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Abdomen wall structure of *Holocryptocanium barbui* (Radiolaria)

MARTA BĄK
Institute of Geological Sciences, Jagiellonian University, Oleandry 2a, 30-063 Kraków, Poland

ABSTRACT - The abdomen wall structure of the cryptothoracic Nassellaria *Holocryptocanium barbui* Dumitrică was studied using scanning electron microscopy. The abdomen wall consists of four layers, all of which have been observed as the 'outer' layer of specimens depending upon the different level of preservation. These different stages of abdominal wall preservation have been described previously as two separate subspecies of *Holocryptocanium barbui*. *J. Micropalaeontol.* **15**(2): 131–134, October 1996.

INTRODUCTION

The Mid-Cretaceous cryptothoracic Nassellaria *Holocryptocanium barbui* Dumitrică (1970) was first described from Podu Dimbovitei (Romania). After Dumitrică (1970) established the systematics of di- and tricyrtid Nassellaria, *H. barbui* was subsequently recorded from Cretaceous (Albian–Cenomanian) deposits of Europe, North America, Japan, NW Pacific and the north and the eastern Atlantic regions (Dumitrică, 1970, 1975; Pessagno, 1977; Nakaseko & Nishimura, 1981; Schaaf, 1981; Taketani, 1982; Sanfilippo & Riedel, 1985; Thurow, 1988; Górka, 1989; Górka & Geroch, 1989; Ožvoldová, 1990; Takahashi & Ling, 1993).

All specimens described as *H. barbui* have their cephalis and thorax completely enclosed within a large spherical abdomen. Specific differences relate to different surficial pore frames on the abdomen: some specimens of *H. barbui* are described without pore frames or with a sparsely porate surface perforated by very small, rounded pores, with a thicker abdomen wall (e.g. Pessagno, 1977), other specimens described as *H. barbui* or *H. japonicum* have hexagonal pore frames (e.g. Nakaseko et al., 1979; Schaaf, 1981).

On the basis of those abdominal differences Nakaseko & Nishimura (1981) divided the species *H. barbui* into two subspecies: *Holoctyptocanium barbui barbui* Dumitrică, having a thicker sparcely perforated or unperforated abdominal wall; and *Holocryptocanium barbui japonicum* Nakaseko & Nishimura, as the form with abdominal wall characterized by hexagonal pore frames. Both forms have identical structures of cephalis and thorax enclosed within the abdomen (Nakaseko & Nishimura, 1981).

Ožvoldová (1990) has found from Albian deposits of the Vienna Basin both subspecies distinguished by Nakaseko & Nishimura (1981). However, some forms of *H. barbui* have a fractured sparsely porous layer on the surface of their abdomen which covered regular pore frames (similar to the abdominal surface of *Holocryptocanium barbui japonicum* as described by Nakaseko & Nishimura).

The species investigated herein originate from samples collected from Albian–Cenomanian marly deposits of the Branisko Succession (Fig. 1: seven samples from Kietowy stream section (Ki) and thirteen samples from Stare Bystre section (SB)) in the Polish part of the Pieniny Klippen Belt, Carpathians (for detailed location see K. Bąk, 1992, 1993). In these deposits *H. barbui* is abundant and is the most characteristic taxon within the radiolarian assemblages as described by M. Bąk (1995).

About 3000 specimens of *H. barbui* have been analysed. The material is curated in the Institute of Geological Sciences, Jagiellonian University.

SYSTEMATIC DESCRIPTIONS

Class **Actinopoda**
Subclass **Radiolaria** Müller, 1858
Order **Polycystida** Ehrenberg, 1838
Suborder **Nassellariina** Ehrenberg, 1875
Family **Williriedellidae** Dumitrică, 1970
Genus ***Holocryptocanium*** Dumitrică, 1970

Type species. *Holocryptocanium tuberculatum* Dumitrică, 1970

Holocryptocanium barbui Dumitrică, 1970

1970 *Holocryptocanium barbui* Dumitrică: 76, pl.17, figs. 105–108a, b; pl. 21, fig. 136.
1981 *Holocryptocanium barbui barbui* Dumitrică; Nakaseko & Nishimura: 153, pl. 3, figs 1–4.
1981 *Holocryptocanium barbui japonicum* Nakaseko & Nishimura: 154, pl. 3, figs 5a–7b, pl. 14, fig. 10.
1982 *Holocryptocanium japonicum* Nakaseko, Nishimura & Sugano; Taketani: 67, pl. 7, figs 2a–3, pl. 13, fig. 21.

