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THE GENUS *GOTHOGRAPTUS* (GRAPTOLITHINA) FROM THE WENLOCK OF POLAND

KOZŁOWSKA-DAWIDZIUK, A.: The genus *Gothograptus (Graptolithina)* from the Wenlock of Poland. Acta Palaeont. Polonica, 35, 3—4, 191—209, 1990. Issued 1991. The Wenlockian retiolitid genus *Gothograptus* Frech, 1897 is here subdivided into subgenera *Gothograptus (Gothographus)* (Frech, 1987) and *Gothograptus (Eisenackograptus* subgen.n. which differ in the lateral wall structure. In *Gothograptus (Gothograptus), virgula* in the middle of lateral wall sets in as early as in the proximal part; it is linked to the pleural lists by means of parietolateral lists. In *Gothograptus (Eisenackograptus),* by contrast, the lateral wall consists of parietolateral lists, whereas *virgula* sets in only in the distal part. Five species are described herein, two of them new and one in the open nomenclature: *Gothograptus (Gothograptus) pseudospinosus* Eisenack, *G. (Eisenackograptus) eisenacki* Obut et Sobolevskaya, *G. (Gothograptus) kozlowskii* sp.n., *G. (Gothograptus) obtectus* sp.n., and *G. (Gothograptus)* sp. A.

Key words: Graptolithina, Retiolitidae, *Gothograptus*, taxonomy, astogeny, Wenlock, Poland.

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INTRODUCTION

The present paper is a part of a comprehensive study of retiolitids from deep boreholes and erratic boulders in northeastern Poland. The genus *Gothograptus* is here described separately because it reveals a peculiar phenomenon — finite rhabdosome formation.

A difference in structure of the lateral wall makes basis for subdivision of the genus *Gothograptus* into two subgenera: *Gothograptus (Gothograptus)* and *Gothograptus (Eisenackograptus).*

Two new species have been recognized in the investigated material: *G. (Gothograptus) kozlowskii* sp.n. and *G. (Gothograptus) obtectus* sp.n. In addition, the material includes also *G. (Gothograptus) pseudospinous* Eisenack, *G. (Eisenackograptus)* Obut et Sobolevskaya, and *G. (Gothograptus)* sp. which could not be identified to the species level. A partly modified, partly new descriptive terminology is here introduced for rhabdosome elements.

A representative of the genus *Gothograptus* was for the first time described by Holm (1890) as *Retiolites nassa*. Wiman (1895) noted *Retiolites nassa* on Lilla Carlsö Island near Gotland: he attributed to the same species also some forms lacking supraapertural lists which are characteristic of *R. nassa* Holm.

Frech (1897) erected a new genus, *Gothograptus*, for the species *Retiolites nassa* Holm. Since the turn of the century, *Gothograptus nassa* has been described from Czechoslovakia (Perner 1899), Shropshire and Wales in Great Britain (Wood 1900, Elles and Wood 1908), Scania in Scandinavia (Moberg and Törnquist 1909), the Atlas Mountains in Morocco (Waterlot 1945), the Holy Cross Mountains in Poland (Tomczyk 1956), Nevada in the United States (Berry and Murphy 1975), and the Arctic Islands in Canada (Lenz and Melchin 1987). Eisenack (1951) discovered another species of this genus, *Gothograptus pseudospinosus*. Later on, Obut and Sobolevskaya (1965) described still another species, *Gothograptus eisenacki*, from Taimyr in the Soviet Union. This species has been recently found also in Canada (Lenz and Melchin 1987).

Obut and Sobolevskaya (1979) studied astogeny of *Gothograptus nassa* (Holm) from Kaliningrad area in the Soviet Union and demonstrated that the form without supraapertural lists described by Wiman represents in fact the early stages of *G. nassa* (Holm). This result has been confirmed by Lenz and Melchin (1987). In 1983, Obut and Zaslavskaya erected a new retiolitid family, Gothograptinae, for the genus *Gothograptus* Frech.

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MATERIALS AND METHODS

The investigated material derives from the borehole Zawada 1 in northeastern Poland and from an erratic boulder found at Jarosławiec

(fig. 1). The borehole was drilled in 1967 by Enterprise of Oil and Gas Research at Piła. Cores of Silurian rocks come from the depth interval of 1533.3 to 1673.5 m, and the borehole was finished in the Cambrian at the depth of 1830.3 m (Teller 1976).

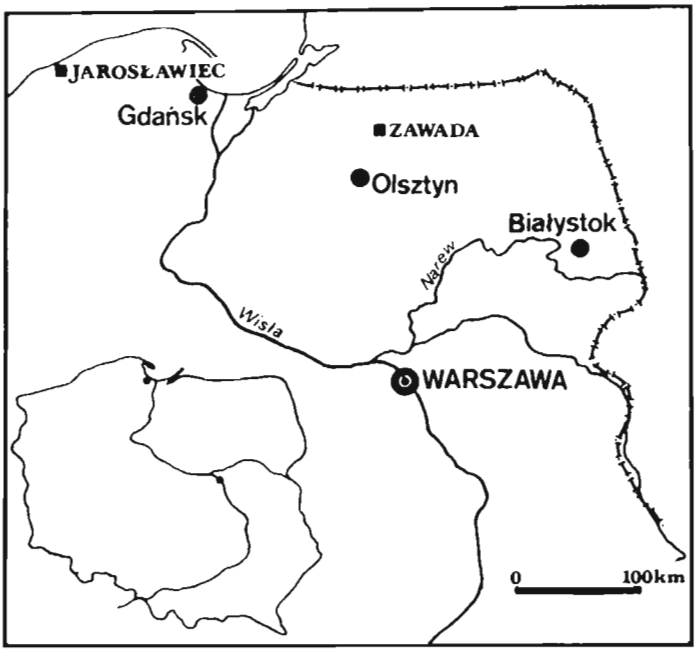

Fig. 1. Location map of Zawada 1 borehole and Jarosławiec outcrop.

Specimens of *Gothograptus* Frech have been found in Wenlock strata at depth intervals of 1603.1—1609.1, 1555.5—1562.0, and 1533.3—1540.0 m. The rocks are light-grey calcareous siltstones with abundant graptolites and some intercalations (up to 20 cm in thickness) of light-grey marly limestones (Teller 1976).

The following graptoloids occur in the investigated stratigraphic intervals (monograptid identifications after Teller's unpublished data):
1603.1—1609.1 m: *Monograptus flemingi* (Salter), *Monograptus vomerinus* (Nicholson), *Cyrtograptus rigidus* Tullberg, *Monoclimacis* sp., *Plectograptus* (*Sokolovograptus*) *textor* (Bouček and Münch), *Plectograptus* sp., and *Gothograptus (Eisenackograptus) eisenacki* Obut et Sobolevskaya — rigidus Zone;
1555.5—1562.0 m: *Monograptus flemingi* (Salter), *Monograptus testis* (Barrande), *Cyrtograptus lundgreni* Tullberg, *Cyrtograptus* sp. "A", *Paraplectograptus eiseli* (Manck), *Plectograptus* sp., *Gothograptus (Eisenackograptus) eisenacki* Obut et Sobolevskaya — lundgreni Zone;

1533.3—1540.0 m: *Monograptus flemingi* (Salter), *Monograptus testis* (Barrande), *Cyrtograptus lungreni* Tullberg, *Cyrtograptus hamatus* (Baily), *Pristiograptus dubius* (Suess), *Paraplectograptus eiseli* (Manck), *Gothograptus* (*Gothograptus*) *pseudospinosus* Eisenack, *Gothograptus* (*Gothograptus*) *obtectus* sp.n., and *Gothograptus* (*Gothograptus*) sp. A — lundgreni Zone.

The erratic boulder from Jarosławiec is a grey *Orthoceras* limestone with retiolitids: *Gothograptus* (*Gothograptus*) *kozlowskii* sp.n. and *Plectograptus* sp. and with chitinozoans *Angochitina* cf. *crassispina* Eisenack, *Conochitina pachycephala* Eisenack, *Conochitina* sp., and *Linochitina* (*Cingulochitina*) *cingulata* (Eisenack). The Chitinozoa indicate Late Wenlockian age of the boulder (Dr. R. Wrona pers. comm.).

