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HEXACTINELLID SPONGES FROM THE SANTONIAN DEPOSITS OF THE KRAKÓW AREA (SOUTHERN POLAND)

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Abstract: Hexactinellid sponges are extremely abundant in the basal sequence of the Santonian of the Kraków region. This is the only known area in Poland where Santonian deposits with sponges are exposed. The studied sponges are redeposited and probably represent a Santonian or/and Coniacian assemblage. They inhabited a quiet, deeper part of the epicontinental sea that covered the southern part of Poland in Late Cretaceous times.

This paper is a taxonomic revision of sponges collected from this region by the late Prof. J. Małecki. Based on existing old collections and newly collected material comprising 1020 specimens, 34 species have been described, including 14 belonging to the Hexactinosida and 20 to the Lychniscosida.

All sponge species occurring in the Santonian succession of the Kraków area are also known from various Late Cretaceous sponge assemblages of Europe. Five species described, *i.e. Eurete halli* (Schrammen), *Lefroyella favoidea* Schrammen, *Spirolophia tortuosa* (Roemer), *Coeloptychium lobatum* Goldfuss, and *Wollemannia araneosa* Schrammen have not been so far noted in pre-Campanian deposits. The examined assemblage is particularly similar to the sponge fauna from the Middle Coniacian – Middle Santonian deposits of England and from the Lower Santonian of Russia (Saratov area).

Key words: sponges, Hexactinosida, Lychniscosida, taxonomy, Santonian, Upper Cretaceous, Southern Poland.

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INTRODUCTION

Santonian strata of the Kraków area contain a particularly rich assemblage of phosphatized macrofauna, dominated by hexactinellid sponges. These sponges were collected in two exposures at Korzkiew (Małecki, 1980; Kudrewicz, 1992; Kudrewicz & Olszewska-Nejbert, 1997; Świerczewska-Gładysz, 1997), Zabierzów (Golonka & Rajchel, 1972; Jasionowski, 1995) and Mydlniki (Jasionowski, 1995). Sponges were also documented in marly glauconitic limestones of Wielkanoc (Olszewska-Nejbert & Świerczewska-Gładysz, 2008, 2009), where they were found for the first time by D. Olszewska-Nejbert.

The occurrence of sponge fauna in all studied successions is restricted to the lowermost part of the Santonian succession, where they are accompanied by echinoids. The phosphatization of fossils suggests their redeposition (Małecki, 1980; Kudrewicz, 1992; Kudrewicz & Olszewska-Nejbert, 1997; Świerczewska-Gładysz, 1997; Olszewska-Nejbert & Świerczewska-Gładysz, 2008, 2009). Due to lack of well documented autochthonous fauna, the precise age of the deposits with sponges is still a controversy and has been considered as Middle or Late Santonian (Kudrewicz, 1992; Walaszczyk, 1992) or even Early Santonian (Machaniec *et al.*, 2004; Machaniec & Zapałowicz-Bilan, 2005). Palaeontological descriptions have been supplied only for sponges from the Korzkiew "Above The Castle" exposure (Małecki, 1980). The taxonomic position of some specimens from the collection of J. Małecki was revised earlier in a paper on sponges from the Campanian and Maastrichtian of the Middle Vistula Valley (Świerczewska-Gładysz, 2006). In the mentioned work, a taxonomic revision of all archival collections with the addition of new material from both locations at Korzkiew was presented. In the present paper described are also sponges from Zabierzów and Wielkanoc, which until now were only preliminarily studied (Olszewska-Nejbert & Świerczewska-Gładysz, 2008).

GEOLOGICAL SETTING

The study area is located in the southern part of the Polish Jura Chain (Fig. 1). In the Late Cretaceous, this region constituted the southern periphery of a large epicontinental basin, which covered the area of Central Poland following the Albian–Cenomanian transgression (Marcinowski, 1974; Marcinowski & Radwański, 1983, 1989; Jaskowiak-Schoeneichowa & Krassowska, 1988; Leszczyński, 1997). In the early Late Cretaceous, a submarine swell started to form (Marcinowski, 1974; Marcinowski & Radwański, 1983, 1989; Walaszczyk, 1992); this structure is referred to as the Polish Jura Swell (Marcinowski & Radwański, 1983) or

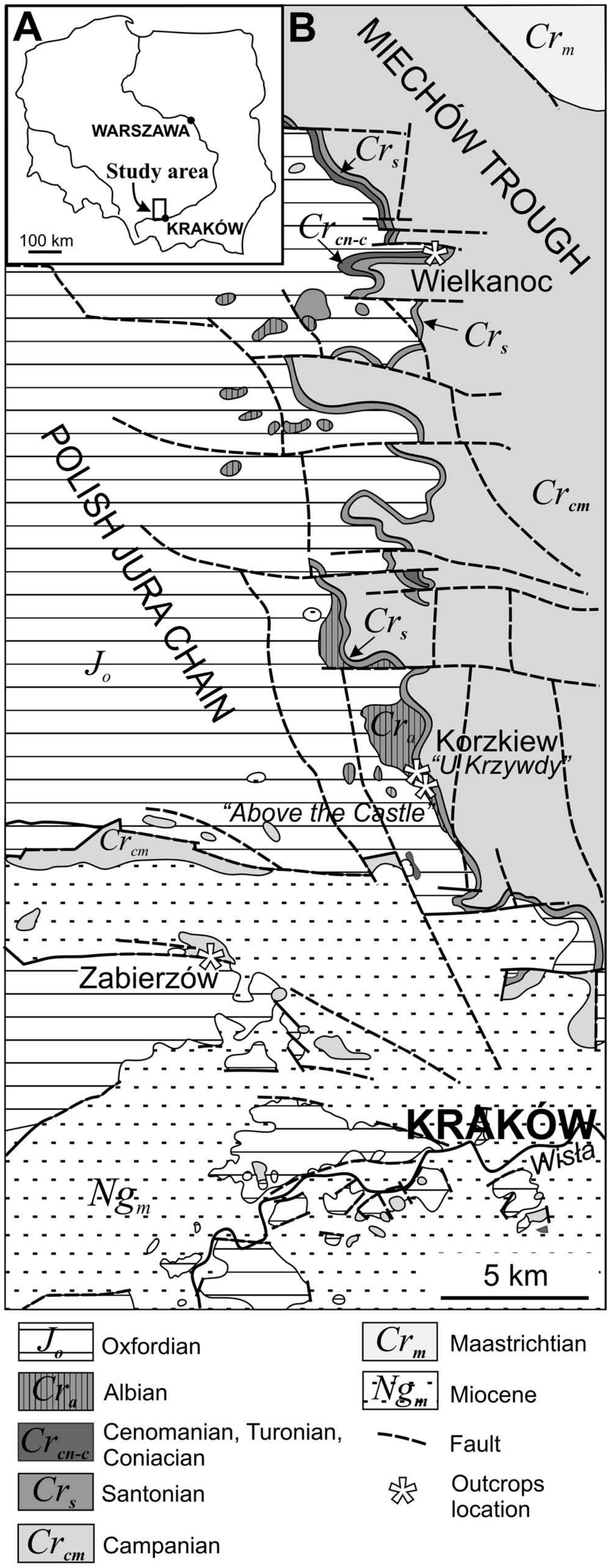

Fig. 1. **A.** Location of studied area on the general map of Poland; **B.** Geological sketch – map of the study area (after Kaziuk, 1978; modified and simplified)

Kraków Swell (Walaszczyk, 1992). In the Turonian-Santonian interval, the Kraków Swell was an elevation with a NW-SW axis, located between two deeper basins: the Miechów basin (part of the Danish-Polish Trough) to the north-east and the Opole Trough (part of the circum-Sudetic basins) to the south-west. The Kraków Swell was subdivided into smaller individual blocks of variable synsedimentary uplift; therefore, the lithological sequence in each part is different (Marcinowski, 1974; Marcinowski & Radwański, 1989; Walaszczyk, 1992). As contrasted with the adjoining basins, the area of the entire swell is characterized by large reduction of the sediment thickness and the presence of numerous stratigraphic gaps corresponding to discontinuity surfaces, *e.g.*, abrasion platforms, hardground and omission surfaces, often with stromatolitic bands (Alexandrowicz, 1954; Golonka & Rajchel, 1972; Marcinowski & Szulczewski, 1972; Marcinowski, 1974; Marcinowski & Radwański, 1983, 1989; Walaszczyk, 1992; Jasionowski, 1995; Krajewski *et al.*, 2000; Olszewska-Nejbert, 2004; Bromley *et al.*, 2009). The very low deposition rate with episodes of non-deposition favoured the phosphatization of stromatolites and sponges (Jasionowski, 1995; Olszewska-Nejbert, 2004; Olszewska-Nejbert & Świerczewska-Gładysz, 2009).

In the Late Santonian, the uplift stopped and marly and siliceous marly chalk facies appeared (Marcinowski, 1974; Walaszczyk, 1992). This uniform facies was also common in the Campanian (*e.g.*, Barczyk, 1956; Bukowy, 1956; Walaszczyk, 1992). Lithological and faunal changes in the Late Santonian and Campanian point to the gradual deepening of the basin (Marcinowski & Szulczewski, 1972; Kudrewicz & Olszewska-Nejbert, 1997; Machaniec & Zapałowicz-Bilan, 2005). In the end of the Cretaceous, the whole area underwent emersion and thorough rebuilding as a result of Laramide movements (Marcinowski, 1974; Marcinowski & Radwański, 1989). In consequence of post-Cretaceous erosion, a significant amount of Upper Cretaceous deposits were removed from the examined area. At present, the Santonian exposures occur in a narrow, generally NNW-SSW striking zone.

STUDIED SECTIONS

The outcrop near Wielkanoc village is the northernmost exposure studied, located 31 km from the centre of Kraków city (Fig. 1B). The oldest Upper Cretaceous deposits are exposed only in the southern wall of the quarry where – similarly as in other exposures – they cover the abrasion surface topping Oxfordian limestones (Marcinowski, 1974; Walaszczyk, 1992; Olszewska-Nejbert, 2005). The sections begin with a thick complex of various limestones (pelitic, sandy, organodetrital) representing the upper Middle Turonian and lower Upper Turonian (*Inoceramus lamarcki* and *Inoceramus perplexus* Zones – Walaszczyk, 1992). A hardground horizon and thin discontinuous phosphatic stromatolites (Olszewska-Nejbert, 2004) separate the Turonian deposits and the upper Lower Coniacian limestones (*Cremnoceramus crassus crassus*/*deformis deformis* Zone – Walaszczyk, 1992). The upper part of the succession is preserved only in the northern wall of the quarry (Fig. 2). It re-

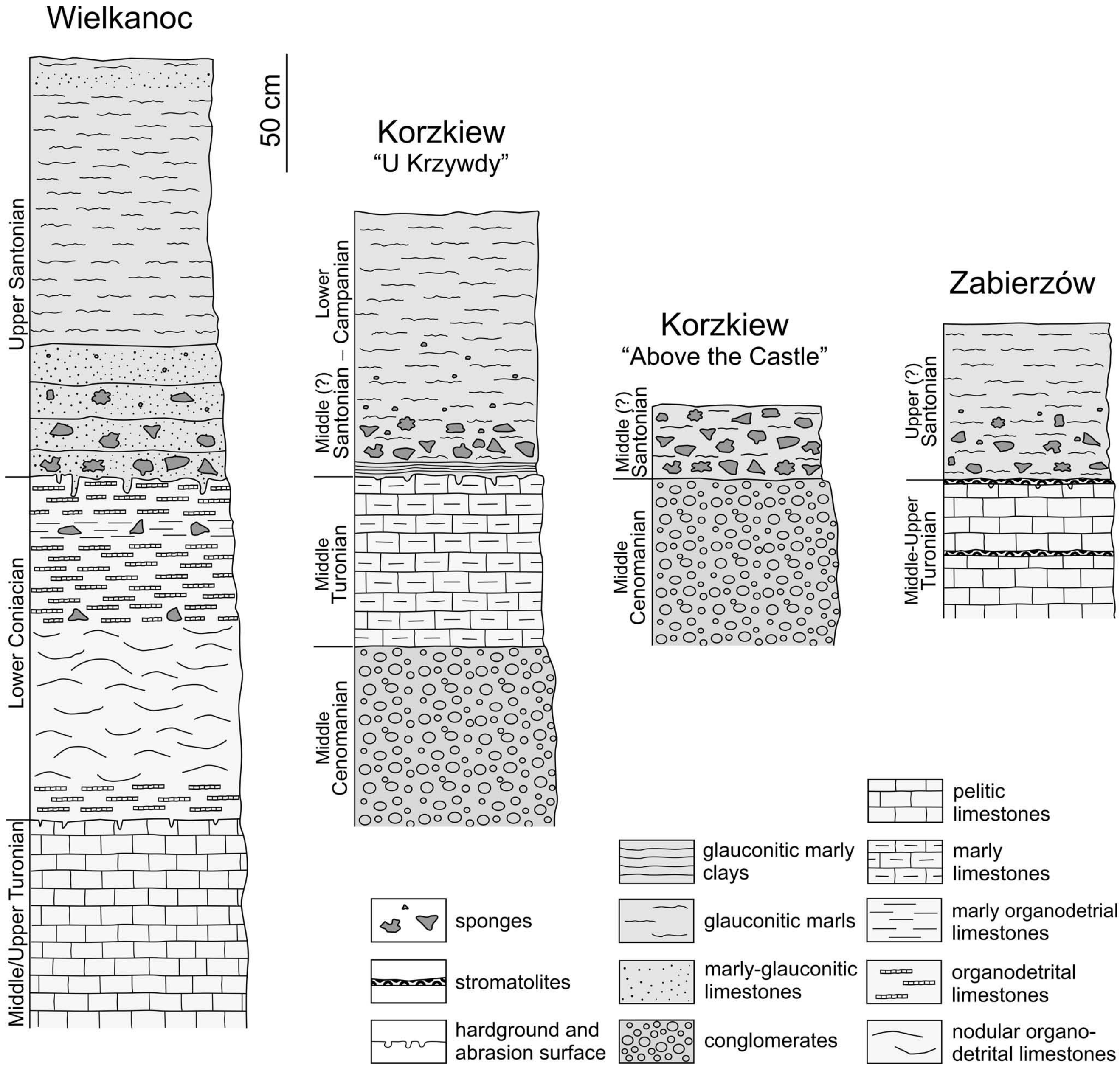

Fig. 2. Lithostratigraphical columns of studied sections; Wielkanoc section after Olszewska-Nejbert & Świerczewska-Gładysz (2009); Korzkiew "U Krzywdy" section after Kudrewicz & Olszewska-Nejbert (1997); Korzkiew "Above the Castle" section after Małecki (1980); Zabierzów section after Krajewski *et al.*, 2000; modified and simplified; stratigraphy after Walaszczyk (1992)

veals marly and nodular organodetrital limestones of the Lower Coniacian. In the upper part there occur two horizons with rare and poorly preserved sponges (Olszewska-Nejbert & Świerczewska-Gładysz, 2009). These are, so far, the only pre-Santonian sediments of the Upper Cretaceous in the region where hexactinellid sponges have been noted. On a hardground surface developed at the top of the limestone, marly-glauconitic limestones occur passing into clayey marls of the Upper Santonian (*Sphenoceramus patootensiformis* Zone – Walaszczyk, 1992). Phosphatized sponges occur only in the lowermost part of the Santonian.

In the Korzkiew region about 12 km north of Kraków (Fig. 1B), Upper Cretaceous deposits are represented by sandy conglomerates and marly deposits from the Upper Albian to the Lower Campanian (Panow, 1934; Bukowy, 1956; Kudrewicz, 1992; Walaszczyk, 1992). In the Korzkiew "U Krzywdy" exposures (Fig. 1B), Middle Turonian white marls rest on Cenomanian conglomerates (Fig. 2). The abrasion surface truncating the marls is covered with a thin bed of green glauconitic marly clays with echinoids (Kudrewicz, 1992; Kudrewicz & Olszewska-Nejbert, 1997). Kudrewicz (1992) attributed these clays to the Middle Santonian based on the presence of the belemnites *Actinocamax verus* Miller and *Goniateuthis westfalica-granulata* (Stolley). Above the clays, there occur green glauconitic marls with numerous phosphatized sponges. They pass upwards gradually into laminated, greyish-green marls with small fragments of phosphatized sponges and further into white marls devoid of phosphoritic concretions. The foraminiferal assemblage from the lower part of the marly succession is typical of the *Gavelinella thalamanni* Zone corresponding to the Lower Santonian; however, considering the stratigraphic condensation and/or redeposition of the fossils, this dating is uncertain (Machaniec & Zapałowicz-Bilan, 2005). The upper parts of the marly succession represent the Upper Santonian/Lower Campanian *Bolivinoides strigillatus* Zone and the Lower Campanian *Bolivinoides decoratus* Zone (Machaniec & Zapałowicz-Bilan, 2005). This is in accordance with the view of Walaszczyk (1992), who also places the white marls amongst the Lower Campanian.

In the Korzkiew "Above the Castle" section, the abrasion surface developed on the Cenomanian conglomerate is covered by glauconitic marly clays (Fig. 2). Numerous sponges occur within these deposits, accompanied by echinoids, belemnites and gastropods. Bukowy (1956) determined the age of these deposits as Santonian based on the presence of the belemnites *Actinocamax granulatus* (Blainville) and *Actinocamax verus* Miller. The top of the clays is unknown, cut erosionally and covered by loess.

The abandoned quarry in Zabierzów is located 12 km to the north-west from the centre of Kraków (Fig. 1B). The Upper Cretaceous sequence starts with condensed Turonian deposits composed of two superimposed units. The units correspond to the *Mytiloides labiatus* Zone of the Lower Turonian and the *Inoceramus lamarcki* and *Inoceramus costellatus* Zones of the Middle-Upper Turonian (Walaszczyk, 1992). Turonian deposits rest discordantly on Oxfordian massive limestones (Alexandrowicz, 1969; Golonka & Rajchel, 1972; Jasionowski, 1995; Krajewski *et al.*, 2000; Felisiak & Matyszkiewicz, 2001). Due to lateral diversity of the lithological units, strong fracturing of the rocks, erosion, as well as destruction caused by exploitation, the Cretaceous sections strongly differ among the different parts of the quarry (*cf.* Golonka & Rajchel, 1972; Jasionowski, 1995; Krajewski *et al.*, 2000; Machaniec *et al.*, 2004). The sponges come from the eastern part of the upper exposure. In the lower part of the section are exposed pelitic limestones (Krajewski *et al.*, 2000) of the Turonian upper unit (Fig. 2). According to Jasionowski (1995), this part of the quarry lacks the lower unit and the limestones rest here directly on Oxfordian limestones. Due to poor state of the exposure, the direct contact of these units is not visible. The uppermost part of the limestones displays bioturbation. The top of the limestone is covered by a thin bed of calcareous-phosphatic stromatolite (Golonka & Rajchel, 1972; Jasionowski, 1995; Krajewski *et al.*, 2000). Above, Upper Santonian green marls with glauconite and phosphatized sponges occur. These deposits terminate the Cretaceous succession; the Lower Campanian marls and opokas, existing in other parts of the quarry, have been eroded here.

MATERIAL AND METHODS OF STUDY

The studied material consists of 1020 specimens (collection UL XXI) that have been collected at four exposures: Wielkanoc – 149 specimens, Zabierzów – 44 specimens, Korzkiew "Above the Castle" – 153 specimens, and Korzkiew "U Krzywdy" – 492 specimens. The collection from Museum ING PAN no. A-1-81 described by J. Małecki (1980) was also studied. This collection includes 182 specimens from the Korzkiew "Above the Castle" exposure.

All sponges are phosphatized but their state of preservation strongly varies (see Olszewska-Nejbert & Świerczewska-Gładysz, 2009). All large specimens (above 10 cm in height) are broken and their real size is unknown. Part of the smaller specimens are complete or only slightly damaged. Others are strongly crushed and their outer surface is destroyed. The sponge spongocoel is usually filled with phosphatized material and their inner surface is usually only partly visible or invisible. Therefore, in the case of several species some features of the morphology cannot be examined.

The siliceous skeleton of the studied sponges is completely dissolved. Some voids after spicules are filled with glauconite, goethite or calcite. The skeleton structure was determined on the basis of voids after spicules. The observations were performed on the sponge surfaces under a binocular, as well as in thin sections in bright-field microscopy. Usually, the voids of spicules were most easily recognized on the surface of the specimens. Inside the wall, the spicules voids are often visible only locally due to diagenetic processes. In this case, the skeletal canalization is also undistinguishable.

SYSTEMATIC ACCOUNT

Class HEXACTINELLIDA Schmidt 1870
Order HEXACTINOSIDA Schrammen 1903
Family Euretidae Zittel 1877b
Genus *Wollemannia* Schrammen 1912
Type species: *Wollemannia araneosa* Schrammen 1912

Wollemannia araneosa Schrammen 1912
Figs 3A, 4

*1912. *Wollemannia araneosa* nov. sp.: Schrammen, p. 247, text-pl. 10, figs 4–6; pl. 27, fig. 2; pl. 41, fig. 5.
2006. *Wollemannia araneosa* Schrammen: Świerczewska-Gładysz, pp. 235–236, figs 4a, 5c-e, 6 (cum syn.).

Material: 7 specimens from Wielkanoc.
Description: Narrow conical or nearly cylindrical sponges (Fig. 3A). Largest fragment about 40 mm high and 25 mm wide. Wall thickness 2–3 mm. Both surfaces without canal openings. Canalization dictyorhysal. Dictyonal skeleton very regular with quadrangular or rectangular meshes, 0.3 mm × 0.3–0.4 mm in size. In transverse section, skeleton irregular, with quadrangular or triangular meshes, 0.15–0.2 mm in size. On both surfaces secondary small hexactines form single layer of dense network with small (averagely 0.05 mm) quadrangular or triangular meshes (Fig. 4).
Remarks: The analysed forms are identical with the specimens from Germany and Central Poland. According to Reid (1968a), the species *Wollemannia laevis* (Philips 1835) is common in the Coniacian and Santonian deposits of England and Ireland. It is possible that *W. araneosa* is a younger synonym of *W. laevis*, though the existing data on the latter species are insufficient to confirm this supposition.
Occurrence: Poland – Kraków area (Coniacian or/and Santonian sponges redeposited to Santonian deposits), Middle Vistula Valley (Upper Campanian–Lower Maastrichtian); N Germany (Upper Campanian); E Ukraine (Lower Maastrichtian).

