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ZAPADNÉ KARPATY

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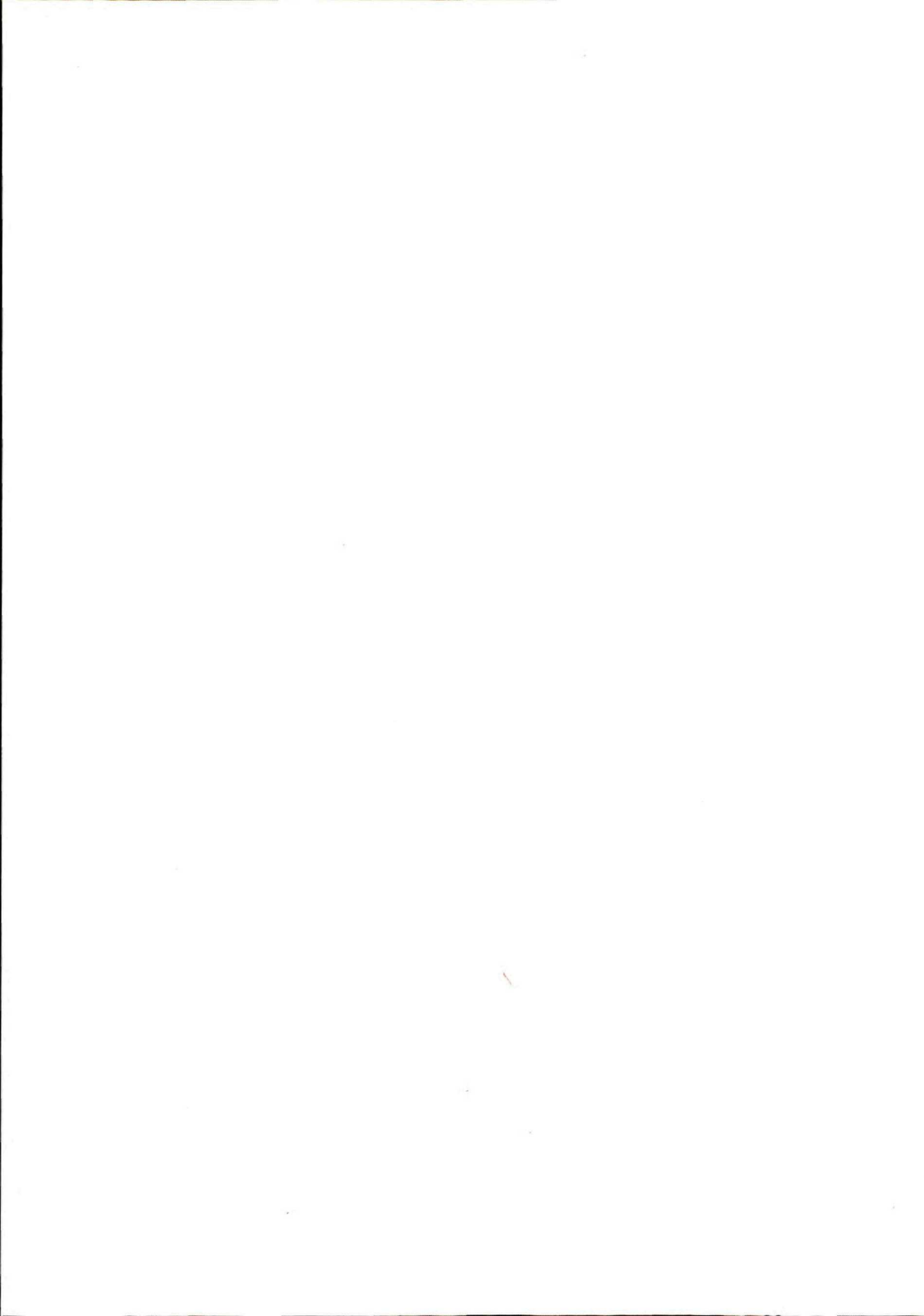
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Miloš Rakús

Cephalopod Fauna of the Lias and Lower Dogger from Olistoliths of the Rača Unit of the Magura Flysch (Locality Lukoveček)

18 obr. 4 fotogr. tab. (I—IV), slovenské resumé

Abstract. Ammonite fauna of the Lias and Lower Dogger from the locality Lukoveček is described in this work. The Jurassic occurrence is here linked to the Magura Flysch, to its marginal part of the Rača partial unit. The Jurassic sediments occur as olistoliths in the lower Solán beds of Upper Cretaceous age.

Fauna belonging to three Jurassic ages is described in the systematic part. As most ancient we regard the following assemblage: *Amaltheus* cf. *bifurcus* HOW., *Phylloceras* cf. *hebertinum* (REY.), *Partschiceras* cf. *striatocostatum* (MGH.), *Juraphyllites* cf. *libertus* (GEM.) and *Cenoceras striatum* (SOW.). This assemblage corresponds to the Lower Domerian, zone stokesi.

The Upper Domerian is represented by the species: *Pleuroceras solare* (HILL.) and *Cenoceras striatum* (SOW.).

The Toarcian is characterized by *Dactylioceras* (*Orthodactylites*) cf. *athleticum* (SIMPSON) and *D. (O.)* cf. *semicelatum* (SIMP.). These species correspond to the zone *Tenuicostatus*.

From the faunistic viewpoint the Aalenian assemblage is richest. It is characterized by the species: *Costileioceras* cf. *costatum* (HORN.), *Costileioceras* sp., *Brasilia* ex gr. *bradfordensis* (BUCKM.), *Ludwigia* ex gr. *murchisonae* (SOW.), *Oedania?* ex gr. *falcifera* BUCKM., *Reynesella?* ex gr. *lineata* BUCKM.

From the paleobiogeographic viewpoint we may state that the Mediterranean influence in the faunistic spectrum decreases from the Domerian to Aalenian and on the contrary the influence of the European faunistic province increases.

Introduction

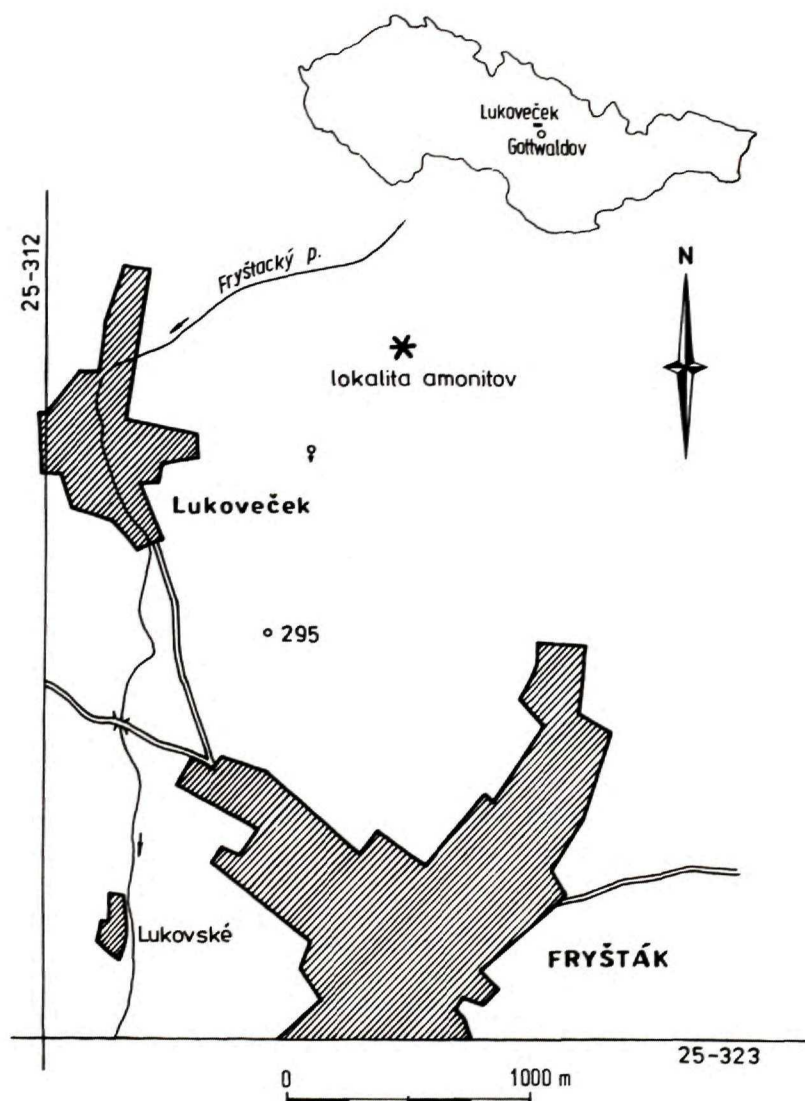
In the Flysch belt of the Outer Carpathians there occur few localities of Jurassic sediments that attracted attention from the very beginning of geological exploration of this area. This attention was probably caused by two factors:

1. entirely different lithological composition (predominantly various kinds of limestones) contrasting with the detritic development of the surrounding flysch
2. relatively abundant macroflora occurrences

One of these significant Jurassic localities is situated near the SW end of the Hostýnske vrchy Mts., 1250 m ENE of the middle of the village Lukoveček, in the wood work Kříby. It is an abandoned flooded quarry.

According to J. Reinelt's data (in A. RZEHAČ 1904), in the middle of the 19th century, pelosiderite concretions (Brauneisensteinkugel) were mined in it and they were shipped to Vítkovice for processing. After flooding of the quarry and collapse of the walls in 1880, the mining ceased and the quarry quickly perished. The quarry was reopened after having been drained in 1902 and macrofauna occurrences date from this period.

The Jurassic occurrence near Lukoveček was recorded for the first time in geological literature by V. UHLIG (1888, 1903). The first paleontological report



on Jurassic fossils originating from the quarry was submitted by A. RZEHAK in 1903. One year later (1904), the author publishes a comprehensive work in which he summarizes paleontological material collected. The rich fauna consisting of foraminifers, sea urchin remains, crinoids, worms, brachiopods, abundant lamellibranchiates, gastropods, belemnites, sporadic ammonites and fish teeth come from dark gray grained bituminous limestones with pyrite. A. RZEHAK (l.c) assigned them to the Middle Lias.

The presence of the Middle Lias in the dark limestones was confirmed by J. OPPENHEIMER (1906, 1913) and D. ANDRUSOV (1959), too. The latter presumes that it is a shallow-water development of the Middle Lias.

Besides Lias, V. UHLIG (in A. RZEHAK 1904) recorded also the presence of the Upper Jurassic in the locality Lukoveček. On the basis of the fauna of gray heavy-bedded limestones, J. OPPENHEIMER (1913) identified the presence of the Oxfordian — Kimmeridgian.

According to present researches in the area of the Hostýnske vrchy Mts. (written communication of Dr. V. PESL), the Jurassic occurrence is linked to the Magura flysch, to its marginal part of the Rača partial unit. It occurs in the lower part of the lower Soláň beds, in the vicinity of the axis of the emerging and widening Ondřejov anticlinal belt. No significant strike dislocation justifying the supposition that the Jurassic occurrence is a tectonic fragment (klippe) drawn from the underlier along the thrust plane, was found in the immediate vicinity of it. A. RZEHAK (1904) was of this opinion — he linked the Jurassic occurrence near Lukoveček to the so-called Outer klippen belt.

New researches of Dr. V. Pesl confirm V. Uhlig's opinion (in A. RZEHAK 1904, p. 152), that the Jurassic sediments (Lias and Malm) occur in the locality Lukoveček only as intercalations in the flysch. Because of these aspects we regard the Jurassic occurrence in the locality Lukoveček as an olistolith that is a synsedimentary part of the Upper Cretaceous sedimentation of the Soláň Formation.

The below-described material comes from the collections of the Geological-Paleontological Department of the Moravian Museum in Brno. Unfortunately we failed to find doubtlessly which part of the material belongs to original collections of A. RZEHAK and J. OPPENHEIMER. From the study of manuscripts in the labels we judge that the ammonite collection comes from various collectors and various lithological types. I had at my disposal 50 specimens of ammonites with a very different degree of preservation (study of suture lines was possible only in rare cases). The paleontological material contains 16 different species that belong to 7 families. Stratigraphic range of the described fauna is from the Domerian to Aalenian.

Already the first superficial examination of the material in the Moravian Museum in Brno showed that its generic and specific diversity is much greater than A. RZEHAK (1904), J. OPPENHEIMER (1906) and D. ANDRUSOV (1959) state.

In the end it is my pleasant duty to thank Dr. J. UHROVÁ from the Moravian Museum for lending me the paleontological material from the locality Luko-

veček. I am obliged to Dr. V. PESL for providing me with foundations to the historical-geological part on the Jurassic from Lukoveček. Next I thank Dr. A. KULLMANOVÁ for helping me in microfacial evaluation of the thin section material.

Description of the material

The ammonite material described is preserved in the form of rock cores, that, as regards their lithology, can be assigned to three different types (it is interesting that this lithological difference coincides with the different stratigraphic age):

1. gray organogene limestones with a clastic admixture.

From the microfacial viewpoint they have a clastic (detritic) structure. The clasts are represented by quartz, mica and organogene clasts. The quartz grains are unsorted and are not rolled. The magnitude 0.04—0.062 mm amounts 7—10 % of the grains (estimation). Muscovite scales are very rare. Of organoclasts, crinoidal segments (abundant), thick-walled lamellibranchiate shells, ostracod shells, foraminifers (*Fronicularia*, *Lenticulina*, *Epistomina*) occur. Sponge and sea urchin spines are abundant, too. Opaque minerals are represented by small globules of pyrite that are limonitized in their margins¹. A thin section was made from a rock core of the species *Juraphyllites* cf. *libertus* (GEM.) that we assign to the Domerian.

2. dark-gray to greenish marly limestones with a psammite admixture.

In this lithotype, fossilized Toarcian ammonites occur. It was impossible to carry out a microfacial analysis because of the lack of material.

3. Dark-gray organodetritic limestones have, from the microfacial viewpoint, a psammite texture. The matrix is calcareous. The clasts are represented by poorly rolled, but rather well sorted quartz grains in the sand fraction (0.25—0.31 mm). Besides them, also mica scales and in a slight amount of sericitized feldspars — acid plagioclases occur. Of dark opaque minerals, pyrite grains occur. A dark organic matter is present, too. These two components form most frequently filling of cameras of the genus *Protoglobigerina* and exactly unidentified foraminifers of the subfamilies *Involutinae* and *Permodiscinae* as well as juvenile ammonite shells. Organoclasts are made up by fragments of thick-walled lamellibranchiates and ammonites. A thin section was made from a rock core of the species *Costileioceras* cf. *costatum* (HORN).

¹ Small pelocarbonate pellets occur sporadically.

Systematic part

Nautiloidea AGASSIZ, 1847

Nautilidae DE BLAIVILLE, 1825

Cenoceras HYATT, 1884

Cenoceras striatum (J. SOWERBY, 1817)

Pl. I, fig. 3, text-fig. 1, 2

1817 *Nautilus striatus* F. J. SOWERBY — p. 183, pl. 182

1904 *Nautilus* F. ind. — A. RZEHA, p. 111

1915 *Nautilus striatus* Sow. — J. PIA, p. 51, pl. 8, fig. 14a, b (cum syn.)

1956 *Cenoceras striatus* (SOWERBY) — B. KUMMEL, p. 362, pl. 3, fig. 1, 2

Material: an incomplete rock core with a partly preserved calcified and pyritized shell

Dimensions:	inv. No	D	H	E	O
	13	35.0	20.0	24.5	3.0

Remarks: The first description of a nautilid form comes from A. RZEHA (1904, p. 111), who does not identify it exactly but states that it is close to the species *C. striatum* (SOW.). The specimen pictured in pl. 1, fig. 3 represents a juvenile stage that in its whorl cross-section (text. fig. 1), suture line (text. fig. 2) as well as in its typical reticular texture of the shell surface corresponds well with the description and illustration of G. GEYER (1886, p. 213, pl. 1, fig. 1a, b), J. PIA (1915, p. 51, pl. 8, fig. 14a, b) and KUMMEL (1956, pl. 3).

Stratigraphic range: *Cenoceras striatum* (SOW.) is a species with a wide stratigraphic range and is known from the Sinemurian to Upper Lias. Maximum occurrences, however, seem to be in the Middle Lias — Domerian.

Phylloceratidae ZITTEL, 1884

Phylloceras SUESS, 1865

Phylloceras cf. *hebertinum* (REYNÉS, 1868)

Pl. I, fig. 1, text. fig. 3, 4

Material: an incomplete and immature individual with a partly preserved calcified shell

D — overall shell dimension, H — last whorl height,

E — last whorl width, O — umbilical width,

N/2 — number of ribs on the last whorl, dimensions in mm

Dimensions:	No. of sample	D	H	E	O
	1	20.7	12.6	9.6	3.2

Description: The below-described specimen is characterized by a small involutely coiled shell. The cross-section of the last preserved whorl (text. fig. 3) is widely elliptic with a widely rounded ventral part with arched sides. The maximum width of the whorl is in the middle of its height. In the periumbilical part of the whorl, the sides are made up by moderately arched arches converging towards the umbilicus. The umbilicus is small, but not closed. The surface of the shell is smooth.

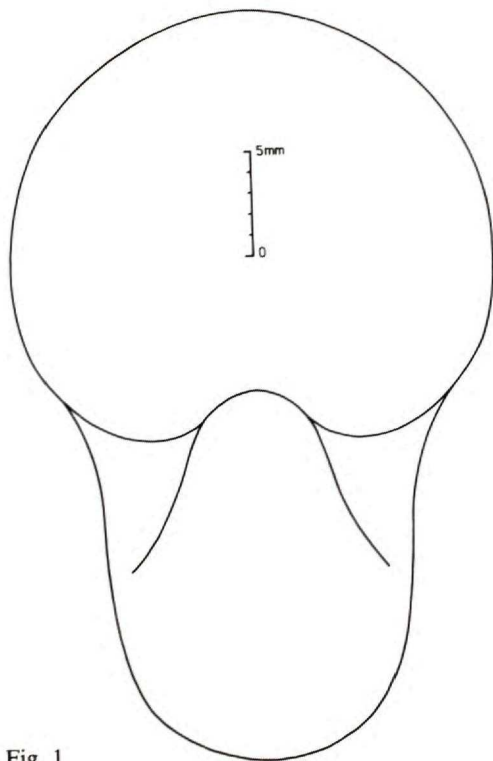


Fig. 1

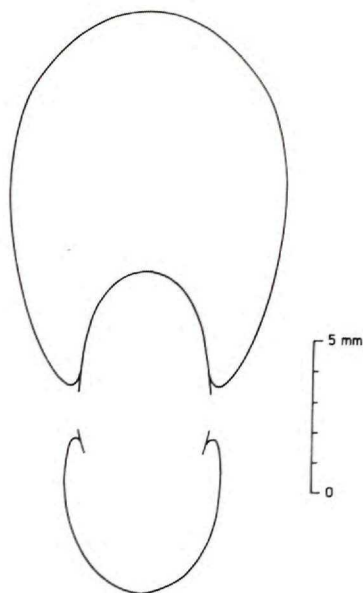


Fig. 3

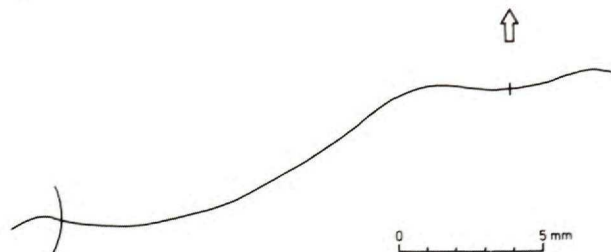


Fig. 2

Suture line: is typically phylloceratoid. The lobes E and L are nearly equally deep, L is trifid and wide at the base. Trunks of the saddles E/L (S_1) and L/ U_2 (S_2) are nearly parallel with the plane of symmetry. Folioles are widely leafy-spatulate and relatively deeply cut (text. fig. 4).

Remarks: As our specimen is an immature individual, a doubtless specific assignation has not been feasible. In the whorl cross-section and suture line, our specimen corresponds well with the species *Phylloceras hebertinum* (REYNÉS, 1868). The latter, however, resembles much the species *Phylloceras meneghinii* GEMERELLARO, 1874. It was noted already by J. MONESTIER (1934, p. 12, 13) and distinguishing of the two species in early ontogenetic stages only on the basis of the cross-section shape is by no means reliable. The medium growth stages (over the diameter of 25—30 mm), as it was recently pointed out by F. WIEDENMAYER (1977, p. 13), seem to be well distinguishable also according to the shape of the whorl cross-section. Maximum width of the whorl of the species *Ph. hebertinum* is in the middle of the whorl height, while as regards the species *Ph. meneghinii*, it is always under the middle of the whorl height i.e. in the periumbilical third of the whorl height. Orientation of the first lateral saddle E/L may serve as another distinguishing criterion. The species *Ph. hebertinum* has this saddle nearly parallel with the plane of symmetry (P. REYNÉS, 1868, pl. 2, fig. 3), while in the genus *Ph. meneghinii* it is oblique to the plane of symmetry (G. G. GEMMELLARO, 1874, pl. 2, fig. 15).

Stratigraphic range: In the classical area (Aveyron and Lozère) the species *Ph. hebertinum* is known in the Domerian, zone margaritatus (P. REYNÉS, 1868, p. 94). According to N. FANTINI SESTINI (1974, p. 211, tab. 3) and F. WIEDENMAYER (1977, p. 13) the stratigraphic range of the species is longer — from the zone jamesoni to zone spinatum. In the locality Lukoveček, this species occurs in association with *Amaltheus cf. bifurcus*.

Geographic distribution: The species has a large distribution in the western part of the Tethyd province, where it occurs in many localities (see B. GÉCZY, 1967, p. 13).

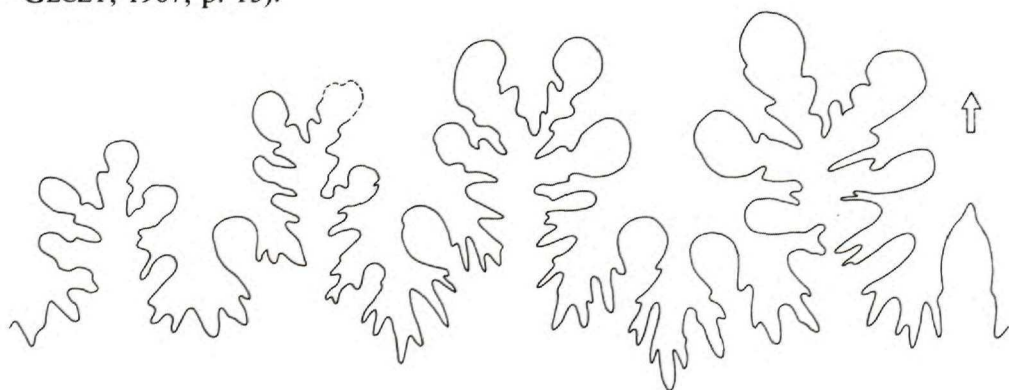


Fig. 4

Partschiceras FUCINI, 1923

Partschiceras cf. *striatocostatum* (MENEHINI, 1853)

Pl. I, fig. 4

Material: an incomplete rock core with suture line relics.
The core is made up by beige organodetrictic limestone

Dimensions:	No. of sample	D	H	E	O
	14	62.0	30.7	12.0	9.0

Description: A medium-sized involute laterally pressed form. The whorl cross-section is highly elliptic. The ventral part of the last preserved whorl is formed by a short arch that gradually passes into moderately arched to flat sides. The umbilicus is small and deep. In well preserved parts we can observe, using oblique light, remains of rectiradiate ribs.

The suture line is preserved very poorly but relics of typical spatulate folioles can be distinguished.

Remarks: Because of insufficient preservation, our specimen cannot be assigned taxonomically with a greater accuracy. The overall shape, whorl cross-section and relics of rectiradiate ribs suggest the affinity of our specimen to the species *Partschiceras striatocostatum* (MENEHINI, 1853).

Stratigraphic range: it is considerable and according to F. WIEDENMAYER (1977, p. 17) is from the Lotharingian (raricostatum zone) to Lower Toarcian (tenuicostatum zone). In the locality Lukoveček it is most probably the Domerian.

Geographic distribution: It is a typical Mediterranean element that has a large distribution in the Tethyd area.

Juraphyllitidae ARKELL, 1950

Juraphyllites MÜLLER, 1939

Juraphyllites cf. *libertus* (GEMMELLARO, 1884)

Pl. I, Fig. 2

Material: an incomplete and immature individual with a preserved calcified shell

Dimensions:	No. of sample	D	H	E	O
	2	22.5	10.8	7.2	4.0

Description: the shell is small planispiral involute. The whorl cross-section is highly oval, the ventral part forms a short arch. The latter gradually

passes into flat sides that are nearly parallel. The umbilical margin is highly rounded, formed by a short arch. The umbilicus is relatively open and therefore also younger ontogenetic whorls can be seen. The surface of the whorls is covered with prorsiradiately orientated constrictions of about 45° inclination (in whorl 4). Otherwise the surface is smooth. The suture line is preserved only poorly, but spatulate termination of the folioles can be distinguished beyond doubt.

Remarks: as our specimen represents only an immature stage, its doubtless assignation has not been possible. The whorl cross-section as well as presence of constrictions suggest its assignation to the species *J. libertus* (GEMM.)

Stratigraphic range: according to the latest studies of F. WIEDERMAYER (1977, p. 36) this species occurs from the Lotharingian (oxynotum zone) up to Lower Toarcian (falciferum zone). In our case we regard it as Domerian.

Geographic distribution: this species is wide-spread predominantly in the Mediterranean area where it occurs in numerous localities.

Lytoceratidae NEUMAYER, 1875

Lytoceras sp.

Material: a highly corroded incomplete rock core of light-gray fine-grained (? biomicritic) limestone.

Remarks: an exact assignation has not been possible because of poor preservation. Our specimen is a small individual whose overall diameter does not exceed 30 mm.

Stratigraphic position: as the fossilization limestone is identical with that fossilizing Dactyliocerases, we regard our specimen as Lower Toarcian.

Amaltheidae HYATT, 1867

Amaltheus DE MONTFORT, 1808

Amaltheus cf. *bifurcus* HOWARTH, 1958

Pl. I, fig. 7

Material: two partly preserved pyritized cores (two incomplete whorls).

Description: the cross-section of the preserved whorl is lanceolate. The ventral part consists of a short arch that gradually passes into sides. In the ventre is a marked ropy keel, on both sides accompanied by very shallow depressions. The umbilical angle is highly rounded. The surface of the whorl is covered with marked, but not sharp rectiradiate to moderately sigmoidal ribs. The ribs commence in the umbilical angle where they are prorsiradiate. After a

short course they become radiate, thicken and in the periventral third of the whorl height they bend aperturally at the angle of about 45°. They cross the ventrum forming chevrons. Sometimes we observe bifurcations of ribs, the place of bifurcation being stressed by an inconspicuous "protuberance". The suture line was not preserved.

Remarks: Because of incomplete preservation (early ontogenetic whorls with protuberances are missing) we did not assign our specimens with certainty to the species *Amaltheus bifurcus* HOWARTH, 1958. The character of ribs of the preserved whorl, mainly bifurcations of ribs in the periventral part of the whorl as well as indications of protuberances in the place of bifurcation suggest that the specimens from Lukoveček could be assigned to *A. bifurcus*.

Our specimen, as it could have already been stated by the author of the species (HOWARTH, 1958, p. 2), is very closely related to the species *Amaltheus stokesi* (SOWERBY, 1818). From the latter our species differs in a lower involution, presence of strong radial or moderately sigmoidal ribs and presence of protuberances in the place of bifurcation.

In 1906, J. OPPENHEIMER (p. 140) mentions the species *Amaltheus Margaritatus* DE MONTF. from Lukoveček. This statement was later taken over by D. ANDRUSOV (1959, p. 115). The study of the material from the collections could not have proved presence of this species in Lukoveček.

Stratigraphic range: In the region of NW Europe, the species *bifurcus* is situated in the Lower Domerian, zone *Amaltheus stokesi* (HOWARTH, 1958). The same position in the Tethyd region is supposed by J. DOMMERGUES et al. (1983). In the region of the West Carpathians this species has not been known so far.

Geographic distribution: the species is wide-spread predominantly in NW Europe. Frequency of its occurrences decreases substantially towards the S and SE and in northern margins of the Tethys it is rather rare.

Pleuroceras HYATT, 1867

Pleuroceras solare (PHILLIPS, 1829)

Pl. I, fig. 8, Pl. II, fig. 1, text. fig. 5, 6

1904 *Amaltheus costatus* REIN. var. *nudus* QU — A. RZEHAK p. 111, fig. 1

1958 *Pleuroceras solare* (PHILLIPS). — M. K. HOWARTH, p. 28—30, pl. 5, fig. 1—7, text. fig. 15—17 (cum syn.).

1961 *Pleuroceras solare* (PHILLIPS). — DH. TINTANT et al. p. 150, pl. 1, fig. 5.

1971 *Pleuroceras solare* (PHILLIPS). — D. PATRULIUS et E. POPA, p. 134, pl. 2, fig. 3.

1976 *Pleuroceras solare* (PHILLIPS). — R. SCHLEGELMILCH, p. 73, pl. 36, fig. 2

1980 *Pleuroceras solare* (PHILLIPS) *solare*. — F. WIEDENMAYER, p. 53, pl. 3, fig. 8—13.

1981 *Pleuroceras solare* (PHILLIPS). — E. POPA, p. 234, pl. 9, fig. 5, 6.

Material: three more or less complete specimens with a partly preserved calcified shell

Dimensions:	inv. No	D	H	E	O
	8	10.2	5.0	3.6	3.2
	5	19.0	7.2	—	6.3
	7	31.0	11.0	—	11.0

Description: early ontogenetic stages (up to overall diameter of 3—4 mm) have a subcircular cross-section of the whorl, where the H/E ratio is approximately equal. During the ontogenesis the ratio H/E increases and the cross-section becomes wide elliptic to rounded oblong (text. fig. 5).

Medium sized individuals (diameter of about 30 mm) have a flat ventral part of the whorl that passes by a wide arch into flat and parallel sides. In the ventre is a rather marked keel, accompanied by strips on its sides.

The surface of the whorls is covered first with fine, then with marked sharp moderately prorsiradiately orientated ribs. The ribs commence in the umbilical angle and from the beginning are marked with a tendency to increase in size towards the ventre. In the ventral third of the whorl height they abruptly bend aperturally, get thinner and cease in the vicinity of the pericarinal strip.

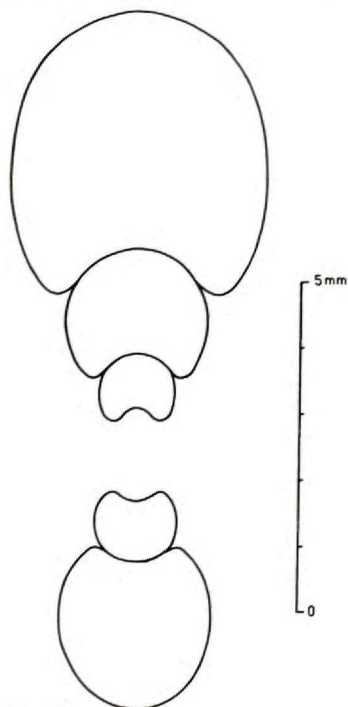


Fig. 5

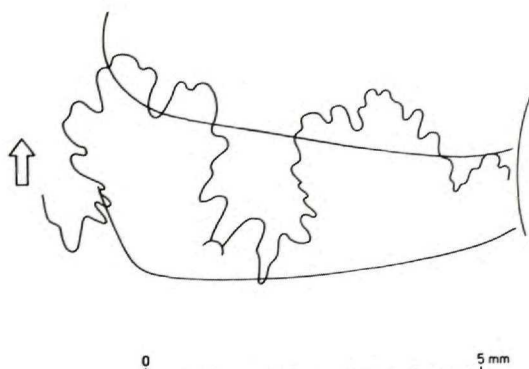


Fig. 6

The suture line (text. fig. 6) is only little divided and L_1 is only somewhat deeper than E. The first lateral saddle E/L is higher and narrower than L/U_2 .

Remarks: In his morphology M. K. HOWARTH (1958) depicts and describes a number of subspecies and transitory forms to the typical species. A

reliable distinguishing of the subspecies and varieties is impossible without a rich and well preserved material. The species *Pleuroceras apyreum* (S. BUCKMAN, 1911) differs from ours mainly in well developed ribs whose diameter attains 25—30 mm. Young individuals *Pleuroceras hawskerense* (YOUNG et BIRD, 1828) resemble our species but can be distinguished from it by small, but conspicuous protuberances in the place where the sides pass into the ventre.

Stratigraphic range: Upper Domerian, spinatum zone, subzone apyreum.

Geographic distribution: The species is wide-spread in NW Europe and in northern margins of the Tethyd Province (Alps, Carpathians, Caucasus)

***Pleuroceras spinatum* (BRUGUIÈRE, 1789)**

Pl. I, fig. 5, 6, text. fig. 7, 8

- 1958 *Pleuroceras spinatum* (BRUGUIÈRE). M. K. HOWARTH, p. 36—39, pl. 7, fig. 2—5, text. fig. 14—17 (cum syn.)
 1961 *Pleuroceras spinatum* (BRUGUIÈRE). — H. TINTANT et al., p. 153, pl. 1, fig. 9.
 1961 *Pleuroceras spinatum* (BRUGUIÈRE). — W. T. DEAN et al. pl. 71, fig. 1
 1964 *Pleuroceras* cf. *spinatum* (BRUGUIÈRE, 1789) M. RAKÚS, p. 132, pl. 2, fig. 2
 1966 *Pleuroceras spinatum* BRUGUIÈRE — K. Š. NOUTSUBIDZE, p. 85, pl. 18, fig. 7—11, pl. 25, fig. 22-23.
 1971 *Pleuroceras spinatum* (BRUGUIÈRE) — D. PATRULIUS et POPA, p. 134, pl. 2, fig. 4
 1976 *Pleuroceras spinatum* (BRUGUIÈRE, 1789), — R. SCHLEGELMILCH, p. 73, pl. 36, fig. 3
 1980 *Pleuroceras* cf. *spinatum* (BRUGUIÈRE) *spinatum* — F. WIEDENMAYER, p. 54, pl. 4, fig. 9—12
 1981 *Pleuroceras spinatum* (BRUGUIÈRE) — E. POPA, p. 234

Material: three uncompletely calcified rock cores

Dimensions:	inv. No.	D	H	E	O
	10	12.8	7.2	7.5	6.0
	9	20.4	8.0	—	7.4

Description: the cross-section of ontogenetically young whorls is kidney-shaped (text. fig. 7). The cross-section of medium growth stages is sub-square. The ventral part of the whorl is flat to moderately pressed in the median-keel part. The transition to flat sides is made up by a short arch.

The surface of the whorls is covered with marked sharp ribs that commence in the umbilical wall, gradually get stronger and in the place of transition of the sides into the ventre they abruptly bend aperturally. Near the conspicuous keel they get thinner and disappear. Approximately from the diametre of 10—15 mm, protuberances appear on the ribs (in the beginning of the ventral third of the whorl height).

Suture line: the first lateral lobe L is narrow and bifid. The first lateral saddle E/L is wide and little cut (text. fig. 8).

Remarks: The species *Pleuroceras spinatum* (BRUG.) is a characteristic and well identifiable species. In its cross-section, a lesser number of ribs and presence of protuberances on the ribs it can be easily distinguished from *Pl. solare* (PHILIPS).

Stratigraphic range: Upper Domerian, where it represents a guide-fossil of the spinatum zone.

Geographic distribution: it belongs among common species in NW Europe. The frequency of its occurrences decreases towards the S and SE and in northern parts of the Tethyd province it is a rare species.

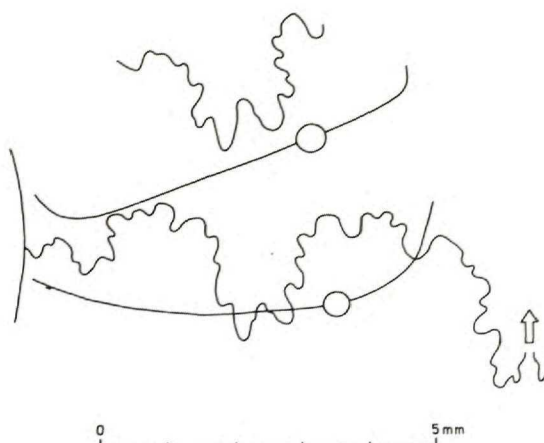
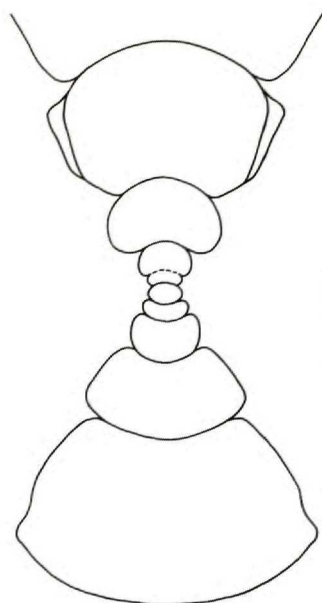


Fig. 8

◀ Fig. 7

Dactylioceratidae HYATT, 1867

Dactylioceras HYATT, 1887

subgenus *Orthodactylites* BUCKMAN, 1926

Dactylioceras (Orthodactylites) cf. athleticum (SIMPSON, 1855)

Pl. II, fig. 2, 4

Material: two partly deformed rock cores of fine-grained biomicritic light-gray limestone.

Description: young ontogenetic stages (diameter up to 30 mm) characterized by relatively fine, dense prorsiradiately orientated ribs and an oval cross-section of the whorls. Older growth stages are characterized by a rounded oblong cross-section of the whorl. The ventral part is made up by a short arch that gradually passes into moderately arched to flat, nearly parallel sides. The umbilical angle is highly rounded but conspicuous. The umbilical wall is relatively high and perpendicular to the plane of symmetry. In this growth stage, the ribs are less prorsiradiate, but are sharp and bifurcate in the place where the

sides pass into the ventre. The ribs commence in the umbilical angle, quickly become conspicuous and continue without getting thinner as far as the place of bifurcation.

Remarks: reliable measurements and taxonomic assignation could not have been carried out because of a relatively strong deformation. The character of the primary ribs and the conspicuous angle of the last preserved whorl suggest close relations to *Dactylioceras* (*Orthodactylites*) *athleticum* (SIMPSON, 1855), fide holotype depicted by S. S. BUCKMAN 1912, pl. 51 a)

Stratigraphic range: originally (see S. S. BUCKMAN, 1912, 516) the stratigraphic position was not sufficiently exact and the species was assigned to transitory beds between the Domerian and Toarcian. Now the species is assigned only to the Lower Toarcian, zone with *D. tenuicostatum* (J. WIEDENMAYER 1980, p. 138).

Geographic distribution: The species is relatively rare. It was originally described in England (Yorkshire). Occurrences in NW Europe are known. In the region of the West Carpathians it has not been known so far, the locality Lukoveček is its first occurrence here.

***Dactylioceras* (*Orthodactylites*) cf. *Semicelatum* (SIMPSON, 1843)**

Pl. III, fig. 1, 2

Material: two rather damaged and deformed rock cores of gray fine-grained biomicritic limestone.

Description: An incomplete specimen of an 85 mm diameter has (according to reconstruction) a highly oval cross-section of the whorls with moderately arched sides. The whorl surface is covered with dense prorsiradiate simple-angular or bifurcating rather sharp ribs. The suture line was not preserved.

Remarks: In the type and density of ribs, the specimens from Lukoveček resemble most the species *D. (Orthodactylites) semicelatum* (SIMPSON) as it was depicted by S. S. BUCKMAN 1911, pl. 31, fig. 1, 2. From the Buckman's illustration they differ, however, in more irregular bifurcations and our specimen seems to be a little more involute.

According to M. K. HOWARTH (1973), the species *semicelatum* is much wider than in the sense of BUCKMAN (1911) and he assigns to this species also forms that have tuberculate whorls in the early ontogenetic stage. The opinion of the former seems us too wide and we have accepted the Buckman's conception of this species. *D. (O.) polymorphum* FUCINI, 1935 has finer ribs, mainly secondary. *D. (O.) tauromense* FUCINI, 1935 has, in comparison with our specimen, a little less dense arrangement of ribs.

Stratigraphic range: the species is abundant in NW Europe, where it occurs in the Lower Toarcian — *tenuicostum* zone.

Geographic distribution: the species is wide-spread predominantly in NW Europe. Its occurrences in the Tethyd region are rather sporadic (F. WIEDENMAYER, 1980).

Costileioceras cf. *costatum* (HORN, 1909)

Pl. IV, fig. 3, text. fig. 9, 10

Material: a nearly complete individual with a partly preserved calcified shell and three whorl fragments of various growth stages.

Description: a convolutedly coiled shell with a relatively dense umbilicus, whose overall diameter amounts about 110—120 mm. The cross-section of medium and adult whorls is lanceolate. The cross-section of the last preserved whorl of the living camera is roof-shaped in the ventre with a moderately indicated bend in the place where the sides pass into the ventre (text. fig. 9). The sides are moderately arched and in the periventral middle of the whorl height are parallel to impressed. The umbilical angle is rounded but conspicuous. The umbilical wall is oblique.

The whorl surface is covered in the beginning with rather conspicuous falcoid ribs that gradually get flatter. The living camera is smooth. The ribs commence

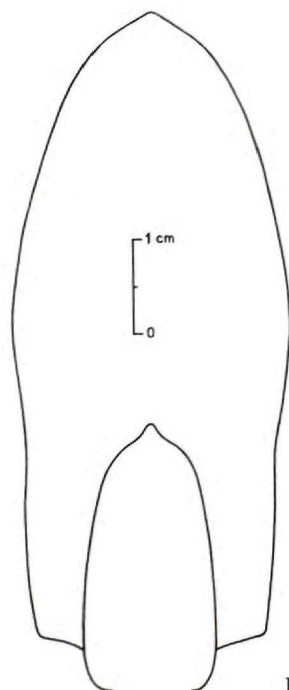


Fig. 9

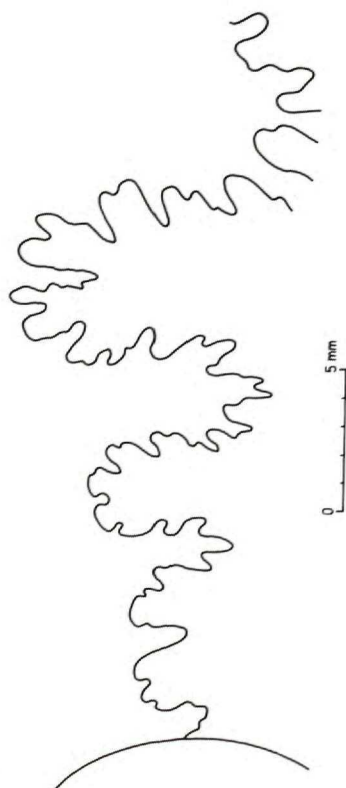


Fig. 10

in the umbilical angle from where they are directed aperturally at the angle of 55°. In the middle of the whorl height they bend radially and in the place where the sides pass into the ventre they again bend aperturally and after a short course disappear in the vicinity of the keel. The ribs branch mainly in two, the place of the branching being approximately in the first third of the whorl height.

The suture line (text. fig. 10) is preserved incompletely but it doubtlessly has features of a graphoceratoid suture.

Remarks: the specimens from the locality Lukoveček seem, in their whorl cross-section and rib type, to be closest to the species *Costileioceras costatum* (HORN, 1909). As it results from a monographic study of Prof. B. GÉCZY (1967), the taxonomy of the family Graphoceratidae is very disunited and criteria for distinguishing individual taxons are markedly different by individual authors. Because of the incomplete material we could not have defined it more exactly than cf.

Stratigraphic range: Middle Aalenian, zone with *Ludwigia murchisonae*.

Geographic distribution: the species is wide-spread predominantly in central Europe.

Costileioceras sp.

In the ammonite collection from Lukoveček there occurs a whorl fragment that can be well assigned to the genus *Costileioceras*. The whorl cross-section is highly oval with a roof-shaped ventre with moderately arched sides and the largest whorl width in the middle of the whorl height. The surface is covered with sigmoidally bent, not very conspicuous ribs.

Brasilia BUCKMAN, 1898

Brasilia ex gr. *bradfordensis* (S. BUCKMAN, 1881)

Pl. IV, fig. 4

Remarks: in the material was an incomplete specimen that, on the basis of its rib type and the course of the radial line, we assign to the group *bradfordensis*. From this species our specimen partly differs in a narrower whorl cross-section and narrower ventral part of the whorl.

Stratigraphic range: Middle Aalenian, *murchisonae* zone, subzone *bradfordensis*.

Ludwigia BAYLE, 1878

Ludwigia ex gr. *murchisonae* (SOW.)

text. fig. 11

Remarks: in the ammonite collection are four immature specimens that doubtlessly belong to the genus *Ludwigia*. As seen on the whorl cross-section (text. fig. 11), the ventral part of the whorl is flat, moderately roofy-bent. The sides are arched and the maximum width is somewhat lesser than a half of the whorl height. The ribs are conspicuous, consisting of simple or forkedly branching, relatively strong, flexiradiate ribs. The ribs commence in the umbilical angle from where they are prorsiradiately orientated. In the end of the periumbilical third of the whorl height they bend adaperturally and are nearly radiate. In the place of transition of the sides into the ventre they again bend aperturally and quickly disappear. Nodosites sometimes appear in the place of branching.

Stratigraphic range: Middle Aalenian, *murchisonae* zone.

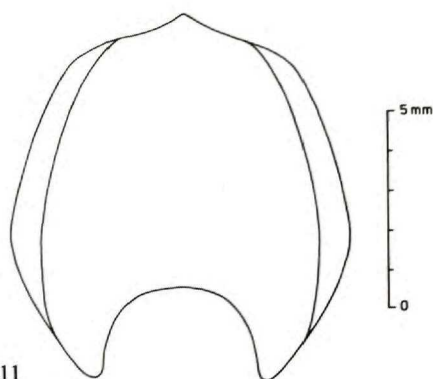


Fig. 11

Oedania BUCKMAN, 1904

Oedania ? ex gr. *falcifera* BUCKMAN, 1904

Pl. IV, fig. 1, text. fig. 12, 13

Material: Two incomplete rock cores

Dimensions:	inv. No	D	H	E	O	N/2
	27	16.5	7.4	4.6	4.0	21
	29	24.5	9.5	5.6	6.5	21

Description: a small convolutely coiled strongly laterally pressed form (text. fig. 12). The cross-section of the last whorl is elliptic. The ventral part of the whorl is formed by a rather arched arch that passes gradually into moderately arched sides. The umbilical angle is strongly rounded but distinct. The umbilical wall is low, obliquely orientated. In the ventre is a fine, but sharp keel. The whorl surface is covered with densely arranged flexiradiate ribs. The ribs are mainly simple, but forkedly branched ones occur, too. The ribs commence in the umbilical angle from where are directed aperturally. In the end of the umbilical third of the whorl height they become straight and are directed towards the

ventre, where in the near-keel zone they become weaker and disappear. In the place where the diameter is 25 mm are about 43 ribs. The place of branching may be sometimes thicker — indications of the formation of protuberances.

The suture line is typically graphoceratoid — relatively little divided (text. fig. 13). The external lobe E is wide shallow and little divided. The first lateral saddle E/L is also little cut and is asymmetrically divided in two parts. The first lateral lobe L is little divided. U_2 is shallow and attains approximately a half of the L height.

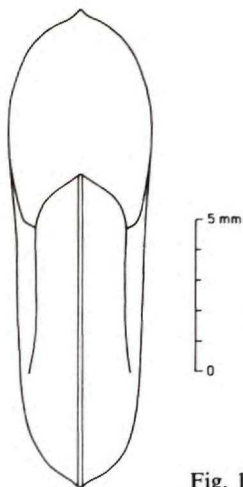


Fig. 12

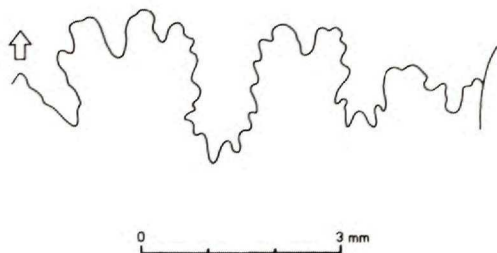


Fig. 13

Remarks: overall magnitude, rather conspicuous umbilical angle as well as shape and course of the radial line made us assign the specimens from Lukoveček to the group *Oedania falcifera* BUCKMAN, 1904. From this species, however, our specimens partly differ in a little opener umbilicus — the feature in which they are close to the species *Reynesella lineata* BUCKMAN, 1904.

Stratigraphic range: Upper Aalenian — ? Lower Bajocian (zone *Concavum discites*)

Geographic distribution: western Europe

Reynesella BUCKMAN, 1902

Reynesella ? ex gr. *lineata* BUCKMAN, 1904

Pl. II, fig. 3, Pl. IV, fig. 2, text. fig. 14—17

Material: 12 incomplete rock cores

Dimensions:	inv. No.	D	H	E	O	N/2
	19	8.5	3.3	3.5	2.6	14
	17	9.0	3.2	2.8	2.0	14
	16	9.4	3.4	3.4	2.5	12
	18	12.5	5.0	—	6.0	17
	24	14.8	5.6	5.6	5.9	16
	31	16.7	7.0	5.5	4.7	16
	26	17.5	9.0	6.6	6.0	18
	30	19.5	9.0	—	6.0	16
	35	22.0	10.0	—	6.5	16
	32	25.0	11.5	7.0	8.7	20

Description: small convolutely coiled strongly laterally pressed form (text. fig. 15). The cross-section of ontogenetically young whorls (text. fig. 14) up to the diameter of 10 mm is kidney-shaped then becomes oval. By the diameter of 15 to 20 mm the whorl cross-section is highly oval. The ventral part is moderately roofy bent and the transition of the ventre into the whorl sides is also marked by a moderate bend. The sides are moderately arched with a maximum width in the middle of the whorl height. The umbilical angle is rounded, the umbilical wall is oblique.

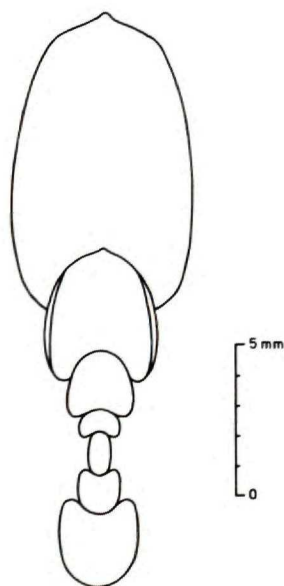


Fig. 14

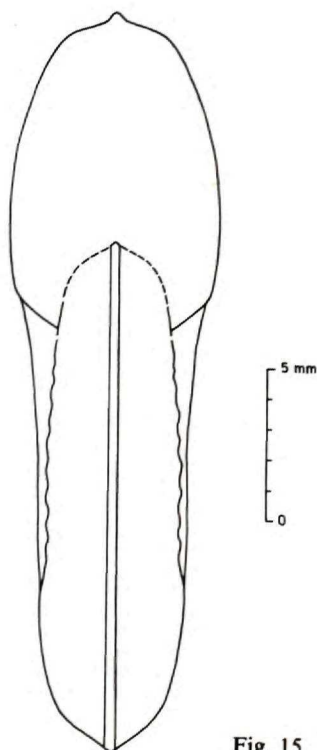


Fig. 15

The early ontogenetic stages are smooth. From the diameter of about 8 mm, first simple ribs commence. They have the shape of small moons with the concave side orientated aperturally. Double ribs commence gradually (from the diameter of about 10 mm) and their branching takes place in the vicinity of the umbilical angle. The orientation and course of the ribs is the same as in the preceding stage. In the following growth stage, the point of branching moves to the end of the periumbilical third of the whorl height. In this stage the ribs commence on the umbilical side and are orientated prorsiradiately. In the end of the umbilical third of the whorl height they branch in two. From the place of branching on, they are orientated adaperturally, but in the place of transition of the sides into the ventre they bend towards the aperture again. By the diameter of about 20 mm, thickenings occur in the place of branching.

The suture line (text. fig. 16—17) is characteristic by a wide outer lobe E. The first lateral saddle E/L is also wide and asymmetrically divided in two. The first lateral saddle is narrow. U_2 is narrow and reaches only to the middle of the L height.

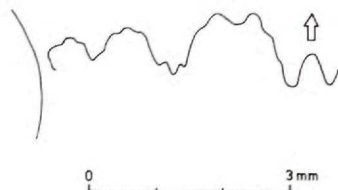


Fig. 16

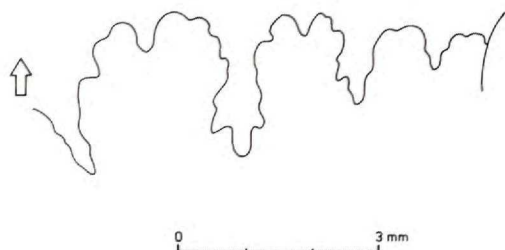


Fig. 17

Remarks: all our specimens are immature growth stages whose exact assignation is impossible. In the type of ribs and whorl cross-section they most resemble the species *Reynesella? lineata* BUCKMAN, 1904. From the individuals, that we have assigned to *Oedania? ex gr. falcifera* BUCKMAN 1904, our specimens differ in thicker and less numerous ribs and in the presence of nodosites in the place of branching.

Stratigraphic range: Upper Aalenian — ? Lower Bajocian (concaum ? discites zone).

Geographic distribution: western Europe

Stratigraphic evaluation of the fauna

By stratigraphic evaluation of ammonites we come out from the taxonomic assignation. It is mainly because the ammonite collection comes from various collections and has not been horizoned.

The fauna described in the systematic part belongs to three to four stages of the Jurassic. As the oldest assemblage we regard these species *Amaltheus* cf. *bifurcus* HOW., *Phylloceras* cf. *hebertinum* (REYNÉS), *Partschiceras* cf. *striatocostatum* (MENEHINI), *Juraphyllites* cf. *libertus* (GEM.) and *Cenoceras striatum* (SOWERBY). The species of the families *Phylloceratidae* and *Juraphyllitidae* are generally of a longer stratigraphic range than the Domerian (Lotharingian — Domerian). We are of the opinion, however, that in our case species older than the Lower Domerian are not present. This interpretation is supported by the lithology, but mainly by the fact that the oldest zone species is *Amaltheus* cf. *bifurcus*. This species is an index species of the Domerian and corresponds to the zone *stokesi*.

The assemblage *Pleuroceras solare* (PHILL.) and *P. spinatum* (BRUG.) corresponds to a stratigraphically higher Domerian horizon. Both species, but especially the latter, represent significant index fossils and characterize the zone *spinatum* of the Upper Domerian.

We could not have proved the presence of the Middle Domerian *margaritatus* zone, though it is probable.