The isolated retiolitid material had contaminations in reticular meshes. To remove them, ultrasonic preparation has been applied. Specimens were placed in ultrasonic cleaning apparatus (UM 0.5) in such a way that it did not touch the wall of the vessel, for it undergo damage otherwise. After a few seconds, the specimen was inspected under stereoscopic microscope, and this procedure was repeated until a satisfactory result has been obtained.

TERMINOLOGY

The terminology employed for description of rhabdosome elements characteristic of the subfamily Gothograptinae (fig. 2a, b, c) is partly new and partly modified after Tullberg (1883), Törnquist (1890), Holm (1890), Wiman (1895; see Elles and Wood 1908: fig. 220f), Bouček and Münch (1952), Urbanek (1959), and Kirk (1973, 1987). The descriptive terms are defined as follows:

apertural lists (ap.l.) — lists surrounding the aperture;
intrathecal list (inth.l.) — list placed above the aperture inside the theca; it links the pleural lists;
finite rhabdosome (f.r.) — rhabdosome with fully accomplished development; it cannot grow any more;
lateral wall (l.w.) — side wall of the rhabdosome; it lacks any thecae;
medial list (m.l.) — thecal list placed in the middle of the ventral wall; it links the supra- and subapertual lists of successive thecae of the same order;
parietal wall (prl.w.) — lateral wall consisting solely of parietal lists;
parietal list (prl.l.) — lists in the lateral wall which link either the pleural lists of the respective thecae of different orders, or the virgula and a pleural list;
pleural list (pl.l.) — thecal list which links the extremes of the supraapertural lists of successive thecae of the same order;
pleuroapertural list (pla.l.) — side section of the pleural lists surrounding the aperture;

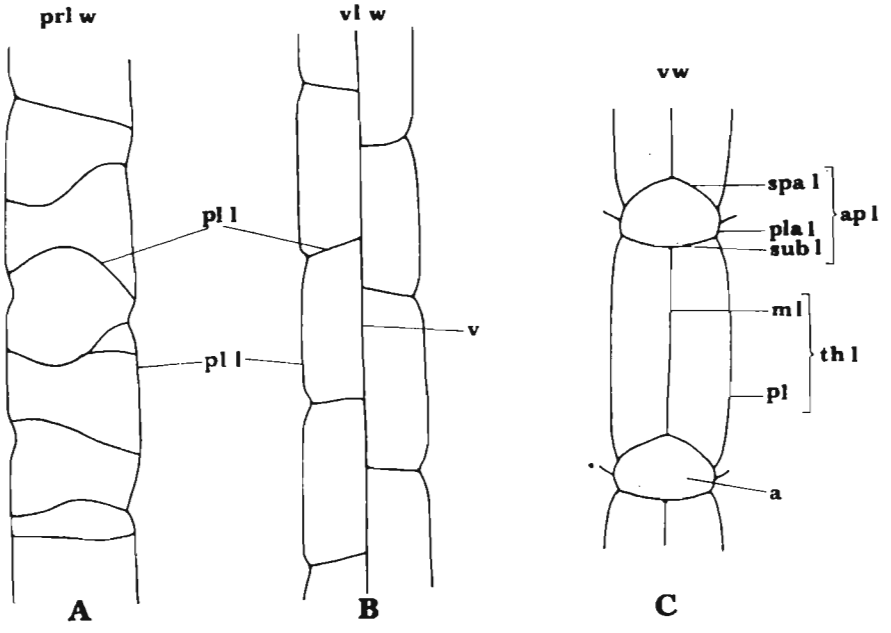

Fig. 2. Explanation of descriptive terms for retiolitid morphology. *A*—*B* lateral walls, *C* ventral wall; *a* aperture, *ap. l* apertural list, *m l* medial list, *pla l* pleuro-apertural list, *pl l* pleural list, *pr l* parietal list, *prl w* parietal wall, *spa l* supraapertural list, *suba l* subapertural list, *th l* thecal lists, *v* virgula, *vl w* virgulolateral wall. For the sake of clarity, reticula is omitted.

subapertural list (sba.l.) — lower apertural list;
supraapertural list (spa.l.) — upper apertural list;
thecal list (th.l.) — list placed in the ventral wall between the apertural lists;
veil (vl.) — reticular structure covering the aperture and sometimes also the theca; it is linked with clathrium and represents an additional element of the rhabdosome, in analogy to lacinium;
ventral wall — rhabdosome wall with thecae;
virgulolateral wall (v.w.) — lateral wall consisting of virgula and parietal lists.

SYSTEMATIC DESCRIPTIONS

Family **Plectograptidae** Bouček et Münch, 1952
Subfamily **Gothograptinae** Obut et Zaslavskaya, 1983

Type genus: *Gothograptus* Frech, 1897, Silurian, Upper Wenlock, Sweden.

Revised diagnosis. — Clublike rhabdosome with finite development, terminate with reticulate appendix. Reticula and fairly regular clathrium well developed.

Virgula central situated in corona, incorporated in the lateral wall proximally, or distally. Thecae of *Pseudoglyptograptus* type, equipped with medial list and pleural lists. Apertural structure variable. Monotypic.

Genus *Gothograptus* Frech, 1897

Type species: Retiolites nassa Holm, 1890.

Diagnosis as a subfamily.

Remarks. — The diagnosis given for the subfamily by Obut and Zaslavskaya (1983) and for the genus *Gothograptus* Frech given by Bouček and Münch (1952) and Lenz and Melchin (1987) differ from each other. The differences concern the position of virgula in the rhabdosome and hence, the structure of lateral walls. The presence of new species in the investigated material, as well as detailed analysis of the structure of lateral walls and discovery of new elements of clathrium (intrathecal lists in *Gothograptus eisenacki* Obut et Sobolevskaya) have forced the author to revise the diagnosis of genus and to subdivde the genus into two subgenera: *Gothograptus* (*Gothograptus*) Frech and *Gothograptus* (*Eisenackograptus*) subgen.n.

Subgenus *Gothograptus* (*Gothograptus*) Frech, 1897

Type species: Retiolites nassa Holm, 1890, Silurian, Gotland.

Diagnosis: Virgulolateral wall includes a centrally located virgula and divergent parietal lists.

Species assigned. — *Gothograptus (Gothograptus) nassa* (Holm, 1890); *Gothograptus* (*Gothograptus*) *pseudospinosus* Eisenack, 1951; *Gothograptus* (*Gothograptus*) *kozlowskii* sp.n.; *Gothograptus* (*Gothograptus*) *obtectus* sp.n.; *Gothograptus* (*Gothograptus*) sp. A.

Gothograptus (*Gothograptus*) *pseudospinosus* Eisenack, 1951
(pl. 23: 5)

1951. *Retiolites pseudospinosus* Eisenack; 143—145. pl. 25: 1—6.

Material. — One ventrolaterally flattened specimen, Zawada 1 borehole, depth 1533.3—1540.0 m.

Description. — Juvenile rhabdosome with 10 thecae and no appendix; 5.8 mm in length and 0.8 mm in ventrolateral width (almost constant along the entire specimen).

Clathrium filled with reticula until midlength of the rhabdosome; reticula absent from the distal part. Virgula joins the lateral wall at the level of the second pair of thecae (1.3 mm from the ancora). Apertural lists of the proximal thecae have no processes. More distal thecae, however, bear each a pair of spines

(0.75 mm in length) attached to the pleural lists just above the aperture. The youngest thecae have no spines.

Remarks. — The investigated specimen is almost fully consistent with the one described by Eisenack (1951: pl. 25, fig. 1a, b). The only difference is that its supraapertural spines are located a bit higher above the aperture.

The species has thus far been known solely from Baltic erratic boulders (Eisenack 1951). Although Eisenack attributed this species to the genus *Retiolites*, he noted also its relationship to *Gothograptus*. Bouček and Münch (1952) then assigned it to the latter genus.

Occurrence. — Baltic area—Silurian glacial boulders. NE Poland—Wenlock, the lundgreni Zone.

Gothograptus (*Gothograptus*) *kozlowskii* sp.n.

(pl. 23: 1--4; pl. 24: 3; fig. 3A-F; fig. 4A-E)

Holotypus: ZPAL G.XIII/43; pl. 24: 3.

Locus typicus: Baltic erratic boulder from Jarosławiec.