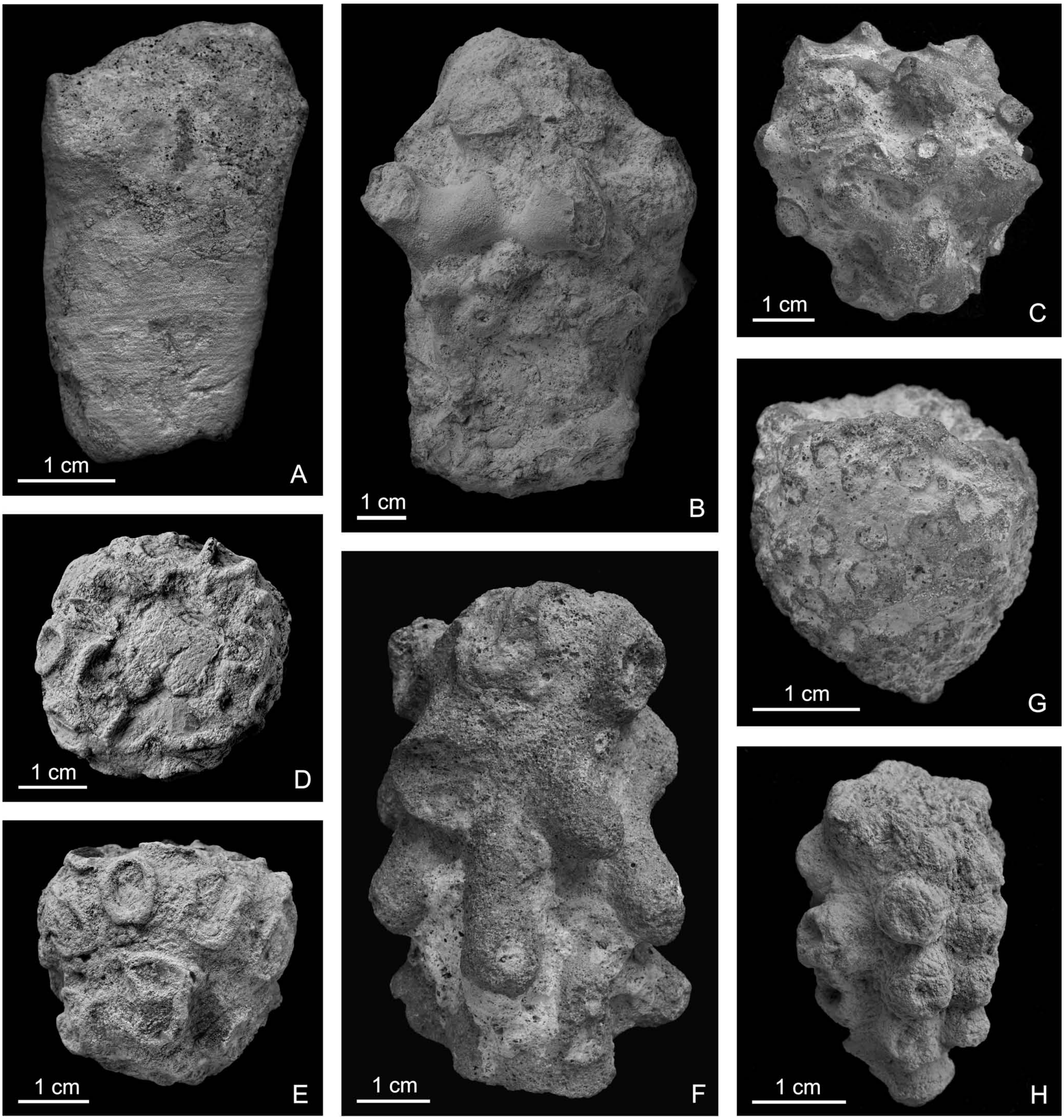

Fig. 3. Hexactinosida; **A.** *Wollemannia araneosa* Schrammen 1912; lateral view; Wielkanoc (W7); **B.** *Eurete halli* (Schrammen 1912); lateral view; Korzkiew (K289); **C.** *Periphragella plicata* Schrammen 1902; lateral view; Korzkiew (K194); **D, E.** *Verrucocoelia alpina* Hèrenger 1944; D – upper view; E – lateral view; Korzkiew [ING PAN A-I-82/43 as *Plocoscyphia fenestrata* (Smith 1848)]; **F.** *Verrucocoelia tubulata* (Smith 1848); lateral view; Korzkiew (K178); **G.** *Lefroyella favoidea* Schrammen 1912; lateral view; Korzkiew [ING PAN A-I-82/54/2 as *Toulminia catenifer* (Smith 1848)]; **H.** *Verrucocoelia* sp.; lateral view; Korzkiew (K304)

Genus *Eurete* Semper 1868
Type species: *Eurete simplicissimum* Semper 1868

Eurete halli (Schrammen 1912)
Figs 3B, 5A, D

1912. *Farrea halli* nov. sp.: Schrammen, pp. 210–211, pl. 28, fig. 4; pl. 40, fig. 19; pl. 44, fig. 5; text-pl. 11, fig. 10.
1980. *Farrea halli* Schrammen: Małecki, pl. 2, fig. 2.

Material: 14 specimens from Korzkiew (including 1 from collection ING PAN A-I-82 no. 14).

Description: Sponges in columnar or conical form, reaching up to 90 mm (Fig. 3B). They are composed of thin-walled (1 mm) tubes, 10–13 mm in diameter. Dichotomously divided tubes are connected with each other at a similar distance of *ca.* 10 mm. Locally, additional small, short branches (3–6 mm in diameter, 2–3 mm long) appear on the tubes. Dictyonal skeleton regular towards the dictyonal strands, with rectangular or square meshes, 0.2–0.3 mm

× 0.3–0.4 mm in size (Fig. 5A). In transverse section meshes are smaller (*ca.* 0.2 mm), triangular or rhomboidal in shape (Fig. 5D). Skeleton on dermal surface dense and irregular with small, round, evenly distributed openings. Canals are lacking.

Remarks: According to Reid (2004a), the specimens described by Schrammen (1912) as the new species *Farrea halli* have a euretoidal type of skeleton (*cf.* Schrammen, 1912, text-pl. 11, fig. 10; pl. 44, fig. 5). This type of skeleton has also been found in the Korzkiew specimen (Fig. 5D), which allows to assign it to the genus *Eurete*.

Occurrence: Poland – Kraków area (Coniacian or/and Santonian sponges redeposited to Santonian deposits); N Germany (Campanian).

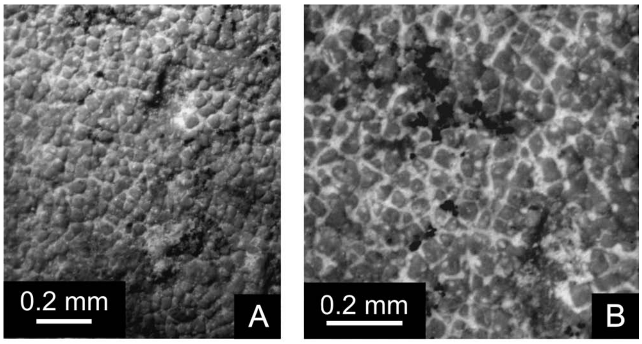

Fig. 4. Hexactinosida; **A, B.** *Wollemannia araneosa* Schrammen 1912; voids after secondary network on dermal surface filled with calcite; Wielkanoc (W7)

Genus *Periphragella* Marshall 1875
Type species: *Periphragella elisae* Marshall 1875

Remarks: Distinguishing the extant genera *Periphragella* Marshall and the fossil *Verrucocoelia* Éttalon 1859 is a matter of controversy (Reiswig & Wheeler, 2002). According to Reid (1969, 2004a), the genus *Periphragella* is represented by euretid sponges with an axial funnel emanating divided and anastomosing lateral tubes.

Periphragella plicata Schrammen 1902
Figs 3C, 5B

*1902. *Proeurete plicata* Schrm. n. sp.: Schrammen, p. 22, pl. 1, fig. 6.
1912. *Periphragella plicata* Schrammen: Schrammen, p. 214, pl. 25, figs 3, 4; pl. 44, figs 1, 2; text-pl. 12, figs 2, 3.
v1980. *Eurete raufii* Schr.: Małecki, pl. 3, fig. 1.
v1980. *Periphragella johannae* Schr.: Małecki, pl. 2, fig. 3.
v1980. *Plocoscyphia roemeri* Leonhardt: Małecki, pl. 9, fig. 4.
v1980. *Plocoscyphia* sp.: Małecki, pl. 11, fig. 4.

Material: 142 specimens – 2 from Zabierzów, 7 from Wielkanoc and 133 from Korzkiew (including 21 from collection ING PAN A-I-82 nos.: 13/1, 2; 5/1–4; 44; 49/1–14).

Description: Spherical, club-shaped or irregular sponges with a narrow and twisted central cavity (Fig. 3C). Largest specimens up to 55 mm in diameter. They are composed of dividing and anastomosing thin-walled (1–1.2 mm) tubes, 5–8 mm in diameter. Free endings of tubes, 3–9 mm in height, with round terminal opening,

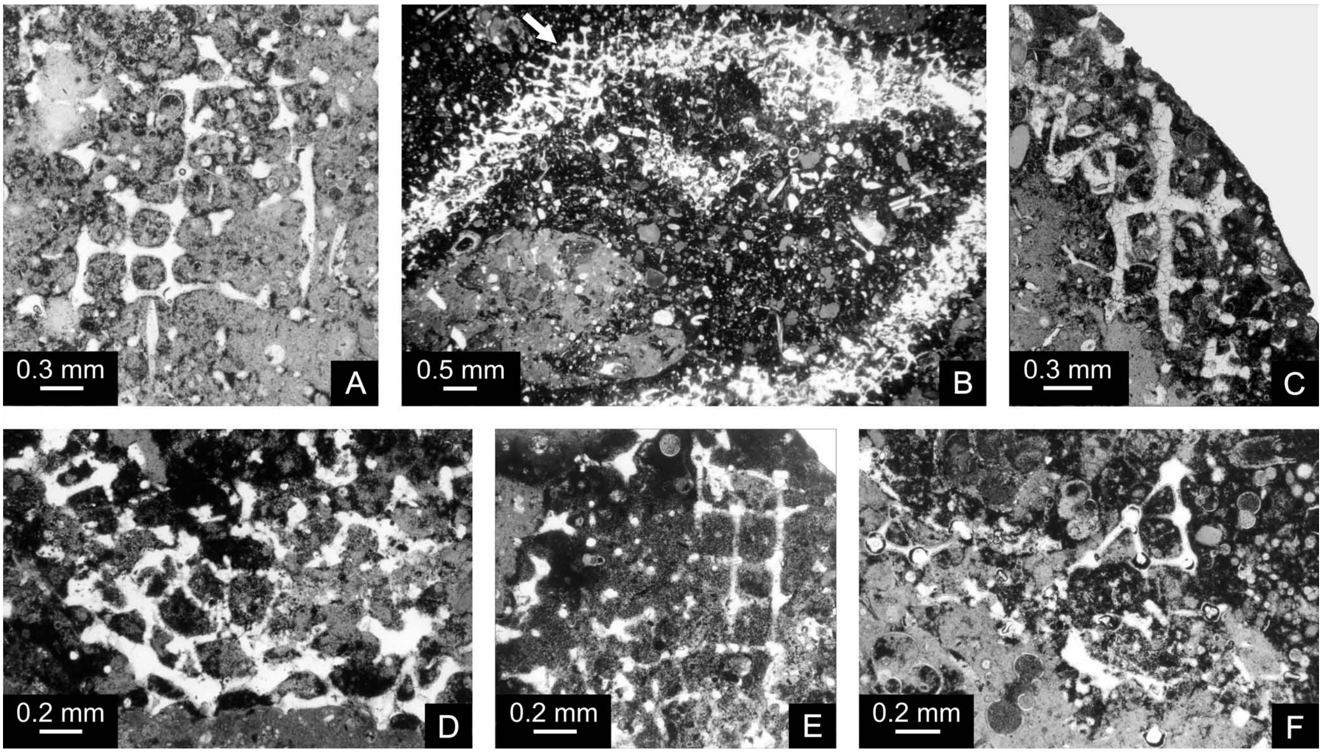

Fig. 5. Dictyonal skeleton of Hexactinosida; **A, D.** *Eurete halli* (Schrammen 1912); voids after the dictyonal skeleton; A – longitudinal section of the wall; D – transverse section of the wall; Korzkiew (ING PAN A-I-82/14 as *Farrea halli* Schrammen 1912); **B.** *Periphragella plicata* Schrammen 1902; transverse section of the tube wall; well visible voids after hexactines pointed by arrow; Korzkiew (ING PAN A-I-82/44 as *Plocoscyphia roemeri* Leonhardt 1897); **C.** *Verrucocoelia tubulata* (Smith 1848); voids after hexactines filled with calcite; Korzkiew [ING PAN A-I-82/60 as *Bolidium capreoli* (Roemer 1864)]; **E, F.** *Lefroyella favoidea* Schrammen 1912; E – voids after regular dictyonal skeleton from central part of the wall; F – voids after dictyonal skeleton visible in transverse section; Korzkiew (K311)

of a diameter slightly smaller than the tube. Sporadically the tubes are blind. Dictyonal skeleton rather regular. Square meshes dominate, 0.25–0.3 mm in size. In transverse section the skeleton is irregular with triangular meshes, *ca.* 0.1–0.15 mm in size. On both surfaces occurs irregular, dense network with quadrangular and triangular meshes. Small openings (0.4 mm) locally occur on dermal surface. Canals not developed.

Remarks: The examined specimens are filled with phosphatized sediment, of which a significant amount often adheres to the sponge surfaces. As a result, the central cavity is visible only in some of the specimens. Małecki (1980) regarded some specimens as representing the genus *Plocoscyphia*, despite well-recognizable hexactines (see Fig. 5B). Sponges described by Małecki (1980) as *Periphragella johannae* (*cf.* Schrammen, 1912, p. 215, pl. 25, figs 5, 6) and *Eurete raufii* Schrammen (*cf.* Schrammen, 1912, p. 211, pl. 28, figs 8, 9) are small fragments of crushed specimens of the discussed species, in which the central cavity is not preserved.

Occurrence: Poland – Kraków area (Coniacian or/and Santonian sponges redeposited to Santonian deposits); N Germany (Campanian); England (Turonian) after Reid (1968a).

Genus *Verrucocoelia* Éttalon 1859
Type species: *Scyphia verrucosa* Goldfuss 1829

Remarks: According to Reid (1969), some Cretaceous species attributed earlier to *Periphragella* Marshall, correspond to the genus *Verrucocoelia*. This genus is characterized by an axial tube or a funnel with hood-, nipple- or finger-like lateral outgrowths (Reid 1969, 2004a). Pervushov & Yanochkin (2001) and Pervushov (2002) included sponges with these features to the genus *Balantionella* Schrammen 1902. These characteristics are totally different from those in the type species *B. elegans* Schrammen 1902, which does not have an axial tube and has bag-like and leaf-like lateral branches (*cf.* Schrammen, 1902, p. 24, pl. 4, fig. 1a-c).

Verrucocoelia alpina Hèrenger 1944
Fig. 3D, E

*1944. *Verrucocoelia alpina* nov. sp.: Hèrenger, p. 84, figs 2a-d.
1962. *Verrucocoelia alpina* Hèrenger: Lagneau-Hèrenger, p. 79, pl. 1, fig. 10; text-pl. 12, figs 2a-d.
v1980. *Plocoscyphia fenestrata* (Smith): Małecki, pl. 10, figs 7a, b.

Material: 2 specimens – 1 from Wielkanoc and 1 from Korzkiew (collection ING PAN A-I-82 no. 43).

Description: Sponge 32 mm in height, 34 mm in diameter, in the shape of a cup with large spongocoel (Fig. 3D, E). Terminal aperture of spongocoel irregularly undulating, *ca.* 20 mm in diameter. Simple lateral outgrowths thin-walled (1–1.3 mm) and very short (*ca.* 5–6 mm). Average diameter 8–10 mm. Outgrowths ending with a wide, terminal, round, oval or irregular osculum. Skeleton without canalization. Dictyonal skeleton rather regular, with square or quadrangular meshes, 0.3 mm in size. On dermal surface occurs irregular network with quadrangular and triangular meshes. Beams of surface hexactines strongly thickened, therefore the meshes are smaller (0.2–0.25 mm) and rounded. On gastral surface the network is also not very regular but the hexactines are without thickened beams.

Remarks: The main feature distinguishing the described species from other Cretaceous representatives of *Verrucocoelia* is the shape of its outgrowths. In *V. alpina* they are very short and open. The analysed specimens differ from the specimens from France in a less rounded termination of the outgrowths.

Occurrence: Poland – Kraków area (Coniacian or/and Santonian sponges redeposited to Santonian deposits); France (Valanginian).

Verrucocoelia tubulata (Smith 1848)
Figs 3F, 5C

*1848. *Brachiolites tubulatus*: Smith, pp. 366–367, pl. 15, fig. 7.
1912. *Periphragella simplex* nov. sp.: Schrammen, p. 215, pl. 25, figs 1, 2; text-pl. 12, fig. 4.
1926. *Periphragella elongata* nov. sp.: Moret, p. 223, pl. 24, fig. 8.
1962. *Periphragella elongata* Moret: Lagneau-Hèrenger, p. 84, pl. 16, fig. 6; text-pl. 12, fig. 8.
v1980. *Periphragella simplex* Schrammen: Małecki, pl. 3, fig. 4.
v1980. *Bolidium capreoli* (Roemer): Małecki, pl. 12, fig. 4.

Material: 31 specimens – 6 from Wielkanoc, 25 from Korzkiew (including 7 from collection ING PAN A-I-82 nos.: 16, 60, 49/10–14).

Description: Conical or nearly cylindrical sponges with deep spongocoel and lateral outgrowths, 6–9 mm in diameter and 6–12 mm long (Fig. 3F). Wall thickness about 1–1.5 mm. Largest specimen is 65–70 mm high and 30–35 mm in diameter. Finger-like outgrowths usually directed downwards. Most of them terminate blindly or sometimes with a round osculum with a diameter smaller than that of the outgrowths. Round pores (diameter about 0.2 mm) distributed evenly on the dermal surface of tubes. Dictyonal skeleton without canalization, comprising large hexactines. Skeleton regular, with rectangular meshes, 0.3 mm × 0.4–0.5 mm in size (Fig. 5C). On dermal surface occurs denser, irregular network with triangular meshes (0.2 mm). Gastral surface without secondary network.

Remarks: Based on the analysis of the material from Korzkiew and literature data, the author agrees with Reid's (1969) opinion that *Periphragella simplex* Schrammen and *Periphragella elongata* Moret are younger synonyms of *V. tubulata* (Smith). Blind or open finger-like outgrowths directed usually downwards are characteristic of the species. This feature is usually visible in specimens from Russia described by Pervushov (2002) as *Balantionella fragilis* Pervushov. The specimen presented by Małecki (1980, pl. 3, fig. 4) has outgrowths apparently directed upwards. This is, however, the result of illustrating the sponge inversely to its growth direction. Probably, also the incomplete specimens from France, described as *P. elongata* (see Lagneau-Hèrenger, 1962, text-pl. 12, fig. 8a; pl. 16, fig. 6a) have been incorrectly presented, according to the illustration; the sponges narrow upwards, while in *P. simplex* the longest tubes appear in the upper part. Also a fragment described by Małecki (1980) as *Bolidium capreoli* (Roemer 1864) – a representative of lithistids – has been included to the species *V. tubulata*, based on the structure of its skeleton (see Fig. 5C) and morphological form.

Occurrence: Poland – Kraków area (Coniacian or/and Santonian sponges redeposited to Santonian deposits); France (Albian, Cenomanian); N Germany (Campanian); England (Turonian) after Reid (1968a).

Verrucocoelia sp.
Fig. 3H

Material: 1 specimen from Korzkiew.

Description: Conical sponge, 32 mm in height and 24 mm in diameter (Fig. 3H). Spongocoel with undulating apertures. Short outgrowths 4–6 mm in diameter, reaching up to 5 mm in length. They are ranged densely in 5 vertical rows. In the upper part of the sponge, the outgrowths are the largest and have a less regular distribution. Rounded endings of the outgrowths with terminal osculum, 1–3 mm in diameter. On dermal surface occur irregularly distributed round openings, 0.6–0.7 mm in size. Dictyonal skeleton rather regular, with square or rhomboidal meshes, 0.3 mm in size. Skeleton lacks canalization. Irregular secondary network with small (0.1–0.2 mm) triangular meshes covers the dermal surface.

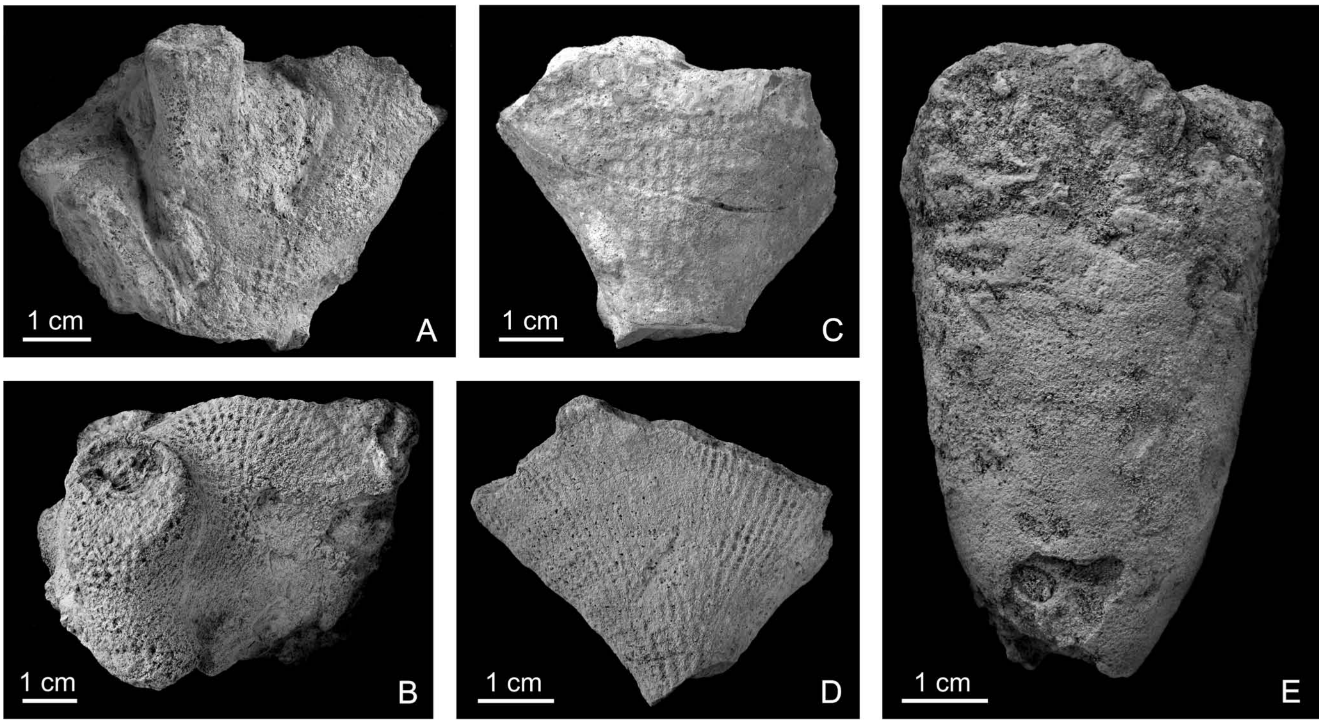

Fig. 6. Hexactinosida; **A, B.** *Laocoetis fittoni* (Mantell 1822); A – lateral view; Korzkiew (Ko40); B – branches attached forming fold; Korzkiew [ING PAN A-I-82/8 as *Strephinia convoluta* (Hinde 1883)]; **C.** *Laocoetis relicta* (Schrammen 1912), lateral view; Korzkiew (K105); **D.** *Laocoetis virgatula* (Schrammen 1912); lateral view; Korzkiew (Ko31); **E.** *Leptophragma micropora* Schrammen 1912; lateral view; Wielkanoc (W1)

Remarks: The described specimen differs from other *Verrucocoelia* specimens in the regular arrangement of the outgrowths. A similar arrangement is visible in the specimen from the Maastrichtian of the Volga Region described by Pervushov (2002) as a new species *Balantionella nevejkensis*, which most probably belongs to *Verrucocoelia*. The specimen from Korzkiew varies from the mentioned species in the presence of 4 (instead of 5) rows of outgrowths. Because of poor preservation it is impossible to decide whether these differences reflect intraspecific variability or the specimen from Poland belongs to a different species.
Occurrence: Poland – Kraków area (Coniacian or/and Santonian sponges redeposited to Santonian deposits).

Genus *Lefroyella* Thomson 1877
Type species: *Lefroyella decora* Thomson 1877

Lefroyella favoidea Schrammen 1912
Figs 3G, 5E, F

*1912. *Lefroyella favoidea* nov. sp.: Schrammen, p. 216, pl. 28, figs 10, 11; pl. 42, fig. 1; text-pl. 12, figs 8, 9.
v1980. *Toulminia catenifer* (Smith): Małecki, p. 423, pl. 11, fig. 5.

Material: 10 specimens – 1 from Wielkanoc and 9 from Korzkiew (including 4 from collection ING PAN A-I-82 nos. 54/1–4).
Description: Funnel-like sponges, reaching 30 mm in height and 25 mm in diameter (Fig. 3G). Outer surface with open lateral outgrowths. Outgrowths thin-walled (*ca.* 1 mm), very short, about 2 mm in diameter. They are densely distributed in longitudinal or slightly diagonal rows. Surface of the central cavity shows shallow longitudinal furrows. Dictyonal skeleton regular with square meshes, 0.2–0.25 mm in size (Fig. 5E). In transverse section meshes are smaller, triangular or rhomboidal (Fig. 5F). On the outer surface the network is less regular. Skeleton without canalization.
Remarks: Considering only the general shape of the specimens, Małecki (1980) mistakenly included them to *Toulminia catenifer* (Smith 1848), in which the skeleton is composed of lychniscs. Because the specimens are filled with sediment, features of the gastral surface can be observed only in transverse section, which shows that the furrows are less developed than in the recent species of *Lefroyella*.
Occurrence: Poland – Kraków area (Coniacian or/and Santonian sponges redeposited to Santonian deposits), N Germany (Campanian).