The Toarcian is characterized by the species *Dactylioceras* (*Orthodactylites*) cf. *athleticum* (SIMPSON) and *D. (O.)* cf. *semicelatum* (SIMPSON). Both species correspond to the tennicostatus zone, i.e. to the Lower Toarcian. Species indicating the Middle and Upper Toarcian have not been found yet.

From the faunistic viewpoint, the Aalenian contains the largest number of individuals: *Costileioceras* cf. *costatum* (HORN), *Costileioceras* sp., *Brasilia* ex gr. *bradfordiensis* (BUCK.), *Ludwigia* ex gr. *murchisonae* (SOW.), *Oedania* ? ex gr. *falcifera* BUCK. *Reynesella* ? ex gr. *lineata* BUCKM. This assemblage corresponds to the Middle Aalenian, zone *murchisonae*. The last two species could correspond to the Upper Aalenian to Lower Bajocian. As their taxonomic assignation is uncertain, we do not state the presence of the Bajocian with certainty, though it is probable.

Paleobiographic remarks

When we evaluate the paleobiographic appurtenance of the Domerian ammonite assemblage, we may state that this assemblage is of a rather strong Mediterranean character. The presence of the genus *Partschiceras* representatives and predominantly *Juraphyllites* indicate a direct communication with the Tethyd area. At the same time ubiquitous elements represented by the species *Pleuroceras solare* and *P. spinatum* occur. Both species mentioned occur in NW Europe but are rather common in the Tethyd area, too (WIEDENMAYER, 1977, 1980).

The Toarcian assemblage has no clean-cut character. Both species are common in NW Europe, but like the Upper Domerian species they occur in the marginal parts of the Tethyd area, too.

The Aalenian association is the richest and is composed of evident European elements. Phylloceratida and litoceratida are absent.

We may state that the Mediterranean influence in the fauna of Lukoveček decreases from the Middle Lias — Domerian to Aalenian and on the contrary the influence of the European faunistic province increases. This development of the situation is well seen in the graph of the overall percentage of cephalopods in the locality Lukoveček (text. fig. 18).

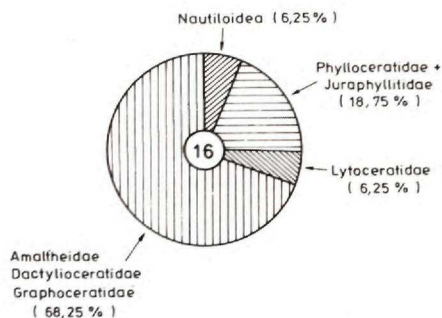


Fig. 18 Percentual composition of fauna at the locality Lukoveček

An interesting relation results from the analysis of the lithology, lithofacies and faunistic assemblage of the Aalenian. This association is rather close to that of the murchisonae beds of the Czorsztyn succession described by E. SCHEIBNER (1964), mainly as far as representatives of the family Graphoceratidae are concerned. Some difference, however, exists: absence of the representatives of the orders Phylloceratida and Lytoceratida that make up an important constituent of the faunistic spectrum e.g. in the locality Litmanová (cf. SCHEIBNER, l.c.). The presence of the above-mentioned orders in the sedimentation area of the Czorsztyn Group indicates encroachment of the Tethyd faunistic province.

The lithological — stratigraphic, as well as faunistic relations of the Aalenian of the locality Lukoveček make us suppose a connection of both sedimentation basins during the Aalenian.

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Cefalopódová fauna liasu a áľenu z olistolitov račianskej jednotky magurského flyšu (lokalita Lukoveček)

Resumé anglického textu

Výskyty jury vo flyšovom pásme sú veľmi zriedkavé, a tak každý nový údaj je prínosom. V práci opísaná fauna amonitov pochádza z olistolitov, ktoré sa vyskytujú v spodných soláňských vrstvách vrchnokriedového veku. Tieto vrstvy prináležia čiastkovej jednotke račianskej.

V systematickej časti opísaná fauna patrí trom jurským stupňom. Za najstaršie považujeme toto spoločenstvo: *Amaltheus* cf. *bifurcatus* HOW., *Phylloceras* cf. *hebertinum* (REY.), *Partschiceras* cf. *striatocostatum* (MGH.), *Juraphyllites* cf. *libertus* (GEM.) a *Cenoceras striatum* (SOW.).

Toto spoločenstvo zodpovedá spodnému doméru, zóne *Stokesi*.

Vrchný domér je reprezentovaný druhmi: *Pleuroceras solare* (HILL.) a *P. spinatum* (BRUG), ktoré charakterizujú zónu *Spinatum*.

Toark je charakterizovaný: *Dactylioceras* (*Orthodactylites*) cf. *athleticum* (SIMPSON) a *D. (O.)* cf. *semicelatum* (SIMPS.). Tieto druhy zodpovedajú zóne *Tenuicostatus*.

Áľenské spoločenstvo je po faunistickej stránke najbohatšie. Charakterizujú ho tieto druhy: *Costileioceras* cf. *costatum* (HORN.), *Costileioceras* sp., *Brasilia* ex gr. *bradfordensis* (BUCKM.), *Ludwigia* ex gr. *murchisonae* (SOW.), *Oedania* ? ex gr. *falcifera* BUCKM., *Reynesella* ? ex gr. *lineata* BUCKM.

Z paleobiogeografického hľadiska možno konštatovať, že od doméru do áľenu pozorujeme pokles mediterránneho vplyvu vo faunistickom spektre a naopak stúpa vplyv európskej faunistickej provincie.

Explanations to Plates I—IV

Plate I

- 1 — *Phylloceras* cf. *hebertinum* (REYNÉS, 1868), magn. 1.5 X
- 2 — *Juraphyllites* cf. *libertus* (GEMMELLARO, 1884), magn. 2 X
- 3 — *Cenoceras striatum* (SOWERBY, 1817), magn. 1 X
- 4 — *Partschiceras* sp. cf. *striatocostatum* (MENEGHINI, 1853), real size
- 5 — *Pleuroceras spinatum* (BRUGUIÈRE, 1789), magn. 2 X
- 6 — *Pleuroceras spinatum* (BRUGUIÈRE, 1789), magn. 1.5 X
- 7 — *Amaltheus* cf. *bifurcus* HOWARTH, 1958, magn. 1.5 X
- 8 — *Pleuroceras solare* (PHILLIPS, 1829), magn. 1.5 X

Plate II

- 1 — *Pleuroceras solare* (PHILLIPS, 1829), magn. 1.5 X
- 2 — *Dactylioceras* (*Orthodactylites*) cf. *athleticum*, (SIMPSON, 1855) real size
- 3 — *Reynesella* ? ex gr. *lineata* BUCKMAN, 1904, magn. 2 X
- 4 — *Dactylioceras* (*Orthodactylites*) cf. *athleticum*, (SIMPSON, 1855) real size

Plate III

- 1, 2 — *Dactylioceras* (*Orthodactylites*) cf. *semicelatum* (SIMPSON, 1843), real size

Plate IV

- 1 — *Oedania* ? ex gr. *falcifera* BUCKMAN, 1904, magn. 1 X
- 2 — *Reynesella* ? ex gr. *lineata* BUCKMAN, 1904, magn. 1 X
- 3 — *Costileioceras* cf. *costatum* (HORN, 1909), Aalenian, zone scissum, real size
- 4 — *Ludwigia* ex gr. *bradfordensis* (BUCKMAN, 1881), magn. 1 X

Photographed by L. Oswald

Mária Kochanová

Obertriassische Muscheln von Ostré vršky (Slowakischer Karst)

1 obr., 3 fotogr. tab. (V—VII), slovenské resumé

Abstrakt. Die Kalksteine vom Raume der Kote Ostré vršky auf dem Plešivec-Plateau im Slowakischen Karst waren bisher von unklarer stratigraphischen Position. Mittels der biostratigraphischen Untersuchung war es bei ihnen möglich einen zum Karn und einen zum Nor angehörenden Teil auszugliedern. Vom Karn stammen die Arten *Halobia bystrickyi* sp. n., *H. lenticularis* (GEM-MELLARO), *H. superba superba* MOJSISOVICS und vom Nor *Halobia celtica* MOJSISOVICS und *H. norica* MOJSISOVICS.

Einleitung

Die Muscheln, welche wir in der vorliegenden Arbeit anführen, stammen von den Lokalitäten in Kalksteinen im obersten Teil des Plešivec-Plateaus und dies vom Kamme der Kote Ostré vršky. Es handelt sich um helle dickbankige Kalksteine, welche faziell sehr an die Wettersteinkalke erinnern. Stellenweise befinden sich in ihnen Linsen und Lager von Krinoiden und Krinoid-Lumachelnkalcken. In den letzteren fanden wir eine verhältnismässig reiche Makrofauna von Muscheln, Brachiopoden und seltener wurden auch Cephalopoden gefunden. So wurde die im ganzen monotone Schichtfolge von L. BARTKÓ (1953) auf Grund der Art *Halobia celtica* MOJS. und von J. BYSTRICKÝ (1955) auf Grund der Arten *Halobia distincta* MOJS. und *Koninckina* aff. *Leopoldi austriacae* (BITTN.) als norisch betrachtet. Später hat J. BYSTRICKÝ (1964) nach der Untersuchung des Charakters der Karn-Fauna bei Silická Brezová das norische Alter der Kalke auch auf Ostré vršky bezweifelt. J. MELLO (1973) betrachtet diese Kalke als eine lithostratigraphische Einheit der Tisovec-Kalke, daher als karnisch. Die Hauptursache der Unklarheit betreffs der stratigraphischen Zugehörigkeit dieser Kalke ist die Tatsache, dass, da in denen fazielle Verschiedenheiten nicht existieren, der fazielle Standpunkt als Kriterium für ihre Gliederung nicht angewendet werden kann. Als erfolgreicher haben sich die biostratigraphischen Kriterien gezeigt und die sich an die Makrofauna von diesem Raume

anlehnenden biostratigraphischen Studien führten auch zu positiven Resultaten. Mit derer Hilfe war es möglich festzustellen, dass in den untersuchten Kalken der Karn und das Nor vertreten sind.

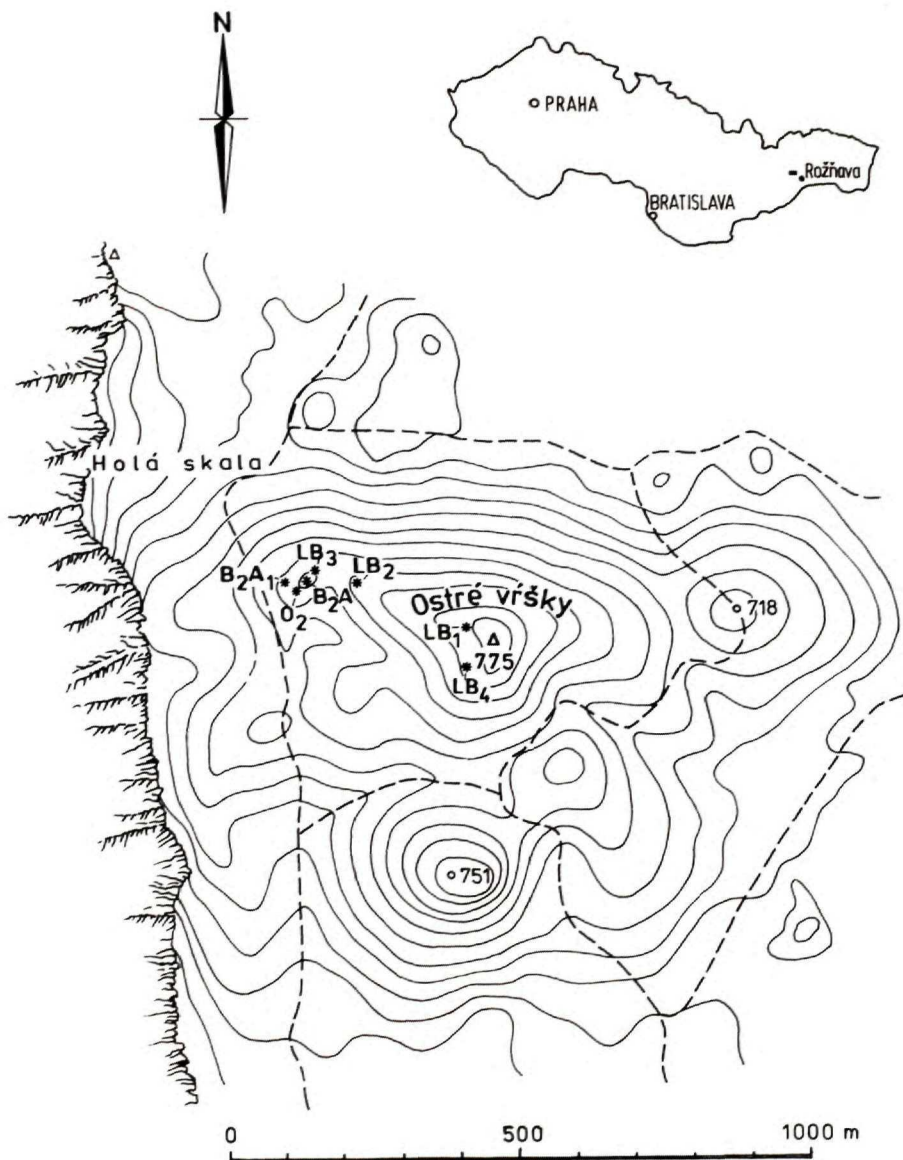


Abb. 1 Die Lokalitäten der untersuchten Region

Die Lokalitäten und ihre Fauna

Die Makrofauna dieser Region stammt von Lokalitäten, welche sich am von der Kote Ostré vršky in nordwestlicher Richtung zur Kante am Westrande des Plešivec-Plateaus führendem Kamme befinden. (Abb. 1) Es sind die Lokalitäten folgender Bezeichnung: LB-1, LB-2, LB-3, LB-4, B₂ A, B₂ A₁ und O₂. Der Höhenunterschied zwischen der Lokalität LB-1 und O₂ ist ca 50 m, wobei O₂ die niedrigste und LB-1 die höchst liegende Lokalität ist.

Die erste, zur Kote nächst gelegene Lokalität ist LB-1, von ihr ca. 60 m NW entfernt. Es wurden hier nur Muscheln, vertreten durch Halobia-Arten: *Halobia celtica* MOJSISOVICS, 1874, *Halobia norica* MOJSISOVICS, 1874, *Halobia* cf. *subreticulata* GEMMELLARO, 1882, *Halobia* cf. *superba* MOJSISOVICS, *Halobia* sp. n., *Halobia* sp. 3, *Halobia* ex gr. *superba* MOJSISOVICS, gefunden.

An der weiteren Lokalität LB-2, welche sich ca. 200 m westlich von der vorhergehenden Lokalität befindet, überwiegen in der makrofaunischen Vergesellschaftung Brachiopoden, begleitet von seltenen und schlecht erhaltenen Muscheln. Diese Vergesellschaftung besteht aus den Arten: *Austriellula gomensis* (BALOGH), *Austriellula undosa* (SIBLÍK) (bestimmt von M. SIBLÍK), *Leptochondria* sp. und *Halobia* sp.

Ungefähr 80 m westlich liegt am Kamme eine weitere Lokalität LB-3. Die Makrofauna ist hier nur von Halobien vertreten, unter welchen das massenhafte Vorkommen der Art *Halobia lenticularis* (GEMMELLARO, 1882) den Eindruck einer Mono-Vergesellschaftung erweckt. Nur mit einigen Individuen ist in ihr *Halobia* sp. 4 vertreten.

Die gemeinsame Lokalität von Brachiopoden, Cephalopoden und Muscheln, benannt als B₂A, ist ca. 30 m südwestlich von der vorhergehenden entfernt. Eine gemeinsame Assoziation bilden hier die Arten: *Austriellula angulifrons* (BITTNER), *Austriellula halophila* (BITTNER), *Laballa suessi* (ZUGMAYER) bestimmt von M. SIBLÍK, Muscheln *Leptochondria* sp., *Halobia* sp. und *Halobia* ex gr. *radiata* GEMMELLARO. Die Cephalopoden und Conodonten von dieser und den übrigen Lokalitäten werden noch bearbeitet.

Ungefähr 20 m in westlicher Richtung befindet sich eine weitere Lokalität B₂A₁. Zahlenmässig herrschen hier Halobien vor, besonders die Art *Halobia bystrickyi* sp. n. aber es wurden auch hier einige Exemplare der Arten *Halobia* cf. *superba* MOJSISOVICS, 1874 und *Gemerithyris hungarica hungarica* (BALOGH) gefunden.

Die Reihenfolge der Lokalitäten am Kamme beendet die Lokalität O₂. Sie liegt cca. 50 m südwestlich von der Lokalität B₂A. Den Muscheln und Brachiopoden gehören hier die Arten *Camptonectes* (*Annulinctes*) sp., *Halobia superba superba* MOJSISOVICS, 1874 *Halobia* ex gr. *superba* MOJSISOVICS, *Halobia* sp. 2 und *Gemerithyris hungarica hungarica* (BALOGH) an. Die Brachiopoden von diesen beiden Lokalitäten wurden von M. SIBLÍK bestimmt.

Die letzte Lokalität vom Raume von Ostré vršky ist LB-4. Sie befindet sich

am südlichen Bergabhänge cca. 40 m unterhalb der Lokalität LB-1. Es ist eher ein Schotterfeld, in welchem wir nur die Art *Halobia superba superba* MOJSISOVICS, 1874 gefunden haben.

Systematischer Teil

Pectinacea RAFINESQUE, 1815

Aviculopectinidae MEEK et HAYDEN, 1864

Leptochondria BITTNER, 1891

Leptochondria sp.

Tab. VI, Abb. 3, Tab. VII, Abb. 1, 3

Material: Kerne einer linken und zwei unvollständigen rechten Schalen.

Dimensionen: rechte Schale	Höhe = 11,5 mm,	Länge = 12 mm
linke Schale	Höhe = 12 mm,	Länge = ?

Beschreibung: Die kleinen symmetrischen Schalen sind annähernd gleich breit wie hoch, mässig gewölbt. Die Ohren sind die Fortsetzung des Schalenkörpers, das vordere ist grösser als das hintere und das rechte hat einen Byssusausschnitt. Die Skulptur der Oberfläche ist von strahlenförmigen Rippen, vom Wirbel auslaufend und ausgebreitet über die ganze Oberfläche verteilt, gebildet. Sie teilen sich in primäre Rippen, zwischen welche eine sekundäre eingeschoben ist. Seltener kommt noch eine tertiäre Rippe vor. Über diese ziehen gleichmässig gelegene konzentrische Streifen durch. Die Skulptur der rechten Schale scheint um etwas dicker zu sein. An den Ohren gehören ihr senkrechte Anwachsstreifen und an den vorderen also Spuren von strahlenförmigen Rippen an.

Bemerkungen: Die gesamte Morphologie der Individuen von unserem Material erinnert sehr an die Art *Leptochondria vadaszi* (KUTASSY). Ursprünglich war sie als *Pecten raricostatus* und dies durch E. VADÁSZ (1910), S. 122, Tab. 4, Abb. 7) von den Dachsteinkalken der Obertriass (des Rhaets) von Ungarn, beschrieben. Da schon A. KLIPSTEIN (1843) diesen Namen für eine andere Art angewendet hat, A. KUTASSY (1931) nennt dieselbe auf *Pecten vadaszi* um. A. ALLASINAZ (1972, S. 254, Tab. 31, Abb. 4) revidierend die triassische *Pectinidae*, vergenauert er ihre Gattungseinreihung als *Leptochondria*. Ebenso wie Kutassy betrachtet er sie als Art des Nors. Von dieser Art ist nur die linke Schale bekannt, welche, zum Unterschiede von unserem Individuum schmaler ist und weniger konzentrische Rippen besitzt. Ob man dies als Folge der Variabilität auf Grund von drei Exemplaren, welche uns zur Verfügung stehen, betrachten kann, können wir kaum einen verantwortungsvollen Standpunkt einnehmen..

Vorkommen: Ostré vrš' y, Lokalität LB-2 und B₂A. Tuval auf Grund von Brachiopoden.

Pectinidae RAFINESQUE, 1815
Camptonectes AGASSIZ in MEEK, 1864
Annulinectes ALLASINAZ, 1972

Camptonectes (Annulinectes) sp.

Material: Eine kleine, zur Hälfte vom Gestein bedeckte Schale und ein Fragment.

Bemerkungen: Die artenmässige Bestimmung dieser Individuen wird von ihrem Erhaltungszustande nicht gestattet. Man kann sich aber bei ihnen auf einige für den Taxon *Camptonectes (Annulinectes)* charakteristische Merkmale stützen. Es ist der dreieckige Umriss der Schale und regelmässige dichte konzentrische Rippen, seine Oberfläche bedeckend. Dabei hat die Schale eine Höhe von nur 4 mm und die Anzahl der Rippen ist ungefähr 13.

Vorkommen: Ostré vršky, Lokalität O₂, Tuval.

Posidoniidae FRECH, 1909
Halobia BRONN, 1830

Halobia bystrickyi sp. n.

Tab. V, Abb. 6, Tab. VII, Abb. 2, 4

? 1976 *Halobia carnica* — B. GRUBER, Abb. 1 (nomen nudum)

Derivatio nominis: Zum Andenken des verstorbenen Dr. J. BYSTRICKÝ, des langjährigen Forschers des Slowakischen Karstes

Holotypus: Das auf Taf. 3. Abb. 2, abgebildete Exemplar, Inv. Nr. Pl. p.1/1

Locus typicus: Ostré vršky, Lokalität B₂A₁

Stratum typicum: Karn (Tuval)

Diagnose: Die asymmetrischen Schalen besitzen einen hinausragenden Wirbel, im vorderen Teil des Schlossrandes gelegen. Das Vorderrohr ist zweiteilig. Die Oberflächenskulptur besteht aus radialen, bis zu den beiden Schlossrändern reichenden Rippen, konzentrischen Runzeln und dichten Anwachslinien.

Material: 54 grösstenteils unvollständige Kerne, viele Fragmente und Abdrücke.

Dimensionen: Rechte Schale —	Höhe = 16 mm,	Länge = 22 mm,
	Höhe = ?,	Länge = 30 mm,
	Höhe = 11 mm,	Länge = 20,5 mm
Linke Schale —	Höhe = 19,5 mm,	Länge = 32 mm
	Höhe = 15 mm,	Länge = 25 mm

breiter und spärlicher sind. Sie reichen zu den beiden Schlossrändern, beim hinteren sind sie besonders schmal und dicht. Sie zweigen sich zweimal paarweise, manche auch auf drei. DE CAPOA BONARDI (in CAFIERO et BONARDI 1982, S. 63) erwähnt auf Grund des faktologischen Materials, welches sie zur Verfügung hatte, dass zwischen den Arten *Halobia celtica* MOJSISOVICS und *Halobia beneckeii* GEMMELLARO eine enge morphologische Affinität existiert, so dass sie vielleicht Synonyma sind.

Stratigraphische und geographische Verbreitung: Nor (Lac—Alaun). Nordalpen.

Vorkommen: Ostré vršky, Lokalität LB-1. Nor.

***Halobia lenticularis* (GEMMELLARO, 1882)**

Taf. VI, Abb. 4, 5

1882 *Daonella lenticularis* GEMM. — G. GEMMELLARO, p. 466—467, Taf. 1, Fig. 3—5.

1980 *Halobia lenticularis* (GEMMELLARO) — B. CAFIERO et P. DE CAPOA BONARDI, p. 192—194, Taf. 3; Fig. 7—8 (cum syn.).

1982 *Halobia lenticularis* (GEMMELLARO) — B. CAFIERO et P. DE CAPOA BONARDI, p. 56—58, Taf. 2, Fig. 1—10, Text. Fig. 6.

Material: Viele Individuen von juvenilen bis erwachsenen in reichhaltigen Lumachellen.

Bemerkungen: Die Individuen, besonders die kleineren, erinnern in ihrer gesamten Morphologie an die Vertreter der Gattung *Posidonia*. Die Schalen sind vorwiegend von kleineren Dimensionen, bei den best erhaltenen Exemplaren erreichen sie eine Höhe von 9 und 11 mm, Länge von 12 und 16,5 mm. Sie sind mässig in die Länge gezogen und haben einen kleinen überragenden Wirbel, im vorderen Drittel des Schlossrandes gelegen, so dass sein hinterer Teil ausdrücklich länger ist. Das Vorderrohr ist einfach, es ist nur eine kleine dreieckige Fläche, abgetrennt durch eine seichte Vertiefung vom Schalenkörper. Es ist selten erhalten und meistens nur mit Hilfe einer Lupe bemerkbar und dies nur an fünf linken und einer rechten Schale. Sie ähneln sehr auch Kittl's Art *Halobia disperseinsecta*. Die Ähnlichkeit zwischen den Arten *Halobia lenticularis* und *Halobia disperseinsecta* konstatierte schon E. KITTL (1912, S. 91). Neuestens betrachtet P. DE CAPOA BONARDI (in CAFIERO et BONARDI 1980, S. 194) als sehr wahrscheinlich, dass in beiden Fällen es sich um eine und dieselbe Art handelt.

Stratigraphische und geographische Verbreitung: ? Jul — Tuval 2 — Lac 1 (GRUBER, 1976, S. 191), Tuval 2? — 3 (DE CAPOA BONARDI 1982, S. 58). Sizilien, Jugoslawien.

Vorkommen: Ostré vršky, Lokalität LB-3. Tuval.

***Halobia norica* MOJSISOVICS, 1874**

Taf. V, Abb. 4

Halobia norica E. v. MOJSISOVICS — E. v. MOJSISOVICS, p. 25, Taf. 5, Fig. 7.

- 1980 *Halobia norica* MOJS. — P. DE CAPOA BONARDI, p. 87—94, Taf. 18, Fig. 1—13, 15—44 (cum syn.).
 1982 *Halobia norica* MOJSISOVICS — B. CAFIERO et P. DE CAPOA BONARDI, p. 63, Tab. 5, Fig. 14—15 (cum syn.).

Material: Ein Kern der rechten Schale ohne Vorderohr, beschädigt beim Schloss- und Vorderrande.

Dimensionen: Höhe = 10 mm, Länge = 19 mm

Bemerkungen: Die Schale hat einen ovalen Umriss, kopfartigen Wirbel, hinausgeschoben in das vordere Drittel des Schlossrandes und vom diagnostischen Standpunkte eine charakteristische Skulptur. Sie wird von breiteren Radialrippen gebildet, durch schmale untiefe Furchen abgetrennt. Sie sind zweimal geteilt, das erstmal in der oberen Hälfte der Schale, wenn auch nicht in der gleichen Höhe, das zweitemal näher zum Unterrande. Sie fehlen nur am hinteren dreieckigen Felde. Da befinden sich nur konzentrische Runzeln, welche am Wirbel beginnen und auf der ganzen Oberfläche verteilt sind. Beim Unterrande auf einem kleinen Schalenstück kann man mit Hilfe einer Lupe auch dichte regelmässige Anwachslineen bemerken, über die Rippen hinziehend. Das beschriebene Exemplar ähnelt jenen, welche DE CAPOA BONARDI (1970) auf Taf. 18, Abb. 4 und 6 abbildet.

Stratigraphische und geographische Verbreitung: Nor, Lac 2 — Alaun 2 (GRUBER, 1976, S. 191), Alaun 2 (CAFIERO et BONARDI, 1982) S. 63). Sizilien, Nor in den Südalpen, Jugoslawien, Rumänien, ? Bulgarien, Griechenland und Indochina.

Vorkommen: Ostré vršky, Lokalitäten LB-1. Nor.

***Halobia superba superba* MOJSISOVICS, 1874**

Taf. VII, Abb. 5

- 1874 *Halobia superba* E. v. MOJSISOVICS — E. v. MOJSISOVICS, p. 30, Tab. 4, Fig. 9, 10
 1970 *Halobia superba* MOJS. — P. DE CAPOA BONARDI, p. 104—111, Tab. 14, Fig. 1—12, Tab. 5, Fig. 1—20. (cum syn.).
 1976 *Halobia superba superba* — B. GRUBER, p. 191.

Material: Unvollständige Kerne von drei rechten, einer linken Schale und sieben Fragmenten.

Dimensionen: Höhe = 20 mm, Länge = ?25 mm, Höhe = ?, Länge = 45 mm.

Bemerkungen: Die schräg-ovalen in der oberen und mittleren Region gewölbten Schalen, haben einen überragenden konischen Wirbel, welcher im vorderen Drittel des langen Schlossrandes gelegen ist. Das Vorderohr ist breit, zweiteilig, durch eine Furche deutlich vom Schalenkörper abgetrennt. In der Wirbelregion beginnen die Radialrippen, zu beiden Teilen des Schlossrandes reichend, nur beim hinteren sind sie dünner und dichter. In der Entfernung von 13 mm vom Wirbel befindet sich eine Biegungszone, auf welcher sich die Rippen der mittleren Region plötzlich nach vorne biegen, aber bald kehren sie in die

ursprüngliche Richtung zurück. Die Rippen der vorderen und hinteren Region verlaufen ohne Umbiegung geradlinig. Hinter der Biegungszone teilen sich die bisher meistens einmal gezeigten Rippen weiter und sind bündelförmig geordnet. Die konzentrischen Runzeln sind besonders auf dem jungen Entwicklungsstadium gehörenden Teil ausgeprägt. Meist auffallend ist die schon erwähnte Biegungszone.

Stratigraphische und geographische Verbreitung: Karn bis Untenor (Jul — Lac). Nordalpen, Jugoslawien, Italien, Griechenland, Himalaya, Indochina, Timor, Spiti, Kalifornien, Alaska und Britisch-Kolumbien.

Vorkommen: Ostré vršky, Lokalität LB-4 und O₂.

***Halobia* sp. n.**

Taf. VI, Abb. 2

Material: Gipsabguss einer, beim Unterrande unvollständigen linken Schale, ein Kernfragment eines zweischaligen Individuums und fünf Kernfragmente der linken Schale.

Beschreibung: Das besterhaltene Individuum in Form eines Gipsabgusses hat den Umriss eines länglichen Ovals mit einer Länge von 24 mm und Höhe 15 mm. Der über dem geraden Schlossrande hervortretende Wirbel ist sehr exzentrisch, so dass das Verhältnis der Länge des vorderen und hinteren Schlossrandes 9: 15 mm ist. Die mittlere Region der Schale, einschliesslich des Wirbels, ist gewölbt. Das Vorderrohr ist einfach, von der Gestalt einer Aushöhlung, klar vom Körper der Schale abgetrennt. Die ganze Oberfläche ist von feinen, dichten, meistens paarweisen Radialrippen und über diese durchziehenden konzentrischen Runzeln bedeckt. Diese sind am hinteren dreieckigen Felde deutlicher. In der Entfernung von ungefähr 12 mm vom Wirbel verläuft eine ausgeprägte konzentrische Falte, auf welcher, mit Ausnahme des hinteren dreieckigen Feldes, es zur Biegung der Radialrippen und in der mittleren Region zu deren weiteren Teilung kommt. Zum unteren Rande verlaufen sie schon deshalb in Form von Bündeln. Am hinteren dreieckigen Felde sind die Radialrippen viel schwächer und hier wie auch am anliegenden Teil der Schale haben sie einen wellenförmigen Verlauf. Sie erinnert an die Art *Halobia superba superba*, aber sie stimmt nicht mit ihr überein. Sie hat nämlich ein kleineres und hauptsächlich einfaches Vorderrohr und gewellte Rippen. Sie stimmt mit keiner der bekannten Arten überein.

Vorkommen: Ostré vršky, Lokalität LB-1. Nor.

***Halobia* sp.**

Material: Kerne zweier jungen rechten Schalen und eines unvollständigen erwachsenen Individuums.

Bemerkungen: Der Erhaltungszustand dieser Individuen erlaubt nur die

Gattungsbestimmung. Man kann auf diese nach der gesamten Morphologie, dem Skulpturcharakter und bei jungen Exemplaren auch von der Anwesenheit des Vorderohres schliessen.

Vorkommen: Ostré vršky, Lokalität LB-2 Tuval (auf Grund von Brachiopoden).

***Halobia* sp. 1**

Taf. V, Abb. 2

Material: Kern einer unvollständigen linken Schale, zwanzig Kerne junger Individuen, sechs Fragmente und zwei Abdrücke.

Dimensionen: Höhe = 18 mm, Länge = 20 mm.

Bemerkungen: Die Schale ist oval, etwas schräg, ihr Wirbel ist im vorderen Drittel des Schlossrandes gelegen, wo sich auch das Vorderohr in Form einer Aushöhlung befindet, deutlich vom Schalenkörper abgetrennt. Der Wirbel- und mittlere Teil ist gewölbt und durch eine seichte Vertiefung ist von ihm die hintere dreieckige Area abgetrennt. Die Oberfläche ist von dünnen, dichten zahlreichen Radialrippen bedeckt. Sie beginnen in der unter dem Wirbel gelegenen Region und in ungleicher Höhe verdoppeln sie sich ein-bis zweimal. Auf der hinteren Area sind sie so schwach, dass dieselbe glatt zu sein scheint, nur mit konzentrischen Runzeln, welche hier ausgeprägter sind als auf der übrigen Oberfläche. In der Entfernung ungefähr 15 mm vom Wirbel befindet sich eine Biegungszone. Der Charakter der Rippen hinter ihr, wegen der Unvollständigkeit der Schale, ist aber unklar. Sie stimmt mit keiner der bekannten Arten überein, aber für die Feststellung einer neuen Art ist der Erhaltungszustand der Individuen ungenügend.

Vorkommen: Ostré vršky, Lokalität B₂A. Tuval (auf Grund von Brachiopoden).

***Halobia* sp. 2**

Material: Kernfragmente von zwei linken und zwei rechten Schalen.

Bemerkungen: Weder die Gesamtform der Schalen, noch des Ohres kann festgestellt werden. Nur die dichten, feinen Radialrippen sind bemerkbar, vorwiegend einmal gezweigt im mittleren Teil der Schale. Auf dem hinteren dreieckigen Felde sind sie wesentlich schwächer und gewellt. Sie erinnern an die Art *Halobia superba superba* KITTL, aber da es nicht gelungen ist die ganze Schale zu gewinnen, kann dies nicht bestätigt werden.

Vorkommen: Ostré vršky, Lokalität O₂. Tuval.

***Halobia* sp. 3**

Taf. VI, Abb. 6, 7

Material: Unvollständige Kerne von vier linken und einer rechten Schale ohne Vorderohr.

Bemerkungen: Nach dem Erhaltungszustande kann man nicht die Gesamtform der Schalen, auch nicht den Charakter des Vorderohres feststellen. Es kann beobachtet werden, dass ihr Mittelteil gewölbt ist und die gesunkene hintere Area von ihm durch eine vertiefte Furche getrennt ist. Der Wirbel ist exzentrisch, mehr auf der Vorderseite des Schlossrandes liegend. Die ganze Oberfläche ist von radialen, feinen, dichten zweifach verzweigten Rippen bedeckt, welche bis zu beiden Schlossrändern reichen. Weniger markant sind die konzentrischen Runzeln. Sie erinnern an die Art *Halobia lineata* MÜNSTER, bei DE CAPOA BONARDI 1970, Taf. 19, Abb. 2ab abgebildet. Zum Unterschiede von ihr sind aber die Individuen von unserem Material grösser und die Radialrippen zwar um etwas schwächer als auf der übrigen Oberfläche, aber mit freiem Auge noch sichtbar, sie bedecken auch die hintere Area. Bei der Art *H. lineata* befindet sich auf ihr nur eine konzentrische Skulptur. Ausser der erwähnten Individuen wurde hier noch eine rechte Schale gefunden, mit Dimensionen der erhaltenen Teile, Höhe 29 mm, Länge 31 mm (siehe Taf. VI, Abb. 7) und eine kleinere linke Schale, beide auch ohne Ohr. Sie stimmen mit den oben beschriebenen Exemplaren überein, bis auf die Tatsache, dass näher zum Unterrande bei beiden eine Biegungszone vorhanden ist. Vom uns zur Verfügung stehendem Materiale kann man schwer beurteilen, ob es sich um eine pathologische Erscheinung, wie schon E. KITTL (1912, S. 144) darauf aufmerksam machte, oder um ein variables Artmerkmal handelt.

Vorkommen. Ostré vršky, Lokalität LB-1. Nor.

***Halobia* sp. 4**

Material: Unvollständige Kerne von vier linken, einer rechten Schale und zwei Abdrücke.

Bemerkungen: Diese Individuen kommen unter den viel zahlreicheren Vertretern der Art *Halobia lenticularis* (GEMMELLARO) vor. Sie unterscheiden sich von ihnen durch einen weniger exzentrischen, stark hervortretenden Wirbel und Vorderohr, welches die Form einer Aushöhlung hat. Zahlreiche Radialrippen bedecken die Schalenoberfläche mit Ausnahme des Wirbels. Der Erhaltungszustand ermöglicht keine nähere Bestimmung, aber es ist möglich, dass diese junge Entwicklungsstadien der Art *Halobia beyrichi* MOJSISOVICS sind.

Vorkommen: Ostré vršky, Lokalität LB-3. Tuval.

***Halobia* cf. *subreticulata* GEMMELLARO, 1882**

Material: Unvollständige Kerne einer grösseren und einer kleineren rechten Schale.

Bemerkungen: Die Gesamtform der Schale kann nicht festgestellt werden. Die Höhe des erhaltenen Teiles der grösseren Schale ist 23 mm. Der Wirbel scheint exzentrisch zu sein. Die mittlere Region ist gewölbt, das Vorderohr zweiteilig, vom Schalenkörper durch eine Furche getrennt. Sein unterer Teil ist

schmäler, gewölbter, der obere vertieft. Die Oberfläche ist von Radialrippen und konzentrischen Linien bis Runzeln bedeckt. Die Radialrippen teilen sich in zwei, vereinzelt in drei. Die regelmässigen konzentrischen Linien bilden auf ihnen Höcker bis Knoten, mit Hilfe einer Lupe bemerkbar, besonders im mittleren Teil der Schale. In den erwähnten Merkmalen ähneln die beschriebenen Individuen der Art *Halobia subreticulata*, wie sie G. GEMMELLARO (1882, Taf. 3, Abb. 13) abbildet. Da aber die hintere Schlossregion bei unseren Exemplaren nicht erhalten ist, kann es nicht festgestellt werden, ob sie die für die angeführte Art charakteristische glatte hintere Area haben. Diese Art wird in der Literatur von Sizilien und den Dinariden als eine Art des Karns (DIENER, 1923, S. 60) und Nors, Lac 3-Alaun (GRUBER, 1976, S. 191) angeführt.

Vorkommen: Ostré vršky, Lokalität LB-1. Nor.

***Halobia cf. superba superba* MOJSISOVICS, 1874**

Material: Unvollständige Kerne von zwei rechten Schalen und zwei Fragmenten.

Bemerkungen: In der Vergesellschaftung mit einer überwiegenden Anzahl von Individuen der Art *Halobia bystrickyi* sp.n. gehörend, kommen einige Exemplare vor, bei welchen zwar die Gesamtform der Schalen nicht festgestellt werden kann, aber in der Oberflächenskulptur und im Aussehen des Vorderohres erinnern sie beträchtlich an die Art *Halobia superba superba* MOJSISOVICS. In der Skulptur weichen sie von ihr nur in der Hinterregion ab, wo die Radialrippen so schwach sind, dass dieser Teil glatt zu sein scheint. Dies könnte auch eine Folge der Verwitterung sein, durch welche dieser Teil besonders betroffen ist. Bei zwei Individuen kann auch die Biegungszone beobachtet werden, da aber ein weiterer Teil der Schale fehlt, kann es nicht festgestellt werden, wie die Rippen hinter ihr gestaltet sind. Das Ohr ist verhältnismässig breit, vom Schalenkörper durch eine schmale Furche abgetrennt. Bei einem der Individuen ist es deutlich zweiteilig, wobei der Unterteil gehoben, der obere Randteil flach ist.

Vorkommen: Ostré vršky, Lokalität B₂A₁. Tuval.

***Halobia ex gr. radiata* GEMMELLARO, 1882**

Material: Fragment des unteren Teiles des Schalenkernes.

Bemerkungen: Auf diesem Fragmente ist das einzige charakteristische Merkmal, auf welches man sich bei seiner Einreihung stützen kann, die für die Art *Halobia radiata* sensu lato typische Skulptur. Ob es sich aber um einen Vertreter der Art *Halobia radiata radiata* GEMMELLARO, oder *H. radiata hyatti* KITTL handelt, welche sich voneinander durch die zentrale oder exzentrische Lage des Wirbels unterscheiden, kann von dem uns zur Verfügung stehenden Fragmente nicht festgestellt werden.

Vorkommen: Ostré vršky, Lokalität B₂ A. Tuval.

***Halobia ex gr. superba* MOJSISOVICS**

Taf. VI, Abb. 1

Material: Ein Kern der rechten Schale, bei den Rändern beschädigt und mit verwitterter Oberfläche des Vorderohres.

Dimensionen: Höhe = 20 mm, Länge = 21 mm.

Bemerkungen: Im Charakter der Skulptur erinnert dieses Individuum an die Arten *Halobia superba superba* MOJSISOVICS und *Halobia praesuperba* KITTL. Von der ersteren unterscheidet sie sich in der Gesamtform, weil die Schale eher höher ist, nicht verlängert. In der Skulptur sind sie sich ziemlich ähnlich, nur die Biegungszone ist weniger ausgeprägt und auf dem hinteren dreieckigen Felde sind die Rippen haarförmig fein, lockenartig wie bei der Art *Halobia praesuperba*. P. DE CAPOA BONARDI (1970, Taf. 14, Abb. 5) reiht ein Individuum mit ähnlicher Skulptur zur Art *Halobia superba*. Das Vorderohr des beschriebenen Individuums, auch wenn es verhältnismässig breit ist, scheint einfach zu sein und nicht zweiteilig, was für die Art *H. superba* charakteristisch ist.

Vorkommen: Ostré vršky, Lokalität LB-1. Nor.

Stratigraphische Bemerkungen zu den Lokalitäten

Vom biostratigraphischen Standpunkte kann man in den Kalken vom Wettersteintype auf Ostré vršky Schichtfolgen unterscheiden, welche dem Oberkarn — Tuval angehören und norische Schichtfolgen. Die Mehrzahl der untersuchten Lokalitäten, wie LB-2, LB-3, B₂A, B₂A₁, O₂ und ?LB-4 entspricht dem Inhalte ihrer Fauna nach dem Oberkarn, auf der Lokalität LB-1 wurde auch Nor festgestellt.

Bei der Feststellung des Tuvals an einigen Lokalitäten spielten Muscheln, an anderen Brachiopoden eine bedeutendere Rolle. Es hing davon ab, wie die Vertreter dieser Organismen-Gruppen in der Makrofauna-Vergesellschaftung vertreten waren, besonders soweit es sich um den Erhaltungszustand handelt, oder ob deren verlässliche Gattungs-Bestimmung möglich war. Zu den Lokalitäten, wo die Bestimmung des Tuvals-Alters sich auf die Muscheln stützt, gehört die Lokalität LB-3 mit der Art *Halobia lenticularis* (GEMM.). Nach B. GRUBER (1976) hat diese Art eine weitere stratigraphische Spannweite und reicht auch bis in das Unternor. Da aber auf Ostré vršky das Tuval auch noch in den hangenden Kalken der Lokalität LB-2, ungefähr 80 m entfernt erwiesen worden ist, ist es offensichtlich, dass auf der Lokalität LB-3 die angeführte Art noch als tuvalisch betrachtet werden muss. Auf der Lokalität B₂A₁ ist das Tuval durch die zahlreich vertretene Art *Halobia bystrickyi* sp.n. bestimmt und den begleitenden Brachiopoden *Gemerithyris hungarica hungarica* (BALOGH) bestätigt. Über die Zugehörigkeit der Kalke zum Tuval auf den Lokalitäten LB-2 und B₂A haben mehr die Brachiopoden entschieden. Es sind die Arten *Austriellula gomorensis*

(BALOGH) und *A. undosa* (SIBLÍK) auf der Lokalität LB-2 und *A. angulifrons* (BITTN.), *A. halophila* (BITTN.) und *Laballa suesi* (ZUGM.) auf der Lokalität B₂A. Auf der Lokalität O₂ ist die weitere stratigraphisch Spannweite der Art *Halobia superba superba* MOJSIS. (Kordevol — Lac) durch das Mitvorkommen der Art *Gemerithyris hungarica hungarica* (BALOGH) als Tuval vergenauert worden.

Bei Anwendung der Analogie über die stratigraphische Zugehörigkeit der Art *Halobia superba superba* MOJSIS. von der Lokalität O₂, sollte zum Tuval auch die Lokalität LB-4 gehören. Man kann aber die Möglichkeit nicht ausschliessen, dass auf dieser Lokalität diese Art schon das Nor repräsentiert, weil in den Kalken des Hangenden auf der Lokalität LB-1 dieses verlässlich bewiesen worden ist. Da aber diese Art die einzige von der Lokalität LB-4 ist, bestehen gegenwärtig keine Beweise für die Bestätigung dieser Voraussetzung. Umso mehr, da sich diese Lokalität im Schuttfelde befindet. Die einzige Lokalität, welche zum Nor gehört, ist LB-1. Bei der Feststellung der stratigraphischen Position dieser Kalke kann man sich nur auf die Halobien als die einzigen Organismen, welche hier gefunden wurden, stützen. In der verhältnismässig reichhaltigeren Vergesellschaftung sind vom stratigraphischen Standpunkte hauptsächlich die Arten *Halobia celtica* MOJSIS. und *H. norica* MOJSIS. von Bedeutung. Beide haben eine stratigraphische Spannweite Lac bis Alaun, so dass sie das Alter der Kalke in verhältnismässig weitem Umfange als Unter- bis Mittel-Nor bestimmen.

Übersetzung: J. Pevný

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M. Kochanová

Vrchnotriasové lastúrníky Ostrých vrškov (Slov. kras)

Resumé

Vápence z oblasti kóty Ostré vršky na Plešiveckej planine v Slovenskom krase faciálne veľmi pripomínajú vápence wettersteinské, a preto ich stratigrafické postavenie bolo nejasné.

Sú hrubolavcovité, miestami sa v nich vyskytujú šošovky krinoidovo-lumachelových vápencov, v ktorých pri stratigrafickom výskume sa našiel celý rad lokalít s makrofaunou lastúrníkov, ramenonožcov a zriedkavejšie aj hlavonožcov. Pomocou týchto fosílií bolo možné zistiť, že väčšia časť vápencových súvrství tejto oblasti je vrchnokarnského veku. Z litostratigrafického hľadiska ide teda o jednotku tisovských vápencov. Vo vrchnej časti však bol v nich preukázaný norik, takže tieto treba považovať za vápence furmanské.

K fosíliám, na základe ktorých bolo možné stanoviť ich vrchnokarnský — tuvalský vek patria najmä druhy *Halobia bystrickyi* sp. n., *Halobia lenticularis* (GEMMELLARO), *Halobia superba superba* MOJSISOVICS, ako i ramenonožce (určené M. SIBLIKOM) napr. *Gemerithyrus hungarica hungarica* (BALOGH), *Austriellula gomorensis* (BALOGH) a *Austriellula undosa* (SIBLIK).

V norickej časti súvrstvia sa našli len lastúrníky, ale v dosť bohatom spoločenstve. Škoda len, že nie sú zachované tak, aby bolo možné aj ich spoľahlivé druhové určenie. Predsa však druhy *Halobia celtica* MOJSISOVICS a *Halobia norica* MOJSISOVICS určujú príslušnosť vápencov k spodnému až strednému noriku.

Erklärungen zu den photographischen Tafeln

Tafel V

- Abb. 1 *Halobia celtica* MOJS., LB-1, $\times 1,4$
Abb. 2 *Halobia* sp. 1, B₂A, $\times 2$
Abb. 3 *Halobia celtica* MOJS., LB-1, $\times 1,5$
Abb. 4 *Halobia norica* MOJSIS., LB-1, $\times 1,9$
Abb. 5 *Halobia celtica* MOJSIS., LB-1, $\times 2$
Abb. 6 *Halobia bystrickyi* sp. n., B₂A₁, $\times 1,5$

Tafel VI

- Abb. 1 *Halobia* ex gr. *superba* MOJSIS., LB-1, $\times 1,5$
Abb. 2 *Halobia* sp. n., LB-1, $\times 1,5$
Abb. 3 *Leptochondria* sp., linke Schale, B₂A, $\times 2$
Abb. 4 *Halobia lenticularis* (GEMM.), LB-3, $\times 2$
Abb. 5 *Halobia lenticularis* (GEMM.), LB-3, $\times 2$
Abb. 6 *Halobia* sp. 3, LB-1, $\times 1,5$
Abb. 7 *Halobia* sp. 3, (mit der Biegungszone), LB-1, $\times 1,5$

Tafel VII

- Abb. 1 *Leptochondria* sp., rechte Schale, B₂A, $\times 4$
Abb. 2 *Halobia bystrickyi* sp. n. Holotypus, B₂A₁, $\times 1,5$
Abb. 3 *Leptochondria* sp., rechte Schale, B₂A, $\times 2$
Abb. 4 *Halobia bystrickyi* sp. n., B₂A₁, $\times 1,5$
Abb. 5 *Halobia superba superba* MOJSIS., LB-4, $\times 4$

Photo: František Martančík

Das beschriebene und abgebildete Fossilien-Material befindet sich in den Sammlungen des Geologischen Institutes D. Štúr in Bratislava.

Margita Vaňová

Paleontological characteristics of some species from the Jeruzalemský vrch mountain near Dobšiná

5 text-figs., 4 Pls. (VIII—XI), Slovak summary

Abstract: The paper presents paleontological characteristics of the species *Streblopteria* sp. indet. 1, *Streblopteria* sp. indet. 2, *Euchondria* sp. indet., *Thrinoceras rakuszi* sp. n., *Proshumardites jeruzalemburgi* sp. n., *Dobshinaeceras nopcsai* (RAKUSZ) and *Pleomartus* sp. indet. from marly shales (horizon γ of GY. RAKUSZ, 1932) of the Westphalian B-C of the Dobšiná Group from the locality Jeruzalemský vrch mountain near Dobšiná.

In the rich literature on fauna of Upper Carboniferous sediments, the monography of GY. RAKUSZ "Die Oberkarbonischen Fossilien von Dobsina (Dobšiná) und Nagyvisnyó" published in 1932 belongs among most significant. In it, the author presents the results of his paleontological-stratigraphic studies of variegated fauna from various localities in the vicinity of Dobšiná. Besides species that had been described prior in the classical areas of the Carboniferous, the author mentioned new species, too. Some of them were named, other remained nameless, designated as sp. nov. ind. Majority of the new species came from marly shales (horizon γ) in the locality Jeruzalemský vrch mountain (Jeruzsálemhegy, Jerusalemberg) and from sandy shales (horizon ϕ) in the localities Baňa Michaeli and Mačacie diery (Mihálybánya, Macskalyukak, Michaeligrube, Katzenlöcher).

In 1981 the Geologický ústav D. Štúra (Geological Institute of D. Štúr) received a collection of fauna from marly shales of the Jeruzalemský vrch mountain (horizon γ of GY. RAKUSZ, 1932) from collector Š. MESAROŠ and we added our own collections to it. In the material of Š. Mesaroš, there are species known from the Jeruzalemský vrch Mt. as well as ones that were not described here before. Among species known from the Jeruzalemský vrch Mt., we found fragments of sutures and a nice incomplete impression of inner whorl of the species *Gastrioceras nopcsai* RAKUSZ, on the basis of which we can supplement Gy. Rakusz's observations and to make them more precise. We assign it to a new taxon designated as *Dobshinaeceras* gen.n. with a typical species *Dobshinaeceras nopcsai* (RAKUSZ). Among forms that had not been described in the vicinity of Dobšiná, we found a core with its impression that we regard as a new

species and refer it as *Thrincoceras rakuszi* sp.n. and a core that we also regard as a new species under the name *Proshumardites jerusalembergi* sp.n. Using available literature we failed to define the species of four other specimens. That is why we describe them preliminarily as *Streblopteria* sp. indet. 1, *Streblopteria* sp. indet. 2, *Euchondria* sp. indet. and *Pleomartus* sp. indet. From the stratigraphic point of view, our species do not contradict prior assignments of macrofauna assemblages from the vicinity of Dobšiná to the Westphalian B-C.

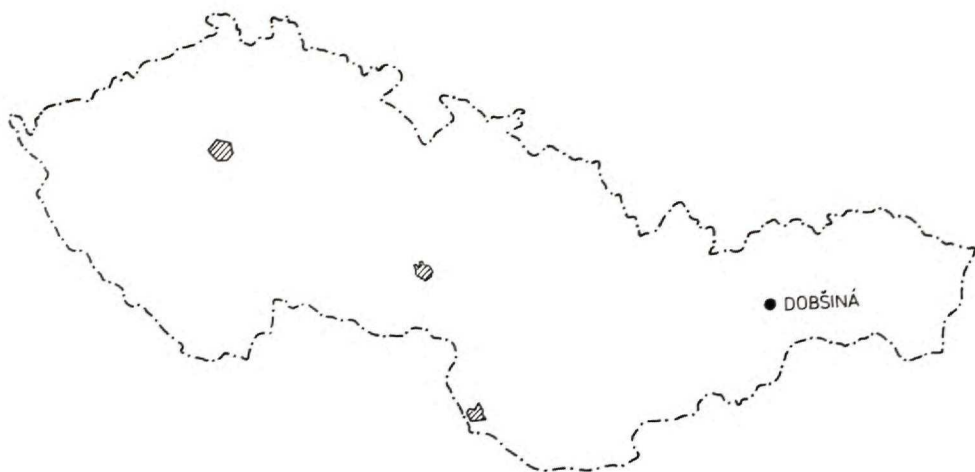


Fig. 1 Sketch map of locality

BIVALVIA

Aviculopectinidae MEEK — HAYDEN, 1864

Streblopteria COY, 1851

Type species: *Streblopteria laevigata* COY 1851

Streblopteria sp. indet. 1

Pl. VIII, Fig. 1

Material: Sculptural core

Appearance of the shell: The sculptural core represents a left valve with a slightly broken-off upper part of the anterior margin, broken-off ventral margin and with a broken-off part of the lower posterior margin. According to the passing of the lower part of the anterior margin to the ventral one, it can be supposed that the valve was of slightly oval, nearly circular shape with a straight hinge line. Its small, slightly pointed beak is situated in the middle of the shell

length, therefore the anterior and posterior portions of the valve are of the same length. The concave anterior and convex posterior part of the valve are perpendicular to each other. The shell is slightly convex. The greatest convexity is in the beginning of the posterior half, from the beak part to the middle of the height. Towards the anterior and ventral margin, it flattens gradually. The shell flattens more steeply towards the posterior margin, which gives it an asymmetric appearance. The anterior auricle has a triangular shape. In the anterior margin it is slightly rounded, in the posterior one it is conspicuously convex. Its upper margin attains the height of 4.5 mm. It is separated from the valve by a conspicuous groove with a deep sinus. The posterior auricle has a shape of a triangle with one of its angles over 90 degrees. It is small, flat, separated from the valve by a shallow groove. Both the auricles are smooth, without any decoration. In the valve in the upper third of its height, there are visible concentric lamellae in the surface. As the shell was damaged, the only measurable dimension was the length of 23 mm.