Stratum typicum: Upper Wenlock, Silurian.

Derivation of the name: Named after Professor Roman Kozłowski, a great paleontologists and eminent student of graptolites -- on the centenary of the birth.

Diagnosis. — Finite rhabdosome with apertures of the proximal thecae bearing small hoods close to supraapertural lists. Apertures of the medial thecae bear paired spines projecting laterally from supraapertural lists. In more distal thecae, the spines bend toward each other, then form a loop, the base of which moves in the most distal thecae to the subapertural list. Medial and distal thecae have subapertural hoods produced by loops projecting laterally from subapertural lists. Apertures uncovered.

No reticula is present under the hood between thecal lists. In the last theca, the hood is reticulated and covers the aperture.

Material. — Five well-preserved specimens at various astogenetic stages; one of them in finite growth stage.'

Description. — Finite rhabdosome is. 9.9 mm long and 1.24 mm wide (at the level of the fourth pair of thecae); the width decreases slowly toward distal thecae, and falls rapidly at the last pair of thecae. Clathrium is rather thin though distinct. The finite rhabdosome has reticula at all its length. Virgula incorporated to the lateral wall above the first pair of the thecae.

In the corona of the finite rhabdosome, lateral walls have openings with swollen rims and spines bent toward each other (pl. 24: 3b, c). In juvenile rhabdosomes, these openings have neither swollen rims nor spines (pl. 23: 1—4).

The apertural lists of the first theca are thickened, while the supraapertural list of the second theca forms a small hood (pl. 24: 3b, d; fig. 4A). In the next three thecae, the apertures bear paired spines with rather wide, triangular base (pl. 21: 3d; fig. 4B). The spines are thin with underdeveloped base in juvenile rhabdosome (pl. 23: 1—4; fig. 3B-D).

The spines and their branching knots in successive thecae are fused, forming semicircular, a bit elongate, multifold subapertural loops with thickened margins

(pl. 24: 3a, d; fig. 4D). In juvenile rhabdosomes, the loops are singular and thin (pl. 23: 2, 3, 4; fig. 3E, F).

In two most distal thecae, a thin list projects obliquely downwards from the supraapertural lists; in one instance, it reaches above the multifold loop and beyond the theca (fig. 4D). This list has probably been destroyed in the remaining thecae.

The aperture of the last theca is covered with reticulated hood (fig. 4E; pl. 24: 3a). There is no reticula between thecal lists beneath the multifold loops.

In juvenile rhabdosomes, reticula occurs solely in the proximal part, apertural

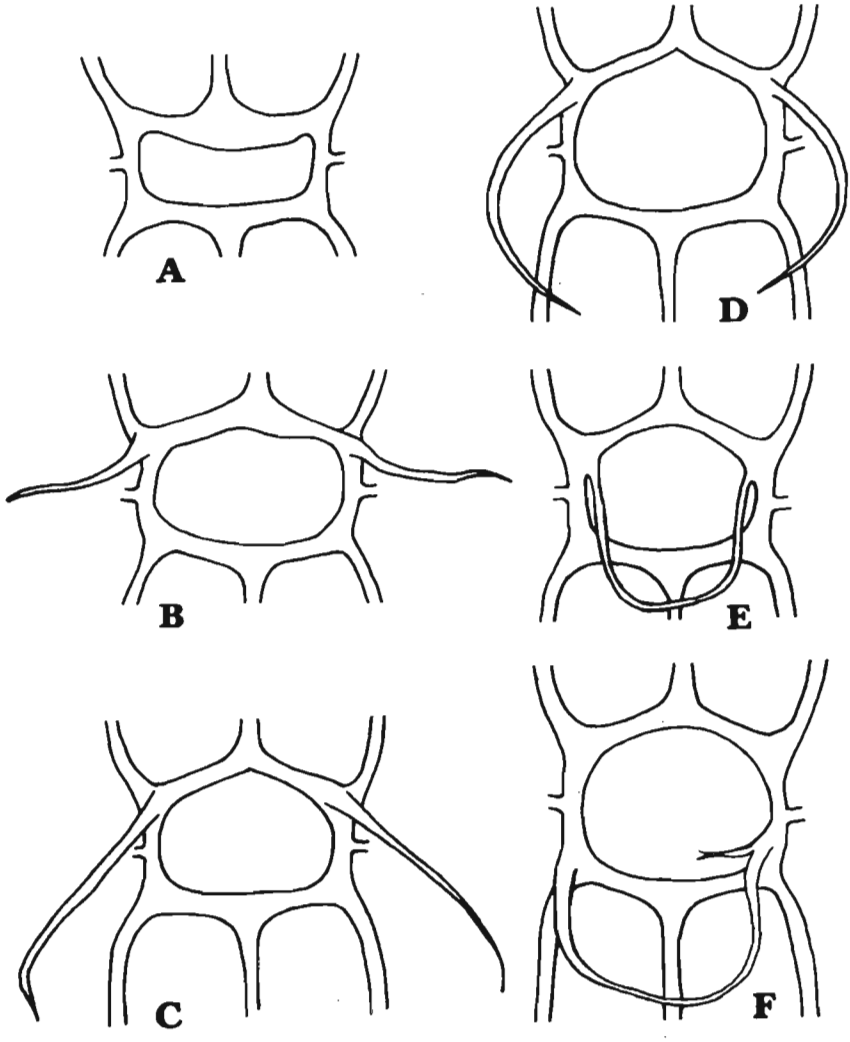

Fig. 3. *A—F* apertures of the successive thecae in a juvenile rhabdosome of *Gothograptus* (*Gothograptus*) *kozlowskii* sp.n. For the sake of clarity, reticula is omitted.

structures are thin, and their loops are at most slightly branching. The finite rhabdosome bears appendix 1.03 mm long (jointly with virgula) and 0.18 mm wide.

Astogeny. — Astogeny of *Gothograptus* (*Gotograptus*) *kozlowskii* sp.n. can be reconstructed on the basis of a variation in apertural structure depending on the astogenetic stage. Differences in thecal structure between three astogenetic stages are presented in Table 1.

As indicated by these observations, the elements that develop early in astogeny undergo further modifications at later astogenetic stages and even after the end of the rhabdosome growth.

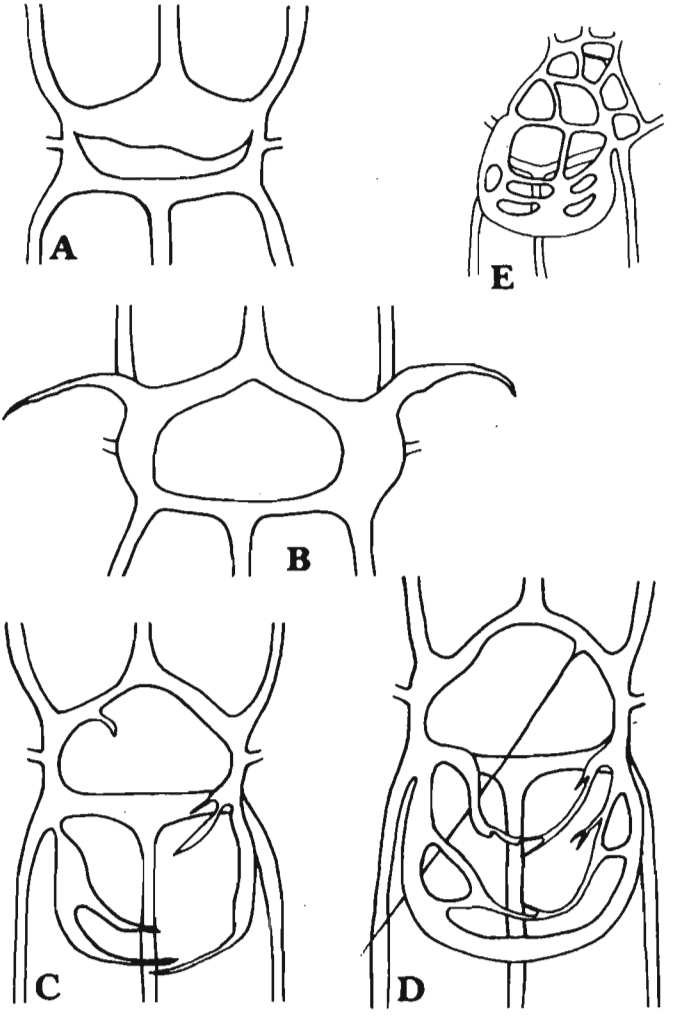

Fig. 4. *A—E* apertures of the successive thecae in finite rhabdosome of *Gothograptus* (*Gothograptus*) *kozlowskii* sp.n. For the sake of clarity, reticula is omitted.

