Hanna GÓRKA

Lower Turonian radiolarians (Polycystina) from borehole Władysławowo IG 1 (Baltic region)

Six micropalaeontological samples from borehole Władysławowo IG 1 (Poland, Baltic region) supplied very rich material of siliceous radiolarian skeletons (Polycystina). The samples are of Lower Turonian age, as indicated by the Radiolaria and associated planktonic foraminifers. Seventeen species of spumellarians and thirteen nassellarians are described.

INTRODUCTION

Borehole Władysławowo IG 1 located in the Baltic region was drilled by the Polish Geological Institute (Warsaw, Poland). Six micropalaeontological samples from the following depths: 131.20, 128.00, 124.70, 124.00, 121.00, 114.00 m yielded rich material for studying siliceous skeletons of Radiolaria (Polycystina). The samples were dated as Lower Turonian, on the basis of Radiolaria and associated foraminifers. Described below are 17 species of Radiolaria belonging to Spumellaria and 13 belonging to Nassellaria. The collection of Radiolaria reported in this paper is housed in the Laboratory of Palaeontology of the Institute of Geology of Warsaw University; the collection acronym is IGPUW-V.

GEOLOGICAL, STRATIGRAPHICAL AND ECOLOGICAL REMARKS

Borehole Władysławowo IG 1 is situated in Baltic region, 50 km NNE from Gdańsk, at the base of the Hel Spit (Fig. 1). The thickness of Lower Turonian deposits in borehole Władysławowo IG 1 equals 72.00 m; their boundary with underlying Čenomanian strata
occurs at a depth 186.00 m, while the lower boundary of overlying Upper Turonian sediments is probably at 114.00 m depth.

The Radiolaria are best represented in dark grey, compact sandy silt at a depth of 119.70–131.20 m and in sandy clay at 114.00–119.70 m, where only a single planktonic foraminiferal species, *Hedbergella planispira* (Tappan), occurs (Fig. 2).

Among Radiolaria (Polycystina), typical Turonian species include *Cavaspongia antelopensis* Pessagno, *C. californiensis* Pessagno, *Crucella cachensis* Pessagno, *Eucyrtidium* (Taketani), *Hedbergella planispira* (Tappan), and *Orbiculiforma vacaensis* Pessagno.

In the Lower Turonian sediments of Władysławowo IG 1 there occur planktonic Foraminifera of the family Rotaliporidae, with *Hedbergella caspia* (Vassilenko), very common *H. trocoidea* (Gandeloff), as well as *Praeglobotruncana imbricata* (Mornod). Also represented are Heterohelicidae with *Heterohelix striata* (Ehrenberg) and Planomalinaidae with *Globigerinelloides escheri* (Kaufmann).

There are no agglutinated foraminifers in the Lower Turonian of Władysławowo IG 1. Benthic foraminifers are represented only by a single species of Polymorphinidae — *Pyrolina cylindroides* (Roemer), and Turrilliniidae — *Neobulimina schwageri* (Yokoyama). The latter species was previously reported only from the Boreal zone. There are also members of Nonionidae (*Nonionella cretacea* Cushman), Lingulogavellinidae, Anomalini-da and other families. Echinoid spines and fish teeth are also found.

The radiolarian assemblage described herein is much richer than the assemblage of the same age from borehole Leba IG 1 (H. Górka, 1991), both in terms of species diversity and abundance.

**CONCLUSIONS**

Numerous Radiolaria from the families Porodiscidae, Patulibrachidae, Cavaspongidae, Spongodiscidae, Hagiastridae, Orbiculiformidae within Spumellaria, and from Xitidae, Stichocyrtidae, Theoperidae, Archaeodictyomitridae, Spongocapsulidae and Cyrtoidida in-
Fig. 2. Radiolarian distribution in Władysławowo IG 1 borehole.  
1 — sandy clay, 2 — sand, silt, clay, 3 — sand, 4 — sand, silt, sand, 5 — clay, 6 — samples.

<table>
<thead>
<tr>
<th>Age</th>
<th>Lithology</th>
<th>Samples</th>
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<tr>
<td>Lower Turonian</td>
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<td>186.0</td>
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<td>132.0</td>
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1 — piaski maszty, 2 — mulec piaskowy, 3 — piaski, 4 — piasek, 5 — piasek pylasty, 6 — miejsce pobrania

certae sedis within Nassellaria, as well as accompanying planktonic Foraminifera of several families: Heterohelicidae, Planomaliniidae, Schackoinidae and Rotaliporidae may indicate presence of Boreal Province in Baltic region during Early Turonian. Planktonic foraminifers suggests rather shallow and cold water basin.

PREVIOUS WORKS ON CRETACEOUS RADIOLARIA IN POLAND

The first unspecified Cretaceous Radiolaria from Poland were mentioned by Z. Sujkowski in 1930. They came from a deep borehole in Lublin. In 1932, the same author presented a list of 20 species of Radiolaria (Polycystina) from the Eastern Carpathians. Then, after quite a long break, S. Geroch and W. Nowak (1963) described Radiolaria from the Lower Cretaceous deposits of Lipnik near Bielsko-Biała in the Western Carpathian region. This study was revised by H. Górka and S. Geroch (1989).

The present author described Lower Turonian Radiolaria from the Łeba IG 1 borehole (H. Górka, 1991), as well as Radiolaria from Lower Campanian outcrops in Cracow (H. Górka, 1989).

Recently, M. A. Gasinski (1988) and M. Bąk (1993) described Radiolaria from the Pieniny Klippen Belt (Carpathians). The latter author recognized 53 species of Polycystina. The present author’s research on Radiolaria from an Upper Cretaceous outcrop in Spława (Carpathians) is in preparation.