Comparing remarks: Our specimen resembles most, by its contours, convexity of the shell, position of the beak of smooth pectinides, Fig. 14 and by the shape of its anterior auricle Fig. 15, in Pl. 21 in the work of W. HIND (1903), that show the species *Pseudamusium anisotum* PHILLIPS. We do not assign our specimen to this species, however, as both the cited figures do not correspond strictly to the characteristics given in p. 104, where we can read that shell is of an obliquely circular, oval shape with an elongated anterior margin. W. HIND probably did not regard this sign as a substantial one, because the specimens in Fig. 16 and 18 in the same plate are not oblique and elongated towards their anterior margin and their anterior part is shorter than the posterior one.

Of other smooth pectinides, our specimen could be compared with the species *Streblopteria elliptica* (PHILLIPS em. HIND), *Streblopteria sericea* (VERNEUIL), *Streblopteria englehardti* (ETHERIDGE et DUN.) and *Streblopteria krasnoufimskensis* FREDERIKS. From the species *Streblopteria elliptica* (PHILLIPS em. HIND) (W. HIND, 1903, Pl. 20, fig. 11—17) it differs in the beak shape, concave anterior beak edge, convex posterior beak edge, asymmetric convexity of the shell and shape of the anterior auricle. From Fig. 18 in the same plate it differs in the beak shape and shell contours. From the specimens of this species described in the Russian Carboniferous (M. JANIŠEVSKIJ, 1900, 1910, B. J. ČERNYŠEV 1941, T. A. ALEKSANDRI—SADOVA and V. A. MUROMCEVA, 1947) it differs in the beak position, different concavity of the anterior beak edge, different convexity of the posterior beak edge and different convexity of the shell. From the species *Streblopteria sericea* (VERNEUIL) in the work of N. JAKOVLEV (1903) it differs in its auricle shape, less concave anterior beak edge, less elongated in length anterior part of the shell and more central position of the beak. From the specimen described in A. ŠTUKENBERG's (1898) work, it differs in the shape of its beak and auricles and in valve contours. From the specimens depicted by B. K. LICHAREV (1927) it differs in the shape and position of the beak, less concave anterior and less convex posterior beak edge and in the convexity of the shell. From the species *Streblopteria krasnoufimskensis*

FREDERIKS (FREDERIKS, 1915) it differs in the more central beak, less concave anterior beak edge, less elongated in length anterior part of the valve, as well as in lesser convexity of the valve. From the specimens of the same species depicted by B. K. LICHAREV (1927) it differs in the less elongated in height shape of the valve, more central beak, less concave anterior beak edge, less convex posterior edge and less elongated anterior lower margin of the valve.

In Fig. 4. in Pl. 5 GY. RAKUSZ (1932) depicted *Pecten (Pseudamusium)* cfr. *ellipticus* PHILLIPS. This specimen equals ours with the nearly circular shape of the valve, more central beak, concave anterior and convex posterior beak edge, apical angle of 90 degrees, and asymmetric convexity of the shell. It differs from it in the straight pointed beak. Disregarding this difference, we might suppose that it represents a juvenile right valve of our species. Until we manage to receive further material we do not assign GY. RAKUSZ's specimen to ours.

***Streblopteria* sp. indet. 2**

Pl. VIII, Fig. 2

Material: Sculptural core

Appearance of the shell: In the material we found a sculptural core of the right valve with a broken-off anterior lower margin. It is of an oval shape, elongated in height. Its small rounded beak is situated in the anterior half of the length. The anterior beak edge is slightly concave, the posterior is slightly convex. They form the apical angle of 90 degrees. The valve is most convex in the beginning of the second quarter under the beak and it from here flattens towards the anterior margin more steeply than towards the posterior one. The hinge line is straight. The anterior auricle is of a triangular shape. In the anterior margin it is slightly rounded and to about one third of the lower margin it is separated from the valve by a narrow sinus and then by a deep groove. In the side adjacent to the valve, the auricle is strongly convex. It flattens steeply towards the valve and less steeply towards the hinge line. The posterior auricle is a gradual continuation of the posterior margin of the shell. It is small, rounded and separated from the valve by a shallow groove. The anterior auricle has a length of 5.3 mm, the posterior one 3.5 mm. Both the auricles are smooth, without any decoration. The surface of the valve is smooth from the beak to the middle of the height, in other parts there are conspicuous concentric lamellae. Indications of radial ribs cannot be seen. The exact dimensions of the shell could not be measured as the lower anterior margin is damaged. The length of the valve was probably 19 mm and its height amounts 23 mm. The height to length ratio is roughly 1.21.

Comparing remarks: A characteristic feature of this specimen is its oval valve elongated in height and the auricle shape. Because of its valve elongated in height it resembles species *Streblopteria elliptica* (PHILLIPS, em. HIND), *Streblopteria sericea* (VERNEUIL), *Streblopteria krasnoufimskensis* FREDERIKS and *Streblopteria* sp. B the latter mentioned by A. ŠTUKENBERG in

1905. From the specimens of the species *Streblopteria elliptica* given in works of W. HIND (1903), M. E. JANIŠEVSKIJ (1900, 1910) and B. J. ČERNYŠEV (1941) it differs in the valve more elongated in height, shape of the anterior auricle and convexity of the shell. From the specimen of the species *Streblopteria sericea* (VERNEUIL) in work of N. JAKOVLEV (1903) it differs in the valve shape elongated in height. From the specimens of the same species in the works of A. ŠTUKENBERG (1898), B. K. LICHAREV (1927) it differs in the beak situated in the anterior part of the valve, less concave anterior and less convex posterior beak edge as well as in convexity of the shell. It differs in the same signs from the specimens of the species *Streblopteria krasnoufimskensis* FREDERIKS in works of N. FREDERIKS (1915) and B. K. LICHAREV (1927). From the specimen of *Streblopteria* sp. B in work of A. ŠTUKENBERG (1898) it differs in the shape of its beak and beak edges and in the shell convexity.

GY. RAKUSZ (1932), in his description of the species *Pecten* (*Pseudamusium*) cfr. *ellipticus* PHILLIPS, gives a specimen equal to the one elongated in height in Fig. 18, Pl. 20 in the work of W. HIND (1903). Though GY. RAKUSZ's is likely to equal ours, we cannot confirm that as no picture of the former is available.

Comparing our specimens *Streblopteria* sp. indent. 1 and *Streblopteria* sp. indent. 2, we observe some common and different signs. As common signs we can mention less concave anterior beak edges, less convex posterior beak edges, magnitude of the apical angle, anterior and posterior auricle shape, presence of concentric lamellae in the shell surface, the same character of the shell convexity and absence of radial ribs in the whole surface including auricles. On the other hand, the different valve shape, beak position, anterior auricle contours and shell dimensions are different signs. The above mentioned common features make us consider both the specimens as the same species and not to place much importance to the different signs as we can see it also in the works of the above mentioned authors, where specimens with a circular and elongated in height valve or with a different beak position are assigned to the same species. The difference in the valve shape of our specimens is so striking that we regard them as two different species.

Euchondria MEEK, 1874

Type species: *Pecten neglectus* GEINITZ, 1866

Euchondria sp. indent.

Pl. VIII, Fig. 3—4

Material: Sculptural core and impression of two different specimens.

Appearance of the shell: The sculptural core and the impression represent the left valve damaged in the lower portion of the anterior margin and in the ventral margin. The shell is slightly convex, elongated in the posterior direction, a little longer than higher. The beak is small, prosogyrous and it

slightly surpasses the hinge line. The anterior beak edge is straight, the posterior one is very slightly concave. The apical angle of the sculptural core is 98 degrees, and that in the gyps mould amounts 90 degrees. The hinge line covers about one third of the valve length. The auricles are flat and conspicuously separated from the body. The anterior auricle is shorter. In the sculptural core, where it is indistinctly limited, the auricle measures 2.0 mm, in the gyps mould, which is of smaller dimensions, it amounts 2.0 mm again. The length of the posterior auricle in sculptural core attains 5.2 mm, in the mould only 3.1 mm. The anterior auricle is smooth, in the lower part it has a deeper sinus than the posterior one and forms a conspicuous tip in the upper part. The posterior auricle has one short, less conspicuous and one striking, sharp, long radial rib. Under microscope using side light, small protuberances and grooves can be seen throughout the hinge line of the sculptural core and in the anterior auricle of the mould. They prove that small resilifers were developed here. The valve surface is decorated with radial ribs, thicker concentric lines to lamellae and with fine concentric lines. In the upper part of the height, only very faint primary radial ribs can be seen. They start in the beak, are more conspicuous in the central part and in the last quarter of the height i.e. near the shell margin they are very striking. As the shell was damaged we cannot give the exact number of primary ribs, but probably there were 10 to 15 of them. From the half of the shell height, there appear between them secondary ribs and in places slightly lower tertiary ribs. Therefore near the periphery there are 1—2 weaker ribs between the primary ones. The primary ribs, as well as secondary and tertiary ones, are sharp. In places where they intersect thicker concentric lines to lamellae or finer concentric lines they form small protuberances. The well seen thick concentric lines to lamellae are in the second half of the valve height. The fine concentric lines are situated near its periphery. The height of the sculptural core is 16 mm, the length about 17 mm, the mould height is 10.5 mm and its length is not measurable.

Comparing remarks: The most substantial sign of our specimens is the presence of small resilifers in the hinge line, which makes it possible to assign them to the species *Euchondria*. In this sign they differ from specimens of some species of the genus *Aviculopecten*, to which they are more or less similar. From the species so far available in literature, *Euchondria tenuidentata* (CRAMER), *Euchondria levicula* NEWELL, *Euchondria neglecta* (GEINITZ) and *Euchondria densistria* (SANDBERGER) depicted by A. PŘIBIL (1954, Pl. 3, Fig. 1—5), P. L. SHULGA (1956, Pl. 5, Fig. 65, in N. E. BRAZHNIKOVA et al.), O. S. VJALOV et al. (1960, Pl. 8, Fig. 14, in A. G. EBERZIN et al.), N. D. NEWELL (1969, Fig. C 65, 1a, in L. R. COX et al.), F. ŘEHOŘ and M. ŘEHOŘOVA (1972, Pl. 37, Fig. 7—11, Pl. 38, Fig. 1—6) they differ in their shape and valve appearance. As we lack literature with descriptions and pictures of other species of the genus *Euchondria* we cannot denominate our specimens more accurately than *Euchondria* sp. indet.

In 1932 GY. RAKUSZ depicted in Pl. 5, Fig. 10 a specimen which he referred to *Aviculopecten* cfr. *knockonniensis* COY. Our specimens equal GY. RAKUSZ's

one in the valve elongated in the posterior direction, nearly invisible decoration in the apical part, intercalation of secondary ribs, indications of concentric decoration in the centre of its height, magnitude of the apical angle and probably in the dimensions, too. The difference is that GY. RAKUSZ's specimen has the anterior auricle longer than the posterior one. In the description of his specimen, Gy. Rakusz does not mention in detail its characteristic signs. He merely compares it, as far as the shell shape and characteristic decoration are concerned, with Fig. 10 and 11, Pl. 14 in the work of W. HIND (1903), that show the species *Aviculopecten knockonniensis* COY. As the lower third of the valve of GY. RAKUSZ's specimen is broken, the character of the decoration near its ventral margin is unclear, which makes it difficult to judge this denomination. GY. RAKUSZ's specimen seems to resemble more our specimens than those of W. HIND, the latter differing from ours. We cannot equal it to our specimens so far because of the different anterior and posterior auricle ratio. The fact that he does not mention small resilifers can be explained as they cannot be seen by unaided eye and under microscope they are distinct only when a very intensive light is used.

CEPHALOPODA

Nautiloidea

Trigonoceratidae HYATT, 1884

Thrinoceras HYATT, 1893

Type species: *Thrinoceras depressum* HYATT, 1893

Thrinoceras rakuszi sp. n.

Pl. VIII, Fig. 5—6, Pl. IX, Fig. 1, 2, Text-fig. 2e

Holotype: Sample No 56 — partial core and partial impression, sample 56a — partial core and partial impression of the same specimen, deposited in collections of GÚDŠ (Geological Institute of D. Štúr).

Paratype: Sample No 55 — fragment of the core of the last whorl, deposited in collections of GÚDŠ.

Stratum typicum: Upper Carboniferous, Westphalian B-C.

Locus typicus: Dobšiná, Jeruzalemský vrch Mt. (Jerusalemberg), Slovakia, CSSR.

Derivatio nominis: According to GY. RAKUSZ that wrote a monograph on fauna of Dobšiná.

Material: Partial core and partial impression.

Diagnosis: A large discoid shell with a wide shallow umbilicus and the last whorl free from two-thirds of its length. In inner whorls is a network sculpture, in the last whorl are longitudinal ridges and growth lines. The longitudinal ridges are thinner, separated by unequal interspaces, while the transversal ribs are thicker, in places bifurcating. The aperture has a shallow sinus.

Shape of the shell: The core and impression of the very depressed specimen represent a part of a discoid shell with a relatively wide and shallow umbilicus. A part of the last whorl is free, the gap between it and the last but one whorl is about 4 mm wide. In the aperture is a not very deep sinus. The whorl section is oval. The umbilical declivity has no decoration. It is oblique and passes into a slightly convex, nearly straight flank by an edge. The flank passes into a rounded venter by a ventrolateral shoulder. In inner whorls we can see a network sculpture that is in the last whorl reduced to longitudinal ridges and growth lines. The holotype diameter is more than 100 mm. The shell dimensions cannot be measured as the shell is incomplete. The umbilical width is about 50 to 60 mm and its exact dimensions cannot be given because of the incomplete shell. The last whorl height is 46 mm.

Sculpture: The reticular sculpture is made up by smaller, longitudinal ridges and thicker transversal ribs. In places of their intersections, indications of nodes can be seen. The longitudinal ridges commence in a certain distance from the umbilical shoulder. The interspaces between them increase gradually towards the ventrolateral shoulder. The transversal ribs commence in a shorter distance from the umbilical shoulder. Between thicker transversal ribs are one to three fine, slightly visible transversal ribs. Some thicker transversal ribs bifurcate near the ventrolateral shoulder of the whorls. In the whorl next to the last but one whorl, the transversal ribs near the umbilical shoulder are slightly bent towards the apex, in the middle of the height of the shell they become straight. In the last but one whorl they are slightly bent towards the apex, from the middle of the shell height they are bent towards the aperture.

In the whorl next to the last but one whorl there are five longitudinal ridges, roughly 0.13 mm wide, in the whorl height of 7 mm. Between the first, second and third longitudinal ridge are interspaces 0.8 mm wide, between other longitudinal ridges the interspaces are 1 mm wide. The transversal ribs are up to 0.23 mm wide. The gap between thicker transversal ribs near the umbilical shoulder is 0.3 mm, near the ventrolateral shoulder it amounts 0.4 mm. The height of the whorl itself is 8 to 10 mm. In the last but one whorl — whorl next to the body chamber — the first marked longitudinal ridge is developed in the site where the umbilical declivity passes into the flank. In the whorl height of 11 mm are 8 longitudinal ridges about 0.16 mm wide. Between the first, second and third longitudinal ridges are interspaces 1.0 mm wide, between the third, fourth and fifth longitudinal ridge they are 1.6 mm wide, between the fifth, sixth and seventh longitudinal ridge the interspaces are 1.7 mm wide and between the seventh and eighth longitudinal ridge its width amounts 2 mm. The distance between the seventh and eighth longitudinal ridge attains in places 3 mm. Here the transversal ribs are about 0.4 mm wide. The distance between the thicker transversal ribs near the umbilical shoulder is 1 mm, near the ventral part it is 1.5 mm.

In the last whorl is a longitudinal structure between the middle of the whorl height and the ventrolateral shoulder. It consists of seven longitudinal ridges. The first two of them are indications, visible only in a small part of the whorl.

The width of interspaces between longitudinal ridges varies between 2 and 3.5 mm. Between the first and second longitudinal ridge it amounts 2 mm, between the second, third, fourth and fifth 2.5 mm, between the fifth and sixth 3 mm and between the sixth and seventh longitudinal ridge the interspace is 3.5 mm wide. The transversal decoration consists of very dense growth lines, that have the same course as marked thicker transversal ribs in the preceding whorl.

Suture: In our specimen the suture is invisible.

Comparing remarks: If we compare our specimen with the genus *Thrinoceras hyatti* FOORD (A. H. FOORD, 1900, Pl. 26, Fig. 1a—1g) from the Carboniferous of Ireland, we can see some differences because of which we cannot assign our specimen to it. Our specimen has larger dimensions, flatter flanks, flatter venter and slightly rounded pass between the flanks and venter. The decoration of the surface of its whorls is different, too. The species *Thrinoceras hyatti* FOORD has all the shell, including umbilical declivity, covered with sharp longitudinal ridges. Microscopically fine longitudinal lines can be seen between them, with the exception of the umbilical declivity. The transversal decoration in all the surface consists of fine growth lines, that form small protuberances in crossings with the longitudinal ridges.

From *Thrinoceras hibernicum* FOORD (A. H. FOORD, 1900, Pl. 26, Fig. 2a, b) our specimen differs in larger dimensions and the type of decoration. The species *Thrinoceras hibernicum* FOORD has 9 to 10 quite sharp longitudinal ridges in flanks and 11 ridges in marginal parts. The transversal decoration consists of fine lines, that form sharp protuberances in crossings with longitudinal ridges.

From the species *Thrinoceras uralicum* (FREDERIKS) our specimen differs in larger dimensions, free part of the last whorl and its sculpture. The sculpture in inner whorls of our specimen consists of thinner longitudinal ridges irregularly distanced from one another and of thicker transversal ribs, between which there are one to three nearly invisible ribs. Some transversal ribs bifurcate near the ventrolateral shoulder of whorls. In the last whorl are inconspicuous longitudinal ridges and dense growth lines. As regards the species *Thrinoceras uralicum* (FREDERIKS) (V. E. RUŽENCEV — V. N. ŠIMANSKIJ 1954), the sculpture covers the entire shell. Its longitudinal ridges are more conspicuous, the transversal sculpture consists of dense fine lines. The profiles of the whorls of both the specimens are similar.

Ammonoidea

Agathiceratidae ARTHABER, 1911

Proshumardites RAUSER, 1928

Type species: *Proshumardites karpinskii* RAUSER, 1928

Proshumardites jerusalembergi sp. n.

Pl. X, Fig. 1, 2, Text-fig. 2a, 3a

Holotype: Sample No 40, the core is deposited in collections of GÚDŠ.

Stratum typicum: Upper Carboniferous, Westphalian B-C
Locus typicus: Dobšina, Jeruzalemský vrch Mt. (Jerusalemberg), Slovakia, CSSR.

Derivatio nominis: According to the locality where it was found.

Material: Core deformed by pressure.

Diagnosis: Entire surface of the small shell is covered with marked spiral ridges and dense fine transversal lines. The suture consists of a deep ventral lobe which is divided by a relatively high ventral saddle in two pointed prongs. The lateral lobe is divided by two low saddles in three parts.

Shape of the shell: The core represents a specimen deformed by pressure with a broken-off aperture in the venter and with shell remains on the surface. The original shape and cross-section of the whorl, the place where the venter passes into the flanks as well as its length and height cannot be described because of the above-mentioned pressure deformation. The shell diameter attained approximately 12.2 mm.

Sculpture: The shell surface is covered with marked longitudinal ridges. In the visible part of the last whorl are 45 of them. In the distance of about 7 mm from the margin of the last whorl, the width of the ridges varies between 0.10 and 0.18 mm and the width of the interspaces between them ranges from 0.15 to 0.24 mm. In the wall near the last whorl margin the width of the ridges varies between 0.06 and 0.12 mm and the width of the interspaces ranges from 0.18 to 0.28 mm. The transversal decoration is made up by fine dense lines, visible both in the ridges and interspaces.

Suture consists of a deep ventral lobe, ventral saddle, lateral lobe and lateral saddle (text-fig. 2a, 3a). The ventral lobe is divided by a relatively high ventral saddle in two pointed prongs. The lateral lobe is trifid. The ventral saddle shape can be inferred from two sutures. It is narrow, high, with the cutting of a crooked V on the top. It attains about five-sixths of the first lateral saddle height. The adjacent prong of the ventral lobe is deep, pointed and narrower than the first lateral saddle. In the adjacent part of the ventral saddle is an indication of a small dent. The first lateral saddle is high, wedge-shaped. The lateral lobe is divided by two small saddles in three not entirely independent lobes. The saddles are rounded in one suture, in the other they are wedge-shaped. The first — ventrally positioned secondary lobe — is pointed and has slight indications of a dent in the side adjacent to the first lateral saddle. The second lobe — central secondary lobe — is pointed and deeper by one-third than the first and third one. The shape of the third — umbilically positioned secondary lobe — cannot be observed.

Comparing remarks: When we assigned our specimen to a new species, only the sculpture character and suture could serve us as a basis for it. In a more conspicuous division of the lateral lobe, our specimen differs from the Namurian species *Proshumardites uralicus* LIBROVIČ (L. S. LIBROVIČ, 1941, in V. VEGER et al. 1941, p. 153, Fig. 43), *Proshumardites keideli* (LEUCKS) (E. V. RUŽENCEV, 1960, p. 216, Fig. 91), *Proshumardites karpinskii* RAUSER (D. RAUSER—ČERNOUSOVA, 1928, p. 166, Fig. 1—4), *Proshumardites delepinei*

SCHINDEWOLF (A. V. POPOV 1975 in D. L. STEPANOV et al. 1975, p. 127, Pl. 50, Fig. 6) and *Proshumardites principalis* RUZHENCEV et BOGOSLOVSKAYA (A. V. POPOV, 1975 in D. L. STEPANOV et al. 1975, p. 127, Fig. 5). The species *Proshumardites primus* PLUMMER et SCOTT, described from the Middle Carboniferous of Texas, from the zone *Gastrioceras listeri* MARTIN, has a similar more conspicuous division of the lateral lobe. Its suture is dealt with in the works of V.

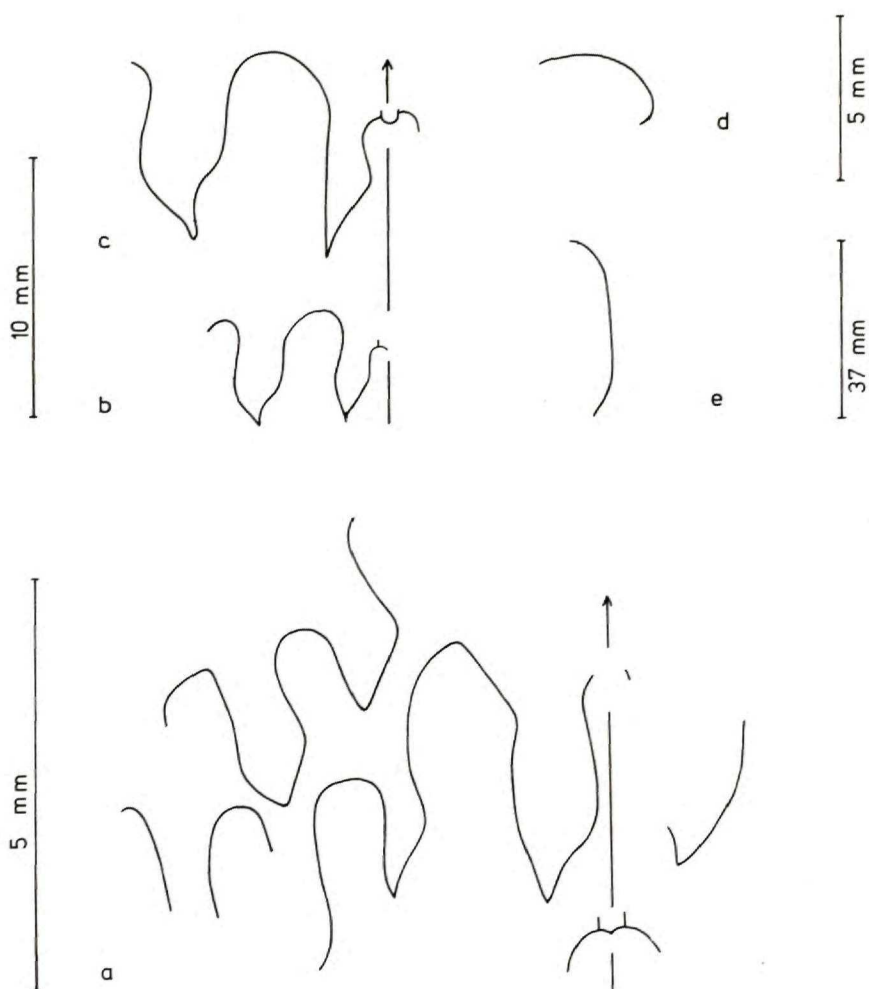


Fig. 2 a—e Sutures and profiles of the whorls of the species:

a — *Proshumardites jerusalembergi* sp.n., number of specimen 40, holotype, b—d *Dobshinaeceras nopcsai* (RAKUSZ); b—number of the specimen 100, paratype, suture, c—number of the specimen 101, paratype, suture, d—number of the specimen 103, paratype, profile of the whorl, e — *Thrinoceras rakuszi* sp. n., number of the specimen 56, holotype, profile of the whorl.

E. RUŽENCEV (1951), p. 91, Fig. 29b and L. R. MOORE et al. (1971), p. 352, Fig. 7a. When we compare these two pictures we can see that they are different. The suture given by V. E. RUŽENCEV (1950) has rounded saddles and more rounded lobes. Our specimen with its wedge-shaped saddles and pointed lobes resembles more the picture in the work of L. R. MOORE et al. (1971), but it differs from it by the ratio of the ventral saddle height to the first lateral saddle height and in the ratio of the height of small secondary saddles to the height of the first lateral saddle. In our specimen the ventral saddle is higher and the secondary ones are lower. Both the specimens have the same dimensions of the shell, number of ribs and interspaces between them.

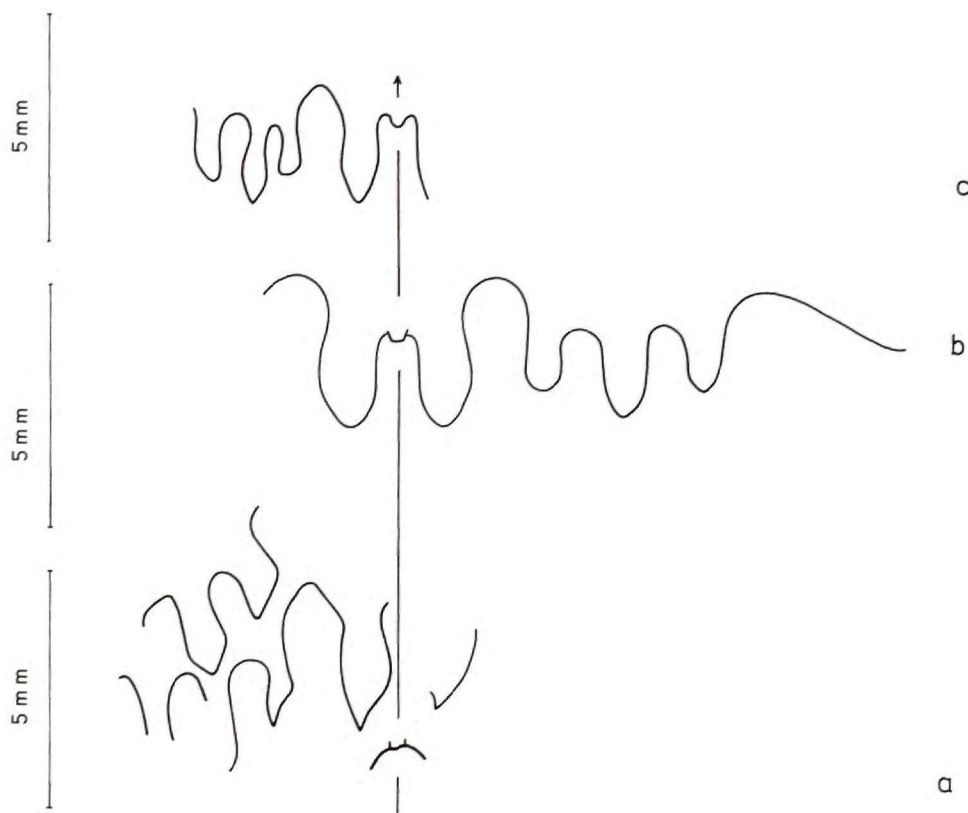


Fig. 3 a—c Sutures of the species:

a — *Proshumardites jerusalembergi* sp. n., number of the specimen 40, holotype, b — *Proshumardites primus* PLUMMER et SCOTT, in: V. E. RUŽENCEV (1950), p. 91, fig. 29, c — *Proshumardites primus* PLUMMER et SCOTT, in: L. R. MOORE et al. (1971), p. 352, fig. a.

Dobshinaeceras gen. n.

Typical species: *Gastrioceras nopcsai* n. sp. — GY. RAKUSZ 1932: Die Oberkarbonischen Fossilien von Dobsina (Dobšina) und Nagyvisnyó p. 117—119, Pl. 6, Fig. 11—20.

Diagnosis: A flat circular shell has a triangular coiling of its first whorls. The first whorls are coiled more loosely to the beginning of the umbilical shoulder. The cross-section of the whorl with triangular coiling has the shape of a flattened circle. Its sculpture is reticular. The transversal ribs gradually become less marked from the juvenile to the adult stage. In the ephebic stage, wavy-lines originate in the ventral part and in the adult stage, protuberances arise near the umbilical shoulder. The longitudinal lines commence when the shell diameter attains 10 mm. The external suture has, besides the ventral saddle, two lateral saddles, adjacent prong of the ventral lobe and a lateral lobe. The ventral saddle attains two-thirds of the first lateral saddle height and has a shallow, wide cutting. The prong of the ventral lobe is narrow, pointed, with slight indications of a dent in the side adjacent to the ventral saddle. The first lateral saddle is large, wide. The lateral lobe is pointed, nearly as deep as the ventral one and a little wider. In lower part has indications of a small dent in the side adjacent to the first lateral saddle. The second lateral saddle is nearly as high as the first one, but it is incomplete.

Presence of the species and their distribution: To the genus *Dobshinaeceras*, we can assign only the species *Dobshinaeceras nopcsai* (RAKUSZ) discovered in numerous localities near Dobšina of Westphalian B-C age.

Remark: The first representative of this genus was described in 1932 by GY. RAKUSZ as *Gastrioceras nopcsai* n. sp. The genus *Gastrioceras* does not include, however, species with a marked triangular coiling of the initial stage. Therefore it was necessary to assign our as well as Gy. Rakusz's specimens to some of the genera with triangularly coiled initial stage. The external part of the suture equals in some features the genus *Diaboloceras*, in other features it equals the genus *Paralegoceras*, which made us define a new genus with the typical species *Dobshinaeceras nopcsai* (RAKUSZ 1932).

Dobshinaeceras nopcsai (RAKUSZ 1932)

Pl. X, Fig. 3, 4, Pl. XI, Fig. 1—5, Text-fig. 2b—d, 4a—b

1932: *Gastrioceras nopcsai* n. sp. — GY. RAKUSZ: Die oberkarbonischen Fossilien von Dobsina (Dobšina) und Nagyvisnyó, p. 117—119, Pl. 6, Fig. 11—20, Text-fig. 20

Holotype: Sample No 60, incomplete impression deposited in collections of GÚDŠ.

Paratypes: Samples No 100, 101, 102, 103 deposited in collections of GÚDŠ

Stratum typicum: Upper Carboniferous, Westphalian B-C

Locus typicus: Dobšiná, Jeruzalemský vrch Mt. (Jerusalemberg), Slovakia, CSSR.

Derivatio nominis: According to the former chairman of the Hungarian Geological Institute in Budapest F. Nopcsa.

Material: Incomplete cores and impressions.

Diagnosis: The flat, circular shell has a triangular coiling of the first whorls. Looser coiling of the first whorls ends where the umbilical shoulder commences. The cross-section of such a whorl with triangular coiling has the shape of the flattened circle. The sculpture is reticular. The exterior suture consists of a ventral saddle, two lateral saddles, adjacent parts of the ventral lobe and a lateral lobe.

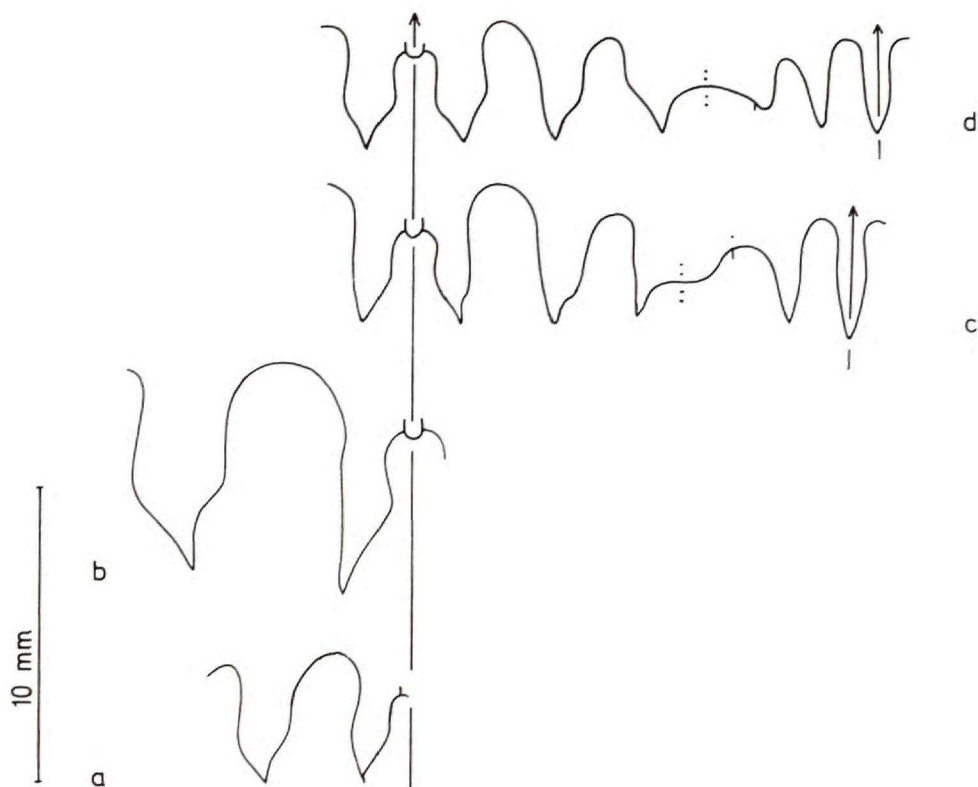


Fig. 4 a—d Sutures of the species:

a — *Dobshinaeceras nopcsai* (RAKUSZ), number of the specimen 100, paratype, b — *Dobshinaeceras nopcsai* (RAKUSZ), number of the specimen 101, paratype, c — *Diaboloceras varicosatum* MILLER et FURNISH, in: Treatise on Invertebrate Paleontology, Part L, p. 64, fig. 94 B, d — *Paralegoceras iowense* (MEEK—WORTHEN) in: Treatise on Invertebrate Paleontology, Part L 64, fig. 94 c.

Shape of the shell: It can be observed in the holotype (sample No 60, Pl. 3, Fig. 3) and in specimens in Pl. 6, Fig. 11, 17, 20 in the work of Gy. RAKUSZ (1932). A characteristic feature of this species is triangular coiling of the first whorls, that can be best observed in our specimen. It begins in the first third of the third whorl. Its conspicuousness ends in the third quarter of the seventh whorl, where the edge of the triangle attains 6 mm. According to specimens in Pl. 6, Fig. 11, 20 in the work of Gy. Rakusz it is evident that further whorls gradually obtain circular coiling. In the place, where the marked triangular coiling ends, the diameter of the umbilicus attains 6 mm. Initial whorls have no umbilical shoulder and are more loosely coiled. According to Gy. Rakusz the whorls are more tightly coiled from the place where the umbilical shoulder commences. A whorl with triangular coiling, in the place where the shell diameter is 6 mm, has an oblique umbilical declivity, rounded umbilical shoulder and a low, nearly straight flank that passes into a wide, slightly rounded venter. The width of the whorl is two times larger than its height. The shape of other whorls can be inferred merely according to fragmental material. According to Gy. Rakusz the width of the whorls increases rather slowly after the evolute juvenile stage and therefore the width of younger whorls is only slightly larger than their length and such a whorl covers about one-third of the previous whorl as far as the protuberances in the umbilicus. The umbilical declivity is relatively low. It is nearly vertical as far as the shell diameter of 20 mm, further it becomes oblique. It passes into the flank by a rounded shoulder. The overall shell appearance is rounded, flat and discoidal of ephebic specimens. The aperture shape and shell dimensions of an ephebic specimen cannot be described as we failed to find a complete, undamaged specimen. The holotype diameter (sample No 60) attains 21.5 mm, the paratype diameter (sample No 102) is 20.5 mm.

Sculpture: In the holotype, a distinct sculpture is visible from the second half of the second whorl, where dense, smooth ribs commence. In the end of the fourth whorl are five ribs in the area of 0.5 mm. When the shell diameter attains 6 mm, the ribs in the flank start to bend and bifurcate. They are sharp in the umbilical shoulder in the venter, where the shell diameter amounts up to 10 mm, they form thin, bent wavy-lines, that are intersected by very fine longitudinal ridges. According to Gy. Rakusz the juvenile ribs gradually get thinner. In the adult stage they form marked umbilical protuberances, meanwhile the ribs of adult specimens remain, however, indicated as faint waves that quickly flatten towards the exterior.

The growth lines seem to commence in places of rib bifurcations. Later their course is independent on the ribs. In the vicinity of the umbilical shoulder they cross the ribs obliquely. The growth lines are supplemented by the presence of other lines between them. Their course is between the protuberances and, with the exception of one fragment, the lines do not reach the umbilical declivity. The growth line shape changes markedly during the ontogenetic development. In the beginning they are straight, later they become one- or double-arched.

Longitudinal lines in our as well as in Gy. Rakusz's specimen commenced

when the shell diameter attained 10 mm. Their thickness is variable. The characteristic reticular structure begins in the close vicinity of the protuberances and covers entire surface of the whorl. It is most conspicuous in the ventral side.

Suture: Among numerous fragments we found two relatively small whorl fragments, in which the course of the outer part of the suture can be seen.

The specimen No 100 represents a fragment of a younger part of the shell. The completest suture commences with a ventral saddle, that has a shallow, wide cutting and attains two-thirds of the first lateral saddle height. The ventral saddle divides the ventral lobe in two narrow, deep prongs pointed in their lower part, of which only one is visible. The first lateral saddle is large, wide and rounded. The lateral lobe is deep and wider than the adjacent prong of the ventral lobe. It passes into the second lateral saddle, that is nearly as high as the first one. This saddle is incomplete.

In comparison with the specimen No 100, the specimen No 101 represents a fragment of an adult shell. Its more complete suture commences with a lateral saddle with a shallow, wide cutting. The ventral saddle attains two-thirds of the height of the first lateral saddle and has a shallow, wide cutting. The adjacent prong of the ventral lobe is narrow, pointed, with slight indications of a dent in the side from the ventral saddle. The first lateral saddle is large, wide. The lateral lobe is pointed and nearly as deep as the ventral lobe. The former is a little wider than the latter. In the lower part of the side from the lateral saddle it has indications of a small dent. The second lateral saddle is nearly as high as the first one, but it is incomplete. When we compare the suture of our fragments with that in Fig. 20 in the work of GY. RAKUSZ (1932) we may say, that on the basis of our material a ventral saddle can be added to outer course of the suture.

Comparing remarks: In the description of his specimen, Gy. Rakusz did not pay attention to the triangular coiling of the whorls, though it is distinctly visible in Fig. 17 and 20, Pl. 6. In 1958, B. BOUČEK and A. PŘIBIL, in a footnote in p. 119 state that the species *Gastrioceras nopcsai* published by Gy. Rakusz belongs to the genus *Trigonogastrioceras* LIBROVIČ, that is typical of the Middle Carboniferous (Russian Moscowian) of the west slope of the Urals.

In 1957, in a diagnosis L. S. Librovič characterizes *Trigonogastrioceras* by a flat shell and triangular coiling of the first whorls. As its sculpture the author mentions transversal radial ribs and lines. In the periphery of the ventral part of the whorl the radial lines bend forward and in its centre they form a sinus. In the core showing the ventral part of the shell there run in its centre two marked longitudinal grooves, that correspond to longitudinal cylinders — ridges — in the inner surface of the shell. The longitudinal grooves are not visible in the outer surface of the shell. The outer suture has a wide ventral lobe divided by a relatively high and wide ventral saddle. The first lateral lobe is short, narrow, rounded, while the second lateral lobe is angular. The shape of the inner suture is unknown. L. S. Librovič remarks that the genus *Trigonogastrioceras* is more similar to juvenile whorls of the genus *Paralegoceras* HYATT. It differs markedly from the latter by the presence of two longitudinal grooves

in the core of the ventral side of the whorl as well as in corresponding cylinders — ridges — in the inner surface of the shell. Other different features are smaller dimensions of the genus *Trigonogastrioceras*, absence of longitudinal ridges in the shell surface and resulting absence of the network sculpture.

Like the genus *Paralegoceras*, our specimens differ from L. S. Librovič's genus *Trigonogastrioceras* in the absence of two longitudinal grooves in the cores of the middle part of the whorl ventral side, in the presence of fine longitudinal ridges, that, together with the radial decoration, make up a marked reticular sculpture in the ventral side of the whorls. Moreover they differ in the suture, too. By comparison with the species *Trigonogastrioceras uralicus* LIBROVIČ the same different features can be mentioned.

Of genera with triangular initial whorls, our specimens most resemble the genera *Diaboloceras* and *Paralegoceras*, that differ from one another in the fact that the genus *Paralegoceras* has a more conspicuous triangular coiling of inner whorls and a less distinct decoration in the adult stage. The suture of the genus *Diaboloceras* has eight lobes, while the suture of the genus *Paralegoceras* has 10 lobes, of which are five inner and five outer. (A. K. MILLER — W. M. FURNISH 1940). According to V. E. RUŽENCEV (1950) the difference between the genera *Diaboloceras* and *Paralegoceras* lies mainly in the suture course. The umbilical lobe of the genus *Diaboloceras* has an incomplete two-member division. Its basic outer part is in the flank and the originating lobe is in the umbilical declivity. The initial umbilical lobe of the genus *Paralegoceras* changed into an independent lobe situated in the inner wall of the shell.

In 1940, in a description of the species *Paralegoceras iowense* MEEK — WORTHEN, A. K. MILLER and W. M. FURNISH stated, that the only congeneric mate of the species *Paralegoceras texanum* (SHUMARD) and *Paralegoceras iowense* MEEK — WORTHEN is *Paralegoceras nopcsai* (RAKUSZ) of the Upper Namurian of Slovakia and that the latter more resembles the species *Paralegoceras texanum* (SHUMARD) than *Paralegoceras iowense* MEEK — WORTHEN.

In 1964, M. GORDON mentioned among species of the genus *Paralegoceras* also the species *Paralegoceras nopcsai* (RAKUSZ) 1932 (*Gastrioceras*). He remarks that in Europe *Paralegoceras* occurs in the Upper Namurian and maybe in the Lower Westphalian of Slovakia and in the Lower Westphalian or Bashkirian of the Urals.

While comparing our specimens with the genera *Diaboloceras* and *Paralegoceras* we see that in marked triangular coiling of inner whorls they most resemble the genus *Paralegoceras*.

Of the suture we possess only its incomplete outer part and therefore in assignation of our specimens we cannot apply the same criteria as V. E. RUŽENCEV (1950). We can take into account only the shape and dimensions of the ventral saddle, lateral saddles and lobes that separate them. Our specimens equal the genus *Diaboloceras* in the same ratio of the first lateral saddle height to the ventral saddle height and in minor width of the adjacent prong of the ventral lobe. It has the same shape of the first lateral saddle as the genus

Paralegoceras. Our specimen resembles in some features the genus *Diaboloceras* and in other features the genus *Paralegoceras* and therefore it cannot be assigned to any of them. According to the character of the so far known part of the suture, they can be regarded as representatives of a genus that is between these two genera.

The assignation of the species *Gastrioceras nopcsai* RAKUSZ to the genus *Paralegoceras* by K. E. MILLER and W. M. FURNISH in 1940 and M. GORDON in 1964 can be considered as premature. This is suggested by the not quite equal course of the outer part of the suture of our specimens and the genus *Paralegoceras* as well as by the absence of inner suture in our specimens, that is very important for the characteristics of the genus *Paralegoceras*.

Arachnida

Stethostomata

Anthracomartidae HAASE, 1890

Pleomartus PETRUNKEVITCH, 1945

Type species: *Anthracomartus trilobitus* SCUDDER, 1884

Pleomartus sp. indet.

Pl. X, Fig. 5, Text-fig. 5

Material: sculptural core, sample No 71

Shape of the body: The prosoma and opistosoma are preserved in the specimen. The length of the entire body is 16 mm. The prosoma is 5 mm long and approximately 5 to 6 mm wide. The opistosoma is 11 mm long and probably 11 mm wide. Both the above mentioned widths are not exact as the left part of the entire body and the right part of the opistosoma are partly damaged. In the place where the opistosoma is widest, one half of the width from the middle of the body to the right margin amounts 5.5 mm.

The prosoma is rounded in the front part and straight at the posterior. In its left front part is a narrow projection that might represent its first walking leg. In its right front part as well as further to the right towards the side, indications of small projections can be seen. They might be coxae of the second and third walking leg.

The opistosoma has the shape of a slightly elongated oblong with rounded edges. It can be supposed that it had the shape of a square with rounded corners and slightly rounded not cut out margins. It consists of nine segments. In the back side the first tergite, by which the prosoma is connected with the opistosoma, is shortest and the following tergite, that originated by the connection of the second and third one, is longest. The fourth to eighth are of the same length, the ninth has submarginal plates. The width of marginal widening of tergites is smaller than the width of their lateral part. The surface of the tergites

is smooth, only in their margins are indications of very fine protuberances. In the back half of the opistosoma there is impressed the shape of the abdominal parts of individual segments — sternites.

Comparing remarks: According to its appearance and body shape, the specimen can be assigned to the family *Anthracomartidae*. Of the species of this family, it most resembles the genus *Pleomartus* PETRUNKEVITCH. Of the representatives of this genus, only a sketch of the species *Pleomartus trilobitus* (SCUDDER) and *Pleomartus palatinus* (AMMON) (A. PETRUNKEVITCH, 1955) is available in literature. Our specimen more resembles the species *Pleomartus palatinus* (AMMON) because its opistosoma narrows irregularly towards the prosoma. Therefore its width in the place of connection with the prosoma is larger than the posterior part of the prosoma. From this species it differs, however, in the fact that its length and width of prosoma as well as of opistosoma are nearly the same. In the place of connection with prosoma, the opistosoma of our specimen is more angular and wider in comparison with the width of the prosoma. In our specimen the central zone of the ninth tergite in the back part of the body is narrower and longer. Because of these differences we cannot assign our specimen to the species *Pleomartus palatinus* (AMMON). We denominate our specimen only *Pleomartus* sp. indet. until we obtain further literature on this group of arachnides. In 1958, A. PŘIBIL described the abdominal side of a part of an opistosoma and assigned it, with a question-mark, to the genus *Eophrynus*. This species differs from ours in a more egg-shaped opistosoma.

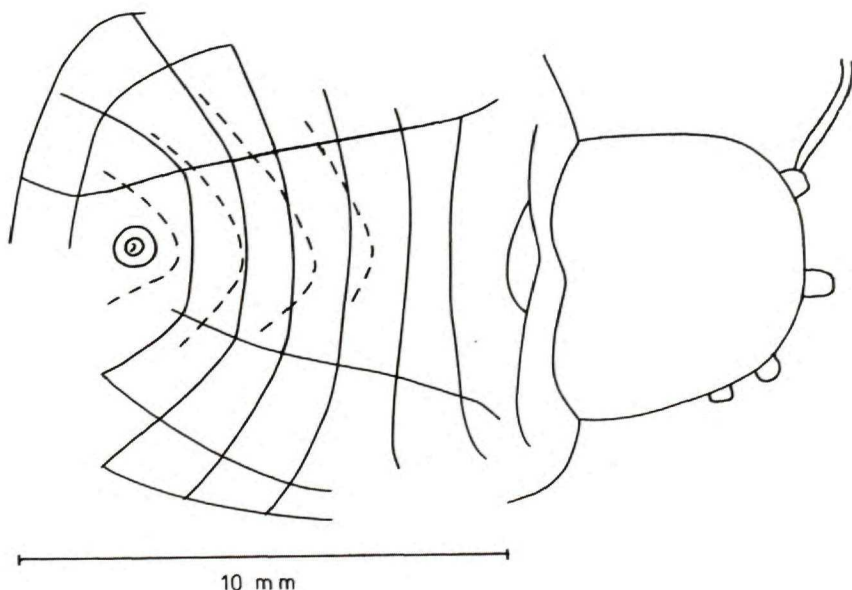


Fig. 5 *Pleomartus* sp. indet., number of the specimen 71.

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Margita Vaňová

Paleontologická charakteristika niektorých druhov z Jeruzalemského vrchu pri Dobšinej

Resumé anglického textu

V bohatej literatúre o faune vrchnokarbónskych sedimentov popredné miesto zaberá i monografia Gy. Rakusza „Die Oberkarbonischen Fossilien von Dobsina (Dobšiná) und Nagyvisnyó“ z r. 1932. Autor v nej podáva výsledky svojich paleontologicko-stratigrafických štúdií rôznorodej fauny pochádzajúcej z viacerých lokalít z okolia Dobšinej. Popri druhoch prvý raz opísaných z klasických oblastí karbónu autor uvádzal tiež druhy nové, niektoré pomenované, iné nepomenované, označené ako sp. nov. ind.. Väčšina nových druhov pochádzala zo slienitých bridlic (horizont γ) na lokalite Jeruzalemský vrch (Jeruzsálemhegy, Jerusalemberg) a piesčitých bridlic (horizont ζ) na lokalitách Baňa Michaeli a Mačacie diery (Mihálybánya, Macskalyukak, Michaeligrube, Katzenlöcher).

V r. 1981 získal Geologický ústav D. Štúra od zberateľa Š. Mesaroša zbierku fauny zo slienitých bridlic z Jeruzalemského vrchu, ktorú sme sa snažili doplniť vlastnými zbermi fauny. V materiáli Š. Mesaroša sa nachádzajú druhy z Jeruzalemského vrchu a z okolia Dobšinej uvádzané ako i druhy neuvedené. Medzi exemplármi druhov známych z Jeruzalemského vrchu sa našli úlomky suturálnych línii a pekný neúplný odtlačok vnútorných závitov druhu *Gastrioceras nopsai* RAKUSZ, na základe ktorých môžeme Gy. Rakuszove určenie doplniť a spresniť v tom zmysle, že ho vyčleňujeme

do nového taxónu, ktorý označujeme ako *Dobshinaeceras* gen. n. s typickým druhom *Dobshinaeceras nopcsai* (RAKUSZ). Medzi formami z okolia Dobšinej doteraz neuvádzanými sa našlo i jadro s odtlačkom, ktoré považujeme za nový druh a uvádzame ho ako *Thrincoceras rakuszi* sp. n. a jedno jadro, ktoré uvádzame ako nový druh pod názvom *Proshumardites jerusalembergi* sp. n.. Ďalšie štyri exempláre sme podľa prístupnej literatúry nemohli zatiaľ druhovo určiť. Preto ich predbežne opisujeme iba ako *Streblopteria* sp. indet. 1. *Streblopteria* sp. indet. 2, *Euchondria* sp. indet. a *Pleomartus* sp. indet. Zo stratigrafického hľadiska naše druhy nevyvracajú doterajšie zariadenie makrofaunistických spoločností z okolia Dobšinej do vestfálu B—C.

Explanations to plates VIII—XI

Plate VIII

- 1 *Streblopteria* sp. indet. 1, number of the specimen 19, $\times 2,75$.
- 2 *Streblopteria* sp. indet. 2, number of the specimen 20, $\times 2,2$.
- 3—4 *Euchondria* sp. indet., number of the specimen 72; 3- $\times 1,8$, 4-detail of the hinge line, $\times 4,8$.
- 5—6 *Thrincoceras rakuszi* sp. n., number of the specimen 56, holotype; 5-detail of the first whorl, $\times 1,9$, 6-detail of the second whorl, $\times 1,8$.

1—3 photo by H. Jendeková
4—6 photo by M. Vaňová

Plate IX

- 1—2 *Thrincoceras rakuszi* sp. n., holotype; 1-number of the sample 56, natural size, 2-number of the sample 56a, natural size; both samples are partial moulds and prints of the same specimen.

Photo by H. Jendeková

Plate X

- 1—2 *Proshumardites jerusalembergi* sp. n., number of the specimen 40, holotype; 1- $\times 4,2$, 2-detail, $\times 6,7$.
- 3—4 *Dobshinaeceras nopcsai* (RAKUSZ); 3-number of the specimen 62, fragment of the whorl, $\times 2,2$, 4-number of the specimen 61, fragment of the whorl, $\times 1,8$.
- 5 — *Pleomartus* sp. indet., number of the specimen 71, $\times 3,5$.

3,4 photo by H. Jendeková
1,2,5 photo by M. Vaňová

Plate XI

- 1—5 *Dobshinaeceras nopcsai* (RAKUSZ); 1-number of the specimen 60, holotype, $\times 2,6$, 2-number of the specimen 60, holotype detail, $\times 5,1$, 3-number of the specimen 100, paratype, suture, $\times 2,3$, 4-number of the specimen 101, paratype, suture, $\times 5,1$, 5-number of the specimen 103, paratype, profile of the whorl, $\times 4,7$.

1, 2 photo by H. Jendeková
3—5 photo by M. Vaňová

Viliam Sitár — Eva Planderová — Emília Čierna

Knowledge on fossil flora of the Handlová — Nováky lignite basin obtained from the Vt-D-5 drillhole

13 fotogr. tab. (XII—XXIV), slovenské resumé

Abstract: In the submitted paper the individual authors publish results of the Vt-D-5 drillhole research, as far as fossil flora remains i.e. macroflora, pollen grains and spores and diatoms (*Diatomaceae*) are concerned. The results are very interesting and contributed to the solution of paleoecological and biostratigraphic results.

Fossil flora findings in the Handlová — Nováky basin are very interesting. It is proved by the published works of F. NĚMEJC (1952, 1959), B. PACLTOVÁ (1958), E. PLANDEROVÁ (1966), E. PLANDEROVÁ—P. SNOPOKOVÁ (1970), M. TAKÁČ (1967, 1974), V. SITÁR (1976) and by rich findings in the last years in the lignite opencast pit Lehota pod Vtáčnikom, dumps in the vicinity of Nováky or in drillholes.

The submitted paper deals complexly with fossil remains from the Vt-D-5 drillhole, which was performed by GÚDŠ (Geological Institute of D. Štúr) employees within the staten research task S-52-547-105 — Hydrogeological research of chosen areas of the Slovak Socialist Republic, stage 05 — Hydrogeological research of the Vtáčnik Mts. (responsible manager Dr. V. DOVINA).

