Trace fossils from the Roblín Member of the Srbsko Formation (Middle Devonian, Barrandian area, central Bohemia)

Ichnofosilie z roblínských vrstev srbského souvrství (střední devon Barrandienu) (Czech summary)

(1 text-fig., 6 plates)

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Trace fossils show that the Roblín event at the boundary between the Kačák Mbr. and the Roblín Mbr. (of the Srbsko Formation, Middle Devonian of the Barrandian area) is comparable to the regressive (glacioeustatic) event at the base of the Kosov Formation (Upper Ordovician of the Barrandian area): the ichnoassemblages formed mostly by *Chondrites* are substituted by a mixture of elements of the Arenicolites, Cruziana and Nereites Ichnofacies. The studied ichnoassemblage of the Roblín Member contains the ichnogenera?*Arenicolites, Planolites, ?Chondrites, Gordia, Helminthopsis, Treptichnus, ?Urohelminthoida, Bifungites,* and *Zoophycos*. The ichnoassemblage is consistent with the presumption that the sedimentation in the Prague Basin was terminated by the Roblín Member.

Key words: Ichnofossils, Devonian, Barrandian area

Introduction

The Roblín Member, upper of two members of the Srbsko Formation (Uppermost Eiffelian-Givetian), occupy an exceptional position in the Barrandian area: they represent the uppermost member of the Prague Basin, which has continuous sedimentation from the Tremadocian to the Middle Devonian. The Roblín Member differs from all older Devonian units by its flysch-like character. It is formed of grey and greyish-green siltstones alternating rhythmically with intercalations and laminae of clay shales, and with beds of subgreywackes of thicknesses from centimetres and decimetres. Grading, cross bedding and flute marks are characteristic of the subgreywackes, trace fossils are rare (e.g., Kukal - Jäger 1988, Chlupáč 1992).

The problem of the original thickness of the Roblín Member (because the preserved occurrences are only denudation remnants lying mostly near an axis of the basin), and the related question of the end of sedimentation in the Prague Basin, remain unclear. Relics of the Roblín Member in the Koněprusy area (where they succeed the Suchomasty and Acantopyge Limestones after a hiatus) are considered to be possibly younger than other occurrences (Kukal - Jäger 1988); otherwise, there are known no sedimentary rocks in Central Bohemia of an age between the Roblín Member (Givetian) and a post-Variscian limnic Upper Carboniferous.

The beginning of the Srbsko Formation is synchronous with an important global transgressive event (the Kačák Event, after Chlupáč - Kukal 1988). The post-event dysoxic sedimentation [the Kačák Member showing dense accumulations of *Chondrites* ichnosp. in certain beds representing probably the „piped zones" of Savrda - Bottjer (1989) and reflecting short oxygen level fluctuations] continued for a short time only. The so-called Roblín event is of regional extent (Chlupáč - Kukal 1986) and started with the flysch-like sedimentation of the Roblín Member.

These problems show the importance of study of palaeontological content of the Roblín Member. A substantial part of it is represented by ichnofossils; however, little attention has so far been paid to them. A short paper by Pfeiffer (1966) contained a description and an idealized figure of a supposed *Phycosiphon.* After a study of that find (housed in collections of the National Museum, Prague), we conclude that it is an indeterminable specimen, possibly a cross-section of an unfavourably preserved spreiten-structure. Finds of *Zoophycos* observed on a vertical profile are mentioned by Kukal and Jäger (1988). No attempt to obtain more representative collection of ichnofossils preserved on soles of subgreywacke layers has been made.

Our material comes from large exposures at Praha-Barrandov made at the end of 80's in the area of a present-day new housing development. It represents mostly the uppermost preserved layers of the Roblín Beds. The excavated material was placed in several dumps and left to weather. Collection of ichnofossils from these dumps enabled us to observe a large area of subgreywacke bedding planes in a good state of natural preparation by weathering; this would be impossible at any outcrop of undisturbed beds. The material is not exactly located in a vertical geological section thereby reducing its informative value. This material was supplemented by a find of *Zoophycos* from the classical locality at Praha-Hlubočepy (lower layers of the