SYSTEMATIC DESCRIPTIONS

Subclass Radiolaria Müller 1858
Superorder Polycystina Ehrenberg 1875 emend. Riedel 1967
Order Spumellaria Ehrenberg 1875
Family Porodiscidae Haeckel 1881 emend. Koslova
in: M. G. Petrushevskaya, G. E. Koslova, 1972
Genus Histiastrum Ehrenberg 1847
Type species Histiastrum quaternarium Ehrenberg 1847

Histiastrum aster Lipman 1952
(Pl. I, Fig. 12; Pl. II, Figs. 5–11)

1952 Histiastrum aster Lipman; R. H. Lipman: p. 35, Pl. 6, 7, 11.
1962 Histiastrum aster Lipman; R. H. Lipman: p. 300, Pl. 2, Fig. 5.
1966 Histiastrum aster Lipman; G. E. Koslova, A. N. Gorbovetz: p. 84, Pl. 3, Fig. 9.
1981 Crucella aster (Lipman); K. Nakaseko, A. Nishimura: p. 148, Pl. 2, Figs. 9, 10.
1981 Histiastrum aster Lipman; A. Schaaf: p. 435, Pl. 8, Fig. 1; Pl. 11, Fig. 5.
1989 Histiastrum aster Lipman; H. Górka: p. 333, Pl. 14, Fig. 11.
1989 Histiastrum aster Lipman; H. Górka, S. Geroch: p. 187, Pl. 3, Fig. 5.
1991 Histiastrum aster Lipman; H. Górka: p. 43, Pl. 2, Fig. 11.
Material: 80 well preserved specimens.


Remarks. There is much variability of width and extent of the shoulders, of the degree of concavity of the sides, and of rounding of the terminations.


_Histiastrum latum_ Lipman 1960

(Pl. II, Figs. 1–3)

1960  _Histiastrum latum_ Lipman; R. H. Lipman: p. 130, Pl. 19, Figs. 7, 8.
1962  _Histiastrum latum_ Lipman; R. H. Lipman: p. 303–304, Pl. 2, Fig. 4.

Material: 38 well preserved specimens.

Dimensions (in μm): distance between shoulder terminations — 110–140.

Description. Skeleton square, flat, with straight or rarely slightly concave sides. Terminations straight or slightly extended. Centrum slightly raised. Irregularly spaced perforations with small pores.

Remarks. The specimens from Władysławowo IG 1 tend to have quite regular dimensions, and the variability concerns the degree of concavity of sides and protrusion of the terminations.

Occurrence. Santonian to Campanian of Western Siberia. Poland: Lower Turonian of Władysławowo IG 1.

**Family Porodiscidae** Haeckel 1881 emend. Petrushhevskaya, Koslova 1972

*Genus Pentinastrum* Haeckel 1881

Type species _Pentinastrum asteriscus_ Haeckel 1887

_Pentinastrum subbotinae_ Lipman 1960

(Pl. IV, Fig. 8)

1960  _Pentinastrum subbotinae_ Lipman; R. H. Lipman: p. 132, Pl. 30, Figs. 6, 7.
1962  _Pentinastrum subbotinae_ Lipman; R. H. Lipman: p. 306–307, Pl. 2, Fig. 7.

Material: 5 differently preserved specimens.


Description. Skeleton pentagonal, flat, porous, with 5 stout, short conical processes. Between the processes the sides are deeply concave.

Remarks. The terminations of processes are truncated or rounded, without spines.
Occurrence. Santonian to Campanian of Russia. Poland: Lower Turonian of Władysławowo IG 1.

Family Patulibracchidae Pessagno 1971 emend. Baumgartner 1980
Genus Crucella Pessagno 1971 emend. Baumgartner 1980
Type species Crucella messina Pessagno 1971

Crucella cachensis Pessagno 1971
(Pl. I, Figs. 1–11; Pl. II, Fig. 4)

1971 Crucella cachensis Pessagno; E. A. Pessagno: p. 53, Pl. 9, Figs. 1–3.
1986 Crucella cachensis Pessagno; J. Thurow, W. Kuhnt: p. 436, Fig. 9: 5, 6.
1989 Crucella cachensis Pessagno; H. Górka: p. 331, Pl. 11, Figs. 3, 4.
1991 Crucella cachensis Pessagno; H. Górka: p. 42, Pl. 2, Figs. 7, 8.

Material: 120 well preserved specimens.

Remarks. The specimens from Władysławowo IG 1 display substantial variability of shoulder width, angle between shoulders, and size of the central part.

Occurrence: Lower and Middle Turonian of California, Cenomanian and Turonian of Morocco, Spain and Italy. Poland: Lower Turonian of Łeba IG 1 and Władysławowo IG 1, Lower Campanian of Cracow.

Family Cavaspongidae Pessagno 1973
Genus Cavaspongia Pessagno 1973
Type species Cavaspongia antelopensis Pessagno 1973

Cavaspongia antelopensis Pessagno 1973
(Pl. III, Figs. 1–3, 6–12; Pl. IV, Fig. 14)

1973 Cavaspongia antelopensis Pessagno; E. A. Pessagno: p. 76–77, Pl. 18, Fig. 46; Pl. 19, Fig. 1.
1976 Cavaspongia antelopensis Pessagno; E. A. Pessagno: p. 37, Pl. 4, Fig. 4.
1986 Cavaspongia antelopensis Pessagno; A. Schaab, V. Thomas: p. 1597, Pl. 2, Fig. F.
1986 Cavaspongia antelopensis Pessagno; J. Thurow, W. Kuhnt: Pl. 9, Fig. 3.
1991 Cavaspongia antelopensis Pessagno; H. Górka: p. 40–42, Pl. 2, Fig. 9.