The Vt-D-5 drillhole was situated SE of the village Kamenec pod Vtáčnikom for the purpose of hydrogeological research to a depth of 344.5 m. Rocks from depths 135 to 296 m are interesting from the paleontological point of view. They are various epiclastic sandstones, siltstones, claystones and fine-grained sandstones.

Macroflora (impressions of leaves) comes from depths 135 to 296 m. From the petrographic point of view (according to V. KONEČNÝ) following rock types are present:

135—136 m coarse-grained, epiclastic sandstones with scattered rounded andesite fragments

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- 149—162 m layer of epiclastic siltstones with irregular sandstone and bituminous sediment intercalations
 188—201 m coarse-grained, epiclastic sandstones
 231—240 m claystones with lignite
 288—296 m monotonous epiclastic siltstone series

Remains of carbonized leaf blades were preserved in numerous impressions and therefore we were able to prepare specimens with cuticle, which resulted in a more accurate systematic assignation. Following impressions are present in the drillcores:

- 135—136 m *Tilia vindobonensis* Stur,
Myrica lignitum (UNG.) SAP.,
Salix sp.,
Quercus rhyolitica ANDREÁNSZKY.
 149—150 m *Myrica lignitum* (UNG.) SAP.,
 150—151 m *Laurophyllum* sp.,
 157—158 m *Fraxinus* sp.,
Carya serraefolia (GOEPP.) KRÄUSEL,
 158—159 m *Taxodium dubium* (STNBG.) HEER,
Glyptostrobus europaeus (BRONGN.) UNG.
 161—162 m *Castanea atavia* UNG.,
Laurophyllum sp.,
Myrica lignitum (UNG.) SAP.,
Acer tricuspidatum BRONN.,
Acer integerrimum (VIV.) MASS.
 188—189 m *Myrica lignitum* (UNG.) SAP.,
 200—201 m *Glyptostrobus europaeus* (BRONGN.) UNG. — cone,
Phragmites oeningensis AL. BR.,
Juglans acuminata AL. BR.
 231—232 m *Myrica lignitum* (UNG.) SAP.,
Daphnogene polymorpha (AL. BR.) ETT.,
Diospyros brachysepala HEER,
Acer sp. — fruit.
 232—233 m *Laurophyllum* sp.
 233—234 m *Acer* sp. — fruit
 234—235 m *Myrica lignitum* (UNG.) SAP.
 237—238 m *Myrica* sp.,
Ulmus pyramidalis GOEPP.,
Viscophyllum sp.
 239—240 m *Sapindus falcifolius* AL. BR.,
Ulmus pyramidalis GOEPP.
 288—289 m *Glyptostrobus europaeus* (BRONGN.) UNG.,
Pinus rigios (UNG.) ETT.,
Pinus sp.,
Sphagnum sp.,
Salix tenera AL. BR.,

- Carya serraefolia* (GOEPP.) KRÄUSEL.,
Quercus pseudocastanea GOEPP.,
Castanea sp.,
Myrica lignitum (UNG.) SAP.,
Acer sp. — fruits,
 fish remains.
- 289—290 m *Lycopodium* sp.,
Laurophyllum markvaticense KVAČEK,
Daphnogene polymorpha (AL. BR.) ETT.,
Myrica lignitum (UNG.) SAP.,
Quercus cf. *urophylla* UNG.,
Castanea sp.,
Castanopsis bavarica KNOBLOCH et KVAČEK,
Zelkova zelkovaefolia (UNG.) BUŽEK et KOTL.,
Leguminosites sp.,
Carya serraefolia (GOEPP.) KRÄUSEL,
Sapindus falcifolius AL. BR.,
Podogonium knorrii (AL. BR.) HEER,
Acacia parschlugiana UNG.
- 290—291 m *Glyptostrobus europaeus* (BRONGN.) UNG.,
Laurophyllum nemejcii KVAČEK,
Laurophyllum markvaticense KVAČEK,
Daphnogene polymorpha (AL. BR.) ETT.,
Myrica lignitum (UNG.) SAP.,
Leguminosites ellipticus UNG.,
Celastrus sp.,
Acer tricuspidatum BRONN,
Acer integerrimum (VIV.) MASS.,
Acer sp. fruitd,
Ulmus pyramidalis GOEPP.,
Ulmus sp. — fruit,
Magnolia sp.
- 291—292 m *Glyptostrobus europaeus* (BRONGN.) UNG.,
Pinus hepios (UNG.) HEER,
Myrica lignitum (UNG.) SAP.,
Juglans acuminata AL. BR.,
Parrotia pristina (ETT.) STUR,
Sapindus falcifolius AL. BR.,
Acer tricuspidatum BRONN,
Acer integerrimum (VIV.) MASS.,
Acer sp. — fruit,
Laurophyllum nemejcii KVAČEK,
Daphnogene polymorpha (AL. BR.) ETT.,
Laurophyllum sp.

- 292—293 m *Pinus* sp. — fruit,
Typha latissima AL. BR.,
Myrica lignitum (UNG.) SAP.,
Diospyros brachysepala HEER,
Daphnogene polymorpha (AL. BR.) ETT.,
Zelkova zelkovaefolia (UNG.) BUŽEK et KOTL.,
Podogonium knorrii (AL. BR.) HEER,
Acer tricuspidatum BRONN,
Acer sp. fruits,
Prunus sp.
- 293—294 m *Myrica lignitum* (UNG.) SAP.
- 294—295 m *Juglans acuminata* AL. BR.,
Castanea kubinyi KOV.,
Diospyros brachysepala HEER,
Melania cf. *aquitana* NOULET — gastropods.
- 295—296 m *Pterocarya denticulata* (O. WEB.) HEER,
Laurophyllum sp.

The fossil flora is rather rich. Lower plants — diatoms are present, too. Higher plants are rarely represented by spore plants — *Sphagnum*. Of class *Pinopsida*, they are *Glyptostrobus europaeus*, *Taxodium dubium*, representatives of the genus *Pinus*, needles and seeds. Of angiosperms, *Myrica lignitum*, *Laurophyllum*, *Acer tricuspidatum* with three basal veins, *Acer integerimum* with five to seven basal veins are plentiful. Leaf impressions of *Magnolia*, *Daphnogene polymorpha*, *Podogonium knorrii*, *Salix*, *Diospyros brachysepala*, *Acacia parschlugiana*, *Sapindus falcifolius*, *Juglans acuminata*, *Carya serraefolia*, *Castanea atavia*, *C. kubinyi*, *Castanopsis bavarica*, *Quercus pseudocastanea*, *Ulmus pyramidalis*, *Zelkova zelkovaefolia* are present, too. The *Monocotyledonae* *Phragmites oeningensis* and *Typha latissima* also occur. The presence of other forms, spore plants as well as seed plants, is supplemented by palynological results.

Samples for palynological research were taken from depths 150.7 to 300 m, 20 samples were processed in the laboratory, of which 10 contained rich sporomorph assemblages. The richest assemblages come from depths 202 to 209, 230 and 283 to 295 m. In all these depths are clayey sediments with coal intercalations. The samples processed in the laboratory come from the following depths:

179.1—179.2 m negat.	245.2—245.3 m negat.
181.1—182.2 m negat.	283.2—283.3 m posit.
185.2—185.5 m negat.	290.8—290.9 m negat.
204.3—204.4 m posit.	294.3—294.4 m negat.
205.7—205.8 m posit.	295.3—295.4 m posit.
209.7—209.8 m posit.	296.4—296.5 m negat.
211.0—211.1 m posit.	297.8—297.9 m negat.
230.6—230.7 m posit.	298.9—299.0 m negat.
232.8—232.9 m posit.	299.6—299.7 m negat.
238.1—238.2 m posit.	300.2—300.3 m negat.

According to the presence of individual species and the depth of sediments we can form two different groups. Microfloristic assemblage in a depth of 204.2 to 238.1 m makes up the first group and the second one comes from a depth of 283.2 to 295.4 m. All the samples from these depths are rich, as far as number of species and their quantity are concerned, and contain sporeplants as well as seed plants (both coniferous and angiosperms).

Following sporomorphs were present in samples from depths of 204.2 to 238.1: Spore plants are represented mainly by algae of the family *Botryococcaceae*, species *Botryococcus braunii* that is known for its production of bituminous mass. *Pteridophyta* spores of the species *Laevigatosporites neddeni*, *Leio-triletes structuris*, *Foveolotisorites pessinensis*, *Stereisporites microgranulus crassixinus*, *Trilites multivalatus*, *Trilites paucivallatus*, *Gleicheniidites elegans* are present, too. According to the botanic system, most of the above-mentioned species belong to the families *Schizeaceae* and *Gleicheniaceae*, that require a tropical climate and in our territory occur only up to the Lower Sarmatian.

Coniferous were represented by: rare *Pinus* type *silvestris* and abundant *Pinus* type *Haploxydon*. The genus *Picea* was rare. Species of the family *Taxodiaceae* are rather rare, but constantly present. On the basis of pollen grains of coniferous plants in the examined assemblages we may say that they are very abundant, but nearly all belong to the genus *Pinus*. The portion of the family *Taxodiaceae* is rather low, but it confirms the presence of a developed *Taxodium* vegetation, that gave rise to coal.

Angiosperms are most valuable, as far as the number of species and their quantity are concerned. Most abundant of all species were pollen grains of the family *Myricaceae*, mainly *Myricipites rurensis*, more rarely *Myricipites bituitus* that occasionally occurs up to the Middle Miocene. Pollen grains of the family *Cyrillaceae*, typical of subtropical, swampy environment, were plentiful. We suppose such an environment in our territory in the period of the Lower to Middle Miocene. Species of the family *Cyrillaceae* occasionally occur in the period of the Badenian to Sarmatian. Other discovered pollen grains came from the genera *Ulmus*, *Carya*, very frequently from *Engelhardia*, species *Tricolporopollenites cingulum pusillus* (*Castanea*), *Tricolporopollenites cingulum oviformis* (*Castanea*), *Momipites punctatus*, *Magnolipollis neogenicus*, representatives *Leguminosae*, *Nyssaceae*, *Cistaceae*, *Quercus* type *petrea*, *Pterocarya* sp., *Juglans* sp., *Acer* sp., *Alnus* sp.

Samples from depths of 283.2 to 295.4 m were rich in sporomorphs and were very well preserved, which proves their autochthonous origin and a short transport to the sedimentary basin. The composition of sporomorphs is following: spores of spore plants are less abundant than in the overlying sediments. Green algae of the species *Botryococcus braunii* are present also here. Pollen of *Coniferopsida* is rare. Of angiosperms, pollen grains of the genus *Engelhardia*, families *Oleaceae*, *Myricaceae*, *Momipites punctatus*, species *Castanea*, *Carya*, *Ulmus*, *Zelkova*, *Alnus*, *Quercus* and *Betula* prevail. Arctotertiary elements are less frequent in comparison with the prevailing subtropical assemblage *Myrica* — *Engelhardia* — *Oleaceae*.

Diatoms (*Diatomaceae*), represented by centric as well as penat forms, were found in specimens from depths of 179 to 292 m. The following taxons have been identified:

Melosira arenaria MOORE,
Melosira distans (EHR.) KÜTZ. var. *distans*,
Melosira distans var. *scala* (EHR.) RALTS var. *granulata*,
Melosira italica (EHR.) KÜTZ. var. *italica*,
Melosira kochii Pant.,
Melosira scabrosa OESTRUP,
Melosira undulata (EHR.) KÜTZ. var. *undulata*,
Stephanodiscus sp.,
Coscinodiscus sp.,
Actinoptichus sp.,
Actinocyclus ehrenbergii var. *tenellus* (BRÉB.) HUST.,
Tetracyclus lacustris RALFS var. *lacustris*,
Opephora martyi HÉRIB. var. *martyi*,
Fragilaria construens (EHR.) GRUN. var. *construens*,
Fragilaria construens var. *venter* (EHR.) GRUN.,
Fragilaria leptostauron (EHR.) HUST. var. *leptostauron*,
Fragilaria leptostauron var. *fossilis* (PANT.) HUST.,
Fragilaria pinnata EHR. var. *pinnata*,
Fragilaria transylvanica PANT.,
Eunotia gracilis (EHR.) RABH.,
Cocconeis placentula EHR.,
Cocconeis placentula var. *euglypta* (EHR.) CLEVE,
Stauroneis phoenicenteron (NITZSCH) EHR.,
Navicula amphibola CLEVE,
Navicula gastrum (EHR.) KÜTZ. var. *gastrum*,
Navicula haueri GRUN.,
Navicula oblonga KÜTZ.,
Pinnularia viridis (NITZSCH) EHR.,
Cymbella aspera (EHR.) CLEVE,
Cymbella cymbiformis (AG., KÜTZ.) var. *leptoceros*,
Cymbella leptoceros (EHR.) KÜTZ. var. *leptoceros*,
Cymbella turgida (GREGORY) CLEVE,
Gomphonema lingulatum HUST.,
Epithemia cistula var. *lunaris* GRUN.,
Rhopalodia gibba var. *jastrabensis* (EHR.) ŘEH.,
Nitzschia sp.,
Surirella costata NEUP.

Prevailing group are diatoms, that belong to the group of indifferent obligohalobes, i.e. species that live in a fresh-water, eutrophic environment, e.g. *Melosira italica*, *Fragilaria pinnata*. Only an unimportant number can be designated as halophilous types i.e. fresh-water species that require for their development

increased salinity of the water e.g. *Epithemia cistula* var. *lunaris*, *Rhopalodia gibba* var. *jastrabensis*. Mesohalob i.e. brackish forms are very rare and are represented by the species *Actinocyclus ehrenbergii* var. *tenellus* and *Gomphonema lingulatum*. The halophilous and mesohalophilous species are quantitatively much less numerous and therefore the sedimentary environment cannot be classified as brackish.

Planktonic forms are represented by the species *Melosira granulata*, *Melosira arenaria*, *Melosira italica*, *Melosira undulata*, *Actinocyclus ehrenbergii* var. *tenellus* and by the genus *Stephanodiscus*. Benthonic and epiphyte genera *Cymbella*, *Fragilaria*, *Cocconeis*, *Navicula*, *Epithemia* and *Rhopalodia* make up a prevailing group.

Among diatoms, littoral species predominate. They are *Melosira distans*, *Fragilaria construens*, *Fragilaria pinnata*, *Navicula gastrum*, *Navicula oblonga*, *Navicula radiosa*, *Cymbella aspera* and *Cymbella cymbiformis*.

The above-mentioned facts make it possible to infer the character of the sedimentary basin. From the analysis it results that diatom sediments were deposited in fresh-water, not very deep lakes near the shore. The climate during sedimentation was warm, which is proved by the presence of the species *Gomphonema lingulatum*.

Psychrophilous elements are very infrequent (*Tetracyclus lacustris*).

On the basis of macroremains and sporomorphs we may state that in both depths, up to 230 m and from 283 to 300 m, the assemblages are the same. The difference is only in the percentage of arctotertiary and thermophile elements. In depths up to 230 m, there are more arctotertiary elements and their number decreases downwards. It means that climatic conditions influenced the composition of flora — subtropical elements become less numerous upwards.

As regards the sedimentary environment, we have evidence that it was fresh-water. It is suggested by occurrences of the algae *Botryococcus*, which, according to B. BLACKBURN (1977), is a significant indicator of lacustrine sedimentation with coal. Moreover, when their percentage is high, this genus can be regarded as an indicator of oil deposits. This green alga lives in a fresh-water environment and only exceptionally was found in a brackish one. Therefore we suppose that the sedimentation in depths up to 290 m took place in a fresh-water environment, but we may admit that deeper sedimentary zones were slightly brackish. It is suggested by findings of shells of the molluscs *Melania* cf. *aquitana* and some diatoms e.g. *Actinocyclus ehrenbergii* var. *tenellus* and *Gomphonema lingulatum*. The latter are present in small amounts and they may be relics from the period when the studied sedimentary basin was connected with a sea. The connection with the sea came to its end in the beginning of the Badenian and since then the size and salinity of the basin gradually decreased.

According to macroremains and sporomorphs of higher plants, the sediments contain elements of swampy vegetation of the types *Taxodiaceae*, *Myricaceae*, *Carya*, *Cyrillaceae*, *Nyssaceae* and some *Pteridophyta*. The vicinity of the sedimentary basin was covered with mixed woods. Of coniferous, mostly pine-

trees occurred, that could grow on plains as well as on the slopes of volcanic mountains. Angiosperms were represented by the genera *Quercus*, *Castanea*, *Olea*, *Ulmus*, *Zelkova*, *Carpinus*, *Myrica*, *Acer*, *Juglans*, *Carya*, *Pterocarya*, *Diospyros*, on dry slopes bush forms of *Engelhardia*, next *Laurus*, *Daphnogene*, *Myrica* and *Magnolia*. According to the discovered plant assemblage the paleoclimate was tropical, warm.

The findings of the above-mentioned macro- and microflora can be compared with flora of the sediments over- and underlying coal beds in the vicinity of the town Nováky. Occurrences of lignite and the species *Botryococcus brauni* prove that in the area Vtáčnik — north there were good conditions for the origin of coal and other bituminous elements, but in a lesser extent than in the neighbourhood of Nováky.

As regards biostratigraphy, the found flora is interesting, too. Macroflora remains (abundant leaves) indicate very warm and humid conditions. There are representatives of the genera *Laurophyllum*, *Daphnogene*, *Myrica*, *Magnolia*, *Parrotia*, as well as *Tilia*, *Acacia*, *Castanopsis*, *Sapindus*. *Myrica* grows mainly in tropical and subtropical regions. The genus *Castanopsis* belongs among evergreen woody-plants and is more thermophile than *Castanea*. As regards the genera *Acacia* and *Podogonium* and family *Lauraceae*, the situation is similar.

The subtropical climate is proved by the presence of pollen grains of the genus *Engelhardia*, family *Cyrillaceae* and numerous *Pteridophyta* spores. Diatoms are represented by numerous thermophile species, too.

When comparing the flora studied by us with that of other Slovak localities, we state a difference in its composition. In typical Sarmatian localities (Jastrabá, Ihráč, Močiar etc.), there are more arctotertiary elements. E.g. in the drillhole we did not record impressions of the genera *Betula*, *Carpinus*, *Alnus*, *Fagus*, that prevail in the above-mentioned localities. They were found only in the form of pollen grains. Family *Cyrillaceae*, genus *Lygodium* prove Badenian age. As regards overall composition of the flora, we may also consider the studied sediments as Upper Badenian or transitory Badenian to Sarmatian.

By comparison of macroflora remains with pollen grain occurrences, some of the pollen grains can be assigned to the natural system. We suppose that the species *Myricipites rurensis* corresponds probably with the species *Myrica lignitum*, *Tricolporopollenites cingulum* subsp. *oviformis*, which is known to belong to the species *Castanea*, can be assigned more exactly to the species *Castanea atavia* etc. Macroflora and sporomorphs found in the same environment are very valuable for an exact assignation of species according to botanic names, which is very important for the evaluation of the ecosystem. The palynological results supplement the composition of vegetation, which gives us good informations on numerous paleogeographic and biostratigraphic problems.

Conclusion

On the basis of macroflora, sporomorphs and diatoms (*Diatomaceae*) discovered in the sediments in the Vt-D-5 drillhole, we may state that they

deposited in the Upper Badenian or in the boundary Badenian — Sarmatian.

The environment was probably fresh-water, which is proved by the fresh-water alga *Botryococcus braunii* and by most of *Diatomaceae* representatives. Shells of the molluscs *Melania* cf. *aquitana* and some *Diatomaceae* (*Actinocyclus ehrenbergii* var. *tenellus* and *Gomphonema lingulatum* as well as *Epithemia cistus* var. *lunaris*, *Rhopalodia gibba* var. *jastrabensis*, that require increased salinity), suggest that the environment was slightly brackish.

The paleoclimate was warm, subtropical, more humid in the period of the sedimentation of clays with coal (204—230 m) and drier during the sedimentation of the underlying beds (283—295 m), where genera *Engelhardia*, *Laurophyllum* and *Daphnogene* are more frequent.

The sedimentation commenced probably in a lacustrine environment that gradually became swamps with their typical vegetation.

Comparison of leaf impressions with palynological results made it possible to identify some species of pollen grains according to the natural system. It results from the study of diatoms, that the diatomite sediments were deposited in shallow lakes, mostly in the vicinity of the shore, which is suggested by numerous littoral forms.

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Poznatky o fosilnej flóre z hnedouhoľnej handlovsko-nováckej panvy z vrtu VT-D-5

Resumé

V práci sú uvedené biostratigrafické výsledky, založené na štúdiu makroflóry, mikroflóry a rozsievkovej flóry.

Predmetom tohto komplexného štúdia boli sedimenty z vrtu VT-D-5, ktorý bol situovaný jv. od obce Kamenec pod Vtácnikom.

Makroflóra je bohatá na druhy rodov *Myrica*, *Tilia*, *Salix*, *Laurophyllum*, *Fraxinus*, *Carya*, *Taxodium*, *Castanea*, *Acer*, *Glyptostrobus* a iné. Mikroflóra bola veľmi bohatá na druh *Botryococcus braunii*, ktorý je indikátorom nahromadenia bituminóznej hmoty. Zastúpené boli druhy čeľ. *Polypodiaceae*, *Sphagnum*. Z ihličnatých boli hojné druhy rodu *Taxodium*, *Pinus*, *Picea*. Z *Angiospermae* boli najhojnejšie zastúpené *Myricaceae*, *Cyrillaceae*, *Ulmus*, *Carya*, *Castanea* a iné.

Rozsievky boli zastúpené centrickými aj penátnymi formami. (Druhy rodu *Melosira*, *Stephanodiscus*, *Actinoptichus*, *Fragilaria*, *Navicula* a iné).

Podľa výskytu vyššie uvedených spoločenstiev predpokladáme sladkovodné sedimentačné prostredie, pri hlbších zónach mierne brakické. Spoločenstvo flóry poukazuje na vrchnobádenský až spodnosarmatský vek skúmaných sedimentov. Paleoklíma bola teplá — subtropická. Sedimentácia začala pravdepodobne v jazernom prostredí a prešla do močiarného prostredia s typickou močiarnou vegetáciou.

Explanation to the plates XII—XXIV (Magn. VIII—X 1000 ×)

Plate XII

- 1 *Glyptostrobus europaeus* (BBRONGN.) UNG., 288—289 m
- 2 *Pinus* sp. 2 ×, 291—293 m
- 3 *Acer tricuspidatum* BRONN., 291—293 m
- 4 *Taxodium dubium* (STNGB.) HEER, 158—159 m
- 5 *Daphnogene polymorpha* (AL. BR.) ETT., 289—290 m
- 6 *Acer* sp., 231—232 m
- 7, 8 *Acacia parschlugiana* UNG., 290—294 m
- 9 *Tilia vindobonensis* STUR., 135—136 m
- 10 *Carya* cf. *serraefolia* (GOEPP.) KRÄUSEL, 289—290 m
- 11 *Quercus* cf. *urophylla* UNG., 289—290 m

Plate XIII

- 1—3 *Myrica lignitum* (UNG.) SAP., (1 — 293—294 m, 2 — 289—290 m, 3 — 291—292 m)
- 4 *Zelkova zelkovaefolia* (UNG) BUŽEK et KOTL., 289—290 m
- 5 *Laurophyllum* sp., 232—233 m
- 6 *Carya serraefolia* (GOEPP.) KRÄUSEL, 157—158 m

Plate XIV

- 1 *Myrica lignitum* (UNG.) SAP., 291—293 m
- 2 *Magnolia* sp., 290—291 m
- 3 Zvyšky ryby, 288—289 m
- 4 *Acacia parschlugiana* UNG., UNG., 289—290 m

Plate XV

- 1 *Acer tricuspidatum* BRONN, 290—291 m
- 2 *Acer integerrimum* (VIV.) MASS., 291—292 m
- 3 *Carya* cf. *serraeifolia* (GOEPP.) KRÄUSEL, 289—290 m
- 4, 5 *Laurophyllum* sp., 290—192 m

Plate XVI

- 1 *Daphnogene polymorpha* (AL. BR.) ETT, upper cuticle, 260 ×, 291—292 m
- 2 *Myrica lignitum* (UNG.) SAP., upper cuticle, 260 ×, 290—291 m
- 3, 4 *Laurophyllum markvaticense* KVAČEK,
3 — upper cuticle, 260 ×, 289—290 m,
4 — lower cuticle, 260 ×, 289—290 m
- 5 *Laurophyllum nemejcii* KVAČEK, lower cuticle, 260 ×, 291—292 m
- 6 Parasitic Fungi in the cuticle of the leaf *Laurophyllum nemejcii* KVAČEK, 260 ×, 291—292 m
- 7 *Castanopsis bavarica* KNOBLOCH, KVAČEK, 260 ×, 150—151 m

Plate XVII

- 1 *Sphagnum* sp., 289—290 m
- 2 *Melania* cf. *aquitana* NOULET, 294—295 m
- 3 *Castanea atavia* UNG, 161—162 m

Plate XVIII (30,6—238 m, 283,2—283,3 m)

- 1—3 *Botryococcus braunii* KÜTZING
- 4 *Pinus* typ *Haploxyton*
- 5 *Verrucatosporites favus* (R. POT.) TH. PF.
- 6 *Picea* sp.
- 7—8 *Taxodium* sp.

Plate XIX (230,6—238 m, 283,2—283,3 m)

- 1—6, 9, 10, 12, 16 *Alnus* sp.
- 7—8, 11, 13 *Myricipites rurensis* (PF.) NAGY
- 14—15 *Momipites punctatus* NAGY
- 17—18 *Platycarya* sp.
- 19, 22 *Momipites* sp.
- 20 *Betula* sp.
- 21, 24 *Engelhardia* sp.
- 23 *Tricolporopollenites* sp.
- 25 *Tricolporopollenites kruschi* (PF. TH.)
- 26 *Carya* sp.
- 27 *Ulmus* sp.

Plate XX (230,6—238 m, 283,2—283,3 m)

- 1, 12 *Juglans* sp.
- 2—4, 6, 9 *Carya* sp.
- 5, 10, 11 *Pterocarya* sp.
- 7 *Subtriporopollenites* sp.
- 8 *Carpinus* sp.
- 11—16 *Castanea* sp.
- 17—18 *Leguminosae* sp.

Plate XXI (236,6—238 m, 283,2—283,3 m)

- 1 *Cornus* sp.
- 2 *Tricolpopollenites* sp.
- 3—4 *Cyrillaceae* sp.

- 5 *Castanea* sp.
- 6 *Salix* sp.
- 7—10 *Tricolporopollenites cingulum oviformis* (TH. PF)
- 11 *Tricolporopollenites* sp.
- 12 *Quercus* sp.
- 13 *Tricolporopollenites* sp.
- 14 *Cupuliferae* sp.
- 15—17 *Salix* sp.

Plate XXII

- 1 *Melosira arenaria* MOORE, 290—291 m,
- 2 *Melosira granulata* (EHR.) RALFS var. *granulata*, 290—291 m, 2000 ×
- 3 *Melosira distans* (EHR.) KÜTZ. var. *distans*, 290—291 m,
- 4 *Melosira distans* var. *scala* (EHR.) GRUN., 290—291 m,
- 5 *Melosira kochii* PANT., 289—290 m, 750 ×
- 6 *Melosira* sp., 290—291 m,

Plate XXIII

- 1 *Actinocyclus ehrenbergii* var. *tenellus* (BRÉB.) HUST., 288—289 m, 1750 ×
- 2 *Actinocyclus ehrenbergii* var. *tenellus* (BRÉB.) HUST., 288—289 m, 1500 ×
- 3 *Actinocyclus ehrenbergii* var. *tenellus* (BRÉB.) HUST., 288—289 m, 2500 ×
- 4 *Actinocyclus* sp., 291—292 m, 2000 ×
- 5 *Tetracyclus lacustris* RALFS var. *lacustris*, 288—289 m, 1200 ×
- 6 *Fragilaria leptostauron* (EHR.) HUST. var. *leptostauron*, 290—291 m, 1100 ×

Plate XXIV

- 1 *Fragilaria construens* (EHR.) GRUN. var. *construens*, 290—291 m,
- 2 *Cocconeis placentula* var. *euglypta* (EHR.) CLEVE, 290—291 m, 1750 ×
- 3 *Stauroneis phoenicenteron* (NITZSCH) EHR., 288—289 m, 350 ×
- 4 *Navicula* sp., 290—291 m, 1250 ×
- 5 *Gomphonema lingulatum* HUST., 290—291 m,
- 6 *Rhopalodia gibba* var. *jastrabensis* (EHR.) ŘEH., 290—291 m, 760 ×

Adriana Zlinská

Recent foraminifers of the central equatorial region of the Pacific ocean

5 fotogr. tab. (XXV—XXIX), slovenské resumé

Abstract: Several samples were taken from the central equatorial region of the Pacific ocean from depths: 4736 m, 4766 m, 4900 m, 4983 m, and 5127 m. The analysed samples were represented by pelites of the globigerina mud type. Of planktonic foraminifers, representatives of the group *Globorotalia menardii* (ORBIGNY) were most abundant. Dextral species prevail over sinistral ones. Of benthonic forms, species *Melonis pompilioides* (FICHTEL et MOLL) occurred very frequently. In spite of the fact that dead planktonic and benthonic species come from great depths, they were not affected by dissolution.

In foraminiferal assemblages there are no agglutinated species.

From Dr. J. Horniš, who had taken part in a research oceanic expedition on board of the soviet ship "Georgij Maximov", we received several samples from the Pacific ocean.

The samples were taken from the following depths: 4736 m, 4766 m, 4900 m, 4983 m and 5127 m. The analysed samples were represented by pelites of the globigerina mud type. Minimal variability and mass occurrence of some species of planktonic foraminifers are typical for the studied foraminiferal microfauna. Representatives of the group *Globorotalia menardii*, mainly *Globorotalia tumida* (BRADY) are most abundant. The mass occurrence of planktonic foraminiferal shells proves only insignificant dissolution of CaCO_3 . The so-called compensation depth, known from higher latitudes, is not present, or it may occur in a greater depth. Besides the already mentioned representatives of the group *Globorotalia menardii*, other plentiful species are represented by *Pulleniatina obliquiloculata* (PARKER et JONES) and *Globigerina* aff. *duertrei* ORBIGNY. *Hastigerina aequilateralis* (BRADY), *Globigerinoides conglobatus* (BRADY), *Globoquadrina venezuelana* (HEDBERG) and *Sphaeroidinella dehiscens* (PARKER et JONES) that are mentioned in literature on oceanic abyssal sediments of the equatorial region of the Pacific and Atlantic, are rare.

Of benthonic species, *Melonis pompilioides* (FICHTEL et MOLL) is most frequent. *Gyroidina neosoldanii* BROTZEN and *Favocassidulina favus* (BRADY), the

Synoptical plate of foraminifer occurrences

	Depth (m)				
SPECIES	4 736	4 766	4 900	4 983	5 127
<i>Textularia</i> sp.			x		
<i>Eggerella brady</i> (CUSHMAN)			x		
<i>Pyrgo murrhina</i> (SCHWAGER)			x		
<i>Lenticulina</i> aff. <i>cultrata</i> (MONTFORT)					
<i>Pyrulina</i> sp. (cf. <i>P. angusta</i> (EGGER))				x	x
<i>Oolina desmophora</i> (RYMER et JONES)					x
<i>Oolina</i> cf. <i>laevicostata</i> (CUSHMAN et GRAY)	x				
<i>Fissurina</i> cf. <i>lacunata</i> (BURROWS et HOLLAND)					x
<i>Fissurina marginata</i> (MONTAGU)	x				
<i>Fissurina</i> sp. (cf. <i>F. scarenaensis</i> (HANTKEN))		x			
<i>Fissurina subformosa</i> PARR		x			
<i>Rosalina bertheloti</i> ORBIGNY	x			x	
<i>Hastigerina aequilateralis</i> (BRADY)		x			x
<i>Globorotalia menardii</i> (ORBIGNY)		x	x	x	x
<i>Globorotalia tumida</i> (BRADY)	x	x	x		x
<i>Globigerina</i> aff. <i>duertrei</i> ORBIGNY	x	x			x
<i>Globigerinoides conglobatus</i> (BRADY)		x			
<i>Globoquadrina venezuelana</i> (HEDBERG)		x			
<i>Pulleniatina obliquiloculata</i> (PARKER et JONES)	x	x	x	x	x
<i>Sphaeroidinella dehiscens</i> (PARKER et JONES)		x			x
<i>Favocassidulina favus</i> (BRADY)		x	x		x
<i>Pullenia bulloides</i> (ORBIGNY)		x		x	
<i>Pullenia quinqueloba</i> (REUSS)		x			
<i>Pullenia</i> cf. <i>subcarinata</i> (ORBIGNY)				x	
<i>Gyroidina neosoldanii</i> BROTZEN			x	x	x
<i>Melonis pompilioides</i> (FICHTEL et MOLL)	x	x		x	x

latter discovered by the author of the species in recent abyssal sediments of the Pacific ocean in lower latitudes, were abundant, too. Rarely can be found:

Pyrulina sp. (cf. *P. angusta* (EGGER))

Oolina desmophora (RYMER et JONES)

Oolina cf. *laevicostata* (CUSHMAN et GRAY)

Fissurina cf. *lacunata* (BURROWS et HOLLAND)

Fissurina marginata (MONTAGU)

Fissurina subformosa PARR

It is interesting that the dead planktonic species, as well as benthonic foraminifers, had not been affected by dissolution in spite of the fact that they were taken from great depths. As far as planktonic species are concerned, dextral prevail over sinistral ones.

Agglutinated forms are not present in foraminiferal assemblages.

Besides foraminifers also radiolarians and sponge spines were relatively frequent, while ostracode shells and an echinoid spine were rare.

The ratio of planktonic and benthonic foraminifers from individual depths is following:

A. Zlinská

Recentné foraminifery z centrálnej rovníkovej oblasti Pacifického oceánu

Resumé

Za účelom paleontologického vyhodnotenia obsahu recentných mikrofosílií boli po biofaciálnej stránke prehodnotené vzorky z výskumnej oceánskej expedície absolvovanej sovietskou loďou "Georgij Maximov" v roku 1981.

Získané vzorky pochádzajú z ekvatoriálnej časti Pacifického oceánu z hĺbok 4736 m, 4766 m, 4900 m, 4983 m a 5127 m. Z litofaciálneho aspektu sú tvorené pelitmi typu globigerinových kalov.

Pre poznanie mikroorganicznej štruktúry boli komponenty študované pomocou elektrónového riadkovacieho mikroskopu JSM-U3.

Dominantné zastúpenie v rezídiu majú foraminifery s minimálnym obsahom rádiolárií, ostrakód, ihlíc húb a iných.

Z planktonických foraminifer sú najrozšírenejší zástupcovia zo spektra *Globorotalia menardii* (ORBIGNY), hlavne *Globorotalia tumida* (BRADY). Spomedzi nich majú prevahu pravotočivé druhy nad ľavotočivými. Okrem uvedených je výrazne rozšírený druh *Globigerina* aff. *dutertrei* ORBIGNY.

Veľmi hojné rozšírenie z bentonických foraminifer má *Melonis pompilioides* (FICHEL et MOLL). Hojne sa vyskytuje aj *Gyroidina neosoldanii* BROTZEN a *Favocassidulina favus* (BRADY), nájdená autorom druhu v recentných hlbokomorských sedimentoch Pacifiku v malých zemepisných šírkach.

Explanations to Plates XXV—XXIX

Photographs were made by electron scanning microscope JSM-U3 by K. Šebor

Plate XXV

1, 6 *Globorotalia tumida* (BRADY), 25 ×, 4766 m

2 *Globorotalia tumida* (BRADY), 30 ×, 4736 m

3 *Globorotalia tumida* (BRADY), 30 ×, 4766 m

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- 4 *Globorotalia menardii* (ORBIGNY), 17.5 ×, 4900 m
- 5 *Globorotalia menardii* (ORBIGNY), 25 ×, 4766 m
- 7 *Fissurina* sp. (cf. *F. scarenaensis* (HANTKEN)), 120 ×, 4766 m
- 8 *Fissurina* sp. (cf. *F. scarenaensis* (HANTKEN)), 90 ×, 4766 m
- 9 *Fissurina subformosa* PARR., 25 ×, 4766 m

Plate XXVI

- 1 *Sphaeroidinella dehiscens* (PARKER et JONES), 30 ×, 4766 m
- 2 *Sphaeroidinella dehiscens* (PARKER et JONES), 50 ×, 5127 m
- 3 *Pulleniatina obliquiloculata* (PARKER et JONES), 35 ×, 4766 m
- 4 *Pulleniatina obliquiloculata* (PARKER et JONES), 80 ×, 4736 m
- 5, 6 *Pulleniatina obliquiloculata* (PARKER et JONES), 30 ×, 4766 m
- 7 *Favocassidulina javus* (BRADY), 30 ×, 4766 m
- 8, 9 *Globigerina* aff. *duertrei* ORBIGNY, 100 ×, 4766 m

Plate XXVII

- 1 *Pullenia bulloides* (ORBIGNY), 80 ×, 4766 m
- 2 *Pullenia bulloides* (ORBIGNY), 140 ×, 4983 m
- 3 *Pullenia quinqueloba* (REUSS), 40 ×, 4766 m
- 4 ?*Parafissurina*, 60 ×, 4766 m
- 5 *Gyroidina neosoldanii* BROTZEN, 80 ×, 4983 m
- 6 *Gyroidina neosoldanii* BROTZEN, 70 ×, 4900 m
- 7 *Pyrgo murrhina* (SCHWAGER), 30 ×, 4900 m
- 8 *Eggerella bradyi* (CUSHMAN), 70 ×, 4900 m
- 9 *Eggerella bradyi* (CUSHMAN), 60 ×, 4900 m

Plate XXVIII

- 1 *Textularia* sp., 20 ×, 4900 m
- 2 *Melonis pompilioides* (FICHEL et MOLL), 50 ×, 4983 m
- 3 *Pyralina* sp. (cf. *P. angusta* (EGGER)), 50 ×, 4983 m
- 4 *Rosalina bertheloti* ORBIGNY, 50 ×, 4736 m
- 5 *Rosalina* aff. *bertheloti* ORBIGNY, 70 ×, 4983 m
- 6 *Oolina* cf. *laevicostata* (CUSHMAN et GRAY), 25 ×, 4736 m
- 7 *Melonis* sp., 50 ×, 4736 m
- 8 *Fissurina marginata* (MONTAGU), 40 ×, 4736 m
- 9 *Oolina* sp., 30 ×, 4736 m

Plate XXIX

- 1 *Oolina desmophora* (RYMER et JONES), 60 ×, 5127 m
- 2 *Oolina desmophora* (RYMER et JONES), 300 ×, 5127 m
- 3 *Hastigerina aequilateralis* (BRADY), 35 ×, 5127 m
- 4 *Hastigerina aequilateralis* (BRADY), 400 ×, 4736 m
- 5 *Hastigerina aequilateralis* (BRADY), 70 ×, 4736 m
- 6 *Lenticulina* aff. *cultrata* (MONTFORT), 50 ×, 5127 m
- 7 *Fissurina* cf. *lacunata* (BURROWS et HOLLAND), 100 ×, 5127 m

А. Т. Вегуни

Обоснование стратиграфической схемы деления палеогеновых отложений

В результате многочисленных исследований к настоящему времени выработаны четыре схемы расчленения палеогеновых отложений, каждая из которых имеет свои преимущества и недостатки. Первой схемой расчленения является «международный» стратотип Англо-Парижского бассейна, получивший наибольшее признание. Стратотип Южной Франции или, вернее, Западных Альп территориально распространяется на Средиземноморскую геосинклиналь и легко увязывается с другими разрезами палеогена этой геосинклинали. Стратотип Крыма и его парастратотип на Кубани приемлемы для аналогичных разрезов юга СССР (без Закавказья) и приняты за основу расчленения палеогена юга СССР. Схема деления палеогена острова Тринидад, разработанная Г. М. Болли (1957) и предложенная В. А. Крашенинниковым (1965, 1969) в качестве стратотипа, отличается стройностью, детальностью расчленения и возможностью ее применения на больших пространствах.

Все эти схемы резко различаются, и каждая из них не лишена погрешностей. Общим для них является то, что по всем этим схемам отложения палеогена делятся на три отдела — палеоценовый, эоценовый и олигоценовый. В большинстве случаев палеоцен делится на два подотдела, эоцен — на три, а в олигоцене фактически подотделы не выделяются. Таким образом, на уровне отделов и подотделов основной каркас расчленения палеогена сохраняется, что позволяет в определенной мере коррелировать отложения палеогена весьма отдаленных областей. Но в вопросе определения стратиграфического объема этих подразделений и их границ наблюдаются значительные противоречия. Существенно различаются эти схемы и в подробности расчленения.

По фауне микрофораминифер каждый отдел делится на различное число — от двух до восьми — биостратиграфических зон. По фауне нуммулитид нередко удается в палеогене выделить несколько ярусов и зон. Но весьма трудной задачей стала корреляция выделенных разными методами стратиграфических единиц между собой.

В связи с расхождениями во взглядах на проведение границ отделов и подотделов палеогена определение объема этих стратиграфических единиц стало одной из наиболее актуальных проблем стратиграфии палеогена. Причем эта проблема возникла давно, неоднократно дискутировалась в геологической литературе и поныне не нашла своего общепризнанного решения. По мнению И. М. Ямниченко (1966): «... эти разногласия с течением времени, в процессе накопления новых данных, не только не устранились или сгладились, но сохранили свою остроту». Здесь же уместно привести следующее высказывание Д. Л. СТЕПАНОВА (1958): «В настоящее время, пожалуй, нет ни одной системы, границы которой не были бы предметом дискуссии».

Почему же такие важные вопросы стратиграфии палеогена, при таком пристальном внимании к ним, не могут найти своего окончательного решения? Чтобы дать на этот вопрос более или менее разумный ответ, следует упомянуть о некоторых положениях, лежащих в основе стратиграфического расчленения толщ. Общеизвестно, что до сего времени наиболее надежным и объективным методом возрастного расчленения толщ является палеонтологический метод. В основе палеонтологического метода лежит изменчивость фауны, связанная с изменением условий обитания животных организмов. Изменение среды обитания — результат происходящих в области тектонических движений. Тектонические движения непосредственно влияют на закономерности изменения среды обитания, что в свою очередь приводит к изменению органического мира, а именно видового и родового состава животных.

Биостратиграфическое расчленение толщ в соответствии со стратотипом носит на себе отпечаток теории катастрофизма, согласно которой тектонические движения имеют глобальный характер, и поэтому обусловленные ими изменения среды происходят одновременно. Теоретическая геология давно отказалась от такого упрощенного понимания закономерностей тектонических движений. Но ряд положений этой теории в других областях геологии продолжает влиять на образ мышления геологов. При сопоставлении конкретного разреза со стратотипическим геологи исходят из того положения, что закономерности изменения среды обитания органического мира в области накопления отложений исследуемого разреза не отличались от стратотипического. Предполагается, что все изменения среды повсеместно происходили одновременно, и поэтому изменчивость фауны на различных регионах также должна быть подчинена единому правилу. В настоящее время этого никто не может утверждать. Закономерности изменения среды обитания могут быть одинаковыми лишь в пределах одной структурно-формационной зоны или, по крайней мере, сопряженных и близко расположенных структурно-формационных зон. В пределах таких сравнительно ограниченных площадей можно проследить за одинаковым ходом изменения среды обитания и изменчивости органического мира. Поэтому и появляются региональные схемы стратиграфического расчленения толщ. В каждой

региональной стратиграфической схеме обобщены материалы тех разрезов, отложения которых накопились в близких условиях среды обитания, и изменения этой среды в пределах всего региона в основных чертах подчинены одной единой последовательности. Следовательно, изменчивость фауны в пределах данного региона также протекает по единой или почти единой схеме.

Исходя из изложенных позиций, поиски глобального стратотипа и глобальной единой схемы стратиграфического расчленения являются неразрешимой задачей. По этому поводу хорошо высказался Д. Л. СТЕПАНОВ: «Следует заметить, что многие зарубежные стратиграфы, основываясь на идеалистических представлениях о направленном и предопределенном развитии отдельных групп организмов, ошибочно допускали, что эпоболи имеют очень широкое, а иногда мировое значение, причем их последовательность строго выдерживается».

В последние годы с резкой критикой стратотипов выступает О. ШИНДЕВОЛЬФ (1975). Он считает, что «стратотипы не только излишний, но и вредный балласт, и что от них поэтому следует отказаться».

Различные группы организмов на изменения среды обитания реагируют по-разному: для одних групп организмов малейшие изменения условий среды обитания приводят к вымиранию отдельных видов и даже родов, другие же группы органического мира проявляют большую приспособленность. Следует также отметить, что одни и те же изменения среды обитания (изменения pH, солености, глубины, температуры и др.) на одни группы организмов воздействуют мгновенно (в геологическом понимании этого слова), а на другие — через определенное время, и поэтому на одних уровнях происходит резкая смена одних групп организмов, а на других уровнях — резкая смена видового и даже родового состава. В связи с этим весьма трудно по остаткам различных групп организмов расчленить толщу на одних и тех же уровнях. По фауне нуммулитид в одних стратотипах средний эоцен подразделяется на две, а в других на три фаунистические зоны, а по фауне мелких фораминифер те же отложения на Тринидадском региональном разрезе расчленяются на пять биостратиграфических зон. Обратную картину мы наблюдаем при расчленении верхнеэоценовых отложений. Порой по другим группам органических остатков одна биостратиграфическая зона охватывает промежуток между смежными отделами и подотделами. Так, например, выделенные по флоре нанопланктона В. А. КРАШЕНИННИКОВЫМ и Н. Г. МУЗЫЛЕВЫМ (1975) отложения зоны с *Cyclococcolithina robusta* охватывают верхи датского яруса и низы палеоцена; отложения зоны с *Discoaster binodosus* охватывают отложения верхов нижнего и низов среднего эоцена. Такое же положение занимают отложения зоны с *Nannotetrins fulgens* между средним и верхним эоценом. Приведенные факты, может быть, являются тривиальными истинами, но, к сожалению, в практической деятельности в стремлении разработать унифицированные и детальные схемы стратиграфического расчленения эти истины зачастую забываются.

При расчленении толщ первоначально подыскивались руководящие формы (виды), и по этим видам производилось сопоставление смежных разрезов и их корреляция со стратотипом. По мере накопления фактов некоторые руководящие формы потеряли свое значение, так как для многих из них было установлено более широкое вертикальное распространение, чем предполагалось раньше. Возникла необходимость производить сопоставление разрезов между собой и со стратотипом не посредством отдельных «руководящих» видов, а посредством характерных комплексов. Характерным комплексом считается группа видов, наиболее часто встречающихся в пределах данной стратиграфической единицы. В последние годы наряду с характерным комплексом выделяется (из того же комплекса) зональный вид, т.е. вид, который встречается только в данной стратиграфической единице или преимущественно приурочен к ней. Выделенные таким путем стратиграфические единицы называются биостратиграфическими зонами. Делаются попытки выделить аналогичные зоны по фауне нуммулитид (Г. Н. Немков 1967), микрофораминифер (Е. К. Шуцкая 1969, В. А. Крашенинников 1965), по нанопланктону и другим группам органического мира. Имеются тенденции приписывать этим биостратиграфическим зонам глобальное значение, т.е. поднять их до уровня зоны или опельзоны. В последние годы теоретическим вопросам биостратиграфии стали снова уделять большое внимание В. В. Меннер (1962), Д. Л. Степанов (1958), Г. П. Леонов (1973), В. А. Крашенинников и Г. И. Немков (1975), О. Шиндевольф (1975) и др.

Первоначально в стратиграфическом расчленении палеогена ведущая роль принадлежала моллюскам, в частности пелелиподам и гастроподам, а позже эта роль перешла к нуммулидам, в особенности к отряду нуммулитов. Биостратиграфическое значение этой группы считалось чуть ли не универсальным. По мере развития палеонтологической науки ряд специалистов стал приписывать такую универсальную роль микрофораминиферам, в частности планктонным. В последнее время некоторые исследователи в упомянутом смысле большое значение придают нанопланктону. Наиболее достоверные результаты получаются при комплексном, совместном их использовании. Безусловно, планктонные животные, в частности микроорганизмы (микрофораминиферы, нанопланктон), в принципе должны обладать и обладают рядом преимуществ, которые, в частности, заключаются в большой миграционной способности. Их обилие, следовательно, большая частота встречаемости, еще больше увеличивает их биостратиграфическое значение. Тем не менее статистический анализ закономерностей распространения современных представителей планктонных фораминифер на больших пространствах привел исследователей к выводу о том, что и эта группа организмов в значительной мере подчинена законам географического распространения. По данным Н. В. Беляевой (1969), Н. В. Беляевой и С. Б. Кругликовой (1969), наблюдается географическая зональность в распределении некоторых групп микрофораминифер. Так, в северном полушарии севернее

широты 40° ($\pm 2-3^{\circ}$), а в южном полушарии южнее широты 40° ($\pm 2-3^{\circ}$) преобладают представители рода *Globigerina*. В субтропических поясах, как в северном, так и в южном полушариях, соотношение глобигеринид и глобороталид в планктоне равное. На тропиках между широтами $+20^{\circ}$ — -20° преобладают виды из рода глобороталид. Здесь семейство *Globigerinidae* представлено почти исключительно родом *Globigerinoides*. Такая зональность в распространении представителей мелких фораминифер заведомо существовала и в палеогене. Может быть, границы этих географических зон были несколько иными, но что такая зональность была, и она должна была повлиять на частоту встречаемости тех или других групп организмов вне всякого сомнения.

Упомянутые соображения говорят о том, что на первый взгляд универсально распределенные планктонные организмы, как в стадии жизни, так и в стадии захоронения, подвергаются перераспределению. Последнее усугубляется тем, что в основном мы имеем дело с отложениями шельфовой зоны, где расхождения в количественном распределении видов выражены сильнее и, следовательно, после вымирания они больше подвергаются перераспределению. Имеются свидетельства о том, что одно только течение Гольфстрим значительно сдвигает зону развития глобигеринид на север.

Исследование закономерностей распределения и дальнейшего перераспределения микрофауны приводит к мысли о том, что ни одна группа организмов не может претендовать на универсальность и на исключительную и однозначную биостратиграфическую роль. Это еще явственнее обосновывается при сопоставлении одновозрастных, но разнофациальных толщ. На это обратили внимание Б. П. Жижченко (1968), В. В. МЕННЕР (1962) и другие, предложившие для подобных случаев ряд оригинальных методов корреляции разрезов.

Как было сказано выше, расчленение толщ по остаткам органического мира производится путем изучения закономерностей вертикального распространения отдельных видов или комплекса видов той или иной группы организмов. Следовательно, чем короче длительность существования вида или комплекса видов, тем больше их биостратиграфическое значение, т.е. по ним можно разработать более дробную схему биостратиграфического расчленения толщ. По мере накопления фактов выяснилось, что биоцена вида значительно шире его биостратиграфической зоны, например *Nummulites laevigatus*, являющийся зональным видом низов среднего эоцена, в последствии был найден в отложениях средней части среднего эоцена (Парижский бассейн, Иран, Индия), верхней части среднего эоцена (Карпаты, Болгария, Турция, Грузия, Азербайджан) и даже, по недостоверным данным, в отложениях низов верхнего эоцена (Азербайджан). Такое положение мы наблюдаем и в отношении закономерности вертикального распространения другого вида — *Nummulites perforatus*, являющегося зональным видом верхнего лютета. В настоящее время он найден на различных уровнях всего среднеэоценового разреза. Его присутствие зафиксиро-

вано и в отложениях верхнего эоцена. Такое же положение наблюдается в вертикальном распространении мелких, в том числе планктонных фораминифер. Так, *Globigerina triloculinoides*, считавшаяся зональным видом низов палеоцена, встречается и в отложениях всего эоцена. Не исключена возможность, что расширение вертикального диапазона развития тех или иных видов обусловлено субъективными причинами, а именно — неправильным пониманием объема вида. Нередки случаи, когда название одного вида имеет собирательное значение, т.е. объединяет несколько видов или подвидов, на что указывали многие палеонтологи. Субъективно интервал вертикального распространения вида может быть расширен и в результате неправильного определения стратиграфического положения толщи, в которой обнаружен данный вид. Такие искажения в определении интервала вертикального распределения видов вызваны низким уровнем наших знаний и приурочены, в частности, к малоизученным регионам. По мере накопления новой информации уменьшаются искажения пределов и расширяются интервалы вертикального распространения вида. При изучении полных и непрерывных разрезов, где отсутствуют внутрiformационные и другие перерывы в осадконакоплении, все меньше обнаруживаются скачкообразные смены фауны. Смена одного вида другим или одной группы фауны другой происходит плавно, весьма постепенно, что лишает нас возможности более четко установить пределы вертикального распространения отдельных видов, а тем более группы видов, и отбить по ним границы толщ. Поэтому в настоящее время для установления длительности существования одного вида употребляются разные обозначения: тейльзона (тейлохрон, эпиболь и др.). Большинство исследователей при расчленении толщ на дробные биостратиграфические единицы для включения вида в характерный комплекс берется не конкретное развитие данного вида по всему разрезу, а его эпиболь (А. Т. ВЕГУНИ (1964), Г. ШАУБ (1966), Б. Т. ГОЛЕВ (1969) и др.). Причем для выяснения эпоболи вида предложены различные методы, в основном опирающиеся на содержание данного вида в единице объема породы (пробы), и этим устанавливается частота встречаемости (р). В последние годы для выделения эпоболей видов применяются методы математической статистики Б. В. ПОЯРКОВА (1969) и др.

Как было сказано выше, при выделении комплекса характерных видов для биостратиграфических единиц автор настоящих строк также руководствовался установлением эпоболей (А. Т. ВЕГУНИ 1964). Но дальнейшие исследования и обзор литературы по закономерностям и распространению нуммулитид и некоторых мелких фораминифер привели к убеждению, что включение эпоболи того или другого вида в характерный комплекс правомерно для небольших регионов, обладающих идентичными условиями среды осадконакопления и обитания, на что указывали еще Д. Л. СТЕПАНОВ (1958) и другие. За пределами данной конкретной структурно-формационной зоны эпиболь одного и того же вида фиксируется на различных уровнях, зачастую выходящих за пределы тех стратиграфичес-

ких единиц, которые были выделены по эпиболи одного или эпиболям нескольких видов. Следовательно выделение биостратиграфических единиц только по эпиболям видов на больших площадях сопряжено также с большими погрешностями и может привести к ошибкам.

В нашем распоряжении имелось свыше 500 послойных разрезов из различных областей развития палеогена. Биостратиграфическими критериями произведено их расчленение, и путем сопоставления созданы сводные разрезы. Группирование их большинством исследователей произведено по принадлежности этих разрезов к отдельным тектоническим структурам, фациальным зонам, структурно-формационным единицам. По типовым разрезам составлены региональные схемы биостратиграфического расчленения. Произведена их корреляция с одним из названных нами выше стратотипов. На каждом этапе генерализации для устранения имеющихся неувязок в той или иной мере приняты вольные решения, и поэтому в настоящее время ни одна схема не может претендовать на универсальность или научную безупречность.