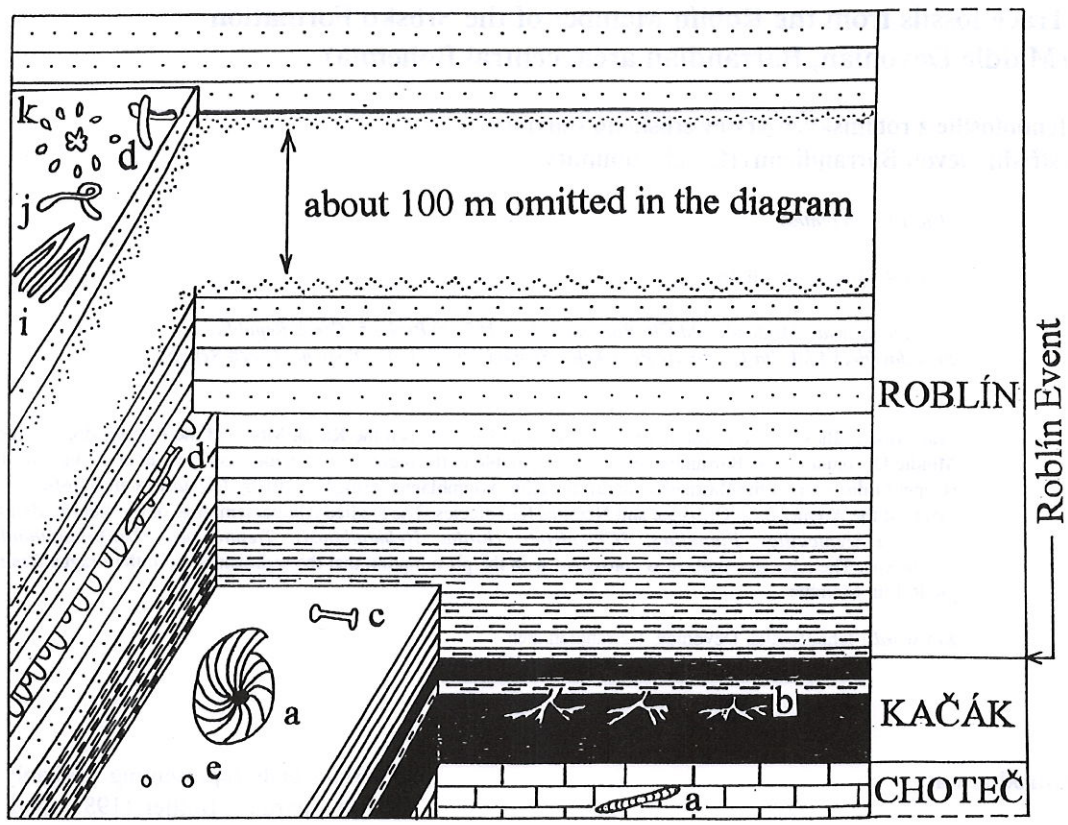


Fig. 1. (after R. Mikuláš 1996) Schematic comparison of the ichnological record of the Roblín Event (Middle Devonian; left side) and the Basal Kosov Event (Late Ordovician; right side) in the Prague Basin. Králův Dvůr: greyish-green clay shales of the upper part of the Králův Dvůr Formation; Kosov: rhythmic alternation of fine-grained sandstones, siltstones and shales of the lower part of the Kosov Formation, showing two layers of diamictite at the base; Choteč: biodetritic or micritic limestones of the Choteč Formation; Kačák: grey to black calcareous shales of the Kačák Member, showing an intercalation of white shale; Roblín: rhythmic alternation of subgreywackes, siltstones and shales (at the base with pale grey, greyish-green or greyish-brown siltstones and shales) of the Roblín Member. Ichnofossils: a - *Zoophycos*, b - *Chondrites*, c - *Bifungites*, d - *Planolites*, e - *Arenicolites*, f - *Laevicyclus*, g - *Monofungites*, h - *Torrowangea*, i - *Urohelminthoida*, j - *Gordia*, k - *?Sublorenzinia*. The left side was made after data from localities mentioned in the text, and after profiles published by Chlupáč (1960). The right side after Mikuláš (1992), who used also data by Štorch and Mergl (1989)

Roblín Member), devoted us kindly by Prof. I. Chlupáč, and by finds of *Planolites* and *Bifungites* from the permanent outcrop of the middle part of the Roblín Beds at Praha-Hlubočepy (railway station).

In 1995, development of the locality Bubovice - airport started. Here, the uppermost preserved layers of the Roblín Member are present. They yielded, e.g., the ichnofossil *?Sublorenzinia* ichnosp. (elaborated to the scheme on Fig. 1). Field work on this locality will continue.

Acknowledgement: We are grateful to Dr. T. P. Crimes (University of Liverpool) for critical reading of the manuscript, and to Prof. Dr. I. Chlupáč (Charles University, Prague) for valuable comments to the topic.

Systematic ichnology

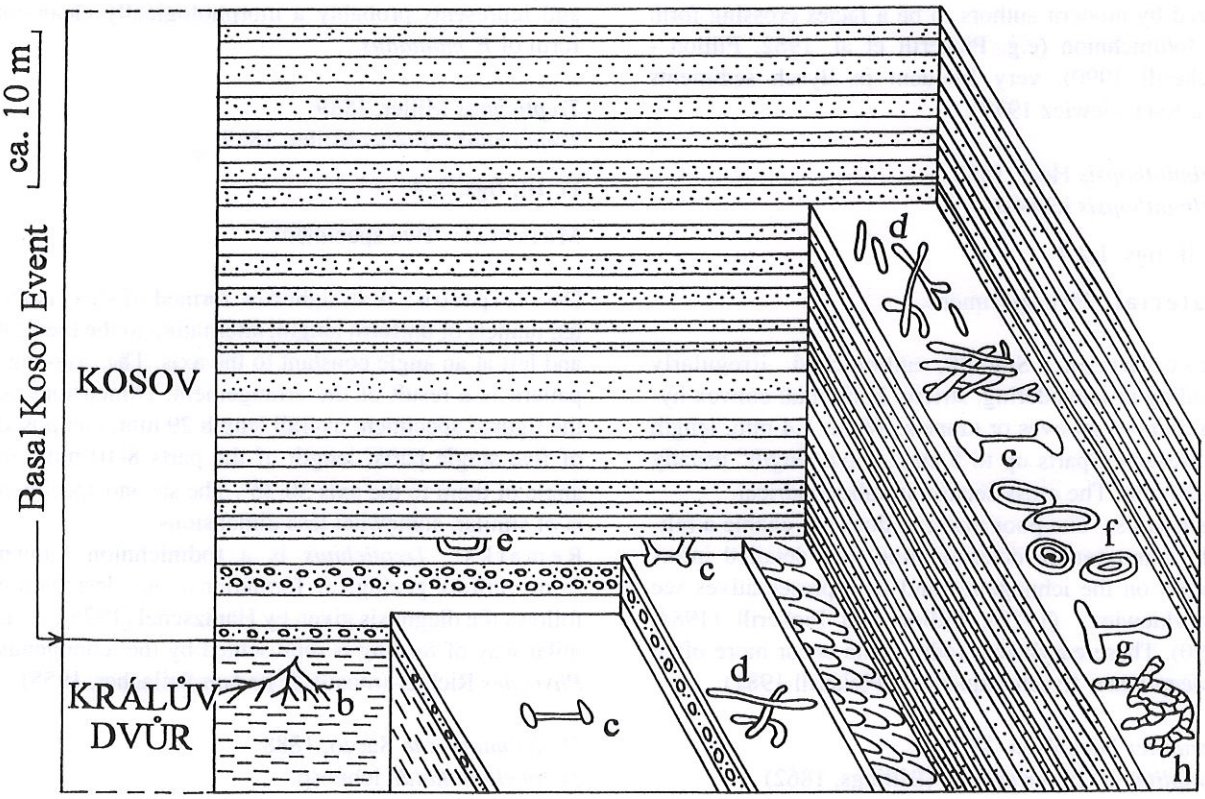
Arenicolites Salter, 1857
? *Arenicolites* ichnosp.

