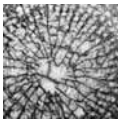
Spinophyllum Wedekind, 1922 (Anthozoa, Rugosa), in the Lower Givetian (Devonian) of the Bohemian Massif

ARNOŠT GALLE



The rugose coral genus *Spinophyllum* Wedekind, 1922, occurs in Moravia (*S. conicum* Kettnerová, 1932 and *S. ondra* sp. nov.). Its most peculiar character is coarse septal trabeculae displaying the double bend of charactophyllids. In this feature it resembles *Charisphyllum* Oliver & Sorauf, 1988, synonymous with *Spinophyllum. Spinophyllum* sp. cf. *conicum* Kettnerová, 1932, known from the Koněprusy Acanthopyge Limestone of the Prague Basin, has its slender septal trabeculae arranged in a half-fan or asymmetrical fan and does not belong to *Spinophyllum.* The fine structures of rugose corals are repeating at the same taxa in various preservational environments. It seems to prove that these fine structures are at least based on the structures which originated through the life of corals. The mentioned fine structures were considered important diagnostic feature in the present paper. • Key words: Middle Devonian, Rugosa, systematics, septal structures, biostratigraphy.

GALLE, A. 2007. *Spinophyllum* Wedekind, 1922 (Anthozoa, Rugosa), in the Lower Givetian (Devonian) of the Bohemian Massif. *Bulletin of Geosciences 82(2)*, 133–144 (7 figures, 3 tables). Czech Geological Survey, Prague. ISSN 1214-1119. Manuscript received March 30, 2007; accepted in revised form June 22, 2007; issued June 30, 2007. • DOI 10.3140/bull.geosci.2007.02.133

Arnošt Galle, Academy of Sciences of the Czech Republic, Geological Institute, Rozvojová 269, 165 02 Praha 6 – Lysolaje, Czech Republic; galle@gli.cas.cz

The present paper deals with the genus *Spinophyllum* Wedekind, 1922, in the Bohemian Massif. While in Moravia there are two species resembling the genus *Charisphyllum* Oliver & Sorauf, 1988, known with coarse septal trabeculae and a double charactophylloid bend (*Spinophyllum conicum* Kettnerová, 1932, and *S. ondra* sp. nov.), slender septal trabeculae of the Bohemian species "*Spinophyllum* sp. cf. *conicum* Kettnerová, 1932" are arranged in a half-fan or asymmetrical fan and they probably do not belong to *Spinophyllum.*

Discussed Moravian species *Spinophyllum conicum* Kettnerová, 1932, and *S. ondra* sp. nov. can be, in my opinion, considered congeneric with *Spinophyllum altevogti* (Oliver & Sorauf, 1988). On the other hand, the three above-mentioned species are not necessarily congeneric with the type species of *Spinophyllum, S. spongiosum* (Schlüter, 1889). One of the species discussed here, *Spinophyllum conicum* Kettnerová, 1932, occurs in Čelechovice na Hané (Fig. 1). The Čelechovice Devonian crops out at the Kosíř Hill, approximately 7 km NW of Prostějov. In literature the locality has been mentioned under the names of Čelechovice, Kaple, and Rittberg. Hladil *et al*. (2002) summarized the research history of the Devonian at Čelechovice and also confirmed the age of the fossiliferous beds as close to the boundary between the *Po. hemiansatus* and early *Po. varcus* zones (= Lower Givetian). The Čelechovice Limestone consists of dark algal limestones, packstones, floatstones, coquines, and biostromes with typical "Čelechovice fauna". It is underlain by dark marlstone of an extremely shallow environment and overlain by laminated, sometimes siliciferous limestone (Galle & Hladil 1991). Faunal lists and a detailed measured section are seen in Galle & Hladil (1991), too.

Another species discussed here, *Spinophyllum ondra* sp. nov., is known from the borehole Mě-1 Měnín (Fig. 1), core No. 12, depth 397.8–398.9 m, and from the localities of Lažánky – Zrcadla in the Moravian Karst, both of the early Givetian age.

The locality of Zrcadla S of Lažánky in the Moravian Karst (Fig. 1) was discovered in course of mapping the Devonian and Carboniferous of the Moravian Karst by late J. Dvořák (Czech Geological Survey, Brno). It was mentioned in Chlupáč (1964) and Galle (1985a, b). Rugose coral fauna of the Čelechovice Limestone in Lažánky, although never systematically described, is very rich and diverse. Besides *Spinophyllum ondra* sp. nov. it also contains *Acanthophyllum* sp., *Dohmophyllum* sp., *Grypophyllum primum* (Wedekind, 1923), *Moravophyllum ptenophylloides* Kettnerová, 1932, *Thamnophyllum caespitosum* (Goldfuss, 1826), *Pseudohexagonaria katerinae* (Galle, 1985), *Battersbyia* cf. *anisactis* (Frech, 1886), *Dendrostella trigemme* (Quenstedt, 1879), *Cyathophyllum (C.) dianthus* Goldfuss, 1826, and others.

Figure 1. Diagrammatic map with the geographic position of localities mentioned in text.

The dominant genera – *Favosites, Pachyfavosites, Thamnopora, Alveolites, Spongioalveolites, Squameoalveolites, Placocoenites, Coenites, Caliapora, Aulopora* and *Hillaepora,* accompanied by *Rhapidopora* and *Heliolites* – rank among among tabulate corals with other "tabulatomorphic organisms". Syringoporidae occur together with stromatoporoids as "*Caunopora*", often in association with stromatoporoid genus *Salairella* (Hladil 1974, 1985a, 1985b, and pers. comm. 2007).

The Devonian of the borehole Mě-1 was described in detail in Zukalová *et al.* (1981), rugose corals in Galle (1981), tabulates in Hladil (1981), stromatoporoids and microfossils in Zukalová (1981), its clastic pre-Devonian part, *e.g.*, in Vavrdová (2004). Rugose corals are represented there by rich *S. ondra* and by *Cystiphylloides* sp., *Battersbyia* cf. *anisactis* (Frech, 1886), *Grypophyllum* sp., and ?*Stringophyllum* sp.

The localities of Čelechovice and Lažánky – Zrcadla belong to the rugose coral biozone *Cyathophyllum dianthus – Thamnophyllum caespitosum* as described in Galle (1985b) and Galle *et al.* (1988). The stratigraphical position of the core No. 12 from the borehole Mě-1 Měnín, depth 397.8–398.9 m, has not been clear till now. Rich occurrence of *Spinophyllum ondra* sp. nov. known also from Lažánky – Zrcadla supports the opinion about *C. dianthus – Th. caespitosum* age of rocks, the drilled rock core No. 12 of Mě-1.

Material and methods

Birenheide & Lütte (1990) chose the lectotype and reillustrated *Spinophyllum spongiosum* (Schlüter, 1889), the type species of *Spinophyllum*. Some of the specimens illustrated, for instance in figs 15 and 19 in pl. 3 and possibly also figs 10, 12, 13, 14 and 16, have coarse monacanths, while the trabeculae in the fig. 11b and possibly also in figs 11, 17, and 20 are slender and arranged in high angle and seem to belong to another genus. Such fine structures are, in my opinion, the character important in rugosan morphology and systematics. Rugose coral taxa show fine structures which repeat at the same taxa in various preservational environments. It seems to prove that known fine structures are at least based on original biological fine structures. The mentioned fine structures were considered important diagnostic feature in this paper. No changes in the growth rate have been observed in material from Moravia. The single section from the Acanthopyge Limestone from Koněprusy displays what can be interpreted as the "dark zone".

The thin sections of corals from the borehole Měnín Mě-1 were disintegrated in course of the thin-sectioning. It was probably caused by extremely brittle material of the core No. 12.