Material: 90 well preserved specimens.

Remarks. There is little variability of size, but the specimens vary in the degree of concavity of sides, “gate” depth and rounding of the terminations.
Occurrence. Lower Turonian of California, Morocco and Italy, Lower Campanian of Wadi Ragmi de Semail, Oman. Poland: Lower Turonian of Łeba IG 1 and Władysławowo IG 1.

*Cavaspongia californiensis* Pessagno 1973

(Pl. IV, Fig. 7)

1976 *Cavaspongia californiensis* Pessagno; E. A. Pessagno: p. 37, Pl. 4, Figs. 2–3.

Material: 15 specimens.
Dimensions (in μm): height — about 130, maximum shoulder width — about 50.

Remarks. The specimens from Władysławowo IG 1 have more slender and elongated shoulders than the type and paratypes of *Cavaspongia californiensis* Pessagno.

Occurrence. Cenomanian to Coniacian, Lower and Middle Turonian of California. Poland: Lower Turonian of Władysławowo IG 1.

*Cavaspongia* sp.

(Pl. III, Figs. 4, 5, 13, 14)

Material: 7 specimens.

Remarks. Those specimens which are more flattened than *Cavaspongia antelopeensis* Pessagno and which have no prominent “gate” were designated as *Cavaspongia* sp.

Occurrence. Lower Turonian of Władysławowo IG 1.

Genus *Pyramispongia* Pessagno 1973

Type species *Pyramispongia magnifica* Pessagno 1973

*Pyramispongia glascockensis* Pessagno 1973

(Pl. IV, Figs. 9–11)

1973 *Pyramispongia glascockensis* Pessagno; E. A. Pessagno: p. 79–80, Pl. 21, Figs. 2–5.
1976 *Pyramispongia glascockensis* Pessagno; E. A. Pessagno: p. 37, Pl. 1, Fig. 9.
1982 *Pyramispongia glascockensis* Pessagno; Y. Takeuti: Pl. 1, Fig. 18.
1982 *Pyramispongia glascockensis* Pessagno; M. Yamauchi: Pl. 1, Fig. 5; Pl. 2, Fig. 9.
1986 *Pyramispongia glascockensis* Pessagno; J. Thurow, W. Kuhnt: text-fig. 9: 4.
1988 *Pyramispongia glascockensis* Pessagno; J. Thurow: p. 31, Pl. 2, Fig. 23.

Material: 25 well preserved specimens.
Remarks. In specimens from Władysławowo IG 1 no cupola in the central part nor spines have been observed, probably due to their damage.

Occurrence. Upper Cenomanian to Middle Turonian of Europe and NW Africa, Cenomanian to Turonian of California, Cenomanian to Santonian of Japan. Poland: Lower Turonian of Władysławowo IG 1.

Family Spongodiscidae Haeckel 1882
Genus Spongodiscus Ehrenberg 1854
Type species Spongodiscus resurgens Ehrenberg 1854

Spongodiscus multus Koslova 1966
(Pl. IV, Figs. 1–4)

1966 Spongodiscus (?) multus Koslova; G. E. Koslova, A. N. Gorbovetz: p. 87–88, Pl. 4, Fig. 10.
1989 Spongodiscus multus Koslova, H. Górka, S. Geroch: p. 188, Pl. 3, Fig. 6.
1991 Spongodiscus multus Koslova, H. Górka: p. 43, Pl. 1, Figs. 1–3.

Material: 35 specimens.

Remarks. There is little size variability in specimens from Władysławowo IG 1.

Occurrence. Cosmopolitan species in Turonian to Campanian. Poland: Lower Turonian of Leba IG 1 and Władysławowo IG 1.

Family Hagiastridae Riedel 1971 emend. Baumgartner 1980
Genus Hagiastrum Haeckel 1881 sensu Baumgartner 1980
Type species Hagiastrum plenum Rüst 1885

Hagiastrum sp.
(Pl. IV, Figs. 5, 6)

1989 Hagiastrum sp.; H. Górka: p. 329–330, Pl. 14, Fig. 12.

Material: 7 specimens.

Description. Skeleton flat, formed by four shoulders, set at right angles to each other; one coaxial pair of shoulders is longer than the other, perpendicular pair. Shoulder terminations are rounded and without spines. Central area concave, forming a small lacuna.

Remarks. No patagium has been observed in specimens from Władysławowo IG 1. Furthermore, the angle between shoulders tends to be wider than the straight angle given in the original diagnosis of the genus Hagiastrum.

Occurrence. Poland: Lower Campanian of Cracow and Lower Turonian of Władysławowo IG 1.
Family *Orbiculiformidae* Pessagno 1973

Genus *Orbiculiforma* Pessagno 1973

Type species *Orbiculiforma quadrata* Pessagno 1973

*Orbiculiforma reniUaeiformis* (Campbell et Clark 1944) emend. Pessagno 1976
(Pl. V, Figs. 3, 5, 9)

1944 *Spongodiscus* (*Spongodesmus*) *reniUaeiformis* Campbell et Clark; A. S. Campbell, B. L. Clark: p. 18, Pl. 6, Figs. 5, 6, 10.


1976 *Orbiculiforma reniUaeiformis* (Campbell et Clark); E. A. Pessagno: p. 36, Pl. 11, Fig. 8.

1981 *Spongodesmus reniUaeiformis* Campbell et Clark; A. Schaaf: p. 438, Pl. 8, Figs. 4, 5, 8

1984 *Spongodesmus reniUaeiformis* Campbell et Clark; A. Schaaf: p. 161, Fig. 1.