Pl. III, figs. 1-2; Pl. VI, figs. 1-6

Material: 10 sandstone slabs with the solitary traces or with clusters of them.

Description: Pairs of circular protuberances (convex hyporeliefs) on upper bedding planes of subgreywacke layers. Diameter of the protuberances is equal within the pair; usually 1 to 5 mm. Another way of preservation of the described ichnotaxon represent solitary or clustered finds of short, straight, non-oriented „bars" (convex hyporeliefs), usually more or less arched down in a vertical plane. Their width is equal with diameter of the above-described protuberances (1-5 mm), length comparable with the distance of them (4-10 mm).

Remarks: The described structures can be explained probably as cross-sections (pairs of protuberances) or bases („bars") of the ichnogenus *Arenicolites*, which includes simple or U-shaped domichnia (e.g., Häntzschel 1975, Crimes et al. 1977, Bjerstedt 1988). *Arenicolites* is a subject of the Arenicolites Ichnofacies (Bromley - Asgaard 1991). The ichnofacies involves the cases when the sandstone layer sedimented suddenly in an incongruous settings (storm layer, or turbidite). This sandy substrate can be rapidly colonised, e.g., by producers of the ichnogenera *Arenicolites* and *Skolithos*; however, the community is quickly suppres-



sed because of a return of clay sedimentation. Therefore, the Arenicolites Ichnofacies occurs in settings of low physical energy and sandy substrates.

Bifungites Desio, 1940
Bifungites ichnosp.

Pl. II, fig. 3; Pl. III, fig. 5

Material: Three specimens.

Description: A dumbbell-shaped structure preserved as a convex hyporelief on a subgreywacke layer. Horizontal „bar", moderately arched upwards, is 5.5 mm long and 1.5-1.7 mm wide. Their widened formations are different in shape and dimensions: one is heart-shaped of dimensions 3.0 x 4.5 mm in ground plan, the second is much less prominent, hemispherical, 2 x 1.5 mm in dimensions.
Remarks: *Bifungites*, found usually in associations showing an ecological stress, represents domichnia of filter feeders (e.g., Gutschick - Lamborn 1975, Pickerill - Forbes 1979).

Chondrites Sternberg, 1833
? *Chondrites* ichnosp.

Pl. V, fig.3

Material: One sandstone slab covered with the described trace in a sole.

Description: Minute root-like or dendroidal systems of narrow passages, often irregularly ramifying. Their width is 0.2-0.5 mm, length of preserved sections 2-5 mm. The passages do not form the more-or-less regular „chondrite systems"; they cover in irregular density the bedding planes. Besides *?Chondrites* ichnosp., flute marks, *Planolites* ichnosp. and cross-sections of vertical tubes are also present.
Remarks: These remains do not give a sufficient picture of their original morphology. The most probable explanations is that they are incompletely preserved systems of a minute *Chondrites*. For the most complete modern revision of *Chondrites* see Fu (1991).

Gordia Emmons, 1844
Gordia cf. *marina* Emmons, 1844

Pl. I, fig. 3

Material: One sample of a brown silty shale showing several specimens (concave reliefs, probably epireliefs) at one bedding plane.
Description: Smooth, unbranched horizontal grooves, constant in width, irregularly winding, or forming loops. Width about 0.5 mm, length of preserved parts usually 10-15 mm. The epirelief is very shallow, in places missing, therefore it is difficult to separate strictly individual specimens preserved on the bedding plane.
Remarks: Overall scheme of the trace (winding, tendency to crossing) enables us to designate the find as *Gordia*. According to Fillion and Pickerill (1990), the find is comparable to *G. marina* (younger synonym: *G. molassica*), which shows all the course of the groove (not only apical parts of arcs). *Gordia* is consi-

dered by modern authors to be a facies crossing form of fodinichnion (e.g. Pickerill et al. 1982, Fillion - Pickerill 1990), very frequent in flysch sediments (e.g.Książkiewicz 1977).

Helminthopsis Heer, 1887
Helminthopsis ichnosp.

Pl. II, figs. 1,2,4

Material: Five specimens.