Family Craticulariidae Rauff 1893
emended Reid 1963, 1964; emended Mehl 1992;
emended Pisera 1997
Genus *Laocoetis* Pomel 1872
[= *Craticularia* Zittel 1877b,
Paracraticularia Schrammen 1936,
Thyridium Laubenfels 1955, *Laocaetis* Mehl 1992]
Type species: *Laocoetis crassipes* Pomel 1872

Remarks: According to the opinion of Mehl (1992) and Pisera (1997), the genus *Craticularia* Zittel is a junior synonym of *Laocoetis* Pomel. In the opinion of Reid (2004a), the genus *Craticularia* is distinguished from the genus *Laocoetis* by the presence of dermal stauractines, but their occurrence may be related to the state of preservation of the specimens.

Laocoetis fittoni (Mantell 1822)
Figs 6A, B, 7A, B

*1822. *Millepora fittoni*: Mantell, p. 106, pl. 15, fig. 10.

v1980. *Paracraticularia fittoni* (Mantell): Małecki, pl. 1, fig. 1.
v1980. *Paracraticularia subseriata* (Roemer): Małecki, pl. 1, figs 2, 4; pl. 2, fig. 1.
v1980. *Strephinia convoluta* (Hinde): Małecki, pl. 2, fig. 6.
v1980. *Rhizopoterionopsis pruvosti* Dfr-Lefr.: Małecki, pl. 3, fig. 3.
2006. *Laocoetis fittoni* (Mantell): Świerczewska-Gładysz, p. 241, fig. 9i (cum syn.).

Material: 60 specimens – 1 from Zabierzów, 3 from Wielkanoc and 56 from Korzkiew (including 14 from collection ING PAN A-I-82 nos.: 4/1–6, 5/1–5, 6, 8, 22).

Description: Irregular sponges composed of tube-like branches (Fig. 6A, B). Largest specimens reaching 70 mm in height, 80 mm in diameter. Branches 12–20 mm in diameter, divided dichotomously two or three times. They are sometimes attached to each another, forming winding folds (Fig. 6B). On both surfaces occur round or oval canal openings, 1.2–1.5 mm in diameter. Canal openings on dermal surface locally irregular. Canal openings distributed in regular horizontal and vertical rows, 30–36/cm^2. Canals straight, perpendicular to wall (Fig. 7A). Dictyonal skeleton regular, with square meshes about 0.3 mm in size. In subdermal part occurs irregular network with triangular or quadrangular meshes (Fig. 7B). Finely-porous cortex on both surfaces.

Remarks: Specimens assigned by Małecki (1980) to *Rhizopoterionopsis pruvosti* Defretin-Lefranc 1960 bear voids of an irregular network comprising hexactines (Fig. 7B). This excludes their assignment to this species, which is a representative of the Lychniscosida. In Korzkiew, apart from the specimen with a shape typical of *L. fittoni*, are present rare forms, in which some branches are linked with each other once more; in consequence the sponges attain an irregular shape (*cf.* Hinde, 1883; Reid, 1964, p. 57). One of such specimens has been assigned by Małecki (1980) to *Strephinia convoluta* Hinde 1883. The gastral surface of this specimen is not visible; the transverse sections of the branches, however, indicate that there are no longitudinal grooves characteristic of the genus *Strephinia*. The mentioned specimen has canal openings distributed in regular horizontal and vertical rows (Fig. 6B), while the alternating distribution of the canal openings is a characteristic feature of *S. convoluta* (*cf.* Hinde, 1883, pp. 96–97, pl. 23, figs 3, 3a, 3b). In the discussed specimen, similarly as in other representatives of *L. fittoni*, this pattern is slightly deformed usually in points of bifurcation.

Occurrence: Poland – Kraków area (Coniacian or/and Santonian sponges redeposited to Santonian deposits), Middle Vistula Valley (Upper Campanian–Maastrichtian); France (Valanginian, Turonian, Cenomanian); Czech Republic (Upper Turonian); S France (Campanian) after Hèrenger (1946); Spain (Aptian); N Germany (Cenomanian, Lower Campanian); England (Aptian–Coniacian).

Laocoetis relicta (Schrammen 1912)
Figs 6C, 7D

*1912. *Craticularia relicta* nov. sp.: Schrammen, p. 233, pl. 31, figs 4, 5; pl. 43, fig. 4; text-pl. 10, fig. 1.
1960. *Craticularia relicta* Schrammen: Defretin-Lefranc, p. 51, pl. 1, figs 3, 10.
v1980. *Craticularia relicta* Schrammen: Małecki, p. 413, pl. 1, fig. 5.
v1980. *Craticularia radicosa* Počta: Małecki, pl. 1, fig. 3.
v1980. *Sporadoscinia capax* Hinde: Małecki, pl. 6, fig. 7.

Material: 13 specimens from Korzkiew (including 8 from collection ING PAN A-I-82 nos.: 1/1–3; 2; 26/7; 28/1, 2; 29/4).

Description: Wide conical or funnel-shaped sponges (Fig. 6C), reaching 35 mm in height and 50 mm in diameter. Wall thickness 4–7 mm. On both surfaces occur round or oval canal openings,

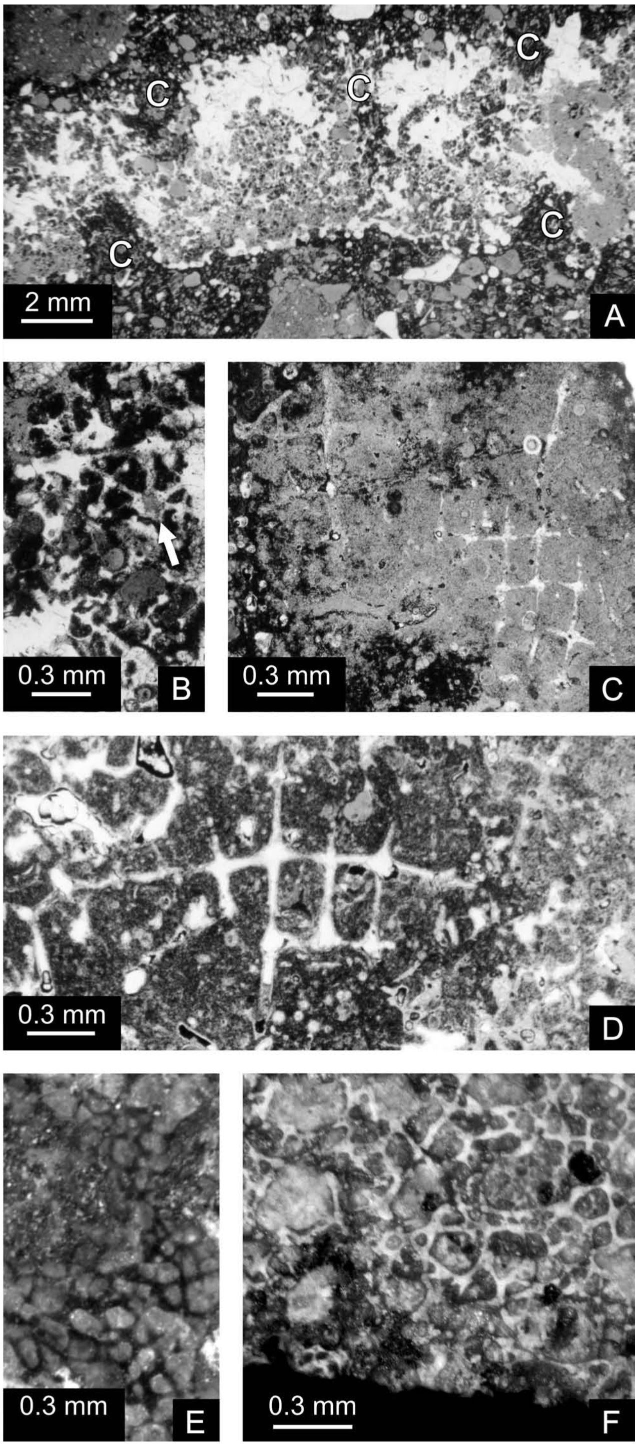

Fig. 7. Dictyonal skeleton of Hexactinosida; **A, B.** *Laocoetis fittoni* (Mantell 1822); A – transverse section of the wall showing diplorhysis (c); B – detail of subdermal skeleton; multiradiate node pointed by arrow; Korzkiew (ING PAN A-I-82/22 as *Rhizopoterionopsis pruvosti* Dfr-Lefr. 1960); **C, E.** *Laocoetis virgatula* (Schrammen 1912); C – voids after regular dictyonal skeleton in longitudinal section of the wall; Korzkiew (ING PAN A-I-82/23/1 as *Lepidospongia rugosa* Schlüter 1870); E – voids after sub-d ermal skeleton filled with goethite; **D.** *Laocoetis relicta* (Schrammen 1912); voids after hexactines of dictyonal skeleton; Korzkiew (ING PAN A-I-82/28/1 as *Sporadoscinia capax* Hinde 1883); **F.** *Leptophragma micropora* Schrammen 1912; dermal surface with canal openings and calcitized cortex

regularly arranged in vertical and horizontal rows. On dermal surface are present canal openings, 1.2–1.5 mm × 1.8–2.1 mm in diameter, separated by longitudinal skeletal bands, 1.2–1.5 mm wide. Transverse bands slightly narrow, 1–1.2 mm wide. On gastral surface occur canal openings of similar size and on both surfaces the distribution is averagely 16–20 /cm^2. Dictyonal skeleton within wall is very regular, with rectangular and square meshes, 0.2–0.35 mm in size (Fig. 7D). In external parts occurs dense, irregular network, with triangular or quadrangular meshes. Dermal surface covered with thick cortex. Cortex poorly developed on gastral surface.

Remarks: The species *Laocoetis relicta* (Schrammen) was until now known only as wall fragments. The material from Korzkiew allows confirming the conical shape of these sponges as suggested by Defretin-Lefranc (1960). Some of the examined specimens, similarly as the specimen from France, have a thinner wall in comparison to the type specimen, in which the wall thickness is 8 mm. The typical morphological structure of the dermal surface and the skeleton allowed to include to *L. relicta* also some specimens described by Małecki (1980) as *Craticularia radicosa* Počta (*cf.* Počta, 1883, pp. 12–13, pl. 1, fig. 4; text-fig. 1) and specimens with a partly abraded dermal surface, described by that author as *Sporadoscinia capax* Hinde 1883. Representatives of *S. capax* in contrast to the examined specimens have a skeleton composed of lychniscs and irregularly placed, transversely elongated canal openings (*cf.* Hinde, 1883, pp. 116–117, pl. 26, figs 4, 4a, 4b).

Occurrence: Poland – Kraków area (Coniacian or/and Santonian sponges redeposited to Santonian deposits); N Germany (Campanian); N France (Turonian); England and Ireland (Coniacian–Santonian) after Reid (1968a).

Laocoetis virgatula (Schrammen 1912)
Figs 6D, 7C, E

*1912. *Craticularia virgatula* nov. sp.: Schrammen, p. 234, pl. 30, fig. 1; pl. 43, fig. 3; text-pl. 11, fig. 9.
1962. *Craticularia virgatula* Schrammen: Lagneau-Hèrenger, p. 49, pl. 2, figs 3, 8; text-pl. 7, fig. 5.
non v1968. *Craticularia virgatula* Schrammen: Hurcewicz, pp. 59–60, pl. 14, fig. 3. [= *Pleurostoma dichotoma* Schrammen].
v1980. *Craticularia virgatula* Schrammen: Małecki, p. 414, pl. 1, fig. 6.
v1980. *Lepidospongia rugosa* Schlüter: Małecki, p. 414, pl. 1, fig. 6.

Material: 31 specimens – 3 from Wielkanoc and 28 from Korzkiew (including 9 from collection ING PAN A-I-82 nos.: 3/1–3, 23/1–6).

Description: Widely conical or funnel-shaped sponges, reaching 7 cm in height (Fig. 6D). Wall thickness c. 2–3 mm. Dermal surface with round or oval canal openings, 1 mm × 1–1.5 mm in size. Canal openings distributed in horizontal and vertical rows, typically 36–42/cm^2. Canal openings separated by longitudinal skeletal bands, 0.7–0.9 mm wide. Transverse bands narrower, up to 0.3 mm. Similar distribution and size of canal openings on the gastral surface. Dictyonal skeleton within wall is very regular, with rectangular and square meshes, 0.2–0.3 mm in size (Fig. 7C). In external parts occurs a less regular skeleton, with smaller (0.1–0.2 mm), mainly triangular meshes (Fig. 7E). Both surfaces with thin cortex.

Remarks: All features of the examined specimens fit the diagnosis of *Laocoetis virgatula* (Schrammen). Although its skeleton is composed of hexactines (see Fig. 7C, E), the widest specimens of the species have been described as the lychniscosid *Lepidospongia rugosa* Schlüter 1870 by Małecki (1980, pl. 1, fig. 6).

Occurrence: Poland – Kraków area (Coniacian or/and Santonian sponges redeposited to Santonian deposits); N Germany (Campanian); Spain (Aptian); France (Albian).

Genus *Leptophragma* Zittel 1877b
emended Reid 1963, 1964
Type species: *Scyphia murchisoni* Goldfuss 1833

Leptophragma micropora Schrammen 1912
Figs 6E, 7F

?1883. *Leptophragma fragilis* Roemer: Hinde, p. 103.
*1912. *Leptophragma micropora* nov. sp.: Schrammen, pp. 237–238, pl. 32, figs 4, 5; pl. 43, fig. 2; text-pl. 9, fig. 1.
v1980. *Leptophragma micropora* Schrammen: Małecki, p. 414, pl. 43, figs 5a, b.
?2002. *Leptophragma micropora* Schrammen: Pervushov, p. 139, Pl. 50, fig. 4.
2006. *Leptophragma micropora* Schrammen: Świerczewska-Gładysz, p. 240, figs 7c, d, 8a-c.

Material: 18 specimens – 1 from Zabierzów, 8 from Wielkanoc and 9 from Korzkiew (including 3 from collection ING PAN A-I-82 nos.: 7, 34/1, 35/2).

Description: The studied fragments suggest cup-shaped sponges (Fig. 6E). The largest fragment (lower part of cup) is 30 mm high and 25 mm in diameter. Wall thickness 1–2 mm. On dermal surface the round canal openings are 0.2–0.3 mm in size; 450 openings/1 cm^2 on the average. Canals openings distributed in vertical rows. Horizontal rows are disturbed. Skeletal band between canal openings 0.2 mm wide. Gastral surface invisible. Dictyonal skeleton irregular in subdermal part (Fig. 7F). Meshes triangular and quadrangular, averagely 0.1–0.2 mm. On dermal surface occurs dense network with small rounded meshes.

Remarks: The studied specimens were included to *Leptophragma micropora* Schrammen based on the skeleton structure, characteristic small size and patterns of canal openings on the dermal surface.

Pervushov (2002) included one specimen from the lower Santonian of Saratov to *L. micropora*. Based on the presented illustration and incomplete description it is impossible to decide whether the specimen belongs to this species.

Occurrence: Poland – Kraków area (Coniacian or/and Santonian sponges redeposited to Santonian deposits), Middle Vistula Valley (Upper Campanian–Upper Maastrichtian); N Germany (Santonian–Campanian); E Ukraine (Lower Maastrichtian); England (Coniacian– Santonian) after Reid (1968a); ?Russia – Saratov area (Lower Santonian).

Family Aphrocallistidae Gray 1867
Genus *Aphrocallistes* Gray 1858
Type species:: *Aphrocallistes beatrix* Gray 1858

Aphrocallistes cylindrodactylus Schrammen 1912
Figs 8A–D, 9A

*1912. *Aphrocallistes cylindrodactylus* nov. sp.: Schrammen, p. 220, text-fig. 1; text-pl. 11, fig. 6.
v1980. *Aphrocallistes lobatus* Schrammen: Małecki, pl. 2, fig. 7.
v1980. *Aphrocallistes coronatus* sp. nov.: Małecki, pp. 414– 415, text-fig. 4; pl. 3, fig. 2.
v1980. *Becksia soekelandi* Schlüter: Małecki, pl. 9, fig. 2.
v1984. *Aphrocallistes coronatus* Małecki: Hurcewicz, pp. 329–330, pl. 87, fig. 1.
2006. *Aphrocallistes cylindrodactylus* Schrammen: Świerczewska-Gładysz, pp. 245–248, figs 11g-l, 12b, c, 13, (cum syn.).

Material: 37 specimens – 1 from Zabierzów, 6 from Wielkanoc

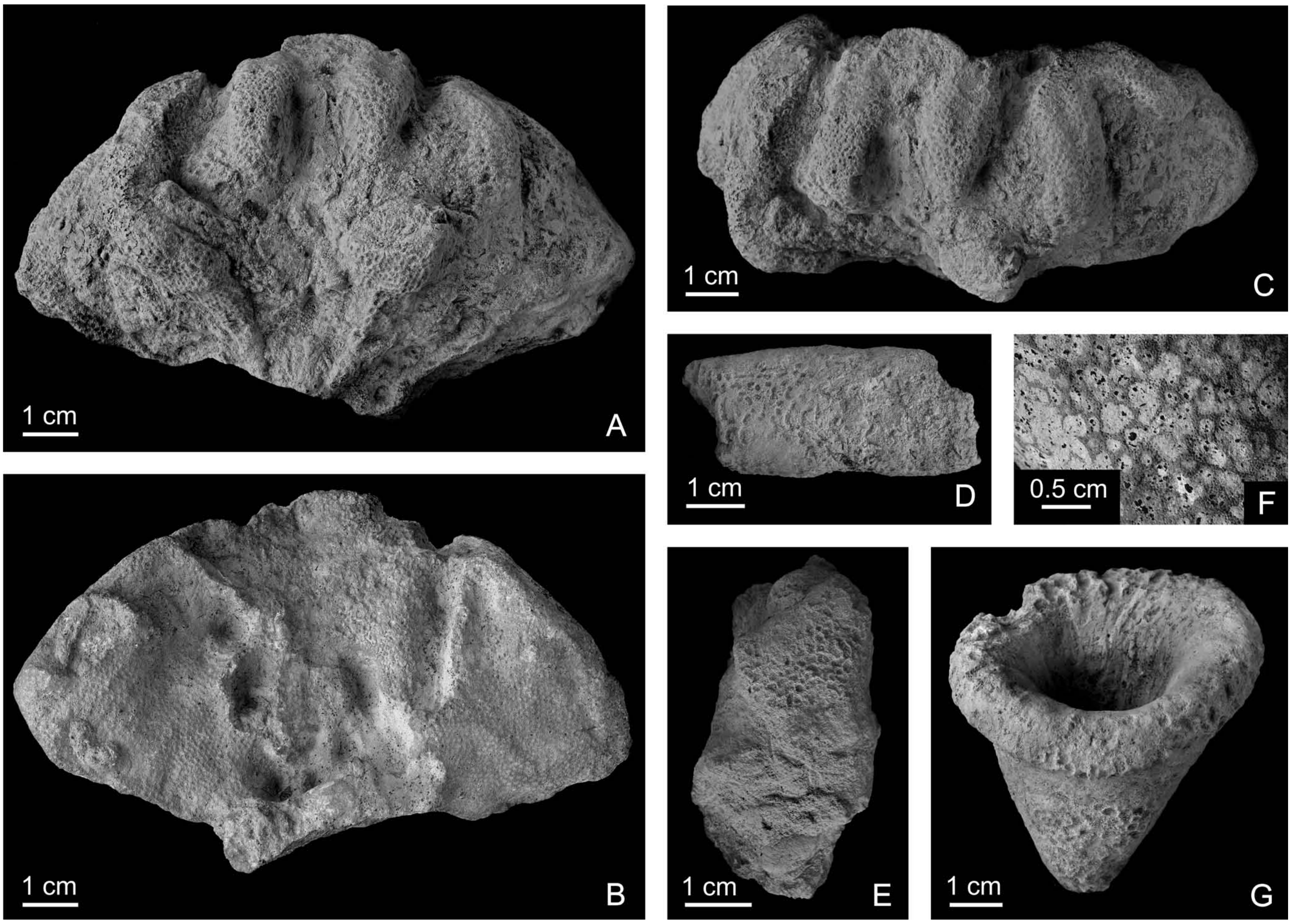

Fig. 8. Hexactinosida; **A–D.** *Aphrocallistes cylindrodactylus* Schrammen 1912; A – lateral view, B – inside view; in central part visible fragment of sieve plate; C – top view of half of specimen with preserved five lobes; Korzkiew (ING PAN A-I-82/12/1 as *Aphrocallistes coronatus* Małecki 1980); D – single branch; Korzkiew (K155); **E.** *Aphrocallistes* sp.; lateral view; Korzkiew (K139). **F, G.** *Polyopesia angustata* Schrammen 1902; F – fragment of external surface with canal openings; G – lateral view; Korzkiew (ING PAN A-I-82/10/2)

and 30 from Korzkiew (including 8 from collection ING PAN A-I-82 nos.: 11, 12/1–3, 34, 41).

Description: Cup-shaped sponges, up to 60 mm high, with a short stem and lateral, radially arranged lobes (Fig. 8A–C). The most complete specimen has 8 lobes. Cup-formed sieve plate closes the sponge aperture. Laterally flattened lobes have rounded protuberances on their outer edge. Traces after broken side branches present in the lower parts of some lobes. The largest preserved fragment of a cylindrical branch is 40 mm long and 20 mm in diameter (Fig. 8D). Wall, about 2 mm thick, is pierced by straight, perpendicular canals. On dermal surface occur round canal openings, 0.2–0.5 mm in diameter, densely but randomly distributed, usually 120–150/cm^2. Irregularly distributed sieve plate pores are polygonal, 1–1.6 mm in size. Choanosomal skeleton composed of hexactines, forming a disordered network with small (0.1–0.2 mm in size), square and triangular meshes. Fine-porous cortex occurs on the dermal surface.

Remarks: The studied sponges are characterized by a star-like pattern of the lateral lobes, similarly as in the Campanian–Maastrichtian representatives of this species from England (*cf.* Reid, 1964, p. 64) and the Middle Vistula Valley (Świerczewska-Gładysz, 2006). In the studied material there are no complete lobes with longer lateral outgrowths. These may be found loose in the sediment.

The variable degree of damage of the specimens from Korzkiew caused the erroneous description of their shape and structure and in consequence their assignment by Małecki (1980) to the new species *Aphrocallistes coronatus* Małecki and *Becksia soekelandi* Schlüter 1868 – a representative of the Lychniscosida (compare Fig. 9A). According to Hurcewicz (1984), who studied the collection of Małecki, there are 14 or more ribs with outgrowths, locally connected by a slanted band in *A. coronatus* Małecki. In fact, the "two ribs" correspond to the wall of one broken lobe, of which the number probably does not exceed 10.

Mermighis and Marcopoulou-Diacantoni (2004, pp. 334, 336, pl. 9. figs 1–4, pl. 13, fig. 1) described six specimens from the Santonian of Greece as *A. coronatus* Małecki, although their structure is different from the Korzkiew specimen. These massive, globular sponges with convex upper surfaces do not posses lateral plates and outgrows.

Occurrence: Poland – Kraków area (Coniacian or/and Santonian sponges redeposited to Santonian deposits), Middle Vistula Valley (Upper Campanian–uppermost Maastrichtian), Łódź area (Campanian); N Germany (Campanian); Ukraine (Upper Maastrichtian); England (Campanian–Maastrichtian) and Ireland (Campanian) after Reid (1968a).

Aphrocallistes sp.
Figs 8E, 9D

Material: 4 specimens – 1 from Wielkanoc and 3 from Korzkiew (including 1 from collection ING PAN A-I-82 no. 37/3).