1988 *Orbiculiforma reniUaeiformis* (Campbell et Clark); V. S. Vishnauksaya: Pl. 2, Fig. 2.

Material: 35 very well preserved specimens.

Dimensions (in μm): diameter ~ 140-180, central cavity diameter ~ 50-70.

Remarks. The presence of small triradiate spines in this species seems to be doubtful.

Occurrence. Cosmopolitan species, present in W and E Europe from Albian to Maastrichtian, as well as in the Maastrichtian of California. Poland: Lower Turonian of Wladyslawowo IG 1.

*Orbiculiforma vacaensis* Pessagno 1973
(Pl. V, Figs. 1, 2)


1976 *Orbiculiforma vacaensis* Pessagno; E. A. Pessagno: p. 37, Pl. 6, Figs. 5, 6, 9.

1982 *Orbiculiforma vacaensis* Pessagno; M. Yamauchi: p. 394, Pl. 2, Fig. 8.

1989 *Orbiculiforma vacaensis* Pessagno; H. Górska: p. 330, Pl. 9, Figs. 7, 10.

Material: 25 well preserved specimens.

Dimensions (in μm): diameter ~ 107-165, diameter of the central cavity ~ 50-55.

Remarks. This species shows high variability of dimensions. Specimens from Poland are smaller and less incised at the periphery.

Occurrence. Upper Cretaceous of California and Japan. Poland: Lower Turonian of Wladyslawowo IG 1 and Campanian of Cracow.

*Orbiculiforma ex gr. monticelloensis* Pessagno 1973
(Pl. V, Figs. 4, 6, 7)

1973 *Orbiculiforma monticelloensis* Pessagno; E. A. Pessagno: p. 72-73, Pl. 16, Figs. 5, 6; Pl. 18, Figs. 1, 2.

1976 *Orbiculiforma monticelloensis* Pessagno; E. A. Pessagno: p. 35, Pl. 6, Figs. 4, 5.
1982 *Orbiculiforma monotellaensis* Pessagno; Y. Taketani: p. 368, Pl. 2, Fig. 18.

**Material**: 15 well preserved specimens.
**Dimensions** (in μm): maximum width — 150–190, maximum diameter of the central cavity — 35–190, length of processes about 3.

**Description**: Discoidal shape, almost circular with a small peripheral incision. Central cavity shallow. Very short processes are present at the periphery.

**Remarks**: Triradiate spines have not been observed on specimens from Poland.

**Occurrence**: Turonian to Santonian of California, Lower Campanian to Lower Upper Turonian of NE Brazil. Poland: Lower Turonian of Władysławowo IG 1.

*Orbiculiforma* sp.  
(Pl. V, Fig. 8)

1988 Gen. et sp. indet. aff. *Holocryptocanium* sp. A; J. Thurow, Pl. 8, Fig. 19.

**Material**: 2 well preserved specimens.
**Dimensions** (in μm): total diameter — about 175–180.

**Remarks**: *Orbiculiforma* sp. resembles *Archeosphaera* (?) sp. A from Lower to Middle Turonian of northeastern Brazil because of its spherical shape, presence of tiny perforations and spongy structure of the skeleton, although the description deviates from E. Haeckel’s (1862) diagnosis. The material described herein is most closely similar to the Cretaceous specimen from the Atlantic Ocean illustrated by J. Thurow (1988) and labelled as Gen. et sp. indet.

**Occurrence**: Poland: Lower Turonian of Władysławowo IG 1.

**Family Incertae sedis**

Gen. et sp. indet. A  
(Pl. III, Fig. 15)

**Material**: 1 well preserved specimen.
**Dimensions** (in μm): height — 180, maximum width — 194.

**Remarks**: The specimen is slightly bigger than those of *Cavaspangia antelopesis* Pessagno, more robustly built, with two sides convex and one side concave, and with markedly rounded terminations.

**Occurrence**: Poland: Lower Turonian of Władysławowo IG 1.
Lower Turonian radiolarians (Polycystina)...

Gen. et sp. indet. B
(Pl. IV, Fig. 12)

Material: 1 well preserved specimen.
Dimensions (in µm): height — 150, maximum shoulder width — 80.

Description. Skeleton flat, of triangular outline, with arched, concave base and the two opposite sides incised in mid-length. Terminations rounded. Structure spongy.

Occurrence. Poland: Lower Turonian of Władysławowo IG 1.

Gen. et sp. indet. C
(Pl. IV, Fig. 13)

Material: 1 well preserved specimen.
Dimensions (in µm): height — 140, maximum width — 120.

Description. Skeleton flat, tiara-shaped, of triangular outline, with slightly concave base and the two other sides convex. Terminations less rounded than in the specimen described above. Structure spongy.

Occurrence. Poland: Lower Turonian of Władysławowo IG 1.

Order Nassellaria Ehrenberg 1875
Family Xitidae Pessagno 1977b
Type species Lithostrbus (Lithostrbus) pseudoconulus Pessagno 1963

Amphipyndax mediocris (Tan Sin Hok 1927)
(Pl. VI, Figs. 1, 2)

1927 Dicyonyma mediocris Tan Sin Hok; Tan Sin Hok: p. 1955, Pl. 10, Fig. 82.
1944 Stichostrbus (?)stocki Campbell et Clark; A. S. Campbell, B. L. Clark: p. 44, Pl. 8, Figs. 31–33.
1968 Amphipyndax stocki (Campbell et Clark); H. Foreman: p. 78, Pl. 8, Fig. 12a–c.
1974 Amphipyndax mediocris (Tan Sin Hok); G. W. Renz: p. 788, Pl. 5, Figs. 7, 9; Pl. 12, Fig. 3.
1981 Amphipyndax mediocris (Tan Sin Hok); A. Schaaf: p. 431, Pl. 3, Fig. 11; Pl. 22, Fig. 7a, b.
1988 Amphipyndax mediocris (Tan Sin Hok); I. Thurow: Pl. 1, Fig. 7; Pl. 4, Fig. 5.
1991 Amphipyndax mediocris (Tan Sin Hok); H. Görka: p. 43, Pl. 2, Figs. 2, 3.