Table 1

astogenetic stages	apertural structures in successive thecae		
	proximal	medial	distal
juvenile rhabdosome (5 thecae)	apertural lists without processes	thin paired spines	—
juvenile rhabdosome (7 thecae)	supraapertural lists with small hood	thin branching spines and singular supraapertural loops	—
finite rhabdosome		thick spines with triangular base	subapertural multifold loops with thickened margins, and reticulated supraapertural hoods

Remarks. — The species *Gothograptus* (*Gothograptus*) *kozlowskii* sp.n. differs from the type species *Gothograptus* (*Gothograptus*) *nassa* (Holm) in its apertural structures and their astogenetic variation. In the latter species, supraapertural hoods occur in all the thecae of finite rhabdosomes, varying solely in size.

The astogenetically variable apertural structures of *Gothograptus* (*Gothograptus*) *kozlowskii* sp.n. resemble some other congeneric species. Thus, its small supraapertural hoods in proximal thecae resemble *Gothograptus* (*Gothograptus*) *nassa* (Holm). Its similarity to *Gothograptus* (*Gothograptus*) *pseudospinosus* Eisenack consists in the proximal and medial apertural spines in both juvenile and finite rhabdosomes. Furthermore, the reticulated supraapertural hood of its ultimate theca is similar to both medial and distal thecal hoods of the latter species. Finally, the apertural loops in medial thecae of *Gothograptus* (*Gothograptus*) *kozlowskii* sp.n. are quite similar to those in *Gothograptus* (*Gothograptus*) *obtectus* sp.n.

The uniqueness of *Gothograptus* (*Gothograptus*) *kozlowskii* sp.n. consists, however, in its subapertural multifold loops with thickened fringes. This is the only representative of the subfamily Gothograptinae Obut et Zaslavskaya which is thus sofar known to show so much variation in apertural structures. It is also the first one to have openings with swollen rims and paired spines in lateral walls in the corona of the finite rhabdosome.

Occurrence. — As for the holotype.

Gothograptus (*Gothograptus*) *obtectus* sp.n.

(pl. 24: 1; pl. 25: 3; pl. 26: 1, 3, 4, 5; fig. 5A-D)

Holotypus: ZPAL G.XIII/23; pl. 2: 1.

Locus typicus: Zawada 1 borehole, depth 1533.3—1540.0 m, NE Poland.

Stratum typicum: lundgreni Zone, Upper Wenlock, Silurian.

Derivation of the name: Latin *obtectus* — covered over.

Diagnosis. — Finite rhabdosome with loops linking the opposite pleuroapertural lists, thus crossing the aperture, in medial thecae. Successive medial and distal thecae and their apertures covered with more and more extensive veil. Veil attached to apertural and pleural lists, but not to medial lists. Parallel to development of the veil, reticula between pleural and medial lists undergoes reduction.

Material. — One finite and four flattened subfinite rhabdosomes.

Description. — Finite rhabdosome is 9.9 mm long and its maximum width (at the level of the fourth pair of thecae) is 1.2 mm; more distally, the rhabdosome width decreases slowly and then rapidly (at the ultimate pair of thecae) to form a thin appendix (pl. 24: 1).

Clathrium is rather thin. Reticula extends along the entire finite rhabdosome; in juvenile rhabdosomes, however, it is restricted to the proximal part.

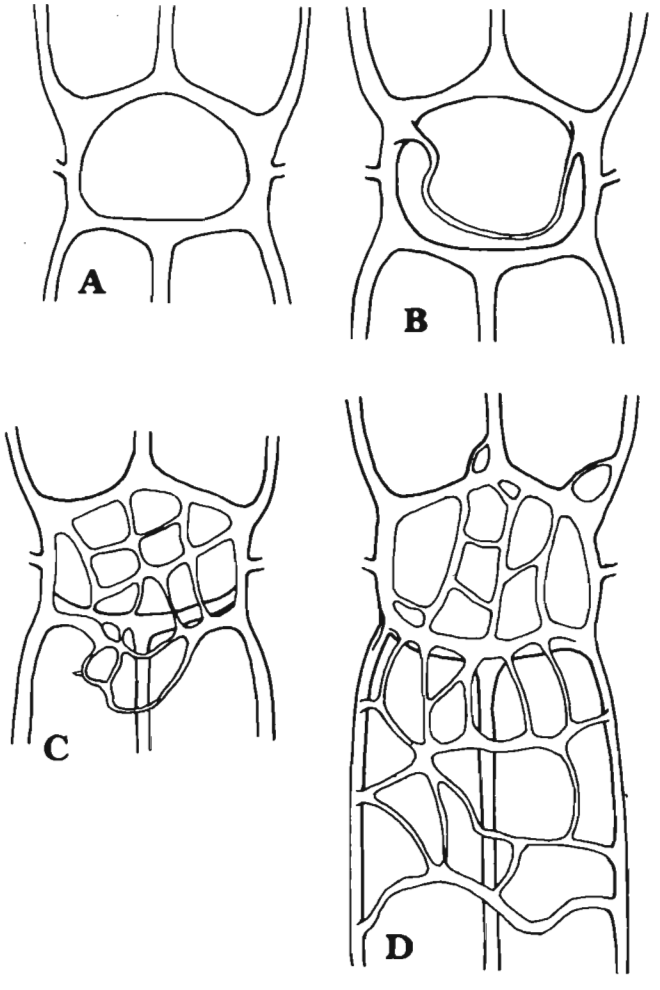

Fig. 5. *A—D* apertures of the successive thecae in a finite rhabdosome of *Gothograptus* (*Gothograptus*) *obtectus* sp.n. For the sake of clarity, reticula is omitted.

There are no apertural structures in proximal thecae (fig. 5A). In successive thecae, a transversal loop appears and links the pleuroapertural lists (fig. 5B). The pleural lists of medial and distal thecae are linked together by reticula which covers the apertures and thecase (fig. 5C, D). Progressively, apertures become poorly visible, the more so because — except for supraapertural list — apertural lists are no thicker than reticula. In distal thecae veil is swollen at the level of supraapertural lists.

Appendix of the finite rhabdosome is 1.6 mm long (with damaged virgula) and 0.25 mm wide.

Remarks. — The species *Gothograptus* (*Gothograptus*) *obtectus* sp.n. considerably differs in apertural structures from its congeners. None of its apertural structures is known from the type species *Gothograptus* (*Gothograptus*) *nassa* (Holm). Its characteristic veil covers the aperture and sometimes also theca. A similar structure has been observed solely in *Gothograptus* (*Gothograptus*) sp. A. These two forms differ, however, in their apertural lists, for *Gothograptus* (*Gothograptus*) *obtectus* sp.n. has its supraapertural lists thickened, whereas in *Gothograptus* (*Gothograptus*) sp. this is the case with subapertural lists. In the form of the finite rhabdosome, *Gothograptus* (*Gothograptus*) *obtectus* sp.n. most closely resembles *Gothograptus* (*Gothograptus*) *pseudospinosus* Eisenack.

Occurrence. — As for the holotype.

Gothograptus (*Gothograptus*) sp. A

(pl. 24: 2; fig. 6A-E)

Material. — One finite rhabdosome, a little damaged, from Zawada 1 borehole, depth 1533.3—1540.0 m, lundgreni Zone.

Description. — Finite rhabdosome (exclusive of the damaged appendix) is 9.75 mm long. It attains its maximum width at the level of the fourth pair of thecae; more distally the width decreases down to 0.65 mm at the ultimate thecae.

Cathrium is thin. Reticula extends along the entire rhabdosome. Virgula becomes incorporated into the lateral wall above the first pair of thecae, 1.6 mm away from the beginning of the rhabdosome.