Description: The studied specimens are fragments of cylindrical

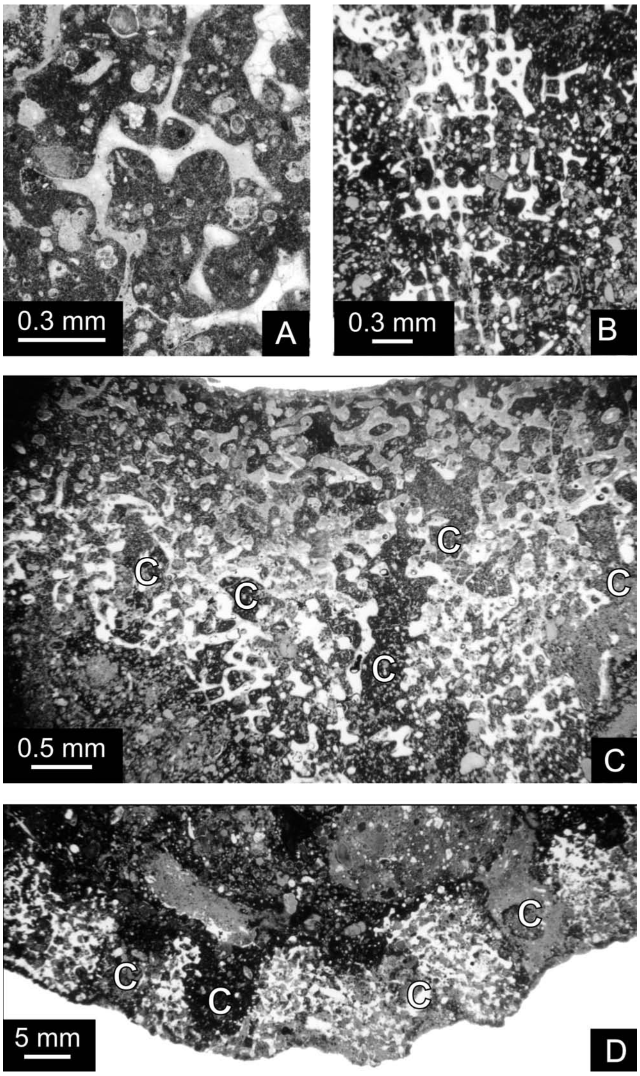

Fig. 9. Dictyonal skeleton of Hexactinosida; **A.** *Aphrocallistes cylindrodactylus* Schrammen 1912; dictyonal skeleton; Korzkiew (ING PAN A-I-82/41/2 as *Becksia soekelandi* Schlüter 1868); **B, C.** *Polyopesia angustata* Schrammen 1902; B – voids after regular dictyonal skeleton in longitudinal section of the wall; Korzkiew; C – transverse section through the wall of lower part specimen; visible voids after thickness basal skeleton and canals (c); [ING PAN A-I-82/57 as *Ragadinia rimosa* (Roemer 1864)]; **D.** *Aphrocallistes* sp.; transverse section of the wall with diarhysis (c); Korzkiew (ING PAN A-I-82/37/3)

branches, reaching 25 mm in diameter and 53 mm in length (Fig. 8E). The largest specimen is with lateral small protrusions and basal plate oblique to the branch. Wall thickness 1–2 mm. Canals perpendicular to the sponge surface and running through the wall. On dermal surface occur polygonal canal openings, 0.8–2.2 mm in size, distributed irregularly or alternating. Canal openings separated by 0.6 mm wide skeletal bands (Fig. 9D). Skeletal network irregular, with small, 0.1–0.2 mm in size, mainly quadrangular meshes. In places traces of a fine porous cortex are visible.

Remarks: The shape of the body and the organization of the canal openings on the dermal surface of the examined specimens is similar to that in *Aphrocallistes alveolites* Roemer and *A. macroporus* Lagneau-Hèrenger 1962. The differences are in the details of the skeletal network. *A. alveolites* is characterized by very thin partitions between the canals with a single-layer network and its hexactines have deformed rays (see, *e.g.*, Reid, 1964, p. 108; Świerczewska-Gładysz, 2006, fig. 12a). *A. macroporus* has, similarly as the studied specimens, a skeleton with well-developed dictyonal connections, but the network is quite regular with the prevalence of square meshes (see Lagneau-Hèrenger, 1962, text-pl. 12, fig. 6).

Occurrence: Poland – Kraków area (Coniacian or/and Santonian sponges redeposited to Santonian deposits).

Family Cribrospongiidae Roemer 1864
Genus *Polyopesia* Schrammen 1902
emended Reid 1964
Type species:: *Polyopesia angustata* Schrammen 1902

Remarks: The genus *Polyopesia* Schrammen has a labyrinth-like diplorhysis (see Reid, 1964, text-fig. 52 c), whereas the genus *Hexactinella* Carter is characterized by the presence of a schizorhysis.

Polyopesia angustata Schrammen 1902
Figs 8F, G, 9B, C

*1902. *Polyopesia angustata* Schrm. n. sp.: Schrammen, p. 26, pl. 2, fig. 1.
1902. *Polyopesia radiciformis* Schrm. nov. sp: Schrammen, p. 26, pl. 3, fig. 1.
1910. *Hexactinella angustata* Schrammen: Schrammen, p. 223, pl. 26, figs 6, 7, 10; text-pl. 2, fig. 8.
1962. *Hexactinella angustata* Schrammen: Lagneau-Hèrenger, p. 75, text-pl. 11, fig. 3.
1964. *Hexactinella angustata* (Schr): Gierst, pp. 221–222.
v1980. *Hexactinella angustata* Schrammen: Małecki, pl. 1, figs 7a, b.
v1980. *Hexactinella* sp.: Małecki, pl. 2, fig. 4.
v1980. *Homalodora pusilla* Schrammen: Małecki, p. 425, pl. 12, fig. 4.
v1980. *Ragadinia rimosa* (Roemer): Małecki, p. 424, pl. 12, figs 2a, b.

Material: 48 specimens – 3 from Zabierzów, 3 from Wielkanoc and 42 from Korzkiew (including 5 from collection ING PAN A-I-82 nos.: 9/1, 2; 10/1, 2; 57; 59).

Description: Cone- or cup-shaped sponges, up to 70 mm high (Fig. 8G). Upper edge sometimes turned outwards or slightly bent inwards. Some specimens have a short massive stalk with traces of broken rhizoidal processes. Wall 4–5 mm thick. On the outer surface occur irregular canal openings, 1–3 mm in size (Fig. 8F). They are irregularly distributed, usually 15–25/cm^2, and surrounded by papillae, on the top of which occur small, round, accessory apertures of aporhyses. On the inner surface the oval openings are large, 1.5 mm × 2–3 mm in size, placed in a quincunx. Inside the wall occur large branched chambers that are part of epirhytic and aporhytic labyrinths. Dictyonal skeleton inside the wall quite regular, with square and rectangular meshes, usually about 0.2 mm × 0.2 mm in size (Fig. 9B, C). Network in subdermal and subgastral part with the prevalence of triangular and square meshes. Rays of superficial hexactines are thickened, meshes in the network are rounded, usually about 0.1 mm in size.

Remarks: In *P. angustata* the distal rays of the superficial hexactines are not reduced (*cf.* Schrammen, 1912). Due to dissolution of the skeleton, the features cannot be observed in the material from Korzkiew. Other characteristics of the studied specimens correspond well to the type species. The specimen assigned to the lithistid *Ragadinia rimosa* (Roemer) by Małecki (1980) belongs clearly to this species. Its outer surface is partly abraded, which makes the identification difficult but the skeleton of hexactines and characteristic canalization pattern are recognized in the lower part of sponge (Fig. 9C). The specimen described by Małecki (1980) as *Homalodora pusilla* Schrammen (also a lithistid) is only

a broken sponge stem. In the upper part, the distribution of canals as well as the skeleton composed of hexactines is characteristic of *Polyopesia*. Two specimens described by Małecki (1980) as *Hexactinella* sp. differ from other specimens only in the margin bent inwards.
Occurrence: Poland – Kraków area (Coniacian or/and Santonian sponges redeposited to Santonian deposits); SE France (Valanginian, Albian); N Germany (Campanian); England (Santonian) after Reid (1968a).

Order LYCHNISCOSA Schrammen 1903
Family Callodictyonidae Zittel 1877b
Genus *Porochonia* Hinde 1883
emended Reid 1962

Remarks: According to Reid (1962), the external skeletal membrane on the dermal surface, described by Hinde (1883), does not exist.

Porochonia simplex (Smith 1848)
Figs 10A, 11A, B

*1848. *Ventriculites simplex* Smith, p. 204, pl. 8, fig. 1
1878. *Ventriculites simplex* Smith: Quenstedt, p. 470, pl. 137, fig. 17.
1883. *Porochonia simplex* Smith: Hinde, pp. 143–144, pl. 30, figs 5, 5a, 5b.
1962. *Porochonia simplex* (Smith): Reid, pp. 3–4.
non 1960. *Porochonia simplex* (Smith): Defretin-Lefranc, p. 85, pl. 11, fig. 5.
2002. *Porochonia simplex* (T. Smith): Wood, p. 31, pl. 1, fig. 3.

Material: 10 specimens – 3 from Wielkanoc, 7 from Korzkiew.
Description: Funnel- or cup-shaped sponges without stalk (Fig. 10A). Largest fragment 50 mm in height and 30 mm in width, with wall 1.5–2 mm thick. In the lower part occur numerous broken rhizoidal processes. Openings on the dermal surface round and small (0.3–0.4 mm in diameter). They are distributed evenly but without any order, at about 100/cm^2. Dictyonal skeleton consists of large lychniscs, forming a regular network with cube meshes, *ca.* 0.4 mm in size (Fig. 11A). In transverse section (specimen no. KO/70), 5 layers of the skeleton are visible. Very thin synapticular cortex occurs on the dermal surface (Fig. 11B). Gastral surface not visible. Canals not developed.
Remarks: In the studied specimens the pores on the dermal surface are slightly smaller than in the specimens from the Upper Chalk of England (0.5 mm – see Hinde, 1883). According to Reid (1962), some of the specimens described by Hinde (1883) as *Porochonia simplex* represent *Wollemannia araneosa* Schrammen (Hexactinosida). Also the specimens examined by Defretin-Lefranc (1960) most probably belong to the latter species. Due to their poor preservation, the presence of lychniscs as well as openings on the dermal surface is doubtful. Contrary to *P. simplex*, quadrangular, rhomboid and triangular meshes occur in transverse section in these specimens (see Defretin-Lefranc, 1960, pp. 85–86).
Occurrence: Poland – Kraków area (Coniacian or/and Santonian sponges redeposited to Santonian deposits); England (Upper Chalk, Turonian) after Reid (1968a).

Genus *Cinclidella* Schrammen 1912
Type species: *Cinclidella solitaria* Schrammen 1912

Cinclidella angustata (Hinde 1883)
Figs 10G, 11C

*1883. *Callodictyon angustatum* nov. sp.: Hinde, pp. 142–143, pl. 30, figs 4, 4a, 4b.
1960. *Callodictyon angustatum* Hinde: Defretin-Lefranc, pp. 83–84, pl. 10, figs 4–6; text-fig. 24.
v1980. *Callodictyon angustatum* Hinde: Małecki, pl. 5, figs 4, 5.
v1980. *Cinclidella solitaria* Schrammen: Małecki, pl. 6, fig. 6.
?2002. *Coscinopora* (*Coscinopora*) *praecuta* Pervushov: Pervushov, p. 108, pl. 11, figs 1–3.

Material: 18 specimens – 4 from Wielkanoc, 14 from Korzkiew (including 6 from collection ING PAN A-I-82 nos.: 36/1–6, 35/1–3).
Description: Narrow, cup-shaped sponges reaching 105 mm in height and 40 mm in diameter (Fig. 10G), with wall 3 mm thick. Openings on dermal surface round or slightly oval, *ca.* 0.5 mm in diameter. Openings, 140–160/cm^2, regularly distributed in longitudinal and horizontal rows; horizontal rows less distinct. No dictyonal canalization. Skeleton comprising large lychniscs, forming a regular network with rectangular meshes, 0.3–0.4 mm × 0.6–0.7 mm in size. In transverse section meshes rectangular and quadrangular (0.3–0.4 × 0.3 mm); locally meshes trapezoidal or triangular. On dermal surface occurs fine secondary meshwork with spicules without nodal octahedral (Fig. 11C). Gastral surface not visible. Dictyonal strands diverging at very small angles towards the dermal surface.
Remarks: Hinde (1883) and other workers (see synonymy) attribute the discussed species to the genus *Callodictyon* Zittel 1877b, whereas Reid (1968a) mentions it as a representative of *Cinclidella* Schrammen 1912. The genus *Callodictyon* (= *Callodictyonella* Strand 1928) is characterized by a synapticular cortex on the dermal surface, which is formed of flattened extensions of the rays (see Schrammen, 1912, text-pl. 14, fig. 15; pl. 45, fig. 2). In the investigated species the secondary meshwork is pierced by openings (see Fig. 11C), a feature that in fact occurs in the diagnosis of the genus *Cinclidella* Schrammen (see Schrammen 1912, p. 334). The general body plan and the skeleton of the studied specimens fit the description of the specimens from England and France.

Three lower fragments of sponges were assigned by Małecki (1980) to *Cinclidella solitaria* Schrammen. This species, in contrast to *C. angustata*, has irregularly distributed canal openings on the dermal surface (*cf.* Schrammen, 1912, p. 334, pl. 31, fig. 6). The organization of the canal openings characteristic of *C. angustata* is also visible on Santonian specimens from Saratov described by Pervushov (2002) as *Coscinopora praecuta* Pervushov. The unequivocal determination of the systematic position of these specimens is impossible because the structure of the skeleton has not been described and its canalization is unknown.
Occurrence: Poland – Kraków area (Coniacian or/and Santonian sponges redeposited to Santonian deposits); France (Turonian, Coniacian, Campanian), Germany (Campanian); England and Ireland (Coniacian–Santonian) after Reid (1968a); ?Russia – Saratov area (Lower Santonian).

Spirolophia Pomel 1872
[=*Marshallia* Zittel 1877b] emended Reid 2004b
Type species: *Pleurostoma tortuosa* Roemer 1864

Spirolophia tortuosa (Roemer 1864)
Figs 10B, 11D

1864. *Pleurostoma tortuosum* nov. sp.: Roemer, p. 15, pl. 6, fig. 1.
1877b. *Marshallia tortuosa* Roem.: Zittel, p. 58.
1912. *Marshallia tortuosa* Roem.: Schrammen, pp. 291–292, text-pl. 15, fig. 12.

Material: 10 specimens – 1 from Zabierzów, 2 from Wielkanoc and 7 from Korzkiew.

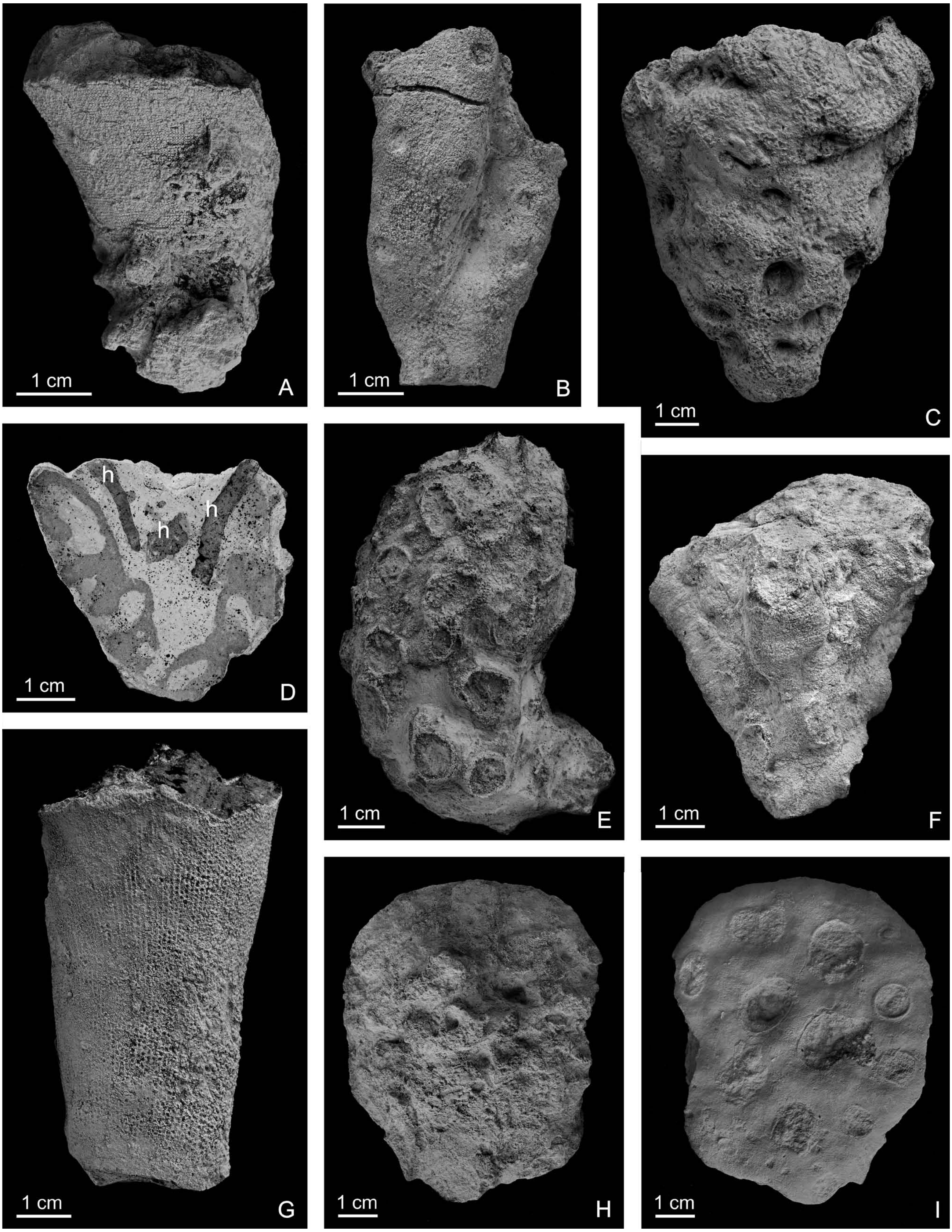

Fig. 10. Lychniscosida; **A.** *Porochonia simplex* (Smith 1848); lateral view; Korzkiew (Ko70); **B.** *Spirolophia tortuosa* (Roemer 1864); lateral view; Korzkiew (Ko128); **C, D.** *Becksia crispata* (Quenstedt 1878); C – lateral view; Korzkiew (ING PAN A-I-82/42/1 as *Becksia ojcoviensis* Małecki 1980); D – connected tubes visible in longitudinal section; in central cavity fragments of broken hexactinosid sponges (h); **E.** *Plocoscyphia communis* Moret 1926; lateral view; Korzkiew (ING PAN A-I-82/47); **F.** *Becksia plicata* (Sinzov 1878); lateral view; Korzkiew (K281); **G.** *Cinclidella angustata* (Hinde 1883); lateral view; Korzkiew (K43); **H, I.** *Tremabolites megastoma* (Roemer 1841); H – lower surface of specimen; I – upper surface of specimen; Korzkiew (Ko11)

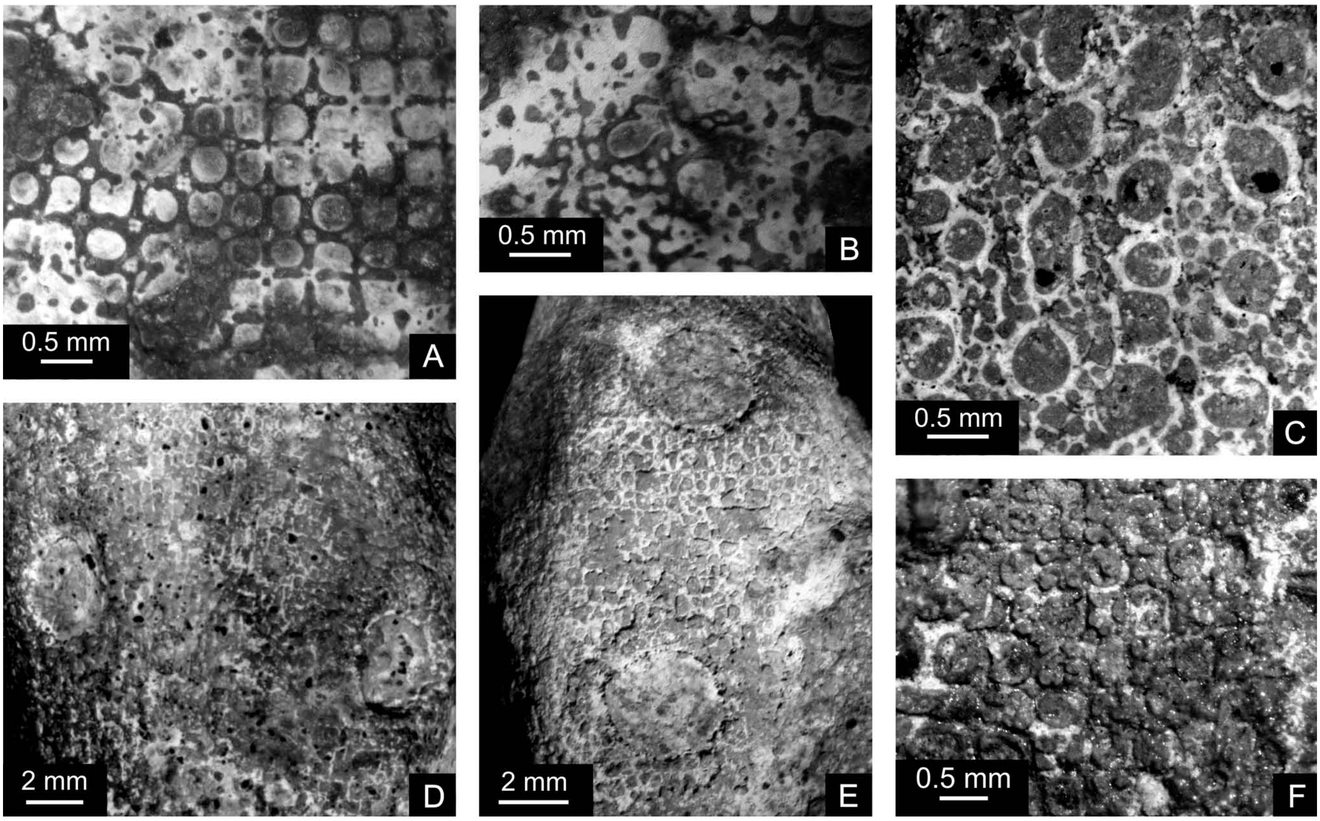

Fig. 11. Dictyonal skeleton of Lychniscosida; **A, B.** *Porochonia simplex* (Smith 1848); A – voids after dictyonal skeleton filled with glauconite; B – voids after cortex and openings locally preserved on dermal surface; Korzkiew (Ko87); **C.** *Cinclidella angustata* (Hinde 1883); voids after cortex on dermal surface of dictyonal skeleton filled with calcite; Korzkiew (K44); **D.** *Spirolophia tortuosa* (Roemer 1864); fragment of external surface with oscula and cast of subdermal skeleton; Korzkiew (Ko128); **E.** *Coeloptychium lobatum* Goldfuss 1831; lower surface of disc with oscula; Wielkanoc (W63); **F.** *Becksia plicata* (Sinzov 1878); voids after dermal cortex; Korzkiew (K281)

Description: Funnel-like sponges with plicate wall (Fig. 10B). Folds twisted slightly spirally. Height of specimen 50 mm, diameter 30 mm. Tubular long stalk (reaching up to 30 mm) without folds. On folds occur round oscula, 3–4 mm in diameter, arranged in 2–3 rows per fold (Fig. 11D). Oscula arranged in alternating rows. Single oscula also appear on stalks. On dermal surface occur round or oval openings, 0.5 mm in size, more or less in a quincunx pattern. Dictyonal skeleton regular, without canals. Meshes rectangular, 0.25–0.3 mm × 0.4–0.45 mm in size. On dermal surface occurs thin synapticular cortex.

