Llandovery–Wenlock boundary beds in the graptolite-rich sequence of the Barrandian area (Bohemia)

Hraniční polohy llandovery a wenlocku ve facii graptolitových břidiel v Barrandienu (Czech summary)

(4 plates, 5 text–figs.)

PETR STORCH
Geologický ústav Akademie věd ČR, Rozvojová 135, 165 00 Praha 6
Submitted April 19, 1994

Temporary excavations at Velká Ohrada and two other sections through the graptolite-rich Llandovery–Wenlock boundary strata have been examined bed by bed. In the St. grandis, Cyrt. insectus, Cyrt. centrifugus, and Cyrt. murchisoni Zones 43 graptolite taxa have been found. The diverse graptolite assemblages are listed, seven poorly known Bouček’s and Přibiyl’s species redescribed and Monograptus vitatus sp.n. described. The Barrandian sections account for a distinct change in graptolite fauna at about the base of the insectus Zone as opposed to a very minor change at the base of the centrifugus Zone. The base of the insectus Zone and of the Wenlock Series respectively are correlated with the base of the centrifugus Zone in these regions in abroad (including the type Wenlock area), where the insectus Zone is not recognized.

Introduction

Some doubts about absolute correlative potential of global boundary stratotypes of the Silurian series and stages have been confirmed in course of present discussion on an internationally acceptable Silurian standard graptolite zonal scheme. The Llandovery–Wenlock boundary sections in the type Wenlock area, for instance, little contributed to precise international correlation based on graptolites. In Bohemia and elsewhere in the world, however, the corresponding, but graptolite rich Llandovery–Wenlock boundary strata yield good basis for detailed graptolite biostratigraphy and correlation.

In Bohemia many sections through the graptolitic shales of Barrandian area have been studied by Bouček (1930, 1931, 1937, 1942, 1946), Přibiyl (1937, 1938a, 1938b, 1940a), Bouček and Přibiyl (1952), Štorch (1980, 1986, 1991 MS) and Turek (1990). Comprehensive papers on the lower Silurian graptolite biostratigraphy of the Barrandian area were published by Bouček (1953) and Štorch (1994). The range–zones, partial–range zones, couple–range zones, partial couple–range zones, interval zones, and abundance zones have been recognized by Štorch (1994) and utilized in his zonal chart. The same zones are used in present paper.

The uppermost Telychian and lower Sheinwoodian, i.e. the Llandovery–Wenlock boundary interval, is developed in form of dark grey to black, graptolitic shales of Motol Formation. In course of Cyrt. centrifugus and Cyrt. murchisoni Zones the black calcareous shales alternated with dark muddy limestones with occasional laminae of fine biotetral limestones. The calcareous graptolitic shales persisted into the succeeding M. riccartonensis and Pr. dubius Zones. The shales are bleached by fossil humid weathering where an old pre–Quaternary penneplain is preserved near the outcrops.

Recently the Llandovery–Wenlock boundary interval has been accessible to stratigraphical studies at several places in the SW part of Prague territory. Sedimentary sequence cropping out at rocky slope above the Vltava River locality “Na Vyskočilce” near Malá Chuchle, grid references X5544371, Y3456698 (Gauss – Krueger), text–fig. 1, no. 2] has already been described by Bouček (1953). It is slightly tectonized and disrupted by a basalt sill between the grandis and insectus Zones. The steep slope is not suitable for extensive collecting and much old data came from isolated blocks fallen below the rock. Another locality has been studied at the opposite bank of Vltava River, in railway cutting, besides the railway bridge in Braník (X5544072, Y3457544, text–fig. 1, no. 3, locality “Hodkovicky” described by Přibiyl 1938b and Štorch 1991). There the basalt sill penetrated the black shales below the base of the murchisoni Zone.

The best of Llandovery–Wenlock boundary sections, bearing common and moderately well preserved graptolites in the continuous sedimentary sequence, has been temporarily exposed by building excavations along Červenán–
ského Street at the eastern margin of Velká Ohrada Settlement (X5545408, Y3452684, text-fig. 1, no. 1). It can be well used as local Llandovery–Wenlock boundary reference section in the Barrandian area.

**Lithology and stratigraphy of Velká Ohrada reference section**

The section begins with the upper part of the upper Ordovician Kosov Formation and terminates with the upper Wenlock basalt tuffs in the Motol Formation. All the beds of about 40 m thick sequence dip about 30° to the South-West. No faults and few and weak folds have been recorded there. The rocks are bleached by deep fossil weathering typical of old, Tertiary peneplain at the SW and W periphery of Prague. The Silurian shales yielded common graptolites preserved as brown–black carbon films on light-grey bedding planes.

About four metres thick light–grey to white mudstones intercalated by few solid siltstone beds were exposed at the base of the section. They represent the upper part of the Kosov Formation. The last metre of this unit is composed of bioturbated and limonitized calcareous mudstones with infrequent pelocarbonate nodules. The calcareous rocks, though decalcified by fossil weathering, yielded uncommon brachiopods [*Dalmannia testudinaria* (Dalman), *Eostrophocodonta squamosa* Havlíček, *Leptaenopoma sp.*] along with rare *Normalograptus persculptus* (Salter) = *Gt. bohemicus* Marek. The fossils belong to the famous *Hrnčířia* Fauna and *persculptus* (= *bohemicus*) Biozone which both are well known from several other localities of the NE part of the Prague Basin (Marek and Havlíček 1967, Štöch 1986, 1991).

The mudstones of the Kosov Formation are overlain by 2 m of green–to-yellow–coloured barren mudstone, a marker bed of the base of the Litohlav Formation (*Kříž 1975, Štöch – Pašava 1989, Štöch 1991*).

According to precise dating by graptolites of neighbouring black shales, the base of the basal mudstone of Litohlav Formation varies usually between the top of the *sedgwickii* Zone and the base of the *turrilarius* Zone, being preceded by about 15 m of graptolitic shales of the Želkovice Formation (*Rhuddanian and Aeranian*). In the NE part of the Prague Basin, where an intensive along-shore current of NE–SW direction (*Štöch 1981*) caused a long period of nondeposition, at several places the basal mudstone of the Litohlav Formation was found at the immediate base of the Silurian sediments. At Velká Ohrada section the whole Želkovice Formation is missing and the Silurian sequence starts with this mudstone bed.

In this section the basal mudstone is succeeded by black graptolitic shales of the *griestoniensis* Zone. About 2 m thick sequence of the *griestoniensis* Zone is composed by almost regular alternation of graptolitic shales and light-coloured claystones. Common laminae, few mm in thickness, of fine, unsorted, clayey breccias are the only feature markedly different from the common lithology of the Litohlav Formation. Breccias originated by rapid sedimentation of angular fragments of grey claystones, pale claystones, greenish claystones, and uncommon,
subrounded, green, partly decomposed volcanic glasses. Quartz grains or pebbles are not present. The shaly fragments up to 10 mm in diameter account for rather high-energy depositional regimen.