Material: 35 well preserved specimens.
Dimensions (in µm): height — 117–140, width at the base — 70–78

Description. Skeleton conical, with subspherical, unperforated cephalis. Post-abdominal segments, numbering 3 to 5, of subtrapezoidal shape, slightly swollen, with very minuscule perforation of irregular to rounded pores, arranged in transverse rows. Locally, a second layer is observed. Basal orifice subcircular.
Remarks. Little variability of size is observed in *Amphipyndax mediocris* (Tan Sin Hok).

Occurrence. Cosmopolitan species from Turonian to Campanian. Poland: Lower Turonian of Leba IG 1 and Wladyslawowo IG 1.

*Amphipyndax uralica* (Gorbovetz 1966)
(Pl. VI, Fig. 10)


Material: 7 well preserved specimens.

Description. Skeleton conical, elongate, widening towards the base, consisting of a small, rounded capitulum and 6 more segments of trapezoidal shape with slightly convex sides. Incisions between segments are more pronounced in the initial part. Wall with tiny perforation, basal orifice hardly discernible.

Remarks. The preservation of specimens from Poland does not allow for precise description of the perforation pattern nor for confirmation of the existence of a second layer of the wall, because the covering meshwork obscures deeper structures.


Family Stichocystidae Haeckel 1882 1885
Genus *Stichomitra* Cayeux 1897
Type species *Stichomitra costata* Cayeux 1897

*Stichomitra communis* Squinabol 1903
(Pl. VI, Figs. 8, 11, 17)

1975 *Stichomitra* sp.; P. Dumitrica: p. 87–89, Pl. 2, Fig. 21.
1982 *Stichomitra communis* Squinabol; Y. Taketani: p. 54, Pl. 3, Fig. 9; Pl. 11, Fig. 5.
1986 *Stichomitra communis* Squinabol; W. Kuhnt et al.: p. 236, Pl. 7w.
1987 *Stichomitra communis* Squinabol; S. Gorčan: p. 186, Pl. 3, Fig. 21.
1988 *Stichomitra communis* Squinabol; V. S. Vishnevskaya: Pl. 4, Fig. 6.
1993 *Stichomitra communis* Squinabol; M. Baj: p. 193, Pl. 3, Figs. 11, 12.

Material: 38 well preserved specimens.

Description. Skeleton conical, slender or slightly widened, consisting of 7 to 10 segments of trapezoidal shape. In some specimens the cephalis bears tiny perforations. Postabdominal segments irregularly perforated — both the pores and their arrangement are irregular.
Lower Turonian; radiolarians (Polycystina)...

Occurrence. Cosmopolitan species; Cenomanian to Turonian of S Europe and NW Africa, Upper Cenomanian to lowermost Coniacian of Japan, and Albian to Turonian of Oman. Poland: Upper Albian to Lower Cenomanian of the Pieniny Klippen Belt (Carpathians), Lower Turonian of Wladyslawowo IG 1.

Stichomitra sp. A
(Pl. VI, Fig. 6)

Material: 5 well preserved specimens.

Description. Skeleton conical, elongate. Cephalis small, trapezoidal. Abdomen and postabdominal segments, numbering 5 to 7, are trapezoidal, low and wide, divided by shallow incisions. Segments are wider in the middle part. The skeleton has spongy structure.

Remarks. Stichomitra sp. A from Wladyslawowo IG 1 differs from Stichomitra sp. from Lower Turonian of Leba IG 1 (H. Górka, 1991) by having a smaller number of segments. It is most similar to a Stichomitra sp. specimen from Cretaceous sediments of the Atlantic Ocean, illustrated by J. Thurow (1988).

Occurrence. Poland: Lower Turonian of Wladyslawowo IG 1.

Stichomitra sp. B
(Pl. VI, Figs. 14, 16)

Material: 9 well preserved specimens.

Remarks. Specific assignment of this form is difficult despite its abundance in the studied material. Skeleton conical, with quite widened base, consists of poorly discernible, unperforated capitulum, trapezoidal thorax, and 5 to 6 postabdominal segments, which are low, and widening towards the base. The last segment is often smaller than the other ones. The incisions between segments are only slightly marked at the periphery. In some specimens an oval orifice has been noted. Skeleton with spongy structure.

Occurrence. Poland: Lower Turonian of Wladyslawowo IG 1.

Genus Stichocapsa Haeckel 1881 sensu Petrushevskaya, Koslova 1972
Type species Stichocapsa jaspidea Rust 1885

Stichocapsa sp.
(Pl. VI, Figs. 3, 4)

Material: 7 well preserved specimens.
Description. Skeleton elongate, spindle-shaped, cephalis more or less rounded. Present are thorax, abdomen and postabdominal segments, of trapezoidal shape with slightly marked incisions. Skeleton spongy. The base slightly rounded, closed.

Remarks. The specimens described herein from Poland do not match any known species of *Stichocapsa*.

Occurrence. Poland: Lower Turonian of Władysławowo IG 1.