Remarks: The material from Korzkiew is represented only by the lower parts of sponges, therefore the spiral organization of folds is visible merely on one specimen. In specimens of *Spirolophia tortuosa* from Germany, the oscula are situated only on the fold ridges. On the lateral surface of the folds in the examined specimen, there are additional rows, which possibly continue on the fold ridges, formed in the upper, unpreserved part of the sponge.

Occurrence: Poland – Kraków area (Coniacian or/and Santonian sponges redeposited to Santonian deposits), N Germany (Campanian).

Genus *Becksia* Schlüter 1868
Type species: *Becksia soekelandi* Schlüter 1868

Becksia crispata (Quenstedt 1878)
Fig. 10C, D

*1878. *Gyrispongia crispata*: Quenstedt, pp. 482–483, pl. 138, fig. 7.
1878. *Plocoscyphia Zitteli* nov. sp.: Sinzov, pp. 15–16, pl. 3, figs 1–4.
1912. *Becksia crispata* Quenst. sp.: Schrammen, p. 296.
1960. *Becksia crispata* Quenstedt: Defretin-Lefranc, p. 86, pl. 12, figs 1, 2.
v1980. *Becksia ojcoviensis* sp. nov.: Małecki, pp. 419–421, pl. 9, figs 1a, b; text-fig. 7.
1991. *Becksia crispata* Quenstedt: Gasse *et al.*, p. 31, figs 2b, 3a, b.

Material: 23 specimens from Korzkiew (including 6 from collection ING PAN A-I-82 nos. 42/1–6).

Description: Funnel-shaped sponges with central cavity, reaching 75 mm in height, and 35 mm in diameter (Fig. 10C). Wall of the funnel composed of thin-walled, 9–14 mm wide tubes. On outer surface of the funnel the tubes are longitudinally distributed. They dichotomously divide more or less regularly and then again join each other. Deep elongated hollows (0.5–1.5 m in length) form between the tubes. Usually surface of tubes is smooth, although in some cases protuberances appear on them. Inner surface of the funnel not visible. Dictyonal skeleton very regular with rectangular meshes, 0.3 × 0.4–0.5 mm in size. Synapticules appear in network on the inner surface of the tubes, therefore the meshes are rounded and smaller. On the outer surface of tubes occurs thick synapticular cortex (Fig. 10D). Round or oval openings, 0.5 mm in diameter, are arranged randomly in the cortex. Additionally, synapticular fibres cover lower part of sponges. No dictyonal canalization.

Remarks: According to Sinzov (1878), the new species described by him as *Plocoscyphia plicata* is closely related to *Gyrispongia crispata* Quenstedt [= *Becksia crispata* (Quenstedt 1878)]. The affinity of this species with *Becksia* is suggested by the presence of a central cavity, without apertures of tubes on the external surface (see Sinzov, 1878, pl. 3, fig. 9). The diagnostic feature of *B. plicata* is the distribution of longitudinal tubes and elongated hollows between them on the outer surface. These features characterize also the specimens from Germany described as *Becksia augustae* Schrammen that differ only in a more cylindrical shape. Therefore, the discussed species should be considered a junior synonym of *B. plicata*. Similarly as in the sponges from Korzkiew, the central cavity is not very deep in the material from Saratov, although the discussed specimens are incomplete, broken in the upper part.

Occurrence: Poland – Kraków area (Coniacian or/and Santonian sponges redeposited to Santonian deposits); N Germany (Turonian); N France (Coniacian–Santonian), Russia – Saratov area (Lower Santonian).

Becksia plicata (Sinzov 1878)
Figs 10F, 11F

*1878. *Plocoscyphia plicata* nov. sp.: Sinzov, pl. 3, figs 8, 9.
1902. *Becksia augustae* nov. sp: Schrammen, p. 18, pl. 2, fig. 2.
1912. *Becksia augustae* Schrammen: Schrammen, p. 298, pl. 40, fig. 1; text-pl. 14, fig. 5.
v1980. *Becksia augustae* Schrammen: Małecki, pl. 5, fig. 7.

Material: 5 specimens – 1 from Zabierzów, 4 specimens from Korzkiew (including 2 from collection ING PAN A-I-82 nos. 40/1, 2).

Description: Funnel-shaped sponges with central cavity (Fig. 10F). Height exceeds 75 mm, diameter is 35 mm. Wall of funnel composed of thin-walled, wide (9–14 mm) tubes. On outer surface of the funnel the tubes are longitudinally distributed. They dichotomously divide more or less regularly and then again join each other. Deep elongated hollows (0.5–1.5 mm in length) form between the tubes. Usually surface of tubes is smooth, although in some cases protuberances appear on them. Inner surface of funnel not visible. Dictyonal skeleton very regular. Meshes rectangular, 0.3 × 0.4–0.5 mm in size. Synapticules appear in the network on the inner surface of the tubes, therefore the meshes are rounded and smaller. On the outer surface of the tubes occurs thick synapticular cortex (Fig. 11F). In cortex are present round or oval openings, 0.5 mm in diameter, arranged randomly. Additionally, synapticular fibres cover lower part of sponges. Canals in dictyonal skeleton not developed.

Remarks: According to Sinzov (1878), the new species described by him as *Plocoscyphia plicata* is closely related to *Gyrispongia crispate* Quenstedt [= *Becksia crispata* (Quenstedt 1878)]. The diagnostic feature of *B. plicata* is the pattern of longitudinal tubes and elongated hollows between them on the outer surface. These features are also characteristic of specimens from Germany described as *Becksia augustae* Schrammen, differing only in a more cylindrical shape. Therefore, the discussed species should be considered a junior synonym of *B. plicata*. Similarly as in the sponges from Korzkiew, the central cavity is not very deep in the material from Saratov, although the discussed specimens are incomplete with the upper part broken.

Occurrence: Poland – Kraków area (Coniacian or/and Santonian sponges redeposited to Santonian deposits); Russia – Saratov area (Lower Santonian); N Germany (Campanian).

Genus *Plocoscyphia* Reuss 1846
emended Reid 1962, 2004b
Type species: *Scyphia labyrinthica* Reuss 1844

Remarks: According to Reid (1962), part of the species described as *Plocoscyphia* Reuss *sensu* Zittel (1877), including also *Plocoscyphia communis* Moret, belongs to the genus *Brachiolites* Smith 1848. However, Reid (2004b) assigned the mentioned species again to the genus *Plocoscyphia*, restricting the genus *Brachiolites* to forms with undivided lateral tubes.

Plocoscyphia communis Moret 1926
Fig. 10E

*1926. *Plocoscyphia communis* nov. sp.; Moret p. 230, pl. 23, fig. 14, pl. 24 figs 12, 12'.
1944. *Plocoscyphia communis* Moret: Hèrenger, p. 99, fig. 7d.
1960. *Plocoscyphia communis* Moret: Defretin-Lefranc, pl. 8, fig. 3.
v1980. *Plocoscyphia communis* Moret: Małecki, pl. 10, fig 1.
v1980. *Plocoscyphia labrosa* (Smith): Małecki, pl. 10, fig 4.
v1980. *Plocoscyphia vagans* Hinde: Małecki, pl. 10, fig. 6.
non 2004. *Plocoscyphia communis* Moret: Mermighis & Marcopoulou-Diacantoni, p. 338, pl. 10, figs 1, 2; pl. 15, figs 1, 2; pl. 18, figs 5, 6).

Material: 55 specimens – 16 from Wielkanoc, 39 specimens from Korzkiew (including 7 from collection ING PAN A-I-82 nos.: 46/1–3; 47/1, 2; 48; 49/1).

Description: Club to bulbous-like sponges, consisting of bifurcating and fusing again tubes, with wall 1 mm thick (Fig. 10E). Largest specimen 80 mm high. Tube diameter 6–12 mm. In the peripheral part, the free ends of tubes cylindrical or slightly widened. Tube openings round, sometimes elongated. On the summit of some of the specimens, the tubes are not fully developed and the wall forms twisting folds. Dictyonal skeleton very regular, without canals. Meshes quadrangular or rectangular, 0.2–0.3 mm × 0.2 mm in size. On dermal surface occurs network with thickened beams and rounded meshes. Only in the lower part of sponges a better developed cortex appears with randomly distributed round pores. No cortex on gastral surface.

Remarks: The specimens described by Małecki (1980) as *Plocoscyphia labrosa* (Smith 1848) (= *Exanthesis labrosa* according to Reid, 1962) do not display dictyonal canalization diagnostic of this genus. In these specimens, as well as in those assigned to *P. vagans* Hinde by Małecki (1980), the ends of the tubes are mostly broken or abraded. In the undestroyed parts of the sponges, the tubes are of identical shape and size as in other representatives of *P. communis*.

Specimens from Greece included in *P. communis* do not have developed tubes (see Mermighis & Marcopoulou-Diacantoni, 2004, pl. 10, figs 1, 2; pl. 18, figs 5, 6). They are characterized by a massive body with irregular large protrusions like in lithistid sponges. The systematic position of the specimens is impossible to define because their skeleton is unknown.

Occurrence: Poland – Kraków area (Coniacian or/and Santonian sponges redeposited to Santonian deposits); France (Albian, Cenomanian), SE England (Cenomanian) after Reid (1968a).

Genus *Tremabolites* Zittel 1877b
(= *Pachychlaenium* Pomel 1872,
Maeandroptychium Sinzov 1878)
Type species: *Manon megastoma* Roemer 1841

Remarks: According to Zhuravleva (1962, p. 44), *Maeandroptychium* Sinzov is a synonym of *Tremabolites* Zittel. This opinion seems justified, because specimens representative of the genus *Maeandroptychium* described by Sinzov (1878) have all features of this genus.

Tremabolites megastoma (Roemer 1841)
Fig. 10H, I

*1841. *Manon megastoma* N.: Roemer, p. 3, pl. 1, fig. 9.
v1980. *Tremabolites megastoma* (Roemer): Małecki, pl. 10, fig. 2.
2006. *Tremabolites megastoma* (Roemer): Świerczewska-Gładysz, pp. 269–270, figs 35c, 36h, (cum syn.).

Material: 4 specimens from Korzkiew (including 2 from collection ING PAN A-I-82 nos. 53/1, 2).
Description: Disc-like sponges, c. 80 mm in diameter (Fig. 10H, I), consisting of irregularly connected thin-walled tubes (1–2 mm), *ca.* 5 mm in diameter. Upper, flattened part covered by finely-porous siliceous membrane with large (5–20 mm in diameter), round or slightly elongated openings. Some of the openings with elevated margin. Openings distributed irregularly. Dictyonal skeleton composed of lychniscs forming very regular network with quadrangular or rectangular meshes, 0.4 mm × 0.5 mm in size. Cortex developed on outer surface of tubes. No dictyonal canalization.
Remarks: All characters of the analyzed specimens correspond well to the known descriptions of this species.
Occurrence: Poland – Kraków area (Coniacian or/and Santonian sponges redeposited to Santonian deposits), Middle Vistula Valley (Upper Campanian), Opole area (Upper Turonian); Spain (Aptian–Albian); France (Aptian–Santonian); Czech Republic (Cenomanian, Upper Turonian) after Vodrážka *et al.* (2009); Russian – Saratov area (Santonian); N Germany (Turonian–Campanian).

Family **Coeloptychidae** Roemer 1864
emended Reid 2004b
Genus *Coeloptychium* Goldfuss 1826
emended Mehl 1992
[= *Myrmecioptychium* Schrammen 1912,
Foliscyphia Pervushov 2002]
Type species: *Coeloptychium agaricoides* Goldfuss 1826

Remarks: According to Fritzsche (1920) and Mehl (1992), the genus *Myrmecipotychium* Schrammen 1912 is included to *Coeloptychium* Goldfuss 1833 because it differs only in the form of openings located on the folds. According to the diagnosis of Pervushov (2002), the genus *Foliscyphia* differs from *Coeloptychium* in distinct cracks on one side of the disc membrane. The form of cracks may vary even within one species, therefore, according to the present author, there is no basis to propose a new genus.

Coeloptychium subagaricoides Sinzov 1871–1872
Fig. 12 (A–C)

*1871–1872. *Coeloptychium subagaricoides* n. sp.: Sinzov, p. 49, pl. 7, figs 1–4.
1876. *Coeloptychium subagaricoides* Sinzov: Zittel, pp. 66– 68.
1912. *Myrmecioptychium bodei* sp. nov.: Schrammen, p. 333.
1962. *Myrmecioptychium subagaricoides* (Sinzov): Zhuravleva, pl. 3, fig. 4a, b; text-figs 50a, b.
v1980. *Myrmecioptychium subagaricoides* (Sinzov): Małecki, pp. 417–418, pl. 7, figs 3a-c, 4a, b.
v1980. *Myrmecioptychium jordanum* sp. nov.: Małecki, pp. 418–419, pl. 8, figs 1a-c; text-figs 6a-c.
v1984. *Myrmecioptychium jordani* Małecki: Hurcewicz, pp. 332–333, pl. 87, fig. 2.
1992. *Coeloptychium subagaricoides* Sinzov: Mehl, p. 121, pl. 19, fig. 5.
1995. *Coeloptychium agaricoides* forma *subagaricoides*; Mehl & Niebuhr, pl. 1, figs 7–9.
2002. *Coeloptychium convexilatus* sp. nov.; Pervushov, p. 114, pl. 16, figs 1, 2
2002. *Coeloptychium tenuialtus* sp. nov.; Pervushov, p. 114, pl. 17, figs 1–4; pl. 18, fig. 1.
2002. *Foliscyphia profonda* sp. nov.; Pervushov, p. 121, pl. 34, fig. 3.
2002. *Foliscyphia disciplana* sp. nov.; Pervushov, p. 121, pl. 31, figs 2, 3; pl. 32, fig. 1.
2002. *Foliscyphia insigniformae* sp. nov.; Pervushov, p. 122, pl. 33, fig. 1.
2002. *Foliscyphia pertusa* sp. nov.; Pervushov, p. 122, pl. 35, fig. 1.
2002. *Foliscyphia partivasa* sp. nov.; Pervushov, p. 122, pl. 33, fig. 2; pl. 34, figs 1, 2.

Material: 13 specimens – 2 from Wielkanoc, 11 from Korzkiew (including 8 from collection ING PAN A-I-82 nos.: 38/1–4, 39/1–4).
Description: Mushroom-like sponges (Fig. 12A–C). Discoid upper part up to *ca.* 90 mm in diameter. Thickness of discs very variable, from 150 to 250 mm. Lower part (preserved short fragments) conical, 15–20 mm in diameter. Furrows and folds present on conical surface. Disc composed of radially folded wall, *ca.* 1.5 mm thick. On the lower surface occur 5 primary folds, 7–9 mm wide. Primary folds dichotomously divided; secondary folds in the number of about 20. Round openings, 3–4 mm in diameter, placed at 6–10 mm from each other on the fold ridges. Upper surface slightly concave or bowl-like, depending of the disc thickness. Disc margin wide, slightly sloping inwards, smooth, with oval and elongated cracks. Dictyonal skeleton regular. Meshes quadrangular or rectangular, 0.4 mm × 0.4–0.5 mm in size. In the subdermal part skeleton with numerous synapticules and smaller rounded meshes (*ca.* 0.3 mm in size). Cortex with numerous pores (0.1–0.3 mm) on dermal surface. Dense synapticular filaments form protruding ring around openings on the folds. Upper part of disc covered with siliceous synapticular membrane. Membrane composed of finely-porous bands on fold ridges and bands with large (1.5–2 mm), irregular meshes above furrows between bands. Membrane on disc margin with very small oval meshes.
Remarks: Compared to the holotype, the described specimens of *Coeloptychium subagaricoides* have more sparsely distributed oscula in the lower part of the disc. Mehl and Niebuhr (1995) specified *C. subagaricoides* among the morphotypes of *C. agaricoides* Goldfuss. According to these authors, this form varies from other sponges in the structure and distribution of the openings on the folds; however, it has features present in both *C. subagaricoides* forma *decinimum*, and *C. subagaricoides* forma *sulciferum*. The present author does not exclude the correctness of the opinion of Mehl and Niebuhr (1995); nevertheless, the distinction of *C. subagaricoides* is retained herein. The opinion of Mehl and Niebuhr (1995) does not seem sufficiently documented, because the specimen of *C. agaricoides* forma *subagaricoides* has not been considered in the comparative analysis (*cf.* Mehl & Niebuhr, 1995, tab 1).

The author's analysis, in turn, confirms the view of Mehl (1992) that *Myrmecioptychium jordanum* Małecki is a junior synonym of *Coeloptychium subagaricoides* Sinzov. The specimen assigned by Małecki (1980) to the new species differs from other representatives of *C. subagaricoides* from Korzkiew only by a thicker disc and a wider margin. A similar morphological difference has also been noticed among the specimens of *C. subagaricoides* from Saratov (Sinzov, 1871–1872). According to Małecki (1980, text-fig. 6 a, c), *M. jordanum* has a diaphragm on the upper surface, with circular pores that are evenly but sparsely distributed. On small exposed fragments of the diaphragm occur also narrow stripes with small pores and wide stripes with large, irregular and densely distributed pores. Dark trails, visible on the longitudinal section of one specimen, interpreted as irregular water canals (see Małecki 1980, text-fig. 6c), are the result of phosphati-

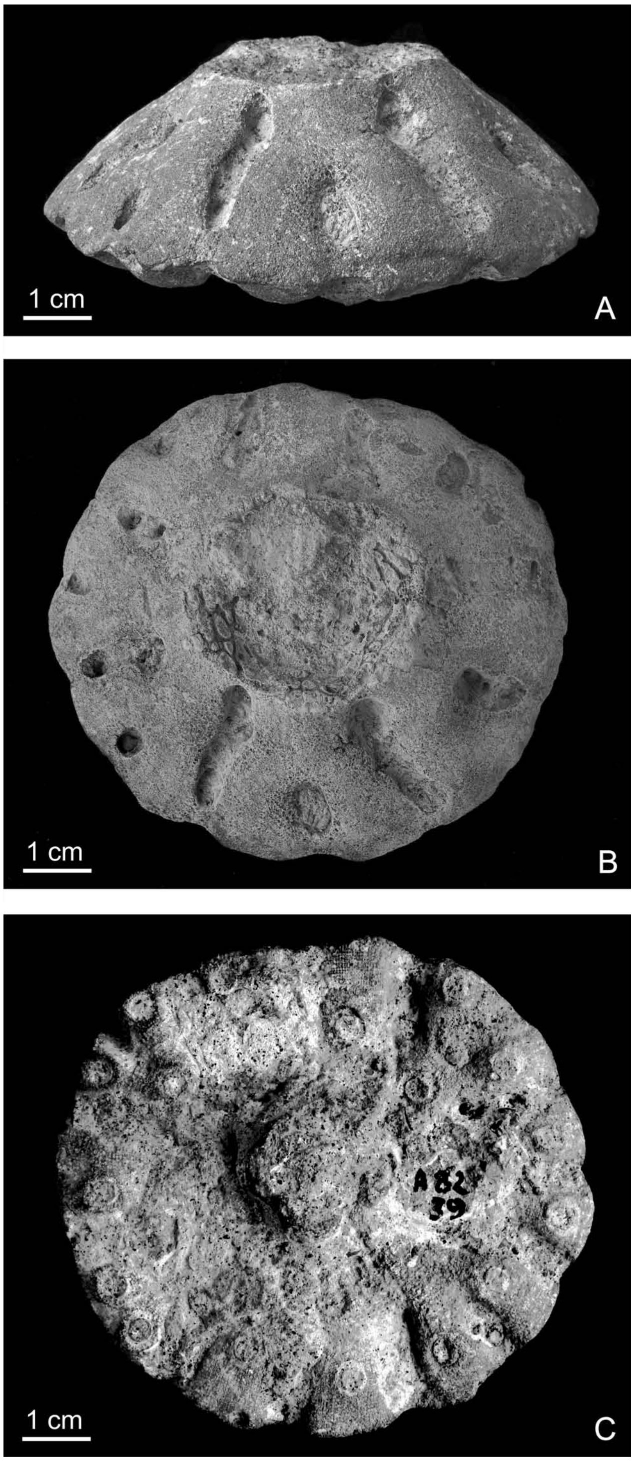

Fig. 12. Lychniscosida; **A–C.** *Coeloptychium subagaricoides* Sinzov 1871-1872; A – lateral view; B – upper surface of specimen; C – lower surface of specimen; Korzkiew (ING PAN A-I-82/39/2 as *Myrmecioptychium jordanum* Małecki)

zation, as well as the difference in glauconite concentration in the sediment filling the sponge skeleton.

Pervushov (2002) assigned *Myrmecioptychium jordanum* Małecki to a new genus *Foliscyphia*, within which five new species have been distinguished. The differences between the species (more or less concave upper disc surface, width of disc margin, sponge size) pointed out by Pervushov (2002) are minor and not different from the diagnosis of *C. subagaricoides*. According to Pervushov (2002), some specimens described by Siznov (1871–1872) as *C. subagaricoides* represent the new species *C. tenuialtus*. In *C. tenuialtus* as well as in representatives of *C. convexilatus* Pervushov are visible large oscula with a broad margin typical of *C. subagaricoides*. According to the present author, other characteristic features that would justify distinguishing a new taxon are missing.

Occurrence: Poland – Kraków area (Coniacian or/and Santonian sponges redeposited to Santonian deposits); Russia – Saratov area (Lower Santonian); N Germany (Santonian/Campanian, Upper Campanian).

Coeloptychium lobatum Goldfuss 1831
Figs 11E, 13A

*1831. *Coeloptychium lobatum* nobis: Goldfuss, p. 220, pl. 65, fig. 11.
1992. *Coeloptychium lobatum* Goldfuss: Mehl, pp. 120–121, pl. 19, fig. 6 (cum syn.).
1992. *Coeloptychium lobatum* Goldfuss: Zawischa, p. 18, fig. 1.
1998. *Coeloptychium lobatum* Goldfuss: Gasse *et al.*, fig. 2.
1999. *Coeloptychium lobatum* Goldfuss: Gasse *et al.*, p. 208, pl. 1, fig. 2, pl. 2, figs 2–3, pl. 3, fig. 3.
1995. *Coeloptychium lobatum* Goldfuss: Hauschke, pl. 8, figs 1–8, pl. 9, figs. 1–4.
1995. *Coeloptychium agaricoides* forma *lobatum*: Mehl & Niebuhr, pl. 1, figs 1–3, pl. 3, fig. 6.
2002. *Troegerella* (*Troegerella*) *brevilobata* sp. nov.: Pervushov, pl. 22, figs 1–3.
2002. *Troegerella* (*Troegerella*) *mugodjariensis* sp. nov.: Pervushov, pl. 24, fig. 1.
2002. *Troegerella* (*Troegerella*) *quadrifurcata* sp. nov.: Pervushov, pl. 26, fig. 1.

Material: 1 specimen from Wielkanoc.

Description: Fragment of a disc *ca.* 50 mm in diameter of a mushroom-like sponge (Fig. 13A). Upper surface 22 mm in diameter, highly concave. Disc margin widely divided probably into five lobes (only two are well-preserved), 10 mm wide. These lobes subdivide into two, more or less in the middle of their width. On their ridges appear singular round oscula, 3 mm in diameter. On lower, flat side of the disc the oscula are placed in a row on the folds at a regular distance of about 9 mm (Fig. 11E). Dictyonal skeleton very regular. Meshes quadrangular or rectangular, 0.3 mm × 0.3–0.4 mm in size. On dermal surface occurs synapticular cortex with numerous round pores, 0.15–0.35 mm in diameter. Pores distributed in regular rows, corresponding to the meshes of a skeletal network. Membrane on upper part of disc not preserved.

Remarks: The specimen from Wielkanoc has additional singular oscula, placed on the lateral surface of the lobes, similarly to the specimen from the Campanian of Germany described by Zawischa (1992). Such location of oscula also exists in *Troegerella subhercynica* Ulbrich 1974 from the Campanian of Germany, from which the discussed species differs mainly in the flattening of the lower disc surface, resulting in triangular, instead of blade-like, lateral lobes. The similarity to *Troegerella* lead Pervushov (2002) to include the representatives of *C. lobatum* from the Lower Santonian of Saratov to a new species of this genus. The poor state of preservation as well as the inadequate documentation of the Volga Region specimen allowed distinguishing only three undoubted synonyms of *C. lobatum* – *T.* (*Troegerella*) *brevilobata* Pervushov, *T.* (*Troegerella*) *mugodjariensis* Pervushov and *T.* (*Troegerella*) *quadrifurcata* Pervushov. The presence of *C. lobatum* in the Santonian deposits of Poland and in the Volga Region indicate that it was a common species and allows to speculate that the genus *Troegerella* is derived from this taxon.