Description: Smooth, unbranched, irregularly winding or meandering, strictly horizontal convex hyporeliefs of grooves or tunnels. Width 1-4 mm, length of preserved parts up to 5 cm, „wave length" usually 10-20 mm. The cross-section is subcylindrical.
Remarks: The poor material does not enable a reliable ichnospecific determination. For detailed information on the ichnogenus and its representatives see Książkiewicz (1977), Fillion and Pickerill (1984, 1990). These eurybathic fodinichnia occur more often in deep-water flysch sequences (Pickerill 1981).

Planolites Nicholson, 1873
Planolites cf. *beverleyensis* (Billings, 1862)

Pl. IV, figs. 2-5; Pl. V, fig. 4

Material: 21 rock samples with the trace.

Description: Smooth, straight or moderately curved cylindrical tunnels (convex hyporeliefs), 3-10 mm wide. Length of preserved parts up to 80 mm. The tunnels are unbranched, occurring solitary or in small groups, often crossing themselves; in one case (Pl. IV, fig. 3) they form a star-like structure.
Remarks: A placement of the trace in *P. beverleyensis* follows the work of Pemberton and Frey (1982). It is the most widespread ichnofossil (mostly fodinichnion) in numerous sedimentary sequences of various settings, from Precambrian to Quaternary.

Planolites cf. *montanus* Richter, 1937

Pl. IV, fig. 1

Material: Five sandstone samples showing the traces preserved as convex hyporeliefs.

Description: Relatively narrow (1-3 mm), smooth, moderately curved to contorted, sometimes branching traces. Length of preserved parts up to 20 mm, but usually less; the specimens figured on Pl. IV, fig. 2 are only 3-5 mm long.
Remarks: The ichnospecific designation of this trace follows criteria by Pemberton and Frey (1982). The short sections of moderately curved or almost straight tunnels resemble the ichnogenus *Popradichnium* Plička, 1987; however, Plička's ichnogenus complies fully with an ichnogeneric criteria given for *Planolites* and represents probably a morphologically clean-cut form of *P. montanus*.

Treptichnus Miller, 1889
Treptichnus bifurcus Miller, 1889

Pl. III, figs. 3, 4

Material: Two specimens.

Description: A straight row formed of short isolated tunnels of uniform length, alternating to the theright and left at an angle constant to the axis. The „zig-zag" pattern is a result of the arrangement. Dimensions of the figured specimen: overall length 29 mm; composed of five single parts; length of the parts 8-10 mm; an angle of them to the axis 30-35°. The second specimen is of similar, somewhat less dimensions.
Remarks: *Treptichnus* is a fodinichnion known from various geological formations; our designation follows the diagnosis given by Häntzschel (1975). A similar way of feeding is represented by the ichnogenus *Phycodes* Richter (mostly *P. pedum* Seilacher, 1955).

Urohelminthoida Sacco, 1888
?Urohelminthoida ichnosp.

Pl. I, figs. 1, 2

Material: Three sandstone slabs with the trace.

Description: Series of subparallel, smooth, semicylindrical grooves of constant width (convex hyporeliefs). Ends of neighbouring grooves come near and fuse in some cases, or they cross. Width of grooves 1.0-1.5 mm, length up to 70 mm, number of traces in the series 3-5, distances between them in middle part of the series 10-15 mm.
Remarks: The constant width of grooves in each series, their regular course, and differences in orientation between the grooves and preserved flute marks, suggest a biogenic (not mechanogenic) structure. The structure originated most probably by oriented feeding of the uppermost part of the sediment; the ichnogenus *Urohelminthoida* shows a close morphology (for description, synonymy and remarks see Häntzschel 1975, Książkiewicz 1977, a.o.).

Zoophycos Massalongo, 1855
Zoophycos ichnosp.

Pl. I, fig. 4

Material: A single find from Praha-Hlubočepy (coll. I. Chlupáč).

Description: On the bedding plane of grey siltstone containing remains of terrestrial flora, a helicoidal plane oval in outline is preserved. Axes of the oval are about 45 mm long. From the centre of the oval, weathercock-like arranged ridges and grooves point up to

the margin; distance between them is 15 mm at the margin. Parts of the trace show also further segmentation of these ridges by narrow (ca. 1 mm) lamellae. The oval is partly bordered by a poorly preserved horizontally flattened, 4 mm wide tunnel.

Remarks: A poorly preserved specimen of the ichnogenus *Zoophycos*. For further information on the ichnogenus, its representatives and its ethological sense, see Książkiewicz (1977), Chlupáč (1990), Ekdale and Lewis (1991), a.o. *Zoopyhcos* occurs typically in settings of the ecological stress, e.g. dysoxia.

Conclusions

The trace fossil assemblage of the Roblín Beds shows a low diversity. The presumed distal trubidite character of sedimentation (Chlupáč 1992), probably with relatively short intervals between individual turbidite events, contrasts with the character of preceeding sedimentation (the carbonates of the Choteč Limestone and dark shales of the Kačák Member), coupled with a probably increasing isolation of the Prague Basin, enabled a development only to *r*-strategic forms of filter and sediment feeders (= tracemakers of *?Arenicolites, Planolites, ?Chondrites, Gordia, Helminthopsis, Bifungites, Zoophycos*). Also, the density of this assemblage was low except for local fluctuations.

In the Prague Basin, a very similar ichnoassemblage is present in the Kosov Formation (Uppermost Ordovician), namely in its lower part above diamictite layers of glacial origin. *Arenicolites, Planolites, Gordia, Helminthopsis, Treptichnus* and *Bifungites* are the common elements of these assemblages (see Mikuláš 1992). Schematic comparison of both the ichnoassemblages and geological circumsatnce of their appearance is made on Fig. 1.

