

Hoffmanigraptus n. gen., a new retiolitine
(Graptolithina), an early member
of the *Plectograptus* lineage
from the Silurian of Baltica, Poland

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***Hoffmanigraptus* n. gen., a new retiolitine (Graptolithina), an early member of the *Plectograptus* lineage from the Silurian of Baltica, Poland**

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ABSTRACT

Most upper Homeric and Ludfordian retiolitines have a tubarium with hexagonal meshes and a zigzag pattern in the middle part of their lateral walls, a shallow ancora umbrella, and a free nema. *Hoffmanigraptus varsoviensis* n. gen., n. sp. is described from isolated, three-dimensional material, from the upper part of the *Colonograptus praedeubeli* Biozone (upper Homeric, Silurian) of Poland, Baltica, and represents one of the earliest forms with this construction. This type of tubarium is represented by the upper Homeric *Doliograptus* Lenz & Kozłowska-Dawidziuk, 2002 and *Spinograptus* Bouček & Münch, 1952, differing from *Hoffmanigraptus* n. gen. mainly in larger proximal lateral orifices, pattern of clathrial lists on lateral walls, as well as size and shape of tubaria. *Hoffmanigraptus* n. gen. has a tubarium widening medially, tapering towards the distal end and forming a finite tubarium, with a possible three-vented nematularium. Flattened specimens *Plectograptus? ovatus* Kozłowska, Lenz & Štorch, 2001 and *Plectograptus? karlsteinensis* Kozłowska, Lenz & Štorch, 2001, preserved on a rock surface from the Barrandian area are assigned to the new genus. They are of the same upper Homeric age, and show the main features of the new form. *Hoffmanigraptus* n. gen. is regarded as an early member of the *Plectograptus* clade.

KEY WORDS

Graptolithina,
Retiolitidae,
Silurian,
Poland,
Czech Republic,
new combinations,
new genus,
new species.

RÉSUMÉ

Hoffmanigraptus n. gen., une nouvelle rétiolitine (*Graptolithina*), l'un des représentants précoces de la lignée *Plectograptus* du Silurien de la Baltique, Pologne.

Le tubarium de la plupart des rétiolitidés de l'Homérien et du Ludlow a une réticulation hexagonale qui forme un zigzag dans la partie médiane de la paroi latérale, une ombrelle de l'ancora peu profonde et un néma libre. Nous décrivons ici *Hoffmanigraptus varsoviensis* n. gen., n. sp., provenant du matériel isolé, conservé en trois dimensions, de la partie supérieure de la zone à *Colonograptus praedeubeli* (Silurien, Homérien supérieur) de la Pologne (Baltica). Celui-ci constitue l'un de premiers exemples d'une telle construction. Ce type de tubarium est représenté par le *Doliograptus* Lenz & Kozłowska-Dawidziuk, 2002 et le *Spinograptus* Bouček & Münch, 1952, d'âge Homérien supérieur, différents de *Hoffmanigraptus* n. gen. principalement par les orifices latéraux proximaux plus grands, un modèle de liste clathriale sur les parois latérales, aussi bien que la dimension et la forme des tubaria, *Hoffmanigraptus* n. gen. un tubarium s'élargissant médialement, se rétrécissant distalement et formant un tubarium fini avec un possible nematularium à trois ailes. Des spécimens aplatis *Plectograptus? ovatus* Kozłowska, Lenz & Štorch, 2001 et *Plectograptus? karlssteinensis* Kozłowska, Lenz & Štorch, 2001, conservés sur une surface rocheuse de la zone barrandienne, sont inclus dans ce nouveau genre. Ils sont du même âge Homérien supérieur à cause des caractères principaux qu'ils partagent avec la nouvelle forme. On considère que *Hoffmanigraptus* n. gen. est un représentant précoce de la lignée des *Plectograptus*.

MOTS CLÉS

Graptolithina,
Rétiolitidae,
Silurien,
Pologne,
République tchèque,
combinaisons nouvelles,
genre nouveau,
espèce nouvelle.

INTRODUCTION

The retiolitines are the last Silurian biserial graptolites to have appeared during the evolutionary history of the graptolites. They are different from other biserial forms in having additional lateral walls to the tubarium: the ancora sleeve, developed from the ancora umbrella which arises from division of the virgella (Bates 1987, 1990; Bates & Kirk 1992, 1997). Retiolitine tubaria usually have a complicated and delicate network of lists. Their typical planar graptolite fusellar membrane is very thin, so it is exceptionally preserved (Lenz 1994a, b; Kozłowska-Dawidziuk 1997; Lenz & Thorsteinsson 1997), and bandages make the construction of retiolitine tubaria, forming a network of thin to strong lists (Lenz *et al.* 2018).

The retiolitines comprise a successful group among the planktic graptolites (*Graptolithina* Bronn, 1849) and survived five widely recognized mass-extinction events: *Stimulograptus sedgwickii*, *S. utilis*, *Cyrtograptus lapworthi*, *C. murchisoni* and *C. lundgreni* (Porębska *et al.* 2004). One of the most severe events was the last one, following which retiolitines proliferated after a low diversity interval in the *Pristiograptus dubius*/*Gothograptus nassa* Biozone (Lenz & Kozłowska-Dawidziuk 2002; Kozłowska 2016; Štorch & Manda 2019). They started to diversify in the late Homerian, in the *Colonograptus praedeubeli* Biozone, and flourished and diversified during the late Homerian and the very early Ludlow, then gradually diminished in diversity (Eisenack 1951; Bouček & Münch 1952; Kozłowska-Dawidziuk 1995, 2004; Kozłowska-Dawidziuk & Lenz 2001). The retiolitines became extinct in about mid-Ludlow times, during the *Saetograptus leintwardinensis* Event (Urbanek 1993; Kozłowska & Bates 2014).