Abbreviations used in the text: GMBo – Geological Museum Bonn, Germany; PřFUK – Faculty of the Natural History, Geological Institute, Charles University, Prague, Czech Republic; AG – the author's collection stored in the Geological Institute, AS CR, v.v.i., Prague, Czech Republic. Abbreviations used in the tables: OR – observed range; N – number of measurements; Mean – arithmetic mean; d – corallite diameter; dt – tabularium diameter; nI – number of major septa; nI+II – number of majors and minors; w – wall thickness; tab/5 mm – number of tabulae per 5 mm; r. diss. – number of the dissepiments rows.

All the objects figured here are thin sections. They are stored in the Geological Museum Bonn (GMBo), Faculty of Natural History, Charles University, Prague (PřFUK), and in the author's collection in the Geological Institute, AS CR (AG and the two specimens of "*Spinophyllum* sp. cf. *S. conicum* Kettnerová, 1932"). Photographs were made by D. Hejdová, B. Vávrová, and J. Brožek.

Systematic palaeontology

Class Anthozoa Ehrenberg, 1834
Subclass Rugosa Milne-Edwards & Haime, 1850
Family Charactophyllidae Pedder, 1972

Type genus. – *Charactophyllum* Simpson, 1900 (see Pedder 1972).

Diagnosis. – "Solitary or rarely parricidally budded tetracorals. Septa radial or weakly to moderately pinnate in arrangement; composed, at least in part, of coarse monacanthine trabeculae that are seen to be flexed first downwards, and then, provided the septa are sufficiently long, upwards, when traced adaxially. Septa are commonly dilated, but nature of dilation varies depending on the genus. Dissepiments tend to be globular and are not elongated even in large specimens; horseshoe-shaped dissepiments are not developed" (Pedder 1972).

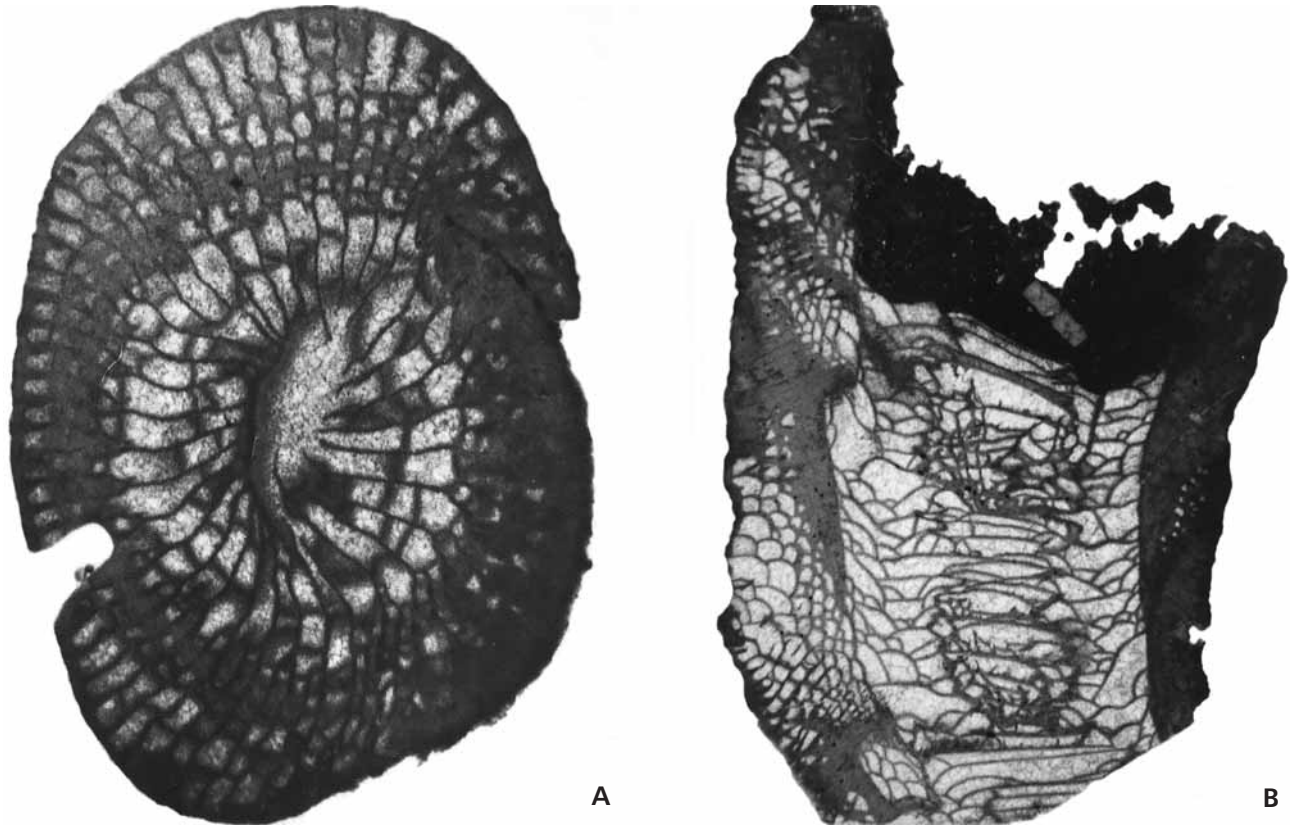


Figure 2. *Spinophyllum spongiosum* (Schlüter, 1889), Birenheide & Lütte (1990), pl. 3, fig. 15, Büchel Formation, abandoned Büchel Quarry, Bergisch-Gladbach, Rheinisches Schiefergebirge. • A – lectotype, transverse section, × 8. • B – lectotype, longitudinal section, × 4.

Discussion to Charactophyllidae. – Besides *Charactophyllum* Simpson, 1900, with synonyms *Hunanophrentis* Sun, 1958, and *Pseudozaphrentis* Sun, 1958, Pedder (1972), assigned to his new family genera *Temnophyllum* Walther, 1928, *Moravophyllum* Kettnerová, 1932, *Aphraxonia* Ünsalaner, 1951, and *Alaiophyllum* Goryanov, 1961.

Birenheide (1978) considered *Charactophyllum* Simpson, 1900 (with synonyms *Spinophyllum* Wedekind, 1922, and *Tropidophyllum* Pedder, 1971) a member of Zaphrentinae Milne-Edwards & Haime, 1850, together with *Heliophyllum* Hall in Dana, 1846, *Moravophyllum* Kettnerová, 1932, *Ceratophyllum* Gürich, 1896, and *Temnophyllum* Walther, 1928.

McLean (1993) characterized charactophyllids as rugosans with – among others - coarse monacanths, usually more or less bent, with globose dissepiments and wide tabularium. He included the genera *Charactophyllum* Simpson, 1900, *Spinophyllum* Wedekind, 1922, *Temnophyllum* Walther, 1928, *Sinodisphyllum* Sun, 1958, *Hunanophrentis* Sun, 1958, *Alaiophyllum* Goryanov, 1961, *Piceaphyllum* Różkowska, 1980, *Chostophyllum* Pedder, 1982, and *Ceciliaphyllum* McLean, 1982. He considered *Mictophyllum* Lang & Smith, 1939, member of Kyphophyllidae Wedekind, 1927 (McLean 1993, 2007).

Wrzołek & Wach (1994) included *Spinophyllum* Wedekind, 1922, into Disphyllidae Hill, 1939, and synonymized it with *Truncicarinulum* Yu & Kuang, 1982, *Charisphyllum* Oliver & Sorauf, 1988, and *Neotemnophyllum* Yu & Kuang, 1984. Further they compared *Spinophyllum* Wedekind, 1922, with other Devonian carinated genera *Ceciliaphyllum* McLean, 1982, and *Charactophyllum* Simpson, 1900.

Schröder (2005) included *Hunanophrentis* Sun, 1958, *Spinophyllum* Wedekind, 1922, and *Temnophyllum* Walther, 1929, into Charactophyllidae Pedder, 1982.

Genus *Spinophyllum* Wedekind, 1922

For synonymy, see Birenheide & Lütte 1990; McLean 1993; Schröder 1997; Pedder 1999; Coen-Aubert 2002.