THE CHARACTERISTICS OF ABDOMINAL WALL STRUCTURE

In the investigated material only the specimens in samples Ki-13 and Ki-14 are pyritized. Replacement of silica by pyrite has led to excellent preservation of Radiolaria with the finest details of ornamentation and other morphological features. As a consequence, it is impossible to observe the inner structure of the test under the light microscope. Fortunately the use of scanning electron microscopy of whole and broken specimens allows the observation of internal wall structures.

In the material investigated, four different forms of the surface of abdomen wall pore frames of *H. barbui* have been found:

1. with a smooth sparcely perforated surface of abdomen (Plate 1, Fig. 1);

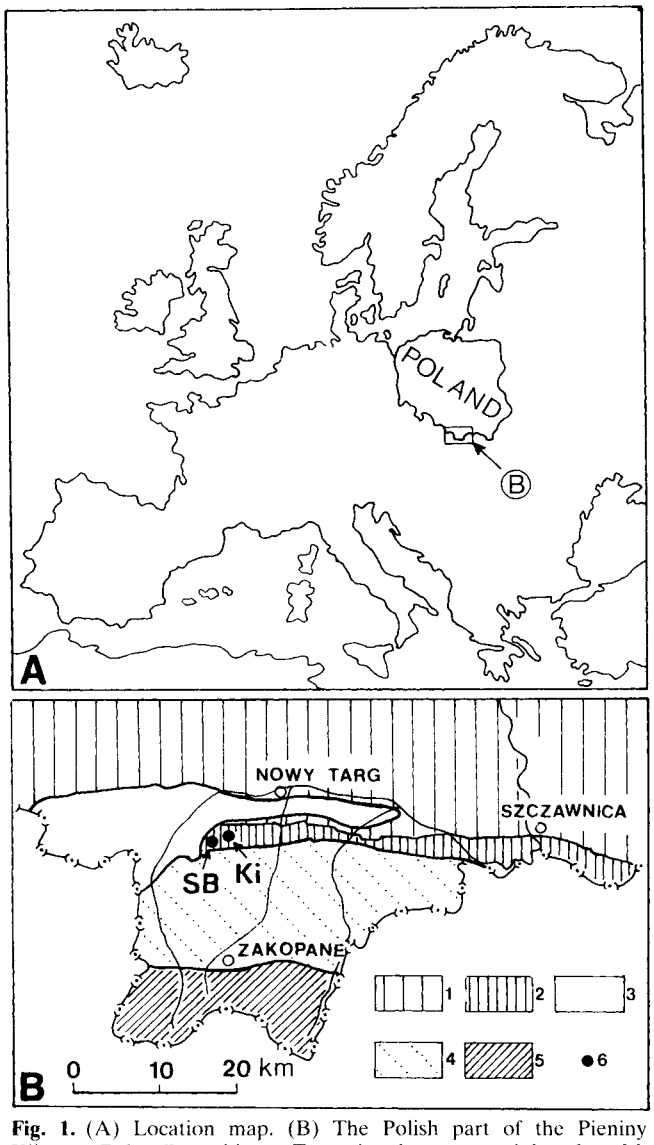

Fig. 1. (A) Location map. (B) The Polish part of the Pieniny Klippen Belt, Carpathians. Tectonic elements mainly after M. Książkiewicz, simplified by K. Birkenmajer, 1985. SB, Stare Bystre section; Ki, Kietowy Stream section; 1, Magura Nappe; 2, Pieniny Klippen Belt; 3, Intramontane freshwater Miocene–Pliocene molasse; 4, Podhale Palaeogene; 5, Tatra units; 6, sections investigated.

2. with a smooth surface and circular pores bigger than in type 1 (Plate 1, Fig. 4);
3. with regular hexagonal pore frames and circular pores (the same size as in type 2) which are slightly depressed into the mesh (Plate 1, Fig. 7);
4. with a surface mesh slightly coarse , with hexagonal pore frames and circular pores bigger than those in type 3 (Plate 1, Fig. 10).