The new form, *Hoffmanigraptus* n. gen., is one of the first upper Homerian retiolitines having a shallow ancora umbrella, free nema, a genicular list, and a regular hexago-

nal pattern of lists in the ancora sleeve with a zigzag list in the middle part of the lateral wall. It is regarded herein as a possible ancestral form of *Plectograptus* lineage (*sensu* Kozłowska-Dawidziuk 2001).

This paper describes the morphology of *Hoffmanigraptus* n. gen. based on isolated material from Poland, and forms already described from the Czech Republic (Kozłowska-Dawidziuk *et al.* 2001). It shows its advanced features, characteristic of *Plectograptus* lineage, and provides discussion of its similarities to some post *C. lundgreni* genera.

MATERIAL AND METHODS

The graptolite material comes from the Bartoszyce IG-1 core of Poland, geographical coordinates 54°14'56"N, 20°48'29"E, eastern part of the Peribaltic Syncline of the Polish part of the East European Platform, Baltica, located in low latitudes during the Silurian (Porębska *et al.* 2004: fig. 1A). The total thickness of the Silurian deposits of the Bartoszyce IG-1 core is about 300 m. The studied material of *Hoffmanigraptus varsoviensis* n. gen., n. sp. comes from depths 1643.0 m, 1642.4 m and 1642.0 m in the upper part of the *Col. praedeubeli* Biozone (see Porębska *et al.* 2004).

The rock samples were treated with 10–30% hydrochloric acid solution. Sediment not dissolved was partly removed using 5–15% HF. A fine hairbrush was used to pick and transfer specimens. The material is stored in glycerin in plastic containers or on SEM stubs. Specimens are deposited at the Institute of Paleobiology of the Polish Academy of Sciences, Poland under catalogue number ZPAL G.67.

The terminology for retiolitine graptolites, *sensu* Melchin *et al.* (2011), follows Bates *et al.* (2005) and Lenz *et al.* (2018). The term tubarium, initiated by Lankester (1884) to describe

the housing of the extant Pterobranchia, was reintroduced in the newest edition of Treatise Online (Maletz *et al.* 2014), instead of the previously used term rhabdosome.

INSTITUTIONAL ABBREVIATION

ZPAL Institute of Paleobiology of the Polish Academy of Sciences, Warszawa.

SYSTEMATIC PALEONTOLOGY

Phylum HEMICHORDATA Bateson, 1885
 Class PTEROBRANCHIA Lankester, 1877
 Subclass GRAPTOLITHINA Bronn, 1849
 Superfamily RETIOLITOIDEA Lapworth, 1873
 Family RETIOLITIDAE Lapworth, 1873
 Subfamily RETIOLITINAE Lapworth, 1873

Hoffmanigraptus n. gen.

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ETYMOLOGY. — In honor of the late Polish biologist and paleontologist, Antoni Hoffman, author of significant books and papers on evolution and paleoecology; *graptus* – graptolite (Graptolithina).

TYPE SPECIES. — *Hoffmanigraptus varsoviensis* n. sp.

TYPE LOCALITY. — Bartoszyce IG-1 core, depth 1643.0 m, Poland.

SPECIES INCLUDED. — *Hoffmanigraptus varsoviensis* n. gen., n. sp., *Plectograptus? ovatus* Kozłowska-Dawidziuk, Lenz & Štorch, 2001; *Plectograptus? karlsteinensis* Kozłowska-Dawidziuk, Lenz & Štorch, 2001.

REMARKS

The new genus, *Hoffmanigraptus* n. gen., is established based on isolated specimens from Poland, showing clearly the most important features of the tubarium. Two species of *Plectograptus?* Kozłowska, Lenz & Štorch, 2001 from the Všeradice section, Barrandian are included in the new genus. *Plectograptus? karlsteinensis* (Kozłowska-Dawidziuk *et al.* 2001: figs 6.2-6.4) and *Plectograptus? ovatus* (Kozłowska-Dawidziuk *et al.* 2001: figs 7.1, 7.7, 7.11) are flattened and preserved on bedding planes. In this material we can see some differences in the shape of the ancora umbrella (oval or angular), which are regarded as of specific importance.

The good preservation of the new genus *Hoffmanigraptus* n. gen. from Poland allows comparison with other well preserved and isolated retiolitines. The upper Homeric retiolitids comprise the genera *Gothograptus*, *Baculograptus*, *Papiliograptus*, *Semigothograptus* (Rickards & Palmer, 2002), *Doliograptus* Lenz & Kozłowska-Dawidziuk, 2002 and *Spinograptus* Bouček & Münch, 1952. The new genus, *Hoffmanigraptus* n. gen., essentially differs from *Gothograptus*, *Baculograptus*, *Papiliograptus*, and *Semigothograptus* in the arrangement of the ancora umbrella. These forms have a characteristic ancora umbrella with two pairs of larger looping meshes and strongly undulated ancora umbrella rim (Kozłowska 2016: fig. 2; Kozłowska *et al.* 2019: fig. 4A, B).