Type species. – By monotypy, *Campophyllum spongiosum* Schlüter, 1889, p. 46. Middle Devonian, Givetian, Büchel Formation, abandoned Büchel Quarry, Bergisches Land, Germany.

Diagnosis. – "Solitary rugose corals. Septa of two orders, highly and irregularly carinate in the dissepimentarium with yardarm and zigzag carinae. Septa more or less dilated

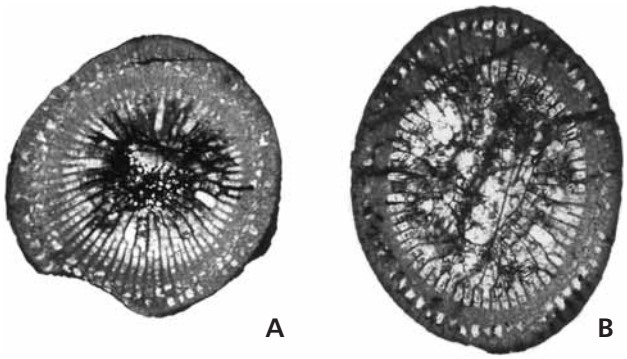


Figure 3. *Spinophyllum conicum* Kettnerová, 1932, Lower Givetian, Čelechovice Limestone, Čelechovice na Hané, Moravia. Holotype, specimen PřFUK 27. • A – transverse section, × 2. • B – transverse section close to the calice, × 2.

in the dissepimentarium and thin in the tabularium. Major septa reaching the axis of the corallum or leaving an open space in the centre of the tabularium. Minor septa traversing the entire dissepimentarium. Dissepimentarium composed of several rows of globose dissepiments arranged in horizontal layers in its outer part and inclined towards the axis of the corallum in its inner part. Tabulae incomplete or compound" (Coen-Aubert 2002).

Liao & Birenheide (1989) added that "traces of a cardinal fossula or a shortening of the cardinal septum are often recognizable".

Pedder (1972, 1999) and McLean (1993) brought attention to the charactophylloid double bend of septal trabeculae in *Spinophyllum*. Wrzołek & Wach (1994) also considered it an important feature of the mentioned genus.

Discussion. – Birenheide and Lütte (1990) chose the lectotype and re-illustrated *Spinophyllum spongiosum* (Schlüter, 1889), in pl. 3, fig. 15 (lectotype GNBo 174a), and pl. 3, fig. 16 (lectotype GMBo 174b), from Rheinisches Schiefergebirge, Büchel Formation, Bergisches Land, abandoned quarry at Büchel, Bergisch-Gladbach; Coen-Aubert (2002) and Schröder (2005) considered their choice unfortunate. The lectotype is re-figured in Wrzołek & Wach (1994, pl. 2, fig. 11), Coen-Aubert (2002, pl. 2, figs 11, 12), and also here in Fig. 2A, B. The figs 15 and 19 in pl. 3 and possibly also figs 10, 12, 13, 14 and 16 of Birenheide & Lütte (1990) have coarse monacanthine trabeculae. However, they do not have the characteristic charactophylloid bend (see Oliver & Sorauf 1988; Pedder 1972, 1982; and Sorauf 1998). Although there is an upward bend seen in the lower left part of the fig. 15b, the downward then upward double bend of the typical charactophyllids is missing. The trabeculae in fig. 11b and possibly also in figs 11, 17, and 20 are arranged in high angle and seem to belong to the other species or genus. Hill (1981, p. F269–F270, fig. 172/3a, b) illustrated an excellent example of *Spinophyllum spongiosum* with a well-developed double bend of charactophylloids. Mentioned specimen is the topotype from Büchel Quarry, Bergisch Gladbach, and is probably the best illustration of *S. spongiosum* morphology. McLean (1993, p. 110) stated that "characteristic charactophylloid trabeculae" are seen in pl. 2, fig. 10b and pl. 3, fig. 19b of Birenheide & Lütte (1990); he did not mention decisive pl. 3, fig. 15b. Further notes to the lectotype of *S. spongiosum* see Coen-Aubert (2002).

Wrzołek & Wach (1994) have also questioned the Birenheide & Lütte (1984) interpretation of *Spinophyllum spongiosum.*

As mentioned above, Birenheide (1978) considered *Spinophyllum* Wedekind, 1922, a junior synonym of *Charactophyllum* Simpson, 1900. Nevertheless, Sorauf (1998) newly described the type species of *Charactophyllum* and thus discriminated both genera.

Coen-Aubert (2002) adds synonyms to *Spinophyllum* Wedekind, 1922, namely *Charisphyllum* Oliver & Sorauf, 1988, further *Truncicarinulum* Yu & Kuang, 1982, and *Spongielasma* Cao, 1983 *in* Cao *et al.* (1983).

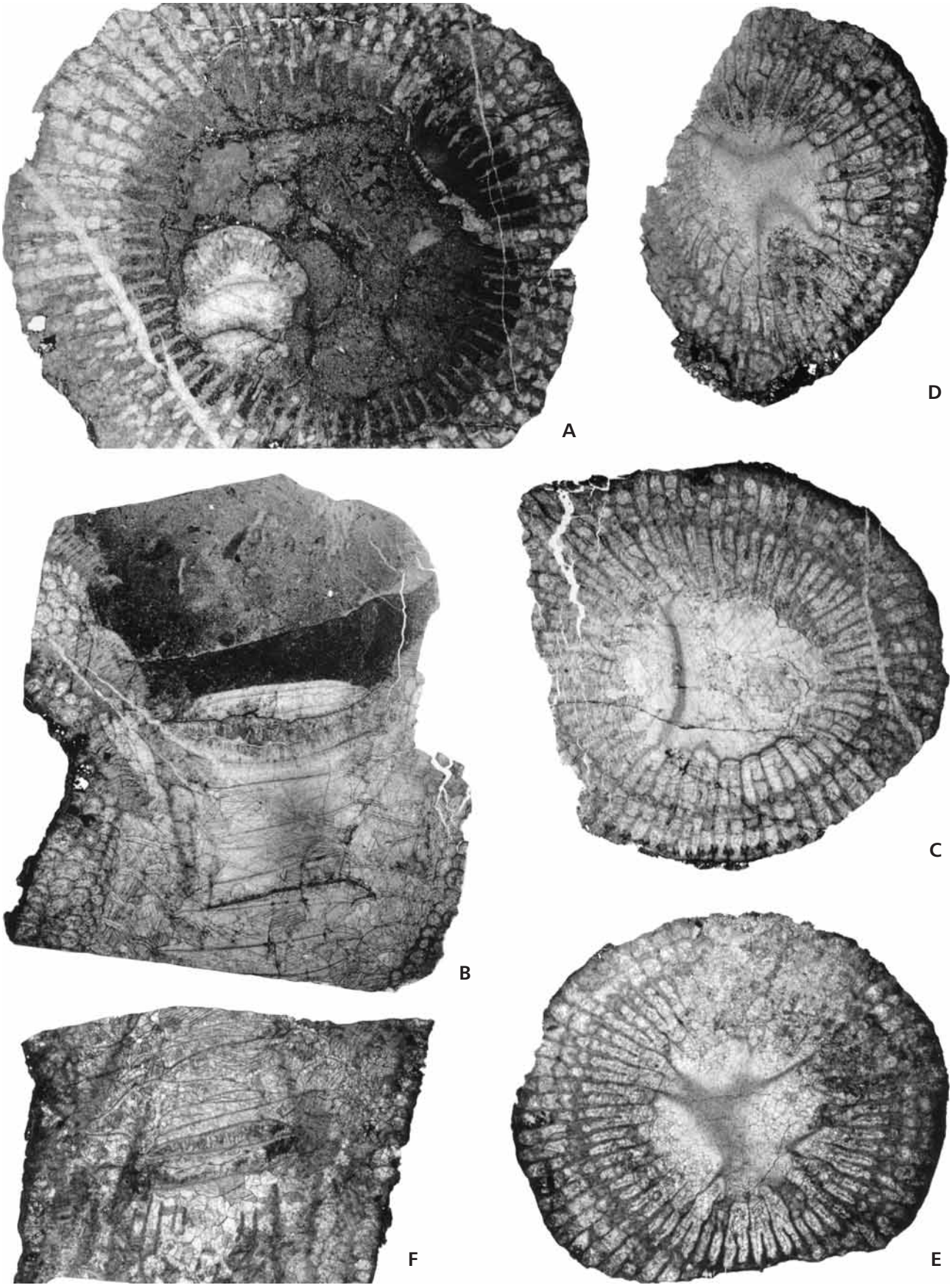
McLean (1993) puts *Truncicarinulum* Yu & Kuang, 1982, and *Charisphyllum* Oliver & Sorauf, 1988, synonymous with *Spinophyllum* Wedekind, 1922.