Badly preserved graptolite fauna confined to dark beds consists of *Petalograptus tenuis* (Barrande), *Monograptus cf. priodon* (Bronn), *Monograptus veles* (Richter), *Monograptus proteus* (Barrande), and *Monoclimacus griestoniensis* (Nicol).

The laminae of clayey breccias gradually disappeared in the lower part of the succeeding *Monograptus tullbergi* Zone. About 3.5 m thick *tullbergi* Zone is formed by alternated graptolitic shales and pale barren mudstones. Here the index graptolite *Monograptus tullbergi* Bouček is common, being accompanied by *P. tenuis* (Barrande), *Retiolites geinitzianus angustidens* Elles and Wood, *Monograptus priodon* (Bronn), *Monograptus veles* (Richter), *Monoclimacus griestoniensis* (Nicol) a.o.

Almost regular alternation of graptolitic shales and light mudstones continues up to the lowermost part of the *Monograptus spiralis* Zone. The base of the *spiralis* Zone is formalized herein in the first bed containing common *M. spiralis* Geinitz. *M. tullbergi* Bouček is already missing in this bed. The base of the succeeding lithostratigraphic unit – the Motol Formation – is formalized at the top of the last light mudstone intercalation, herein 0.8 m above the base of about 12 m thick *spiralis* Zone. Greater part of the thickness of the *spiralis* Zone is formed by silty, often micaceous, partly bleached graptolitic shales. Any precise biostratigraphical data are limited by poor preservation of graptolites. The typical rhabdosomess of *M. spiralis* and of some other species allowed the rough biostratigraphic evaluation of these beds.

Completeness of the graptolite record much improved in the shales of the uppermost part of the *spiralis* Zone. Rich and moderately well preserved graptolitic fauna throughout the *Stomograptus grandis*, *Cystograptus insectus*, *Cyrtr. centrifugus* and *Cyrtr. murchisoni* Zones yields much new data about the graptolite history and fine stratigraphy across the Llandovery–Wenlock boundary.
The uppermost part of the brachiopods with variable silty admixture. The graptolite assemblage is characterized by common Monograptus grandis (Bouck), Monograptus scoticus (Hemm.), and Cyrtograptus grandis (Hemm.). The uppermost graptolite zone, defined by the appearance of the genus Strophomenopsis, is followed by the start of the Llandovery stage, 8 cm thick (the base of the grandis Zone). The base of the grandis Zone at Velká Obora is well recognizable, as a distinct black shale layer, followed by a thin region of greenish-gray shales, and finally by the base of the great Biozone, which is marked by the first appearance of Monograptus grandis. The sequence of Monograptus grandis is generally consistent with the graptolite biozone at Velká Obora, but some discrepancies are observed in the interval between the base of Monograptus grandis and the base of the great Biozone. The graptolite biozone at Velká Obora is known to be 1.2 m thick, which may be due to the presence of a thin layer of detrital material.
common and well determinable *Stomatagruptus grandis grandis* (Suess) soon followed by another characteristic taxon – *Monograptus probosceliformis* Bouček. A single specimen of bivalve *Praecardium* sp. (det. J. Krůž) was found in the lower part of the zone.

Several characteristic species of the succeeding *Cyrtograptus insectus* Zone [*Monograptus kolihai* Bouček, *Monograptus pseudoculitellus* Bouček, *Monoclimacis basilica* (Lapworth), *Monoclimacis chuchlenis* Bouček, and *Pseudoplegmatogruptus giganteus* Bouček and Münch] appear below the top of the *grandis* Zone. They are followed by *Cyrtograptus insectus* Bouček at the base of the *insectus* Zone (partial–range zone by Štorch 1994). Just above this level *Cyrtograptus lapworthi* (Tullberg) disappears, being relieved by *Monograptus kodymi* Bouček. Another graptolite taxa (e.g. *Pseudoplegmatogruptus praemacilentus* Bouček and Münch) and *Monograptus remotus minor* Bouček) appear whilst *St. grandis grandis* (Suess), *Mcl. chuchlenis* Pribyl, and *Pseudoplegmatogruptus* sp. B (ex gr. *obsesus*) disappear in the upper part of the *insectus* Zone. About 1.7 m thick zone is composed of alternation of more and less silty, greyish, often laminated graptolite shales.

The base of the *Cyrtograptus centrifugus* Zone is marked by common, mostly juvenile procladia of *Cyr. centrifugus* Bouček. Besides the index species the graptolite association is dominated by *Monograptus priodon* (Brenn), *Monograptus cf. validus* Perner, *Monoclimacis vomerina* (Elles and Wood), and *Reticolites geinitzianus* ssp. Also *Mcl. basilica* (Lapworth), *M. kolihai* Bouček, *M. pseudoculitellus* Bouček, and *Psp. praemacilentus* (Bouček and Münch) are common. In the middle of the zone *M. kodymi* Bouček disappears and *M. cf. latus* Perner, *M. inconspicuous* Bouček, and *Mcl. gracilis* (Elles and Wood) appear.

At Velká Ohrada the lower part of uniform, 0.8 m thick sequence of brown–grey silty shales of the *centrifugus* Zone (partial–range zone) is disrupted by second, white, 14 cm thick, bed of argillitizado muddy limestone.

At Velká Ohrada the base of *Cyrtograptus murchisoni* Partial–range zone is marked by the first occurrence of *Cyrtograptus murchisoni bohemicus* Bouček. Rare *Cyr. murchisoni murchisoni* Carruthers appears little higher. The two subspecies are hard to tell apart when fragmentary and/or not well preserved. *Cyr. murchisoni bohemicus* seems to be much more common than the nominate subspecies. Besides *Cyr. murchisoni bohemicus* Bouček and numerous long-ranging species (such as *M. priodon*, *M. validus*, *Mcl. vomerina*, *Pr. largus*, *Pr. praedubius*) the *murchisoni* Zone assemblage is composed by *Ret. geinitzianus geinitzianus* (Barrande), *Monograptus remotus minor* Bouček, *M. remotus remotus* Elles and Wood, *Monograptus vittatus* sp. n., and *Mcl. gracilis* Elles and Wood. *Monograptus raditannis Bouček*, *?Monoclimacis adunca* (Bouček), and *Pristograptus dubius dubius* (Suess) are confined to the upper part of 2.4 m thick *murchisoni* Zone. *Monoclimacis defixa* (Bouček) and *M. firmus* Bouček were found just below the first *Monograptus riccartonensis* Lapworth – the zonal index species of the next zone. The *murchisoni* Zone is composed by decalcified and bleached brown–grey shales with variable silty admixture. The third horizon of white, decalcified and argillitizado muddy limestone, 6 cm in thickness, occurs in about the middle of the zone.

Non-graptolite fauna of the *murchisoni* Zone is represented by flattened nautiloid shells ("Dawsonoceras", surprisingly common "Phragmoceras" a.o.), *Aptychopsis* sp., and rare brachiopods *Valdivia budillii* Havlíček. Several mm long chains of chitinozoan cysts are frequent on bedding planes. Dendroid graptolites were represented by rare fragments of *Dictyonema* sp., and *Dendrograptus* sp.