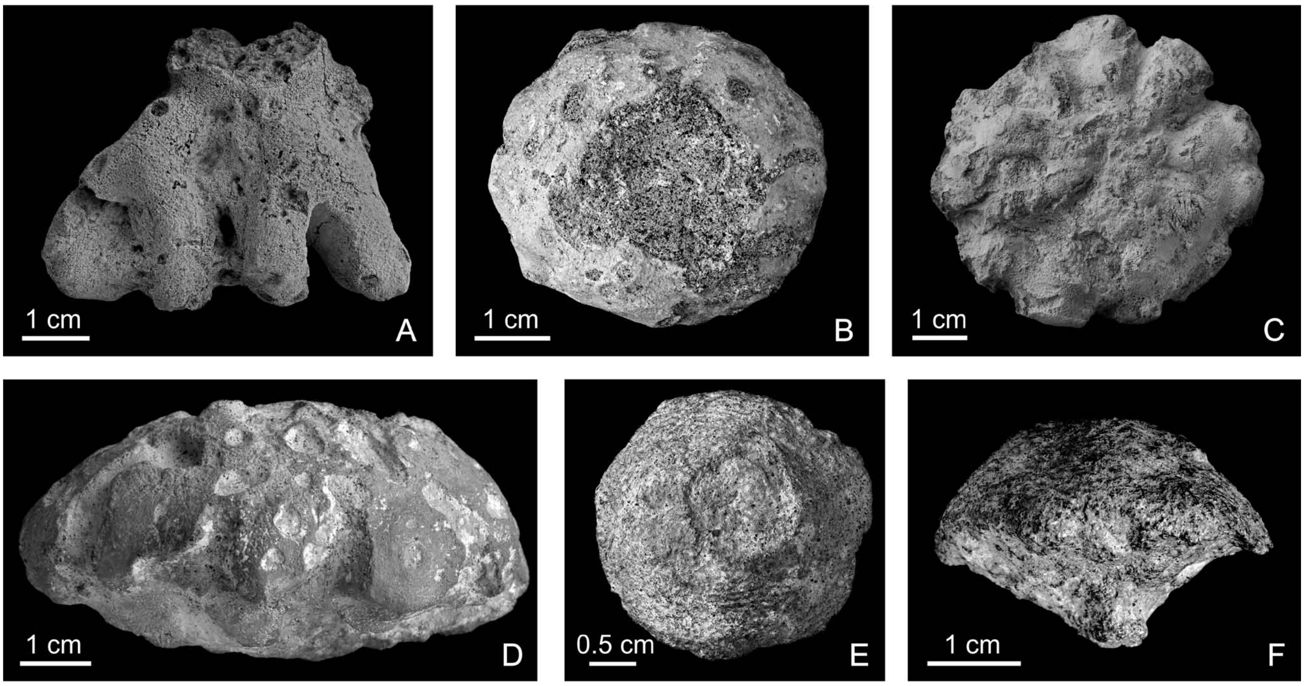

Fig. 13. Lychniscosida; **A.** *Coeloptychium lobatum* Goldfuss 1831; lateral view; Wielkanoc (W63), **B–D.** *Etheridgia mirabilis* Tate 1864; B – upper side of specimen, C – lower side of specimen; Wielkanoc (W50), D – lateral view; Korzkiew (K11); **E, F.** *Camerospongia fungiformis* (Goldfuss 1831); E – upper surface of specimen; F – lateral view; Korzkiew [ING PAN A-I-82/55 as *Camerospongia capitata* (Smith 1848)]

When revising the genus *Coeloptychium*, Mehl (1992) considered *C. lobatum* a valid taxon. In turn, Mehl and Niebuhr (1995) recognized the species *C. lobatum* as one of the nine forms of *C. agaricoides*, which was till now described as a separate species by other authors. It is impossible to exclude that some of the species indicated by Mehl and Niebuhr (1995) are in fact morphotypes of the species *C. agaricoides*. In the case of *C. lobatum*, which clearly differs from other representatives of the genus, the presented arguments do not seem sufficient. Research on the intraspecific variability was conducted only on 22 specimens, including only two assigned to *C. agaricoides* forma *lobatum* (*cf.* Mehl & Niebuhr, 1995, tabl. 1). In contrast to other similar morphotypes, no intermediate form between *C. agaricoides* forma *lobatum* and its closest relative *C. agaricoides* forma *sulciferum* has been found in the material. According to Mehl and Niebuhr (1995), these intermediate forms are known from other collections, but have not been presented. Relying on Schrammen (1912), Mehl and Niebuhr (1995) claim that the intraspecific variability is also proved by the undivided margin of the young disc forms. These specimens have not been, however, documented.

Occurrence: Poland – Kraków area (Coniacian or/and Santonian sponges redeposited to Santonian deposits); N Germany (Campanian); England (Upper Chalk) after Hinde (1883).

Genus *Etheridgia* Tate 1864
(= *Etheridgea* Zhuravleva, 1962, *Myrmecioptychium* sensu Pervushov)
Type species: *Etheridgia mirabilis* Tate 1864

Remarks: Synonymy of the genus *Etheridgia* Tate 1864 and *Tremabolites* Zittel (Sinzov, 1878, p. 6; Zhuravleva, 1962, p. 44; Trestian, 1973, p. 10) is unjustified because *Etheridgia* is characterized by a deep central cavity (see Tate, 1864, pp. 42–43, pl. 5, fig. 4). For that reason the genus *Etheridigia* is similar to *Camerospongia* d'Orbigny 1847, but differs from it in the presence of irregular openings in the membrane covering the upper part of the sponge. De Laubenfels (1955) mistakenly assigned *Etheridigia* to the family Myliusiidae de Laubenfels 1955, representing the Hexactinosida. According to Reid (2004b), in *Etheridgia* the tubes divide dichotomously only once. The analysis showed that in some larger specimens the tubes can divide twice. Pervushov (2002) distinguished the genus *Myrmecioptychium* Leonard 1897 with the type species *Plocoscyphia tenuicostata* Leonhard 1897. However, Leonhard (1897) did not describe such species at all. The species, of which the description and pictures were pointed out by Pervushov (2002), is *P. tenuilobata* (*cf.* Leonhard, 1897, p. 36, pl. 4, fig. 1a-d). The diagnosis given by Pervushov (2002) is completely different from the diagnosis of *Myrmecio- ptychium* Schrammen 1912. It is consistent with the characteristics of the subfamily *Cameroptychinae* Reid 2004 and almost entirely fits the diagnosis of *Etheridgia* Tate 1864.

Etheridgia mirabilis Tate 1864
Fig. 13B–D

*1864. *Etheridgia mirabilis* spec. nov.; Tate, p. 43, pl. 5, figs 4a, b.
1883. *Etheridgia mirabilis* Tate: Hinde, p. 189.
1871–72. *Coeloptychium Goldfussi* Fisch.: Sinzov, pp. 51–52, pl. 9, figs 1–6.
1878. *Meandroptychium goldfussi* Fisch. sp.: Sinzov, p. 12, pl. 6, figs 3, 4.
1962. *Etheridgea goldfussi* (Fischer): Zhuravleva, text-fig. 52.
v1980. *Etheridgea goldfussi* (Fischer): Małecki, p. 421, pl. 10, figs 5a, b.
v1980. *Etheridgea cracoviensis* sp. nov.: Małecki, p. 421, pl. 11, figs 1a, b; text-figs 8a, b.
v1984. *Etheridgea korzkievicensis* Małecki: Hurcewicz, p. 335, pl. 87, fig. 6.
v1980. *Polyptycha becsioides* Defr.-Lefr.: Małecki, pp. 423–424, pl. 12, figs 1a, b.

Material: 20 specimens – 1 from Zabierzów, 8 from Wielkanoc and 11 from Korzkiew (including 9 from collection ING PAN A-I-82 nos.: 50/1–4; 51/1–3; 53/1, 2).

Description: Conical- or bowl-like sponges with convex summit and central cavity (Fig. 13B–D). Largest specimens up to 80 mm in diameter and 40 mm in height. Opening of central cavity irregular, 20–35 mm in diameter. Sponges comprising thin-walled (*ca.* 1 mm) tubes, 7–12 mm in diameter. On the lower side the broad tubes divide dichotomously once or twice. The sides of tubes fuse and form a plate with radial ribs and deep furrows. Singular basal processes (only short fragments are preserved) are observed. In longitudinal section, a tube is visible dividing upwards, surrounding the deep central cavity. Upper part covered by finely-porous siliceous membrane. Membrane with round, oval or figure eight-shaped openings, 3–12 mm in diameter. Margin of openings elevated. Dictyonal skeleton very regular, comprising lychniscs. Meshes rectangular, 0.4 mm × 0.5 mm in size. Dermal surface of tubes covered with thick, finely-porous cortex with round openings, *ca.* 0.5 mm in diameter. No canals developed within dictyonal skeleton.

Remarks: *Etheridgia mirabilis* is polymorphic species, which often resulted in assigning it to different species. Both upper and lower surfaces may range from nearly flat to convex or even cone-shaped (see Tate, 1864; Hinde, 1883; Sinzov, 1871–72). Małecki (1980) assigned to *E. goldfussi* (Fisher) specimens that have a flattened lower part. He considered the cone-shaped forms as the new species *E. cracoviensis*. According to Małecki (1980), the body of *E. cracoviensis* was located on a narrow stem. Though it is possible that the individuals had a stem, its fragments have not been, however, preserved in the studied material. The damage on the lower part of some specimens has been erroneously interpreted as inhalant pores by Małecki (1980, text-fig. 8b). Pervushov (2002) described specimens of the same shape as the new species *Myrmecioptychium claurus*.

Two specimens with a broken upper part were described by Małecki (1980) as *Polyptycha becsioides* Defretin-Lefranc. They are characterized by regularly placed, dichotomously divided tubes in the lower part of the sponges, typical of *E. mirabilis*. Part of the specimens from Poland and the Saratov area differ from specimens from the Upper Chalk of England by larger dimensions of the sponge body and apertures in the membrane.

Mermighis and Marcopoulou-Diacantoni (2004, pp. 334, 336, pl. 9, figs 1–4; pl. 13, fig. 1) described 3 specimens from the Santonian of Greece as *E. korzkievicensis* Małecki [they presumably meant *E. cracoviensis*, because Małecki (1978) used *E. korzkievicensis* in the preliminary study of the material from Korzkiew; this informal name was quoted also by Hurcewicz (1984)]. The illustrated specimens do not have any features characteristic of the genus *Etheridgia* such as a central cavity, membrane or divided tubes. Above all, the wide canals are visible in transverse sections of the sponge wall. Spicules not preserved.

Occurrence: Poland – Kraków area (Coniacian or/and Santonian sponges redeposited to Santonian deposits); Russia – Saratov area (Lower Santonian); Ireland (Santonian) and England (Coniacian–Santonian) after Reid (1968a).

Family Camerospongiidae Schrammen 1912
Genus *Camerospongia* D'Orbigny 1849
(= *Cameroscyphia* Fromentel 1860)
Type species: *Scyphia fungiformis* Goldfuss 1831

Camerospongia fungiformis (Goldfuss 1831)
Fig. 13E, F

*1831. *Scyphia fungiformis* nobis: Goldfuss, p. 218, pl. 65, figs 4a-c.
v1980. *Camerospongia capitata* (Smith): Małecki, p. 423, pl. 8, figs 2a-c.
v1991. *Camerospongia fungiformis* (Goldfuss): Tarkowski, p. 93, pl. 4, figs 5, 6.
1992. *Camerospongia fungiformis* (Goldfuss): Mehl, p. 111 (cum syn.).
2001. *Camerospongia fungiformis* (Goldfuss); Wiese & Wood, fig. 3k.

Material: 6 specimens from Korzkiew (including 2 from collection ING PAN A-I-82 nos. 52/1, 2).

Description: Spherical sponges with central cavity, 7–12 mm in diameter (Fig. 13E, F). Average height 15–20 mm, diameter 25–35 mm. Preserved fragments of thin stalk 6–7 mm in diameter. Sponge comprising anastomosing tubes, 4–5 mm in diameter. Upper part convex or slightly flattened, covered by finely-porous siliceous membrane. Outer surface of lower part with small openings, 0.5–0.8 mm in diameter. Dictyonal skeleton comprising lychniscs forming a rather regular network with quadrangular and rectangular meshes, 0.3–0.35 mm in size. In external parts of the wall occurs irregular network with smaller meshes, 0.2–0.25 mm in size. Cortex developed on dermal surface. Spicules not visible within membrane.

Remarks: Specimens from Korzkiew were assigned by Małecki (1980) to *Camerospongia capitata* (Smith 1848) (= *Cephalites capitatus* Smith 1848). According to that author, this species is characterized by a less elevated summit and non-projecting margins in comparison to *Camerospongia fungiformis* (Goldfuss) (*cf.* Smith, 1883, p. 288, pl. 14, fig. 11). Lack of elevated summit on the described specimens is a result of abrasion during transport. Shape of upper part of the studied specimens is similar to other described specimens of *Camerospongia fungiformis* (Goldfuss).

Occurrence: Poland – Kraków area (Coniacian or/and Santonian sponges redeposited to Santonian deposits); Opole area (Turonian); Spain (Aptian), France (Albian); N Germany (Turonian); England (Coniacian–Santonian) after Reid (1968a).

Family Ventriculitidae Smith 1848
emended Zittel 1877b, emended Mehl 1992
Genus *Rhizopoterion* Zittel 1877b
emended Schrammen 1912, emended Reid 1962, emended Mehl 1992
Type species: *Scyphia cervicornis* Goldfuss 1826

Rhizopoterion cribrosum (Phillips, 1829)
(= *Ventriculites radiatus* Mantell 1822,
sensu Schrammen 1912)
Fig. 14A

*1829. *Spongia cribrosa*: Phillips, pl. 1, fig. 7.
v1933. *Ventriculites radiatus* Mantell: Bieda, p. 25.
v1980. *Ventriculites radiatus* Mantell: Małecki, pl. 3, figs 5, 7, 8.
v1980. *Ventriculites cylindratus* Schrammen: Małecki, pl. 3, fig. 6.
v1980. *Ventriculites mamillaris* Smith: Małecki, pl. 4, fig. 5.
v1980. *Orthodiscus fragilis* Schrammen: Małecki, pl. 5, figs 3, 4.
v1980. *Rhizopoterion tubiforme* Schrammen: Małecki, p. 415, pl. 4, fig. 1.
1998. *Rhizopoterion cribrosus* (Phillips): Pervushov, p. 102, pl. 1, fig. 1.
1998. *Rhizopoterion striatus* Smith: Pervushov, p. 102, pl. 2, figs 1–3; pl. 3, fig. 1.
1998. *Rhizopoterion fractus* sp. nov.: Pervushov, p. 103, pl. 2, figs 4–5.
1998. *Rhizopoterion successor* Schrammen: Pervushov, p. 102, pl. 1, fig. 2.

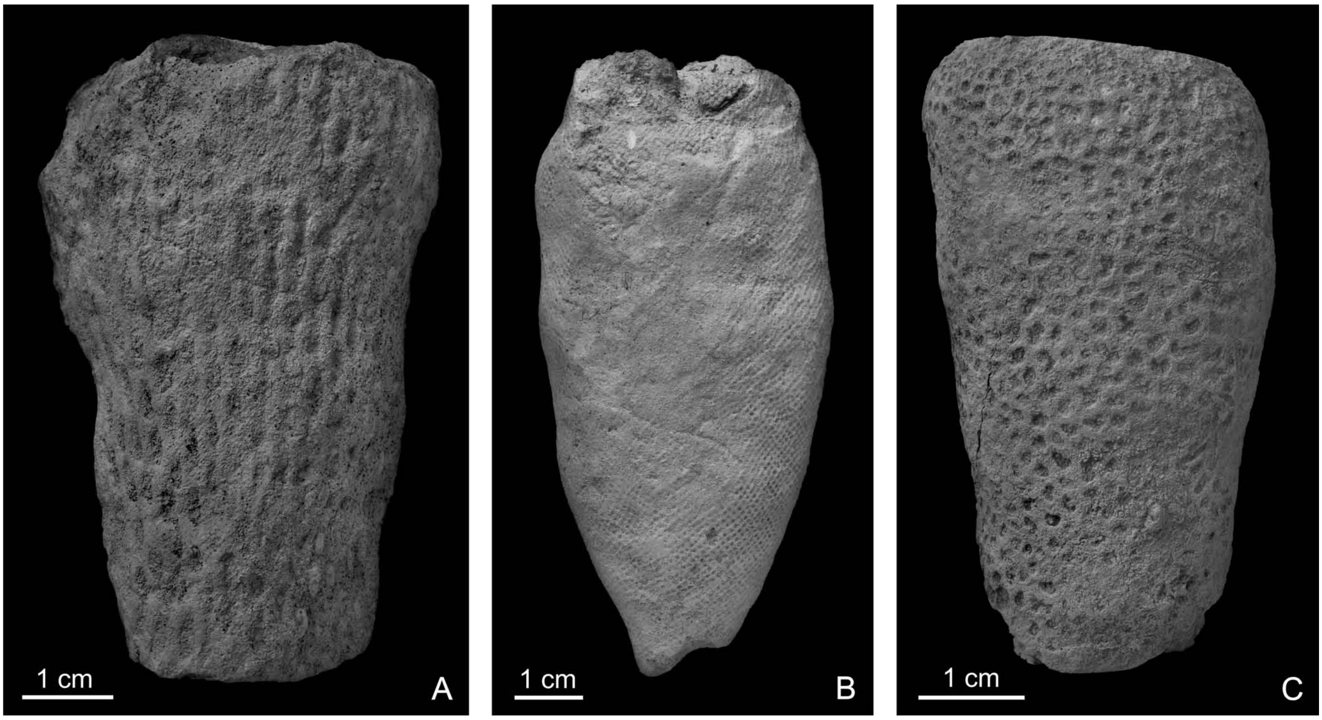

Fig. 14. Lychniscosida; **A.** *Rhizopoterion cribrosum* (Phillips 1829); lateral view of the lower part of specimen; Wielkanoc (W20); **B.** *Coscinopora infundibuliformis* Goldfuss 1826; lateral view; Wielkanoc (W18); **C.** *Leiostracosia angustata* (Roemer 1841); lateral view; Korzkiew (ING PAN A-I-82/29/1)

1998. *Rhizopoterion cylindratus* Schrammen: Pervushov, p. 103, pl. 1, fig. 3.
1998. *Ventriculites obliquus* sp. nov.: Pervushov, p. 103, pl. 4, fig. 1.
1998. *Ventriculites ocreaceus* sp. nov.: Pervushov, p. 104, pl. 4, fig. 2.
1998. *Ventriculites sculptus* sp. nov.: Pervushov, p. 104, pl. 4, fig. 3.
1998. *Ventriculites duplus* sp. nov.: Pervushov, p. 104, pl. 3, fig. 2.
1998. *Ventriculites cruciatus* sp. nov.: Pervushov, p. 104, pl. 5, fig. 2.
2002. *Rhizopoterion cribrosum* (Phillips): Wood, p. 32, pl. 2, fig. 4.
2006. *Rhizopoterion cribrosum* (Phillips): Świerczewska-Gładysz, pp. 252–254, figs 18a-d, 19, 20a-f, (cum syn.).

Material:70 specimens – 1 from Zabierzów, 7 from Wielkanoc and 62 from Korzkiew (including 22 from collection ING PAN A-I-82 nos.: 17/1–3, 18/1–9, 19, 20, 21/1–5, 24/1–3).

Description: Sponges usually trumpet- or funnel-shaped (Fig. 14A), placed on a short, massive stem. Height at least 80 mm (no complete specimen is preserved), diameter up to 100 mm. Wall thickness 7–10 mm. Outer surface covered with longitudinal elliptic canal openings, 1.5–2 × 3–5 mm in size. Openings occur on the bottom of shallow furrows and form a quincunx. Sinusoidal ribs separating the furrows 1–1.5 mm wide. Round canal openings on the inner surface, 1–3 mm in size, less regularly distributed in a quincunx. Epirhyses long, straight and parallel to the wall, terminating blindly under the surface of the inner side. Aporhyses straight at the beginning and then run diagonally downwards and connect with the system of longitudinal canals running inside the wall. Dictyonal skeleton built of lychniscs combined in an irregular network with meshes 0.3–0.4 mm in size. Synapticular cortex on both surfaces.

Remarks: The examined specimens are characterized by large morphological variability, which was the basis of including them to different species, or even to different genera (see Małecki, 1980). The observed variety of the sponge shapes and sizes of the canal openings is, however, typical of this polymorphic species (*cf.* Świerczewska-Gładysz, 2006).

Similar large intraspecific variability also exists amongst the representatives of *R. cribrosum* from the Lower Santonian of the Saratov Region. Various morphotypes of this species were assigned by Pervushov (1988) to a few – including five new – species of the genus *Ventriculites* Mantell 1822. The course of the canals inside the wall visible in horizontal and transverse sections of the specimens from the Volga Region (see Pervushov, 1988, pl. 2, figs 1–6; pl. 3, figs 1–4; pl. 4, figs 1–3) shows a complex network of canals typical of *Rhizopoterion cribrosum* (*cf.* Reid, 1962; Ulbrich, 1974; Świerczewska-Gładysz, 2006). To the above species perhaps may be included specimens described by Pervushov (1988) as species of *Rhizopoterion* – *R. cervicorne* (Goldfuss 1833), *R. inerrutum* (Eichwald 1865), *R. imucalix* sp. nov, *R. supralicharevi* sp. nov. *R. fungiforme* sp. nov, *R. solumiforme* sp. nov, *R. santonicum* sp. nov and *R. cochlear* sp. nov. Conclusions on the systematic position of these species is impossible as they are represented exclusively by the lower parts of sponges (stalks with rhizoids) with diagnostic features lacking.

Occurrence: Poland – Kraków area (Coniacian or/and Santonian sponges redeposited to Santonian deposits; Campanian), Upper Middle Vistula Valley (Campanian–Lower Maastrichtian), Opole area (Turonian–Coniacian); N Germany (Turonian–Campanian); England and Ireland (Senonian); Isle of Rügen (Lower Maastrichtian); Ukraine – Crimean (Maastrichtian), N Donbass region (Maastrichtian); Russia – Saratov area (Lower Santonian); ?France (Turonian).