Schröder (2004) calls attention to wide variability of the septal morphology of *Spinophyllum.* It leads, in his opinion, to erection of numerous new taxa.

Oliver & Sorauf (1988) describe *Charisphyllum altevogti* from the Givetian of Cantabrian Mountains, Asturias, Spain. It differs from the lectotype of *Spinophyllum spongiosum* (Schlüter, 1889) in the presence of well-developed coarse trabeculae with typical charactophylloid double bend. Oliver & Sorauf (1988) also compare *C. altevogti,* besides Moravian *Spinophyllum conicum* Kettnerová, 1932, to an undescribed species from Middle Devonian of Western Sahara, and to *Heliophyllum aiense* Soshkina, 1949 (pl. 36, figs 2, 5).

Pedder (1999) emphasizes that "the most important feature of the *Charisphyllum*... is that the monacanths are

Figure 4. *Spinophyllum conicum* Kettnerová, 1932, Lower Givetian, Čelechovice Limestone, Čelechovice na Hané, Moravia. • A – specimen AG 1398A, calicinal transverse section with calicinal increase and with coarse zigzag and yardarm carinae, × 4. • B – the same specimen AG 1398D, longitudinal section with steeply sloping globose and subpeneckielloid dissepiments and with periaxial tabellae. Note coarse charactophylloid trabeculae, × 4. • C – the same specimen AG 1398B, transverse section, × 4. • D – the same specimen AG 1398C, transverse section with possible fossula or pseudofossula probably with shortened protoseptum, × 4. • E – specimen AG 1380A, transverse section with weakly carinated septa, × 4. • F – the same specimen AG 1380C, longitudinal section with poorly preserved charactophylloid trabeculae, × 4.


A
D
B
C
F
E

not ony separated peripherally to form yardarm carinae, but adaxially they are flexed in the charactophylloid manner".

Moravian specimens of *Spinophyllum* resemble *"Charisphyllum"* in the mentioned character. It is hard to decide whether *Spinophyllum* and *Charisphyllum* are congeneric or not, as the type specimen of *Spinophyllum spongiosum* (Schlüter, 1889) has bent trabeculae, but the double bend characteristic of *Charisphyllum* is not fully developed.

Spinophyllum conicum Kettnerová, 1932

Figures 3, 4

1932 *Spinophyllum conicum* n. sp.; Kettnerová, pp. 55, 56, pl. 2, figs 7, 8; pl. 3, figs 4, 5; text-fig. 41.

Holotype. – PřFUK No. 27, two transverse sections, one of which is figured in Kettnerová, text-fig. 41, Čelechovice, Čelechovice Limestone, early Givetian. Here it is refigured (Fig. 3A). Kettnerová's (1932) unfigured thin section, here in Fig. 3B, very probably belongs to the holotype.

Material. – AG 1380A–C (Fig. 4E, F), 2 transverse and 1 longitudinal sections; AG 1398A–D (Fig. 4A–D), 3 transverse and 1 longitudinal sections; AG 1515A, B (unfigured), 1 transverse and 1 longitudinal sections; AG 1517A, B (unfigured), 1 transverse and 1 tangential sections; and probably also AG 1514B (unfigured), 1 oblique transverse section all Čelechovice.

Diagnosis. – *Spinophyllum* with dilated septa which are sometimes in lateral contact, with globular dissepiments dominating. Mean corallite diameter is 16.7 mm, mean tabularium diameter is 10.3 mm, mean number of major septa is 33.75.

Description. – Corallum solitary, conical, with calicinal increase (Fig. 4A, AG 1398A). Septa are radially arranged, a single section shows possible fossula or psudofossula, probably with shortened protoseptum (Fig. 4D, AG 1398C). Major septa reach a half to two-thirds of the corallite radius and sometimes to the corallite axis, minors attain approximately two-thirds of the length of majors. Both major and minor septa are slightly spindle-shaped, weakly to heavily carinated, particularly in their attenuate peripheral parts. Carinae are of zigzag type, in places the yardarm carinae are present (Fig. 4A, AG 1398A). Both major and minor septa are moderately thickened, in places they are in the lateral contact, particularly in the thickened part of dissepimentarium at the tabularium border. Dissepimentarium is built of two to five rows of steeply sloping globose to subpeneckielloid dissepiments diminishing toward the corallite axis (Fig. 4B, AG 1398D). Rare stereoplasmatic thickening occurs. Tabularium consists of the axial series of flat tabellae, peripheral tabellae are relatively gentle-sloping toward axis.

Dimensions in mm.

Čelechovice	d	dt	nI
OR	7.94–22.94	6.47–12.76	28–38
N	10	8	8
Mean	15.62	9.66	32.5

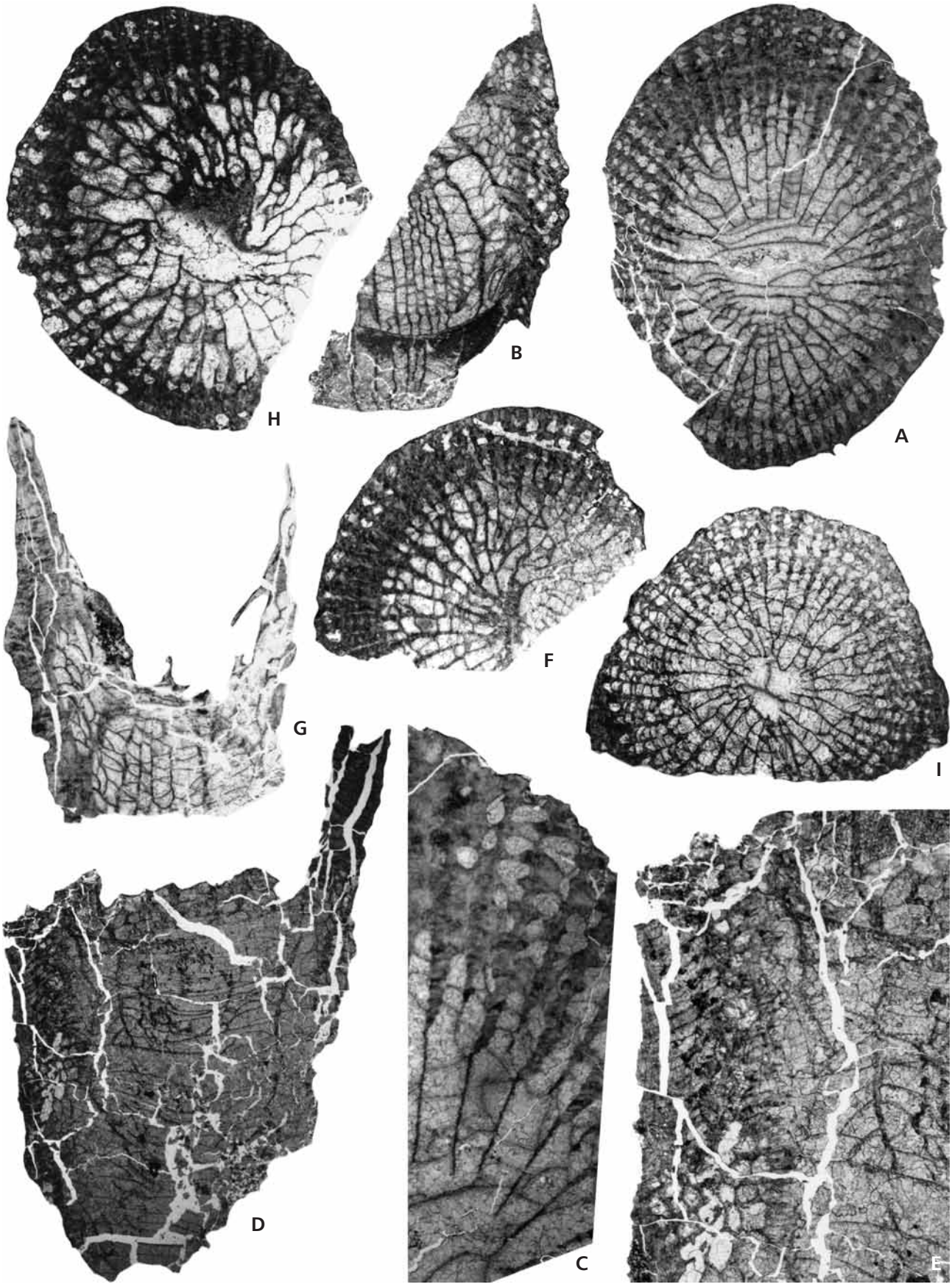
Fine structure. – Septa are built of coarse uniserial charactophylloid monacanths. Monacanths are in some places tufted so that they resemble rhipidacanths. Trabeculae display the pronounced sigmoidal charactophylloid bend; they are flat-lying (75° to almost horizontal) at both their ends, peripheral and adaxial ones, while steeply sloping toward the periphery under the angle of 40° to 20° in the central part of the dissepimentarium (Fig. 4B, F, AG 1398D, AG 1380C).