The proximal two pairs of thecae have no apertural structures. The successive three pairs bear paired supraapertural spines located either at the pleural list above the aperture (fig. 6A), or at the pleuroapertural lists (fig. 6C). Veil becomes progressively more developed in the more distal thecae, and parallel with its development the apertural lists become progressively thinner. Veil consists of a thin and regular reticula; reticula is presumably reduced between the pleural and medial lists, but this is hardly recognizable because of the flattening of the specimen.

Appendix has been destroyed, as evidenced by the remaining thin lists at the virgula.

Remarks. — The specimen described is the only one known. Given the wide astogenetic variation in *Gothograptus* and knowing no juvenile stages of the specimen, its true specific identity cannot be recognized with certainty.

The presence of the veil indicates that *Gothograptus* (*Gothograptus*) sp. A is closely related to *Gothograptus* (*Gothograptus*) *obtectus* sp.n. but the two forms clearly differ from each other. In the former, thick subapertural lists are only poorly visible against the background of thin reticula of the veil. In *Gothograptus*

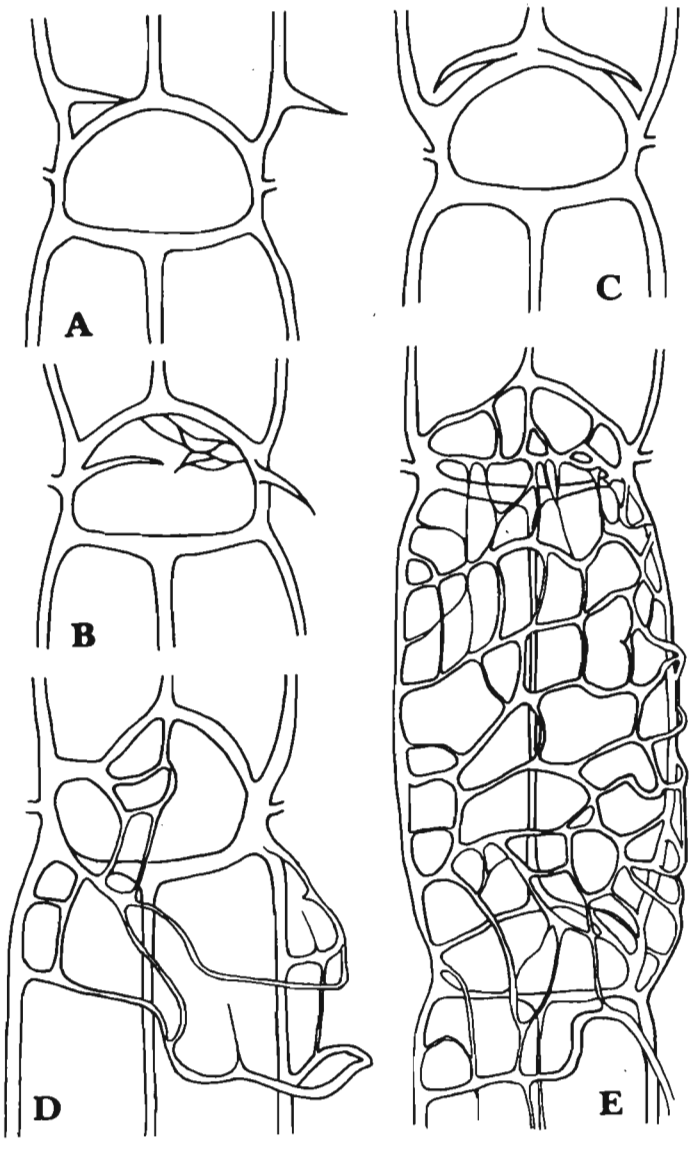

Fig. 6. *A—E* apertures of the successive thecae in finite rhabdosome of *Gothograptus* (*Gothograptus*) sp. A. For the sake of clarity, only reticula of the veil is shown.

(*Gothograptus*) *obtectus* sp.n., by contrast, thick supraapertural lists and similar swellings of the veil are quite distinct.

Subgenus *Gothograptus* (*Eisenackograptus*) subgen.n.

Type species: *Gothograptus eisenacki* Obut et Sobolevskaya 1965.

Diagnosis. — Lateral walls built parietal lists. Virgula incorporated into the

lateral wall only in distal part of the rhabdosome. One or two smooth intrathecal lists link pleural lists with the apertural lists.

Species assigned. — *Gothograptus* (*Eisenackograptus*) *eisenacki* Obut et Sobolevskaya, 1965.

Gothograptus (Eisenackograptus) eisenacki Obut et Sobolevskaya, 1965

(pl. 25: 1, 2, 4; pl. 26: 2; pl. 27: 1, 2; fig. 7A-E)

1965. *Gothograptus eisenacki* Obut et Sobolevskaya: 41—42, pl. 3: 5, 6.
1986. *Gothograptus eisenacki* Obut et Sobolevskaya; Lenz and Melchin, 168—169, pl. 2: 1, 8.

Material. — 28 flattened rhabdosomes, some of them subfinite, the others finite; some specimens damaged, a few with appendix preserved. Zawada 1 borehole, depth 1603.1—1609.1 m and 1555.5—1562.0 m.

Description. — Rhabdosomes are 6.5—7.4 mm long; they attain their maximum width (0.8—0.9 mm) in the proximal part and decrease in width (down to 0.5—0.7 mm) distally.

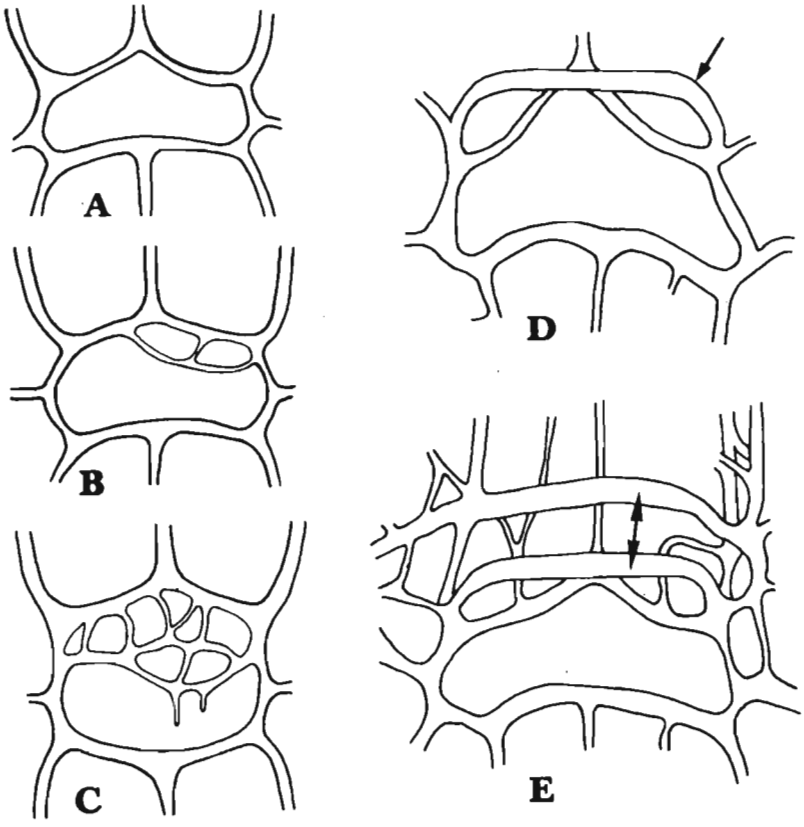

Fig. 7. *Gothograptus* (*Gothograptus*) *eisenacki* Obut et Sobolevskaya: *A*—*C* apertures of the successive thecae in finite rhabdosome: *D*, *E* apertures with intrathecal lists (arrows), seen from the inside. For the clarity, reticula is omitted.