Similar mixed trace fossil assemblages occur in numerous flysch sequences. Pek (1986), Zapletal and Pek (1987) recorded *Arenicolites - Chondrites* assemblages from the Upper Viséan of the Moravian - Silesian Culm deposits; Plička (1987) noted an *Arenicolites - Gordia - Helminthoida - Planolites - Popradichnium* (=*Planolites*) assemblage from the Inner Carpathian Paleogene of Slovakia. The similarity reflects similar lithofacial, hydrodynamic and perhaps also hydrochemical parameters of settings. The presence of *Chondrites* and *Zoophycos* may reflect a dysoxia in the Roblín Member, persisting from the underlying Kačák Member.

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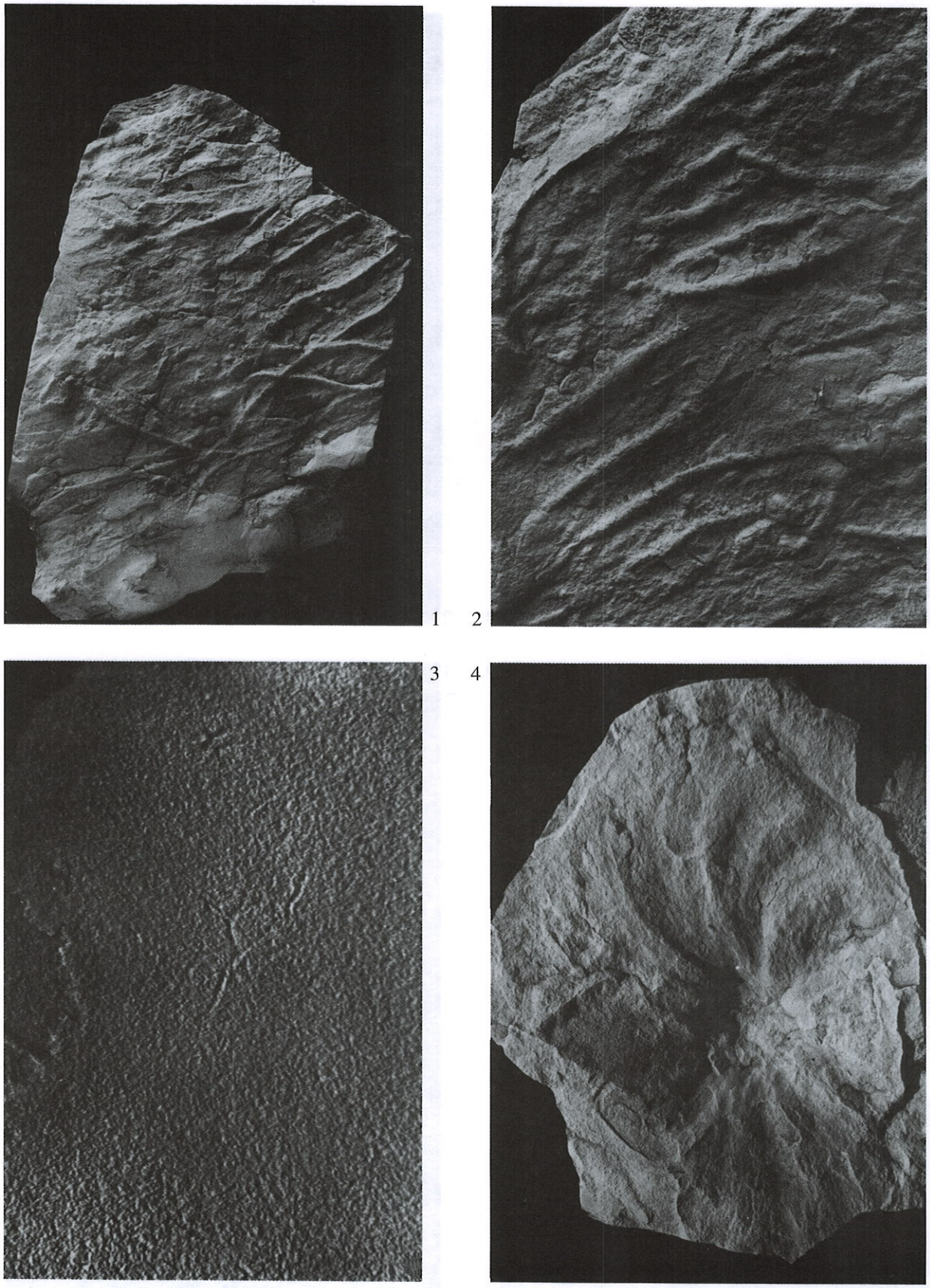
Ichnofosilie z roblínských vrstev srbského souvrství (střední devon Barrandienu)