Discussion. – The type species *Spinophyllum spongiosum* (Schlüter, 1889) differs from *Spinophyllum conicum* Kettnerová, 1932, particularly in the shape of trabeculae which are only very slightly bent or almost straight in *S. spongiosum.*

Spinophyllum conicum Kettnerová, 1932, differs from the species *S. altevogti* (Oliver & Sorauf, 1988) in less conspicuously developed carinae, however, both yardarm and zigzag carinae being present. Majors of *S. altevogti* are longer than those in *S. conicum*; moreover, the corallite diameter and number of septa are larger in the type species.

Oliver & Sorauf (1988) held *S. conicum* Kettnerová, 1932, for probable *Charisphyllum* Oliver & Sorauf, 1988.

Figure 5. *Spinophyllum ondra* sp. nov., Lower Givetian, Čelechovice Limestone, borehole Měnín-1, core No. 12, Moravia. • A – specimen AG 653A, holotype, transverse section, major and minor septa with heavily developed yardarm carinae often in lateral contact, depth 397.9 m, × 4. • B – the same specimen AG 653B, holotype, oblique longitudinal section, depth 397.9 m, × 4. • C – the same specimen AG 653A, holotype, detail of Fig. 12, × 11. • D – specimen AG 656A, paratype, longitudinal section with conspicuous sigmoidally arranged charactophylloid trabeculae, depth 397.8 m, × 4. • E – the same specimen AG 656A, paratype, detail of Fig. 15, × 11. • F – specimen AG 655A, paratype, transverse section with septa reaching the axis, depth 397.8 m, × 4. • G – the same specimen AG 655B, paratype, oblique longitudinal calicinal section, × 4. • H – specimen AG 654A, paratype, transverse section, depth 397.9 m, × 5. • I – specimen AG 661A, paratype, transverse section, septa less carinated, depth 397.8 m, × 5.


H
B
A
G
F
I
D
C
E

Another Moravian species *Spinophyllum ondra* sp. nov. differs from *S. conicum* mainly in its dimensions (corallite diameter = 6.5–17.6 mm, tabularium diameter = 4.1–9.2 mm, number of majors = 20–31 at *Spinophyllum ondra* sp. nov.), and, further, in steeper elongate dissepiments and in much less dilated septa and less pronounced carinae at *S. conicum.*

S. conicum differs from the species described from Poland by Wrzołek & Wach (1994), *S. longiseptatum* (Lütte, 1984), *S.* aff. *longiseptatum* (Lütte, 1984), *S. aiense aiense* (Soshkina, 1949), and *S. aiense liujingense* (Yu & Kuang, 1984) in lacking the charactophylloid double bent trabeculae.

Spinophyllum sp. cf. *S. conicum* Kettnerová, 1932, described in Galle (1994) from the Barrandian Eifelian/Givetian Acanthopyge Limestone from the vicinity of Koněprusy has not the charactophylloid trabeculae developed; herein, the Barrandian specimen is not considered a member of *Spinophyllum* Wedekind, 1922.

Occurrence. – Middle Devonian, Lower Givetian; Moravia, Čelechovice.

Spinophyllum ondra sp. nov.

Figures 5, 6

1981 *Charactophyllum* sp. nov.; Galle, p. 59, pl. 34, figs 1–4; pl. 35, figs 1–4.

Holotype. – Specimen AG 653A–C, two transverse and one oblique longitudinal sections, borehole Měnín-1, core No. 12, depth 397.9 m, figured here in Fig. 5A–C.

Paratypes. – Specimens AG 550, single incomplete transverse section, depth 397.0–402.0 m (unfigured); AG 654A, B, 1 transverse and 1 longitudinal sections, depth 397.9 m (Fig. 5H); AG 655A, B, 1 incomplete transverse and 1 oblique longitudinal sections, depth 397.8 m (Fig. 5F, G); AG 656A, B, 1 axial longitudinal and 1 tangential sections, depth 397.8 m (Fig. 5D, E); AG 657, transverse section, depth 398.7 m; AG 658A–C, 3 oblique transverse sections, depth 398.7 m; AG 659A–C, 1 transverse, 1 longitudinal and 1 oblique sections, depth 397.9 m; AG 660, oblique transverse section, depth 397.9 m; AG 661, transverse section through two corallites, depth 397.8 m (Fig. 5I); AG 662, incomplete transverse section, depth 397.8 m; AG 663A, B, 1 oblique transverse and 1 tangential sections, depth 397.9 m (unfigured); AG 664, tangential section, depth 398.7 m; AG 665, incomplete transverse section, depth 397.8 m; AG 666, incomplete transverse section, depth 398.7 m; AG 667A, B, 2 tangential sections, depth 397.9 m; AG 669, transverse section, depth 397.9 m; AG 670A–C, 3 transverse sections, depth 397.8 m; AG 672, transverse section, depth 398.5 m; and 673A, B, 1 transverse and 1 oblique sections, depth 397.8 m, all unfigured, all specimens borehole Měnín-1, core No. 12.

Material. – Specimens AG 556A, B, 1 transverse and 1 longitudinal sections, depth 397.0–402.0 m; AG 668, transverse section, depth 397.9 m; AG 671A, B, 2 transverse sections, depth 397.9 m; and AG 674, oblique section, depth 398.5 m, all unfigured, all borehole Měnín-1, core No. 12, and AG 1057A–D, 2 transverse and 2 longitudinal sections, Čelechovice Lst., early Givetian, Zrcadla near Lažánky at Blansko, Moravian Karst (Fig. 6A–C).

Etymology. – Ondra – diminutive of Ondřej, Czech first name (Andrew).

Diagnosis. – *Spinophyllum* with relatively steeply arranged elongated dissepiments and with heavily dilated septa, septa in lateral contact, mean values of d = 11 mm, dt = 7 mm, and nI = 27.5.

Description. – Corallum solitary, conical. Major septa sometimes reach the axis where they are sometimes in contact or interfinger, more often they leave the inner tabularium free. Minor septa reach approximately one-half to two-thirds of the length of majors. Both major and minor septa are heavily carinated with yardarm carinae (Fig. 5A, C, AG 653A). Both major and minor septa are dilated, usually they are in the lateral contact in the inner dissepimentarium, less often they are in contact along entire width of dissepimentarium or are touching each other only by their carinae in some places.