Hoffmanigraptus n. gen., together with *Doliograptus* and *Spinograptus*, belong to a group of the youngest retiolitines possessing a shallow ancora umbrella with a slightly undulating rim, a centrally positioned nema, an ancora sleeve secreted from the outside, and a well-developed geniculum, with genicular structures developed in some species. Thus, *Hoffmanigraptus* n. gen. is one of the oldest forms with this advanced type of tubarium.

Doliograptus, from the *Col. praedeubeli/Col. deubeli* Biozone, has a wide, ovate tubarium (Lenz & Kozłowska-Dawidziuk 2002: fig. 11.6). One of the main differences from *Hoffmanigraptus* n. gen. is in the arrangement of the clathrial lists of the lateral wall of the tubarium. They are much less developed, forming an irregular pattern with no single central zigzag lists in the middle, in contrast to the regular, hexagonal meshes, which are characteristic of *Hoffmanigraptus* n. gen.

Spinograptus occurring from the *Col. praedeubeli* to *Neodiversograptus nilssoni* biozones, has a narrower and more elongated tubarium, and is more parallel sided than *Hoffmanigraptus* n. gen. One of the main differences is a lack of a terminal growth point in contrast to *Hoffmanigraptus* n. gen. The ancora umbrella of *Spinograptus* is shallower, the lateral proximal orifices are larger, reaching about two thirds the width of the proximal end above the ancora umbrella rim (Kozłowska-Dawidziuk 1997: fig. 8B; Lenz & Kozłowska-Dawidziuk 2002: fig. 15.1), whereas in *Hoffmanigraptus* n. gen. the proximal lateral orifices are less than one half of the width of the proximal end. There is also a difference in the arrangement of the lateral walls of the ancora sleeve. *Hoffmanigraptus* n. gen. has regular ovate hexagonal meshes with a zigzag in the middle of the wall. In *Spinograptus* the lists of the lateral wall usually have an irregular pattern made by thin clathrium lists or reticulum instead (Lenz & Kozłowska-Dawidziuk 2002: figs 13, 14).

Cometograptus Kozłowska-Dawidziuk, 2001, from the *C. lundgreni* Biozone, has a similar arrangement of the main lists as *Hoffmanigraptus* n. gen. These similarities are only superficial, since the *Cometograptus* ancora sleeve wall is secreted from the inside, in contrast to that of *Hoffmanigraptus* n. gen. This type of secretion is characteristic of most of the older, prae-*lundgreni* forms (Bates *et al.* 2005).

Plectograptus Moberg & Törnquist, 1909, a younger retiolitine form from the *Colonograptus ludensis* Biozone, late Homeric, has a similar arrangement of the lateral ancora sleeve wall and a similar sized tubarium. Its main differences from *Hoffmanigraptus* n. gen. are in its shallow ancora umbrella with very reduced and incomplete rim, and the development of large proximal lateral orifices, one of the largest in retiolitines (Bates *et al.* 2006). The other difference is in the shape of the *Plectograptus* tubarium, which has almost parallel lateral walls over most of its length, whereas the *Hoffmanigraptus* n. gen. tubarium is narrow proximally, wider medially and tapers distally to a terminal growth point (Fig. 1A). However, some mature tubaria of *Plectograptus*, e.g. *P. robustus* from the upper part of the late Homeric *Col. ludensis* Biozone (Štorch *et al.* 2016), taper in the distal part. This suggests that there may have been an ancestral relationship between *Hoffmanigraptus* n. gen. and *Plectograptus*.