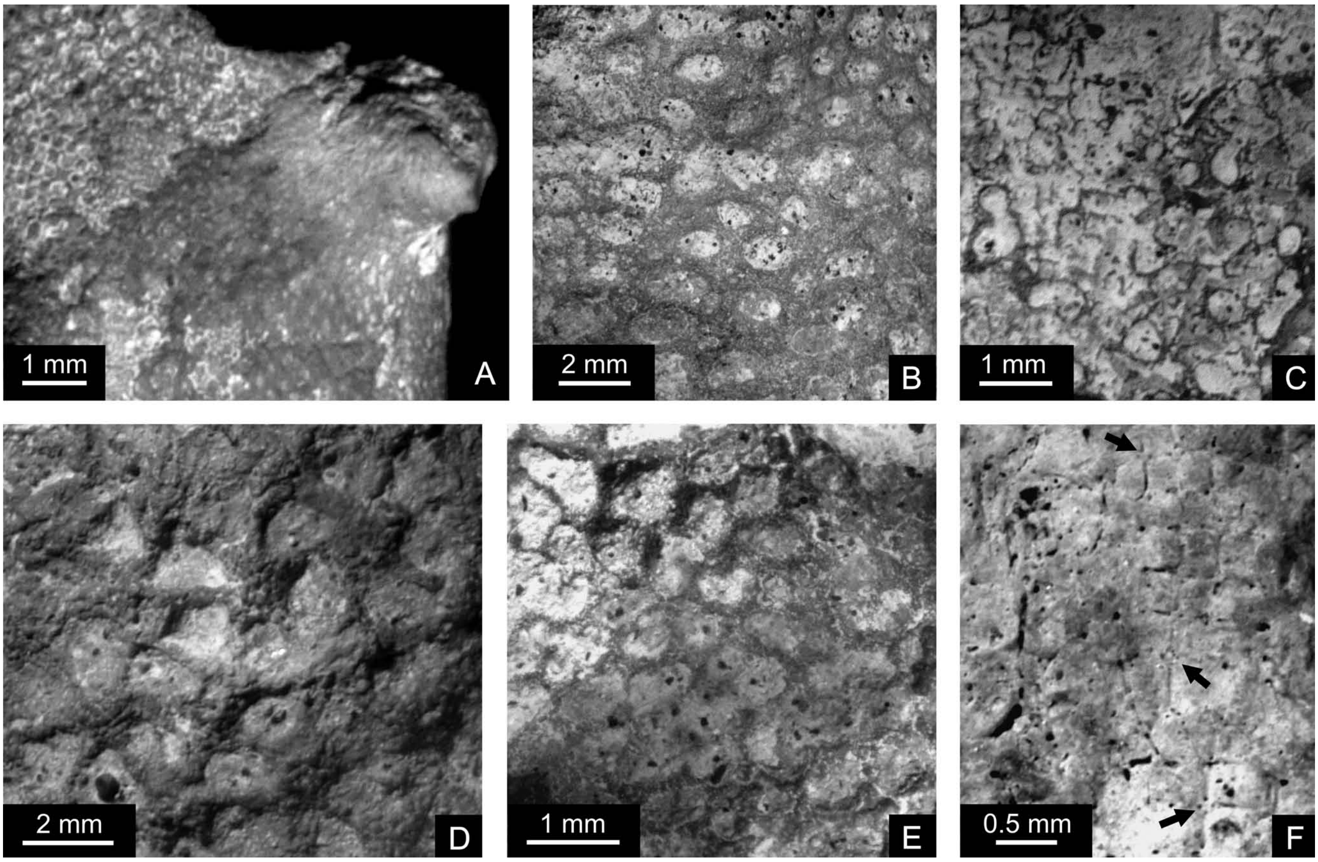

Fig. 15. Lychniscosida; **A.** *Coscinopora infundibuliformis* Goldfuss 1826; fragment of the lower part of specimen; broken rhizoid with traces of synapticular skeleton covering dermal surface of calcitized dictyonal network; Korzkiew (ING PAN A-I-82/33 as *Coscinopora variabilis* Małecki 1980); **B.** *Sporadoscinia stirps* Schrammen 1912; fragment of external surface with canal openings in the lower part of sponges; Wielkanoc (W22); **C, F.** *Napaeana striata* (Schrammen 1902); C – fragment of external surface with canal openings and glauconitized cortex; Korzkiew (ING PAN A-I-82/25/1); F – longitudinal section of the wall showing voids after regular dictyonal skeleton with lychniscs (black arrows);Wielkanoc (W56). **D, E.** *Astropegma stellata* (Roemer 1841); A – fragment of external surface; canal openings with star-like layout, B – irregular layout canals openings on external surface in the upper part of specimens; Korzkiew (ING PAN A-I-82/26/1 as *Sporadoscinia teutoniae* Schrammen 1912)

Genus *Coscinopora infundibuliformis* Goldfuss 1826
Type species: *Coscinopora infundibuliformis* Goldfuss 1826

Coscinopora infundibuliformis Goldfuss 1826
Figs 14B, 15A

*1826. *Coscinopora infundibuliformis* nobis: Goldfuss, p. 30, pl. 9, fig. 16; pl. 30, fig. 10.
1877a. *Coscinopora infundibuliformis* Goldf.: Zittel, p. 359, pl. 2, fig. 4.
1877b. *Coscinopora infundibuliformis* Goldf.: Zittel, p. 49.
1878. *Coscinopora infundibuliformis*: Quenstedt, pp. 461, 464, pl. 137, figs 7, 8.
1883. *Coscinopora infundibuliformis* Goldf. sp.: Hinde, p. 105.
1912. *Coscinopora infundibuliformis* Goldf.: Schrammen, pp. 293–294, text-pl. 15, figs 13, 14.
1933. *Coscinopora infundibuliformis* Goldfuss: Bieda, pp. 33–34.
1933. *Coscinopora infundibuliformis* Gold. var. *micropora* Schrammen: Bieda, pp. 34, pl. 1, fig. 3.
1960. *Coscinopora infundibuliformis* Goldfuss: Defretin-Lefranc, pp. 79–80, pl. 9, figs 1, 5; text-fig. 21.
1974. *Coscinopora infundibuliformis* Goldfuss: pp. 64–65, pl. 13, fig. 4, pl. 14, fig. 2.
v1980. *Coscinopora infundibuliformis* Goldfuss: Małecki, pl. 6, figs 2a, b.
v1980. *Coscinopora quincuncialis* Smith: Małecki, p. 416, pl. 6, figs 1a, b.
v1980. *Coscinopora variabilis* sp. nov.: Małecki, p. 416, pl. 5, fig. 8; text-fig. 5b.
v1980. *Coscinopora* sp.: Małecki, p. 416, pl. 6, figs 5a, b; text-fig. 5a.
v1984. *Coscinopora variabilis* Małecki: Hurcewicz, p. 334, pl. 87, fig. 4.
v1984. *Coscinopora cylindrical* Małecki: Hurcewicz, p. 334, pl. 87, fig. 3.
v1991. *Coscinopora infundibuliformis* Goldfuss: Tarkowski, p. 94, pl. 3, fig. 8.

Material: 31 specimens – 4 from Zabierzów, 11 from Wielkanoc and 16 from Korzkiew (including 11 from collection ING PAN A-I-82 nos.: 30/1–7; 31/1, 2; 32; 33).

Description: Narrow conical or cup-shaped sponges, reaching 75 mm in height (Fig. 14B). Diameter of upper part very variable, from 15 to 60 mm. Wall thickness *ca.* 1–1.5 mm. Few specimens with preserved fragments of stalk. Both surfaces covered with small canal openings, distributed in a quincunx. On dermal surface canal openings round, 0.4 mm in diameter, *ca.* 220/cm^2. On gastral surface canal openings are oval, 0.4 × 0.5 mm in size, *ca.* 200/cm^2.

Both surfaces covered with cortex. On dermal surface the finely-porous cortex is very thick. In subdermal part the skeleton is regular with rectangular meshes 0.35-0.4 × 0.2-0.25 mm in size. Dictyonal skeleton in central part with only single imprints of lychniscs preserved. In lower part of some specimens, above the cortex are developed thick synapticular filaments, which extend into the stalk structure.

Remarks: The specimens of *C. infundibuliformis* from Korzkiew assigned by Małecki (1980) to different species differ only in body shape. Małecki (1980) described wide, cup-like specimens as *C. infundibuliformis* Goldfuss, whereas the narrower forms were assigned to *C. quincuncialis* Smith. *C. variabilis* Małecki is represented exclusively by one specimen, which is the lower fragment of a cup with a broken stem. "Additional oscula" on the cup surface, diagnostic of the species, are in fact traces of broken rhizoids with a characteristic synapticular skeleton (Fig. 15A). Their location on one side of the cup and its abnormal curvature suggests that the sponge might have been bent or even collapsed while alive, which caused additional rhizoids to form.

Occurrence: Poland – Kraków area (Coniacian or/and Santonian sponges redeposited to Santonian deposits; Campanian), Opole area (Upper Turonian–Lower Coniacian); France (Coniacian); NW Germany (Campanian); England (Coniacian–Campanian) after Reid (1968a).

Genus *Leiostracosia* Schrammen 1902 (=*Pachylepisma* Schrammen 1902)

Leiostracosia angustata (Roemer 1841)
Fig. 14C

*1841. *Scyphia angustata* N.: Roemer, p. 8, pl. 3, fig. 5.
1878. *Ventriculites angustatus distortus*: Quenstedt, p. 437, pl. 136, figs 15–19.
1912. *Leiostracosia angustata* Roem. sp.: Schrammen, p. 284.
1960. *Leiostracosia angustata* (Roemer): Nestler, pp. 34–36, pl. 8, figs 1–5.
partim v1980. *Leiostracosia angustata* (Roemer): Małecki, pl. 7, fig. 2; *non* pl. 5, fig. 3 (=*Astropegma stellata* Roemer).
v1991. *Leiostracosia angustata* (Roemer): Tarkowski, p. 92, pl. 3, figs 3, 6.

Material: 16 specimens – 1 from Zabierzów, 6 from Wielkanoc and 9 from Korzkiew (including 6 from collection ING PAN A-I-82 nos.: 29/1, 2; 26/4–6; 27/4).

Description: Narrow conical or nearly cylindrical sponges up to 90 mm in height (Fig. 14C). Wall thickness 6 mm. Dermal surface covered by irregular canal openings, 1.5–2.5 mm in size. They are arranged in distinct vertical rows, 20–25/cm^2. Locally, especially in the upper part, this distribution is disturbed and becomes irregular. Openings separated by *ca.* 1 mm wide, flat skeletal bands. Epirhyses straight, perpendicular to wall, terminating below the surface of ridges of the gastral surface. On gastral surface the longitudinal furrows and ribs (visible in transverse section) are of similar width of 1.5–2 mm. Canal openings on gastral side and aporhyses in wall impossible to determine due to poor state of preservation. On dermal surface occurs thick fine-porous cortex. In subdermal part dictyonal skeleton not very regular with quadrangular meshes, 0.3 mm in size.

Remarks: Some older synonyms of *L. angustata*, pointed out by Schrammen, seem doubtful. From the description and pictures of the specimens *Ventriculites angustatus* from England (see Hinde, 1883, p. 114, pl. 26, fig. 3a) it is evident that they do not have furrows on their gastral surface, typical of the genus *Leiostracosia*. Other forms mentioned by Schrammen (1912), with the exception of the specimen presented by Quenstedt (1878, pl. 136, fig. 18), lack information on the morphology of the gastral surface (see Reuss, 1845–46, p. 74, pl. 7, fig. 11; Leonhard, 1897, p. 31; Wollemann, 1902, pp. 9–10).

A secondary network, spreading above the furrows, which is characteristic of other species of *Leiostracosia*, is unknown in *L. angustata*. In the case of the examined specimens, it also was impossible to diagnose this feature due to tight filling of the folds with phosphatized sediment.

Occurrence: Poland – Kraków area (Coniacian or/and Santonian sponges redeposited to Santonian deposits), Opole area (Turonian); N Germany (Campanian); Czech Republic (Turonian).

Genus *Sporadoscinia* Pommel 1872
Type species: *Scyphia retiformis* Roemer 1841

Sporadoscinia venosa (Roemer 1841)
Fig. 16A

*1841. *Scyphia venosa* N.: Roemer, p. 8, pl. 3, fig. 4.
1912. *Sporadoscinia venosa* Roem. sp.: Schrammen, p. 281, pl. 38, fig. 4; text-pl. 14, fig. 18.
v1933. *Sporadoscinia venosa* (Roemer): Bieda, p. 32, pl. 1, fig. 5.
v1933. *Sporadoscinia* sp.: Bieda, p. 33, pl. 2, fig. 5.
1960. *Sporadoscinia venosa* (Roemer): Defretin-Lefranc, p. 74, pl. 7, figs 5, 6.
1974. *Sporadoscinia venosa* (Roemer): Ulbrich, p. 62, pl. 14, fig. 3.
partim 2002. *Sporadoscinia* (*Sporadoscinia*) *venosa* (Roemer): Pervushov, pp. 100, pl. 1 fig. 5, *non* pl. 8, fig. 1.
2002. *Sporadoscinia* (*Tenuireticulus*) *concavoconvexa* Pervushov; Pervushov, pp.104, pl. 8 figs. 3–4, pl. 9, fig. 3.

Material: 5 specimens – 4 from Wielkanoc and 1 from Korzkiew.

Description: Cup-like sponges, 45 mm in height and 35 in diameter (Fig. 16A). Wall thickness averagely 3–4 mm. On dermal surface canal openings round, oval or irregular, 0.8–1 mm in diameter. They randomly cover the entire wall surface or are locally arranged in indistinct longitudinal rows. Skeletal bands flat, 1 mm wide on the average. Openings distributed at 60–70/cm^2. Oval canal openings alternate on gastral surface, 1 × 1.5 mm in size and at 36/cm^2. Aporhyses and epirhyses initially straight, perpendicular to wall. Further course of canals not observed. Dictyonal skeleton irregular with quadrangular meshes, 0.2–0.25 mm in size. Both surfaces of dictyonal skeleton covered by synapticular cortex.

Remarks: Some of the examined specimens, in comparison to the representatives of *S. venosa* from Germany have more sparsely arranged canal openings on the dermal surface. A similar arrangement is noted in the material from France (Defretin-Lefranc, 1960), as well as in specimens described by Bieda (1933) as *Sporadoscinia* sp.

According to Pervushov (2002), *S.* (*Sporadoscinia*) *venosa* is characterized by a wide-conical skeleton with bilateral symmetry, small size (height up to 50 mm, width 56 × 80 mm) and oval osculum 52 × 76 mm in diameter. According to this diagnosis, not considering the sponge shape, size and the distribution of the canal openings, Pervushov (2002) assigned to *S.* (*Sporadoscinia*) *venosa* specimens with large, 2.5–3 mm in size, polygonal canal openings on the dermal surface, which probably represent *S. decheni* (Goldfuss, 1833). In turn, the asymmetric specimens of *S. venosa* were described by Pervushov (2002) as the species *S.* (*Tenuireticulus*) *concavoconvexa* Pervushov 2000.

Occurrence: Poland – Kraków area (Coniacian or/and Santonian sponges redeposited to Santonian deposits; Campanian), N France (Coniacian), N Germany (Upper Campanian), England (Coniacian–Campanian) after Reid (1968a).

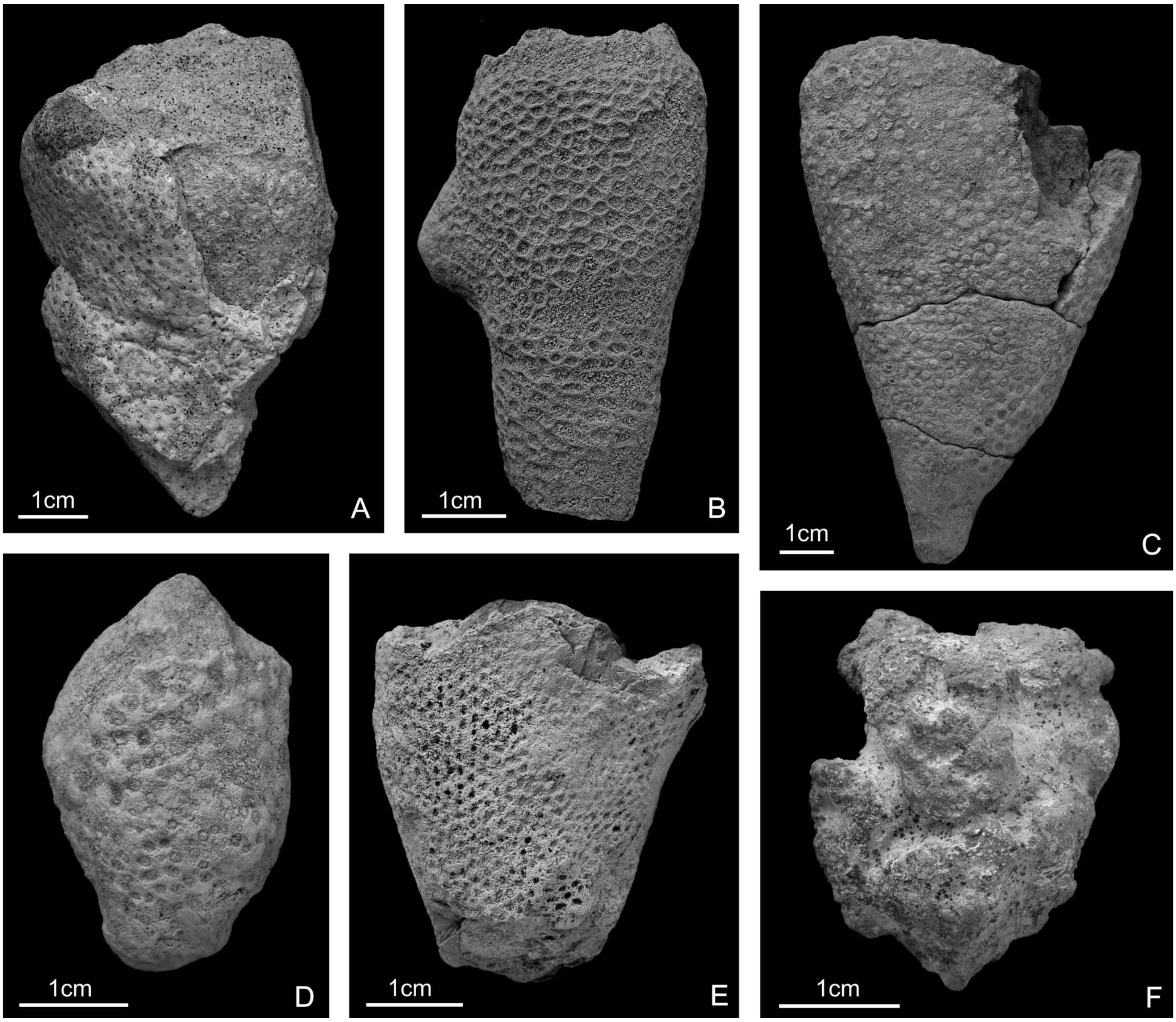

Fig. 16. Lychniscosida; **A.** *Sporadoscinia venosa* (Roemer 1841); lateral view; Wielkanoc (W8); **B.** *Sporadoscinia stirps* Schrammen 1912; lateral view; Wielkanoc (W22); **C.** *Sporadoscinia alcyonoides* (Mantell 1822); lateral view; in the upper part of specimen the external surface is destroyed and filling sediment in canals is visible; Wielkanoc (W28); **D.** *Astropegma stellata* (Roemer 1841); lateral view; Wielkanoc (W31); **E.** *Napaeana striata* (Schrammen 1902); lateral view; Korzkiew (ING PAN A-I-82/25/1). **F.** *Coeloscyphia racemosa* (Smith 1848); lateral view; Zabierzów (Z23)

Sporadoscinia stirps Schrammen 1912
Figs 15B,16B

*1912. *Sporadoscinia stirps* nov. sp.: Schrammen, p. 282, pl. 38, fig. 7; text-pl. 13, fig. 13.

v1980. *Sporadoscinia stirps* Schrammen: Małecki, pl. 5, fig. 1.

partim v1980. *Sporadoscinia teutoniae* Schrammen: Małecki, pl. 5, fig. 6.

Material: 18 specimens – 8 from Wielkanoc and 10 from Korzkiew (including 3 from collection ING PAN A-I-82 nos.: 27/1, 2; 29/3)

Description: Conical or nearly cylindrical sponges with uppermost rim slightly constricted (Fig. 16B). The largest specimen is 80 mm high. Wall thickness 3–3.5 mm. On dermal surface polygonal canal openings usually transversely elongated, 1.5–2.5 mm in size, 35–40/cm^2. They are distributed without order (Fig. 15B) or in longitudinal rows. Usually, rows are well-visible in lower part of sponges. Skeletal bands between canal openings prominent, 0.5 mm in width. In lower part bands are flat and wider (Fig. 15B). On gastral surface canal openings oval, 1 × 1.5–2 mm in size. Their density is 30–35/cm^2. Straight epirhyses join with the system of irregular chambers under gastral surface. Aporhyses straight in initial part. Their further course is impossible to determine due to poor state of preservation of the specimens. Dictyonal skeleton irregular with quadrangle meshes 0.2–0.3 mm in size, subdermally with numerous synapticules. Dermal and gastral surface of dictyonal skeleton with thick synapticular cortex.

Remarks: In the material from Korzkiew, the canal openings on gastral surface are usually smaller and more densely distributed than in the holotype. The canal openings are, however, visible only in the uppermost parts of the studied specimens, where they can be relatively small, similarly as in other species of the genus *Sporadoscinia*.

Occurrence: Poland – Kraków area (Coniacian or/and Santonian sponges redeposited to Santonian deposits); N Germany (Upper Campanian); England (Santonian) and Ireland (Coniacian–Santonian) after Reid (1968a).

Sporadoscinia alcyonoides (Mantell 1822)
Figs 16C, 17A, B

*1822. *Ventriculites alcyonoides*: Mantell, p. 176.
1980. *Prokaliapsis arborescens* (Michelin): Małecki: p. 425, pl. 12, fig. 5.
v1991. *Sporadoscinia eutactopora* Defretin-Lefranc: Tarkowski, p. 92, pl. 3, figs 2, 5.
2006. *Sporadoscinia alcyonoides* (Mantell): Świerczewska-Gładysz, pp. 259–260, figs 23c, 25c-f, 26 (cum syn.).
2009. *Ventriculites alcyonoides* Mantell: Vodrážka *et al.*, fig. 7b, d.

Material: 7 specimens – 1 from Zabierzów, 4 from Wielkanoc and 2 from Korzkiew (including 1 from collection ING PAN A-I-82 no. 58).

Description: Conical sponges, probably with stalk (Fig. 16C). The most complete specimen is 90 mm high and 50 mm in diameter. Wall thickness 4–7 mm. On dermal surface round canal openings arranged in quincunx, 9–20/cm^2. In lower part of the cup the openings are smaller, 1–1.5 mm in diameter, and in the upper part larger, up to 2–2.5 mm. Flat skeletal bands between canals openings 1–1.5 mm wide. On gastral surface oval canal openings, 1.5 × 2–2.5 mm in size. The smallest openings are situated in the upper part of sponge. Openings, 18–24/cm^2, alternate quincuncially in longitudinal rows. Irregular chambers located inside the wall. Their connection with canals is invisible. Skeleton within wall rather regular, with rectangular meshes, 0.2 × 0.25–0.3 mm in size. On both surfaces occurs very thick, fine-porous cortex.

Remarks: Most specimens from the Santonian of the Kraków area, in comparison to the material from the Middle Vistula River valley, have rather large canal openings on the dermal surface. In this respect they are very similar to the specimens from the Santonian of the Saratov Region, described as *Ventriculites spinosus* Sinzov 1871–72, which probably also represent the species *S. alcyonoides*.

Small openings separated by relatively wide (2 mm) skeletal bands are observed on specimens from Korzkiew described by Małecki (1980) as the lithistid *Prokaliapsis arborescens* (Michelin 1840). It is difficult to state to what extent this specimen differs from others, as it is preserved only as the lower part of a wide asymmetric cone with visible voids after lychniscs (see Fig. 17A, B)

The pattern and density of distribution of the canal openings (25/cm^2) on the dermal surface typical of *S. alcyonoides* is also characteristic of the specimen from the Turonian of the Opole Basin, assigned by Tarkowski to *S. eutactopora* Defretin-Lefranc 1960. The latter species, in comparison to *S. alcyonoides*, has smaller canal openings, 80/cm^2.

Occurrence: Poland – Kraków area (Coniacian or/and Santonian sponges redeposited to Santonian deposits), Middle Vistula Valley (Upper Maastrichtian), Opole area (Turonian), Kraków area (Campanian); N Germany (Upper Turonian); France (Upper Turonian); Czech Republic (Upper Turonian); ?Russia – Saratov area (Lower Santonian); England (Middle Turonian–Santonian) after Reid (1968a).

Astropegma Pomel 1872
Type species: *Scyphia stellata* Roemer 1841

Astropegma stellata (Roemer 1841)
Figs 15D, E, 16D

*1841. *Scyphia stellata* N.: Roemer, p. 7, pl. 3, fig. 3.