Dissepimentarium is built of one to two series of flat elongated dissepiments, and an inner series of small globose dissepiments relatively steeply sloping toward the axis. Stereoplasmatic thickening occurs only rarely in the dissepimentarium. Tabularium is built of complete tabulae; they are almost flat-lying, with depressed axial part. Peripheral tabellae are sometimes developed (Fig. 5D, E, AG 656A).

Fine structure. – Septa are built of coarse charactophylloid monacanths. Within the thinner adaxial part of septum monacanths are fine and less pronounced. Carinae are arranged in conspicuously sigmoidal pattern; they are flat-lying under the angle 80° at the periphery and adaxially, more steeply-sloping under the angle 60° in their central parts (Fig. 5D, E, A656B, Fig. 6C, AG 1057C). It is characteristic of charactophylloid trabeculae of Pedder (1972).

Discussion. – The type species *Spinophyllum spongiosum* (Schlüter, 1889) differs from *Spinophyllum ondra* sp. nov. particularly in the shape of trabeculae which are only very slightly bent or almost straight.

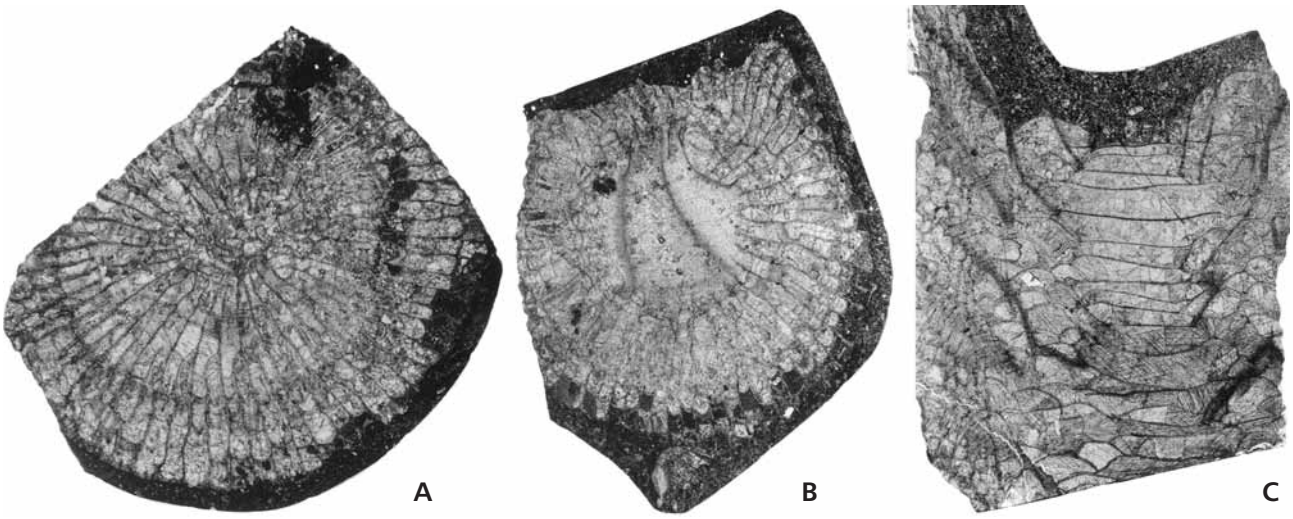


Figure 6. *Spinophyllum ondra* sp. nov., Lower Givetian, Čelechovice Limestone, Zrcadla at Lažánky, Moravian Karst, Moravia. • A – specimen AG 1057B, transverse section with carinated septa reaching the corallite axis, × 4.5. • B – specimen AG 1057A, transverse section with poorly carinated septa, × 4.5. • C – specimen AG 1057C, longitudinal section with coarse charactophylloid monacanths, × 4.5.

Dimensions in mm.

Měnín-1	d	dt	nI
OR	6.47–17.65	4.12–9.23	20–31
N	17	12	8
Mean	11.17	6.94	27.37
Zrcadla	d	dt	nI+II
OR	12.22–23.33	10.00–12.22	69
N	2	2	2
Mean	17.77	11.11	69

Spinophyllum ondra sp. nov. differs from *S. conicum* Kettnerová, 1932, in its dimensions (main value of corallite diameter = 15.5 mm at *S. conicum*). Moreover, *S. conicum* is not as heavily dilated as *S. ondra,* and its dissepiments are elongate and relatively steeply arranged.

Spinophyllum ondra sp. nov. differs from *Spinophyllum altevogti* (Oliver & Sorauf, 1988) from the Spanish Cantabrian Mountains in much more dilated septa which are only seldom in the lateral contact with the Spanish species. The Moravian species is also more heavily carinated. Furthermore, *S. ondra* sp. nov. differs from *S. altevogti* (Oliver & Sorauf, 1988) in more steeply inclined trabeculae/carinae, in less numerous rows of dissepiments, in the tabulae which are incomplete in *S. altevogti,* and in much smaller dimensions.

Spinophyllum ondra sp. nov., similar to other Moravian species *S. conicum,* differs from the species described in Poland by Wrzołek & Wach (1994), *S. longiseptatum* (Lütte, 1984), *S.* aff. *longiseptatum* (Lütte, 1984), *S. aiense aiense* (Soshkina, 1949), and *S. aiense liujingense* (Yu & Kuang, 1984), in lacking the charactophylloid double bent trabeculae.

Occurrence. – *Spinophyllum ondra* sp. nov. is known till now from the borehole Mě-1 Měnín, core No. 12, depth 397.8–398.9 m, and from Lažánky – Zrcadla in the Moravian Karst, both localities of the Lower Givetian age.

"Spinophyllum sp. cf. *conicum* Kettnerová, 1932"

Figures 7A, B

1994 *Spinophyllum* sp. cf. *conicum* Kettnerová, 1932. – Galle, p. 49, pl. 1, figs 6, 7; pl. 2, fig. 12.

Material. – Transverse thin-section No. 3730, derived from the 2nd coral horizon, beds 10, 11, Preislerův Quarry (Fig. 7A); and another specimen with longitudinal thin-section No. 3679, 4th coral horizon, breccia bed 46, Jiráskův Quarry (Fig. 7B). Both thin-sections need not be conspecific.

Description. – Corallum, calice shape and dimensions are unknown. The outline of the corallite is circular, outer wall is missing. Major septa reach half the corallite radius, minors are only slightly shorter. Septa are radially arranged, attenuate, smooth or with inconspicuous zigzag or sometimes yardarm carinae, arranged in half-fans. Dissepimentarium is built of one to three rows of relatively large, flat-lying, elongated, sometimes slightly peneckielloid dissepiments, and another one to three rows of small globose steeply inclined dissepiments. Tabularium is built of flat-lying axial tabellae and smaller periaxial tabellae; axial longitudinal section is missing.