Family *Theoperidae* Haeckel 1881 emend. Riedel 1967
Genus *Eucyrtidium* Ehrenberg 1847
Type species *Lithocampe acuminata* Ehrenberg 1844

*Eucyrtidium (?)matsumotoi* Taketani 1982
(Pl. VI, Fig. 9)

Material: 2 well preserved specimens.
Dimensions (in μm): height — 160–175, maximum width — about 60.

Description. Skeleton spindle-shaped, with unperforated capitulum, ending in a little spine. Thorax trapezoidal. 5 postabdominal segments relatively high and wide are widest at mid-height. Basal orifice not visible. Perforation irregular.

Occurrence. Turonian of Hokkaido (Japan). Poland: Lower Turonian of Władysławowo IG 1.

Family *Archaeodictyomitridae* Pessagno 1976
Genus *Dictyomitra* Zittel 1876 emend. Pessagno 1976
Type species *Dictyomitra multicostata* Zittel 1876

*Dictyomitra* sp.
(Pl. VI, Fig. 15)

Material: 1 well preserved specimen.

Description. Skeleton conical, elongate, with small, smooth cephalis and trapezoidal thorax. The other segments are low, growing bigger along the series. At the periphery, there are clearly noticeable incisions between segments. The last segment is lower than the remaining ones and bears an oval orifice. The costae typical for this genus are at places covered by an irregularly perforated meshwork.

Remarks. The specimen described herein resembles most closely a Middle Jurassic *Dictyomitra* sp. from the Baltic region (V. S. Vishnevskaya, 1988).

Occurrence. Poland: Lower Turonian of Władysławowo IG 1.
Family Spongocapsulidae Pessagno 1977a emend. Pessagno 1977b
Genus Obesacapsula 1977a emend. Pessagno 1977b
Type species Obesacapsula morroensis Pessagno 1977a

Obesacapsula morroensis Pessagno 1977a
(Pl. VI, Fig. 19)

1977a Obesacapsula morroensis Pessagno; E. A. Pessagno: p. 87, Pl. 11, Figs. 5-8.
1977b Obesacapsula morroensis Pessagno; E. A. Pessagno; p. 53, Pl. 11, Fig. 8.

Material: 15 well preserved specimens.

Description. Skeleton robust, consisting of 5 to 9 segments, the last of which is markedly swollen and continues into a cylindrical tubular extension. The proximal part of the skeleton is conical frustum-shaped and not perforated. The wall is thick and spongy.

Remarks. Obesacapsula morroensis Pessagno differs from O. (?)rotunda (G. J. Hinde, 1902, Pl. I, Fig. 5) by having less pronounced incisions between segments, reduced number of segments and the last segment being much higher than the others. The discovery of O. morroensis Pessagno in Lower Turonian deposits of Władysławowo IG 1 extends the known geographical range of the species.

Occurrence. Valanginian and Lower Turonian of California, Poland: Lower Turonian of Władysławowo IG 1.

Obesacapsula cf. rotunda (Hinde 1902)
(Pl. VI, Fig. 5)

Material: 1 well preserved specimen.
Dimensions (in μm): height — 146, maximum width — 68.

Remarks. Obesacapsula cf. rotunda (Hinde) differs from the above described O. morroensis Pessagno by having more prominent incisions between segments, though less marked than in O. cf. rotunda (Hinde), and more numerous segments which grow slightly bigger in size along the series. In O. cf. rotunda (Hinde) from Poland there is an inconspicuous tubular structure.

Occurrence. Poland: Lower Turonian of Władysławowo IG 1.
Cyrtodea incertae sedis

Genus Protostichocapsa Empson-Morin 1982
Type species Stichocapsa (?)stocki Campbell et Clark 1944 emend. Foreman 1968

Protostichocapsa stocki (Campbell et Clark, 1944) emend. Foreman 1968
(Pl. VI, Figs. 13, 20)

1944 Stichocapsa (?)stocki Campbell et Clark; A. S. Campbell, B. L. Clark: p. 44, Pl. 8, Figs. 31–35.
1944 Stichocapsa megalocephala Campbell et Clark; A. S. Campbell, B. L. Clark: p. 44, Pl. 8, Figs. 26, 34.
1968 Amphipyndax stocki (Campbell et Clark); H. Foreman: p. 78, Pl. 8, Fig. 12a-c.
1982 Protostichocapsa stocki (Campbell et Clark); K. M. Empson-Morin: p. 516, Pl. 4, Figs. 1–12.
1982 Amphipyndax stocki (Campbell et Clark) var. B; V. S. Vishnevskaya: p. 53, Pl. 6, Figs. 1–5.
1989 Protostichocapsa stocki (Campbell et Clark) emend. Foreman; H. Górka: p. 343, Pl. 14, Figs. 6, 7.
1991 Protostichocapsa stocki (Campbell et Clark) emend. Foreman; H. Górka: p. 44, Pl. 2, Fig. 6.
1993 Amphipyndax stocki (Campbell et Clark); M. Bár: p. 186, Pl. 2, Figs. 8–10.

Material: 30 well preserved specimens.

Description of specimens and remarks: Protostichocapsa stocki (Campbell et Clark) displays large variability of the size and degree of elongation of the skeleton. The specimens from Władysławowo IG 1 are always conical, and consist of 6 to 8 segments with poorly marked borders on periphery. They have been classified to this species on the basis of their rounded cephalis, lacking an apical spine divided internally into 2 sections. Trapezoidal thorax is poorly marked. Postabdominal segments grow successively bigger. Sometimes the last segment is slightly higher. Basal orifice not always visible. Perforations of irregular shape and size.

Occurrence. Cosmopolitan species from Albian to Campanian. Poland: Upper Albian to Lower Cenomanian of Pieniny Klippen Belt (Carpathians), Lower Turonian of Władysławowo IG 1.