В наших исследованиях мы также придерживались общепринятой последовательности разработки стратиграфической схемы расчленения палеогена. Нами составлено свыше 100 послойных разрезов из различных отрезков палеогеновых отложений Армении, собраны и систематизированы также те геологические разрезы, которые были составлены другими исследователями палеогена Армении и сопредельных территорий. По разработанной нами методике (см. ниже) эти разрезы были сгруппированы на сводные. Сделана попытка произвести корреляцию сводных разрезов и составить региональную схему расчленения палеогена Армении и сопредельных территорий. Последующий этап наших работ должен был состоять в сопоставлении региональной стратиграфической схемы со стратотипом. Без увязки региональной стратиграфической схемы со стратотипом любая стратиграфическая работа остается незавершенной. Но здесь возникает основное препятствие — с каким стратотипом произвести эту корреляцию. С одной стороны, корреляция стратиграфической схемы Армянской ССР, как части юга СССР, должна проводиться с утвержденным палеогеновой комиссией МСК стратотипом (Крымский разрез) или парастратотипом (Кубанский разрез). С другой стороны, Армения, Малый Кавказ и прилегающие к ним области Тавро-Кавказской геосинклинальной системы в геологическом отношении являются неотъемлемыми частями Средиземноморской геосинклинали, и поэтому их геологическое строение тесно связано с этой областью. В связи с этим мы столкнулись с трудностью, заключающейся в несоответствии стратиграфических схем юга СССР и Средиземноморской провинции. Одновременно надо подчеркнуть, что Армения и Малый Кавказ в целом могут, при правильном научном подходе, оказаться местом увязки двух названных стратиграфических схем. Мы задавались целью, если не увязать эти две различные стратиграфические схемы, то по крайней мере, попытаться выявить пути решения этого важного вопроса.

Разбор биостратиграфического материала по палеогену средиземной провинции приводит к выводу о том, что ни один из имеющихся стратотипов не может претендовать на универсальность. Из сказанного вытекает, что классические методы расчленения и сопоставления толщ сталкиваются с большими трудностями. Мы считаем, что для объективного решения вопроса как относительно оптимального числа зон, так и четкой характеристики комплекса видов, разграничивающих зону, следует привлечь тот огромный фактический материал, который собран исследователями из аналогичных отложений областей развития палеогена. Такая задача может быть решена с применением методов математической статистики.

В связи с этим назрела необходимость создания межрегиональной универсальной стратиграфической шкалы. Абстракция в решении стратиграфических задач также не нова. Как справедливо указывает И. М. Ямниченко «... абстракция, к которой часто прибегают в процессе познания истины... помогает отвлечься от всего второстепенного в изучаемых предметах, процессах и явлениях и сосредоточить внимание на самом существенном». Создание моделей является основным направлением современных научных исследований.

Как было отмечено выше, в модель стратиграфической единицы должны включаться виды, имеющие наиболее широкое пространственное распространение и наименьшее вертикальное, иными словами виды, имеющие максимальную частоту встречаемости (P_l) в пространстве и наименьшую частоту встречаемости во времени (P_v). Значение P_l определяется отношением $\frac{m_1}{m}$, где m — количество испытываемых разрезов, а m_1 — число разрезов, в которых встречен данный вид. Значение P_v определяется отношением $\frac{a_1}{a}$, где a — количество стратиграфических подразделений палеогеновой системы, а a_1 — количество стратиграфических единиц, в которых обнаружен данный вид. Соотношение P_l и P_v определяет корреляционное значение вида. Исходя из основных положений биостратиграфии, P_l должен в уравнении занимать положение числителя, так как с увеличением P_l увеличивается корреляционное значение вида, а P_v в уравнении должно занимать положение знаменателя, так как с увеличением значения P_v уменьшается корреляционное значение вида, следовательно, уравнение приобретает следующий вид:

$$K_k = \frac{P_l}{P_v} = \frac{\frac{m_1}{m}}{\frac{a_1}{a}} = \frac{m_1 \cdot a}{m \cdot a_1}$$

где K_k — коэффициент корреляции данного вида.

В уравнении m может иметь значение от 1 до ∞ . Безусловно, из палеогеновых отложений всей планеты можно составить бесконечное количество

разрезов, распределение фауны в каждом из которых чем-то должно отличаться от другого. Но мы оперируем конкретными данными при значениях: $m_{\max}$ — это все известные и описанные разрезы палеогена, количество которых насчитывается тысячами; m_{reg} — это известные нам региональные стратотипические разрезы, которые насчитываются несколькими десятками; m_{opt} — это то количество региональных разрезов, лишь при наличии которых можно получить достоверные данные. Оптимальное количество разрезов определяется законами математической статистики. При наших подсчетах мы приняли за основу m_{opt} считая, что m_{opt} собирает в себе главные черты $m_{\max}$, а наиболее точные данные мы получили бы при $m_{\max}$, привлечение материала которого сопряжено с большими трудностями. Но формула А. Длина допускает возможность создания биостратиграфической модели по фауне нуммулитов $m \geq 20$, так как 20 региональных разрезов областей развития палеогена с достоверностью 70—80 % могут выявить закономерности распространения нуммулитов для всей области в целом.

Определение значения a в уравнении $P_B = \frac{a_1}{a}$ сопряжено с некоторыми трудностями. a — это количество стратиграфических подразделений, входящих в данную стратиграфическую единицу (система, отдел, подотдел, ярус, зона и др.). Стратиграфические подразделения должны отражать смену условий обитания организмов, являющихся следствием тех геолого-тектонических процессов, которые происходили в период накопления пород данного стратиграфического интервала. До сего времени нам не известны все те рубежи, при которых происходили более или менее значительные геолого-тектонические изменения, могущие привести к изменению среды обитания, предопределяющие изменения родового и видового состава органического мира. В биостратиграфии решается обратная задача. Изменчивостью родового или видового состава фаунистического или флористического комплексов определяется количество стратиграфических подразделений, составляющих данную стратиграфическую единицу. Вот здесь и возникают споры. Нередко трудно установить, что считать изменением фаунистического или флористического комплекса — появление нового вида, исчезновение старого, изменение количественного соотношения тех же видов или еще что-то другое. Таким образом и появляются разные схемы биостратиграфических расчленений одних и тех же отложений. Здесь же и возникают споры относительно определения ранга этих биостратиграфических единиц, и в связи с этим вопросы их соподчиненности.

Несмотря на расхождения во взглядах относительно деления палеогена по фауне нуммулитид, наиболее принятым является деление палеогена на десять биостратиграфических единиц, в том числе в палеоцене — одну, в нижнем эоцене — две, в среднем эоцене — три, в верхнем эоцене — три, в олигоцене — одну. Следовательно, значение a соответствует цифре 10.

Определяя значение $m = 20$ и $a = 10$, наша формула приобретает следующий вид:

$$K_K^{\text{opt}} = \frac{m_1 \cdot 10}{20 \cdot a_1}$$

Коэффициент корреляции вида при $m_1 = 1$ и $a_1 = 1$ равен $K_K = \frac{1 \cdot 10}{20 \cdot 1} = 0,5$.

Следовательно, виды, имеющие сугубо ограниченное распространение ($m_1 = 1$), если они даже приурочены лишь к одной стратиграфической единице ($a_1 = 1$), не имеют корреляционного значения. Они, имея узкое вертикальное распространение (тейльзону), не имеют своих аналогов в других испытываемых разрезах. Значение $K_K \leq 0,5$ для отдельных видов мы получим и при разных значениях m_1 и a (табл. 2.1), которые, по этим же соображениям, также не могут иметь корреляционного значения. По нашим статистическим подсчетам, из ста видов отряда нуммулитид, встреченных в палеогеновых отложениях южной ветви Тавро-Кавказской геосинклинальной системы, $K_K^{\text{max}} \geq 0,5$ обладает 29 видов. Остальные виды с $K_K^{\text{max}} \leq 0,5$, при настоящей стадии изученности танатосферы, корреляционного значения не имеют и не должны включаться в состав характерных комплексов биостратиграфических единиц межрегионального универсального стратотипа (модели). По субъективным соображениям, для четырех видов (*Nummulites anomalus* DE LA HARPE с $K_K^{\text{max}} = 0,4$, *N. garnieri* DE LA HARPE с $K_K^{\text{max}} = 0,3$, *N. praefabianii* с $K_K^{\text{max}} = 0,25$ и *N. uroniensis* с $K_K^{\text{max}} = 0,4$) сделаны исключения, учитывая их большую популярность как видов, имеющих большое стратиграфическое значение.

Аналогичные подсчеты нами проведены по установлению K_K и $\sum_{i=1}^n m$ для планктонных фораминифер. В качестве региональных разрезов принято то количество ($m = 20$) региональных разрезов, которое лежало в основе подсчета этих же показателей по нуммулитам. Так как посредством планктонных фораминифер расчленение палеогеновых отложений проводится по биостратиграфическим зонам с последующей их увязкой с подразделениями более высоких рангов, то здесь при определении значения a мы принимали наиболее распространенную схему расчленения палеогеновых отложений по фауне планктонных фораминифер, где значение $a = 14$. В отложениях указанных биостратиграфических зон встречаются более 90 видов планктонных фораминифер, среди которых, по нашим подсчетам, $K_K > 0,5$ обладает 48 видов. Для каждого вида установлены коэффициенты корреляции для тех биостратиграфических зон, в которых они встречаются. После определения K_K этих видов планктонных фораминифер были подсчитаны коэффициенты корреляции $\sum_{i=1}^n m$ четырнадцати биостратиграфических зон межрегионального универсального стратотипа (модели) (табл. 2.2). Значительная часть (44 %) видов планктонных фора-

минифер обладает $K_K^{\max} \geq 0,5 \leq 1,5$ при 93 % для нуммулитов с соответствующими $K_K^{\max}$. При $K_K^{\max} \geq 2 \leq 3$ их содержание соответственно составляет 56 % для планктонных фораминифер и 7 % для нуммулитов. Следовательно, планктонные фораминиферы не только представляют нам большее количество видов, имеющих корреляционное значение, но и по абсолютному значению K_K они выгодно отличаются от соответствующих значений нуммулитов.

Как известно, по одному виду и даже виду-индексу невозможно биостратиграфическое расчленение толщ, и поэтому для правильной возрастной датировки стратиграфических единиц прибегают к выделению комплекса видов, характеризующих данную стратиграфическую единицу. Следовательно, в модель каждой биостратиграфической единицы должны входить все виды, составляющие характерный комплекс. Поэтому формула приобретает следующий вид:

$$\frac{1}{n} \sum_{i=1}^n K_K = \frac{K_{K_1} + K_{K_2} + K_{K_3} + \dots + K_{K_n}}{n} \quad \text{при } n \geq 2,$$

где n число видов, входящих в модель. Значение $\frac{1}{n} \sum_{i=1}^n K_K$ может колебаться в значительных пределах в зависимости от значений K_K видов, входящих в характерный комплекс. Значение $\frac{1}{n} \sum_{i=1}^n K_K$ не может быть ниже 0,5 и обычно колеблется в пределах $\frac{1}{n} \sum_{i=1}^n K_K = 1 \pm 0,5$, теоретически возможный предел для планктонных фораминифер равен $\sum_{i=1}^n = 16,5$, для нуммулитов $\sum_{i=1}^n = 10$. Большое расхождение между теоретически возможным и практически существующим значением K_K и $\sum_{i=1}^n$, доходящее до

одного порядка, еще раз подтверждает отсутствие видов-индексов или комплексов, имеющих глобальное распространение и приуроченных лишь к одной биостратиграфической единице. Определяя значение m_i и a_i в пределах упомянутых 20 региональных разрезов Средиземноморской провинции и сопредельных территорий, мы получим следующие значения для каждого нуммулита и планктонной фораминиферы в разных биостратиграфических единицах (табл. 2.1). Анализ значений K_K для наиболее распространенных нуммулитов и планктонных фораминифер в палеогеновых отложениях южной ветви Тавро-Кавказской геосинклинальной системы показывает, что каждый вид встречается по крайней мере в двух-трех стратиграфических единицах, порой эта цифра доходит до 6—7. Следовательно, ни один вид не имеет четкой приуроченности лишь к одной стратиграфической единице. Отличаются они лишь по частоте встречаемости (P),

точнее значением коэффициента корреляции (K_K). Но значение K_K для одного и того же вида в разных стратиграфических единицах разное и колеблется от 0,2 до 2,2 для нуммулитов и до 3,0 для планктонных фораминифер. Безусловно, данный вид имеет корреляционное значение лишь для той стратиграфической единицы, в которой значение $K_K = \max_1(K_K^{\max})$. С учетом этого положения, в характерные комплексы межрегионального универсального стратотипа биостратиграфических единиц, кратко названные нами моделями, включены виды, имеющие $K_K = \max$ (табл. 2.2). Таким путем, выделяя ряд нуммулитов и планктонных фораминифер, встречающихся в Средиземноморской провинции и сопредельных территориях, нами созданы модели, по которым возможно произвести расчленение любого конкретного разреза палеогеновых отложений этих территорий.

Нами по указанному принципу произведено стратиграфическое расчленение свыше ста разрезов из палеогеновых отложений южной ветви Тавро-Кавказской геосинклинальной системы. В качестве примера приводится стратиграфическое расчленение Айюцзорского разреза, заснятого в районе с. Эртич бассейна р. Арпа юго-западной Армении. Этот разрез отличается большой полнотой, ограниченными перерывами в осадконакоплении и богато представлен остатками крупных и мелких фораминифер (табл. 2.3.). Анализ данных таблицы показывает, что из выделенных 47 пачек пород нуммулитовую фауну содержат 20. Следовательно, по возрастной принадлежности этих пачек можно произвести стратиграфическое расчленение разреза. Пачки 1—8 нуммулитовую фауну не содержат. Пачки 9—25 по комплексу нуммулитов принадлежат к нижней части среднего эоцена с $\sum_{a=2-8}^n = 1,10$, тогда как значение с $\sum_{i=1}^n M$ для отложений аналогичного возраста на межрегиональном универсальном стратотипе (модели) равно $\sum_{M=1}^{n=10} = 1,18$. Пачки пород 28—40 по комплексу нуммулитов принадлежат к средней части среднего эоцена с $\sum_{a=1-4}^{n=1-4} = 1,35$, при значении $\sum_{M=1}^{n=5} = 0,84$ модели. Пачки пород 41—43 по комплексу нуммулитов принадлежат к верхней части среднего эоцена с $\sum_{a=3-9}^{n=3-9} = 0,68$, при $\sum_{M=1}^{n=5} = 0,82$ модели. Пачка 44 принадлежит к нижней части верхнего эоцена с $\sum_{a=1}^{n=8} = 0,7,7$, при значении $\sum_{M=1}^{n=3} = 0,9$ модели. Пачка пород 45 принадлежит к средней части верхнего эоцена с $\sum_{a=1}^{n=5} = 0,77$, при значении $\sum_{M=1}^{n=4} = 0,7$ модели. Пачка пород 46 по возрасту принадлежит к верхней части верхнего эоцена с $\sum_{a=1}^{n=5} = 0,7$ при $\sum_{M=1}^{n=2} = 0,8$ модели. И, наконец, пачка пород 47 по

возрасту принадлежит к нижней и средней частям олигоцена с $\sum_{a=1}^{n=4} = 0,67$,
 при $\sum_{m=1}^{n=2} = 0,9$ модели.

Таким образом, сравнение нуммулитов из пачек, выделенных на конкретном Айондзорском разрезе, с комплексами нуммулитов межрегионального универсального стратотипа (модели) позволяет с большой достоверностью произвести определение возраста пород каждой пачки, сгруппировать их по возрастному принципу и установить их принадлежность к той или другой стратиграфической единице. В целом, границы отдельных биостратиграфических единиц отбиваются четко. Исключение составляет определение границы нижней и средней частей среднего эоцена, где переход постепенный.

Сравнение коэффициентов корреляции биостратиграфических единиц Айондзорского разреза $\left(\sum_{i=1}^n a\right)$ со значениями аналогичных стратиграфических единиц межрегионального универсального стратотипа показывает на наличие некоторых отклонений значений, доходящих $\sum_{i=1}^n -0,13 + 0,25$.

Такое расхождение вызвано тем, что комплекс видов, входящих в биостратиграфические единицы конкретного разреза, в определенной мере отличается от комплекса видов модели. Отличаются и значения K_k видов. Если K_k видов биостратиграфических единиц модели, как правило, имеют максимальное значение ($K_k^{\max}$), то в биостратиграфических единицах конкретного разреза K_k колеблется в значительных пределах, соответствующих K_k вида той биостратиграфической единицы, в которой они обнаружены. Поэтому чем большее количество видов входит в состав биостратиграфической единицы конкретного разреза (K_0), тем ниже значение $\sum_{i=1}^n a$

по сравнению с $\sum_{i=1}^n a$. Заслуживающими доверия (правомочными) можно считать те биостратиграфические единицы на конкретных разрезах, корреляции которых колеблются $\sum_{i=1}^n a \leq \pm 0,25$ по отношению к значению $\sum_{i=1}^n m$ межрегионального универсального стратотипа. Такое ограничение условное, но может обеспечить 75% точность, если учесть, что значение $\sum_{n=1}^n m$ большинства стратиграфических единиц модели тяготеет к единице.

Определение степени достоверности (правомочности) биостратиграфических единиц конкретных разрезов, содержащих меньшее количество видов по сравнению с таковыми межрегионального универсального стратотипа, но обладающие большим значением $\sum_{i=1}^n a$, также вызывает сомнение. Действительно, зачастую, при меньшем количестве видов коэффи-

коэффициент корреляции биостратиграфической единицы $\sum_{i=1}^n a$ конкретного разреза выше таковой на межрегиональном универсальном стратотипе. Это вызвано тем, что такие биостратиграфические единицы выделяются в основном по виду-индексу с максимальным значением K_k , резко завышающим коэффициент корреляции $\sum_{i=1}^n a$ выделенной биостратиграфической единицы в целом. Для подтверждения сказанного приведем один пример. *Nummulites laevigatus* (BRUG.) имеет $K_k^{\max} = 2,2$. Следовательно, при обнаружении этого вида в конкретном разрезе без соответствующего комплекса видов межрегионального универсального стратотипа для „зоны *N. laevigatus*“ или их ограниченного количества, значение $\sum_{i=1}^n a$ выделенной стратиграфической единицы может резко возрасти за счет K_k вида индекса, тяготея к 2,2, тогда как значение $\sum_{m=1}^n m$ отложений нижней части среднего эоцена модели составляет $\sum_{m=1}^{n=10} m = 1,18$. Следует учесть, что *N. laevigatus* (BRUG.) обладает $K_k = 2,2$ только в упомянутой выше биостратиграфической единице. Но этот вид встречается и в других биостратиграфических единицах со значением ниже ($K_k \geq 1,0 \leq 2,2$). Поэтому для определения степени достоверности (правомочности) выделенной стратиграфической единицы следует в комплексе иметь по меньшей мере столько видов данной таксономической единицы, сколько их в межрегиональном универсальном стратотипе. Но комплекс видов может значительно отличаться от комплекса характерных видов, входящих в межрегиональный универсальный стратотип.

Обобщая вышеизложенное, можно прийти к следующим выводам:

1. Выдвинутые в разное время стратотипы палеогена по мере накопления новой информации обнаруживают большие недостатки, что лишает их возможности лечь в основу биостратиграфического расчленения палеогеновых отложений различных регионов.

2. Наиболее удачная биостратиграфическая схема деления палеогеновых отложений разработана по фауне планктонных фораминифер (Е. К. Шуцкая, Н. Н. Субботина, Г. М. Болли и В. А. Крашенинников). Несмотря на ряд положительных сторон этой схемы, она не может применяться повсеместно, в частности для расчленения некоторых отложений неритовой и шельфовой зон, стратиграфия которых разработана в основном по остаткам бентонной фауны.

3. Разработка единого межрегионального универсального стратотипа (модели) по ископаемым остаткам различных групп, с применением методов математической статистики и вычислительной техники, по вышеизложенным причинам становится насущной задачей. Такую модель можно создать по предложенной нами методике, базирующейся на основных

правилах выделения руководящих видов, видов-индексов и характерных комплексов.

4. Применение статистического (вероятностного) метода при решении биостратиграфических задач позволяет вместо качественных критериев оценки биостратиграфического значения видов и комплексов фауны разработать количественные критерии их оценки; способствует выделению характерных комплексов объективными критериями; предоставляет возможность при расчленении и сопоставлении стратиграфических единиц довольствоваться ограниченным числом видов и др.

5. Разработанная методика, при выделении стратиграфических единиц, основной упор делает на наиболее распространенные виды. Виды, имеющие спорадическое или малое распространение и обнаруженные на единичных разрезах, т.е. на данном уровне установленной их танатосферы, для биостратиграфии не имеют решающего значения. Поэтому основной задачей палеонтологических исследований должно являться определение объема вида и пределы его вертикального и географического распространения — танатосферы. В этой связи возникает необходимость дальнейшего уточнения синонимии видов в целях установления сходства и различий топотипов с голотипами. Большое раздробление видов на мутации, варианты, топотипы и подвиды уменьшает биостратиграфическое значение вида. Следовательно, изучение стратиграфической последовательности отдельных видов ископаемых остатков органического мира и дальнейшая разработка их филогении поможет установлению реальных границ биозон, тейлзон и эпиболь видов, содействуя этим правильному определению их коэффициента корреляции.

6. Стратотипические, межрегиональные, региональные, типовые (опорные) и сводные разрезы тем больше будут служить основой для расчленения различных толщ, чем больше комплекс органических остатков, обособляющих их возраст, соответствует комплексу ископаемых остатков межрегионального универсального стратотипа (модели). В этом смысле некоторые типовые и региональные разрезы палеогеновых отложений Малого Кавказа могут служить основой для подтверждения правомерности разработанной методики без претензий на полное их соответствие с моделью. Стратиграфическая схема, заложенная нами в основу расчленения отложений Армении и сопредельных территорий южной ветви Тавро-Кавказской геосинклинальной системы, является некоторым подтверждением сказанного.

7. Предложенный нами количественный метод выделения биостратиграфических единиц (моделей) выдвигается впервые, и, безусловно, многие вопросы, связанные с ним, остаются нерешенными или носят эмпирический характер. Мы убеждены, что при дальнейшем его применении будет возрастать значение (разрешаемая способность) метода в решении некоторых задач биостратиграфии. По-видимому, для правильного определения танатосферы, установления рубежей максимального распространения, уточнения биостратиграфического значения (K_1) видов и определе-

ния соподчиненности выделенных биостратиграфических единиц, следует проявить системный подход с применением современных методов системного анализа, логические начала и некоторые элементы которого легли в основу предложенного нами метода.

К_к наиболее часто встречающихся нуммулитов и планктонных фораминифер палеогеновых отложений Южной ветви Тавро-Кавказской геосинклинальной системы

а) фауна нуммулитов

Таблица 2.1.

Наименование видов	p ₂ ^{1a}	p ₂ ^{1b}	p ₂ ^{2a}	p ₂ ^{2b}	p ₂ ^{3a}	p ₂ ^{3b}	p ₂ ^{3c}	p ₂ ^{3d}	p ₂ ^{3e}
1	2	3	4	5	6	7	8	9	10
1 <i>N. anomalus</i> DE LA HARPE			0,1	0,4	0,1	0,1	0,1		
2 <i>N. atacicus</i> LEYM.			0,7	1,3	1,2	1,0	0,1		
3 <i>N. aquitanicus</i> BEN.			0,1	0,5	0,35	0,17			
4 <i>N. biarricensis</i> D'ARCH.					0,7	0,5			
5 <i>N. bouillei</i> DE LA HARPE							0,2	0,6	0,6
6 <i>N. bolcensis</i> MUN.—CHALM.	0,25	1,0							0,3
7 <i>N. brongniarti</i> D'ARCH. et HAIME				0,25	0,4	0,5	0,4		
8 <i>N. burdigalensis</i> DE LA HARPE			0,5	0,7	0,9	0,6			
9 <i>N. chavannesi</i> DE LA HARPE						0,12	1,0	1,1	1,1
10 <i>N. distans</i> (DESH.)			0,1	1,5	1,3	1,0	0,1		
11 <i>N. fabianii</i> (PREV.)						0,1	0,83	0,91	0,18
12 <i>N. fabianii retiatius</i> ROV.									1,0
13 <i>N. gallensis</i> HAIME				0,4	0,4	0,5	0,17	0,08	0,08
14 <i>N. garnieri</i> DE LA HARPE					0,1	0,1	0,3	0,2	0,1
15 <i>N. globulus</i> LEYM.		0,7	0,8	0,5	0,4	0,13	0,13	0,13	
16 <i>N. gizehensis</i> (FORSK.)			0,5	1,0	1,3	0,1			
17 <i>N. incrassatus</i> DE LA HARPE			0,06	0,06	0,2	0,56	0,7	0,6	0,03
18 <i>N. intermedius</i> D'ARCH.						0,1	0,1	0,4	1,1
19 <i>N. irregularis</i> (DESH.)		0,9	1,37	1,12	1,12				
20 <i>N. laevigatus</i> (BRUG.)			2,2	1,7	1,2				
21 <i>N. millecaput</i> (BOUB.)			0,3	0,6	0,7	0,4	0,15	0,15	
22 <i>N. murchisoni</i> (RÜT.)		0,45	1,5	1,25	0,75				
23 <i>N. partschi</i> DE LA HARPE		0,9	1,1	1,1	0,9				
24 <i>N. perforatus</i> (MONTF.)			0,6	1,1	1,1	0,4	0,17		
25 <i>N. praefabianii</i> VAR. et MENN.						0,26	0,12	0,12	0,12
26 <i>N. praelucasi</i> DOUV.	0,17	1,17	0,33						
27 <i>N. planulatus</i> (LAM.)	0,17	2,2	0,17						
28 <i>N. subplanulatus</i> HANTK. et MAD.		1,0	0,17	0,17					
29 <i>N. striatus</i> (BRUG.)			0,13	0,3	0,6	0,8	0,5	0,5	0,1
30 <i>N. uroniensis</i> HAIME	0,12	0,1	0,4	0,4	0,35				
31 <i>N. variolarius</i> (LAM.)				0,2	0,2	0,7	0,8	0,5	
32 <i>N. vascus</i> JOLY et LEYM.						0,1	0,1	0,3	0,7
33 <i>A. exponens</i> (SOW.)		0,13	0,57	0,64	0,77	0,13	0,07	0,07	

		Наименование биостратиграфических зон													
Наименование ВИДОВ		зона <i>Globorotalia compressa</i>	зона <i>Acarinina inconstans</i>	зона <i>Globorotalia angulata</i>	зона <i>Acarinina subsphaerica</i>	зона <i>Acarinina acarinata</i>	зона <i>Globorotalia subbotinae</i>	зона <i>Globor. marginodentata</i>	зона <i>Globorotalia aragonensis</i>	зона <i>Acarinina crassaeformis</i>	зона <i>Acarinina rotundimarg.</i>	зона <i>Hantkenina alabamensis</i>	зона <i>Globigerina turkmenica</i>	зона <i>Globigapsis semiinvoluta</i>	зона <i>Globorot. cerroazulensis</i>
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	<i>Globorotalia aequa</i> CUSHM et RENZ				0,4	1,6	2,8	0,2							
2	<i>Globorotalia angulata</i> (WHITE)		0,4	3,0	1,4	1,0									
3	<i>Globorotalia aragonensis</i> NUTT.						0,2	0,6	2,6	0,6	0,1				
4	<i>Globorotalia centralis</i> CUSHM. et BERM.											0,2	0,2	0,4	0,5
5	<i>Globorotalia cerroazulensis</i> (COLE)												0,2	0,7	1,0
6	<i>Globorotalia compressa</i> PLUMM.	1,6	1,1	0,4	0,2	0,1									
7	<i>Globorotalia conicotruncata</i> (SUBB.)			1,6	0,4										
8	<i>Globorotalia ehrenbergi</i> BOLLI		0,1	2,5	1,5	0,2									
9	<i>Globorotalia formosa</i> BOLLI					0,2	2,0	0,8	0,8						
10	<i>Globorotalia marginodentata</i> SUBB.				0,1	0,2	1,4	0,7	0,2	0,2	0,1				
11	<i>Globorotalia pseudobulloides</i> PLUMM.	1,0	1,0	1,1	1,1	0,2	0,1	0,1	0,1						
12	<i>Globorotalia pseudomenardii</i> BOLLI			1,8	2,6	1,0	0,2								
13	<i>Globorotalia pusilla</i> BOLLI			2,5	1,2										
14	<i>Globorotalia subbotinae</i> MOR.					0,2	2,3	0,7	0,3	0,2					
15	<i>Globorotalia velascoensis</i> CUSHM.			0,4	1,5	1,6	1,2	0,2	0,2	0,2					
16	<i>Globigerina corpulenta</i> SUBB.									0,1	0,1	0,4	0,6	0,2	0,5
17	<i>Globigerina bulloides</i> D'ORB.									0,1	0,1	0,2	0,3	0,3	0,8
18	<i>Globigerina edita</i> SUBB.	0,5	0,2	0,2	0,2	0,1	0,1	0,1							

Таблица 2.1

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
19	<i>Globigerina eocaena</i> GÜMB.						0,5	0,1	0,2	0,2	0,2	0,5	0,7	0,7	0,1
20	<i>Globigerina frontosa</i> SUBB.									0,2	1,5	1,3	0,2	0,2	0,2
21	<i>Globigerina higginsi</i> (BOLLI)							0,2	0,2	0,8	0,3	0,2			
22	<i>Globigerina pileata</i> CHAL.			0,1	0,2	0,2	0,5	0,4	0,2						
23	<i>Globigerina pseudoecaena</i> SUBB.						0,4	0,4	0,6	0,6	0,5	0,5	0,2		
24	<i>Globigerina senni</i> (BECKM.)						0,1		0,8	1,6	0,1				
25	<i>Globigerina turkmenica</i> CHAL.											0,4	0,6	2,2	0,2
26	<i>Globigerina triloculinoides</i> PLUMM.	1,0	1,2	1,3	0,5	0,3	0,3	0,2	0,2	0,1					
27	<i>Globigerina trivialis</i> SUBB.	2,7	2,5	2,0											
28	<i>Globigerina varianta</i> SUBB.	0,6	0,9	1,2	0,5	0,4	0,4	0,1							
29	<i>Globigerinoides conglobatus</i> BRODY									0,1	0,1	0,1	0,9	0,2	1,5
30	<i>Globigerapsis semivoluta</i> (KEIJZER)													1,2	1,2
31	<i>Globigerapsis subconglobatus</i> BRODY								0,1	0,2	0,2	0,2	0,6	0,1	0,2
32	<i>Pseudohastigerina micra</i> COLE									1,5	1,5	1,5	2,0	0,5	0,2
33	<i>Truncorotaloides röhri</i> BRONN. et BERM.									0,2	0,4	0,4	0,4	0,4	0,4
34	<i>Truncorotaloides topilensis</i> CUSHM.									0,6	0,8	0,6			
35	<i>Acarinina acarinata</i> SUBB.			0,2	0,6	2,0	2,0								
36	<i>Acarinina broedermanni</i> (CUSHM. et BERM.)						0,8	0,6	0,6	0,4					
37	<i>Acarinina crassaeformis</i> GALL. et WISS.						0,1	0,1	1,0	2,8	1,4	0,8			
38	<i>Acarinina inconstans</i> SUBB.	0,2	2,2	0,7											
39	<i>Acarinina pentacamerata</i> (SUBB.)						0,3	0,6	1,8	0,5	0,5				
40	<i>Acarinina rotundimarginata</i> (SUBB.)						0,1	0,1	0,1	0,4	1,0	0,9	0,4		
41	<i>Acarinina subsphaerica</i> SUBB.			0,2	2,2	1,8	1,0								
42	<i>Acarinina tadjikistanensis</i> SCHUTZ			1,0	1,5	0,2									

Таблица 2.1

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
43	<i>Acarinina triplex</i> SUBB.				0,1		2,0	0,1	1,2	0,1					
44	<i>Acarinina uncinata</i> (BOLLI)	0,1	1,0	0,1	0,1	0,1	0,1								
45	<i>Hantkenina alabamensis</i> CUSHM.										0,1	0,4	0,9	0,5	0,1
46	<i>Hantkenina aragonensis</i> NUTT.							0,1	0,1	0,4	0,1	0,1	0,1		
47	<i>Hantkenina dumblei</i> VEINZ. et APPL.									0,1	0,1	0,6	0,4	0,2	0,2
48	<i>Hantkenina liebusi</i> SUBB.									0,1	0,1	0,6	0,4	0,2	0,2

Характерные комплексы фораминифер межрегионального универсального стратотипа (модели)

Таблица 2.2.

наименование видов	K _x	$\frac{1}{n} \sum_{i=1}^n K_{km}$
1	2	3
а) по фауне нуммулитов		
Нижний эоцен (верхняя часть)		
<i>N. bolcensis</i> MUN.—CHALM.	1,0	$\sum_M^{n=4} = 1,35$
<i>N. planulatus</i> (LAM.)	2,2	
<i>N. praelucasi</i> DOUV.	1,2	
<i>N. subplanulatus</i> (LAM.)	1,0	
Средний эоцен (нижняя часть)		
<i>N. anomalus</i> DE LA HARPE	0,4	$\sum_M^{n=10} = 1,11$
<i>N. atacicus</i> LEYM.	1,3	
<i>N. aquitanices</i> BEN.	0,5	
<i>N. distans</i> (DESH.)	1,5	
<i>N. globulus</i> LEYM.	0,8	
<i>N. laevigatus</i> (BRUG).	2,2	
<i>N. irregularis</i> (DESH.)	1,4	
<i>N. murchisoni</i> (RÜT.)	1,5	
<i>N. partschi</i> DE LA HARPE	1,1	
	0,4	
Средний эоцен (средняя часть)		
<i>N. biaricensis</i> D'ARCH	0,7	$\sum_M^{n=6} = 0,78$
<i>N. burdigalensis</i> DE LA HARPE	0,7	
<i>N. partschi</i> DE LA HARPE	1,1	
<i>N. uroniensis</i> HAIME	0,4	
<i>N. perforatus</i> (MONTF.)	1,1	
<i>Assilina exponens</i> (SOUV.)	0,7	

Таб. 2.2 — продолж.

1	2	3
Средний эоцен (верхняя часть)		
<i>N. brongniarti</i> D'ARCH. et HAIME	0,5	
<i>N. gallensis</i> HAIME	0,5	
<i>N. gizehensis</i> (FORSK.)	1,3	
<i>N. millicaput</i> BOUB.	0,7	
<i>N. perforatus</i> (MONTF.)	1,1	$\sum_M^{n=6} = 0,87$
Верхний эоцен (нижняя часть)		
<i>N. chavannesi</i> DE LA HARPE	1,1	
<i>N. fabianii</i> (PREV.)	0,9	
<i>N. striatus</i> (BRUG.)	0,8	$\sum_M^{n=3} = 0,93$
Верхний эоцен (средняя часть)		
<i>N. bouillei</i> DE LA HARPE	0,6	
<i>N. fabianii</i> (PREV.)	0,9	
<i>N. incrassatus</i> DE LA HARPE	0,7	
<i>N. variolarius</i> LAM.	0,8	$\sum_M^{n=4} = 0,70$
Верхний эоцен (верхняя часть)		
<i>N. bouillei</i> DE LA HARPE	0,6	
<i>N. fabianii retiatius</i> ROV.	1,0	$\sum_M^{n=2} = 0,80$
Нижний-средний (?) олигоцен		
<i>N. intermedius</i> D'ARCH	1,1	
<i>N. vasus</i> JELY et LEYM.	0,7	$\sum_M^{n=2} = 0,90$
б) по фауне планктонных фораминифер		
1. Зона <i>Globorotalia compressa</i>		
<i>Globorotalia compressa</i> PLUMM.	1,6	
<i>Globorotalia pseudobulloides</i> PLUMM.	1,0	
<i>Globigerina edita</i> SUBB.	0,5	
<i>Globigerina triloculinoides</i> PLUMM.	1,0	
<i>Globigerina trivialis</i> SUBB.	2,7	
<i>Globigerina varianta</i> SUBB.	0,6	$\sum_M^{n=6} = 1,23$
2. Зона <i>Acarinina inconstans</i>		
<i>Acarinina inconstans</i> SUBB.	2,2	
<i>Globorotalia compressa</i> PLUMM.	1,1	
<i>Globorotalia pseudobulloides</i> PLUMM.	1,0	
<i>Globigerina edita</i> SUBB.	0,5	
<i>Globigerina triloculinoides</i> PLUMM.	1,0	
<i>Globigerina trivialis</i> SUBB.	2,5	
<i>Globigerina varianta</i> SUBB.	0,6	
<i>Acarinina uncinata</i> BOLLI	1,0	$\sum_M^{n=8} = 1,24$
3. Зона <i>Globorotalia angulata</i>		
<i>Globorotalia angulata</i> WHITE	3,0	
<i>Globorotalia conicotruncata</i> (SUBB.)	1,6	
<i>Globorotalia pseudobulloides</i> PLUMM.	1,1	
<i>Globorotalia pseudomenardii</i> (BOLLI)	1,8	
<i>Globorotalia pusilla</i> BOLLI	2,5	

Таб. 2.2 — продолж.

1	2	3
<i>Globigerina ehrenbergi</i> BOLLI	2,5	$\sum_M^{n=11} = 1,70$
<i>Globigerina triloculinoidea</i> PLUMM.	1,3	
<i>Globigerina trivialis</i> SUBB.	2,0	
<i>Globigerina varianta</i> SUBB.	1,2	
<i>Acarinina inconstans</i> SUBB.	0,7	
<i>Acarinina tadjikistanensis</i> SCHUTZ	1,0	
4. Зона <i>Acarinina subsphaerica</i>		$\sum_M^{n=11} = 1,26$
<i>Globorotalia angulata</i> WHITE	1,4	
<i>Globorotalia pseudobulloidea</i> PLUMM.	1,1	
<i>Globorotalia pseudomenardii</i> BOLLI	2,6	
<i>Globorotalia pusilla</i> BOLLI	1,2	
<i>Globorotalia velascoensis</i> CUSHM.	1,5	
<i>Globigerina ehrenbergi</i> BOLLI	1,5	
<i>Globigerina varianta</i> SUBB.	0,5	
<i>Globigerina triloculinoidea</i> PLUMM.	0,5	
<i>Acarinina acarinata</i> SUBB.	0,6	
<i>Acarinina subsphaerica</i> SUBB.	2,2	
<i>Acarinina tadjikistanensis</i> SCHUTZ	1,5	
5. Зоны <i>Acarinina acarinata</i>		$\sum_M^{n=6} = 1,50$
<i>Globorotalia aequa</i> CUSHM. et BERM.	1,6	
<i>Globorotalia angulata</i> WHITE	1,0	
<i>Globorotalia pseudomenardii</i> BOLLI	1,0	
<i>Globorotalia velascoensis</i> CUSHM.	1,6	
<i>Acarinina acarinata</i> SUBB.	2,0	
<i>Acarinina subsphaerica</i> SUBB.	1,8	
6. Зоны <i>Globorotalia subbotinae</i>		$\sum_M^{n=11} = 1,32$
<i>Globorotalia aequa</i> CUSHM. et BERM.	2,8	
<i>Globorotalia formosa</i> BOLLI	2,0	
<i>Globorotalia marginodentata</i> SUBB.	1,9	
<i>Globorotalia subbotinae</i> MOR.	2,3	
<i>Globorotalia velascoensis</i> CUSHM.	1,2	
<i>Globigerina eocaena</i> GÜMB.	0,5	
<i>Globigerina pileata</i> CHAL.	0,5	
<i>Acarinina acarinata</i> SUBB.	2,0	
<i>Acarinina broedermani</i> CUSHM. et BERM.	0,8	
<i>Acarinina subsphaerica</i> SUBB.	1,0	
<i>Acarinina triplex</i> SUBB.	2,0	
7. Зоны <i>Globorotalia marginodentata</i>		$\sum_M^{n=5} = 0,70$
<i>Globorotalia broedermani</i> CUSHM. et BERM.	0,6	
<i>Globorotalia formosa</i> BOLLI	0,8	
<i>Globorotalia marginodentata</i> SUBB.	0,7	
<i>Globorotalia subbotinae</i> MOR.	0,7	
<i>Acarinina pentacamerata</i> SUBB.	0,8	
8. Зоны <i>Globorotalia aragonensis</i>		
<i>Globorotalia aragonensis</i> NUTT.	2,6	
<i>Globorotalia broedermani</i> CUSHM. et BERM.	0,2	
<i>Globorotalia formosa</i> BOLLI	0,8	
<i>Globigerina pseudoeocaena</i> SUBB.	0,6	
<i>Globigerina senni</i> (BECKM.)	0,8	
<i>Pseudohastigerina micra</i> COLE	0,2	

Таб. 2.2 — продолж.

1	2	3
<i>Acarinina crassaeformis</i> GALL. et WISS	1,0	
<i>Acarinina pentacamerata</i> SUBB.	1,8	
<i>Acarinina triplex</i> SUBB.	1,2	$n = 9$ $\sum_M = 1,12$
9. Зоны <i>Acarinina crassaeformis</i>		
<i>Globorotalia aragonensis</i> NUTT.	0,6	
<i>Globigerina higginsi</i> BOLLI	0,8	
<i>Globigerina pseudoeocaena</i> SUBB.	0,6	
<i>Globigerina senni</i> (BECKM.)	1,6	
<i>Truncorotaloides topilensis</i> CUSHM.	0,6	
<i>Pseudohastigerina micra</i> COLE	1,5	
<i>Acarinina crassaeformis</i> GALL. et WISS	2,8	
<i>Acarinina pentacamerata</i> SUBB.	0,5	$n = 8$ $\sum_M = 1,12$
10. Зоны <i>Acarinina rotundimarginata</i>		
<i>Globigerina frontosa</i> SUBB.	1,5	
<i>Globigerina pseudoeocaena</i> SUBB.	0,5	
<i>Truncorotaloides topilensis</i> CUSHM.	0,8	
<i>Pseudohastigerina micra</i> COLE	1,5	
<i>Acarinina pentacamerata</i> SUBB.	0,5	
<i>Acarinina rotundimarginata</i> SUBB.	1,0	
<i>Hantkenina dumblei</i> VEINZ. et APPL.	0,6	
<i>Hantkenina liebusi</i> SCHOKH.	0,6	$n = 8$ $\sum_M = 0,64$
11. Зоны <i>Hantkenina alabamensis</i>		
<i>Globigerina eocaena</i> GÜMB.	0,5	
<i>Globigerina frontosa</i> SUBB.	1,3	
<i>Globigerina pseudoeocaena</i> SUBB.	0,5	
<i>Globigerina turkmenica</i> CHUL.	0,6	
<i>Truncorotaloides topilensis</i> CUSHM.	0,6	
<i>Pseudohastigerina micra</i> COLE	1,5	
<i>Acarinina crassaeformis</i> GALL. et WISS.	0,8	
<i>Acarinina rotundimarginata</i> SUBB.	0,9	
<i>Hantkenina alabamensis</i> CUSHM.	0,9	$n = 9$ $\sum_M = 0,84$
12. Зоны <i>Globigerina turkmenica</i>		
<i>Globigerina bulloides</i> D'ORB.	0,6	
<i>Globigerina eocaena</i> GÜMB.	0,7	
<i>Globigerina turkmenica</i> CHAL.	2,2	
<i>Globigerina semiinvoluta</i> (KEIJZER)	0,5	
<i>Globigerapsis subconglobatus</i> BRADY	0,6	
<i>Pseudohastigerina micra</i> COLE	2,0	
<i>Hantkenina alabamensis</i> CUSHM.	0,5	$n = 7$ $\sum_M = 1,10$
13. Зоны <i>Globigerapsis semiinvoluta</i>		
<i>Globorotalia cerroazulensis</i> (COLE)	0,75	
<i>Globigerapsis semiinvoluta</i> CUSHM.	1,25	$n = 2$ $\sum_M = 1,0$
14. Зоны <i>Globorotalia cerroazulensis</i>		
<i>Globorotalia cerroazulensis</i> (COLE)	1,0	
<i>Globigerina bulloides</i> D'ORB.	0,5	
<i>Globigerina corpulenta</i> SUBB.	0,8	
<i>Globigerapsis semiinvoluta</i> (KEIJZER)	1,2	$n = 7$ $\sum_M = 0,86$
<i>Globigerinoides conglobatus</i> BRADY	1,5	
<i>Pseudohastigerina micra</i> COLE	0,5	
<i>Truncorotaloides centralis</i> CUSHM. et BERM.	0,5	

№№ слоев	Наименование видов	K _x видов по возрасту отложений								
		p ₂ ^{1a}	p ₂ ¹⁶	p ₂ ^{2a}	p ₂ ²⁶	p ₂ ^{3a}	p ₂ ^{3a}	p ₂ ³⁶	p ₂ ^{3a}	p ₃ ¹
1	2	3	4	5	6	7	8	9	10	11
1	Нуммулиты не обнаружены	—	—	—	—	—	—	—	—	—
2	Нуммулиты не обнаружены	—	—	—	—	—	—	—	—	—
3	Нуммулиты не обнаружены	—	—	—	—	—	—	—	—	—
4	<i>Nummulites exilis</i> DOUV.	K _x не подсчитаны								
5	Нуммулиты не обнаружены	—	—	—	—	—	—	—	—	—
6	Нуммулиты не обнаружены	—	—	—	—	—	—	—	—	—
7	Нуммулиты не обнаружены	—	—	—	—	—	—	—	—	—
8	Нуммулиты не обнаружены	—	—	—	—	—	—	—	—	—
9	<i>Nummulites atacicus</i> (LEYM.)	—	0,7	1,3	1,2	1,0	0,1	—	—	—
	<i>Nummulites globulus</i> LEM.	—	0,7	0,8	0,5	0,4	0,13	0,13	0,13	—
	<i>Nummulites laevigatus</i> (BRUG.)	—	—	2,2	1,7	1,2	—	—	—	—
	<i>Nummulites uroniensis</i> (HAIME)	0,02	0,1	0,4	0,4	0,3	—	—	—	—
		$\sum_{a=4}^M$								
		0,02	0,37	1,17	0,95	0,95	0,05	—	—	—
10	Нуммулиты не обнаружены	—	—	—	—	—	—	—	—	—
11	<i>Nummulites atacicus</i> LEYM.	—	0,7	1,3	1,2	1,0	0,1	—	—	—
	<i>Nummulites globulus</i> LEYM.	—	0,7	0,8	0,5	0,4	0,13	0,13	0,13	—
	<i>Nummulites laevigatus</i> (BRUG.)	—	—	2,2	1,7	1,2	—	—	—	—
	<i>Nummulites uroniensis</i> (HAIME)	0,02	0,1	0,4	0,4	0,3	—	—	—	—
	<i>Assilina exponens</i> (SOW.)	0,13	0,57	0,64	0,87	0,13	0,07	0,07	—	—
		$\sum_{a=5}^n$								
		—	0,32	1,06	0,88	0,76	0,07	—	—	—
12	Нуммулиты не обнаружены	—	—	—	—	—	—	—	—	—
13	Нуммулиты не обнаружены	—	—	—	—	—	—	—	—	—
14	Нуммулиты не обнаружены	—	—	—	—	—	—	—	—	—
15	Нуммулиты не обнаружены	—	—	—	—	—	—	—	—	—

Таб. 2.3 — продолж.

1	2	3	4	5	6	7	8	9	10	11
28	<i>Nummulites perforatus</i> (MONTF.) <i>Nummulites uroniensis</i> HAIME			0,6	1,1	1,1	0,4	0,17		
		0,02	0,1	0,4	0,4	0,3				
		$\sum_a^{n=2}$		0,5	0,75	0,7				
29	<i>Nummulites brongniarti</i> DE ARCH. et HAIME <i>Nummulites laevigatus</i> (BRUG.) <i>Nummulites perforatus</i> (MONTF.) <i>Nummulites uroniensis</i> HAIME <i>Assilina exponens</i> (SOW.)			0,2	0,4	0,5				
				2,2	1,7	1,2				
				0,6	1,1	1,1	0,4			
			0,02	1,0	0,4	0,4	0,3			
			0,13	0,5	0,6	0,7				
		$\sum_a^{n=5}$		0,12	0,72	0,84	0,78	0,35		
30	<i>Nummulites ataticus</i> LEYM. <i>Nummulites uroniensis</i> HAIME			0,7	1,3	1,2	1,0			
				0,02	0,1	0,4	0,4	0,3		
		$\sum_a^{M=2}$		0,36	0,7	0,8	0,7	0,15		
31	Нуммулиты не обнаружены									
32	<i>Nummulites ataticus</i> LEYM.		0,7	1,3	1,2	1,0				
33	Нуммулиты не обнаружены									
34	<i>Nummulites ataticus</i> LEYM. <i>Nummulites laevigatus</i> BRUG. <i>Assilina exponens</i> (SOW.)		0,7	1,3	1,2	1,0	—			
				2,2	1,7	1,2				
			0,13	0,5	0,6	0,7				
		$\sum_a^{n=3}$		0,4	1,3	1,2	0,96	—		
35	<i>Nummulites ataticus</i> LEYM. <i>Nummulites perforatus</i> (MONTF.) <i>Nummulites uroniensis</i> HAIME		0,7	1,3	1,2	1,0				
				0,6	1,1	1,1	0,4			
			0,02	0,1	0,4	0,4	0,3			
		$\sum_a^{n=3}$		0,36	0,67	0,9	0,8	0,35		
36	Нуммулиты не обнаружены									
37	Нуммулиты не обнаружены									

Таб. 2.3 — продолж.

1	2	3	4	5	6	7	8	9	10	11
38	<i>Nummulites globulus</i> LEYM.		0,7	0,8	0,5	0,4	0,13			
	<i>Nummulites lorioli</i> DE LA HARPE			K _x не подсчитаны						
	<i>Nummulites laevigatus</i> BRUG.			2,2	1,7	1,2				
	<i>Nummulites perforatus</i> (MONTF.)			0,6	1,1	1,1	0,4			
	<i>Nummulites uroniensis</i> HAIME			0,02	0,1	0,4	0,4	0,3		
		$\sum_a^{n=4}$	0,7	0,9	0,87	0,77	0,3	0,3		
39	<i>Nummulites lorioli</i>			K _x не подсчитаны						
	<i>Nummulites atacicus</i> LEYM.		0,7	1,3	1,2	1,0	0,1			
	<i>Nummulites anomalus</i> DE LA HARPE		0,1	1,3	0,1	0,1				
	<i>Nummulites brongniarti</i> DE ARCH. et HAIME			0,2	0,4	0,5	0,4			
	<i>Nummulites laevigatus</i> (BRUG.)			2,2	1,7	1,2				
	<i>Nummulites perforatus</i> (MONTF.)			0,6	1,1	1,1	0,4			
	<i>Nummulites uroniensis</i> HAIME		0,02	0,1	0,4	0,4	0,3			
	<i>Assiliana exponens</i> (SOW.)		0,13	0,5	0,6	0,7				
		$\sum_a^{n=7}$	0,23	0,88	0,80	0,71	0,27			
40	<i>Nummulites atacicus</i> LEYM.			1,3	1,2	1,0	1,0			
	<i>Nummulites anomalus</i> DE LA HARPE			1,3	0,1	0,1				
	<i>Nummulites brongniarti</i> DE ARCH. et HAIME			0,25	0,4	0,5	0,4			
	<i>Nummulites perforatus</i> (MONTF.)			0,6	1,1	1,1	0,4	0,2		
	<i>Nummulites uroniensis</i> HAIME		0,02	0,1	0,4	0,4	0,3			
	<i>Assilina exponens</i> (SOW.)			0,5	0,6	0,7				
		$\sum_a^{n=6}$		0,66	0,61	0,63	0,5			
41	<i>Nummulites anomalus</i> DE LA HARPE			1,3	0,1	0,1				
	<i>Nummulites brongniarti</i> DE ARCH. et HAIME			0,2	0,4	0,5	0,4			
	<i>Nummulites chavannesi</i> DE LA HARPE					0,1	1,0	1,0		
	<i>Nummulites gizehensis</i> (FORSK.)			0,5	1,0	1,3				

Таб. 2.3 — продолж.

1	2	3	4	5	6	7	8	9	10	11
	<i>Nummulites millecaput</i> BOUB.			0,3	0,5	0,7	0,4	0,15		
	<i>Nummulites paradas-</i> <i>chensis</i> BAGM.					1,0				
	<i>Assilina exponens</i> (SOW.)			0,5	0,6	0,7				
	<i>Nummulites puschi</i> D. ARCH.					0,25				
	<i>Nummulites perforatus</i> (MONTF.)			0,6	1,1	1,0	0,4	0,2		
		$\sum_a^{n=9}$		0,58	0,62	0,64	0,55	0,4		
42	<i>Nummulites anomalus</i> DE LA HARPE			1,3	0,1	0,1				
	<i>Nummulites brongniarti</i> DE ARCH. et HAIME			0,2	0,4	0,5	0,4			
	<i>Nummulites incrassatus</i> DE LA HARPE			0,06	0,06	0,2	0,5			
	<i>Nummulites gizehensis</i> (FORSK.)			0,5	1,0	1,3				
	<i>Nummulites perforatus</i> (MONTF.)			0,6	1,1	1,1	0,4	0,2		
	<i>Nummulites paradas-</i> <i>chensis</i> BAGM.					1,0				
	<i>Nummulites praefabianii</i> VAR. et MENN.					0,25	0,12	0,12		
	<i>Nummulites striatus</i> BRUG.			0,13	0,3	0,6	0,8	0,5		
	<i>Assilina exponens</i> (SOW.)			0,5	0,6	0,7				
		$\sum_a^{n=9}$		0,46	0,51	0,71	0,44	0,24		
43	<i>Nummulites incrassatus</i> DE LA HARPE			0,06	0,2	0,5	0,7	0,6		
	<i>Nummulites perforatus</i> (MONTF.)			0,6	1,1	1,1	0,4	0,17		
	<i>Nummulites striatus</i> (BRUG.)			0,3	0,6	0,8	0,5	0,5		
		$\sum_a^{n=3}$		0,33	0,63	0,8	0,52	0,42		
44	<i>Nummulites brongniarti</i> DE ARCH. et HAIME				0,4	0,5	0,4			
	<i>Nummulites chavannesi</i> DE LA HARPE					0,12	1,0	1,0	1,1	
	<i>Nummulites incrassatus</i> DE LA HARPE				0,06	0,2	0,5	0,7	0,6	
	<i>Nummulites fabianii</i> (PREV.)					0,08	0,8	0,9	0,7	
	<i>Nummulites millecaput</i> BOUB.				0,5	0,7	0,4			
	<i>Nummulites perforatus</i> (MONTF.)			0,6	1,1	1,1	0,4	0,17		

Таб. 2.3 — продолж.