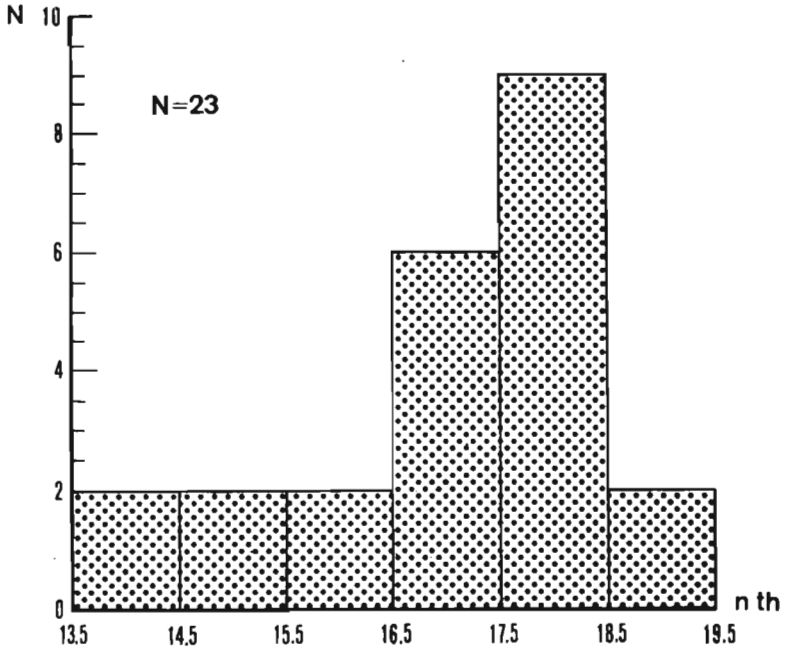

Fig. 8. Frequency distribution of thecal number in a finite rhabdosomes of *Gothograptus* (*Eisenackograptus*) *eisenacki* Obut et Sobolevskaya from Zawada 1 borehole, depth 1603.1—1609.0 m, 1555.5—1562.0 m. *N* number of rhabdosomes, *n th* number of thecae per rhabdosome.

Clathrium and reticula are fairly thick, with reticular mesh size increasing distally. Virgula is initially thin, located in the central part of the corona, but it becomes considerably thicker distally and runs along the lateral wall. At the level of the ultimate pair of thecae, virgula is incorporated into the lateral wall.

One or two intrathecal lists occur inside the thecae; they run parallel to the subapertural list, link the pleural lists with each other, and have no contact with reticula (pl. 27: 2; fig. 7D, E). In contrast to tuberculated lists of the ventral wall and to longitudinally ribbed list of the lateral wall, the intrathecal lists are smooth (pl. 26: 2; pl. 27: 2).

Aperture has the outline shown in fig. 7A, D, E. Proximal thecae have no apertural structures (fig. 7A), while medial thecae bear a little of reticula at the supraapertural list (fig. 7B). The reticula grows in the successive thecae, partly covering the aperture (fig. 7C). In distal thecae of the finite rhabdosome, the supraapertural reticula forms a minor excavation (pl. 25: 7).

Apendix (inclusive virgula) is 0.9—1.7 mm long and approximately 0.2 mm wide.

Remarks. — The number of thecae in the finite rhabdosome ranges between 15 and 20 in the material from Zawada 1 boreholes, with 19 thecae being the modal value. The frequency distribution is unimodal, thus suggesting all these specimens are conspecific (fig. 8).

The species *Gothograptus* (*Eisenackograptus*) *eisenacki* Obut et Sobolevskaya from Zawada 1 borehole differs in the number of thecae in the finite rhabdosome from the specimens described from Taimyr (Obut et Sobolevskaya 1965) and the Laura Lakes and Rockery Creek, Canada (Lenz and Melchin 1987). The holotype from Taimyr has 9 thecae (Obut et Sobolevskaya 1965; pl. 25: 5), while the Canadian specimens have 6 to 8 and, in one case, more than 14 thecae (Lenz and Melchin 1987: pl. 24: 5, 13, 14 and pl. 25: 1). The Polish material, however, resembles the other specimens in all other characters, such as the presence of intrathecal lists, rhabdosome dimensions, thecal density per milimeter.

This comparison indicates, then, that geologically oldest forms (rigidus Zone) have the largest number of thecae in the finite rhabdosome; the forms from the testis Zone have 9 thecae per rhabdosome, while those from the nassa Zone have 6 to 8 thecae. Thus, these forms seem to represent zonal but conspecific forms.

Occurrence. — USSR, Taimyr — Wenlock, the testis Zone; Canada, Laura Lakes and Rockery Creek — Wenlock, the nassa Zone; NE Poland — Wenlock, the rigidus Zone.

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ANNA KOZŁOWSKA-DAWIDZIUK

RODZAJ *GOTHOGRAPTUS* (GRAPTOLITHINA) Z WENLOKU POLSKI

Streszczenie

Przeprowadzono rewizję podrodziny Gothograptinae Obut et Zaslavskaya, 1983 i rodzaju *Gothograptus* Frech, 1897. Wprowadzono nowe i zmodyfikowane terminy dla rabdozomów podrodziny Gothograptinae (fig. 2).

W obrębie rodzaju *Gothograptus* wydzielono dwa podrodzaje: *Gothograptus* (*Gothograptus*) i *Gothograptus* (*Eisenackograptus*) subgen.n. na podstawie odmiennej budowy ścian lateralnych.

Z wiercenia Zawada 1 (NE Polska, fig. 1) oznaczono 3 gatunki (w tym jeden nowy): *Gothograptus* (*Gothograptus*) *pseudospinosus Eisenack* (pl. 23: 4), *G.*(*G.*) *obtectus* sp.n. (pls. 24: 1, 25: 3, 26: 1; fig. 5), *Gothograptus* (*Eisenackograptus*) *eisenacki* Obut et Sobolevskaya (pls. 25: 1, 2, 4, 26: 2, 27: 1, 2; figs. 7, 8) i jeden pozostawiono w nomenklaturze otwartej *Gothograptus* (*G.*) sp. A. (pl. 24: 2; fig. 6). Po raz pierwszy stwierdzono *Gothograptus* (*E.*) *eisenacki* w poziomie rigidus.

Z bałtyckiego głazu narzutowego z Jarosławca opisano *Gothograptus* (*G.*) *kozlowskii* sp.n. (pls. 23: 1—4, 24: 3; figs. 3, 4).

Obecność dobrze zachowanych rabdozomów juwenilnych w różnych stadiach astogenezy *Gothograptus* (*G.*) *kozlowskii* sp.n. pozwoliły na zbadanie prawidłowości astogenezy charakterystycznych dla podrodziny Gothograptinae.

Do oczyszczenia okazów zastosowano metodę ultradźwiękową.

EXPLANATION OF PLATES 23—27

Plate 23

1. *Gothograptus* (*Gothograptus*) *kozlowskii* sp.n., juvenile rhabdosome — ZPAL G.XIII/45, ×21. *a* view of parietolateral wall; *b* view of ventral wall; *c* view of virgulolateral wall.

2. *Gothograptus* (*Gothograptus*) *kozlowskii* sp.n.: medial part of a juvenile rhabdosome — ZPAL G.XIII/44, ×22.
3. *Gothograptus* (*Gothograptus*) *kozlowskii* sp.n.: ZPAL G.XIII/46, ×27. *a* view of ventral wall with secondary thecae, *b* view of ventral wall with primary thecae.
4. *Gothograptus* (*Gothograptus*) *kozlowskii* sp.n.: juvenile rhabdosome — ZPAL G.XIII/47, ×22.
5. *Gothograptus* (*Gothograptus*) *pseudospinosus* Eisenack, juvenile rhabdosome — ZPAL G.XIII/42, ×21.

Plate 24

1. *Gothograptus* (*Gothograptus*) *obtecus* sp.n.: finite rhabdosome, holotype — ZPAL G.XIII/23, ×19.
2. *Gothograptus* (*Gothograptus*) sp. A.: finite rhabdosome — ZPAL G.XIII/35, ×16.
3. *Gothograptus* (*Gothograptus*) *kozlowskii* sp.n.: holotype — ZPAL G.XIII/43 (partly retouched); *a* distal part of rhabdosome in ventral view, ×18; *b* corona with aperture bearing paired spines, ×27; *c* aperture with paired spines at the opposite side of corona, ×27; *d* whole rhabdosome, ×18.