Our samples also contain pyritized forms with broken abdominal walls in which the layers described as types 2, 3 and 4 overlie each other (Plate 1, Figs 2, 3, 6). The abdominal layers defined as types 1 and 2 agree well with those described by Nakaseko & Nishimura (1981) as *H. barbui barbui*, whilst types 3 and 4 are similar to those described as *H. barbui japonicum*. The material described herein contained broken forms in which all three layers are visible in cross-sections of single specimens (Plate 1, Fig. 3). Therefore, it is apparent that Nakaseko & Nishimura (1981) described these various layers as the external abdominal wall. All four layers of the abdominal wall have also previously been observed under the light microscope by Dumitrică (1970), he noted differences in thickness and luminosity. He also noted differences of external abdominal wall, but no definite structures were described.

CONCLUSIONS

Well-preserved forms of *Holocryptocanium barbui* Dumitrică have been found from the Albian to Cenomanian deposits of the Pieniny Klippen Belt (Poland). Pyritized specimens from samples Ki-13 and Ki-14 consist of three porous layers described above as types 2, 3 and 4.

Complete abdominal walls of our forms of *H. barbui* comprise four concentric layers: type 1 (outer layer) is smooth, thin and sparsely perforate with circular pores (Plate 1, Fig. 1); type 2 (the layer below) has larger circular pores than type 1 (Plate 1, Fig. 4); type 3 has hexagonal pore frames structure and circular pores (Plate 1, Fig. 7) and type 4 (the innermost layer) has hexagonal pore frames and the biggest pores which seem to be constricted in the inner side of the abdomen wall (Plate 1, Fig. 10). The thin, most external, sparsely porous layer of type 1 has been observed only in a few siliceous specimens, therefore this layer is probably lost very quickly during the sinking of the skeleton. The forms with broken layer type 1 and situated below layer type 2 are absent in our pyritized material, but they were illustrated by Ožvoldová (1990).

Dumitrică (1970) has explained the differences in *H. barbui* abdominal walls as the different stages of growth. In his opinion very young specimens have thin abdominal walls, and the pores have large external openings (our types

Explanation of Plate 1.

Figs 1–12. Abdomen wall structure of *Holocryptocanium barbui* Dumitrică. **Fig. 1.** Specimen with a smooth abdominal surface, sparsely perforated (type 1); lateral view ×180. SB-7. **Fig. 2.** Specimen of type 2 with a smooth surface and larger circular pores than fig. 1. The inner abdominal layer of type 3 is visible under the broken surface; lateral view showing sutural pore ×220. Ki-14. **Fig. 3.** Specimen with a broken surface and showing inner abdominal layers of type 3 and 4 ×260. Ki-14. **Fig. 4.** Specimen of type 2 showing antapical end of abdomen with aperture ×130. Ki-14. **Fig. 5.** Details of the apical part of the abdomen showing the sutural pore ×500. Ki-14. **Fig. 6.** Broken specimen, details of surface (types 2 and 3) ×500. Ki-14. **Fig. 7.** Specimen with hexagonal pore frames and circular pores (type 3); lateral view showing the sutural pore ×120. Ki-14. **Fig. 8.** Cephalis and fragments of broken thorax completely enclosed within the abdomen ×500. Ki-14. **Fig. 9.** Transverse section through the abdominal wall showing pore structures ×900. Ki-14. **Fig. 10.** Specimen of type 4 with a slightly coarse surface and larger hexagonal pore frames than fig. 7; lateral view showing sutural pore ×120. Ki-14. **Fig. 11.** Cephalis and fragments of broken thorax ×1000. Ki-14. Fig. 12. Inner side of the abdominal wall showing the aperture ×500. Ki-14.