Discussion. – "*Spinophyllum* sp. cf. *S. conicum* Kettne-

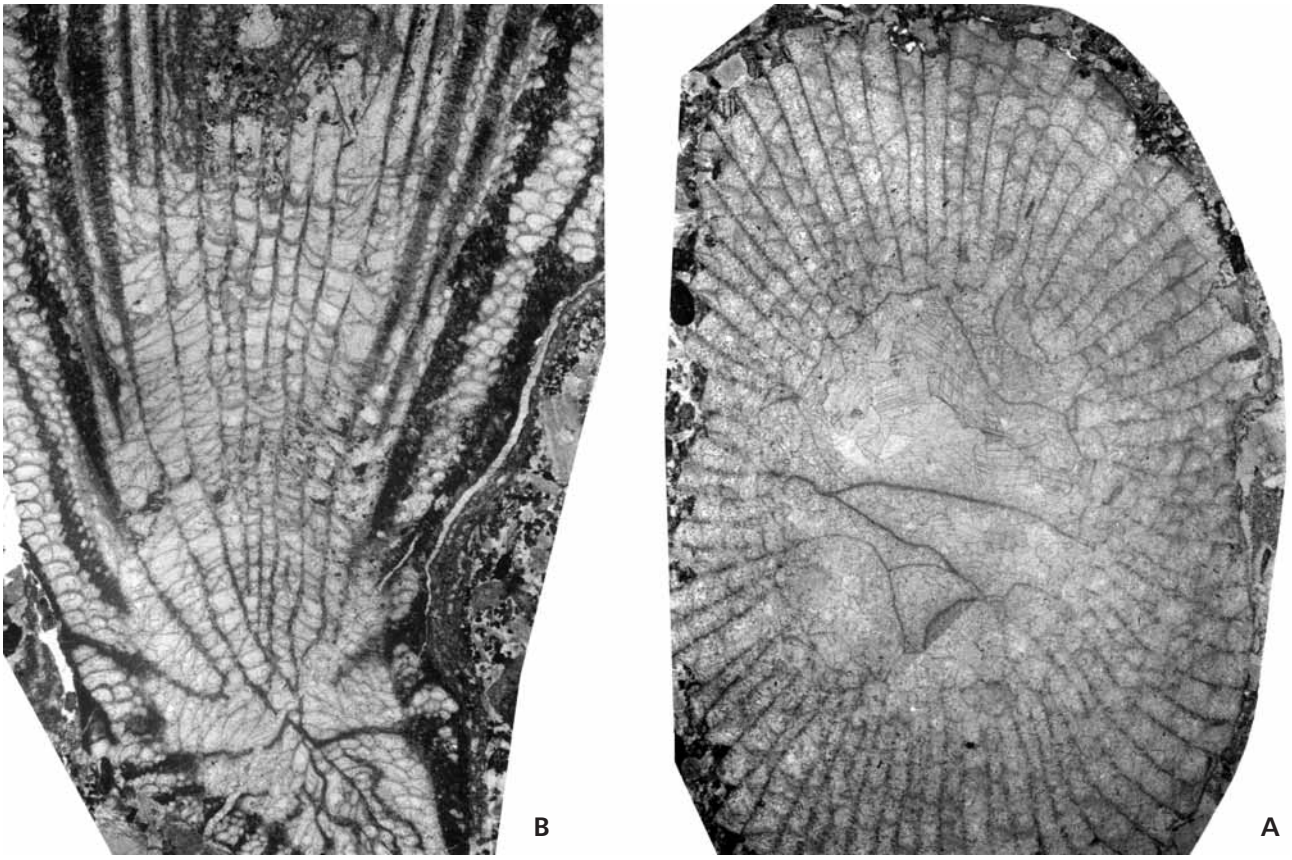


Figure 7. "*Spinophyllum* sp. cf. *S. conicum* Kettnerová, 1932", uppermost Eifelian or lowermost Givetian, Acanthopyge Limestone. • A – 2nd coral horizon, beds 10–11, Preislerův Quarry, Koněprusy. Transverse section No. 3730 with smooth and inconspicuously carinated septa, × 4.5. • B – 3rd coral horizon, Jiráskův Quarry, Koněprusy. Longitudinal section No. 3679 with fine monacanths in half-fan, × 4.5.

Dimensions in mm.

	d	dt	nI+II	w	tab/5 mm	r. diss.
OR	18.09	10.0	36 x 2	0.19	9–15	1–4
N	1	1	1	1	5	10
mean	–	–	–	–	12.2	2.3

rová, 1932" as described in Galle (1994) resembles Moravian specimens of *S. conicum* Kettnerová, 1932, from the early Givetian Čelechovice Lst. from Čelechovice (Kettnerová, 1932, text-fig. 41; here in Figs 3, 4), and *S. ondra* sp. nov. (here in Figs 5, 6) from the borehole Měnín Mě-1 and from Lažánky – Zrcadla in the Moravian Karst. The septa of the Moravian species are composed of coarse charactophylloid monacanths. They are highly variable in their length, reaching the corallite axis and only slightly over half the corallite radius in the same corallite. They also vary in their thickness, being attenuate and slightly dilated, sometimes also in the same specimen. Attenuate septa tend to be smooth or only slightly carinated. Bohemian specimens do not differ in their dimensions from the Moravian ones (d = 7.94–23.33 mm, dt = 6.47–12.76, and nI = 29–38). The Bohemian specimen differs from the Moravian ones in slender and gracile trabeculae/carinae arranged in half-fans, resembling those in some specimens *S. spongiosum* (Schlüter, 1889); figs 11, 11b, 17 and 20 of Birenheide & Lütte (1990).

The Koněprusy specimens differ from *Spinophyllum* in having slender septal trabeculae arranged in a half-fan or asymmetrical fan. In this, and in its flat dissepimentarium, it seems to be close to paradisphyllids. According to Schröder (pers. comm. 2003), it also has "more flat or even evert dissepimentarium in the early stage, almost reminding of the *Gurievskiella*-type".

The type species *Spinophyllum spongiosum* (Schlüter, 1889) from the middle Givetian of the Rhenish Slate Mountains (Birenheide & Lütte, 1990, p. 4, pls 1–3) differs from the species discussed above in that the length of major septa reaches nearly the axis, while minors are just half the length of the radius. In other characters, both the species are similar.

Occurrence. – Middle Devonian, Eifelian and lowermost Givetian, Acanthopyge Lst., Preislerův and Jiráskův quarries nearby Koněprusy, Bohemia.

Conclusions

The species close to those described as *Charisphyllum* Oliver & Sorauf, 1988, are well defined, particularly by their fine structure of coarse monacanthine trabeculae with double sigmoidal bend. On the other hand, it is impossible to exclude "*Charisphyllum"*from the genus *Spinophyllum* Wedekind, 1922, because it is not clear whether *Spinophyllum* differs from *Charisphyllum*: septal trabeculae of *S.* display slight bend but serious comparison of both respective genera is impossible because of inadequate lectotype (see Coen-Aubert 2002).

Acknowledgements

The author is indebted to late William A. Oliver, Jr., U. S. Geological Survey, Washington, D.C., U. S. A., for inspiring discussion of *Charisphyllum* and *Spinophyllum.* Thanks are also due to Jindřich Hladil, Geological Institute, AS CR, for consulting tabulates; to Bernd-Peter Lütte, Universität Münster, and Stefan Schröder, Universität München, for photographing and discussing *Spinophyllum*; and to Dieter Weyer, Berlin, and Tomasz Wrzołek, Silesian University Sosnowiec, for their kind help with the author's sources. I am also indebted to Alan E.H. Pedder, Sydney, B.C., Canada, and Bernd-Peter Lütte, Universität Münster, who read the manuscript with open criticism and contributed to its amendment.The work on the project has been supported by the grant of the Grant Agency of the Czech Academy of Sciences IAA3013207, "Coral fauna of the Bohemian Massif", and, in part, also IAA300130702, "Growth rhythms as an indicator of the Earth's rotation and climate changes in the geological past", with valuable contributions of an overall research plan CEZ AV0Z30130516.

References

BIRENHEIDE, R. 1978. Rugose Korallen des Devon, 1–265. *In* KRÖMMELBEIN, K. (ed.) *Leitfossilien 2*. Gebrüder Borntraeger, Berlin and Stuttgart.

BIRENHEIDE, R. & LÜTTE, B.-P. 1990. Rugose Korallen aus dem Mittel-Givetium (Mittel-Devon) des Rheinischen Schiefergebirges. *Senckenbergiana lethaea 70*, 1–28.

CAO, X.D., OUYANG, X. & JIN, T.A. 1983. Rugosa, 46–179. *In Paleontological Atlas of Northwest China, Shaanxi, Gansu and Ningxia Volume. Part II Upper Palaeozoic.* Geological Publishing House, Beijing.

CHLUPÁČ, I. 1964. Výskyt trilobita *Schizoproetus celechovicensis* (Sm.) v Moravském krasu a jeho význam. *Věstník Ústředního ústavu geologického 39,* 441–447.

