu\text{m}$ ):

maximum length	15.0	maximum width	5.3
minimum length	7.3	minimum width	4.2
number of striae in 10 $\mu\text{m}$	16—22		

**Description.**—Frustule elliptical in outline, with truncate extremities; its dorsal side broader than the ventral one, so that the valve surfaces of the same frustule are not parallel (pl. 36: 1—2). Frustule observed with the light microscope asymmetrical, since its dorsal margin is convex and the ventral one is either almost straight or subconvex in the central part only; apical ends of the valves more or less protracted, bluntly rounded to distinctly rostrate or capitate; the ends may be almost straight (located on a prolongation of the raphe) or bent to the ventral margin of the valve (pl. 37: 1—5). Raphe branches straight, filiform, lateral (at the ventral margin); central nodules drop-like (pl. 37: 1—5); other details of the apical nodule organization undetectable with light microscope. Axial part narrow with the central part varying in shape and size from small lanceolate to asymmetrically developed at the ventral valve margin. Dorsal striae radiate almost over the whole valve, being normal to the raphe at the apical ends only. Ventral striae also radiating, perpendicular to the raphe at the apical ends only, strongly shortened, marginal, interrupted at mid-valve.

Frustules, viewed with the scanning electron microscope, made up of one, uniform, basal siliceous layer. Outer and inner fissures of the raphe almost straight and narrow. On the outer surface of valve face central pores slightly broadened, outer terminal fissures almost reaching the margin of valve face; these latter, located in grooves gradually shallowing and flaring fan-like, are bent toward the dorsal valve margin (pl. 37:6). On the inner surface of valve face, raphe fissures run in slightly thickened longitudinal roll, up to helictoglossae in the terminal inner nodules; in the central nodule there is also a fine longitudinal thickening (slightly broader and higher than those in which the raphes run) that merges with inner central pores (pl. 37: 9).

Outer as well as inner valve surfaces flat, striae being their only ornamentation. Both, dorsal and ventral external striae are shallow grooves, more or less uniform in width, closed from the inner side by a thin membrane partly damaged; this membrane shows fine perforations, porelli (pl. 37: 8, arrow), arranged in two or three alternate rows. Dorsal striae crossed by a hyaline band that runs along the most convex part of valve (pl. 37: 7). From hyaline band the valve slopes sharply, forming well-developed valve margin at the dorsal side, broader than at the ventral side (pl. 37: 7). Hyaline band seems to be a boundary region of the valve face (pl. 36: 3, 4). Overlapping of the frustule valves reaches a half of the breadth of valve margins (pl. 36:6).

Young valves, just after division, overlap each other only by their valve margins (pl. 37: 7). The older frustules have girdle bands (pl. 36: 4). No more than three cingula in the girdle band have been observed. Each cingulum consists of two half bands which overlap at the apical ends of frustules (pl. 36: 4, arrow).

**Remarks.**—The specimens studied are similar to those of *Amphora coffeaeformis* (Agardh) Kützing, 1844 in the shape of valves, ornamentation, and the density of the striae, but they are smaller and more slender. Moreover, the TEM observations showed that their striae (Anderson, 1975; fig. 1) consist of transverse rows of structures similar to areoles and separated by hyaline silica bands (the literature available provides no data concerning other details of the frustules of *A. coffeaeformis*).

The environmental requirements of the two species are different: *A. coffeaeformis*

*mis* is a mesohalobe diatom (Anderson 1975; Patrick and Reimer 1975), while *A. thumensis* has so far been found only in fresh water.

Owing to the strongly developed dorsal part of the valve margin, the complete frustule of *A. thumensis* has its parvalvar axis curved in the manner characteristic of the genus *Amphora*, and both raphes are simultaneously visible from the ventral part of the girdle band side. The older frustules, due to the well developed girdle band, are more distinctly asymmetrical in the parvalvar axis than the younger ones which are more similar, in this position, to the frustules of the *Cymbella* species. This difference between frustules of the older and younger cells are probably responsible for the ambiguous taxonomic position of the species.

*Distribution.* — So far the species has been noted in Europe from a dozen localities of Eemian deposits; in North America it comes from three Late Glacial and Recent sites.

Europe: Eemian (Krasske, 1933: FRG; Jousé, 1936: European part of the USSR; Foged, 1962: Denmark; Kaczmarska, 1976, 1977: Poland); Late Glacial and Holocene (Krieger, 1929: FRG; Round, 1957: Great Britain; Cleve-Euler, 1953: Sweden; Wuthrich, 1961, 1971: Switzerland; Foged, 1969: Denmark; Marciniak, 1973: Poland); Recent (Mayer, 1919: FRG; Meister, 1935; Wuthrich, 1960: Switzerland; Cleve-Euler, 1932, 1953, 1955: Sweden; Hustedt, 1945: Balkans; Pork, 1961: Estonia; Starmach person. comm., 1979: Poland, River Raba).

North America: Late Glacial (Florin, 1970 and Haworth, 1972: Minnesota and South Dakota States); Recent (Kingston pers. somm., 1979: the United States, Lake Michigan).

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UWAGI O PLEJSTOCENŃSKIM *AMPHORA THUMENSIS* (MAYER) KRIEGER  
(BACILLARIOPHYCEAE)

*Streszczenie*

Badania eemskich pancrzyków okrzemki najczęściej określanej jako *Cymbella thumensis* (Mayer) Hustedt, przeprowadzone za pomocą mikroskopu świetlnego i skaningowego mikroskopu elektronowego świadczą, że należy ona do rodzaju *Amphora*

Ehrenberg. Przemawia za tym budowa kompletnych pancerzyków, które mają dobrze rozwinięty pas obwodowy i wygiętą oś główną (perwalwarną).

Pracę wykonano w ramach problemu MR II 2—1—4.

#### EXPLANATION OF THE PLATES 36 AND 37

##### Plate 36

##### *Amphora thumensis* Mayer (Krieger), Eemian, Imbramowice, Poland

1. a two complete daughter frustules from the dorsal girdle band side; b the same specimens differently focused, LM,  $\times 2500$ .
2. a two complete frustules; b the same specimen differently focused a the dorsal side, b the ventral side, LM,  $\times 2500$ .
3. Two complete daughter frustules from the valve side, JSM-35,  $\times 4950$ .
4. The frustule with three ornamented half bands of three cingula (arrows), JSM-35,  $\times 5850$ .
5. Young cell frustule from the ventral side, JSM-35,  $\times 5400$ .
6. The end of the half band (arrow), PSEM-501-B,  $\times 10\ 000$ .

##### Plate 37

##### *Amphora thumensis* Mayer (Krieger), Eemian, Imbramowice, Poland

- 1—5. Valves in light microscope,  $\times 2500$ .
  6. External surface of the apical valve ends, PSEM-501-B,  $\times 10\ 000$ .
  7. Young cell frustule without girdle band, JSM-35,  $\times 4\ 4050$ .
  8. Fragment of the internal surface of the valve: porelli in the membrane that close striae grooves (arrow), JSM-35,  $\times 19\ 500$ .
  9. Internal surface of the valve, JSM-35,  $\times 6450$ .
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