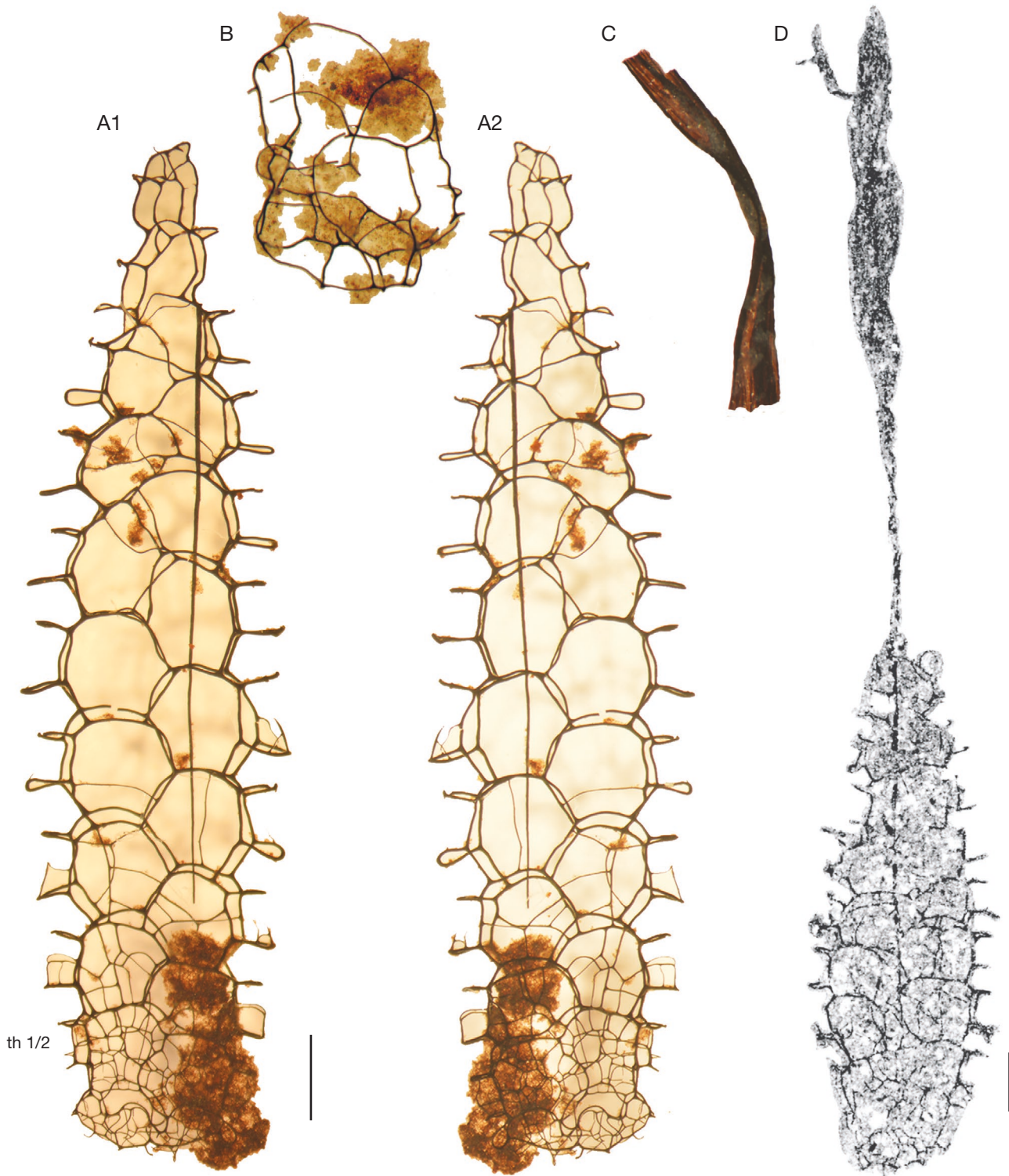


FIG. 1. — **A-C**, *Hoffmaniograptus varsoviensis* n. gen., n. sp. from Bartoszyce IG-1 core, 1643.0 m, Poland: **A1**, **A2**, holotype, ZPAL G.67/1; **A1**, reverse view; **A2**, obverse view; **B**, proximal end of young colony, ZPAL G.67/2; **C**, fragment of nematularium; **D**, *Hoffmaniograptus karlsteinensis* (Kozłowska-Dawidziuk, Lenz & Štorch, 2001) n. comb. with long nematularium, PS956, Všeradice, Barrandian, Czech Republic, vs 110-120 m, lower part of the *Colonograptus prae-deubeli*/*Col. deubeli* Biozone (based on Kozłowska-Dawidziuk *et al.* 2001: fig. 6.1). Scale bars: A, B, D, 1 mm.