Plate 25

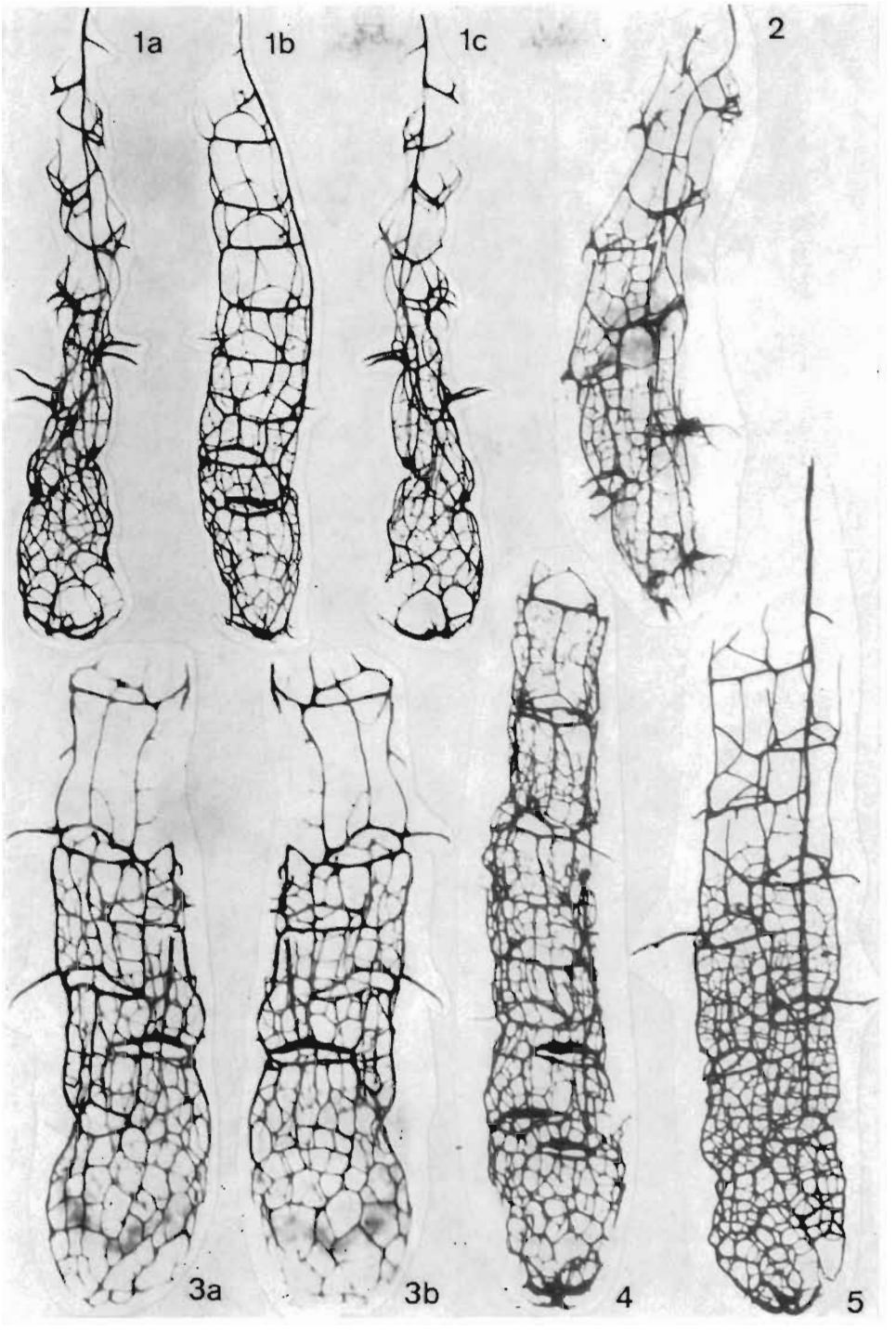
1. *Gothograptus* (*Eisenackograptus*) *eisenacki* Obut et Sobolevskaya: ZPAL G.XIII/10, ×20.
2. *Gothograptus* (*Eisenackograptus*) *eisenacki* Obut et Sobolevskaya: ZPAL G.XIII/7, ×28.
3. *Gothograptus* (*Gothograptus*) *obtectus* sp.n.: ZPAL G.XIII/22, ×20.
4. *Gothograptus* (*Eisenackograptus*) *eisenacki* sp.n.: ZPAL G.XIII/17, ×28.

Plate 26

1. *Gothograptus* (*Gothograptus*) *obtectus* sp.n.: juvenile rhabdosome ZPAL G.XIII/24, ×40.
2. *Gothograptus* (*Eisenackograptus*) *eisenacki* Obut et Sobolevskaya: ZPAL G.XIII/7, ×150. Part of the first theca of finite rhabdosome with intrathecal list (arrow).
3. 4, 5. *Gothograptus* (*Gothograptus*) *obtectus* sp.n.: ZPAL G.XIII/25, ×190; 3 the aperture of theca 1^1; 4 aperture of theca 2^1; 5 aperture of theca 4^1.