1	2	3	4	5	6	7	8	9	10	11
	<i>Nummulites praefabianii</i> VAR. et MENN. <i>Nummulites striatus</i> (BRUG.)					0,25	0,12	0,12	0,12	0,12
					0,3	0,6	0,8			
		$\sum_a^{n=8}$			0,44	0,44	0,62	0,58	0,6	
45	<i>Nummulites chavannesi</i> DE LA HARPE <i>Nummulites incrassatus</i> DE LA HARPE <i>Nummulites fabianii</i> (PREV.) <i>Nummulites garnieri</i> DE LA HARPE <i>Nummulites striatus</i> (BRUG.)					0,12	1,0	1,0	1,1	
					0,06	0,2	0,5	0,7	0,6	
						0,08	0,8	0,9	0,7	
					0,1	0,1	0,3	0,3	0,1	
					0,3	0,6	0,8			
		$\sum_a^{n=5}$			0,17	0,22	0,68	0,72	0,6	
46	<i>Nummulites bouillei</i> DE LA HARPE <i>Nummulites incrassatus</i> DE LA HARPE <i>Nummulites intermedius</i> DE LA HARPE <i>Nummulites vascus</i> JOLY et LEYM. <i>Nummulites retiatius</i> ROV.						0,2	0,6	0,6	
					0,06	0,2	0,5	0,7	0,6	
							0,1	0,1	0,4	
									0,3	0,7
									1,0	
		$\sum_a^{n=6}$					0,23	0,46	0,54	
47	<i>Nummulites bouillei</i> DE LA HARPE <i>Nummulites incrassatus</i> DE LA HARPE <i>Nummulites intermedius</i> DE LA HARPE <i>Nummulites vascus</i> JOLY et LEYM.							0,2	0,6	0,6
								0,5	0,7	0,6
								0,1	0,1	0,4
								0,3	0,5	0,7
		$\sum_a^{n=4}$						0,36	0,47	0,57

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Korelácia stratigrafickej schémy členenia paleogénnych vrstiev

Resumé

V článku sa poukazuje na ťažkosti, ktoré vyplývajú z interregionálnej korelácie, najmä so stratotypmi. Autor sa prikláňa k názoru, že v paleogéne neexistuje žiadna „univerzálna“ skupina fosilných organizmov, na základe ktorej by bolo možné bezvýhradne stanoviť takú sukcesívnu biostratigrafickú schému, ktorá by mala celosvetovú platnosť. Na druhej strane však odlišuje stratigrafickú hierarchiu fosilných organizmov v paleogéne. Najväčší význam v súčasnej dobe pripisuje planktonickým mikrofosiliám (foraminifery, nanoplanktón), pričom zdôrazňuje komplexné zhodnotenie asociácií komparatívnou metódou a metódou matematickej štatistiky, ktorým venuje osobitnú pozornosť. Na základe asi 500 profilov z rozličných štruktúrno-formačných oblastí vyvodzuje všeobecné zákony, ktoré matematicky definuje. Výsledkom sú tzv. indexové taxóny s intraregionálnou platnosťou.

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Biostratigraphic research of Upper Jurassic limestones of the Čachtice Carpathians (locality Bzince pod Javorinou)

7 fotogr. tab. (XXXIII—XXXVI), slovenské resumé

Abstract: On the basis of radiolaria microfauna evaluation and partly also on the basis of the presence of tintinnoid organisms, the Middle to Upper Jurassic limestones of the quarry Bzince pod Javorinou (J. HANÁČEK et al.) were proved to be of Oxfordian to Tithonian age.

Introduction

In the course of a systematic research of radiolarian assemblages of Jurassic and Cretaceous age in the territory of the West Carpathians, samples of Dogger — Malm limestones were taken in the quarry Bzince pod Javorinou.

According to the results of geological research (J. HANÁČEK et al.), in the left part of the quarry there occur the Dachstein Limestones of Norian — Rhetian age. In the right part of the quarry, in the lower 1st bench, there occur Jurassic limestones i.e. folded Lias crinoid limestones in the marginal part of the right side and Dogger — Malm Limestones, underlying the Dachstein Limestones in the left side. Prevailing part of these limestones is regarded as Dogger, only the uppermost parts are assigned to the Malm. These Dogger — Malm limestones outcrop in the upper — 2nd bench, too.

Brief geological characteristics of the researched territory

The investigated formation is assigned to the Nedzov nappe, to the so-called Hrušové Group (J. HANÁČEK et al. 1982).

A complicated geological structure and inadequate number of outcrops make it difficult to find its relation to other West Carpathian units, as well as to those of the Alps.

The formation is supposed to be a continuation of the lithological — stratigraphic complex of the Ötscher nappe.

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The territory seems to have undergone intensive tectonics, especially in a fault — reverse fault zone 2 km wide. The units present in the area have a sliced structure with strips of various thickness and length. Some slices are perpendicular at one another or folded together. Such a structure can be seen in the researched locality, too.

Lithological characteristics and micropaleontological evaluation of the examined rocks

Samples of Dogger — Malm limestones were taken in the right side of the quarry (see Pl. XXX). To the right of this part, in the 1st bench there occur Lias crinoid limestones.

Samples of the following beds were taken from the bottom to the overlier:

1. light-coloured, fine grained limestones with red-brown layers of cherts. Microscopic examination proved that the matrix is micritic, with occurrences of silicified parts and a low content of clay minerals. Organic remains are represented by filaments, mainly calcified radiolarians, spines of sea urchins, fragments of bivalves, sponge spines, rarely crinoid segments, foraminifers and saccocoms. We failed to separate any radiolarian microfauna.

2. rusty-brown limestones with rusty-red cherty layers. Microscopically the matrix is micritic, with irregular silicified layers, organic remains are represented by sponge spines, radiolarians and filaments, often silicified.

Rich radiolarian microfauna assemblage contained following species (sample 25):

- Acanthocircus suboblongus* (YAO)
- Angulobracchia purisimaensis* (PESSAGNO)
- Andromeda podbielensis* (OŽVOLDOVÁ)
- Emiluvia oreia* BAUMGARTNER,
- Higumastra imbricata* (OŽVOLDOVÁ)
- Hsuum brevicostatum* (OŽVOLDOVÁ)
- Mirifusus guadalupensis* PESSAGNO
- Obesacapsula morroensis* PESSAGNO
- Paronaella kotura* BAUMGARTNER
- Tetraditryma pseudoplana* BAUMGARTNER
- Triactoma blakei* (PESSAGNO)
- Tritrabs hayi* (PESSAGNO)
- Tritrabs* sp. aff. *Tritrabs exotica* (PESSAGNO).

Oxfordian age is assumed according to the data of the latest biostratigraphic zoning of the Upper Jurassic (P. O. BAUMGARTNER, 1984), on the basis of the presence of the species *Higumastra imbricata* (OŽVOLDOVÁ) and *Emiluvia oreia* BAUMGARTNER.

3. rusty-red limestones interlaced with light-coloured calcite veinlets. Pseudocherts of a green — gray material can be seen in places. Microscopically the matrix is micritic with the filament microfacies. Silicified parts gradually pass

into calcareous ones. Of organic remains, ostracods, crinoid segments, globochetes and radiolarians are present.

Following species were discovered in the radiolarian assemblage (sample 3):

Acaeniotyle diaphorogona FOREMAN

Acanthocircus dicranacanthos (SQUINABOL)

Emiluvia chica FOREMAN,

Emiluvia hopsoni PESSAGNO,

Pantanellium gr. *lanceola* (PARONA)

Foremanella hipposidericus (FOREMAN)

Parvicingula boesii (PARONA)

Podobursa triacantha (FISCHLI)

Sethocapsa cetia FOREMAN

Podocapsa amphitrepta FOREMAN

Triactoma tithonianum RÜST

Tripocyclia trigonum RÜST.

Presence of the species *Sethocapsa cetia* FOREMAN and *Acanthocircus dicranacanthos* (SQUINABOL) and absence of the Uppermost Tithonian species indicate, according to P. O. BAUMGARTNER'S zoning (1984), the age of the assemblage: Upper Kimmeridgian to lower part of the Upper Tithonian.

4. rusty-red limestone with light-coloured calcite veinlets. Pseudocherts were not observed. Microscopically the matrix is micritic, with the filament microfacies. A low clay mineral content. Of organic remains, sponge spines, fragments of bivalves, more rarely calcified radiolarians and *Globochaete alpina* LOMBART, are present. We failed to separate any radiolarian microfauna.

5. gray limestone with a pink shade. In places visible lamination — alternation of gray and rusty-brown laminae.

Microscopically the matrix is micritic. Organic remains are represented by shells of foraminifers, radiolarians, ostracods, fragments of crinoid segments and lamellibranchiates. Saccocoms and uniserial bryozoa are abundant. Tintinnoid organisms are represented by the species *Crassicollaria intermedia* (DURAND DELGA), which is typical of the middle part of the Upper Tithonian, and *Tintinnopsella carpatica* (MURGEANU et FILIPESCU), whose occurrence begins in the lower part of the Upper Tithonian. We failed to separate any radiolarian microfauna.

In the left part of the upper — 2nd bench, samples of a red-brown, pseudocherty limestone were taken. The pseudocherts consisted of a gray-green material. Microscopically the matrix is micritic. Of organic remains, mainly calcified radiolarians, sponge spines, saccocoms, fragments of bivalves, filaments and rarely aptychuses were found. The separated radiolarian assemblage was very poor and it was impossible to assign it to an exact stratigraphic horizon (sample 10):

Crucella sp.

Paronaella sp.

Sethocapsa cf. *trachyostraca* FOREMAN

Sethocapsa leiostraca FOREMAN
Tritrabs sp.

Because of the presence of the forms *Paronaella* sp. and *Tritrabs* sp., whose species were not identified, but which had been already in the past found in Lower Cretaceous sediments (*Paronaella* sp. A. SCHAAF 1981, *Tritrabs* sp. — L. OŽVOLDOVÁ—M. SÝKORA 1984), these beds most probably represent the uppermost part of the Tithonian formation.

Conclusion

Biostratigraphic research of the investigated formation, based on radiolarian microfauna evaluation and partly also on tintinnoid organism occurrences, proved the stratigraphic span Oxfordian to Tithonian of the investigated formation.

Its Dogger age was not proved. In the end it can be stated, that in spite of abundant radiolarian microfauna in thin sections, its separation was often unsuccessful because of widespread calcification.

List of determined species

Acaeniotyle diaphorogona FOREMAN, 1973
Pl. XXXI, fig. 1

Stratigraphic range: Upper Kelloway-Hauterivian

Acanthocircus suboblongus (YAO, 1972)
Pl. XXXI, fig. 3

Stratigraphic range: Bathonian — Tithonian

Acanthocircus dicranacanthos (SQUINABOL, 1914)
Pl. XXXI, fig. 2

Stratigraphic range: Upper Kimmeridgian — Hauterivian

Andromeda podbielensis (OŽVOLDOVÁ, 1979)
Pl. XXXI, fig. 4, 5

Stratigraphic range: Kelloway — Lower Kimmeridgian

***Angulobracchia purisimaensis* (Pessagno, 1977)**

Pl. XXXI, fig. 6, 7

Stratigraphic range: Upper Kelloway — Lower Tithonian

***Emiluvia chica* Foreman, 1973**

Pl. XXXII, fig. 3, 4

Stratigraphic range: Upper Kelloway — Hauterivian

***Emiluvia hopsoni* Pessagno, 1977**

Pl. XXXII, fig. 5, 7

Stratigraphic range: Upper Kelloway — Lower Berriasian

***Emiluvia orea* Baumgartner, 1980**

Pl. XXXIII, fig. 1, 2

Stratigraphic range: Upper Oxfordian — Middle Tithonian

***Higumastra imbricata* (Ožvoldová, 1979)**

Pl. XXXII, fig. 6, 8

Stratigraphic range: Kelloway — Lower Oxfordian

***Hsuum brevicostatum* (Ožvoldová, 1975)**

Pl. XXXIII, fig. 3

Stratigraphic range: Kelloway — Middle Tithonian

***Mirifusus guadalupensis* Pessagno, 1977**

Pl. XXXIII, fig. 4, 5

Stratigraphic range: Kelloway — Lower Kimmeridgian

***Obesacapsula morroensis* Pessagno, 1977**

Pl. XXXIII, fig. 6, 7

Stratigraphic range: Upper Kimmeridgian — Upper Valanginian

***Pantanellium* ex gr. *lanceola* (PARONA, 1890)**

Pl. XXXIV, fig. 1

Stratigraphic range: Upper Jurassic — Albian

***Foremanella hipposidericus* (FOREMAN, 1975)**

Pl. XXXIV, fig. 2, 3

Stratigraphic range: Upper Oxfordian — Hauterivian

***Paronaella kotura* BAUMGARTNER, 1980**

Pl. XXXIV, fig. 7, 9

Stratigraphic range: Upper Kelloway — Lower Tithonian

***Parvicingula boesii* (PARONA, 1890)**

Pl. XXXIV, fig. 4

Stratigraphic range: Kelloway — Hauterivian

***Podobursa triacantha* (FISCHLI, 1916)**

Pl. XXXIV, fig. 5

Stratigraphic range: Kelloway — Lower Cretaceous

***Podocapsa amphitreptera* FOREMAN, 1973**

Pl. XXXIV, fig. 8

Stratigraphic range: Upper Oxfordian — Lower Berriasian

***Sethocapsa cetia* FOREMAN, 1973**

Pl. XXXIV, fig. 6

Stratigraphic range: Upper Kimmeridgian — Hauterivian

***Sethocapsa leiostraca* FOREMAN, 1973**

Pl. XXXV, fig. 2

Stratigraphic range: Kelloway — Hauterivian

***Tetraditryma pseudoplena* BAUMGARTNER, 1980**

Pl. XXXV, fig. 4

Stratigraphic range: Bathonian — Middle Tithonian

***Triactoma blakei* (PESSAGNO, 1977)**

Pl. XXXV, fig. 5

Stratigraphic range: Kelloway — Middle Tithonian

***Triactoma tithonianum* RÜST, 1885**

Pl. XXXV, fig. 6, 7

Stratigraphic range: Kelloway — Hauterivian

***Tripocyclia trigonum* RÜST, 1885**

Pl. XXXVI, fig. 5

Stratigraphic range: E. A. PESSAGNO (1977) gives range Upper Kimmeridgian — Lower Tithonian. In our region this species was reported from limestones ranked to the Lower Berriasian of the locality Šípkovský Háj in the Čachtické Karpaty Mts. (L. OŽVOLDOVÁ — M. SÝKORA 1984).

Note: Specimens from the locality Šípkovský Háj in the Čachtické Karpaty Mts. differed from the holotype by distinct splitting of the ridges on the spines and by the end of the spines. The spines do not lead into the tip but the ends of the ridges divert to sides. Specimens of our locality have the same features with the exception of the splitting, which is less distinct.

***Tritrabs hayi* (PESSAGNO, 1977)**

Pl. XXXVI, fig. 3

Stratigraphic range: Upper Bathonian — Lower Tithonian

***Sethocapsa cf. trachyostraca* FOREMAN, 1973**

Pl. XXXV, fig. 3

Note: Our specimens differed from *Sethocapsa trachyostraca* FOREMAN by greater number of the segments and substantially higher conical proximal part.

Stratigraphic range: Kelloway — Upper Cretaceous

***Tritrabs sp. aff. Tritrabs exotica* (PESSAGNO, 1977)**

Pl. XXXVI, fig. 2, 4

Note: Our specimens differed from *Tritrabs exotica* (PESSAGNO) by possessing polygonal meshwork of the central area and from *Tritrabs ewingi* (PESSAGNO) by shorter rays and greater width of the rays. Similar specimens occur in the radiolarians in the locality Keblie near Púchov and in the locality Červený Kameň near Podbiel (the Kelloway — Oxfordian), (L. OŽVOLDOVÁ 1975, 1979).

Crucella sp.

Pl. XXXII, fig. 1, 2

Note: A four — rayed test with strongly convex circular central area. The relics of the spines are at the end of the rays. Meshwork of the rays and central area is irregular. Nodes of meshwork are strongly developed.

Paronaella sp.

Pl. XXXV, fig. 1

Note: A three — rayed test with concentric arrangement of pore frames in central area. Meshwork of the rays is indistinct. Ray tips are poorly preserved, with linear meshwork. Nodes of meshwork are strongly developed. This specimen was reported and indetermined by A. SCHAAF in the Lower Cretaceous deposits (A. SCHAAF 1981, p. 436, pl. 8, fig. 7).

Tritrabs sp.

Pl. XXXVI, fig. 1

Note: Relatively small specimen composed of three short rays of unequal length. Ray tips are bulbously inflated with one central and six lateral spines. These specimens also occur in the radiolarian assemblage from Čachtické Karpaty Mts. limestones of the locality Šípkovský Háj. Assemblage is ranked to the Berriasian (L. OŽVOLDOVÁ — M. SÝKORA 1984).

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L. Ožvoldová — M. Peterčáková

Biostratigrafický výskum vrchnojurských vápencov z Čachtických Karpát (lok. Bzince pod Javorinou)

Resumé

V rámci systematického výskumu rádioláriových spoločenstiev jury a kriedy na území Západných Karpát boli odobraté vzorky z doger — malmských vápencov v kameňolome pri Bzinciach pod Javorinou, ktoré sú zaraďované k nedzovskému príkrovu, a to k tzv. hrušovskej skupine (J. HANÁČEK a kol. 1982). Ide o svetlé jemnozrné alebo hrdzavohnedé vápence s červenohnedými polohami rohovcov. Z organických zvyškov obsahovali prevažne rádiolárie a zriedkavo aj tintinoidné organizmy.

Na základe rozboru rádiolárievej mikrofauny a čiastočne aj na základe prítomnosti tintinoidných organizmov bol preukázaný vek oxford-titón.

Explanations to Plates XXX—XXXVI

Plate XXX

- 1 Right side of quarry. Marked places denote sections of sampling on the lower — 1st level and the upper 2nd level.
- 2 Detailed view of the wall from the 1st level.

Plate XXXI

- 1 *Acaeniotyle diaphorogona* FOREMAN, 5122, $\times 170$, No. 3.
- 2 *Acanthocircus dicranacanthos* (SQUINABOL), 3547, $\times 70$, No. 3.
- 3 *Acanthocircus suboblongus* (YAO), 5073, $\times 110$, No. 25.
- 4 *Andromeda podbielensis* (OŽVOLDOVÁ), 5092, $\times 130$, No. 25.
- 5 *Andromeda podbielensis* (OŽVOLDOVÁ), 5093, $\times 100$, No. 25.
- 6 *Angulobracchia purisimaensis* (PESSAGNO), 5107, $\times 150$, No. 25.
- 7 *Angulobracchia purisimaensis* (PESSAGNO), 2832, $\times 200$, No. 25.

Plate XXXII

- 1 *Crucella* sp. 2588, $\times 215$, No. 10.
- 2 *Crucella* sp. 2589, $\times 300$, No. 10.
- 3 *Emiluvia chica* FOREMAN, 3258, $\times 120$, No. 3.
- 4 *Emiluvia chica* FOREMAN, 3224, $\times 150$, No. 3.
- 5 *Emiluvia hopsoni* PESSAGNO, 3550, $\times 125$, No. 3.
- 6 *Higumastra imbricata* (OŽVOLDOVÁ), 5085, $\times 150$, No. 25.
- 7 *Emiluvia hopsoni* PESSAGNO, 3549, $\times 125$, No. 3.
- 8 *Higumastra imbricata* (OŽVOLDOVÁ), 5084, $\times 150$, No. 25.

Plate XXXIII

- 1 *Emiluvia orea* BAUMGARTNER, 5092, $\times 90$, No. 25.
- 2 *Emiluvia orea* BAUMGARTNER, 3065, $\times 70$, No. 25.
- 3 *Hsuum brevicostatum* (OŽVOLDOVÁ), 5065, $\times 280$, No. 25.
- 4 *Mirifusus guadalupensis* PESSAGNO, 5057, $\times 180$, No. 25.
- 5 *Mirifusus guadalupensis* PESSAGNO, 5098, $\times 210$, No. 25.
- 6 *Obesacapsula morroensis* PESSAGNO, 3073, $\times 75$, No. 25.
- 7 *Obesacapsula morroensis* PESSAGNO, 2789, $\times 75$, No. 25.

Plate XXXIV

- 1 *Pantanellium* gr. *lanceola* (PARONA), 5111, $\times 300$, No. 3.
- 2 *Foremanella hipposidericus* (FOREMAN), 0322, $\times 130$, No. 3.
- 3 *Foremanella hipposidericus* (FOREMAN), 3223, $\times 170$, No. 3.
- 4 *Parvicingula boesii* (PARONA), 5121, $\times 250$, No. 3.
- 5 *Podobursa triacantha* (FISCHLI), 3237, $\times 140$, No. 3.
- 6 *Sethocapsa cetia* FOREMAN, 3243, $\times 110$, No. 3.
- 7 *Paronaella kotura* BAUMGARTNER, 5067, $\times 120$, No. 25.
- 8 *Podocapsa amphitreptera* FOREMAN, 3215, $\times 120$, No. 3.
- 9 *Paronaella kotura* BAUMGARTNER, 5068, $\times 280$, No. 25.

Plate XXXV

- 1 *Paronaella* sp. 2620, $\times 150$, No. 10.
- 2 *Sethocapsa leiostraca* FOREMAN, 2616, $\times 150$, No. 10.
- 3 *Sethocapsa* cf. *trachyostraca* FOREMAN, 2602, $\times 100$, No. 10.
- 4 *Tetraditryma pseudoplana* BAUMGARTNER, 5108, $\times 160$, No. 25.
- 5 *Triactoma blakei* (PESSAGNO), 2809, $\times 150$, No. 25.
- 6 *Triactoma tithonianum* RÜST, 3553, $\times 80$, No. 3.
- 7 *Triactoma tithonianum* RÜST, 5119, $\times 100$, No. 3.

Plate XXXVI

- 1 *Tritrabs* sp. 2622, $\times 130$, No. 10.
- 2 *Tritrabs* sp. aff. *Tritrabs exotica* (PESSAGNO), 5078, $\times 120$, No. 25.
- 3 *Tritrabs hayi* PESSAGNO, 5061, $\times 150$, No. 25.
- 4 *Tritrabs* sp. aff. *Tritrabs exotica* (PESSAGNO), 5079, $\times 300$, No. 25.
- 5 *Tripocyclia trigonum* RÜST, 3218, $\times 140$, No. 3.

Miroslav Plička

Fossil Traces in the Inner-Carpathian Paleogene of Slovakia, Czechoslovakia

35 obr., 12 fotogr. tab. (XXXVII—XLVIII), české resumé

Abstract. The ichnofauna found in the Inner-Carpathian Paleogene of Slovakia and described herein consists of 28 ichnogenera and 42 ichnospecies. Two new ichnogenera and five new ichnospecies have been described within this assemblage. The ichnofossils are divided into ten informal morphological groups. The ichnofauna occurs in beds of uppermost Paleogene age. Besides fossil traces, two new "Body Fossil" genera have been determined.

Introduction

In the course of geological field work done in the region of the Carpathian flysch in Czechoslovakia I began, in 1960, to give attention to fossil traces and fossil animal remains. Samples from the whole Outer Carpathian flysch area in Czechoslovakia were occasionally collected and studied; several new findings



Fig. 1 — Delimited study area of the fossil traces in the Inner-Carpathian Paleogene of Slovakia.

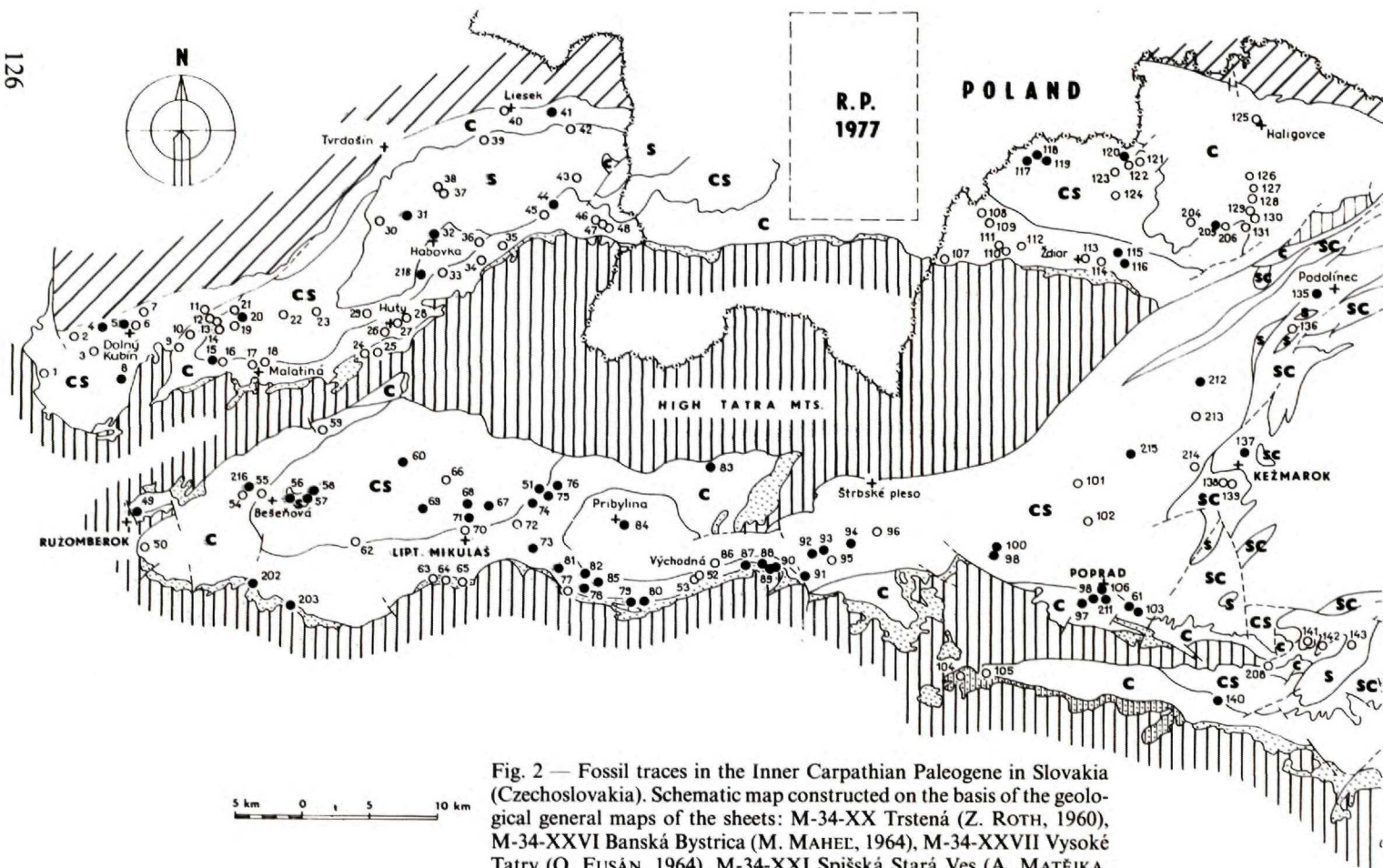
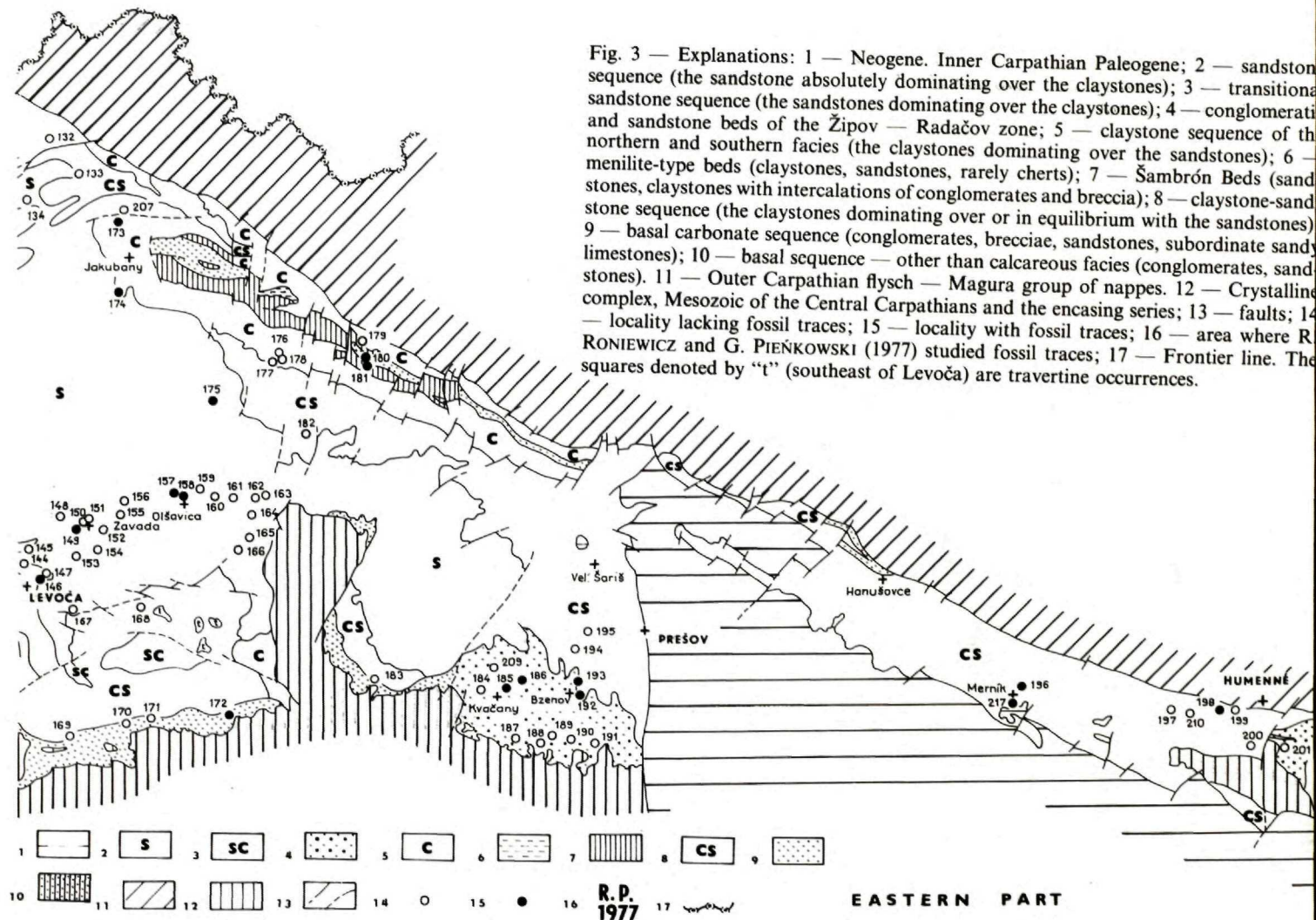


Fig. 2 — Fossil traces in the Inner Carpathian Paleogene in Slovakia (Czechoslovakia). Schematic map constructed on the basis of the geological general maps of the sheets: M-34-XX Trstená (Z. ROTH, 1960), M-34-XXVI Banská Bystrica (M. MAHEL, 1964), M-34-XXVII Vysoké Tatry (O. FUSÁN, 1964), M-34-XXI Spišská Stará Ves (A. MATĚJKA, 1960), and M-34-XXVIII Košice, M-34-XXII Zborov (A. MATĚJKA, 1964).



R. P.
1977

EASTERN PART

List of localities

Localities with the presence of fossil traces (P = presence of coalified remains); the localities in the area studied are numbered roughly from west to east: 4 — Dolný Kubín, 5 — Dolný Kubín, 6 — Dolný Kubín, 8 — Jasenov, 17 — Osádka, 20 — Pribiš, 28 — Huty, 31 — Oravský Biely Potok (P), 32 — Habovka, 41 — Vitanová, 43 — Vitanová, 4 — Vitanová, 49 — Likavka, 51 — Kanská, 56 — Bešeňová, 57 — Liptovská Mara, 58 — Liptovská Mara, 60 — Pavlova Ves, 61 — Poprad, 65 — Závažná Poruba, 67 — Liptovský Mikuláš, 68 — Smrečany, 69 — Liptovský Mikuláš, 71 — Vitališovce, 73 — Jamník, 74 — Liptovský Ondrej, 75 — Jakubovany, 78 — Dovalovo, 76 — Jakubovany, 79 — Hybe (P), 80 — Hybe, 81 — Liptovský Peter, 82 — Dovalovo, 83 — Podbanské (P), 84 — Liptovská Kokava, 85 — Dovalovo, 86 — Východná, 87 — Važec, 88 — Važec, 89 — Važec, 90 — Važec, 91 — Važec, 92 — Važec, 93 — Tatranská Štrba, 97 — Poprad, 98 — Batizovce, 99 — Poprad, 100 — Batizovce, 101 — Nová Lesná, 103 — Poprad, 106 — Poprad, 109 — Podspády, 115 — Bachledová, 116 — Bachledová, 117 — Osturňa, 118 — Osturňa, 119 — Osturňa, 120 — Veľká Franková, 135 — Podolíne (P), 137 — Kežmarok, 140 — Hrabušice, 141 — Dravce (P), 146 — Levoča (P), 149 — Závada, 157 — Olšavica, 158 — Olšavica, 172 — Spišské Vlachy, 173 — Nová Lubovňa, 174 — Jakubovany, 175 — Tichý Potok, 177 — Šarišské Dravce, 180 — Lipany, 181 — Lipany, 185 — Kvačany, 186 — Bajarov, 192 — Bzenov, 196 — Merník, 198 — Myslina, 203 — Liptovské Kľačany, 205 — Rešov, 211 — Poprad (P), 212 — Rakúsy, 215 — Tatranská Lomnica, 217 — Merník, 218 — Zuberec.

Localities With the absence of fossil traces (P = presence of coalified plant remains): 1 — Žaškov, 2 — Veličná, 3 — Oravská Poruba, 7 — Mokrad, 9 — Srňacie, 10 — Pucov, 11 — Pucov, 12 — Pucov, 13 — Pucov, 14 — Pucov, 15 — Pucov, 16 — Pucov, 18 — Malatiná, 19 — Pribiš, 21 — Pribiš, 22 — Chlebnice, 23 — Chlebnice, 24 — Huty, 25 — Huty, 26 — Huty, 27 — Huty, 29 — Malé Borové, 30 — Oravský Biely Potok, 33 — Zuberec, 35 — Liesek, 36 — Habovka, 37 — Zabiedovo, 38 — Zabiedovo, 39 — Breznica, 40 — Liesek, 42 — Vitanová, 45 — Vitanová, 46 — Vitanová, 47 — Vitanová, 48 — Vitanová, 50 — Ružomberok, 52 — Východná, 53 — Východná, 54 — Lisková, 55 — Liptovská Teplá, 59 — Prosiek, 62 — Galovany, 63 — Ifanovo, 64 — Ifanovo, 66 — Trstené, 70 — Liptovský Mikuláš, 72 — Beňadiková, 77 — Dovalovo, 95 — Tatranská Štrba, 96 — Tatranská Štrba, 102 — Veľ. Slavkov, 104 — Vikartovce, 105 — Vikartovce, 107 — Javorina, 108 — Podspády, 110 — Podspády, 111 — Podspády, 112 — Podspády, 113 — Ždiar, 114 — Ždiar, 121 — Veľká Franková, 122 — Veľká Franková, 123 — Veľká Franková, 124 — Malá Franková, 125 — Haligovce, 126 — Veľká Lesná, 127 — Veľká Lesná, 128 — Veľká Lesná, 129 — Veľká Lesná, 130 — Veľká Lesná, 131 — Veľká Lesná, 133 — Hniezdne, 134 — Nižné Ružbachy (P), 136 — Bušovce, 138 — Kežmarok, 139 — Kežmarok, 142 — Dravce, 143 — Levoča, 144 — Levoča, 145 — Levoča, 147 — Levoča, 148 — Levočská Dolina, 150 — Závada, 151 — Závada, 152 — Uloža, 153 — Uloža, 154 — Uloža, 155 — Vyšné Repaše, 156 — Nižné Repaše, 159 — Brutovce, 160 — Brutovce, 162 — Vyšný Slavkov, 163 — Vyšný Slavkov, 164 — Vyšný Slavkov, 165 — Vyšný Slavkov, 166 — Bijacovce, 167 — Spišský Hrhov, 168 — Jabložov, 169 — Markušovce, 170 — Chrást n. Hor., 171 — Vitkovice, 176 — Šarišské Dravce, 178 — Šarišské Dravce, 179 — Lipany, 182 — Vysoká, 183 — Vítaz, 184 — Žipov, 187 — Sedlice, 188 — Sedlice, 189 — Suchá Dolina, 190 — Lubovec, 191 — Lubovec, 194 — Prešov, 195 — Prešov, 197 — Topofovka, 199 — Humenné, 200 — Jasenov, 201 — Chlumec, 202 — Partizánská Ľupča, 204 — Rešov, 206 — Rešov, 207 — Nová Lubovňa, 208 — Spišský Štvrtok, 209 — Žipov, 210 — Topofovka, 213 — Stráne pod Tatrami, 214 — Malý Slavkov, 216 — Lisková.

have been published already (M. PLÍČKA 1968, 1970, 1974, 1978, 1981, 1982, 1983, 1984a, b, c). Occasional studies of fossil traces have been conducted, since 1976, also for the area of the Inner-Carpathian Paleogene in Slovakia. It was in this area that research work was preferentially terminated in 1985, since the Inner-Carpathian Paleogene area exhibits a simpler geological structure than the Outer Carpathian flysch which is a strongly tectonically disturbed region.

CS

Fig. 4

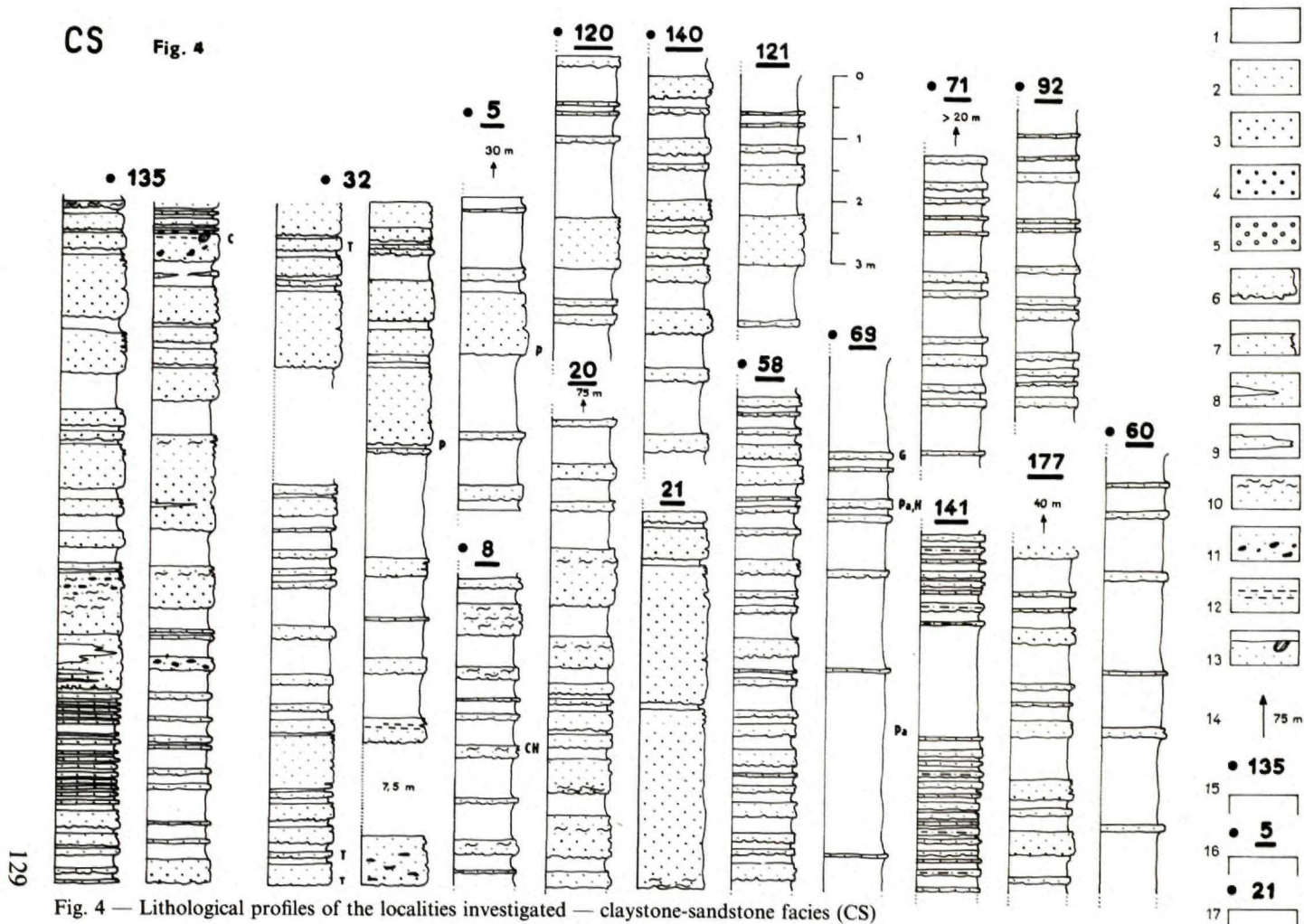


Fig. 4 — Lithological profiles of the localities investigated — claystone-sandstone facies (CS)

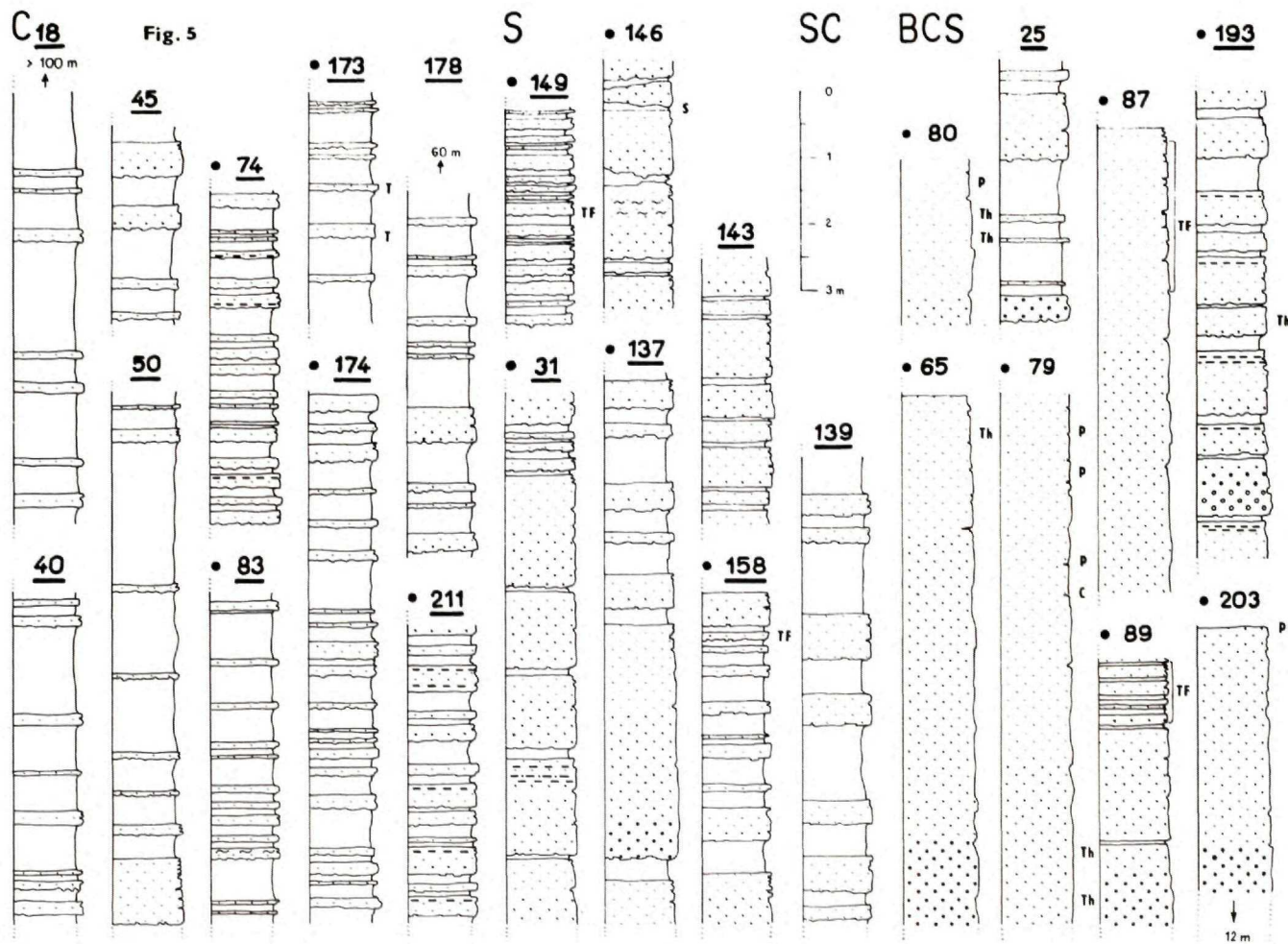


Fig. 5 — Lithological profiles of the localities investigated — claystone (C), sandstone (S), claystonesandstone (CS) facies and basal clastic sediments (BCS).

The investigations were conducted in a more systematic way within the research programme of the Central Geological Survey, Prague, Brno Office, since 1978, and within the programme of the D. Štúr Geological Survey, Bratislava, in the period from 1981 to 1982.

The samples taken in the area studied are deposited in the collections of the Moravian Museum in Brno. 218 sites were examined and about 500 samples of fossil traces were collected in total. The map of the region (Figs 2, 3) also includes the names of localities where no fossil traces were found. This is because rather wide sections were examined either in the vertical direction at some sites (e.g. Pribiš locality (19), about 70 m of the stratigraphic sequence) or along the strike of the beds (e.g. Malatiná locality (18), an about 1.5 km long section along excavations). Such was the case also elsewhere in the region under study.

The boundary of the area in question is set by the klippen belt on the northwest and northeast and by the frontier line with Poland on the north. The south boundary is formed by the Mesozoic rocks of the Low Tatra Mountains and by the Neogene deposits of east Slovakia. The area north of the High Tatra Mountains has been explored by the Polish geologists P. RONIEWICZ and G. PIENKOWSKI (1977) who, recently, have also studied fossil traces there. The geological general map sheets of Trstená (Z. ROTH 1960), Banská Bystrica (M. MAHEL' 1964), Vysoké Tatry (O. FUSÁN 1964), Spišská Stará Ves (A. MATĚJKA 1960), and Košice-Zborov (A. MATĚJKA 1964) have served as the geological basis. For a better understanding of the lithological development of the beds at the individual sites, the lithological sections were constructed in compliance with the detailed descriptions of the beds present at the given locality, or a schematical reconstruction of the profile according to the general features of the stratigraphic development was made (Figs 4, 5).

In an effort to facilitate the studies of fossil traces, of their mutual correlation or relations between the particular areas in various regions of the Carpathian flysch, I follow the group-wise classification of fossil traces made by M. KSIĄŻ-

Figs 4 and 5 — Explanations: 1 — claystones, 2 — fine-to medium grained sandstones, 3 — medium-to coarse grained sandstones; 4 — very coarse-grained to fine conglomeratic sandstone; 5 — conglomerate; 6 — sandstone with rough lower bedding plane; 7 — tabular fissility in the upper part of the sandstone; 8 — claystone wedging out in the sandstone; 9 — sandstone wedging out in the claystone; 10 — convolute bedding; 11 — claystone pebbles in sandstone; 12 — coalified plant remains in the sandstone; 13 — fossil trace of *Calixichnium häntzscheli* on the upper bedding plane of the sandstone; 14 — +75 m thickness — identical lithological development; 15 — locality number above the column indicating fossil traces, lithological profile basing on the detailed description of the beds at the locality; 16 — number of the locality with occurrence of fossil traces, profile schema, reconstruction basing on the written lithological characteristic of the exposure; 17 — locality number above the column indicating the absence of fossil traces; T — *Taprhelminthopsis*, Pa — *Paleodictyon*, H — *Helminthoida*, G — *Gordia*, S — *Scolicia*, P — *Planolites*, C — *Calixichnium*, Ch — *Chondrites*, Th — *Thalassinoides*, TF — Interval of the lithological profile with the presence of fossil traces.

KIEWICZ (1977) who investigated a wide area of the Carpathian flysch in Poland. In the general part of his book the author specifies, in a very detailed way, the data on the relations of fossil traces to lithology and to the depth of the area of sedimentation, data on their position in the deposited beds, etc. For this reason, I abstain from repeating these data and refer to the book quoted. In the sections "occurrence" of the paper presented, I do not report (with a few exceptions) the occurrence of the individual fossil traces on Polish territory or the presence of traces in Poland that also occur in the Outer Carpathian flysch of Czechoslovakia, because this would lead to an enormous increase in data. The list of fossil traces also includes, for completion, two problematic "Body fossil" traces, namely *Carpatia tubiformis* (M. PLIČKA 1986), determined earlier in the Outer Carpathian flysch of the Soláň Beds (Paleogene) of the Rača Unit of the Magura nappe group in Moravia, and *Eulalites obscurus* found in the Inner Carpathian Paleogene in Slovakia (M. PLIČKA 1982). *Zoophycos* sp. has also been found at three localities of the Inner Carpathian Paleogene and has been included into the list of fossil traces, even though I take a different view on its origin (M. PLIČKA 1968, 1969, 1970, 1974; W. HÄNTZSCHEL 1975).

Acknowledgements

In my examinations of fossil traces in the area of the Inner Carpathian Paleogene I closely linked up with the geological field work done by Dr. P. GROSS CSc. who had mapped in detail mainly the western part of the area (P. GROSS 1978, P. GROSS, E. KÖHLER et al. 1980). Dr. GROSS called my attention to localities rich in fossil traces facilitating thus my work. I wish to thank him for his assistance and interest in my studies. Thanks are also due to Dr. T. KORÁB CSc. for pointing to the occurrence of *Zoophycos* near the village of Lipany, to Dr. J. NEMČOK CSc. and Dr. T. ĎURKOVIČ CSc. (D. Štúr Geological Survey, Bratislava) for advice and professional assistance concerning the region of the Inner Carpathian Paleogene. I also wish to express my gratitude to Dr. R. MARSCHALKO DrSc. (Slovak Academy of Sciences, Bratislava) who furnished the latest sedimentological data on the region in question. Appreciation is expressed to Dr. H. PESLOVÁ CSc. and Dr. Z. NOVÁK CSc. (Central Geological Survey, Brno Branch) for their help in collecting samples from the Ružomberok — Východná region.

Descriptive part

For simplicity, the following abbreviations have been used in describing the occurrence of fossil traces: Inner-Carpathian Paleogene (ICP), claystone development (C), claystone-sandstone (CS), sandstone-claystone (SC), sandstone development (S), and basal clastic sediments (BCS).

I. Circular and elliptical structures

This group includes traces with round or elliptical outlines, hypichnial or epichnial. The following three ichnogenera have been included: *Punctumichnium* n. ichnogen., *Cumulusichnium* PLIČKA, and *Liptovichnium* n. ichnogen.

Ichnogenus *Punctumichnium* n. ichnogen.

Type specimen: *Punctumichnium parvum* n. ichnosp.

Denomination: In accordance with the puncture produced by the animal on the surface of the sea-bottom.

Diagnosis: Traces of circular, singularly of elliptical shape, of 1 to 6 mm size, forming a negative epirelief or a positive hyporelief.

Remark: No name has been used in the literature up to now for traces of this species; in general, they are denoted as "tubercules" (see M. KSIĄŻ-KIEWICZ 1977, text-fig. 28). However, studies of fossil traces in the Carpathian flysch of eastern Slovakia (M. PLIČKA 1982) or in the western part of the Outer Carpathian flysch (Godula Beds of the Silesian nappe) have shown that these small traces also can and must be distinguished. Two species were determined in compliance with their size. The different sizes of the punctures (puncture depth, surface diameter) can point to the fact that the punctures were produced by various marine animals (text-fig. 6).

***Punctumichnium parvum* n. ichnosp.**

Plate XXXVII, Fig. 7

Holotype: Sample No 140 (the Moravian Museum in Brno).

Type locality: Hrabušice (140), trench excavated for a gas pipeline south of the village.

Type level: Claystone development, Inner-Carpathian Paleogene, Eocene.

Denomination: In compliance with its small size, from the latin "parvus" = small.

Material: A great number of samples from the Inner-Carpathian Paleogene and the Outer-Carpathian flysch.

Diagnosis: The individual traces are of circular, singularly of elliptical shape, 1 to 3 mm in diameter, forming negative epireliefs or positive hyporeliefs.

Description: Circular, singularly elliptical traces, up to 3 mm wide, separated, frequently occurring in common with other fossil traces. The height of the negative epirelief or the positive hyporelief approximately corresponds to the diameter of the trace. The traces are frequently disturbed by traces of other nature, such as those of Planolites, etc.

Remark: The trace described is rather abundant in the sediments of the Inner and the Outer Carpathian flysch in Czechoslovakia. The traces are particularly clearly developed in the Godula and Istebna Beds of the Silesian nappe (Cretaceous) in the Beskides where I could study them in detail and collect a great number of samples.

Sediment: The holotype occurs on the lower surface of greengrey, fine-grained, slightly fine-micaceous, tabularly fissile sandstone; sample thickness 1.5 to 1.7 mm. It is slightly curly bedded at the upper bedding plane.

Association: *Planolites* sp., *Taprhelminthopsis auricularis*.

Origin: The punctures were produced by marine animals moving on the sea-bottom or in its proximity (small fishes, punctures produced by echinoid spines, etc.).

Occurrence: ICP (Paleogene), Outer Carpathian flysch (Cretaceous, Paleogene).

***Punctumichnium medium* n. ichnosp.**

Plate XXXVII, Fig. 1

Holotype: Sample No 58/12, Moravian Museum in Brno.

Type locality: Liptovská Mara water storage basin (58), slope and excavations northwest of the inundated church.

Type level: Claystone-sandstone development of the Inner-Carpathian Paleogene, Eocene.

Denomination: In compliance with the size, from the latin "medius" = medium.

Material: A number of samples from the area of the Inner Carpathian Paleogene and the Outer Carpathian flysch.