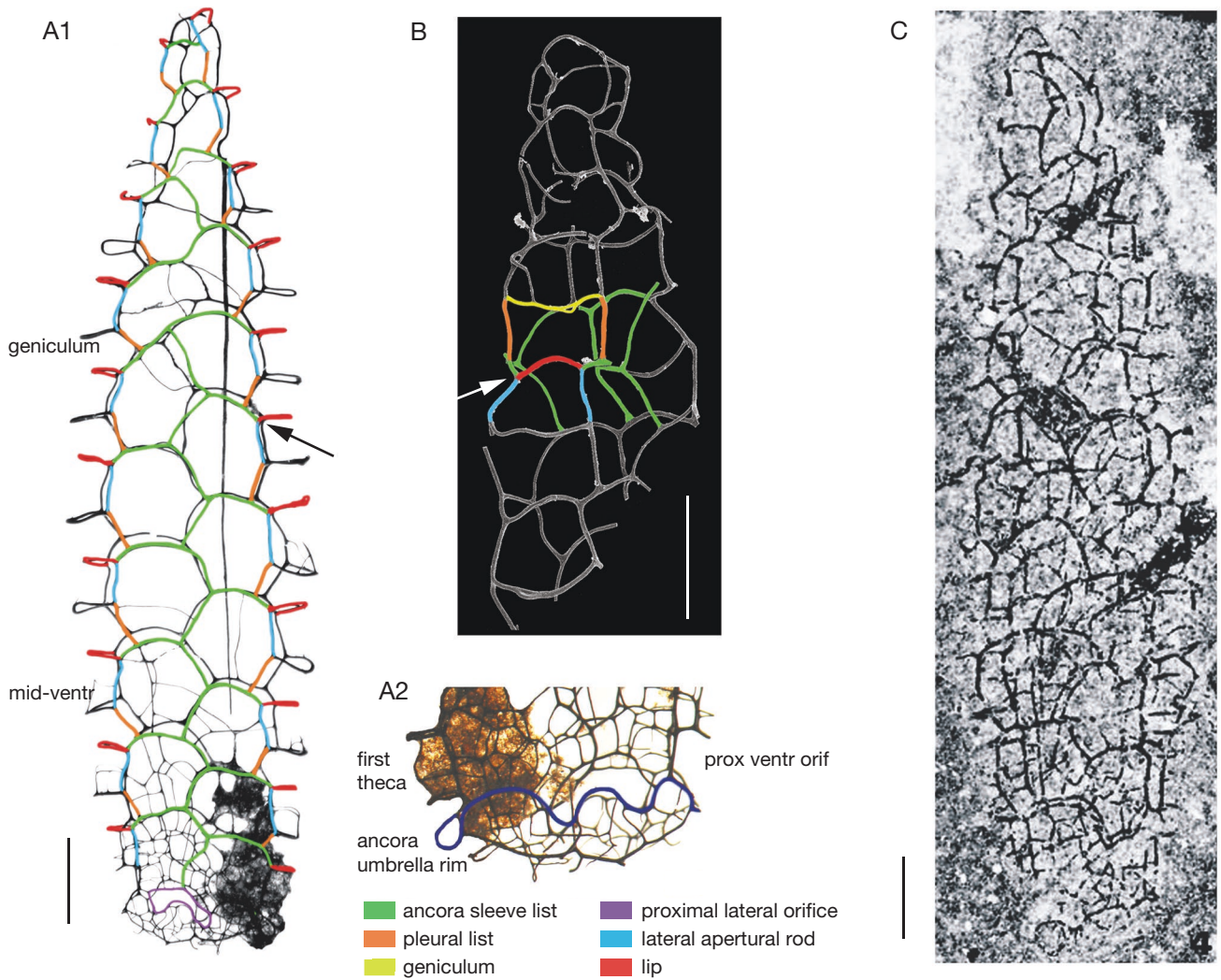


FIG. 2. — *Hoffmanigraptus varsoviensis* n. gen., n. sp.: **A1, A2**, holotype, ZPAL G. 67/1, Bartoszyce IG-1 core, 1643.0 m, Poland; **A1**, lateral view, reverse side, with main structures coloured and triple junction marked (**arrow**); **A2**, proximal end, obverse view, with ancora umbrella rim marked; **B**, fragment of specimen, distal end, ventro-lateral view with triple junction arrowed, ZPAL G. 67/3, Bartoszyce IG-1 core, 1643.0 m, Poland; **C**, flattened specimen on rock surface, reverse side, PS943, Všerádice, Barrandian, Czech Republic. Figure **C** based on Kozłowska-Dawidziuk *et al.* 2001 (fig. 6.4). Abbreviations: **mid-ventr**, mid ventral list; **prox ventr orif**, proximal ventral orifice. Scale bars: 1 mm.

Hoffmanigraptus varsoviensis n. gen., n. sp.
(Figs 1A-C; 2; 3)

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Plectograptus? karlsteinensis Kozłowska-Dawidziuk, Lenz & Štorch, 2001: 157, 159; figs 6.2, 6.4 6.4.; not figs 6.1, 6.3, 6.5-6.8.

TYPE MATERIAL. — ZPAL G.67/1, depth 1643.0 m, Bartoszyce IG-1 core, Poland.

ETYMOLOGY. — After Warszawa, Latin *Varsovia*, capital city of Poland.

MATERIAL EXAMINED. — The material studied comes from the Bartoszyce IG-1 core, Poland, from depths 1643.0 m, 1642.4 m and 1642.0 m. It contains one complete specimen (holotype), many fragments of tubaria, and several of nematularia. All specimens are isolated, well preserved, semi-flattened.

TYPE HORIZON. — Upper part of the *Col. praedeubeli* Biozone, upper Homerian, Wenlock, Silurian.

TYPE LOCALITY. — Bartoszyce IG-1 core, depth 1643.0 m, Poland.

DIAGNOSIS. — Tubarium with narrow and angular proximal end; slightly widens medially and gradually narrows distally; an ancora sleeve with mostly primary lists; thin reticulum developed at proximal end; mid-ventral lists partly developed in proximal part of tubarium; long nematularium, no genicular processes.

DESCRIPTION

The holotype is a complete, mature tubarium with eleven pairs of thecae (Figs 1A1, A2; 2A1, A2). The proximal part of the tubarium widens from the third, and tapers distally from the sixth, pair of thecae. It represents a mature colony of finite growth of similar shape to that of *Plectograptus robustus* (Štorch *et al.* 2016: fig. 4G).