Genus Pseudoeucyrtis Pessagno 1977b
Type species Eucyrtis (?)zhamoidai Foreman 1973
Pseudoeucyrtis sp.
(Pl. VI, Fig. 7)

Material: 1 well preserved specimen.

Description. Skeleton elongate, spindle-shaped. Cephalis small, rounded, lacking an apical spine (perhaps due to damage). The other 7 segments grow gradually higher. They are widest in mid-length of the skeleton. Incisions between segments poorly marked. Distal end truncated. Perforation irregularly spaced.
Remarks. This *Pseudoeucyrtis* sp. seems to be conspecific with the *Pseudoeucyrtis* sp. described from Hauterivian Grodziszcze Shales at Lipnik (H. Górka, S. Geroch, 1989).

Occurrence. Poland: Hauterivian at Lipnik (Outer Carpathians), Lower Turonian of Władysławowo IG 1.

Gen. et sp. indet.
(Pl. VI, Figs. 12, 18, 21)

Material: 10 differently preserved specimens.

Description. Skeleton elongate, robust, frustum-shaped, consisting of few (5–7) segments of trapezoidal shape with slightly convex sides. Borders between segments well marked. The size of segments grows towards the base, and they are widest around the middle of the skeleton's height (i.e., at the 2nd or 3rd postabdominal segment). Cephalis and thorax are indeterminable in the studied specimens. No apical spine has been observed. The skeleton has spongy structure, locally with finely granulate surface. Perforations of irregular shape and irregularly spaced. Basal orifice small, circular, often not visible.

Remarks. Despite large number of specimens, it is difficult to identify their generic and specific affinities, because the incompleteness of the first 2 segments in all of them. The general shape of the skeleton, as well as the number and size of segments make them comparable to *Dictyomitra (?)nodosa* Koslova from the Campanian of the Eastern Caucasus, although the illustrated holotype consists of only 5 segments and not of 8, as stated in the diagnosis. The cephalis is also obscured. Both forms have granulate tuberosities, but the perforation is different. In the species described herein, the pores are smooth and framed with an inflated surface. A size variability has been observed.

Occurrence. Poland: Lower Turonian of Władysławowo IG 1.

Translated by Karol Sabat

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Warszawa, al. Zwirki i Wigury 93
Received: 27.03.1995

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Z próbek pobranych do badań mikropaleontologicznych z otworu wiertniczego Władysławowo IG 1 sześć stanowi materiał wyjątkowo bogaty w dobrze zachowane krzemionkowe szczeciki radiolarii (promienne). Opracowano 30 gatunków radiolarii (Polycystina), w tym 17 przedstawicieli Spumellaria i 13 Nassellaria.

Na podstawie radiolarii i towarzyszących im mikropaleontologicznych, wiek badanych próbek określono na wczesny turon. Ponadto przedstawiono historyczne badania radiolarii kredowych w Polsce, przeprowadzono analizę biometryczną oraz wyciągnięto wnioski ekologiczne, sugerujące występowanie otworne planktoniczne, jak również radiolarie wskazują na otwarte, płytkie i chłodne morze.
Hanna GÓRKA — Lower Turonian radiolarians (Polycystina) from borehole Władysławowo IG 1 (Baltic region)
PLATE II

Fig. 1-3. *Histiastrum latum* Lipman
Fig. 1 — IGPUW-V-30, depth 124.00 m, x 500; Fig. 2 — IGPUW-V-118, depth 131.20 m, x 430; Fig. 3 — IGPUW-V-129, depth 131.20 m, x 416

Fig. 4. *Crucella cacnensis* Pessagno
IGPUW-V-61, depth 124.00 m, x 390

Figs. 5-11. *Histiastrum aster* Lipman
Fig. 5 — IGPUW-V-23, depth 114.00 m, x 400; Fig. 6 — IGPUW-V-18, depth 124.70 m, x 575; Fig. 7 — IGPUW-V-44, depth 121.00 m, x 410, Fig. 8 — IGPUW-V-3, depth 114.00 m, x 410, Fig. 9 — IGPUW-V-26, depth 121.00 m, x 430; Fig. 10 — IGPUW-V-22, depth 121.00 m, x 400; Fig. 11 — IGPUW-V-67, depth 124.00 m, x 400
Hanna GÓRKA — Lower Turonian radiolarians (Polycystina) from borehole Władysławowo IG I (Baltic region)
PLATE III

Figs. 1–3, 6–12. Cavaspungia antelopensis Pessagno
Fig. 1 — IGPUW-V-8, depth 114.00 m, x 410; Fig. 2 — IGPUW-V-15, depth 114.00 m, x 430; Fig. 3 — IGPUW-V-41, depth 121.00 m, x 450; Fig. 6 — IGPUW-V-69, depth 124.70 m, x 370; Fig. 7 — IGPUW-V-73, depth 124.70 m, x 430; Fig. 8 — IGPUW-V-54, depth 124.00 m, x 400; Fig. 9 — IGPUW-V-87, depth 124.70 m, x 420; Fig. 10 — IGPUW-V-5, depth 128.00 m, x 400; Fig. 11 — IGPUW-V-16, depth 114.00 m, x 400; Fig. 12 — IGPUW-V-94, depth 124.70 m, x 420

Figs. 4, 5, 13, 14. Cavaspungia sp.
Fig. 4 — IGPUW-V-95, depth 124.00 m, x 415; Fig. 5 — IGPUW-V-49, depth 124.00 m, x 450; Fig. 13 — IGPUW-V-125, depth 131.20 m, x 390; Fig. 14 — IGPUW-V-114, depth 131.20 m, x 430