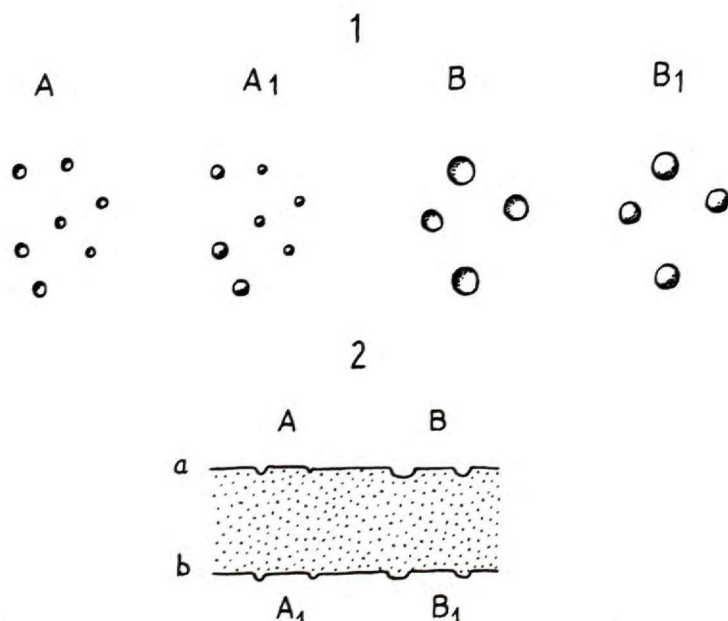


Fig. 6 — Schematic drawing of the new fossil trace *Punctumichnium* n. ichnogen. *Punctumichnium parvum* n. ichnosp. 1 — view on the upper (A) and the lower (B) bedding planes; cross section of the bed: 2Aa — upper bedding plane, 2Ab lower bedding plane. *Punctumichnium medium* n. ichnosp. View on the upper (B) and the lower (B₁) bedding planes; cross section of the bed: 2Ba — upper bedding plane, 2Bb — lower bedding plane.

Diagnosis: Single traces of circular, sparsely elliptical shape, 4 to 6 mm in diameter, forming negative epireliefs or positive hyporeliefs.

Description: Circular, singly elliptical traces, 4 to 6 mm in diameter, frequently associated with other fossil traces. The height of the epi- or the hyporelief is 1 to 3 mm. The traces are often disturbed by traces of other nature.

Remark: The trace described is rather abundant in the sediments of the Carpathian flysch, particularly in the Godula Beds of the Silesian nappe (Cretaceous).

Sediment: Green-grey, fine-grained, fine-micaceous, calcareous sandstone of lamellar fissility, 1 to 2.5 cm thick.

Association: The holotype sample displays traces of *Planolites* sp. and *Belorhapha zickzack* (HEER, 1876). The following traces were also found at the site: *Popradichnium minutum*, *Taprhelminthopsis auricularis*, and *Gordia* sp.

Origin: The punctures were produced by marine animals moving on the sea-bottom or in its close vicinity.

Occurrence: ICP (Paleogene), Outer Carpathian flysch (Cretaceous — Paleogene).

Ichnogenus *Cumulusichnium* PLIČKA, 1984

Type specimen: *Cumulusichnium incertum* PLIČKA, 1984

Remark: Accumulated irregular arched forms with fine internal hill-like dissection (positive hyporelief). Depressions in the clayey surface of the sea-bottom resulted most likely from the activity of sea organisms moving on the floor. The arched arrangement of the traces was most likely produced by the activity of the animal's extremities in a close circle around the place of its temporary dwelling.

***Cumulusichnium incertum* PLIČKA, 1984**

Plate XXXVII, Fig. 8

Material: A sample of laminated sandstone, of 45 × 20 × 3 cm size, Liptovský Ondrej locality (74), sample No 74/9.

Description: Distinct accumulated projections with fine hill-like inner dissection are present on the entire undersurface of the sandstone. They are arranged roughly arc-like. The sizes of the projections range from 0.5 to 6 mm, the arc diameter including projection is 3 to 4 cm. Outside the arcs the projections are isolated, arranged irregularly.

Remark: Liptovský Ondrej locality (74), outcrops in the village creek. The locality is extremely rich in fossil traces. The conditions for the development and the activity of sea organisms on the sea-bottom were extremely favourable in the area comprising the fossil traces under study, as indicated by large accumulations and varied assemblages. They are indicative of shallow-water environment.

Sediment: Green-grey, very fine-grained, calcareous, partly micaceous, slightly convolute sandstone. The lower surface with the new-described traces is light greyish.

Association: *Belorhaphé zickzack*, *Popradichnium erraticum*, *Agrichnium incompositum*, *Planolites* sp., *Godulaichnium tenue*.

Origin: The depressions in the clayey surface of the seabottom resulted most likely from the activity of sea organisms moving on the floor. The arc-like arrangement of the traces resulted most likely from the activity of the animal's extremities in a close circle around its temporary dwelling place.

Occurrence: Eocene, ICP in the sandstone to claystone-sandstone facies; Liptovský Ondrej locality (74).

Ichnogenus *Liptovichnium* n. ichnogen.

Type specimen: *Liptovichnium dubium* n. ichnosp.

Denomination: In compliance with the place of occurrence — the Liptov area near the High Tatra Mountains in Central Slovakia.

Diagnosis: Projections at the lower surface of the sandstone, 3 to 20 mm wide, 0.5 to 3 mm high (positive hyporelief) with pronounced pits (negative hyporelief), 0.5 to 2 mm in diameter and 0.25 to 1 mm deep. About 5 pits are situated near the smaller projections (text-fig. 7).

***Liptovichnium dubium* n. ichnosp.**

Plate XXXVII, Figs 2, 3, 4, 5, 6.

Holotype: Sample No 69/24, in the Moravian Museum, Brno.

Type locality: Liptovský Mikuláš (69), brickworks.

Type level: CS, ICP, (Eocene).

Denomination: In compliance with its problematic origin, from the Latin "dubius" — doubtful, questionable.

Material: 6 samples.

Diagnosis: Projections on the lower surface of the sandstone (positive hyporelief), 3 to 20 mm wide, 0.5 to 3 mm high, with pronounced pits (negative hyporelief), 0.5 to 2 mm in diameter and 0.25 to 1 mm deep. About 5 pits occur near the smaller projections. The margin of the pit is mostly very clear-cut.

Description: Projections with pits of nearly circular or elliptical shape forming a positive hyporelief can be found on fragmental fine-grained sandstones. They occur sporadically or in groups (sample No 69/24, for instance, exhibits 5 projections on a surface of 8 × 3 cm). The pits are very close to each other (see samples 69/24 and 69/17). Projections inclined to the bedding plane at an angle of 30 to 50° have also been found (e.g. samples No 69/24 and 69/58).

Sample No 69/3 displays a less pronounced elevation of about 2 cm in diameter with a "rough" surface that differs from the lower surface by its appearance. The pits are irregularly distributed, but clearly cut, with smooth inside surfaces.

Remark: In their appearance, the minor projections resemble the trace of *Punctumichnium medium* n. sp., but they differ from the latter by the presence of pits that are of the nature of a negative hyporelief.

Sediment: Greenish-grey, yellowish, fine-grained, calcareous, fine-micaeous, platy laminated sandstone.

Association: *Megagraption tenue*, *Paleodictyon intermedium*, *P. minimum*, *P. minutissimum*, *P. strozzii*, *Saportia striata*, *Planolites* sp., *Gordia molassica*, *Subphyllochora laevis*, *Helminthoida miocenica*, *Popradichnium minutum*, *Punctuichnium parvum*, *P. medium*, *Protopaleodictyon submontanum*, *Megagraption irregulare*, *M. tenue*.

Origin: The projections at the lower sandstone surface may have been produced by marine animals that, in their search for food, force their bodies partly into the clayey sea-bottom. As the projections display small pits at their ends or at a larger surface (for instance, with flat projections, see sample No 69/3), the trace could have been produced by a denticulate suction apparatus. Marine leeches (*Hirudinea*) or marine fishes such as the marine lamprey (*Petromyzon marinus*), or the Atlantic hagfish (*Myxine glutinosa*) could be taken into consideration. An undistinct projection of a size larger than that of sample

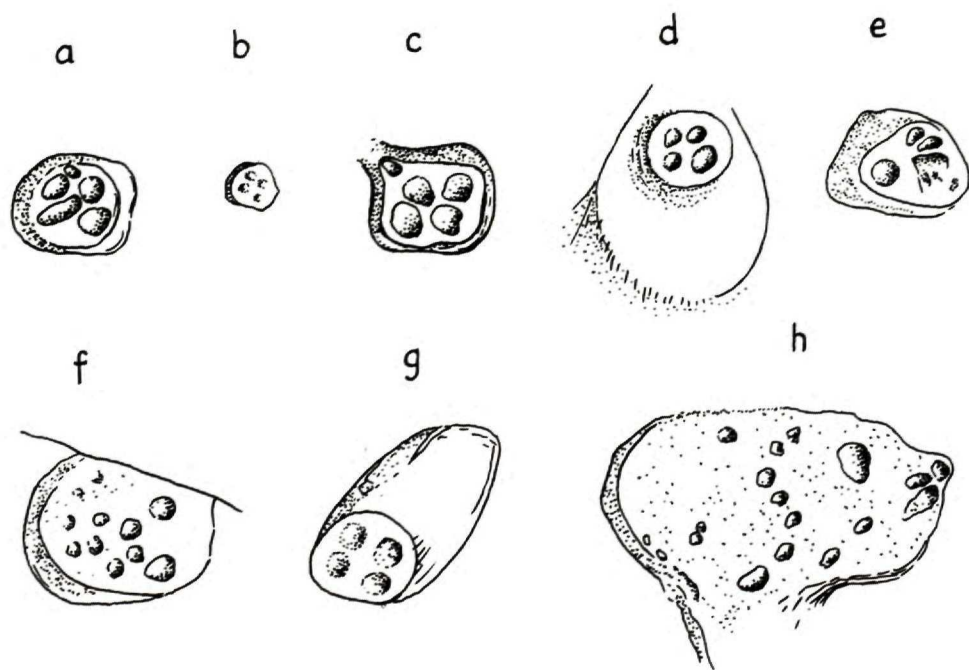


Fig. 7 — *Liptovichnium dubium* n. ichnogen. n. ichnosp., Liptovský Mikuláš locality, claystone-sandstone facies of the Inner Carpathian Paleogene (Eocene). Samples from this locality: a, b — 69/24, c — 69/47, d — 69/29, e — 69/47, f, h — 69/3, g — 69/58.

No 69/3 could have been produced only by the contact with a suction organ on a larger surface.

Occurrence: CS, ICP, (Eocene), Liptovský Mikuláš locality (69).

II. Simple structures

This group is well represented in the Inner-Carpathian Paleogene. It consists of cylindrical, mostly straight, more rarely slightly curved burrows, with no or few lateral branches. The surface is either sculptured or smooth. Sculptural elements, such as ribbing or striation, may be purely superficial, or reflecting an internal segmentation of the burrow. Most of the types are long burrows, with no detectable terminations, but some are short with one end well defined. The classification into ichnogenera is based on the external sculpture. In the area studied, this group includes six ichnogenera: *Planolites* NICHOLSON, *Gyrichnites* WHITEAVES, *Arenicolites* SALTER, *Popradichnium* PLIČKA, *Agrichnium* PFEIFFER, *Merostomichnites* PACKARD.

Ichnogenus *Planolites* NICHOLSON, 1873

Type specimen: *Planolites vulgaris* NICHOLSON and HINDE (W. HÄNTZSCHEL, 1975).

Remark: As reported by M. KSIĄŻKIEWICZ (1977), this is a very poorly defined ichnogenus, as noted by C. K. CHAMBERLAIN (1971), and its "type species" has not been illustrated. The most detailed description of a trace assigned to *Planolites* is given by H. E. REINECK (1955). His *P. rugulosus* is a cylindrical body, about 1 cm in diameter, with its surface marked by annulations and longitudinal striae. The genus *Planolites* closely resembles, by its shape, the genus *Palaeophycus* HALL, 1847, and is difficult to be distinguished from the latter. It is believed, mostly, that the burrow filling of *Palaeophycus* did not pass through the animal's intestines.

The fossil trace consists of nearly cylindrical burrows produced by worms, up to 15 mm in diameter, that are straight or slightly curved. They are horizontal to subhorizontal or diagonal to the bedding plane in their courses. The courses and directions of the burrows are irregular, with crossings of the burrows (W. HÄNTZSCHEL 1977). In view of some confusion in the use of the generic name of this trace, I think that the generic name should better not be used for the time being.

Planolites sp.

Plate XXXVII, Figs 9, 10, 11; Pl. XXXVIII, Figs 1—5; text-fig. 8, 9

Material: 108 samples

Description: Burrows of tubular shape up to 12 mm wide (sample

No 140/2, Hrabušice locality (140) mostly 6 to 8 mm in diameter. The burrow courses in the sediments are mostly parallel to bedding, but they also are oblique or nearly perpendicular to the bedding surface. The course of the trace is mostly parallel to the lower bedding surface (positive hyporelief) or nearly follows the bedding within the rock. In this case, the course of the initially cylindrical trace is somewhat compressed. Sample No 79/1 (Hybe locality) displays a cylindrical trace of 9×5 mm size (the smaller dimension representing the vertical direction). Singularly, the cylindrical trace exhibits segmentation, as, for instance, at Liptovská Mara site (58) where 6 segments per 5 mm of the length could be distinguished for a part of the cylindrical trace. More likely, this seems to be a trace of the genus *Gyrichnites* WHITEAVES, 1883. Difficulties as to the terminology of this trace have already been reported (M. PLÍČKA 1978).

It has been found for a great number of samples that the fossil trace of *Planolites*, appearing as a positive hyporelief at the lower surface of the sandstone, suddenly turns upwards into the sandstone at a certain distance. This fact could be noted for 11 samples (localities No 8, 44, 60, 69, 73, 75, 103, 146, 158, 215). The *Planolites* trace in sample No 196/1 (Merník locality) is also of interest because it runs parallel to the lower bedding surface at about 0.5 cm distance.

Remark: When evaluating the origin of these cylindrical traces that tunnel through the sediments to considerable distance and in all directions, we note a striking agreement with recent continental annelid worms such as *Lumbricus terrestris* which the marine annelid worms closely resemble by the manner of their locomotion (M. PLÍČKA 1978).

A conspicuous feature of the *Planolites* trace is its frequent winding upwards into the sediment, as has been mentioned above. This can be explained by supposing that the marine worm that moved on the clayey surface of the sea-bottom, producing there a trace of the negative epirelief type, was buried under suddenly falling-in, rapidly depositing sandy material. The worm tried to work its way upwards from the place where it had been buried (text-fig. 9A). At Hrabušice (140) and Jakubovany (174) localities, the depression produced by the worm trace was filled with coarse sandy material that was preserved and graded there during the depositional process (text-fig. 9B). The studies of *Planolites* traces from the area of the Outer Carpathian flysch supplied much sedimentological information from the Godula Beds of the Silesian nappe (Cretaceous) at Staré Hamry-1A pilot borehole (M. PLÍČKA 1978) and, therefore, I refer the reader to this paper.

When compared to other fossil traces determined in the Inner Carpathian Paleogene, the *Planolites* trail is one of the most widely distributed fossil traces, much like it is also in the Outer Carpathian flysch. It occurs in all of the facies of the Inner Carpathian Paleogene, including the basal clastic sediments, where *Planolites* trails were also found in very coarse sedimentary material. At Liptovské Kľačany locality (203), for instance, a burrow of *Planolites* sp. 1 cm in diameter was determined in the relatively very coarse-grained sediment with grain sizes up to 5 mm. Where the worm had moved, the grains were impressed

into the flank and aligned at the wall surface of the burrow in the initially water-saturated sediment (text-fig. 9C).

Sediment: Very fine-grained to very coarse-grained sandstones.

Association: As the traces of the genus *Planolites* NICHOLSON, 1873, are widely distributed in all lithofacies of the Inner Carpathian Paleogene in Slovakia, they can be found in common with almost all species of fossil traces determined in this region.

Origin: The traces of the genus *Planolites* NICHOLSON, 1873, were produced by marine annelid worms (*Annelida*, *Polychaeta*).

Occurrence: All facies of the Inner Carpathian Paleogene, marine sediments all over the world from Precambrian to Neogene time.

Ichnogenus *Gyrichnites* WHITEAVES, 1883

Type specimen: *Gyrichnites gaspensis* WHITEAVES, 1883

Description: Trails of large size, undulating, slender, rounded furrows marked transversely by nearly straight, subparallel and subequidistant grooves (W. HÄNTZSCHEL 1975).

***Gyrichnites* sp.**

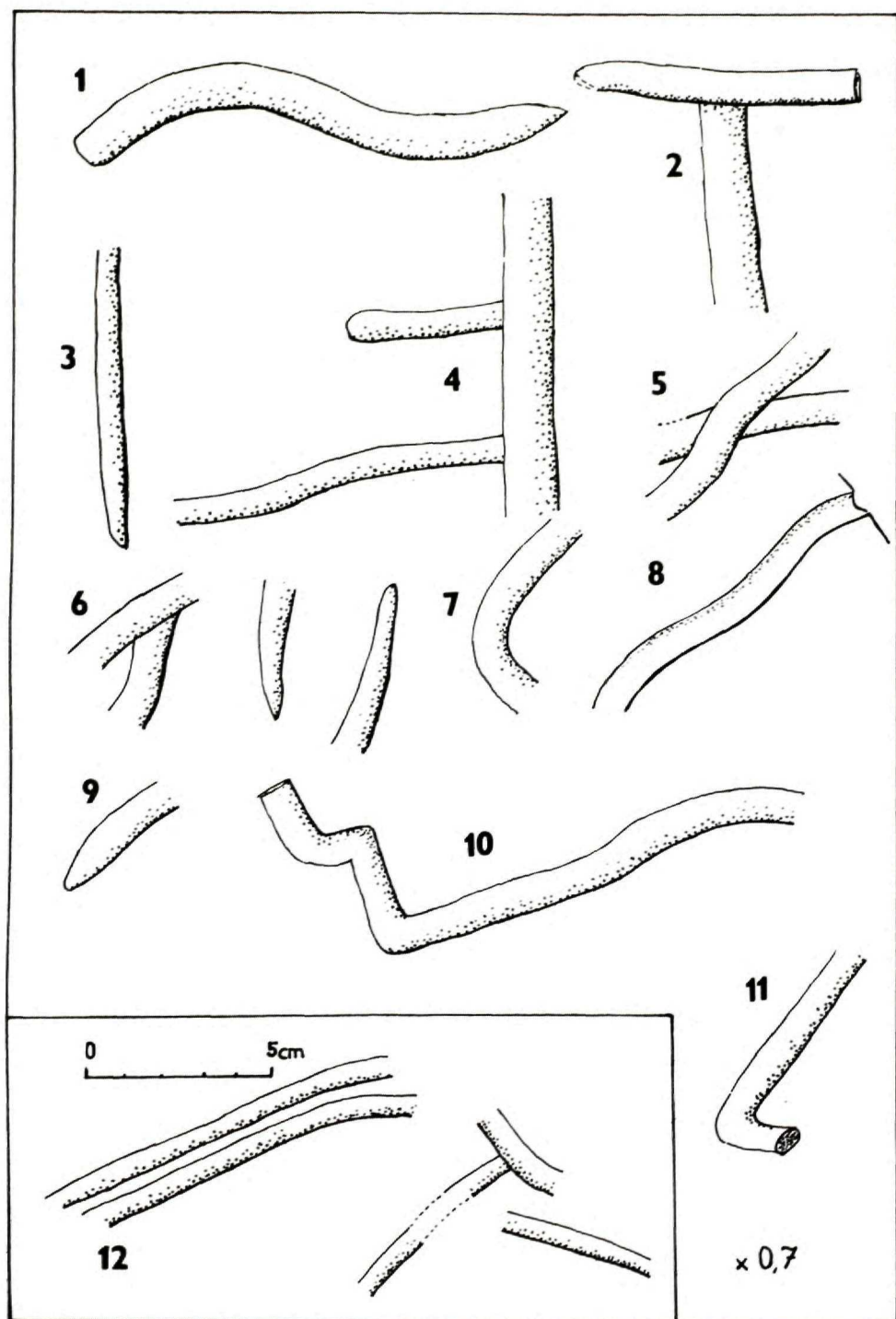
Plate XXXVIII, Figs 6, 7; text-fig. 10

Material: 4 samples

Description: Tubular shapes in the sediment, 4 to 10 mm in diameter, with pronounced transversal segmentation. About 4 segments per 5 mm of the groove length (e.g. sample No 212/2).

Remark: In the region of the ICP, traces with distinct segmentation found at Myslina (sample No 198/1), Rakúsy (sample No 212/2, 1), Jamník (sample No 73/1), and Liptovský Ondrej (sample No 73/13) localities correspond to the fossil trace reported by W. HÄNTZSCHEL (1975) in Fig. 4, Plate 40, p. W. 66. The segmentation of the trace strongly resembles that of marine annelid worms. Two traces 7 mm wide were found in the fine-to medium-grained sandstone of sample No 73/1, three traces 4, 5 and 10 mm wide in sample No 74/13. Claystone development of the beds was determined in both cases. Sample No 212/1, 2 exhibits claystone-sandstone development. This sample displays distinct segmentation (4 segments to each 5 mm of the trace length). The samples from Myslina locality have been assigned to the same facies. There,

Fig. 8 — *Planolites* sp. Figs 1—12: 1 — Bzenov (192) CS, 192/1; 2 — Poprad (103), C, 103/25; 3 — Relov (205), C, 205/1; 4 — Liptovský Mikuláš (69), CS, 69/32; 5 — the same, 69/37; 6 — the same, 69/32; 7 — the same, 69/6; 8 — the same, 69/27; 9 — the same, 69/38; 10 — Olšavica (158), S 158/5; 11 — Liptovský Mikuláš (69), CS, 69/44; 12 — Važec (90), BCS, 90/1.



two *Gyrichnites* traces following the stratification plane, 6 mm wide and over 10 cm long, were found on the sandstone sample. Fossil traces of this nature are widely distributed within the Inner Carpathian flysch in Moravia and also in eastern Slovakia.

Sediment: Fine- to medium-grained sandstones.

Origin: The trace was produced by marine annelid worms, presumably decayed, so that segmentation was preserved as an impression of the body surface where the worm had died. The segmentation would have been obliterated if the worm had continued moving.

Occurrence: C, CS, ICP (Eocene), Outer Carpathian flysch (Cretaceous — Paleogene).

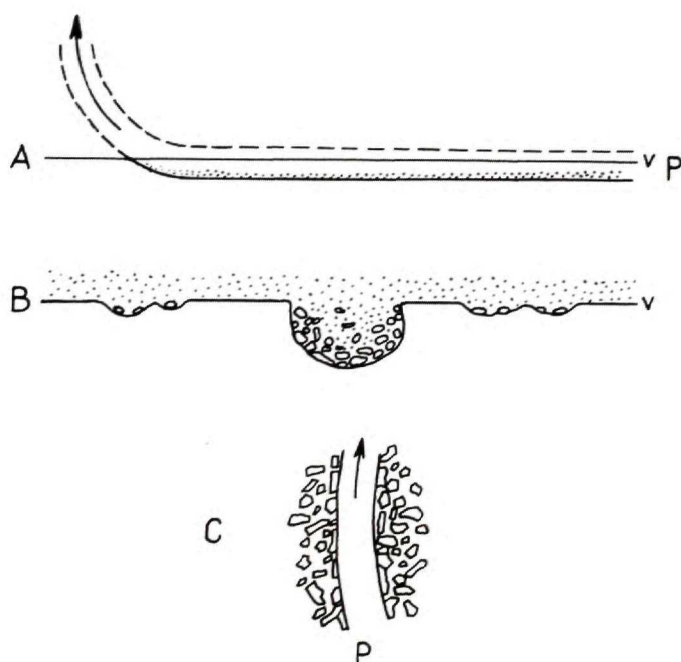


Fig. 9 — Schematic drawings of the data on the fossil trace *Planolites* sp. related to the sediment. A — the *Planolites* sp. trace, often developed as a positive hyporelief, suddenly turns into the overlying bed (in the animal's effort to escape upwards after the sudden deposition of sandy material on the clayey surface of the sea bottom?). Localities: 60, 94, 103, 146, 215; B — the coarser fraction of the sandy sediment is frequently preserved in the initial positive hyporelief on the clayey surface of the sea bottom [e.g. Hrabušice (140) and Jakubovany (17) localities]; C — in coarse-grained sediments (BCS), the worm when tunnelling in the sediment pushes large flat particles into the host rock forming thus a tubular gallery [e.g. Liptovské Kľačany locality (203) where the grains of the sediment were up to 5 mm in size or even larger at some points.] Explanations: P — *Planolites*, v — bedding plane.

Description: Simple U-tubes without spreite, perpendicular to the bedding plane; varying in size, tube diameter, distance of limbs, and depth of burrows; limbs rarely somewhat branched, some with funnel-shaped opening; walls commonly smooth, occasionally lined or sculptured; burrows may reach considerable depth (W. HÄNTZSCHEL, 1975).

Remark: The literature reports several species from various areas all over the world, as, for instance, the species *A. franconicus* (F. TRUSHEIM, 1934) from the Triassic in Germany. However, a certain disagreement in distinguishing the species appears in the literature and, for this reason, I have not used the species name for our discovery.

Arenicolites sp.

Plate XXXIX, Fig. 6

Material: 3 sandstone fragments

Description: U-shaped fossil trace. Two tubular worm trails having up to 2 cm in diameter run perpendicularly to the bedding plane in the mutual distance of 4.5 cm (M. PLÍČKA, 1984, Fig. 3 p. 186; Pl. II). The depth of the U-shaped burrow could not be determined.

Remark: The trace was found at Važec locality (89) in the mine dump at the bank below the highway west of the village.

Sediment: Yellowish-grey, calcareous, fine-grained sandstone, flaggy in the upper part and over 30 cm thick. Fossil remains were found in the upper part of a large sandstone fragment.

Association: Dark remains of marine worms ("Body Fossil") *Eulalites obscurus* PLÍČKA 1984 were found near the trace of *Arenicolites* sp. at Važec

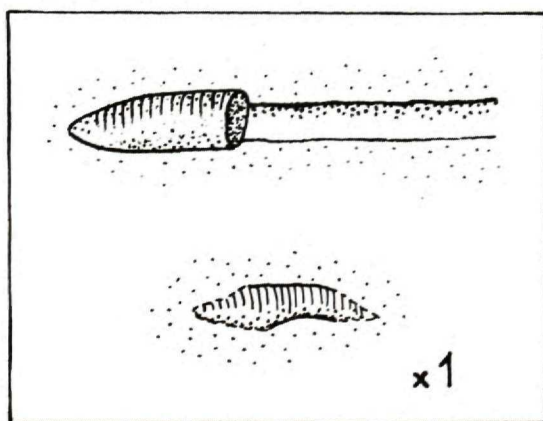


Fig. 10 — *Gyrichnites gaspensis* WHITEAVES in the fine- to medium-grained calcareous sandstone at Jamník locality (73), C, sample No 73/1.

locality (89) and the fossil trace of *Calixichnium häntzscheli* PLIČKA 1981 at Podolíneč site (135).

Origin: The trace was certainly produced by a worm or worm-like animals.

Occurrence: ICP (Eocene), in the vicinity of the BCS facies. Localities: Važec (89), Bajerov (186), and Podolíneč (135).

Ichnogenus *Popradichnium* PLIČKA, 1983

Type specimen: *Popradichnium erraticum* PLIČKA

Remark: Straight or slightly bent minute tubular traces on the lower bedding plane of the sandstone, 1.5 to 3 mm wide and 0.5 to 8 cm long (*Popradichnium erraticum* PLIČKA, 1983) or 0.5 to 1 mm in width and 3 to 30 mm in length (*Popradichnium minutum* n. ichnosp., in press).

***Popradichnium erraticum* PLIČKA, 1984**

Plate XXXIX, Figs 1, 2; Text-figs 11, 12

Material: 53 specimens

Description: The lower bedding plane of the sandstone shows differently oriented relatively short tubular traces, straight or slightly bent that superpose at the contact points like the fingers of the hand. The interruptions in the traces seem to be due to slightly ascending and descending traces during the sub-horizontal movement of the animal. This is evidenced by the tapering of the trace (during its submersion or emersion). As has been shown by detailed studies, sharp locally occurring interruptions of the trace in its full width are due to a part of the tube of the trace peeling off the lower bedding plane of the sandstone when penetrating into the original underlying clayey sediment. Locally the traces form dense clusters on the lower bedding plane of the sandstone, as is obvious, for instance, from sample 103/1 (Holotype Pl. XXXIX, Figs 1, 2; text-figure 12).

Remark: With its tubular shape, the fossil trace *Popradichnium erraticum* slightly resembles that of the genus *Planolites* NICHOLSON, 1873 (W. HÄNTZSCHEL, 1975). In general, the *Popradichnium erraticum* trace differs from that of the genus *Planolites* by its dimensions, by the course of the trace and by its occurrence in rocks where the trace is associated with the bedding plane. Commonly, the trace of the genus *Planolites* penetrates the rock in all directions and its dimensions vary from 6 to 9 mm. With its straight and relatively short course and mutual superposition the trace slightly resembles the fossil trace of the genus *Fucusopsis* PALIBIN in VASSOEVICH 1932 (W. HÄNTZSCHEL 1975, Fig. 37/5, p. W. 59, 64).

Sediment: Fine-grained calcareous sandstones of thin-shaly fissility and varying from 5 to 15 cm in thickness.

Association: *Planolites* sp., *Popradichnium minutum*, *Punctumichnium parvum* n. ichnosp., *P. medium* n. ichnosp., *Aulichnites parkensis*, *Merostomichnites beecheri*, *Scolicia prisca*, *S. plana*, *Taprhelminthopsis auricularis*, *Megagraption tenue*.

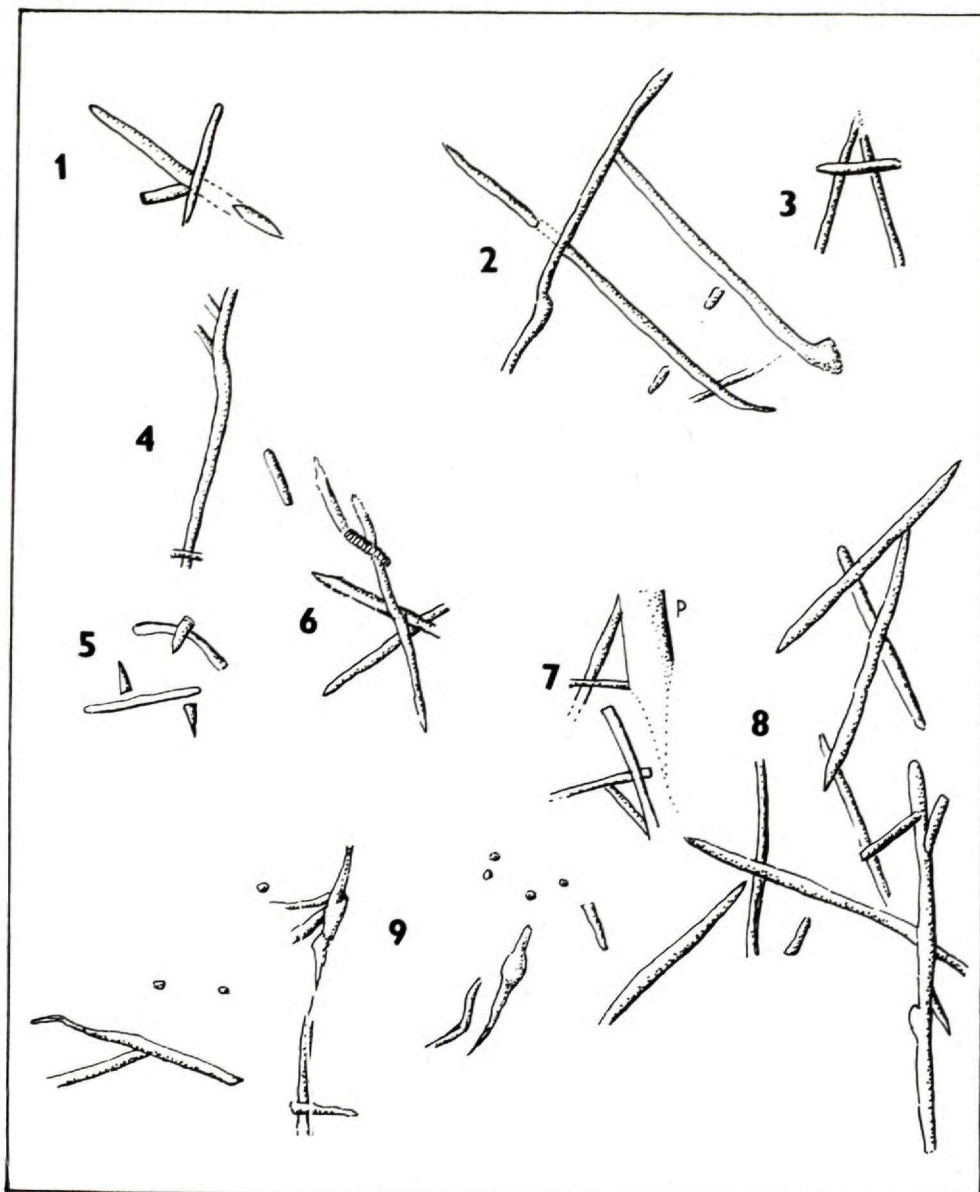


Fig. 11 — *Popradichnium erraticum* PLIČKA on tabular sandstone fragments at Poprad locality (103), C. Samples: 1 — 103/6; 2 — 103/5; 3 — 103/14; 4 — 103/2; 5 — 103-11; 6 — 103/35; 7 — 103/4; 8 — 103/3; 9 — 103/31; P — *Planolites*.

Occurrence: ICP, C, CS, S (Paleogene). Traces of this nature were also found in the sandstones near the basal clastic sediments at Vážec (88, 89) and Bzenov (193) localities. These traces were singularly found in the Godula Beds (Cretaceous) of similar lithologic development in the Silesian nappe of the Outer Carpathian flysch. Traces of this species have been found, recently, in the Upper Devonian sediments in Libya at Fezzán near Sebha (M. PLIČKA, 1983).

***Popradichnium minutum* n. ichnosp. (in press)**

Plate XXXIX, Figs 4, 5

Material: 26 specimens

Description: Straight or slightly bent minute tubular traces on the lower bedding plane of the sandstone, 0.3 to 0.8 mm in width and 2 to 15 mm in length. The traces follow various directions, they do not branch and are superposed at the contact points.

Remark: The new trace of *Popradichnium minutum* is the miniature form of the fossil trace of *Popradichnium erraticum*. Due to its minute dimensions it easily escapes the geologist's attention, particularly if larger patterns of fossil traces appear near-by. Only large accumulations of these small fossil traces point to their presence.

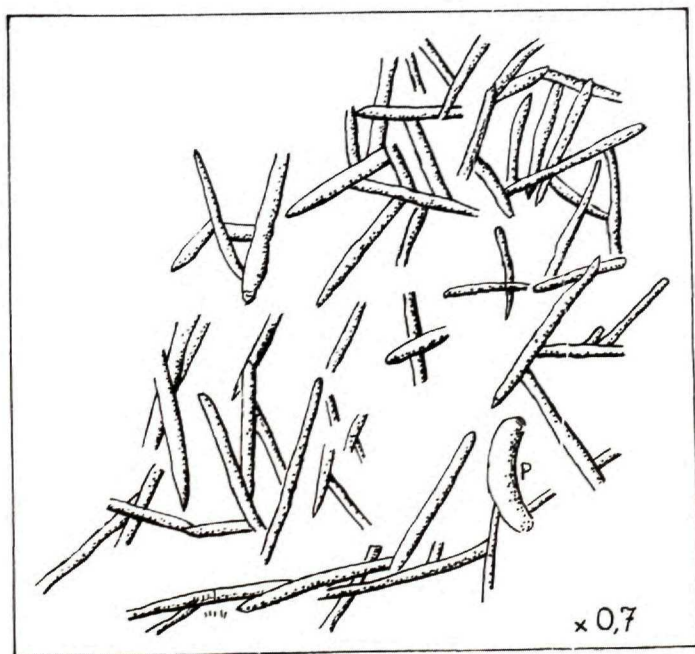


Fig. 12 — *Popradichnium erraticum* PLIČKA, Poprad locality (103), C, h otype, sample No YA 1475 (M. PLIČKA, 1983, Pl. I). P — *Plano: tes*.

Sediment: Fine-grained, calcareous tabular sandstones, 3 to 15 cm thick.

Association: *Planolites* sp., *Popradichnium erraticum*, *Punctumichnium medium*, *P. parvum*, *Eulalites obscurus*, *Arenicolites* sp., *Aulichnites parkensis*, *Paleodictyon regulare*, *P. minimum*, *P. intermedium*, *Gordia molassica*, *Godulaichnium tenue*, *Scolicia prisca*, *S. plana*, *Merostomichnites beecheri*, *Subphyllocorda laevis*, *Taprhelminthopsis auricularis*, *Helminthoida miocenica*, *Agrichnium incompositum*, *Cumulusichnium incertum*.

Origin: The tubular traces are thought to be due to the activity of marine worms of minor dimensions.

Occurrence: Krosno Beds of the Silesian nappe (Oligocene), Inner Carpathian Paleogene, Godula Beds of the Silesian nappe (Cretaceous).

Ichnogenus *Agrichnium* PFEIFFER, 1968

Type specimen: *Agrichnium fimbriatum* (LUDWIG) (W. HÄNTZSCHEL 1975)

Remark: Small cylindrical traces following subparallel (*Agrichnium fimbriatum* (LUDWIG)) or various directions and crossing one another (*Agrichnium incompositum* PLÍČKA). They form a positive hyporelief and their width varies from 0.5 to 1 mm.

***Agrichnium incompositum* PLÍČKA, 1984**

Plate XXXIX, Fig. 3; Text-fig. 13

Material: 8 specimens

Description: Fine thread-sized tubular traces partly curved or almost straight are obvious on the sandstone undersurface. They are running in all directions and overlap one another at their contact points. During its horizontal movement on the clayey surface of the sea-bottom the animal was slightly emerging or submerging forming cylindrical traces tapered at their ends on the undersurface of the sandstone. Numerous accumulations of traces are present at some places.

Remark: The newly found trace resembles *Agrichnium fimbriatum* (LUDWIG) in its form and size and differs from it by its disordered unoriented course on the undersurface of the sandstone, whereas *Agrichnium fimbriatum* (LUDWIG) is characterized by a subparallel course of its trace (H. PFEIFFER 1968, p. 671, Pl. III, Figs 4, 5).

Sediment: Green-grey, non-calcareous, fine-grained sandstone with Fe, Mn coating on the cleavage planes. The sandstone undersurface with the newly found traces is greyish in colour.

Association: *Cumulusichnium incertum*, *Belorhaphe zickzack*, *Planolites* sp.

Origin: Fine vermicular forms are likely to originate from sea worms moving on the surface of the muddy sea-bottom and slightly pressing into the floor. In places of larger accumulations of fine cylindrical forms remnants of extinct worms may also be present.

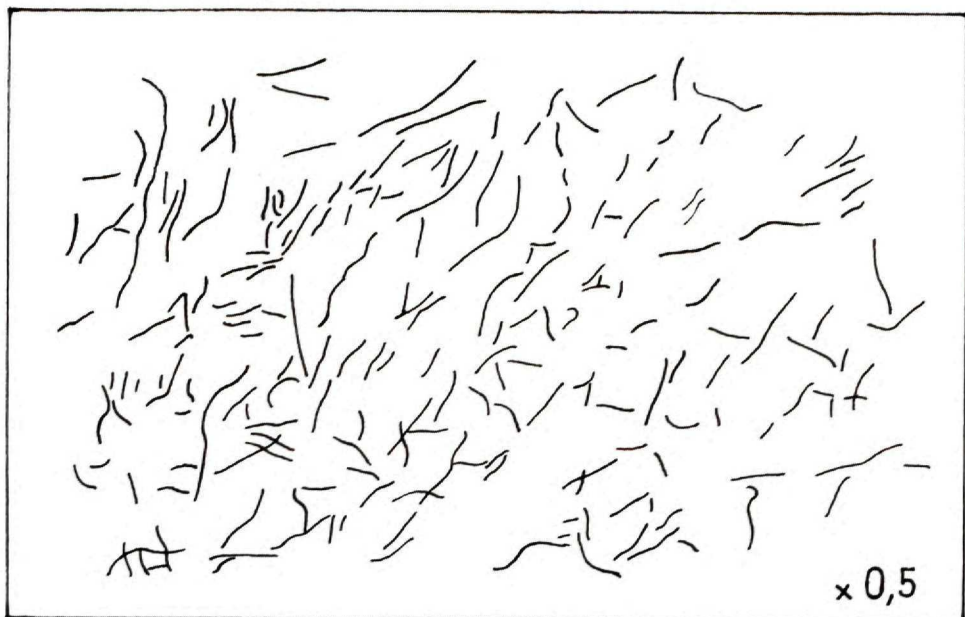


Fig. 13 — *Agrichnium incompositum* PLIČKA, schema of the courses of the traces on sample No 74/1 from Liptovský Ondrej locality (74), C (M. PLIČKA 1984, Pl. LXXXIX, Fig. 2).

Occurrence: ICP, C, CS (Eocene). Liptovský Ondrej locality (74), 6 km NE of Liptovský Mikuláš. Some of the traces described were also found in the Godula Beds (Cretaceous) in the Silesian nappe in Moravia (Outer Carpathian flysch).

Ichnogenus *Merostomichnites* PACKARD, 1900

Type specimen: *Merostomichnites beecheri* PACKARD, 1900 (W. HÄNTZSCHEL, 1975)

Remark: The palaeozoic forms are probably attributable to euripterids, the Triassic forms possibly to phyllopods; the striding track of *Merostomichnites* and the burrowing trail of *Isopodichnus* may have been produced by the same animal (A. SEILACHER, 1961, p. 88).

Occurrence: Cambrian — L. Triassic (Europe — Asia, N. America), Paleogene (Inner Carpathian Paleogene).

***Merostomichnites beecheri* PACKARD, 1900**

Plate XL, Fig. 1; Text-Fig. 14

Material: 1 specimen (positive, negative), 85/11a, 85/11b

Description: Two parallel rows of circular bow- or spindle shaped feet

impressions, transversely or slightly obliquely arranged, opposite to each other (W. HÄNTZSCHEL, 1975).

Remark: The individual was determined at the bedding plane of the sandstone.

Sediment: Light grey, fine-grained calcareous sandstone.

Association: *Scolicia prisca*, *Planolites* sp., *Paleodictyon majus*, *Megagraption tenue*.

Origin: *Merostomichnites* forms that may be attributed to euripterids or to phyllopods (W. HÄNTZSCHEL, 1975).

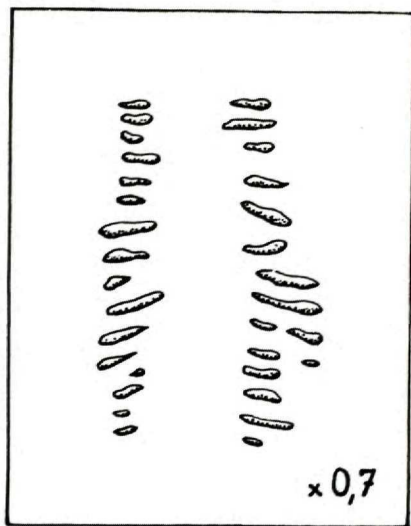


Fig. 14 — *Merostomichnites beecheri* PACKARD, lower bedding plane of the tabular sandstone exhibiting a trace. Dovalovo locality (85), C, 85/11.

III. Branched structures

Here are grouped traces with a main, cylindrical or tubiform stem which in a twig-like or bundle-like manner ramifies into numerous lateral branches. These may be rectilinear or feebly curved, or developed in a tuberculate form. All types branch horizontally or subhorizontally. Within the Inner Carpathian Paleogene, this group of fossil traces includes six ichnogenera: *Calixichnium* PLIČKA, *Saportia* SQUINABOL, *Buthotrephis* HALL, *Chondrites* STERNBERG, *Thalassinoides* EHRENBURG, and *Godulaichnium* PLIČKA.

Ichnogenus *Calixichnium* PLIČKA, 1981

Type specimen: *Calixichnium häntzscheli* PLIČKA

Remark: Calicular bunch of closely spaced tubular trace fossils a few centimetres long, with obtuse ends in upward and downward directions. This

trace fossil is very similar to that of the genus *Cylindricum* LINCK, 1949 (W. HÄNTZSCHEL 1975, Figs 35—4a, 4b) in its shape, obtuse cylindrical ends and presence of the cylinders in groups. It differs, however, in its total cylindrical arrangement (shape), position in the bed and orientation with respect to the bedding plane. Contrary to *Cylindricum* LINCK, 1949 forming a convex hyporelief perpendicular to bedding, the trace fossil *Calixichnium häntzscheli* can be seen as an epichnium — endichnium at the upper bedding plane, with its torn-away, obtuse ends of cylinders gently projecting above it. Another feature distinguishing it from *Cylindricum* LINCK, 1949 is the fact that its single cylinders and calicular cylindrical bunch include an angle of 25° to 30° with the upper bedding plane.

***Calixichnium häntzscheli* PLIČKA, 1981**

Plate XL, Figs 2, 3; Text-fig. 15

Material: 2 specimens

Description: Holotype (No 22146, Moravian Museum in Brno) consisting of ten tubes, closely packed to each other, a few cm long. The diameter of the cylinders tapering upwards to obtuse points ranges from 8 to 17 mm. A group of cylinders are arranged concentrically and run downward into the rock. The shape of the whole fossil is calicular. The trace fossil is 4 cm in diameter and is inclined at 25° to 30° to the upper bedding plane.

Sediment: Greenish-grey, fine-grained calcareous sandstone, with fine-coalified crushed plants in its top part. The sandstone is 38—45 cm thick and contains claystone balls of up to 15 cm size. A distinct hieroglyph can be seen at the lower surface of the bedding plane in the sandstone.

Association: *Planolites* sp., *Taprhelminthopsis* sp., locality No 135, and *Thalassinoides* sp., *Planolites* sp. locality No 79.

Origin: This calicular trace was probably produced by marine worms or larvae of marine animals feeding on organic remains in the sediment. This can be illustrated by the amount of coalified substance at the calicular base toward which the obtuse cylindrical ends are arranged concentrically.

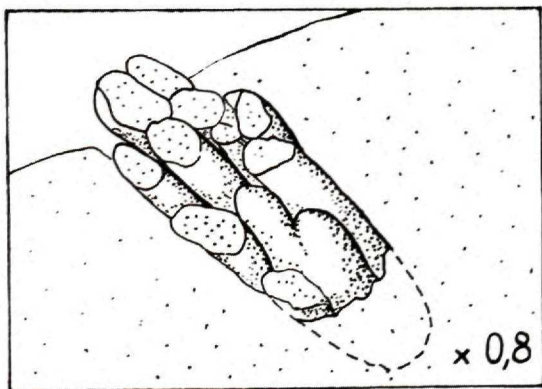


Fig. 15 — *Calixichnium häntzscheli* PLIČKA on the upper bedding plane of the sandstone from Podolíneč locality (135), SC, (M. PLIČKA, 1981, Pl. I, Fig. 1).

Occurrence: Upper Eocene, claystone-sandstone sequence of the Inner Carpathian Paleogene. Podolíneč (135) and Hybe (79) localities.

Ichnogenus *Saportia* SQUINABOL, 1891

Type specimen: *Saportia striata* (SQUINABOL), 1891

Remark: Long large cylindrical burrows, 1 to 2 cm in diameter, commonly in dendriform arrangement, branching dichotomously; surface with rhombic pattern produced by delicate arched parallel striations in two systems. Found in flysch deposits (W. HÄNTZSCHEL, 1975). A. V. BORRELLO (1966) reports another generic name — *Palaeosaportia* BORRELLO, 1966, p. 20 (type P. LOEDEL). A. V. BORRELLO (1966, p. 20) noted that there were only small differences in shape between his *Palaeosaportia* from the Ordovician of South America (Arg.) and *Saportia* from the Tertiary of Italy. W. HÄNTZSCHEL (1975) believes that a new generic name is not required for burrows that vary considerably in shape.

***Saportia striata* (SQUINABOL), 1891**

Plate XL, Figs 4, 5; Plate V, Fig. 6; Text-fig. 16

Material: 3 specimens

Description: A tubular trace 7 mm in diameter, dichotomously branching (sample 69/59) or a central tube bifurcating into two tubular branches of conforming size (sample 69/60). The second sample exhibits tubular branches about 4 cm long with obtuse termination, while double dichotomous branching in intervals of about 1.5 to 2 cm was observed for the first sample (69/59).

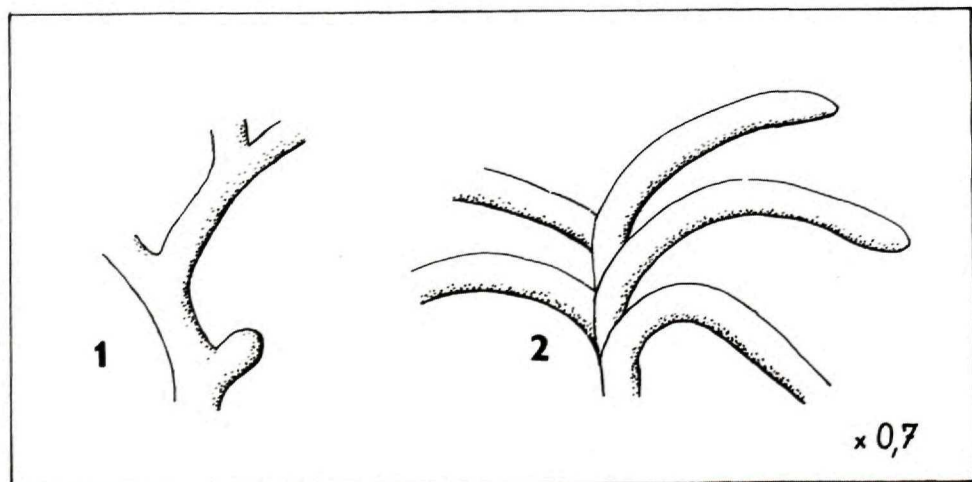


Fig. 16 — *Saportia striata* (SQUINABOL), Liptovský Mikuláš (69), CS. 1 — 69/59, 2 — 69/60.

Remark: The samples from the Eocene flysch in Slovakia are smaller (only 7 mm wide) than the species *Saportia striata* (SQUINABOL). However, there is no reason for erecting a new species (see A. V. BORRELLO, 1966).

Sediment: Yellowish-grey, fine-grained calcareous sandstone, of thin-shaly fissility.

Association: For instance, *Megagraption tenue*, *M. irregulare*, *Paleodictyon minimum*, *P. minutissimum*, *P. intermedium*, *P. strozzii*, *Helminthoida miocenica*, *Planolites* sp., *Gordia molassica*, *Buthotrephis* sp.

Origin: *Saportia* was interpreted by R. RICHTER (in O. WILKENS, 1947) as fillings of burrows produced by animals and later deposited after having passed through the alimentary tract.

Occurrence: CS, ICP, Eocene. Liptovský Mikuláš, brickworks (69) and Osturňa (117).

Ichnogenus *Buthotrephis* HALL, 1847

Type specimen: *Buthotrepsis palmata* HALL

Remark: "Stems subcylindric or compressed, branched; branches are numerous, divaricating, lead-like" (J. HALL, 1847, p. 8). It follows from this description and illustration of particular types that the stems are smooth. W. HÄNTZSCHEL (1960) regards *Buthotrephis* as synonymous with *Chondrites*. Branched cylindrical and subcylindrical types of similar shape have often been described as *Palaeophycus* HALL.

When comparing the specimen from the Inner Carpathian Paleogene at Liptovský Mikuláš site (69) with those studied by M. KSIĄŻKIEWICZ (1977) in the Carpathian flysch in Poland, the specimen from Liptovský Mikuláš has been found to correspond closely to that from Krościenko site, Szczawnica Beds (M. KSIĄŻKIEWICZ, 1977, p. 74, Fig. 10 u).

Buthotrephis sp. indet.

Plate XL, Fig. 6

Material: 1 specimen (sample 69/57)

Description: The trace is 2 to 2.5 mm wide and branched. The branches protrude from the "stem" at various angles. Stem and branches are of about the same width, straight, slightly bent.

Sediment: Greenish-grey, fine-grained, fine-micaceous sandstone of tabular fissility.

Association: For instance, *Paleodictyon minimum*, *P. strozzii*, *Helminthoida miocenica*, *Gordia molassica*, *Planolites* sp.

Origin: The cylindrical shape of the stem and branches indicate post-depositional origin. Probably large polychaete worms might have produced these feeding burrows (M. KSIĄŻKIEWICZ, 1977, p. 73—74).

Occurrence: Claystone-sandstone facies of the Inner Carpathian Paleogene Eocene, brickworks at Liptovský Mikuláš (69).

Ichnogenus *Chondrites* STERNBERG 1833

Type specimen: *Chondrites targonii* (BRONGNIART) (H. N. ANDREWS, 1955)

Remark: As reported by M. KSIĄŻKIEWICZ (1977), the classification is based on branch width and the mode and angle of branching. S. SIMPSON (1957) doubts about the validity and usefulness of specific recognition in *Chondrites*. He presumes that the differences may be attributed to the animal's behaviour controlled by the distribution of food in the sediment.

***Chondrites aequalis* (Brongniart, 1828)**

Plate XL, Fig. 7

Material: 1 specimen (sample 8/1)

Description: The bedding plane of the sandstone exhibits small branched burrows 0.7 to 1 mm in diameter. The main burrow up to 6 cm long diverges, at both sides, into shorter branches of only 1—2 cm length that run obliquely or almost perpendicularly to the main branch. The trace represents a negative epirelief, the burrows in the sandstone are free of filling material.

Remark: In their nature, the burrows correspond to the specimen illustrated in Plate IV, Fig. 6 published in the book by M. KSIĄŻKIEWICZ (1977).

Sediment: Yellowish-grey, fine-grained, thin-shaly, fine micaceous, partially laminated sandstone.

Association: *Popradichnium minutum*, *Planolites* sp., *Punctumichnium parvum* n. sp.

Origin: The nature of the trace fossil was convincingly proved first by R. RICHTER (1927, 1931), though earlier A. G. NATHORST (1881) and TH. FUCHS (1895) had rejected the former interpretation as algae; producer unknown, perhaps worms (W. HÄNTZSCHEL, 1975, p. W. 50).

Occurrence: CS, ICP, Eocene, Jasenová locality (8).

Ichnogenus *Thalassinoides* EHRENBURG, 1944

Type specimen: *Thalassinoides saxonicus* (GEINITZ)

Remark: Cylindrical burrows forming threedimensional branching systems consisting of horizontal networks connected to surface by more or less vertical shafts; burrows 1 to about 20 cm in diameter (typically 10—15 mm); regularly branching, Y-shaped bifurcations, forming polygons in horizontal systems. Undoubtedly feeding and dwelling burrows of crustaceans, sometimes associated with actual remains of callianassids (W. HÄNTZSCHEL, 1975). Recently, R. W. FREY and S. G. PEMBERTON (1985) have reported fossil traces of *Thalassinoides* in compliance with their position in the sediment and the mode of branching (Text-fig. 17).