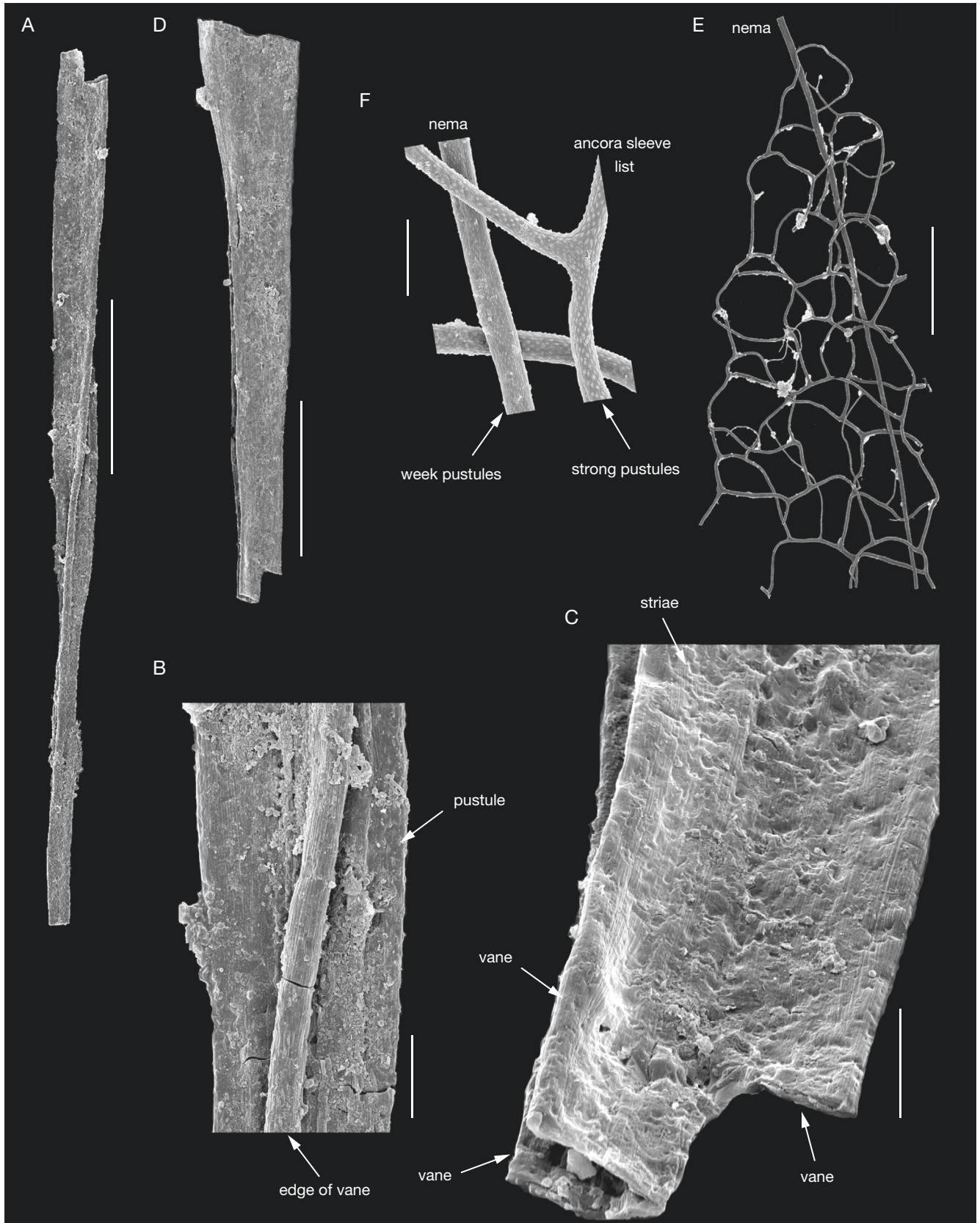


FIG. 3. — *Hoffmanigraptus varsoviensis* n. gen., n. sp. from Bartoszyce IG-1, Poland: **A, B**, fragment of nematularium, ZPAL G.67/4, depth 1642.4 m; **A**, whole specimen; **B**, enlargements showing three-vaned structure; **C, D**, fragment of nematularium, ZPAL G.67/5, depth 1642.4 m; **C**, enlargement of proximal end; **D**, whole specimen; **E, F**, distal end of tubarium with thick nema, ZPAL G.67/6, depth 1642.0 m; **E**, whole fragment of nematularium; **F**, enlargement showing bandages. Scale bars: A, D, 500 μ m; B, C, 50 μ m; E, 1 mm; F, 100 μ m.

The ancora umbrella of the holotype is shallow with a slightly undulating rim. The main lists of the ancora umbrella and the rim are relatively thin, thinner than the main lists of the ancora sleeve. There is some thin reticulum filling the ancora umbrella meshes, some of which possibly belong to an outer ancora. A well-preserved ancora umbrella of a specimen representing an early stage of colony growth clearly shows six meshes (Fig. 1B).

The virgella and virga of the holotype are not preserved, whereas the nema is present inside the tubarium from the level of the th3¹ lip, then it is broken at the level of the lip of th9¹. The nema widens distally (Fig. 1A1, A2).

The holotype is 12.5 mm long, widest at the medial part, while at the level of two last pairs of thecae it is very narrow. The width of the lateral wall of the tubarium between the pleural lists at the level of the first thecal pair is 1.5 mm, at the level of the fourth pair it is 2.0 mm, at the level of the sixth 1.8 mm, of the ninth 0.8 mm, and at the last thecae it is 0.4 mm.

The reticulum is made of thin lists developed at the proximal part, up to the third pair of thecae. The ancora sleeve is made of thicker clathrial lists. They form regular, hexagonal meshes with a distinct zigzag pattern in the middle part of the lateral walls, except for the very narrow distal most part of the tubarium (Figs 1A1, A2; 2B).

Geniculum well-developed, larger than the lip. The thecae are longer in the middle part of tubarium. The approximate distance between lips of the neighbouring thecae is about 1 mm, larger in the middle thecae. In holotype it is about 0.8 mm between two first pairs of thecae, 1.2 mm between three to sixth pairs, and 0.8 mm between the last thecae.