The base of about 2 m thick *Monograptus riccartonensis* Zone (taxon–range zone) is accompanied by almost total breakdown of diversified graptolite assemblage of the *murchisoni* Zone. Fifteen of its 19 graptolite species disappeared at the base of the *riccartonensis* Zone and only one – *M. riccartonensis* Lapworth – appeared, being possible successor of *M. firmus*. Reticolitids, *Barrandograptus* and *Cyrtograptus* disappeared, *Monograptus* and *Monoclimacis* were severely reduced in both species diversity and abundance. Bedding planes of soft, brownish, decalcified shales are crowded by siculai whilst mature graptolite rhadomesomes, mostly of *M. riccartonensis* Lapworth are uncommon. Mass juvenile mortality characterizes both the present zone and succeeding *dubius* Zone. The two zones yield good evidence of one of big crises in graptolite history. The *riccartonensis* Zone assemblage consists of common rhadomesomes of the index species accompanied by infrequent *M. cf. latus* Perner, *Monoclimacis hemipristis* (Meneghini), and *Pr. dubius dubius* (Suess). *Pseudoplegmatogruptus wenlockianus* Štorch was found in about the middle of the zone, *Pr. dubius latus* Bouček appears in the upper part of the zone. *Monograptus solitarius* Bouček and *Streptograptus antennularis* (Meneghini), reported by Bouček (1953), have not been re-
corded at present section.

At Velká Ohrada the graptolite bearing sequence finished with about 2.2 m of pale brown, soft, decalcified shales of the Pristiograptus dubius Zone. The graptolite fauna is represented by Pr. dubius dubius (Suess) and Pr. dubius latus (Bouček). Many bedding planes are crowded by isolated siculae. The zone was taken by Štchorc (1994) as the interval zone of Pr. dubius ranging from the last occurrence of M. ricketsonensis up to the appearance of Monograptus belophorus (Meneghini).

Graptolite shales are succeeded by white to green, often spotted, argillitized basaltic siltstones and tuffs, more than 10 m in thickness, intercalated with badly weathered lenses of biotritral limestones. Volcaniclastic clasts are related to adjacent Řeporyje volcanic centre (Kříž 1990). They belong to initial period of volcanogenic activity, common to Řeporyje and Svatý Jan volcanic centres, and dated by underlying sediments of the dubius Zone and overlying sediments of belophorus Zone (Štchorc 1991 MS). At present section the volcanoclastics are cutted by erosional disconformity and covered by Cretaceous sandstones.

Conclusions

A total of 43 graptolite species have been recorded in the grandis, insectus, centrifugus, and murchisoni Zones. Graptolite taphroconoses account for gradual increase in species diversity, without any prominent radiation and/or extinction events. Despite this statement, several well determinable species of promising correlative potential appear at about the base of the insectus Zone (Ps. giganteus, M. kollahi, M. kodymi, M. pseudocutellus, Mcl. basilica, Mcl. chuchlen- sis, and Cyrn. insectus). The base of the succeeding centrifugus Zone lacks such distinct faunal change.

The base of the Wenlock Series was formally placed at the base of the centrifugus Zone in the Wenlock area in England. Graptolite evidence of the centrifugus Zone, however, is insufficient in the type area, being based on the presence of Pr. watneyae and Mcl. aff. vormerina the stratigraphic range of which is not well known. In general, the graptolites are neither common and diverse in the type Wenlock area (Holland and Bassett 1989) and precise correlation with graptolite-rich sequences is difficult. Graptolite zones equal to the grandis and insectus Zones of Bohemia have not yet been recognized in Great Britain (Bassett et al. 1975, Rickards 1976, White et al. 1992). According to some graptolite successions elsewhere (Bornholm Island, Bjerreskov 1975, Arctic Canada, Lenz and Melchin 1990, China, Mu et al. 1986, and Poland, Teller 1969) Cyrt. insectus occurs along with or in the lower part of stratigraphic range of Cyrt. centrifugus. In the Barrandian area, however, Cyrt. insectus clearly precedes Cyrt. centrifugus as already shown by Bouček (1953) and Štchorc (1991). Here the appearance of Cyrt. insectus is accompanied by a distinct change in the associated graptolite fauna as opposed to a very minor change at the base of the centrifugus Zone. The faunal change at the base of the insectus Zone in Bohemia is correlative to that observed at the base of the centrifugus Zone where the insectus Zone is not recognized. That is why in Bohemia the base of the Wenlock Series is placed traditionally at the base of the insectus Zone despite the last zonal chart by Loydell and Cave (1993) which referred the Bohemian insectus Zone to the top of the Llandovery Series.

The above described Llandovery-Wenlock boundary reference section at Velká Ohrada is remarkable from another points of view as well.

The Hirnantia Fauna (Havlíček 1982, Štchorc 1986) and Glyptograptus perculptus (= bohemicus) were found in the light mudstones just below the top of the upper Ordovician Kosov Formation. The mudstones were succeeded by long period of nondeposition (Štchorc 1986, 1991). Both Rhuddanian, Aeronian, and lower Telychian sediments are missing and the Kosov mudstones are overlain by thick basal mudstone of the Litohlav Formation.

At Velká Ohrada the first graptolite shales above the basal mudstone of the Litohlav Formation contain graptolites of the griesoniensis Zone. The basal mudstone attained the highest stratigraphic level in the sequence if compared to the other localities in the Barrandian area. Thin laminae of clayey breccias in the griesoniensis and lower tulibergi Zones could be related to big storms or some unknown volcanic events. Basalt tuffs and hyaloclastites overlying the graptolite shales of the dubius Zone document the first eruptions in the adjacent Řeporyje volcanic centre.

Systematic part

Family Monograptidae Lapworth, 1873

Diagnosis: See Mitchell, 1987 for Monograptinae.

Genus Monograptus Geinitz, 1852, emend Bulman, 1970

Type species (subsequent designation by Bassler, 1915): Lomatoceras pridion Breuning, 1935, from the Silurian of Germany.


Monograptus pseudocutellus Bouček, 1932

Pl. II, fig. 6; pl. III, figs. 5, 6; text-fig. 5, figs. 12-14

1932 Monograptus pseudocutellus n. sp., Bouček, p. 153, text-fig. 1g.

Holotype: By monotypy. The specimen no. L 30165 from the Motol Formation at Vyskočilka near Malá Chuchle, Prague, Bohemia.

Material: About 80 flattened complete specimens from Velská Ohrada and Vyskočilka, including the type collection.

Description: The rhabdosome is small, weakly dorsally flexed, having a slightly ventrally reflexed proximal end. The maximum length is 12 mm. The dorso-ventral width increases quickly from 0.75–0.9 mm at th1 and 0.95–1.1 at th3 to the maximum of 1.1–1.2 (1.4) mm which is attained at th6.

The sicula is prominent, 1.3–1.5 mm long. The apex reaches to the base of th2. The sicular aperture is 0.2–0.3 mm wide, and is furnished with a 0.3–0.4 mm long virgella. The stipe is terminated by a few mm long nema.