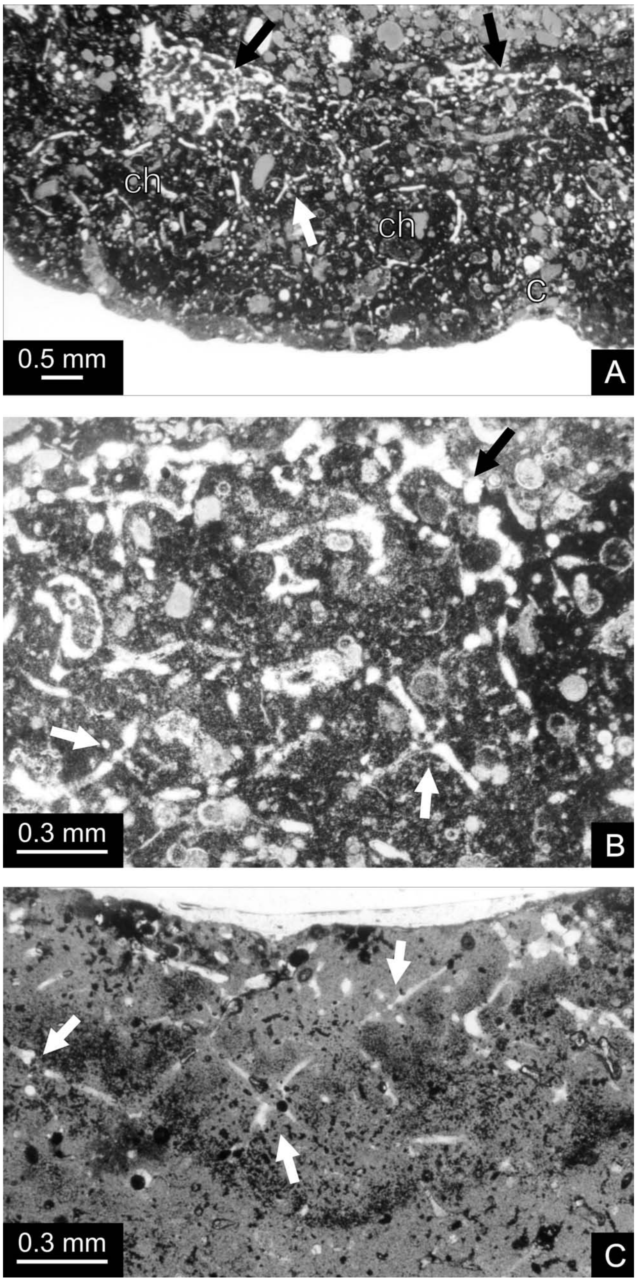

Fig. 17. Dictyonal skeleton of Lychniscosida; **A, B.** *Sporadoscinia alcyonoides* (Mantell 1822); A – transverse section of the wall showing canal (c), chambers (ch), lychnisc (white arrow) and gastral cortex (black arrows); dermal cortex destroyed; B – voids after lychniscs (white arrows) and fragments of dermal cortex (black arrow); Korzkiew (ING PAN A-I-82/58 as *Prokaliapsis arborescens* (Michelin 1840); **C.** *Napaeana striata* (Schrammen 1902); voids after dictyonal skeleton with lychniscs (arrows); Korzkiew (ING PAN A-I-82/56 as *Siphonia micropora* Schrammen 1910)

1926. *Ventriculites stellatus* Schrammen: Moret, pp. 225–226.
1950. *Ventriculites stellatus* Schrammen: Lagneau-Hèrenger, p. 301.
1992. *Ventriculites stellatus* (Roemer): Mehl, p. 128, text-fig. 32 (cum syn.).
v1980. *Leiostracosia angustata* (Roemer): Małecki, pl. 5, fig. 3.
partim v1980. *Sporadoscinia teutoniae* Schrammen: Małecki, pl. 5, fig. 2.

Material: 10 specimens – 3 from Wielkanoc, 2 from Zabierzów and 5 from Korzkiew (including 4 from collection ING PAN A-I-82 nos.: 26/1–3, 27/3).

Description: Cup-like or conical sponges, up to 60 mm high and 45 mm in diameter (Fig. 16D). Thickness of wall 3–4 mm. On dermal surface canal openings triangular or polygonal, 1.5 mm in size, separated by narrow, 0.5 mm wide skeletal bands. Canal openings arranged radially around nodular thickenings of the skeleton, forming star-like clusters (Fig. 15D). In upper part of sponges usually the canal openings are smaller, irregularly distributed and the skeletal bands are without nodular thickenings (Fig. 15E). In lower part, canal openings may be arranged in longitudinal rows. Canal openings on gastral surface oval, 1 × 1.5–2 mm in size. They alternate quincuncially in longitudinal rows. Epirhyses and aporhyses straight, perpendicular to the wall. Dictyonal skeleton irregular. Meshes usually 0.25-0.35 mm in size. Both surfaces of dictyonal skeleton covered by thick synapticular cortex.

Remarks: Due to the poor state of preservation, the star-like pattern of the canal openings on the dermal surface and the nodular thickenings in some of the specimens are visible only in some cases. Probably in consequence, Małecki (1980) assigned these specimens to *Leiostracosia angustata* (Roemer) and *Sporadoscinia teutoniae* (Schrammen).

The discussed species was usually considered a representative of *Ventriculites* Mantell (Schrammen, 1902, 1912; Hèrenger, 1942; Lagneau-Hèrenger, 1950; Ulbrich, 1974; Mehl, 1992). Reid (2004b) assigned it to *Astropegma*, which was proposed by Pomel (1872). It seems, however, that this genus is closely related to *Sporadoscinia* Pomel. This is confirmed by the skeleton structure, as well as the pattern of canal openings on the inner surface, and particularly by the chaotic distribution of the canal openings in the upper part of the specimen on the outer surface.

Occurrence: Poland – Kraków area (Coniacian or/and Santonian sponges redeposited to Santonian deposits); France (Santonian); N Germany (Upper Campanian); Spain (Senonian, Maastrichtian).

Genus *Napaeana* de Laubenfels 1955 nom. nov.
(= *Eudictyon* Schrammen 1902,
non Eudictyon Marshall 1875;
= *Napaea* Schrammen 1912)
Type species: *Eudictyon striatum* Schrammen 1902

Napaeana striata (Schrammen 1902)
Figs 15C, F, 16E, 17C

?1871–72. *Coscinopora quincuncialis* Smith: Sinzov, pp. 31–32, pl. 5, figs 8, 9.
*1902. *Eudictyon striatum* Schrm. n. sp.: Schrammen, p. 15, pl. 2, fig. 5, text-fig. 2.
v1980. *Napaeana striata* (Schrammen): Małecki, pl. 6, fig. 3.
v1980. *Siphonia micropora* Schrammen: Małecki, p. 424, pl. 12, figs 6a, b.
1998. *Napaeana* (*Napaeana*) *striata* (Schrammen): Pervushov, p. 128, pl. 25, fig. 1.
1992. *Napaeana striata* (Schrammen): Mehl, p. 124, pl. 20, figs 1, 3 (cum syn.).
1993. *Napaeana striata* (Schrammen): Jahnke & Gasse, pl. 17, figs 4–6, pl. 18, fig. 4.

Description: Conical sponges, up to over 40 mm high (Fig. 16E). Wall thickness 2.5–3 mm. Dermal surface covered with oval or sometimes round, alternating canal openings, arranged in longitudinal rows, 0.5 × 0.5–1 mm in size and 55–60/cm^2. Straight long canals perpendicular to wall. Rather regular skeleton composed of lychniscs (Fig. 15F). Meshes usually rectangular, 0.25–0.3 mm in size. Subdermal skeleton less regular, locally with synapticules. On the dermal surface occurs fine, synapticular cortex (Fig. 15C). On the gastral surface occur synapticular finely-porous plates, which concatenate with them by synapticular filament bridges.

Remarks: Due to the presence of phosphatized sediment filling the sponges, the traces of plates on gastral surface, specific for *N. striata* were well-visible only on one of the specimens. Other morphological features of the studied specimens, including the specimen described by Małecki (1980) as the lithistid *Siphonia micropora* Schrammen (compare Fig. 17C) are fully concordant with descriptions of this species from Germany.

Apart from *N. striata*, Pervushov (1988) distinguished 15 new species of *Napaeana* in the material from the Santonian of Saratov. The diagnoses of the new species are based on the shape and size of the specimens. These features, however, are variable in all species of the Ventriculitidae and cannot be the only diagnostic criterion distinguishing between species. Therefore, it may be suspected that most of them are simply junior synonyms of *N. strata*. Poor photographical documentation of the species, as well as incomplete descriptions does not allow solving this problem.

Occurrence: Poland – Kraków area (Coniacian or/and Santonian sponges redeposited to Santonian deposits); Russia – Saratov area (Lower Santonian); N Germany (Campanian).

Family Polyblastidiidae Schrammen 1912
Genus *Coeloscyphia* Tate 1865
(= *Polyblastidium* Zittel 1877b)
emended Reid 2004b
Type species: *Coeloscyphia sulcata* Tate 1865

Coeloscyphia racemosa (Smith 1848)
Fig. 16F

*1848. *Brachiolites racemosum*: Smith, pp. 364–65, pl. 15, fig. 6.
1864. *Cephalites ellipticus*: Roemer, p. 7, pl. 4, fig. 6.
1865. *Coeloscyphia sulcata* Tate, p. 43, pl. 5, fig. 5.
1877b. *Polyblastidium luxarians* Zitt. n. sp.: Zittel, p. 52, pl. 3, fig. 7.
1883. *Coeloscyphia sulcata* Tate: Hinde, pp. 118–119, pl. 29, figs 1, 1a.
1883. *Polyblastidium racemosum* Toulm. Smith: Hinde, p. 119, pl. 27, figs 2, 2a.
1902. *Polyblastidium racemosum* T. Smith: Schrammen, p. 10, pl. 2, fig. 3.
1912. *Polyblastidium racemosum* T. Smith: Schrammen, p. 275, pl. 38, figs 8–10, text-pl. 13, fig. 10.
1974. *Coeloscyphia racemosa* (Smith): Ulbrich, p. 64, pl. 13, fig. 3.
v1980. *Plocoscyphia reticulata* Hinde: Małecki, pl. 10, fig. 3.
2000. *Coeloscyphia racemosa* (Smith): Levis, fig. 2a.
2004. *Polyblastidium racemosum* (Smith): Bartholomäus & Hahn, pp. 49–52, pl. 1, figs. 1–3.

Material: 3 specimens – 1 from Zabierzów, 1 from Wielkanoc and 1 from Korzkiew (ING PAN A-I-82 no. 45).

Description: Sponges having a form of axial tube with lateral, bud-like outgrowths (Fig. 16F). Height up to 56 mm, width 40 mm. Stem not preserved. Lateral outgrowths 7–11 mm in diameter with small openings, 2–4 mm in diameter. Both surfaces of tubes with longitudinal furrows and rounded ribs, formed by radial folding of a thin wall (0.5 mm thick). Thickness of tube wall 3–4 mm. Dictyonal skeleton regular, comprising small lychniscs. Meshes rectangular or quadrangular, 0.2-0.25 mm in size. In transverse section network irregular with triangular meshes, 0.2 mm in size. On dermal surface occurs thick synapticular cortex with small rounded openings, 0.5–0.6 mm in size. No cortex on gastral surface. Canals in dictyonal skeleton not visible.

Remarks: The specimen from Korzkiew described by Małecki as *Plocoscyphia reticulata* Hinde [= *Exanthesis reticulata* (Hinde)] is

incomplete and strongly glauconitized; however, the characteristic folds on both surfaces of the outgrowths are locally well-recognizable. According to Reid (2004b), in representatives of the family Polyblasidiidae the epirhyses are short and pit-like. Lack of those in the studied specimens may be the result of poor preservation.
Occurrence: Poland – Kraków area (Coniacian or/and Santonian sponges redeposited to Santonian deposits); N Germany (Cenomanian, Campanian); England (Upper Turonian–Lower Maastrichtian); Ireland (Coniacian–Santonian) after Reid (1968a).

TAXONOMIC REMARKS

The taxonomic composition of the sponge fauna in the studied outcrops is similar. The highest diversity with 30 species was observed at Korzkiew "Above the Castle" and the lowest, with 16 species, at Zabierzów. The difference in the number of recognized species is connected with different number of specimens found in studied locations.

Małecki (1980) described 60 species from the Santonian deposits of the Kraków Region, of which only 15 are considered valid in this report. The author's studies based on a larger number of specimens supported by literature data allowed a significant reduction of the number of species distinguished by Małecki (1980). This reduction particularly concerns the number of ventriculitid species, which display a high intraspecific variety of shape and size of the canal openings. None of the five new species proposed by Małecki (1980) have been confirmed. Some diagnostic features are absent in the holotypes. The misinterpretation of certain elements visible in these specimens resulted from their damage during redeposition or phosphatization. Other described features of supposedly new taxa is just intraspecific variability. For this reason, the new species proposed by Małecki (1980) are junior synonyms: *Aphrocallistes coronatus* Małecki = *Aphrocallistes cylindrodactylus* Schrammen, *Myrmecioptychium jordanum* Małecki = *Coeloptychium subagaricoides* Sinzov, *Becksia ojcoviensis* Małecki = *Becksia crispata* (Quenstedt), *Etheridgea korzkievicensis* Małecki = *Etheridgia mirabilis* Tate, *Coscinopora variabilis* Małecki = *Coscinopora infundibuliformis* Goldfuss. Due to poor state of preservation of some specimens, Małecki (1980) disregarded the spiculation, what resulted in describing some hexactinosid sponges as Lychniscosida [*e.g.*, *Lefroyella favoidea* was described as *Toulminia catenifer* (Smith)].

Małecki (1980) reported also 7 species of lithistid sponges. Specimens of two species – *Scytalia racidiformis* (Philips 1835) and *Homalodora tuberosa* Schrammen 1910 – are missing in the Małecki collection in the ING PAN Museum in Kraków. No description and photographic documentation of these specimens was given, thus it is impossible to have an opinion on their taxonomic assignment. Based on the examination of the skeleton, other specimens of lithistids proved to be representatives of Hexactinosida [*Bolidium capreoli* (Roemer) = *Verrucocoelia tubulata* (Smith), *Ragadinia rimosa* (Roemer); *Homalodora pusilla* (Schrammen) = *Polyopesia angustata* (Schrammen)] and Lychniscosida [*Siphonia micropora* Schrammen = *Napaeana striata* (Schrammen); *Prokaliapsis arborescens* (Michelin) = *Sporadoscinia alcyonoides* (Mantell)]. The species *Sestrocladia furcata* Hinde (not mentioned by Małecki, 1980 in tab. 1 but demonstrated in pl. 7, fig. 1) is a fragment of a rhizoidal process with longitudinal canals and synapticular filaments. This type of broken processes, with a structure typical of the representatives of the family Ventriculitidae Smith, is a common element in all mentioned exposures. Lithistid sponges in the examined material are known from a few small and difficult to assign fragments of sponges of the suborder Rhizomorina Zittel. The presence of representatives of the suborder Tetracladina Zittel is confirmed by a few isolated tetraclones preserved in the material filling the spongocoels of hexactinellid sponges. Based on these observations, lithistid sponges seem to have been present in the described sponge fauna but were an accessory group.

REMARKS ON THE AGE AND DISTRIBUTION OF THE SPONGES

The abundance of sponges in the basal part of all studied Santonian successions and their high taxonomic diversity is the result of secondary accumulation of these fossils. They were exhumed and transported by sea currents from more elevated areas of the Kraków Swell (Olszewska-Nejbert & Świerczewska-Gładysz, 2008, 2009). The state of preservation of the sponges points that only some of them represent lag deposits at the Wielkanoc.

Sponges occurring in Wielkanoc have been dated as late Early Coniacian – Late Santonian (Olszewska-Nejbert & Świerczewska-Gładysz, 2009). Sponges from other localities are probably of the same age, but it cannot be excluded that part of them derive also from eroded lower Lower Coniacian strata. In the studied successions deposits of this age have been preserved only at Wielkanoc. *In situ* sponges have been found in the upper Lower Coniacian deposits of this exposure (Olszewska-Nejbert & Świerczewska-Gładysz, 2008, 2009). This assemblage consists of eight species – *Periphragella plicata* Schrammen, *Polyopesia angustata* Schrammen, *Plocoscyphia communis* Moret, *Etheridgia mirabilis* Tate, *Leiostracosia angustata* (Roemer), *Rhizopoterion cribrosum* (Phillips), *Sporadoscinia venosa* (Roemer), and *Astropegma stellata* (Roemer). All of these species appear also in the phosphatized sponge assemblage in the basal part of the Santonian succession. No hexactinellid sponges have been noted so far in the Cenomanian and Turonian deposits of the Kraków area.

The Coniacian and/or Santonian age of the studied sponges is also indicated by the resemblance to other Cretaceous assemblages from Europe. The composition of the studied assemblage is similar to the sponge fauna from the *Micraster coranguinum* Zone (Middle Coniacian to Middle Santonian) of England (Reid, 1968a). In both regions occur such species as: *Coscinopora infundibuliformis* Goldfuss, *Etheridgia mirabilis* Tate, *Coeloscyphia racemosa* (Smith), *Cinclidella angustata* (Hinde), *Sporadoscinia venosa* (Roemer), *Sporadoscinia alcyonoides* (Mantell), *Rhizopoterion cribrosum* (Phillips) and *Leptophragma micropora* Schrammen.

The Coniacian and Santonian sponges of Central Europe are relatively rare and not well known. The sponges exist, however, abundantly in the Lower Santonian of the Volga Region, especially in the Saratov area. They have been examined by Sinzov (1871–72, 1878) and Pervushov (1998, 2002). The similarity of the sponge fauna from both regions is significant, however, it is difficult to evaluate degree of this similarity. When describing sponges from the Volga Region, Pervushov (1998, 2002) used his own taxonomic criteria, based mainly on the shape of the sponges. This resulted in distinguishing numerous new species, of which many seem to be morphotypes of well-known Cretaceous species. In the presented work, several new species established by Pervushov (1998, 2002) are considered junior synonyms of species earlier described. Most probably, the list of synonyms is still incomplete. Due to lack of data on the dictyonal skeleton structure and canals in the description of specimens from the Volga region, as well as poor illustrations, it is impossible to have an unequivocal opinion on the taxonomic assignment of many species presented by Pervushov (1998, 2002).

Mermighis and Marcopoulou-Diacantoni (2004) described a few sponges species known from the Kraków area, among them also the new species proposed by Małecki (1980), in an assemblage containing rudists and corals from the Santonian of Greece. The skeleton of these specimens is, however, unknown. Macroscopic features, visible on the photographs of the specimens are completely different from the diagnosis of the species. The structure of the sponges, especially the pattern of the canals visible in the sections, suggests that the specimens represent lithistid sponges.

REMARKS ON ECOLOGY

According to Małecki (1980), the sponges from the Santonian deposits of Korzkiew inhabited the littoral zone. This interpretation stays in conflict with the present-day environmental requirement of hexactinosid and lychniscosid sponges, which generally inhabit the bathyal or even the abyssal zone (*e.g.*, Koltun, 1967; Reid, 1968b; Tabachnick, 1988, Beaulieu, 2001; Duplessis & Reiswig, 2004; Finks & Rigby, 2004; McClintock *et al.*, 2005). They only occasionally appear on the deeper shelf (>100 m) (*e.g.*, Vacelet, 1969; Soest van & Stentoft, 1988; Messing *et al.*, 1990; Conway *et al.*, 2001; Finks & Rigby 2004; Leys *et al.*, 2004; Conway *et al.*, 2004, 2007; Krautter *et al.*, 2006; Cook *et al.*, 2008). The largest shelf assemblage of hexactinosid sponges is known only from offshore British Columbia (Krautter *et al.*, 2001, 2006; Conway *et al.*, 2004, 2007; Cook *et al.*, 2008). In this region, the specific environmental conditions are similar as in the deep-water zone (Leys *et al.*, 2004; Whitney *et al.*, 2005; Yahel *et al.*, 2007). Hexactinosids are very rare in shallow water (< 100 m) and were noted in Indonesia (Ijima, 1927) and the fjords of British Columbia (Leys *et al.*, 2004). Even rarer in shallow settings are the lychniscosids; so far they have not been noted in depths shallower than 80 m (Finks & Rigby, 2004).

By analogy to living sponges, it can be speculated that the examined sponges inhabited deeper parts of the shelf sea, where slow sedimentation rate and reduced turbulence favoured their development. The sediment filling the interspicular spaces of sponges from Wielkanoc – foraminiferal/foraminiferal-calcisphere wackestone – suggests also such environments (Olszewska-Nejbert & Świerczewska-Gładysz, 2007, 2009).

Autochthonous sponge fauna is missing from the marly-clayey sediments of Middle?/Late Santonian age that were deposited in high-energy environments. Sponges in the Kraków area appeared again in the Campanian, what reflects water basin deepening and low current activity. Sponges, which re-inhabited the study area in Campanian times were completely different from those composing the assemblage from the basal part of the Santonian. Only two species (*Sporadoscinia venosa* and *Rhizopoterion cribrosum*) are common for both groups.

Pervushov (1998) claims that the hexactinellid sponge assemblage from the Lower Santonian of the Volga Region inhabited the sublittoral zone. According to Pervushov *et al.* (1997) and Pervushov (1998), in the Late Cretaceous sponges began a gradual migration from shallower to deeper sea zones. This may be, however, considered doubtful, because numerous sponges found in shallow-water lower Santonian deposits in the Saratov Region are phosphatized (Pervushov *et al.*, 1997), what suggests that they may represent not *in situ* fauna. Redeposition of sponges is also suggested by the significant erosion of the Turonian–Coniacian deposits in the Volga Region (Pervushov *et al.*, 1997), a situation similar to that noted in the Kraków area. According to Pervushov and Yanochkin (2001), the morphogenesis of *Balantionella* Schrammen 1912 (most probably all presented species belong to the genus *Verrucocoelia* Éttalon 1859) evidences gradual adaptation of the Hexactinellida to deeper zones of the basin. This hypothesis has been based on 8 specimens only representing 4 species from the Cenomanian–Maastrichtian succession of the Saratov area (*cf.* Pervushov & Yanochkin, 2001; Pervushov, 2002). Even if the presented trends – simplification of structure, larger size of the lateral branches and secondary osculum – really exist, it is still not certain whether they are associated with the migration of these sponges to deeper water. The Maastrichtian "deep-water species", as well as the Santonian "shallow-water species" presented by Pervushov and Yanochkin (2001), are characterized by a tube-like body with radial symmetry typical of modern deep-water forms (Tabachnick, 1991).

CONCLUSIONS

Analysis of phosphatized sponges from the Santonian deposits of the Kraków region indicated that the assemblage, apart from a few difficult to assign fragments of lithistid sponges, contains only Lychniscosida and Hexactinosida. All the new species introduced by Małecki (1980) are considered junior synonyms of earlier known species. Among 14 described species of Hexactinosida, representatives of *Periphragella plicata* Schrammen 1902, *Laocoetis fittoni* (Mantell 1822), *Laocoetis virgatula* (Schrammen 1912), *Polyopesia angustata* Schrammen 1902 are most common. Lychniscosida are represented by 20 species, of which *Rhizopoterion cribrosum* (Phillips 1829), *Coscinopora infundibuliformis* Goldfuss 1826, *Plocoscyphia communis* Moret 1926 are most common.

The sponge species occurring in the Santonian of the Kraków area are typical of the sponge assemblages from the Upper Cretaceous of Europe. The studied assemblage is especially similar to sponge fauna from the *Micraster coranguinum* Zone (Middle Coniacian to Middle Santonian) of England and from the Lower Santonian of the Saratov Region. All the studied sponges were redeposited, therefore their age is difficult to establish. The distribution and facies development of the Upper Cretaceous deposits in the Kraków area indicates that the sponges originated from eroded Lower Coniacian – Upper Santonian strata.

Such species as *Eurete halli* (Schrammen 1912), *Lefroyella favoidea* Schrammen 1912, *Spirolophia tortuosa* (Roemer 1864), and *Coeloptychium lobatum* Goldfuss 1831 are noted for the first time from pre-Campanian deposits. According to Reid (1968a), the lychniscosid species *Porochonia simplex* (Smith 1848) is typical of the Turonian, whereas the morphologically similar hexactinosid species *Wollemannia araneosa* Schrammen 1912 appears in the upper stages of the Upper Cretaceous. In the Wielkanoc exposure, the co-occurrence of both species is noted for the first time. However, due to the possibility of stratigraphic condensation it is not certain whether they coexisted at the same time.

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