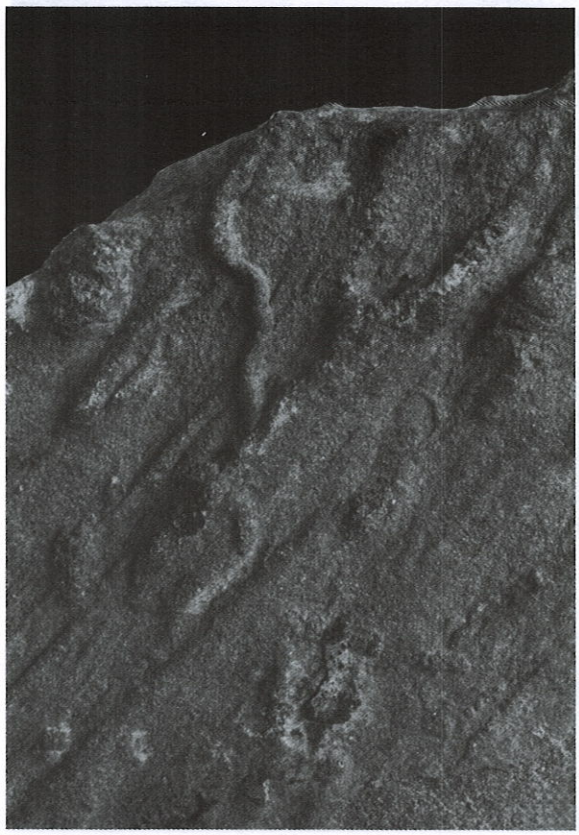
Roblínská událost na hranici kačáckých a roblínských vrstev (srbské souvtství, střední devon Barrandienu) je z ichnologického hlediska velmi blízká např. regresívní (glacieustatické) události na bázi kosovského souvrství (svrchní ordovik): chondritová ichnospolečenstva jsou nahrazena směsí s prvky arenikolitové, kruzianové a nereitové ichnofacie *?Arenicolites, Planolites, ?Chondrites, Gordia, Helminthopsis, Treptichnus, ?Urohelminthoida, Bifungites, Zoophycos*). Nalezené ichnospolečenstvo není v rozporu s koncepcí ukončení sedimentace v pražské pánvi roblínskými vrstvami.

R. Mikuláš - I. Pek: Trace fossils from the Roblín Member of the Srbsko Formation (Middle Devonian, Barrandian area, central Bohemia) (Pl. I)



1-2: *?Urohelminthoida* ichnosp.; 1 - x0.48; 2 - x1.6. 3: *Gordia* cf. *marina* Emmons, 1844; x3.1. 4: *Zoophycos* ichnosp; x1.0. Localities: 1-3: Praha-Barrandov; 4: Praha-Hlubočepy (railway cutting).
The figured finds are housed in the collection of the Czech Geological Survey, Prague (inv. No. RM 160-RM 190). *Photos by R. Mikuláš*

R. Mikuláš - I. Pek: Trace fossils from the Roblín Member of the Srbsko Formation (Middle Devonian, Barrandian area, central Bohemia) (Pl. II)



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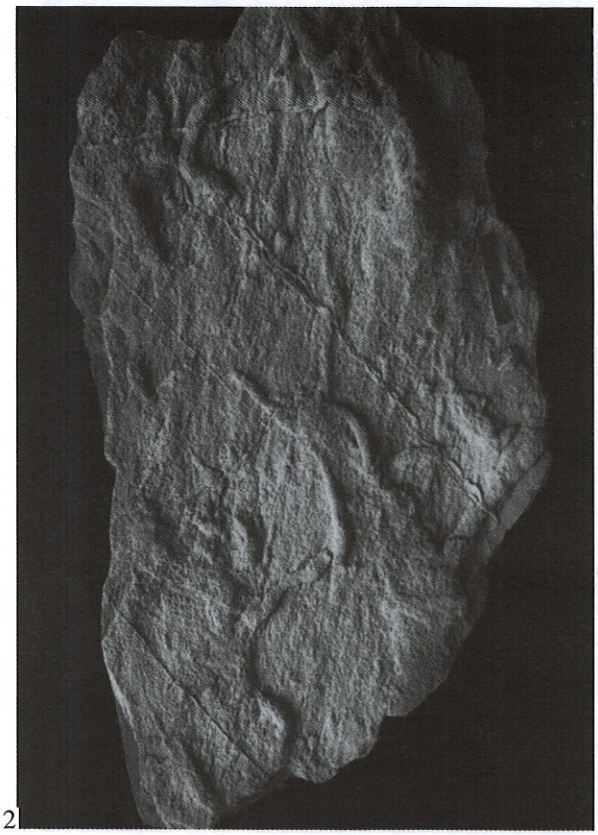