The first theca originates 0.2–0.3 mm above the sicular apert- ture. The length of the th1 is 0.75–0.95 mm. The thecae are hooked, of modified pridion type. The prothecae are robust, box-like, having the free ventral wall weakly inclined or almost parallel to the rhabdosome axis. The S-shaped interthecal septum is nearly perpendicular to the rhabdosome axis. The metathecae grow slightly upwards, then turn downwards and form slender but prominent hooks terminated by dorso-proximally facing apertures. The metatheca hook occupies two-fifths of the width of the rhabdosome. The closely packed thecae number about 6.5 in distal 5 mm. The two-thecae repeat distance of th2 (2TRD 2) is 1.2–1.3 (1.1–1.4) mm, the 2TRD 5 is 1.35–1.6 mm.

Remarks: M. pseudocutellus Bouček is easily distinguished from M. cutellus Törnquist, as well as from any other Telychian and Sheinwoodian monograptids, by the general form and size of the rhabdosome and broad, box-like prothecae terminated by prominent but slim, hooked metathecae. The present material of M. pseudocutellus matches well Bouček's (1932) type material.

Monograptus kolhais Bouček, 1931

Pl. II, figs. 4, 10; pl. IV, figs. 8, text-figs. 5, figs. 6, 11, 13

1931b Monograptus kolhais n. sp., Bouček, p. 8, text-fig. 8a, b.

1951 Monograptus (Mediograptus) kolhais Bouček, 1931, Boljuk and Příbyl, p. 14, pl. 3, figs. 4, 5, text-fig. 3g, h.

Lectotype: Designated Příbyl (1948, p. 39). The specimen no. L 30671 figured by Bouček (1931a, fig. 8a) from the Motol Formation of Vyskočilka near Malá Chuchle, Prague, Bohemia.

Material: 28 flattened, mostly complete rhabdosomes from Velská Ohrada and Repy, and the type collections of Bouček (1931b) and Bouček and Příbyl (1951).

Diagnosis: Rhabdosome small, slender, dorsally curved, widening from 0.4–0.6 mm to the maximum of 0.55–0.75 mm which is attained at th3–th6. Sicula small, apex reaching the first metathecal lobe. The distance between sicular aperture and the first metatheca is 0.8–1.0 mm. Prothecae long, tubular, metathecae lobate, incurved. Apertures face the ventral wall of the protheca and are expanded into lateral processes. They are always distant from the ventral prothecal wall. The 2TRD 2 is 1.9–2.1 mm, 2TRD 10 is 3.1–3.5 mm, distal theca number 6 in 10 mm.

Description: The rhabdosome is dorsally curved throughout, though the curvature is stronger in the proximal part. Commonly the length is 10–20 mm and it rarely exceeds 30 mm. The rhabdosome widens rapidly from the initial width of 0.4–0.6 mm at the level of th1 to the maximum 0.55–0.75 mm which is reached at th3–th6.

The sicula is small but prominent, 0.8–0.95 mm long and 0.2–0.25 mm wide aperturally. The apex reaches almost to the level of the first thecal lobe. Long, 0.25–0.4 mm wide tubular prothecae are terminated by short, lobate metathecae. Prominent metathecal lobes occupy half to three-fifths of the width of the rhabdosome. The metathecae are incurved, obscuring completely the dorsal-facing aperture. The aperture is always separated from the ventral wall of the protheca. The present flattened material, shows that the metathecal lobe expands transversely into symmetrical lateral processes. The thecae overlap for about one-quarter of their length. The distance between the sicular aperture and th1 aperture is 0.8–1.0 mm. The two thecae re-
peat distance (2TRD) is (1.6) 1.9–2.1 mm at the level of th2. The 2TRD 5 is 2.4–3.0 (3.2) mm and 2TRD 10 is 3.1–3.5 mm (3.65 mm). The distal thecae number about 6 in 10 mm.

Remarks: The metathecal lobes of *M. kolihai* have never been seen adjoining the ventral walls of the prothecae as they often did in other related species. The spiny appearance of the apertural margin was created by flattening and distortion of the theca in the course of rock compaction. The author supposes that the metathecae of *M. kolihai* are similar to those described by Teller (1986) as the isolated proximal fragments of his *M. flexuosus* Tullberg. In all their diagnostic features and dimensions the specimens from Velká Ohrada agree with the type material of Bouček (1931) from Vyskočilka.

**Monograptus kodymi** Bouček, 1931

Pl. II, figs. 4, 5; pl. IV, fig. 5; text–fig. 5, figs. 17, 19

1931b Monograptus kodymi n. sp., Bouček, p. 8, text–fig. 8c, f.

1951 Monograptus (Mediograptus) kodymi Bouček, 1931, Bouček and Přibyl, p. 16, pl. 3, figs. 1–3, text–fig. 3d.

1965 Monograptus danuvi sp. nov., Rickards, p. 266, pl. 30, fig. 2, text–fig. 3h.

**Lectotype**: Designated Přibyl (1948, p. 29). The specimen no. L 30669 figured by Bouček (1931b) from the Motol Formation at Vyskočilka near Malá Chuchle, Prague, Bohemia.

**Material**: 28 flattened, mostly complete rhabdosome from Velká Ohrada and Rýpy, and the type collections of Bouček (1931b) and Bouček and Přibyl (1951) from Vyskočilka.

**Diagnosis**: The slender, dorsally curved rhabdosome widens from 0.4–0.6 mm to the maximum 0.65–0.85 mm within the 4–7 proximal thecae. Dorsal curvature is accentuated proximally. Sicula 0.85–1.0 mm long, the apex reaching the first metathecal lobe. Prothecae tubular, metathecae with prominent, transversely expanded symmetrical lobes. Incurred lobe occupies about half of the rhabdosomal width. The 2TRD 2 = 1.6–1.9 mm, 2TRD 10 = 1.9–2.2 mm, distal theca number 9.6–10.5 in 10 mm.

**Description**: The slender rhabdosome rarely exceeds 20 mm in length. It is dorsally curved throughout but the most prominent curvature is confined to its proximal part. The rhabdosome widens from 0.35–0.6 mm (at the level of the first metathecal lobe) to 0.45–0.7 mm, at the level of th3 up to the maximum 0.65–0.85 mm which is reached at th4–th7.

The small but prominent sicula is 0.85–1 mm long and 0.2 mm wide aperturally. The sicular apex reaches the first metatheca. The ventral walls of the tubular prothecae are parallel to the dorsal wall of the rhabdosome. The dorsal walls of the short, incurred metathecae form large lobes which, perhaps, completely cover the proximo–dorsally or dorsally facing apertures. The metathecal lobe is slightly transversely expanded into two symmetrical lateral processes. The lobe is not fully in contact with the free ventral prothecal wall, and occupies about half of the total width of the rhabdosome. The thecae overlap for about quarter of their length. The two thecae repeat distance – 2TRD 2 is 1.6–1.9 mm, 2TRD 5 = (1.6) 1.8–2.1 mm, 2TRD 10 = 1.9–2.2 mm. The most distal theca number 9.5–10.5 in 10 mm.