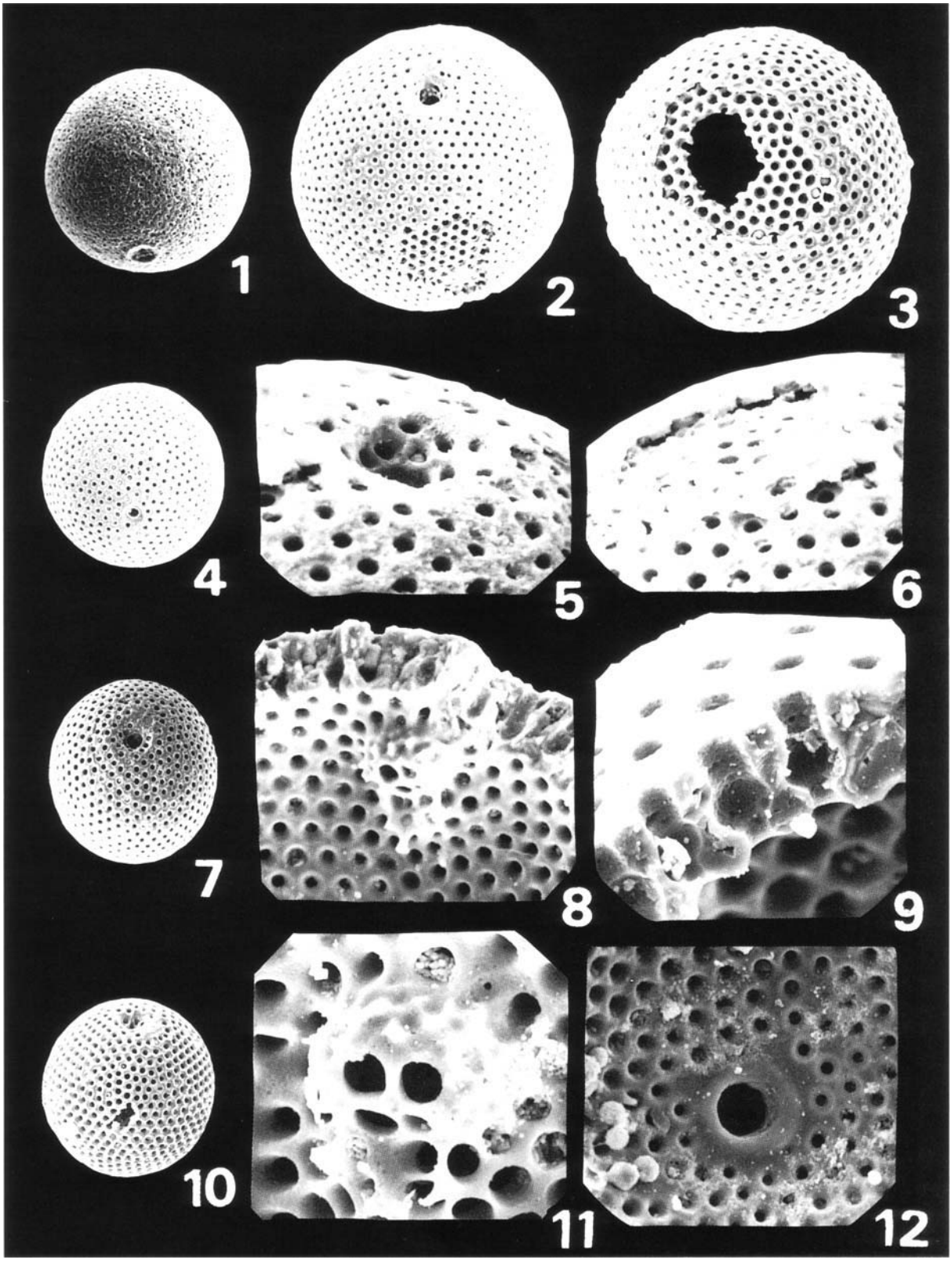

Plate 1

3 and 4), whereas the pores of the mature specimens have very narrow external openings (our types 1 and 2). Thurow (1988), who also observed four different surfaces of *H. barbui*, suggests a progresive trend in skeletal evolution from forms with a smooth surface and small pores (our type 1) to forms with hexagonal pore frames (our type 4). Our well-preserved and pyritized material shows that the different abdominal wall surfaces of *H. barbui* which have been described by previous authors as different species of *Holocryptocanium* or subspecies of *Holocryptocanium barbui* (Holocryptocanium japonicum Nakaseko et al., *Holocryptocanium barbui barbui* Dumitrică, *Holocryptocanium barbui japonicum* Nakaseko & Nishimura) are really the different stages of skeletal preservation (we can observe partly or almost completely broken layers of types 1 to 4 in a single specimen). We also could not make any suggestions about skeletal growth on the basis of our material.

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