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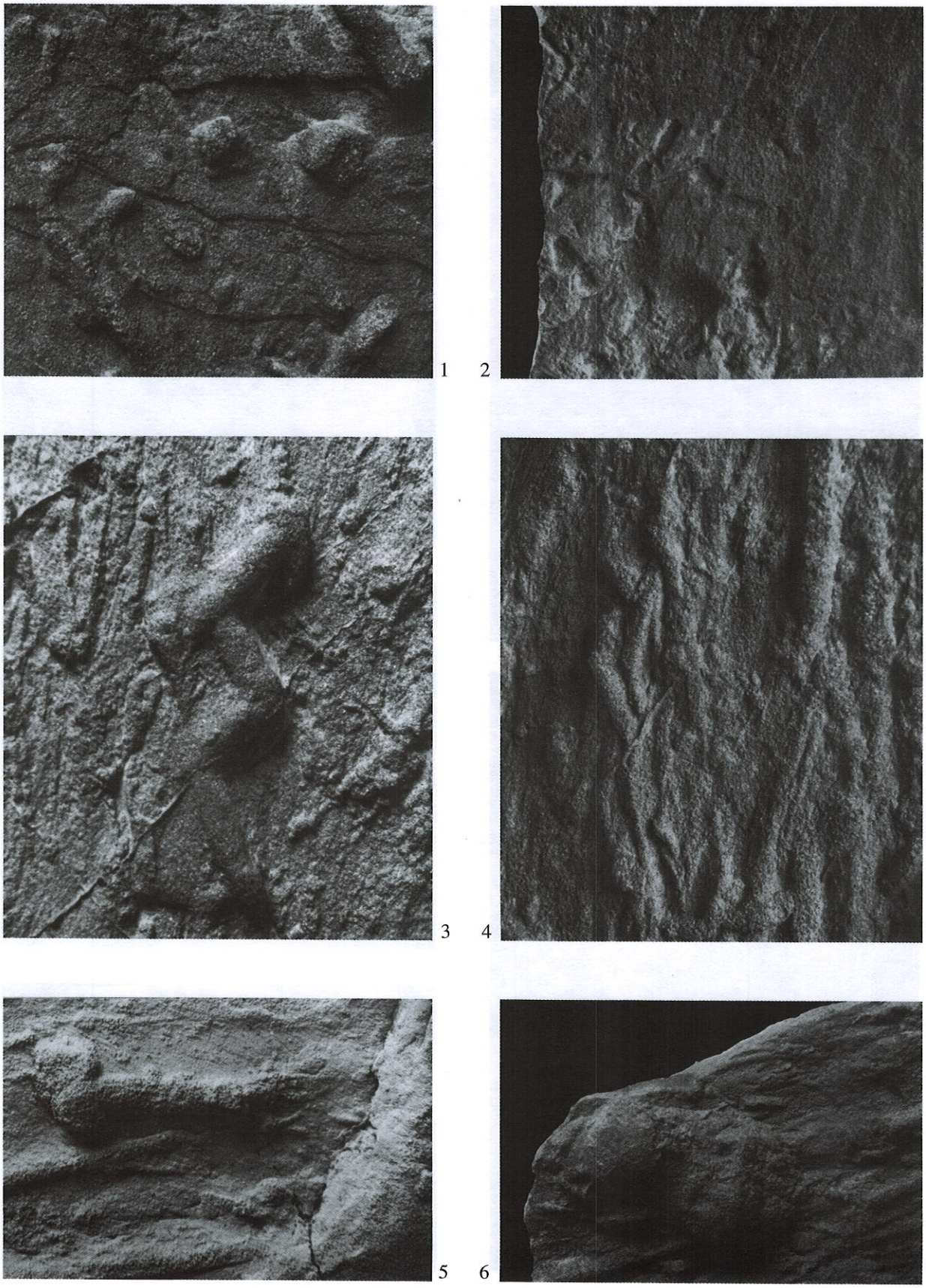
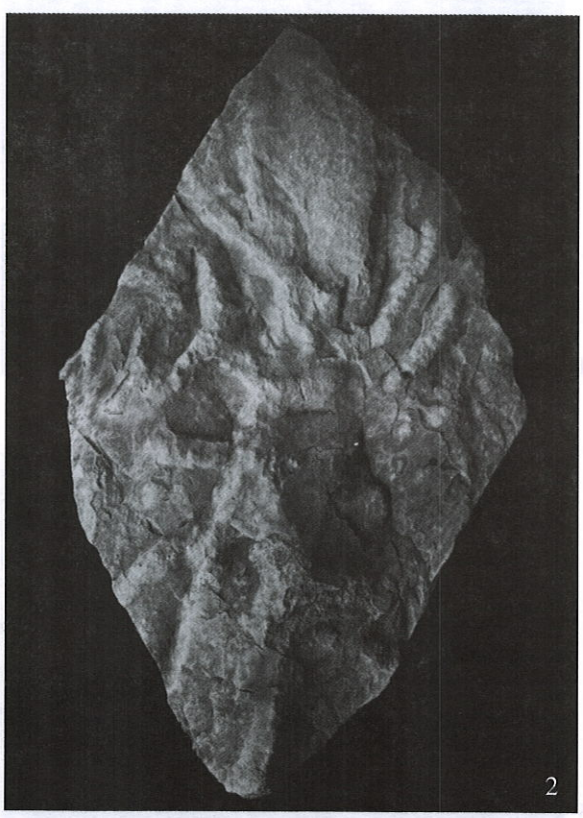
1, 2, 4: *Helminthopsis* ichnosp.; 1 - x2.4; 2 - x1.2; 4 - x2.2. Praha-Barrandov. 3: *Bifungites* ichnosp.; x2.1. Praha-Hlubočepy (railway station).