![Diagram](image_url)

**Fig. 4.** The differences in the 2TRD values among *M. kolihai*, *M. kodymi*, *M. vittatus*, *M. remotus remotus* and *M. remotus minor*.
Fig. 5.
1 - Monograptus remotus minor Bouček, 1931, PŠ 485, (murchisoni Zone)
2, 3a, b - Monoclinacis euchlensis Pribyl, 1941, 2 - PŠ 484, 3a, b PŠ 487, (insectus Zone)
4, 5 - Monograptus remotus remotus Elles and Wood, 1913, 4 - PŠ 5863, 5 - PŠ 5962, (murchisoni Zone)
6, 11, 18 - Monograptus kochiani Bouček, 1931, 6 - PŠ 481, 11 - PŠ 487, 18 - PŠ 477/1, (11 - insectus Zone, 6, 18 - centrifugus Zone)
7a, b, 9a, b, 15 - Monograptus vuittatus sp. n., 7a, b - PŠ 466, 9a, b - PŠ 483, 15 - PŠ 476, (murchisoni Zone)
8, 10, 16, 20a-f - Monoclinacis adunca (Bouček, 1931), 8 - PŠ 479/2 10 - PŠ 479/3, 16 - PŠ 482, 20a-f - PŠ 475, (murchisoni Zone)
12, 13, 14 - Monograptus pseudocutellatus Bouček, 1932, 12 - PŠ 478/1, 13 - PŠ 478/2, 14 - PŠ 480, (insectus Zone)
17, 19 - Monograptus kodymae Bouček, 1931, 17 - PŠ 599/1, 19 - PŠ 599/2, (insectus Zone)
(All specimens from Velká Ohrada, x4, except of fig. 10 (x2))
Remarks: *M. kodymi* is characterized by prominent and rather closely packed thecae the metathecal lobes of which are slightly transversely expanded into lateral processes. Paired lateral processes were recorded in obliquely oriented rhabdosomes. A nodular, almost streptograptid appearance was given to the metatheca when they were flattened in normal (i.e. dorso-ventral) position. The average dimensions of *M. kodymi* from both Velká Ohrada, Repy, and Vyskočilka differ slightly from those of the lectotype which is rather wide (up to 0.85 mm) and has less densely packed thecae (2TRD 2 = 1.9 mm, 2TRD 5 = 2.1 mm, 2TRD 10 = 2.2 mm). All the parameters of Bouček’s type specimens lie, however, within the variability of the present material. Teller (1986) synonymized both *M. kodymi*, *M. kolihai*, and *M. remotus minor* (former kolihai minor) with his *M. flexuosus* despite their entirely different thecal spacing, shape, and rhabdosome width. The incurved, lobate, transversely expanded metatheca appear to be the only feature common to some of these species.

**Monograptus vittatus** n. sp.

Pl. IV, figs. 3, 4, 76, text-fig. 5, figs. 7a, b, 79a, b, 15

Holotype: Complete, flattened specimen no. PŠ 476 (pl. VI, fig 4, text-fig. 4, fig. 15), from the *Cyrtoolithus* Zone of Velká Ohrada, Prague, Bohemia.

Material: 26 flattened, mostly complete rhabdosomes from Velká Ohrada.

Diagnosis: Rhabdosome slender, dorsally curved proximally, almost straight distally. It widens slowly to the maximum width of 0.6–0.7 mm. Prothecae long, their ventral walls parallel to the dorsal margin of the rhabdosome. Metathecae short, lobate. Symmetrical lobes are incurved and adpressed to the ventral prothecal wall, and transversely expanded into paired lateral processes. Thecae number 9.5–10.5 in 10 mm throughout the rhabdosome (2TRD = 1.8–2.1 mm).

Description: The slender arcuate rhabdosome attains a length of more than 40 mm. The dorsal curvature is prominent proximally, much less so distally. The initial width of the rhabdosome, i.e. height of the first theca, is 0.3–0.35 (0.25–0.4) mm. The rhabdosome is 0.35–0.4 (0.5) mm wide at the level of th3 and slowly widens to the maximum of (0.55) 0.6–0.7 mm reached at about th15.

The sicula is 1–1.2 mm long, the apex reaches up to the first metathecal lobe. The sicular aperture, about 0.2 mm wide, is provided with a short, thin virgella. The distance between the sicular aperture and the dorsal wall of the first theca is 1.1–1.4 (1.7) mm.

The thecae have tubular protheal portions having ventral walls parallel to the dorsal wall of the rhabdosome. The short, incurved meta- theca forms a prominent lobe, adpressed to the prothea and covering the thecal aperture. The metathecal lobe is transversely expanded into symmetrical lateral processes which are well seen when the rhabdosome is obliquely or dorso-ventrally oriented to the bedding plane. The “wing-span” of the lateral processes in the “scalariform” view is about 0.6 mm. The thecal lobe occupies about two-fifths of the rhabdosomal width. Thecae overlap a little in the present material. The two thecae repeat distance (2TRD) is 1.8–2.1 mm throughout the rhabdosome and theca number 9.5–10.5 in 10 mm.

Remarks. *M. vittatus* n. sp. differs from most of the related slender streptograptid–like monograptids (such as *M. kolihai*, *M. remotus remotus*, *M. remotus minor*, *M. minimus*) in having more closely spaced thecae and a more slowly widening rhabdosome. The transverse expansion of the metathecal lobes in *M. vittatus* resembles that of the metathecae of *M. flexuosus* sensu Teller (1986).

The rhabdosome of the most similar species – *M. kodymi* – is shorter, more robust, and has stronger proximal dorsal curvature. The maximum width of *M. kodymi* (0.65–0.85 mm) is attained at th4–th7 whilst the maximum width of *M. vittatus* (0.6–0.7 mm) is reached at th15. The more prominent metathecal lobes take up a greater part of the rhabdosomal width in *M. kodymi*. *M. vittatus* has a slightly longer sicula, more prominent lateral processes on the metathecal lobe, and greater 2TRD 2. The species, infrequent throughout the whole of the *Cyrtoolithus* Zone, may be a descendant of *M. kodymi*.

**Monograptus remotus remotus** Elles and Wood, 1913

Text-fig. 4, figs. 4, 5

1913 *Monograptus remotus*, sp. nov., Elles and Wood, p. 461, pl. 46, fig. 9a, b, text-fig. 319.

1926 *Monograptus remotus* Elles and Wood, Gortani, p. 10, pl. figs. 12, 13.
1945 Monograptus remotus Elles and Wood, p. 84, pl. 39, p. 403
1951 Monograptus (Mediograptus) remotus Elles and Wood, 1913, Bouček and Přibyl, p. 18, pl. 3, fig. 6, text-fig. 3(i).

Lectotype: Designated Přibyl (1948, p. 39). The specimen no. GSE 2622 figured by Elles and Wood (1913, pl. 6, fig. 9b, text-fig. 319) from Gala Beds of Rigg Burn, NW of Langholm, Scotland.

Material: 15 flattened, mostly incomplete specimens from Velká Ohráda and Motol, and the specimen figured by Bouček and Přibyl (1951).