COEN-AUBERT, M. 2002. Temnophyllids and Spinophyllids (Rugosa) from the Givetian Mont d'Haurs Formation in Belgium. *Bulletin de l'Institut royal des Sciences Naturelles de Belgique, Sciences de la Terre 72*, 5–24.

GALLE, A. 1981. Rugose corals of the slopes of Bohemian Massif in the region "South", 59–66. *In* KALVODA, J. (ed.) *Biostratigrafie paleozoika na jihovýchodní Moravě. Knihovnička Zemního plynu a nafty 2*.

GALLE, A. 1985a. On some Moravian Devonian Rugosa. *Věstník Ústředního ústavu geologického 60*, 241–244.

GALLE, A. 1985b. Biostratigraphy and rugose corals of Moravian Devonian (Czechoslovakia). *Newsletters on Stratigraphy 14*, 48–68.

GALLE, A. 1994. Rugose corals of the Acanthopyge Limestone of Koněprusy (Middle Devonian, Barrandian, Czech Republic). *Věstník Českého geologického ústavu 69*, 41–54.

GALLE, A., FRIÁKOVÁ, O., HLADIL, J., KALVODA, J., KREJČÍ, Z. & ZUKALOVÁ, V. 1988. Biostratigraphy of Middle and Upper Devonian carbonates in Moravia, Czechoslovakia, 633–645. *In* MCMILLAN, N.J., EMBRY, A.F. & GLASS, D.J. (eds) *Devonian of the World. Vol. III: Paleontology, Paleoecology and Biostratigraphy. Canadian Society of Petroleum Geologists, Memoir 14*.

GALLE, A. & HLADIL, J. 1991. Lower Paleozoic Corals of Bohemia and Moravia. *Fossil VI. Cnidaria Guidebook B3*, 1–83.

HILL, D. 1981. Part F. Coelenterata. Supplement 1. Rugosa and Tabulata. Vol. 1, F1–F378. *In* TEICHERT, C. (ed.) *Treatise on Invertebrate Paleontology.* Boulder and Lawrence.

HLADIL, J. 1974. Tabulate corals from the Paleozoic basement of the Carpathian Foredeep (borehole Nítkovice-2). *Věstník Ústředního ústavu geologického 49*, 219–222.

HLADIL, J. 1981. Devonian tabulate corals from deep boreholes located south of Brno, 35–36. *In* KALVODA, J. (ed.) *Biostratigrafie paleozoika na jihovýchodní Moravě. Knihovnička Zemního plynu a nafty 2.*

HLADIL, J. 1985a. Tabulate corals from the NP 824 Ostravice borehole. *Acta Universitatis Carolinae, Geologica 3*, 251–259.

HLADIL, J. 1985b. The occurrence of the Eifelian tabulate corals, chaetetids and heliolitids in southeast Moravia. *Zemní plyn a nafta 30*, 17–30.

HLADIL, J., PRUNER, P., VENHODOVÁ, D., HLADILOVÁ, T. & MAN, O. 2002. Toward an exact age of Middle Devonian Čelechovice corals – Past problems in biostratigraphy and present solutions complemented by new magnetosusceptibility measurements. *Coral Research Bulletin 7*, 65–71.

KETTNEROVÁ, M. 1932. Palaeontological studies of the Devonian of Čelechovice. Part IV. Rugosa. *Práce geologicko-paleontologického ústavu Karlovy university*, 1–63.

LIAO, W. & BIRENHEIDE, R. 1989. Rugose corals from the Frasnian of Tushan Province of Guizhou, South China. *Courier Forschungsinstitut Senckenberg 110,* 81–103.

MCLEAN, R.A. 1993. The Devonian rugose coral family Charactophyllidae Pedder. *Courier Forschungsinstitut Senckenberg 164*, 109–118.

MCLEAN, R.A. 2007. Kyphophyllid rugose corals from the Frasnian (Upper Devonian) of Canada and their biostratigraphic significance. *Palaeontographica canadiana 26*, 1–109.

OLIVER, W.A. JR. & SORAUF, J.E. 1988. Heliophyllum Hall and *Charisphyllum* n. gen. (Devonian rugose corals) of the Cantabrian Mountains (NW Spain). *Trabajos de Geología 17*, 3–17.

PEDDER, A.E.H. 1972. Species of the Tetracoral genus *Temno-*

phyllum from Givetian/Frasnian boundary beds of the District of Mackenzie, Canada. *Journal of Paleontology 46(5),* 696–710.

PEDDER, A.E.H. 1999. Paleogeographic Implications of a Devonian (Givetian, Lower Varcus Subzone) Rugose Coral Fauna from the Ma'der Basin (Morocco). *In* FEIST, R., TALENT, J.A. & DAURER, A. (eds) *North Gondwana: Mid-Paleozoic Terranes, Stratigraphy and Biota. Abhandlungen der geologischen Bundesanstalt 54,* 385–434.

SCHLÜTER, C. 1889. Anthozoen des rheinischen Mittel-Devon. *Abhandlungen zur Geologischen Specialkarte von Preussen und den thüringischen Staaten 8(4)*, x + 1–207.

SCHRÖDER, S. 1997. Die Rugosen-Fauna des Eilenbergium der Dollendorfer Mulde (Mittel-Devon/Ober-Eifelium; Rheinisches Schiefergebirge/Eifel). *Geologica et Palaeontologica 31,* 1–36.

SCHRÖDER, S. 2004. Devonian rugose corals from the Karakorum Mountains (Northern Pakistan). *Rivista Italiana di Paleontologia e Stratigrafia 110(3),* 605–641.

SCHRÖDER, S. 2005. Stratigraphie und Systematik rugoser Korallen aus dem Givetium und Unter-Frasnium des Rheinischen Schiefergebirges (Sauerland/Bergisches Land). *Zitteliana B25,* 39–116.

SORAUF, J.E. 1998. Frasnian (Upper Devonian) rugose corals from the Lime Creek and Shell Rock Formations of Iowa. *Bulletins of American Paleontology 113(355)*, 1–159.

SOSHKINA, F.D. 1949. Devonskie korally Rugosa Urala. *Trudy Paleontologicheskogo Instituta AN SSSR 15(4)*, 1–160.

VAVRDOVÁ, M. 2004. The Brunovistulicum: assumptions and data. *Zeitschrift der Deutschen geologischen Geselschaft 155*, 1–9.

WEDEKIND, R. 1922. Zur Kenntnis der Stringophyllen des oberen Mitteldevon. *Sitzungs-Berichte der Gesellschaft zur Beforderung der gesamten Naturwissenschaften zu Marburg 1921(1)*, 1–16.

WRZOŁEK, T. & WACH, P. 1994. Tetracoral genus Spinophyllum in the Devonian of the Holy Cross Mts., Poland. *Prace naukowe Uniwersytetu Śląskiego, Geologia 12–13*, 47–63.

YU, C.M. & KUANG, G.D. 1982. Late Middle Devonian rugose corals from Liujing, Heng Xian, Guangxi and their paleoecological significance. *Bulletin of the Nanjing Institute of Geology and Palaeontology, Academia Sinica 4*, 241–278.

ZUKALOVÁ, V. 1981. Distribution and stratigraphical significance of the stromatoporoids and microfossils contained in the Devonian limestones (Givetian and Frasnian) from deep boreholes south and southeast of Brno, 49–57. *In* KALVODA, J. (ed.) *Biostratigrafie paleozoika na jihovýchodní Moravě. Knihovnička Zemního plynu a nafty 2.*

ZUKALOVÁ, V., KALVODA, J., GALLE, A. & HLADIL, J. 1981. The biostratigraphy of the Paleozoic rocks in the deep boreholes southeast of Brno, 21–30. In KALVODA, J. (ed.) *Biostratigrafie paleozoika na jihovýchodní Moravě. Knihovnička Zemního plynu a nafty 2.*