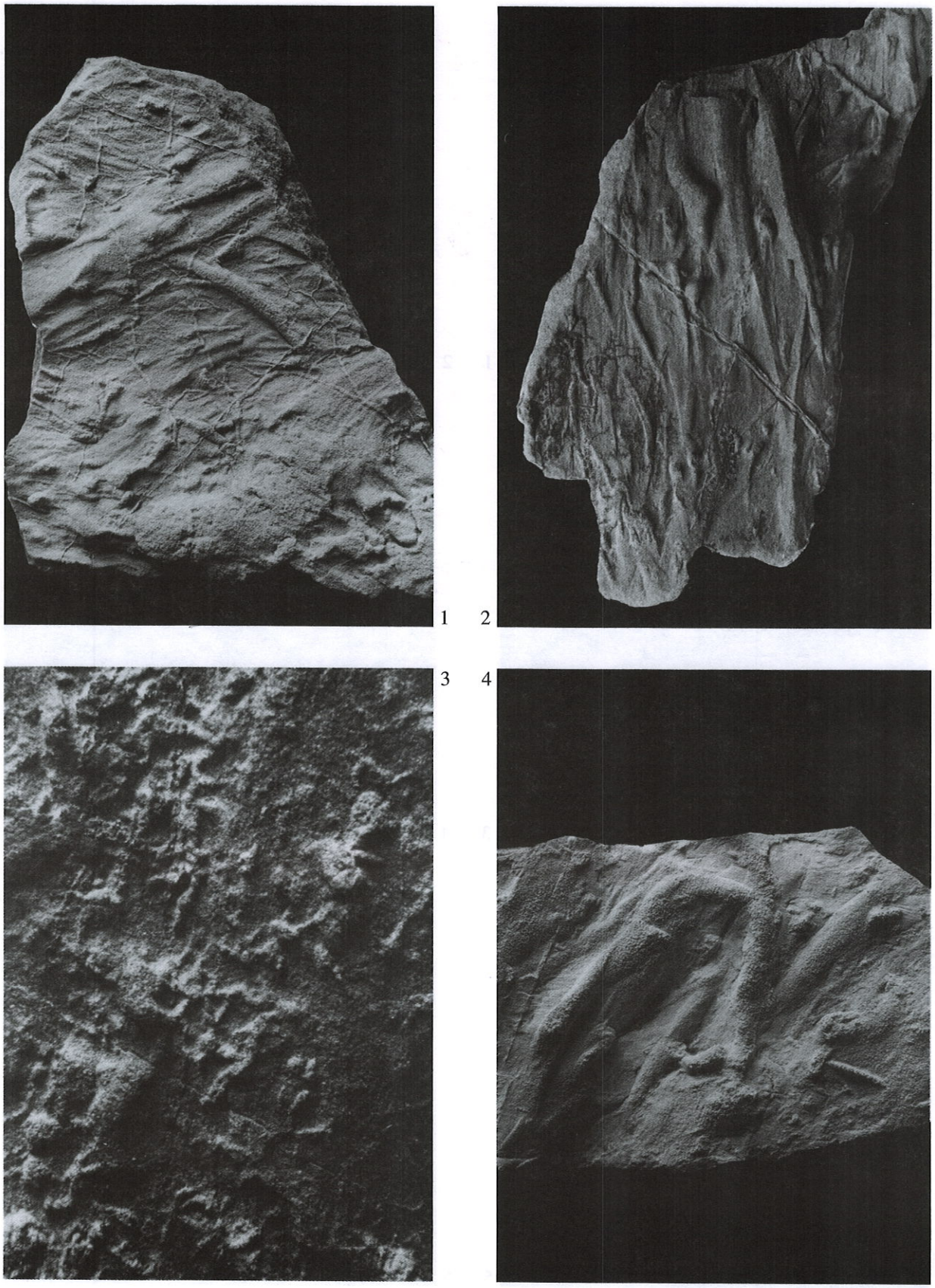
1-2: *?Arenicolites* ichnosp.; 1 - x3.3; 2 - x2.7. 3, 4: *Treptichnus bifurcus* Miller, 1889; 3 - x2.7; 4 - x2.3. 5: *Bifungites* ichnosp; x3.3. 6: *?Bifungites* ichnosp.; x1.7. Praha-Barrandov.

R. Mikuláš - I. Pek: Trace fossils from the Roblín Member of the Srbsko Formation (Middle Devonian, Barrandian area, central Bohemia) (Pl. IV)



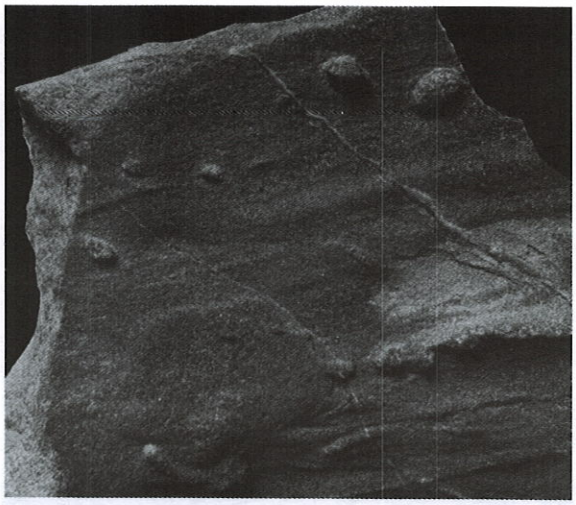
1: *Planolites* cf. *montanus* Richter, 1937; x2.7. 2-5: *Planolites* cf. *beverleyensis* (Billings, 1862); 2 - x1.3; 3 - x1.1; 4 - x1.15; 5 - x0.95. Praha-Barrandov.

R. Mikuláš - I. Pek: Trace fossils from the Roblín Member of the Srbsko Formation (Middle Devonian, Barrandian area, central Bohemia) (Pl. V)



1-2: Flute marks; 1 - x1.0; 2 - x0.9. 3: *?Chondrites* ichnosp.; x4.0. 4: *Planolites* cf. *beverleyensis* (Billings, 1862); x1.5. Praha-Barrandov.

R. Mikuláš - I. Pek: Trace fossils from the Roblín Member of the Srbsko Formation (Middle Devonian, Barrandian area, central Bohemia) (Pl. VI)



1

2

3

4

5

6

1-6: *?Arenicolites* ichnosp.; 1 - x2.6; 2 - x3.6; 3 - x4.44; 4 - x3.6; 5 - x2.5; 6 - x1.2. Praha-Barrandov.