Diagnosis: Rhabdosome very slender, dorsally curved proximally, almost straight distally. It widens slowly from 0.35–0.4 mm to the maximum of 0.55 mm. Prothecae long slender tubes terminated by small, incurved, lobate metathecae. Metathecal lobe adpressed to the ventral prothecal wall. Thecal spacing increases dramatically distally (2TRD 2 = 2.2–2.9 mm, 2TRD 5 = 4.2–4.7 mm, and 2TRD 10 = 4.5–7.7 mm). Distal theca number 3 in 10 mm.

Description: The rhabdosome is arcuate proximally and becomes almost straight distally. The longest measures 44 mm. The dorsal–ventral width increases slowly from 0.35–0.4 mm at the level of the first metatheca to the distal maximum of 0.55 mm.

The sicula is about 0.8 mm long and 0.2 mm wide aperturally. Its apex reaches the dorsal wall of the first metatheca. The prothecae are very long, slender tubes. Small, incurved, lobate metathecae occupy less than half of the dorsal–ventral width of the rhabdosome. They are adpressed to ventral prothecal walls. The first metathecal lobe grows up 0.8–1.0 mm above the sicular aperture. The two thecae repeat distance is 2.2–2.9 mm at the level of th2 (2TRD 2). The 2TRD 5 = 4.2–4.7 mm and 2TRD 10 = 4.5–7.7 mm. The most distal theca number about 3 in 10 mm.

Remarks: The present material matches the type one figured by Elles and Wood (1913) in both the dorsal curvature of the rhabdosome, thecal spacing and shape. The thecal lobes take up the same proportion of the total width of the rhabdosome. They are probably simple, without prominent lateral processes, although the appearance of the thecal lobes may be much influenced by mode of preservation.

Monograptus rematus minor Bouček, 1931

Text-fig. 5, fig 1

1931a Monograptus kolithai minor n. var., Bouček, p. 8, text-fig. 8c,d.
1951 Monograptus (Mediograptus) kolithai minor Bouček, 1931, Bouček and Přibyl, p. 15, pl. 3, figs. 7, 8, text-fig. 30f.

Lectotype: Designated Přibyl (1948, p. 39). The specimen no. L 30667 figured by Bouček (1931b, fig. 8d) from the Curit. murchisoni Zone of Vysokčík near Malá Chuchle, Prague, Bohemia.

Material: 28 flattened, mostly fragmentary rhabdosomes from Velká Ohráda, 10 rhabdosomes from Motol, and the type collection of Bouček (1931b).

Diagnosis: Slender, several cm long rhabdosome, dorsally curved throughout, the curvature accentuated proximally. The initial width 0.3–0.35 mm, the maximum 0.5–0.55 mm reached by th5–th10. Tubular prothecae long and slender, short metathecae incurved and adpressed to the rhabdosome. The 2TRD 2 = 2.4–2.7 mm, 2TRD 5 = 2.7–3.2 mm, 2TRD 10 = 3.5–3.7 mm. Distal theca number 5 in 10 mm.

Description: The slender, arcuate rhabdosome attains a length of more than 7 cm. Its proximal end is dorsally curved whilst the distal portion is only weakly flexed. The dorsal–ventral width of the rhabdosome increases slowly from 0.3–0.35 mm at the level of the first metatheca to the maximum of 0.5–0.55 mm which is reached between th5 and th10.

The sicula is 0.8–1.2 mm long and its apex reaches to almost the first metathecal lobe. The sicular aperture is 0.2 mm wide, and is furnished with a short, thin virgella. The distance between the sicular aperture and the first metatheca is about 1.3 mm. The short, incurved, lobate metathecae grow out from the long, tubular prothecae. Metathecal lobes adpressed to the ventral prothecal wall occupy two–fifths to half of the total width of the rhabdosome and cover the apertures. Thecal overlap appears to be rather low. The 2TRD 2 is 2.4–2.7 mm, 2TRD 5 is about 3.2 mm (2.7 mm in the type specimen), and the 2TRD 10 reaches 3.5–3.7 mm. Most distally the two thecae repeat distance is about 4 mm and the theca number 5 in 10 mm.

Remarks. Bouček (1931b) and Bouček and Přibyl (1951) considered M. remotus minor to be a late subspecies of M. kolithai Bouček. The two taxa differ however in thecal form. The metathecae in M. kolithai are much less adpressed to the rhabdosome, having a distinct space left between their dorsally facing apertures and the ventral prothecal walls. The lateral processes of the metathecal lobes of M. kolithai have not yet been recorded in M. remotus minor. The metathecae of M. remotus minor are probably close to those of M. remotus minor. The metathecae of M. remotus minor differ from the type subspecies in having more closely spaced thecae. Gradual distalward elongation of the prothecae is less dramatic in the former subspecies.
The type specimen of *M. remotus minor* figured by Bouček (1931b, fig. 8d) has particularly closely spaced thecae (2TRD 2 = 2.4 mm, 2TRD 5 = 2.7 mm) whilst the specimen figured as fig. 8c, as well as the other rhabdosome from the same slab of the shale, correspond to my present material in thecal spacing. The thecal shape is difficult to see in Bouček’s (1931b) poorly preserved type material.

**Genus** *Monoclimacis* Frech, 1897

**Type species** (by original designation): *Cryptolithus vomerius* Nicholson, 1872, *emend.* Lapworth, from the Corston Flags (Silurian) of Northern England.

**Diagnosis:** After Bulman, 1970

*Monoclimacis chuchlensis* Přibyl, 1940

*Pl. IV, figs. 1, 2, 7; text—fig. 5, figs. 2, 3a, b*

*1940b Monoclimacis chuchlensis* n. sp., Přibyl, p. 11, pl. 2, figs. 1–5.

**Holotype:** Original designation Přibyl, 1940b, figured on pl. 2, fig. 1. Specimen no. L 30672, from the Cyrt. insectus Zone of Vyskočilka near Malá Chuchle, Prague, Bohemia.

**Material:** 17 flattened, mostly complete but immature rhabdosomes from Vélká Ohrada and the type collection of Přibyl (1940b) from Vyskočilka (mostly distal fragments).

**Diagnosis.** Rhabdosome slender, ventrally curved proximally, almost straight distally. Initial width of the rhabdosome 0.25–0.3 mm, maximum of 0.8 mm attained about 8 cm away from the proximal end. Thecae elongated, monoclimacid, having pronounced geniculum and narrow apertural excavaions. Proximal thecae with tiny apertural hoods. Theca number 9.5–10.5 in 10 mm, 2TRD is 1.8–2.2 mm throughout the rhabdosome.

**Description.** The rhabdosome is slender, almost straight distally. It is characterized, however, by prominent ventral curvature in the several cm long proximal portion, although the proximal end is weakly dorsally reflexed in some specimens. The dorso-ventral width of the rhabdosome increases from 0.25–0.3 mm at th1 to 0.35–0.45 mm at the level of th10. A width of 0.5 mm is reached by th15–th30. The maximum width of 0.8 mm was observed in the distalmost fragments derived from very long (over 10 cm) specimens.