Plate 27

1. *Gothograptus* (*Eisenackograptus*) *eisenacki* Obut et Sobolevskaya: ZPAL G.XIII/7, ×550. Ventral wall with longitudinal ribbed lists in proximal part of finite rhabdosome.
2. *Gothograptus* (*Eisenackograptus*) *eisenacki* Obut et Sobolevskaya: ZPAL G.XIII/49, ×260. Aperture with intrathecal lists — seen from the inside.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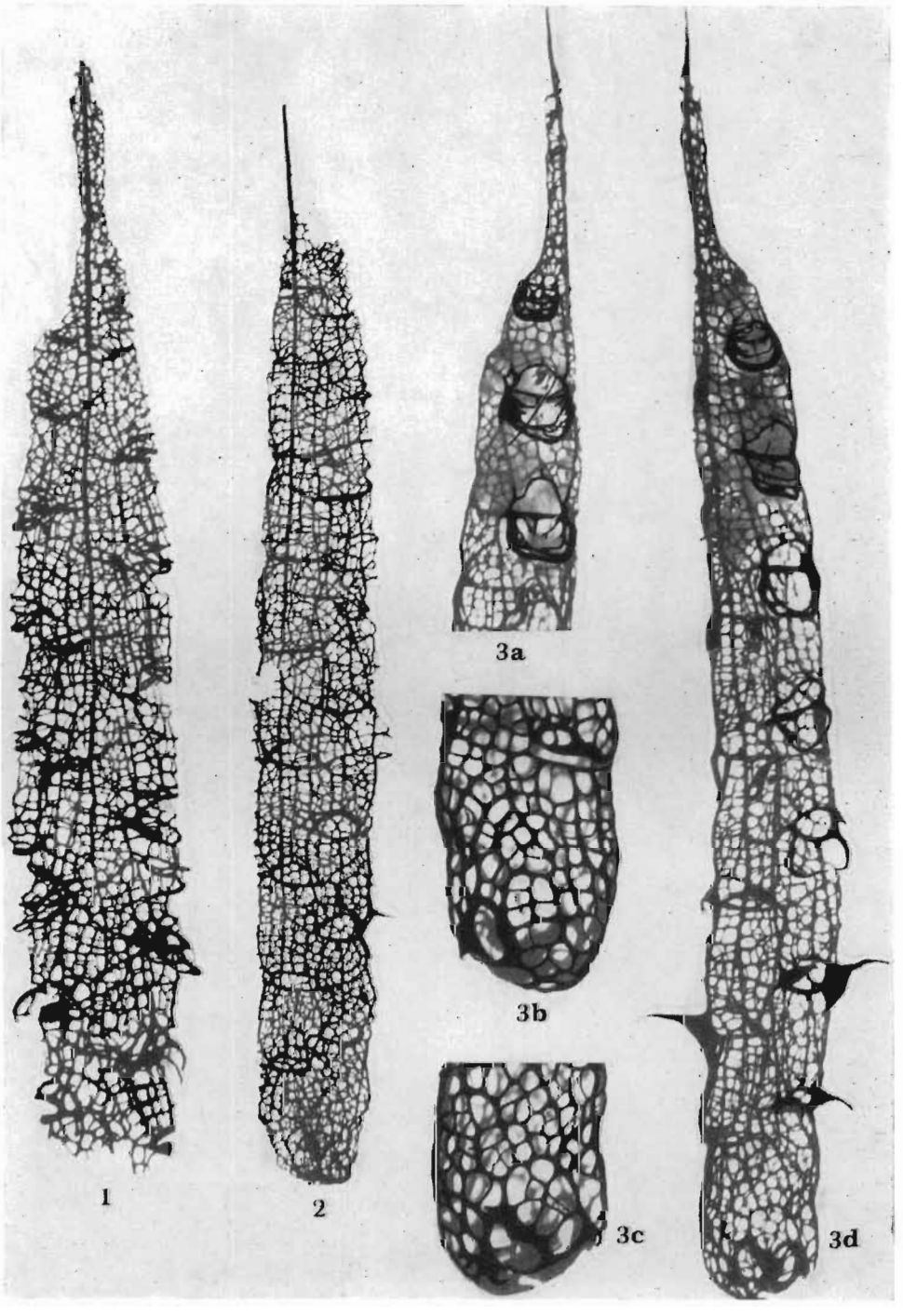
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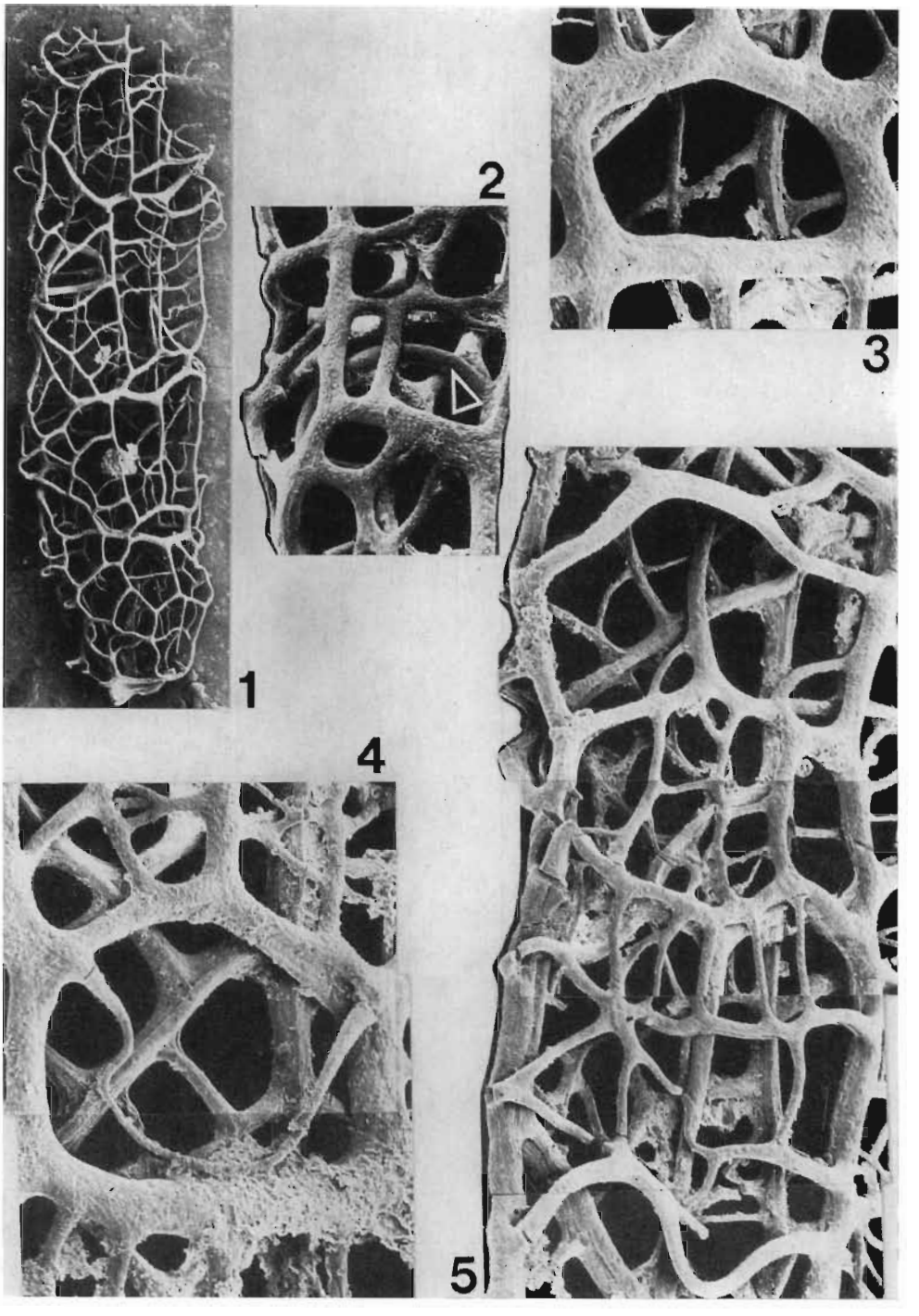
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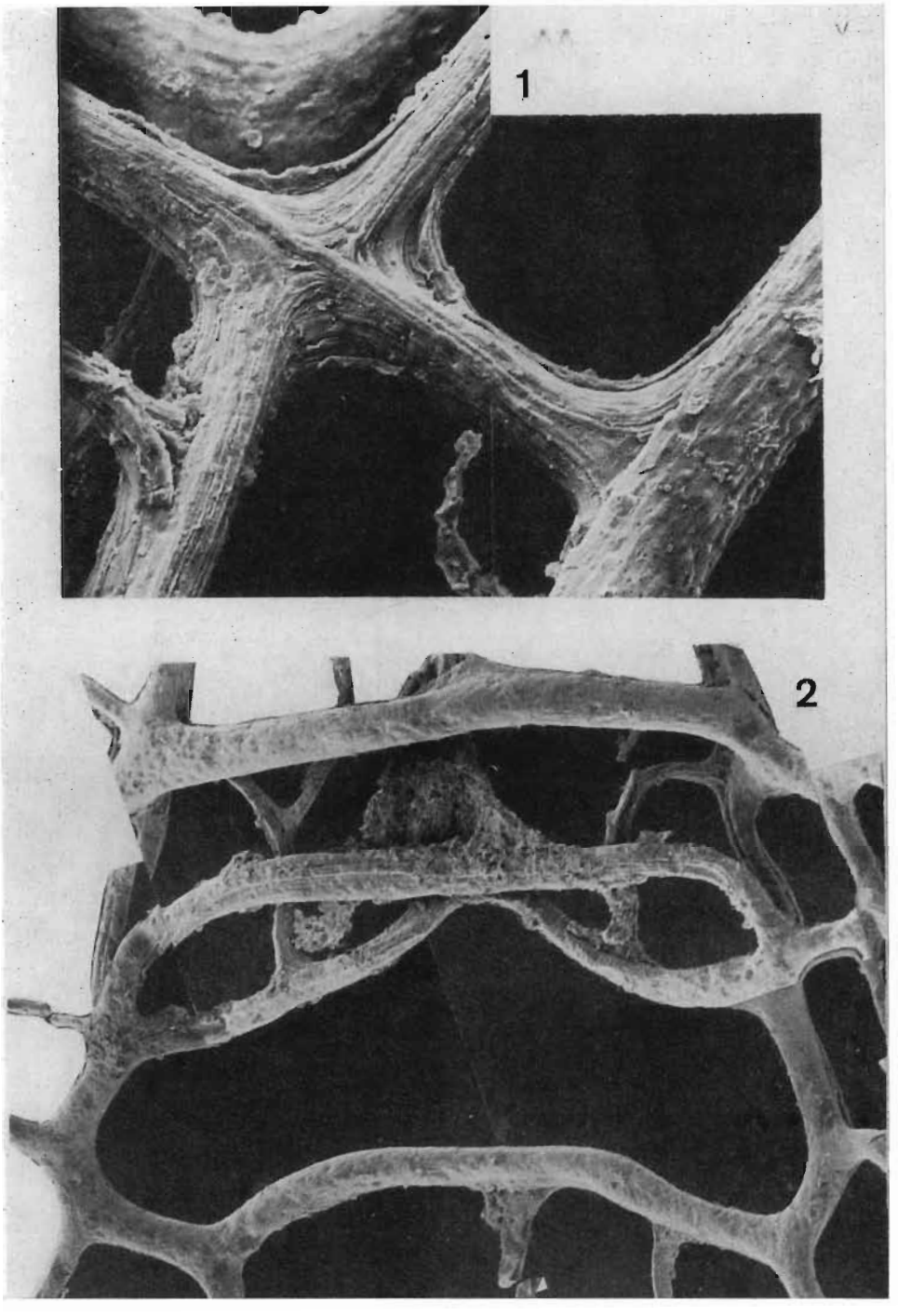
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