Fig. 15. Gen. et sp. indet. A.
IGPUW-V-80, depth 124.70 m, x 360
Hanna GÖRKA — Lower Turonian radiolarians (Polycystina) from borehole Władysławowo IG 1 (Baltic region)
Figs. 1–4. Spongoidiscatus multus Koslova
Fig. 1 — IGPUW-V-93, depth 124.70 m, x 420; Fig. 2 — IGPUW-V-13, depth 114.00 m, x 400; Fig. 3 — IGPUW-V-56, depth 124.06 m, x 420; Fig. 4 — IGPUW-V-45, depth 121.00 m, x 445
Figs. 5, 6. Haginastrea sp.
Fig. 5 — IGPUW-V-97, depth 124.00 m, x 380; Fig. 6 — IGPUW-V-28, depth 121.00 m, x 420
Fig. 7. Cavaspongia californiensis Pessagno
IGPUW-V-71, depth 124.70 m, x 380
Fig. 8. Peniastrea subbotae Lipman
IGPUW-V-40, depth 121.00 m, x 390
Figs. 9–11. Pyramispongia glasbcokensis Pessagno
Fig. 9 — IGPUW-V-37, depth 121.00 m, x 400; Fig. 10 — IGPUW-V-38, depth 121.00 m, x 390; Fig. 11 — IGPUW-V-43, depth 121.00 m, x 430
Fig. 12. Gen. et sp. indet. B
IGPUW-V-30, depth 121.00 m, x 406
Fig. 13. Gen. et sp. indet. C
IGPUW-V-34, depth 121.00 m, x 390
Fig. 14. Cavaspongia antelopeensis Pessagno
IGPUW-V-48, depth 124.00 m, x 460
Hanna GÓRKA — Lower Turonian radiolarians (Polycystina) from borehole Władysławowo IG 1 (Baltic region)
Hanna GÓRKA — Lower Turonian radiolarians (Polycystina) from borehole Władysławowo IG 1 (Baltic region)
PLATE V

Figs. 1, 2, *Orbiculiforma vaccaensis* Pessagno
Fig. 1 — IGPUW-V-76, depth 124.70 m, x 445; Fig. 2 — IGPUW-V-10, depth 114.00 m, x 400

Figs. 3, 5, 9, *Orbiculiforma renilliformis* (Campbell et Clark) Pessagno
Fig. 3 — IGPUW-V-29, depth 124.00 m, x 430; Fig. 5 — IGPUW-V-55, depth 124.00 m, x 400; Fig. 9 — IGPUW-V-59, depth 124.00 m, x 415

Figs. 4, 6, 7, *Orbiculiforma ex gr. monticelloensis* Pessagno
Fig. 4 — IGPUW-V-96, depth 124.70 m, x 410; Fig. 6 — IGPUW-V-22, depth 114.00 m, x 440; Fig. 7 — IGPUW-V-57, depth 124.00 m, x 420

Fig. 8, *Orbiculiforma* sp.
IGPUW-V-42, depth 121.00 m, x 400
Hanna GÓRKA — Lower Turonian radiolarians (Polycystina) from borehole Władysławowo IG 1 (Baltic region)
PLATE VI

Figs. 1, 2. *Amphipynax mediocris* (Tan Sin Hek)
Fig. 1 — IGPUW-V-14, depth 114.00 m, x 410; Fig. 2 — IGPUW-V-18, depth 114.00 m, x 390

Figs. 3, 4. *Stichomitra* sp.
Fig. 3 — IGPUW-V-119, depth 121.20 m, x 410; Fig. 4 — IGPUW-V-68, depth 124.00 m, x 390

Fig. 5. *Obesacapsula cf. rotunda* (Hinde)
IGPUW-V-51, depth 124.00 m, x 430

Fig. 6. *Stichomitra* sp. A
IGPUW-V-19, depth 114.00 m, x 425

Fig. 7. *Pseudoeucynis* sp.
IGPUW-V-17, depth 114.00 m, x 410

Figs. 8, 11, 17. *Stichomitra communis* Squinabol
Fig. 8 — IGPUW-V-31, depth 121.00 m, x 406; Fig. 11 — IGPUW-V-2, depth 114.00 m, x 410; Fig. 17 — IGPUW-V-24, depth 121.00 m, x 400

Fig. 9. *Eucyrtidium (?) matsunotai* Taketani
IGPUW-V-39, depth 121.00 m, x 406

Fig. 10. *Amphipynax aurata* (Gorbovetz)
IGPUW-V-24, depth 121.00 m, x 400

Figs. 12, 13, 21. Gen. et sp. indet.
Fig. 12 — IGPUW-V-78, depth 124.70 m, x 400; Fig. 18 — IGPUW-V-64, depth 124.00 m, x 415; Fig. 21 — IGPUW-V-103, depth 124.00 m, x 420

Figs. 13, 20. *Pseudostichocapsa stocki* (Campbell et Clark) emend. Fuzeau
Fig. 13 — IGPUW-V-66, depth 124.70 m, x 410; Fig. 20 — IGPUW-V-74, depth 124.70 m, x 430

Figs. 14, 16. *Stichomitra* sp. B
Fig. 14 — IGPUW-V-58, depth 124.70 m, x 425; Fig. 16 — IGPUW-V-120, depth 131.20 m, x 410

Fig. 15. *Dictyomitra* sp.
IGPUW-V-7, depth 114.00 m, x 410

Fig. 19. *Obesacapsula marmoreus* Passagno
IGPUW-V-52, depth 124.00 m, x 400
Hanna GÓRKA — Lower Turonian radiolarians (Polycystina) from borehole Władysławowo IG 1 (Baltic region)