The sicula is 1–1.3 mm long and 0.25 mm wide aperturally. The sicular aperture is provided with a tiny virgella and a small ventral lobe. Th1 is 0.85–1.1 mm long. The sicular apex reaches the level of its apertural excavation or a little higher up. The thecae are slender, having pronounced genicula and small, narrow, apertural excavations. The excavations occupy about one-third of the width of the rhabdosome. Tiny apertural hoods were observed in the most proximal thecae of some rhabdosomes. The free suprageneric thecal wall is parallel to the dorsal wall of the rhabdosome. It is 0.95–1.0 mm long in the distal theca. Badly preserved intertheal septa appear to be short and the thecal overlap small. The two thecae repeat distance (2TRD) is 1.8–2.2 mm throughout the rhabdosome. Commonly the theca number 9.5–10.5 in 10 mm.

**Remarks.** The present material from Vélká Ohrada is composed of immature, up to 40 mm long rhabdosomes. Přibyl’s original description (1940b) of *Mcl. chuchlensis*, however, was based on more distal rhabdosomal fragments than any recently found. The proximal part of *Mcl. chuchlensis* had been unknown till now.

Common features, such as thecal count, slow widening, and ventral curvature of the rhabdosome, and narrow apertural excavations, related the present immature rhabdosomes to the distal fragments of *Mcl. chuchlensis*. In addition, the medial part of the rhabdosome has been recently exposed by careful preparation on the type slab. It matches well the corresponding portions of the rhabdosomes from Vélká Ohrada. *Mcl. chuchlensis* can be distinguished from all other monoclimacid by its distinctly ventrally curved, slowly widening rhabdosome, and narrow apertural excavations.

?*Monoclimacis adunca* (Bouček, 1931)

*Pl. III, figs. 1–3, 7; text—fig. 5, figs. 8, 10, 16, 20a–f*

*1931b Monagrapthus adunus* n. sp., Bouček, p. 295, fig. 2a–c.

*1940b Monoclimacis adunca* (Bouček 1931b), Přibyl, p. 8, pl. 1, figs. 11–13.

**Lectotype:** designated Přibyl (1940b, p. 8). The specimen is L 30665 figured by Bouček (1931b, fig. 2a) from the Cyrt. murchisoni Zone at Vyskočilka near Malá Chuchle, Prague, Bohemia.

**Material:** Nearly 100 flattened, mostly complete specimens from Vélká Ohrada and the type collection of Bouček (1931b) and Přibyl (1940b).

**Diagnosis.** Rhabdosome dorsally curved most proximally and then weakly ventrally curved, distal part straight. It widens from 0.5–0.7 mm (th1 level) and 0.6–0.8 mm (th3 level) to a maximum of 1.1 mm, reached about 8 cm away from the sicular end. Distal thecae of monoclimate type, with strong genicula and apertural
hoods. Proximal thecae with apertural hooks. Apertural hooks and hoods often prominent but can be negligible in some specimens. The 2TRD 2 = 1.6–1.8 mm, 2TRD 5 = 1.7–1.9 mm, distal thecae number 10–10.5 in 10 mm.

Description. The rhombosome is weakly doubly curved proximally. The most proximal portion is dorsally curved until the th5–8. Thereafter the curvature is ventral until about the th20–25. The sicula is 1.7–1.9 mm long, reaching up to the level of the dorsal wall of the first metatheca, or a little above. The sicular aperture is 0.3–0.35 mm in diameter.

The thecae (of monoclacidic type) are often provided with more or less prominent, apertural hooks and/or hoods. The proximal thecae are geniculate, with weakly inclined ventral, suprageneric walls. They are terminated by prominent, proximally facing apertural hooks of monograptid appearance. Distally the apertural hooks retreated, being reduced into the apertural hoods composed of the dorsal metathecal walls. In some specimens (e.g. the lectotype), however, particularly in the distal parts, the apertural hooks and hoods are almost negligible. Thecae in this case are of the typical monoclacidic appearance. The dorso-ventral width is 0.5 mm at the level of th1, 0.6 mm at th3, and 0.7–0.8 mm at th5 in these rhambosomes. The maximum width of 1.1 mm is attained about 8 cm away from the sicular end. The width of those specimens, provided with prominent apertural hooks, is 0.7 mm at th1, and 0.8 mm at th3. The thecae overlap for one-third to two-fifths of their length in the distal part of the rhombosome.

The two thecae repeat distance is 1.6–1.8 mm at the level of th2, the 2TRD 5 is 1.7–1.9 mm. Distally the 2TRD values are about 1.9 mm and the theca number 10–10.5 in 10 mm.

Remarks: Surprising variability in the apertural hooks and/or hoods and, consequently, in the thecal appearance was observed in ?Mcl. adunca. The rhambosomes vary from those without apertural hooks and hoods, to those with moderately developed hoods, up to those with prominent hook-like apertural structures. No rhambosome was found in scalariform or sub-scalariform position and the variability of the apertural structures does not depend on the orientation of the rhambosome. The differences in the apertural shape between the rhambosomes appear to have been primary.

?Mcl. adunca differs from ?M. radotinensis Bouček, 1931 by less curved proximal part of the rhambosome and by the thecal shape. The metathecae of ?M. radotinensis are hooked throughout the rhambosome and match the most proximal metathecae of ?Mcl. adunca.

Acknowledgments: I thank D.K. Loydell for his helpful critical reading through the systematic part of the manuscript.

Translated by the author

References


Hraníční polohy llandovery a wenlocku ve facií graptolitových břidlic v Barrandínu


Báze wenlocku byla formálně stanovena na bázi zóny centripitatus v oblasti Wenlocku v Anglii, na profilích s chudou graptolitovou faunou, bez diagnosedních zvířat. Pracovní korelace bazálního stratotypu s graptolitovými sekvencemi v oblastech mimo Británie není dosud možná. Graptolitové zóny ekvivalentní českým zónám grandis a insectus nebyly v Británii dosud rozlišeny. Z graptolitových zón byly popsány na horních (Dansko), v Polsku, v arkáické Kanadě a v Číně je však zjáčněno, že Cyrt. insectus se mohlo objevovat společně s Cyrt. centripitatus. V Barrandínu v cyrt. centripitatus přechází na cyrt. centripitatus a dožívá vymezení samostatné zóny. Báze zóny insectus v Barrandínu je proto korelována s bází zóny centripitatus v Anglii a v dalších oblastech, kde zóna insectus není rozlišena. Ze stejných důvodů je možno bázi wenlocku klást v Barrandínu na podkladu báze zóny insectus. Profil v Velké Obráde přinesl těž absolventy hraníčních fauny a Glyptograptus peregrinus (= bohemius) v kosovském souvrství, doklad o podmínek břidlic ve spodním a středním llandovery a údaje o stratigrafickém postavení bazálního jádra litolitického souvrství. Vyznání v této Pr. dubius dokládají počátek bazaltového vulkanismu v řeporyjském vulkanickém centru.
Explanation of plates

Plate I
1 - *Cyrtoiceras insectus* Bouček, 1931, PŠ 571, (insectus Zone).
2, 3 - *Cyrtoiceras centrifugus* Bouček, 1931, 2 - PŠ 572, 3 - PŠ 488, (centrifugus Zone).
4 - *Cyrtoiceras murchisoni bohemicus* Bouček, 1933, PŠ - 486, (murchisoni Zone).