The mid-ventral lists are very thin, present only in the proximal thecae. They are partly developed from the geniculum up to middle part of the lateral apertural rod (Fig. 2A1). Genicular processes absent.

The lateral apertural rod runs between the geniculum and the lip (Fig. 1A1, B). A triple junction is formed where the lateral apertural rod, lip and an ancora sleeve list meet. This type of connection is typical of some species of *Plectograptus*, e.g. *Plectograptus toernquisti* (Bates *et al.* 2006: fig. 4A).

Proximal lateral orifices are kidney shaped (Figs 1A1, A2; 2A1, A2). The proximal ventral orifices below the first theca (th1¹) is much smaller than this below the second theca (th1²) (Fig. 2A2).

Fragments of a three-vented nematularium have been recovered from the type locality and are included in the new species (Fig. 3). Their bandaged surfaces include bandages with distinctive pustules, small pustules and parallel striae (Fig. 3B, C).

REMARKS

Some of the specimens of *Hoffmanigraptus karlsteinensis* (Kozłowska-Dawidziuk, Lenz & Štorch, 2001) n. comb. from the Všeradice section, Barrandian, illustrated in figures 6.2, 6.4 in Kozłowska-Dawidziuk *et al.* 2001, having a narrow proximal end of the tubarium extending up to the third pair of thecae, are included in the new species.

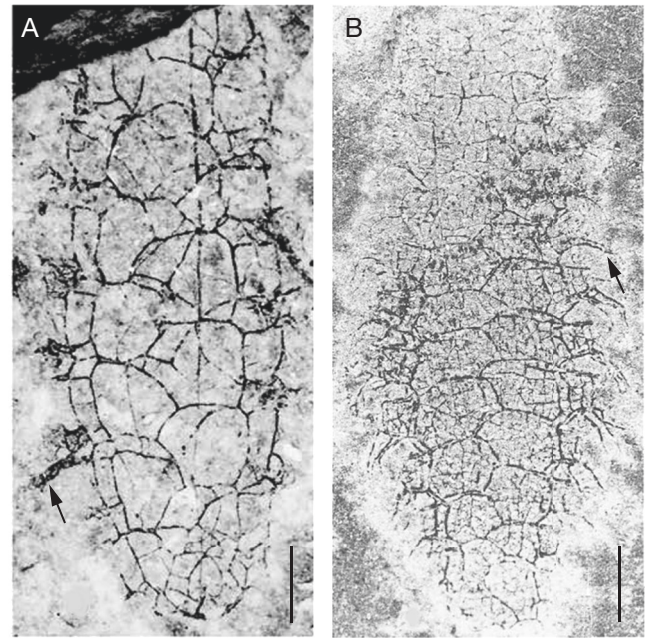


Fig. 4. — Comparison of *Hoffmanigraptus karlsteinensis* (Kozłowska-Dawidziuk, Lenz & Štorch, 2001) n. comb. and *Hoffmanigraptus ovatus* (Kozłowska-Dawidziuk, Lenz & Štorch, 2001), Všeradice, Barrandian, Czech Republic: **A**, *Hoffmanigraptus karlsteinensis* n. comb., holotype PS960, Vs1, 180–200 cm, lower part of the *Colonograptus praedeubeli/Col. deubeli* Biozone; **B**, *Hoffmanigraptus ovatus*, holotype PS964, Vs4, 104–128 cm, the lowest part of the *Col. gerhardi* Biozone. **Arrows** show genicular processes. Figures based on Kozłowska-Dawidziuk *et al.* 2001 (figs 6.5, 7.1). Scale bars: 1 mm.

Hoffmanigraptus varsoviensis n. gen., n. sp. differs from *H. ovatus* (Kozłowska-Dawidziuk, Lenz & Štorch, 2001: fig. 7.1) n. comb. (Fig. 4B) in lacking genicular process, having a much narrower distal end of tubarium and almost complete absence of reticulum (Fig. 1A, B).

Hoffmanigraptus karlsteinensis

(Kozłowska-Dawidziuk, Lenz & Štorch, 2001) n. comb.
(Figs 1D; 4A)

Plectograptus? *karlsteinensis* Kozłowska-Dawidziuk, Lenz & Štorch, 2001: 157, 159; figs 6.1, 6.3, 6.5–6.8; not 6.2, 6.4.

DIAGNOSIS. — Tubarium widens medially with ovate proximal end, well-developed genicular processes of reticulofusellar structure, reticulum poorly developed or absent.

REMARKS

Hoffmanigraptus karlsteinensis n. comb. differs from *Hoffmanigraptus varsoviensis* n. gen., n. sp. in having ovate proximal end, tubarium wider in medial part and presence of genicular processes. The widest part of *Hoffmanigraptus ovatus* n. comb. tubarium, distance between lateral apertural rods, is 3 mm on the level of fifth pair of thecae. *Hoffmanigraptus karlsteinensis* n. comb. is narrower, about 2.5 mm on the level of fourth pair of thecae.

It appears in the *P. parvus/G. nassa* Biozone and *Col. praedeubeli/Col. deubeli* Biozone, thus this is the oldest species of *Hoffmanigraptus* n. gen.