All from Volká Ohrada, x 3.

Plate II
1 - *Monograptus prolasciformis* Bouček, 1931, PŠ 573, (grandis Zone).
3 - *Stomatograptus grandis* Suess, 1851, PŠ 574, (grandis Zone).
4 - *Monograptus kohkai* Bouček, 1931 and *Monograptus kodymani* Bouček, 1931, PŠ 78, (insectus Zone).
5 - *Monograptus kodymani* Bouček, 1931, PŠ 590, (insectus Zone).
6 - *Monograptus pseudocutellus* Bouček, 1932, PŠ 478, (insectus Zone).

1-3, 5, 6 - from Volká Ohrada, 4 - from Řepy, 1, 4-6 x5, 2 x4, 3 x2.5.

Plate III
1-3, 7 - *Monograptus adunca* (Bouček, 1931), 1, 2, 7 - PŠ 475, 3 - PŠ 479/2, (murchisoni Zone).
4 - *Pseudoplectograptus praemaciatus* (Bouček and Münch, 1952), PŠ 510, (centrifugus Zone).
5, 6 - *Monograptus pseudocutellus* Bouček, 1931, 5 - PŠ 478, 6 - PŠ 480, (insectus Zone).

All from Volká Ohrada, 1-3 x5, 4 x10, 5, 6 x9, 7 x3.

Plate IV
1, 2, 7 - *Monograptus chuciensis* Přibyl, 1949, 1, 2 - PŠ 487, 7 - PŠ 484, (insectus Zone).
3, 4, 76 - *Monograptus vittatus* n.sp., 3 - PŠ 466, 4 - PŠ 476, 76 - PŠ 483 (murchisoni Zone).
5 - *Monograptus kodymani* Bouček, 1931, PŠ 599/2, (insectus Zone).
8 - *Monograptus kohkai* Bouček, 1931, PŠ 481, (centrifugus Zone).

All from Volká Ohrada, 1, 3-8 x5, 2 x3.
RECENZE


Knihy profesora všeobecné geologické a mineralogické univerzity H. Millera je určena pro širší geologickou veřejnost a studenty přírodovědných disciplín. Kdež si clade za cíl vyplnit prostor mezi speciálně orientovanými pracemi a populárně–vědeckou literaturou, zabývající se deskovou tektonikou a s ní souvisejícími disciplínami. Jak sám autor v úvodu podotýká, kniha vyhazuje z tradic především německé a středoevropské geologické školy. Svědčí o tom výběr citací v textu (Wegener, Stille, Amperer aj) a velký prostor, který je v knize věnován dnes již klášťovicímu pojetí orogenetického cyklu a geosynklínální teorie. Už z toho je zřejmé, že čtenář od této knihy nemůže očekávat vyčerpávající přehled nejnovějších poznatků současné vědy, zejména z oblastí výzkumů rozhraní kůry a pláště, získaných moderními metodami hlubinné reflexní seismiky, isotopové geologie atd. Knihu však podává historicky ucelený přehled vývoje názorů na základní aspekty dynamiky litosféry. Širší okruh zájemců se tak seznámí nejen se základními principy deskové tektoniky, ale může pochopit i myšlenkové proudy, které vedly k jejímu formování a rozvinutí do dnešního podoby syntetické vědní disciplíny. Dalším kladem je i snaha autora dať deskovou tektoniku do širšího geologického rámce. Poukázat na vztah pohybů litosférických desek k magma-
tismu, orogenezii a vzniku ložisek nerostných surovin. K uklá-
nému výčtu chybí jen více informací o metamatofóze, deformaci a zemětřesení činnosti.

Knihu je rozdělena do 11 kapitol. První tři úvodní kapitoly jsou věnovány teoretickému základu deskové tektoniky, meteorickému a historickému přehledu hlavních argumentů, které vedly k jejímu vzniku, přičemž se hlavní útvar klade na význam paleomagnetických výzkumů.

Ve čtvrté, nejrozšířilejší kapitole, která je jádrem knihy, jsou geologicky charakterizovány litosférické desky, hlavní typy rozhraní, jejichž geologická stavba je dokumentována schematy i velice instruktivními seismickými řezy z recenzí rozhraní. Nechybí zde ani popis současné konfigurace hlavních litosférických desek a některých mikrodesek a paleogeografického rozpoznaní pohybů litosférických desek od spodního kambria do současnosti. Všechny rozpoznané však pocházejí již z počátku 80. let a v některých případech existují již několik let.

V páté kapitole podává autor velmi stručné charak-
teristiku magmatismu na deskových rozhraních a uvnitř desek na základě geochronie stopových prvků, což je na několika stranách textu velice obtížné. Chybí zde obsahující výčet literatury, kde by si čtenář mohl získat potřebné informace.

V dalších dvou kapitolách autor rozebrává jednotlivé případy kolizí litosférických desek a charakterizuje stavbu různých typů kolizních orogenů, zejména na korektních příkladech z evropských alpid. Samostatné, když velmi stručně pojistil kapitoly, jsou věnovány i problematice mikrodesek a exotických terénů a geneze magmatu v horkých skvrnách (kap. 7 a 8).

Poměrně značná pozornost je věnována vzniku pávní a sedimentace v různých částech litosférických desek. Zde však autor, věřen tradici, odkazuje na termíny používané v geosynklínální teorii do současného představy o vzniku pávní a jejich deformaci v různých geotektonických prostředích. Závěrečné kapitoly jsou věnovány distribuci ložisek nerostných surovin vzhledem k jednotlivým petrotektonickým rozhraním, jejich spojení se geologickými procesy na okrajích i uvnitř litosférických desek a shrnulí důsledné poznatky. Jsou zde diskutované zejména modely pláštové konvekce, geneze magmatu a dynamiky pohybů litosférických desek.

Knihu představuje stručně, přehledné a jednoduché seznámení se základními principy deskové tektoniky. Lze ji doporučit především zájemcům zabývajícím se přírodovědnými disciplinami. Užitečná je jen bude zejména tím, že posiluje vývoj geologického myšlení o době formulování geosynklínální teorie do dnešníku a tím, že konfrontuje terminologii a principy této teorie s novými moderními poznatky.

Václav Kachlík
P. Štorn: Llandovery–Wenlock boundary beds in the graptolite–rich sequence. (Pl. 1)

For explanation see p. 177
P. Štorch: Llandovery–Wenlock boundary beds in the graptolite–rich sequence . (Pl. II)
P. Šturch: Llandovery–Wenlock boundary beds in the graptolite–rich sequence. (Pl. III)
P. Štorch: Llandovery–Wenlock boundary beds in the graptolite-rich sequence. (Pl. IV)