Hoffmanigraptus ovatus

(Kozłowska-Dawidziuk, Lenz & Štorch, 2001) n. comb.
(Fig. 4B)

Plectograptus? *ovatus* Kozłowska-Dawidziuk, Lenz & Štorch, 2001: 159; figs 7.1, 7.7, 7.11?.

DIAGNOSIS. — Tubarium ovate, reticulum throughout including proximal end, mid-ventral lists possibly present, well-developed genicular processes of reticulofusellar structure.

REMARKS

Hoffmanigraptus ovatus n. comb. differs from the type species, *Hoffmanigraptus varsoviensis* n. gen., n. sp., in the wider middle part of the tubarium, forming a more ovate shape of, the presence of a reticulum over the whole tubarium, and the presence of genicular processes.

The widest part of tubarium of *Hoffmanigraptus ovatus* n. comb. and *H. varsoviensis* n. gen., n. sp. is on the same level, the fifth pair of thecae. The width of the lateral walls (distance between lateral apertural rods) is 3 mm in *H. ovatus* n. comb. and 2 mm in *H. varsoviensis* n. gen., n. sp.

The difference in development of lateral walls in both species is in the shape of the large meshes of the lateral walls, formed by ancora sleeve lists, pleural lists and lateral apertural rods. They are ovate in shape in *Hoffmanigraptus varsoviensis* n. gen., n. sp. (Fig. 2A1), while in *Hoffmanigraptus ovatus* n. comb., they are narrow horizontally, mostly in the middle and distal part of tubarium (Fig. 4B). The ventral wall of *H. ovatus* n. comb. has mid-ventral lists developed along the whole tubarium, whereas in *H. varsoviensis* n. gen., n. sp. they are only partly developed (Fig. 2A1).

The preservation of the flattened specimens on the rock surface does not allow detailed study, although e.g. some genicular processes show a reticulofusellar structure (Fig. 4B). Additionally, there is no sign of a widening of nema and nematularium on the laterally flattened specimens (Kozłowska-Dawidziuk *et al.* 2001: figs 7.1, 7.7), whereas the specimen illustrated on figure 7.11 in Kozłowska-Dawidziuk *et al.* 2001 is flattened ventro-laterally and the widening of the nema is clear in the distal part of tubarium. This specimen looks narrower than the type species, probably caused by its preservation.

Hoffmanigraptus ovatus n. comb. occurs in the lowest part of the *Col. gerhardii* *Col. ludensis* Biozone (Kozłowska-Dawidziuk *et al.* 2001), whereas *Hoffmanigraptus varsoviensis* n. gen., n. sp. occurs in the upper part of the *Col. praedeubeli* Biozone.

CONCLUSIONS

Hoffmanigraptus n. gen. is one of the first post *C. lundgreni* retiolitines having features typical of the upper Homeric and Ludlow retiolitines. There is a shallow ancora umbrella as well as a combination of advanced features: a central position for the nema, a zigzag pattern of the lateral wall of the ancora sleeve and an arrangement of the ventral walls with a geniculum. The other early genera are *Spinograptus* (Kozłowska-Dawidziuk 1997, 2004; Lenz & Kozłowska-

Dawidziuk 2002), which occurs from the *Col. praedeubeli* to the *N. nilssoni* Biozone, and *Doliograptus* Lenz & Kozłowska, 2002 from the *Col. praedeubeli/deubeli* Biozone.

Two types of ancora umbrella are present in the first retiolitines to appear directly after the post-*lundgreni* extinction event. One, with two pairs of large looping meshes forming an undulating rim, is recognized in *Gothograptus*, *Papiliograptus*, *Semigothograptus* and *Baculograptus*. The second type, with a shallow ancora umbrella, being the most advanced and typical of all later retiolitines, is found in *Doliograptus*, *Spinograptus*, and the new genus *Hoffmanigraptus* n. gen. distinguished based on isolated material from Poland, with included two species, the flattened forms from Czech Republic, tentatively assigned to *Plectograptus?* by Kozłowska-Dawidziuk *et al.* 2001. *Plectograptus*, from the uppermost Homeric *ludensis* Biozone (Ludlow) differs from *Hoffmanigraptus* n. gen. mainly in shallow ancora umbrella with reduced and incomplete rim, and large proximal lateral orifices.

The new genus *Hoffmanigraptus* n. gen. may possess a nematularium, the distal development of the nema. Among the isolated material from Poland, together with *Hoffmanigraptus varsoviensis* n. gen., n. sp., some fragments of nematularia were found (Fig. 3), which possibly belong to the new form. Among the specimens from Czech Republic, there is one complete specimen of *Hoffmanigraptus karlsteinensis* n. comb. with a nematularium (Fig. 1D) (Kozłowska-Dawidziuk *et al.* 2001: fig. 6.1). This is a rare case of preservation of the whole specimen with this very delicate and fragile structure. A complete isolated tubarium with nematularium is almost impossible to obtain. Nematularia with complete specimens are present in some flattened retiolitines, e.g. *Plectograptus* (Moberg & Törnquist 1909; Bouček & Münch 1952; Tomczyk 1956) and in many Silurian biserial graptolites, e.g. *Cystograptus* Hundt, 1942, *Petalolithus* Suess, 1851, *Parapetalolithus* (Hundt, 1965) and *Pseudoplegmatoraptus wenlockianus* (Štorch, 1992).

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