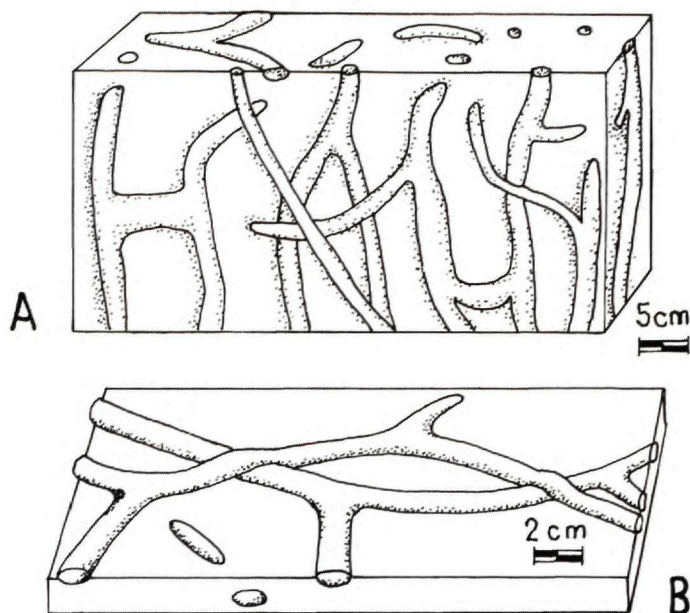


Fig. 17 — Differences in the configuration of the dwelling structure *Thalassinoides*. A, three-dimensional boxwork structures exhibiting mostly T-shaped branches: *T. paradoxicus*. B, essentially planar burrow systems mainly displaying Y-shaped bifurcations: *T. suevicus* (R. W. FREY — S. G. PEMBERTON, 1985, p. 89, Fig. 23).

***Thalassinoides* sp.**

Plate XLI, Figs 1—3, 5; Text-fig. 18

Material: 13 specimens

Description: The burrows determined in Eocene sandstones (ICP) pass through the rock in three dimensions. They branch and their width varies from 1 to 3.5 cm. If following the bedding plane, they are somewhat flattened in vertical direction. In sample 79/10, for instance, the cylindrical sandstone filling material in the burrow is 1 cm high and 2 cm wide (in the horizontal direction). The burrows follow horizontal and vertical directions or run obliquely to the bedding.

The inside walls of the burrows (or the surface of the cylindrical, slightly flattened filling string) are darker in colour than the rock proper, namely rusty-brown. The burrows show internal transversal segmentation varying from several millimetres to nearly 1 cm. It can be seen on the transverse section of the cylindrical burrow filling that the filling surface is smooth in places, but mostly it exhibits irregular rounded projections and depressions, as is obvious from the drawing in the text-figure. The width of the branches diverging from the initial burrow differs in some cases; one branch is 2 cm and the other 2.5 cm wide, for instance.

Remark: Due to the relatively small number of species and the limited occurrence of this fossil trace (three sites), it cannot be established so far whether the inside smooth or somewhat rough surface of the cylindrical burrow filling

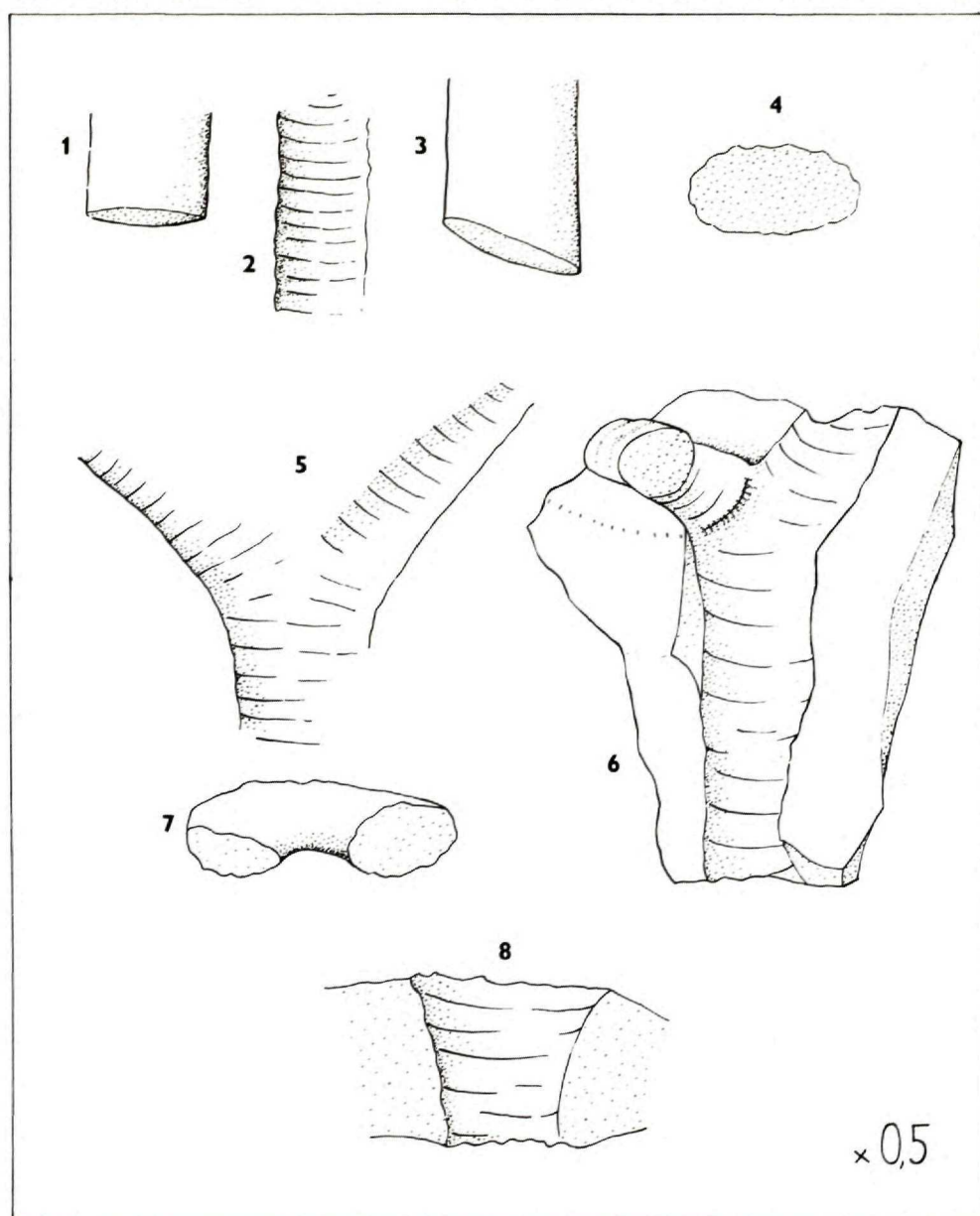


Fig. 18 — *Thalassinoides* sp.: 1 — Hybe (79), BCS, 79/19; 2 — 79/21; 3 — 79/20; 4 — 79/15; 5 — 79/32; 6 — 79/16; 7 — 79/10; 8 — 79/5.

(in the cross section) can be considered a diagnostic sign. The possibility of detecting this trace in the basal clastic sediments seems to be highly affected by the small amount of man-made and natural exposures in these sediments.

Sediment: Light grey, greenish, fine- to medium-grained, calcareous, imperfectly bedded, micaceous sandstone.

Association: *Planolites* sp., *Calixichnium häntzscheli*, *Megagraption irregulare*.

Origin: Formerly interpreted as algae or horny sponges (*Ceratospongiae*); undoubtedly feeding and dwelling burrows of crustaceans; sometimes associated with actual remains of callianassids (K. EHRENBURG, 1938; H. MERTIN, 1941; M. F. GLAESSNER, 1947; A. H. MÜLLER, 1970), described with *Glyphea* crustacean inside burrow (B. W. SELLWOOD, 1971).

Occurrence: BSC, ICP, (Paleogene), localities: quarry near the village of Hybe (79) and excavation dumps near the village of Bzenov (193).

Ichnogenus *Godulaichnium* PLIČKA, 1986

Type specimen: *Godulaichnium tenue* PLIČKA

Remark: A cylindrical, slightly flattened burrow of 1.5 mm maximum width, with a centrally positioned longitudinal groove, branching at some points. The course of the trace is slightly curved, its length exceeds 12 cm. It was first found in the Godula Beds of the Silesian nappe and its generic name has been derived from these beds (M. PLIČKA, 1986). The trace is a positive hyporelief. By its appearance, the fossil trace slightly resembles that of the genus *Subphyllochora* GÖTZINGER and BECKER, 1932, however, it markedly differs from the latter mainly by its size and the centrally located longitudinal groove.

***Godulaichnium tenue* PLIČKA, 1986**

Plate XLI, Fig. 4; Text-fig. 19

Material: 5 specimens

Description: The lower bedding plane of the sandstone exhibits tubular, slightly dorsoventral compressed traces 1 to 1.5 mm wide and at most 4 cm long. The traces are straight or slightly curved, with a longitudinal groove in the median part. The course of the trace is slightly undulated with respect to the bedding plane and thins out in places. This waning-out is particularly obvious for the specimens from the godula Beds of the Silesian nappe (M. PLIČKA, 1986).

Sediment: Greenish-grey, fine-grained, calcareous sandstone.

Association: *Popradichnium minutum*, n. sp., *Planolites* sp., *Punctumichnium parvum* n. sp., *P. medium* n. sp., *Gordia molassica*, *Agrichnium incompositum*, *Belorhapha zickzack*, *Cumulusichnium incertum*, *Eulalites obscurus*.

Origin: The fossil trace was probably produced by the activity of marine animals of small size creeping on the clayey surface of the sea-bottom.

Occurrence: ICP, C, CS (Eocene). Localities: Vitališovce (71), Liptovský Ondrej (74), and Vážec (88).

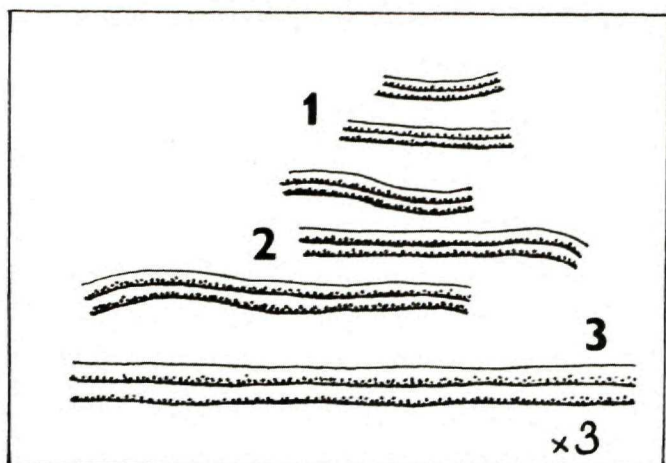


Fig. 19 — *Godulaichnium tenue* PLIČKA: 1 — Podbanské (83), C, 83/3; 2 — Vitališovce (71), CS, 71/2; 3 — Liptovský Ondrej (74), C, 74/20.

IV. Rosetted structures

Star-shaped traces occur either on the lower or the upper surface. A single ichnogenus from the Inner Carpathian Paleogene has been included into this group: *Capodistria* VIALOV.

Ichnogenus *Capodistria* VIALOV, 1968

Type specimen: *Capodistria vettersi* VIALOV, 1968

Remark: The creation of this ichnogenus, with only one ichnospecies, is based on an incomplete specimen illustrated by H. VETTERS (1910). It is a stellate trace with a poorly delineated areola encircled by a few ribs variable in shape and size (M. KSIĄŻKIEWICZ, 1977).

Capodistria vettersi VIALOV, 1968

Plate XLII, Fig. 1; Text-fig. 20

Material: 1 specimen (sample No 88/5)

Description: The central knob of 2 mm size is encircled, at about 1—4 mm distance, by 9 ribs 1 to 1.5 mm wide, mostly elongated and pointed toward the centre.



Fig. 20 — *Capodistria vettersi* VIALOV: Važec locality (88), CS, 88/5. The trace occurs on the lower bedding plane of greenishgrey, fine-grained calcareous sandstone of tabular fissility. $\times 2$.

Sediment: Greenish-grey, fine-grained, calcareous sandstone of tabular fissility and with convolute lamination.

Association: *Aulichnites parkensis*, *Punctumichnium parvum* n. ichnosp., *Popradichnium minutum* n. ichnosp.

Origin: The cylindrical shape of the ribs in some specimens and the reentrants on the flanks of the ribs argue for a postdepositional burrowing. The central knob may mark the outlet of the habitation hole of the animal (*polychaete*?) working below the sand (M. KSIĄŻKIEWICZ, 1977, p. 100).

Occurrence: CS, ICP (Eocene), in close vicinity to the basal clastic sediments, Važec locality (88).

V. Spreiten structures

This group includes radiating forms arranged in spirals that occur at several localities within the Inner Carpathian Paleogene. They have been assigned to the genus *Zoophycos* MASSALONGO.

Zoophycos MASSALONGO, 1855

Type specimen: *Zoophycos circinnatus* (BRONGNIART)

Remark: In 1855, the following diagnosis of the genus was presented by A. MASSALONGO: The leaves simple or branching, linear, tubular, very dense, radial, spirally winding, separated or joined together, at the base converging to a strong phylum of cylindrical or conic shape, rounded, often irregularly rising (A. MASSALONGO, 1855, p. 46).

Origin: The origin of *Zoophycos* has frequently been discussed in the literature all over the world. Initially, vegetable origin was assumed (A. MASSALONGO, 1851, 1855, later e.g. L. BARSANTI, 1902; S. VENZO, 1951, 1952; A. MCGUGAN, 1964). Later their origin was ascribed to fossil traces (O. ABEL, 1935; A. SEILACHER, 1954; J. LESSERTISSEUR, 1955, etc.). Recently, "*Zoophycos*" has also been considered an imprint of the prostomial parts of the gill organs of sedimentary marine worms (M. PLIČKA, 1951, 1968, 1970; G. R. STEVENS, 1968; O. GIROTTI, 1970).

Zoophycos circinnatus (BRONGNIART)

Plate XLII, Fig. 2

Material: 2 specimens (sample No 218/1)

Description: Radiating structure forming a lefthand spiral 30 cm in diameter. The individual rays branch dichotomously and display distinct transversal segmentation (11 segments per 1 cm of ray length). Sample No 218/1 displays two spiral tiers. About 15 cm apart, the fragment of another spiral structure can be seen on the sample.

Remark: The literature does not consistently observe the species and generic indications of these spiral forms. So it comes about that the notion of *Zoophycos* includes even quite different forms. For instance, the paper by W. HÄNTZSCHEL (1975) indicates under the key-word of "*Zoophycos*" on Fig. 75, p. W. 121, Fig. 11 a photograph that is assigned to the genus *Echinospira* GIROTTI, 1970. (*E. pauciradiata* GIROTTI, 1970; O. GIROTTI, 1970). This classification of Fig. 11 seems to have been made inadvertently after prof. HÄNTZSCHEL'S death, when his work was brought to a close by other research workers who added the photographs that I had sent to prof. HÄNTZSCHEL in 1970. For this reason, the latest finds of enormous forms that displayed spiral diameters up to 1.4 m and occurred in the marine sediments of New Zealand from Cretaceous to Paleogene time (G. R. STEVENS, 1970; B. D. WEBBY, 1969) and in the Neogene (Tortonian) sediments of Italy (O. GIROTTI, 1970) have been disregarded. As has been stated by several U.S. scientists engaged in studies of Palaeozoic sediments, the typical spiral form of the original *Zoophycos* specimens from northern Italy exhibiting a single axis of the spiral (A. MASSALONGO 1851, 1855; L. BARSANTI, 1902, S. VENZO, 1951, 1954) that are also abundant in the Carpathian flysch of Czechoslovakia (M. PLÍČKA, 1968, 1970), substantially differs from other forms. The *Zoophycos* schema exhibits two peaks. The schema represents the actual fossil trace that was produced by the activity of marine worms. In its nature and form, the schema approximates the fossil traces that resemble U-shaped burrows (e.g. C. K. CHAMBERLAIN, 1971, 1979; R. C. GUTSCHICK — W. L. MOREMAN, 1967; CH. A. SANDBERG — R. C. GUTSCHICK, 1980). The schematic representation of these forms in themselves suggests that more likely forms evidencing relatively shallow-water environment may be involved (*Rhizocorallium*).

Sediment: Greenish-grey, very fine-grained, calcareous, alterably micaceous, thin-tabular sandstone with convolute lamination.

Association: *Planolites* sp.

Occurrence: ICP (Paleogene), CS (Zuberec 218), BCS (Spišské Vlachy 172) (K. KALCHBRENNER 1873), (Lipany 181). Abundant in Cretaceous and Paleogene sediments within the Inner Carpathian flysch region (Czechoslovakia, Poland, Austria).

VI. Winding structures

The degree of winding is variable. Some types are almost straight and feebly curved, others assume a more sinuous but still irregular course or are loosely meandering. Some traces show combinations of different courses that may be rather complex at some points. Within the Inner Carpathian Paleogene, the following genera have been assigned to this group: *Aulichnites* FENTON and FENTON, *Scolicia* DE QUATREFAGES, *Subphyllochora* GÖTZINGER and BECKER, *Taprhelminthopsis* SACCO.

Ichnogenus *Aulichnites* FENTON and FENTON, 1937

Type specimen: *Aulichnites parkensis* FENTON and FENTON

Remark: Trail 5 to 10 mm wide, commonly strongly curved, consisting of two convex ridges, separated by a rather deep median groove in epirelief.

***Aulichnites parkensis* FENTON and FENTON, 1937**

Plate XLII, Fig. 3; Text-fig. 21

Material: 4 samples

Description: Dichotomous trace, 5.5 and 6 mm wide, slightly curved, in places intersecting at an angle of about 90° (sample 88/6), with a longitudinal sharp median groove that gives the impression of two parallel adjoining strings. The traces overlap at their contact points. The traces appear as positive epireliefs or, if viewed from below, as negative hyporeliefs on the bedding planes of the sandstones.

Remark: The animal, probably a gastropod, grazed on the sandy seabottom at certain time intervals, as is obvious from sample No 89/14. The height difference between the bedding planes comprising the *Aulichnites* trace in the sandstone is 1 cm for this sample.

Sediment: Yellowish-grey, fine-to medium-grained, calcareous sandstone, bluish in the fresh state.

Association: *Planolites* sp.

Origin: Crawling and/or grazing trail, most probably made by a gastropod (W. HÄNTZSCHEL, 1975).

Occurrence: BCS, ICP (Paleogene), Vážec locality (88, 89).

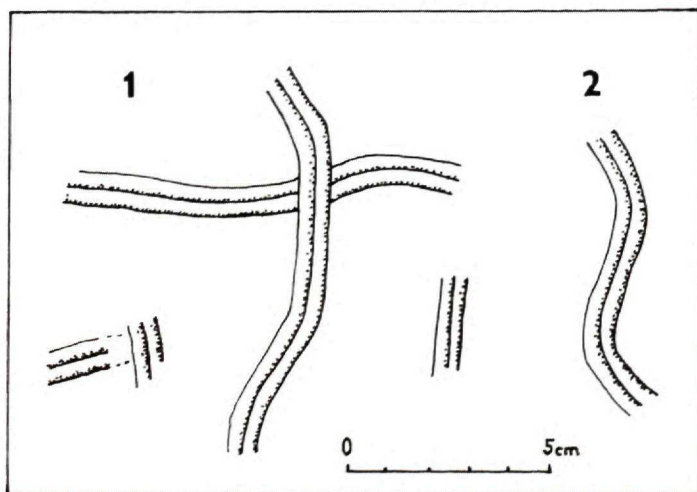


Fig. 21 — *Aulichnites parkensis* FENTON and FENTON: 1 — Vážec (88), CS, facies close to the BCS facies (88/6); 2 — Vážec (89), CS facies close to the BCS facies, 89/14.

Ichnogenus *Scolicia* DE QUATREFAGES, 1849

Type specimen: *Scolicia prisca* DE QUATREFAGES

Remark: Horizontal bilaterally symmetrical trails of great variability, long, bandlike; morphology depending on their origin as surface trails or internal trails; varied sculpture caused by different methods of burrowing, creeping, and removing the sediment; up to about 4 cm wide (W. HÄNTZSCHEL 1975, p. W. 106). The trails of *Scolicia* occur, for the most part, on the upper surfaces of the sandstone layers.

***Scolicia prisca* DE QUATREFAGES 1949**

Plate XLII, Fig. 4; Pl. XLIII, Figs. 1, 2; Text-fig. 22

Material: 3 specimens

Description: Epichnial trilobate furrow. The width of the trace varies from 10 to 20 mm. The median lobe is 4—6 mm wide, the width of the lateral fringes varies in places (see the text-figure). The transverse segmentation of the

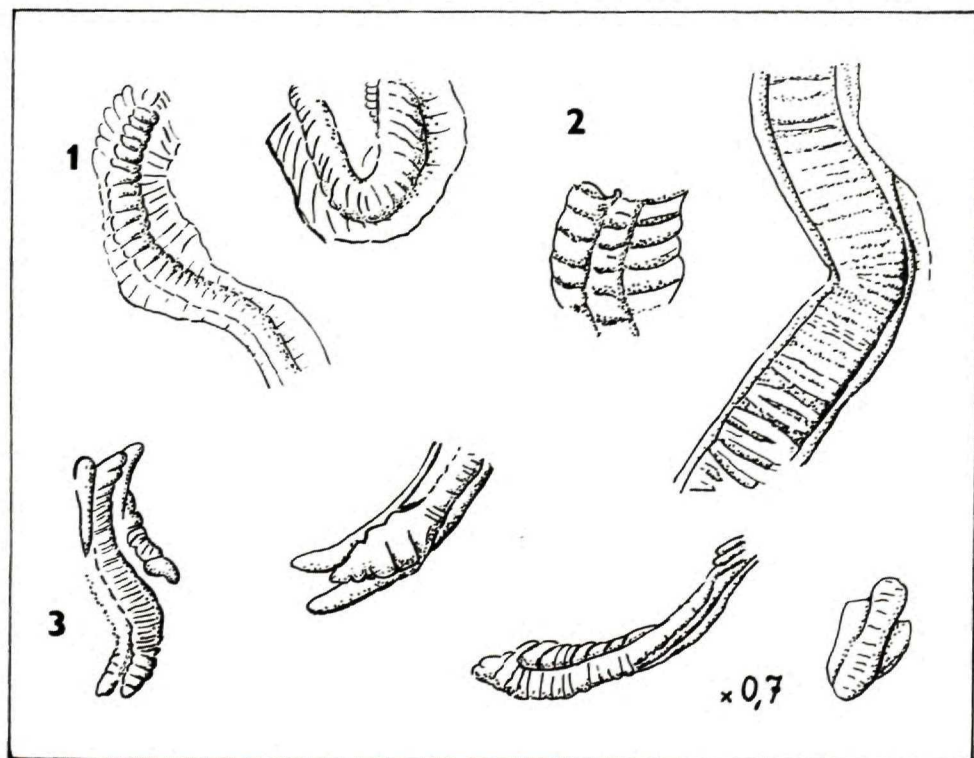


Fig. 22 — *Scolicia prisca* DE QUATREFAGES (1a, 1b, 2a) and *Scolicia plana* KSIĄŻKIEWICZ (26, 3a—d).

median lobe and the lateral fringes is nearly identical. Sample No 146/2 (Levoča locality) exhibits 6 segments per 1 cm length of the median lobe, for instance. Sample No 85/8 (Dovalovo locality) shows 4 segments per 1 cm length of the median lobe and the same values for the lateral fringes (Text-figure). The median lobe is commonly of cylindrical shape and 3 to 5 mm high. The trace irregularly meanders in its course and intersects at several points.

Sediment: Yellowish-grey and greenish-grey, fine-grained, calcareous, fine-micaceous sandstone.

Association: *Subphyllochorda laevis*, *Planolites* sp., *Punctumichnium parvum* n.sp., *Popradichnium erraticum*, *Taprhelminthopsis auricularis*, *Paleodictyon majus*.

Origin: G. H. GÖTZINGER — BECKER (1932) ascribed the *Scolicia* traces to crawling gastropods, C. K. CHAMBERLAIN (1971), however, who noticed certain pits and lobes at the base of the burrow, presumed that this type of burrow might be made by a crustacean. It has also been assumed that the *Scolicia* trace was produced by crawling marine worms (*Polychaeta*).

Occurrence: C, S, ICP (Eocene), Levoča (146) and Dovalovo (85) localities.

***Scolicia plana* KŚIAŹKIEWICZ, 1970**

Plate XLII, Figs 5, 6; Text-Fig. 22

Material: 5 specimens

Description: Epichnial trilobate furrow. The width of the trace varies from 10 to 17 mm. The median lobe is 5 to 12 mm wide, with distinct transversal segmentation, the lateral fringes are narrower, cylindrical, with transverse segmentation only at a few points. The appearance of the trace changes at its termination, as can be seen from the drawings representing sample No 146/3 (Text-fig. 22, 3a, 3b). In one instance, the median lobe suddenly widens from 4 to 10 mm and abruptly terminates with an obtuse apex (3b). The two cylindrical lateral fringes also show obtuse ends and are slightly longer than the median lobe.

Sediment: Yellowish-grey and greenish-grey, fine-grained, calcareous, fine-micaceous sandstone.

Association: Identical as with the species *Scolicia prisca*.

Occurrence: C, S, ICP (Eocene), Levoča (146) and Dovalovo (85) localities.

Ichnogenus *Subphyllochorda* GÖTZINGER and BECKER, 1932

Type specimen: *Subphyllochorda granulata* KŚIAŹKIEWICZ, 1970

Remark: The sculpture of the ventral side is quite different from that of *Scolicia*. The dorsal side is also unlike the *Scolicia* full burrow. The dorsal side of *Subphyllochorda* is seldom to be seen, as this trace is mostly developed as a hypichnial full burrow form well welded with the sole. If the *Subphyllochorda*

cylinder is detached from the sole, one gets a convex burrow on the sole, with a median sculptureless narrow ridge bordered by two featureless depressions, while on the detached cylinder any sculpture is obliterated by welding and compaction. In some instances, however, both on the counterpart of the dorsal side in the furrow and on the back of the cylinder certain features may be seen (M. KSIĄŻKIEWICZ, 1977).

***Subphylochorda laevis* KSIĄŻKIEWICZ, 1970**

Plate XLIII, Fig. 8, and Plate XLIV, Fig. 6

Material: 2 samples

Description: The lower bedding plane of the sandstone exhibits elongated loosely winding traces developed as a positive hyporelief, 2.5 to 3.8 cm wide, up to 10 mm high. Some traces cross at various levels (see sample 4/1). Two longitudinal cylindrical ridges bordering the central part of the trace up to 3 mm wide are not very conspicuous. They are rounded in sample No 69/2. The longitudinal division of the trace is not clearly visible for sample No 4/1. The trace is 8 mm high and 38 mm wide.

Sediment: Greenish-grey, fine-grained, lamellar, calcareous, fine-micaeous sandstone.

Association: *Planolites* sp., *Punctumichnium parvum*, *Megagraption tenue*, *Paleodictyon minimum*, *P. minutissimum*, *Saportia striata*, *Gordia molassica*, *Helminthoida miocenica*, *Popradichnium minutum*, *Liptovichnium dubium*.

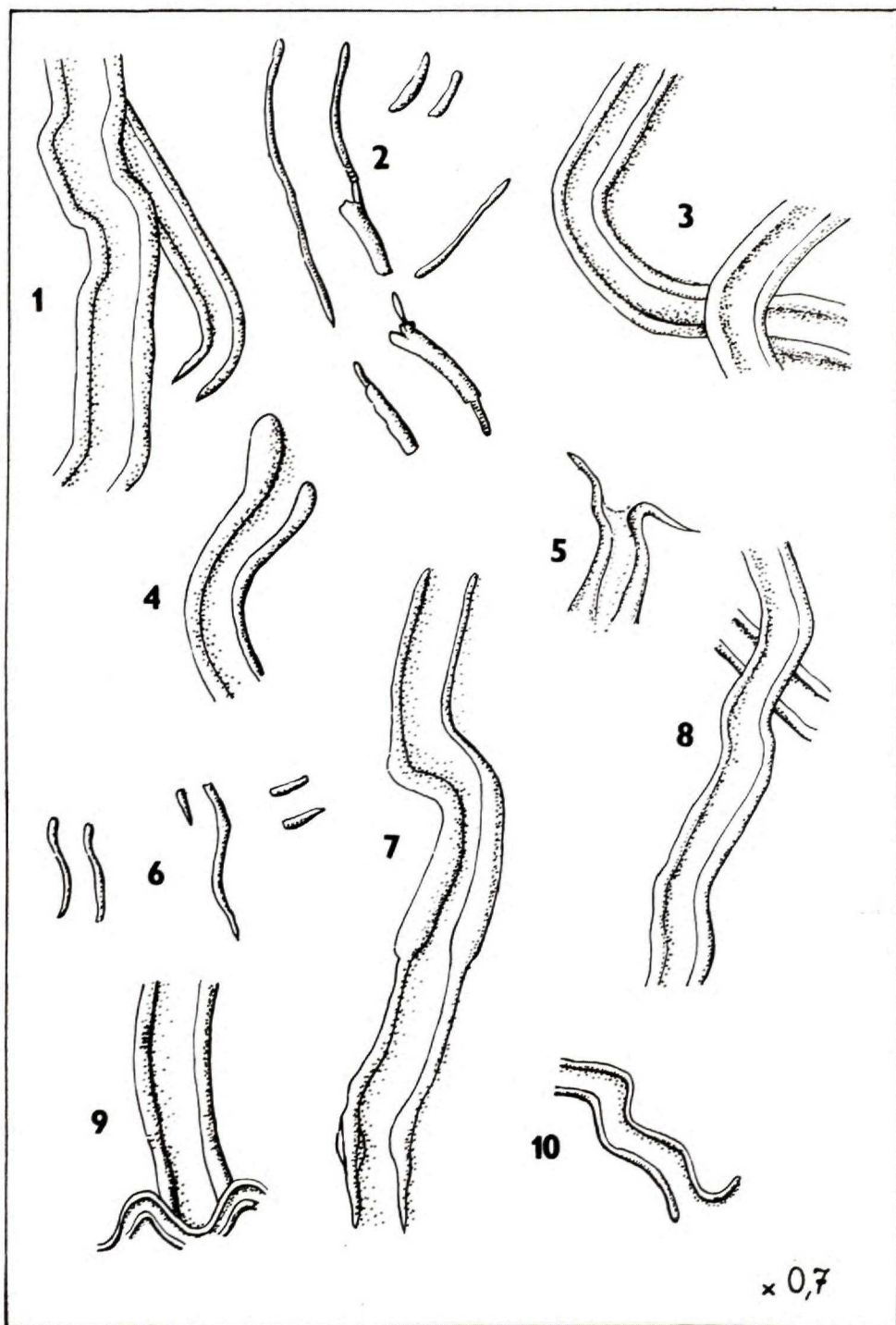
Origin: Some authors ascribe the origin of the *Subphylochorda* trace to the activity of gastropods (G. H. GÖTZINGER and BECKER, 1932, 1934), others believe them to have been produced by holothurians (B. C. HEEZEN and CH. D. HOLLISTER, 1971). Commonly the trace is thought to have been produced by molluscs, however.

Occurrence: SC, ICP (Eocene), Dolný Kubín (4), Liptovský Mikuláš (69).

Ichnogenus *Taprhelminthopsis* SACCO, 1888

Type specimen: *Taprhelminthopsis auricularis* SACCO

Remark: Bilobate trails 1 to 3 cm wide, mostly very long, morphology varying: more or less straight, freely winding or even meandering with a distinct rather large median furrow 3 to 10 mm wide, flat; lateral ridges may be transversally striated; trails varying in size and relief (W. HÄNTZSCHEL, 1975). Recently, M. KSIĄŻKIEWICZ (1977) has introduced the new generic name *Taprhelminthoida* KSIĄŻKIEWICZ 1977 (M. KSIĄŻKIEWICZ, 1977) for the meandering forms of *Taprhelminthopsis*. However, the character, the shape, and the appearance of the trace agree with the existing species *T. auricularis* and *T. recta*. It is advisable, therefore, in the case of a meandering trace, to use only the generic name for this fossil trace that expresses the meandering shape of the



trace. For this reason, I continue to hold to the systematic classification according to W. HÄNTZSCHEL (1975) who, most probably for the reasons mentioned above, abstains from listing the new generic name introduced by M. KSIĄŻKIEWICZ (1970) in 1970.

***Taprhelminthopsis auricularis* SACCO, 1888**

Plate XLIII, Figs 3—7, Plate XLIV, Fig. 4, Plate XLV, Fig. 6; Text-figs 23, 24

Material: 65 specimens

Description: The specimens from the Eocene beds of the Inner Carpathian Paleogene are 4 to 17 mm, most frequently about 10 mm wide. A sample can include larger or smaller forms, as, for instance, sample No 76/9 from Jakubovany site (76), text-fig. 23/ 1, 9. At this locality, it has been found that some beds exhibit only forms of small size varying from 5 to 7 mm. The traces commonly intersect and pass one above the other (see text-fig. 23/1, 3, 8, 9).

At some points of its course, the trace of *Taprhelminthopsis auricularis* displays distinguishing features several of which are shown in text-fig. 23 where, for instance, the bordering protruding lobes of the trace are reduced to two cylinders only 2.5 to 3 mm wide and to another thin cylinder only 1 to 1.5 mm wide, locally with indications of transverse segmentation (sample No 44/2, Vitanová locality). Another interesting fact is the swelling of the bordering ridges in the trace on Fig. 23/7 (sample No 140/1, Hrabušice locality). The bordering ridges widen from 1.5 mm to 5 mm, abruptly narrowing at a distance of 4 cm. In this case, the animal could have worked down its burrow into the sediment (increase in ridge width) and thereupon it could suddenly have turned upwards (sample 44/2). The termination of this trace is also of interest. The cylindrical borders of the trace diverge at its termination in some cases and cease to run in parallel (Text-figs 23/5, 10). Indications of traces within short sections are another characteristic feature observed for samples No 44/2 (Vitanová locality) and No 158/5 (Olšavica locality), Fig. 23/6. Normal courses of *Taprhelminthopsis auricularis* traces are obvious from the photographs of Plate XLIII, Figs 3—7.

Sediment: Greenish-grey, fine-grained, calcareous sandstone of tabular fissility.

Association: *Planolites* sp., *Popradichnium erraticum*, *P. minutum*, *Punctumichnium parvum* n.sp., *P. medium* n.sp., *Belorhapha zickzack*, *Gordia molasica*, *G. marina*, *Paleodictyon intermedium*, *P. minimum*, *P. majus*, *P. minutissimum*, *Merostomichnites beecheri*, *Scolicia prisca*, *S. plana*, *Subphyllochorda laevis*, *Eulalites obscurus*, *Megagraption tenue*, *Spirophycus minimus* n.sp., *Calixichnium häntzscheli*.

Fig. 23 — *Taprhelminthopsis auricularis* SACCO: 1 — Jakubovany (76), C, 76/6; 2 — Vitanová (44), C, 44/2; 3 — Dovalovo (85), C, 85/6; 4 — Ostružná (118), CS, 118/1; 5 — Habovka (32), S, 32/11; 6 — Olšavica (158), S, 158/5; 7 — Hrabušice (140), C, 140/1; 8 — Ostružná (118), CS, 118/2; 9 — Jakubovany (76), C, 76/18; 10 — Olšavica (158), S, 158/6.

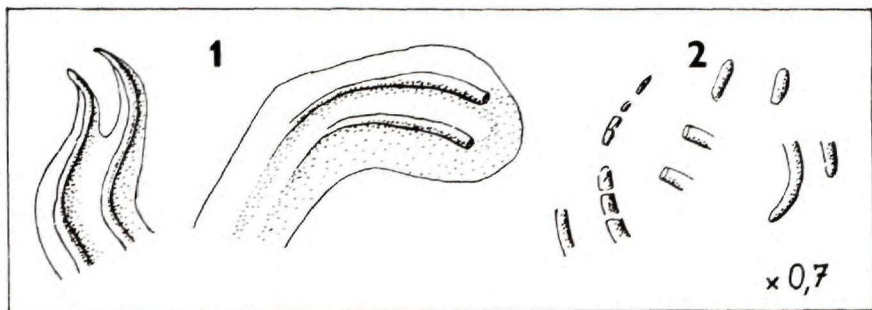


Fig. 24 — *Taprhelminthopsis auricularis* SACCO: 1 — Hybe (79), CS, facies close to the BCS facies; 2 — Jakubovany (76), C, 76/4.

Origin: Most probably a gastropod grazing trail.

Occurrence: The trace of *Taprhelminthopsis auricularis* occurs in all facies developments of the Inner Carpathian Paleogene. It is also widely distributed within the Carpathian flysch of Poland (M. KSIĄŻKIEWICZ, 1977; P. RONIEWICZ and G. PIEŃKOWSKI, 1977).

***Taprhelminthopsis maendriiformis* n. ichnosp.**

Plate XLIV, Fig. 3; Text-fig. 25

Synonym: *Taprhelminthoida convoluta* KSIĄŻKIEWICZ, 1977, p. 168—169, Pl. 22, Fig. 1, Pl. 23, Fig. 5)

Taprhelminthoida plana KSIĄŻKIEWICZ, 1970) (M. KSIĄŻKIEWICZ, 1977, p. 169, Pl. 22, Figs 2, 3).

Holotype: Sample No 173/2, Moravian Museum, Brno

Type locality: Nová Lubovňa

Type level: Claystone development, Inner Carpathian Paleogene, Eocene.

Denomination: In compliance with the meandering course of the trace.

Material: 1 specimen (sample No 173/2, holotype).

Description: Meandriform bent trace of *Taprhelminthopsis*, 9 mm wide; the individual meanders are about 7 cm deep. At some points the meanders approach each other to a distance of 6 mm only. The bordering cylinders are 1.5 to 2 mm wide. The specimens found in Poland (M. KSIĄŻKIEWICZ, 1977, Pl. 22, Figs 2—3, and Pl. 23, Fig. 5) also display meander depths of 6—7 cm.

Remark: The reason why the animal producing the *Taprhelminthopsis* trace moved in meanders on the sea-bottom may have been the animal's effort to gain as much food as possible as is the case, for instance, for the fossil trace of the genus *Helminthoida* SCHAFFHÄUTL, 1851. This may have been due to quality alterations in the sediment and its richness in food required by the animal. This could be evidenced, for instance, if studying a layer comprising the meandering trace of *Taprhelminthopsis* that, in this instance, should cover the whole surface of the layer. If the food was accumulated locally on the surface

of the sea-bottom, the freely moving animal should meander only where the layer contained a reduced amount of food. These questions should be resolved already during field work, when observing and studying the fossil traces.

Sediment: Greenish-grey, fine-grained, calcareous sandstone of thin-tabular fissility.

Occurrence: C ICP (Eocene), Nová Lubovňa locality (173).

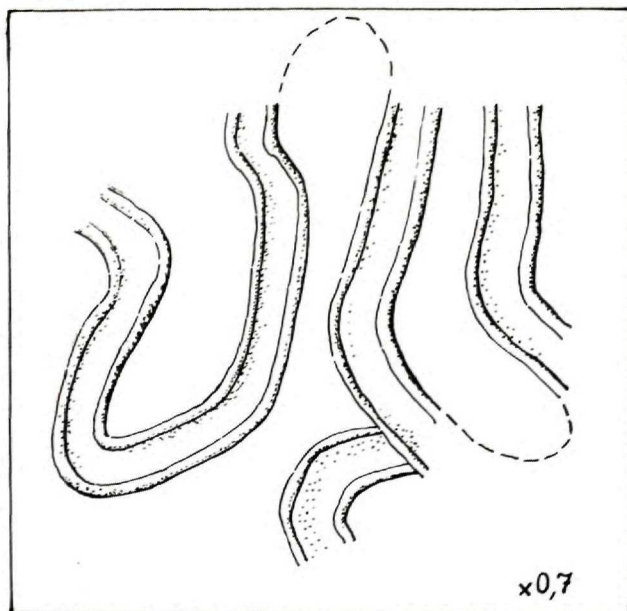


Fig. 25 — *Taprhelminthopsis maeandrimformis* n. ichnosp., Nová Lubovňa (173), C, 173/2 (holotype).

VII. Spiral structures

This group of fossil traces forming spiral trails as positive hyporeliefs on the lower bedding plane includes a single fossil trace within the Inner Carpathian Paleogene: *Spirophycus minimus* n. ichnosp..

Ichnotaxa *Spirophycus* HÄNTZSCHEL, 1962

Type specimen: *Spirophycus bicornis* (HEER)

Remark: Thick traces spirally coiled at one or both ends are included here.

***Spirophycus minimus* n. ichnosp.**

Plate XLIV, Fig. 2; Text-fig. 26

Holotype: Sample No 69/36, Moravian Museum, Brno.

Type locality: Liptovský Mikuláš, brickworks (69)

Type level: CS, ICP, Eocene.

Denomination: In compliance with its small size, from the Latin "parvus" = small.

Material: A sample with three specimens.

Diagnosis: A spirally coiled traced 1 cm in diameter, 2 to 3 mm wide, narrowing toward the centre of the spiral. Positive hyporelief, trace height 1 to 1.5 mm.

Sediment: Greenish-grey, fine-grained, calcareous, strongly fine-micaeous sandstone of tabular fissility. The sandstone fragment is 4 cm thick.

Association: *Paleodictyon minutissimum*, *P. strozzii*, *P. intermedium*, *Planolites* sp., *Taprhelminthopsis auricularis*, *Megagraption tenue*.

Origin: A. SEILACHER (1967) interprets the traces as a full burrow. According to J. PH. KERN and J. E. WARME (1974) *Spirophycus* is a burrow rather than a surface trace. *Spirophycus* is then either a locomotion trail (in most cases) or a feeding burrow. The producer might have been a polychaete, but acorn worms may also be taken into account (B. C. HEEZEN and CH. D. HOLLISTER, 1971).

Occurrence: CS, ICP, Eocene, Liptovský Mikuláš locality, brickworks (69).

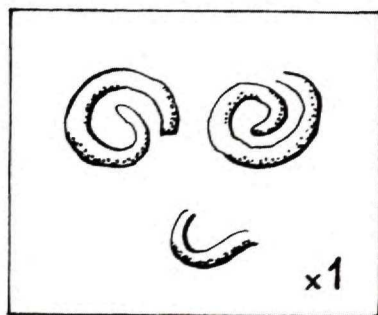


Fig. 26 — *Spirophycus minimus* n. ichnosp.: Liptovský Mikuláš (69), CS, 69/36.

VIII. Meandering structures

Here are assigned all regularly meandering traces not provided with lateral appendages or branches. The meanders of the particular ichnospecies are of approximately uniform shape. In some ichnogenera, the meanders are composite: they consist of larger first-order meanders composed of smaller second-order meanders. In the given instance, this group of fossil traces includes *Gordia* EMMONS and *Helminthoida* SCHAFHÄUTL.

Ichnogenus *Gordia* EMMONS, 1844

Type specimen: *Gordia marina* EMMONS, 1844

Remark: Slender, smooth, loosely meandering traces with numerous level-crossings are assigned to this type.

***Gordia molassica* (HEER, 1865)**

Plate XLIV, Figs 1, 5, 7; Text-figs 27, 28.

Material: 10 specimens

Description: Cylindrical traces on the lower bedding planes of the sandstone (positive hyporelief), irregularly bent, 1.5 to 2 mm wide, up to 10 cm long, overlapping one another at a few points (text-figs 27, 28).

Remark: If only a part of the trace is present on a small sandstone fragment, the trace can be mistaken for that of the genus *Helminthoida* SCHAF-HÄUTL.

Sediment: Greenish-grey, fine-grained, calcareous tabular sandstone.

Association: *Megagraption tenue*, *Paleodictyon intermedium*, *P. minimum*, *P. minutissimum*, *P. strozzii*, *Saportia striata*, *Planolites* sp., *Spirophycus minimus* n. ichnosp., *Taprhelminthopsis auricularis*, *Subphyllochora laevis*, *Helminthoida miocenica*, *Punctumichnium parvum* n. ichnosp., *Liptovichnium dubium* n. ichnogen. n. ichnosp., *Protopaleodictyon submontanum*.

Origin: The trace might have been produced by marine worms.

Occurrence: C, CS, S, ICP (Eocene). Localities: Habovka (32), Liptovská Mara (58), Liptovský Mikuláš (69), Vitališovce (71), Dovalovo (82), and Bachledová Dolina (115).

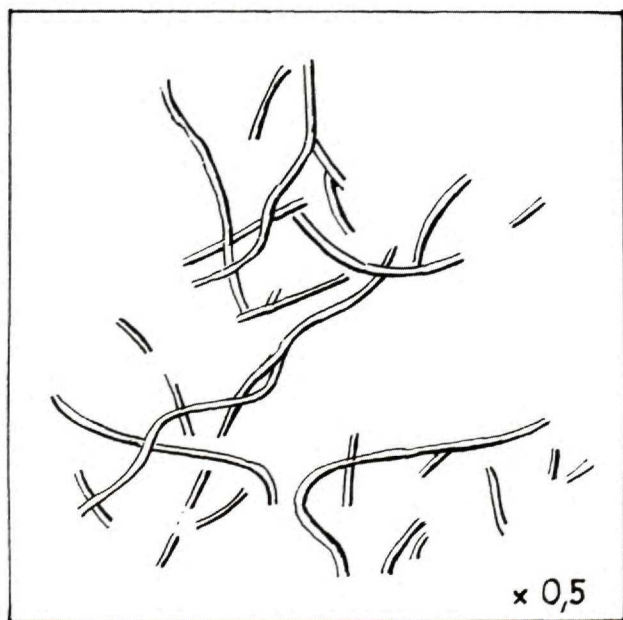


Fig. 27 — *Gordia molassica* (HEER, 1865): Bachledová (115), C, 115/3.

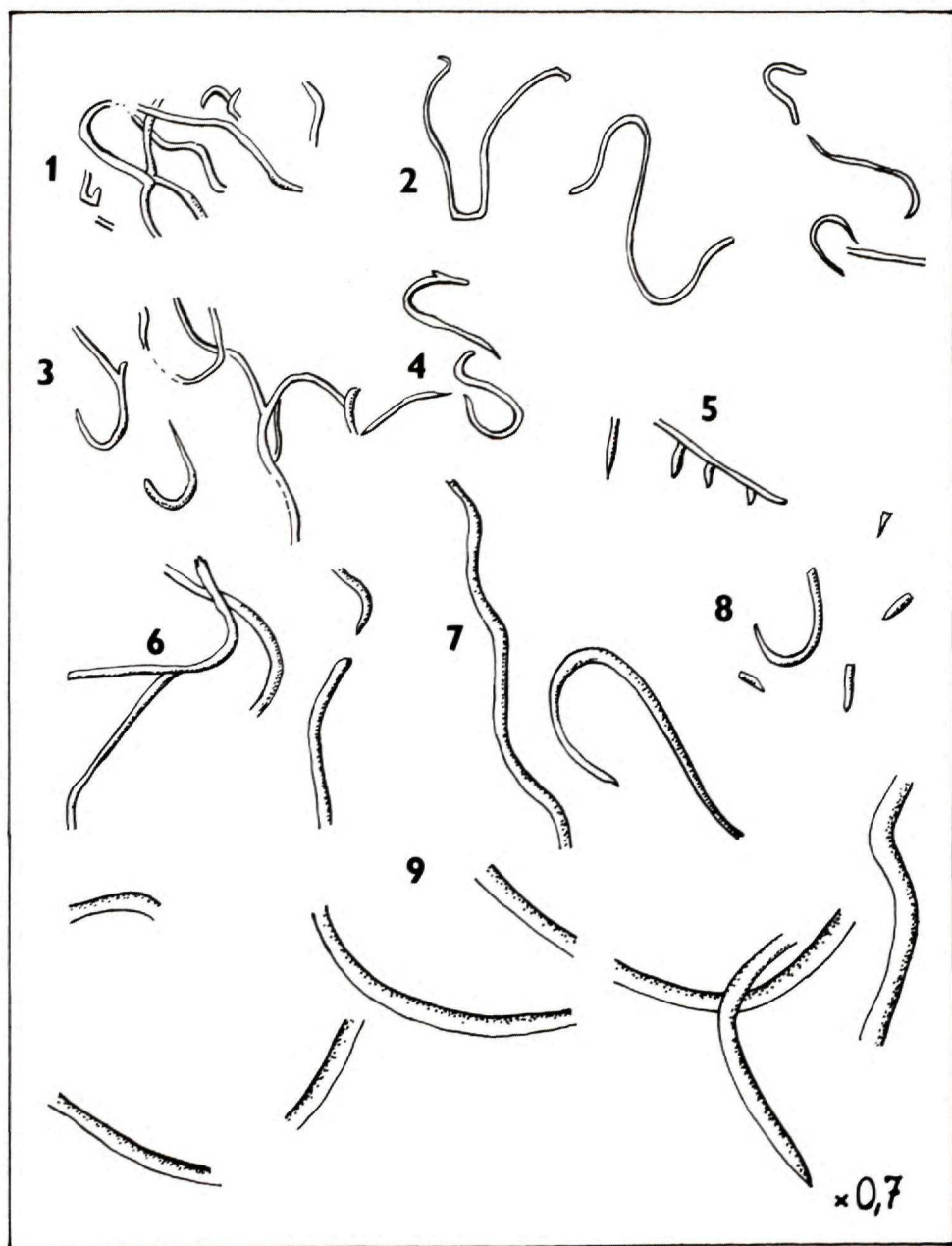


Fig. 28 — *Gordia molassica* (HEER): 1—5 Liptovský Mikuláš (69), CS, 69/11; 69/16, 69/29, 69/1, 69/50; 6 — Liptovská Mara (58), CS, 58/10; 7 — Dovalovo (82), C, 82/10; 8 — Liptovská Mara (58), CS, 58/18. *Gordia marina* EMMONS, 9 — Bachledová (115), C, 115/1.

***Gordia marina* EMMONS, 1844**

Text-fig. 28

Material: 1 specimen (115/1)

Description: Cylindrical traces on the lower bedding plane of the sandstone (positive hyporelief), 2.5 to 3.5 mm wide, more than 8 cm long, arched in various ways, overlapping at some points (Text-fig. 28/9).

Sediment: Greenish-grey, fine-grained, calcareous tabular sandstone.

Association: *Taprhelminthopsis* sp., *Gordia molassica*.

Occurrence: C, ICP (Eocene). Locality: Bachledová Dolina (115).

Ichnogenus *Helminthoida* SCHAFFÄUTL, 1851

Type specimen: *Helminthoida labyrinthica* HEER, 1865

Remark: Cylindrical meandering traces on the lower bedding plane of the sandstone (positive hyporelief), 1 to 2 mm wide. The traces are frequently interrupted in their courses.

***Helminthoida miocenica* Sacco, 1886**

Plate XLV, Fig. 4; Text-fig. 29

Material: 6 specimens

Description: Meandering trace, frequently interrupted in its course, 1—1.5 mm wide. The individual meanders are 1.5 to 4 cm deep.

Sediment: Greenish-grey, fine-grained, calcareous sandstone of tabular fissility.

Association: *Paleodictyon intermedium*, *P. minimum*, *P. minutissimum*, *P. strozzii*, *Megagraption tenue*, *M. irregulare*, *Planolites* sp., *Protopaleodictyon submontanum*, *Gordia molassica*, *Saportia striata*, *Punctumichnium parvum* n. ichnogen. n. ichnosp., *Popradichnium minutum*, *Subphyllochora laevis*, *Taprhelminthopsis auricularis*, *Spirophycus minimus* n. ichnosp.

Origin: The trace was probably produced by marine worms.

Occurrence: C, CS, ICP (Eocene). Localities: Liptovský Mikuláš (69) and Jakubovany (76).

***Helminthoida crassa* SCHAFFÄUTL, 1851**

Plate XLV, Figs 1, 2; Text-fig. 29

Material: 2 specimens (69/4, 69/13)

Description: Meandering trace on the lower bedding plane of the sandstone, 1.5 to 2 mm wide. The individual meanders are up to 7 cm deep, the course of the trace is interrupted at a few points.

Sediment: Greenish-grey, fine-grained, calcareous sandstone of tabular fissility.

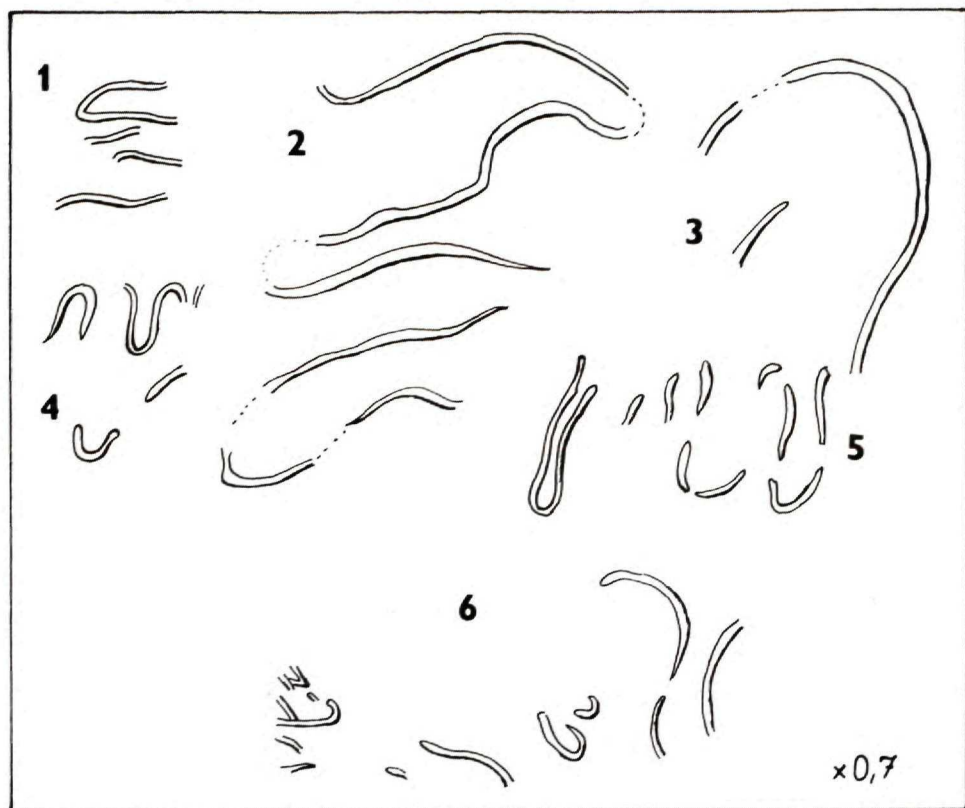


Fig. 29 — *Helminthoida miocenica* SACCO Liptovský Mikuláš (69), CS. 1 — 69/20, 2 — 69/13, 3 — 69/4, 4 — 69/39, 5 — 69/43. *Helminthoida crassa* SCHAFHÄUTL: Liptovský Mikuláš (69), CS.

Association: The same as with the species *Helminthoida miocenica*.

Occurrence: CS, ICP (Eocene). Liptovský Mikuláš locality (69).

IX. Branched winding and meandering structures

Here are grouped freely winding and meandering strings provided with more or less long lateral branches or appendages. In some types the meandering is fairly close and the lateral branches approach or reach the neighbouring main string, thus forming an incomplete network. In this way, some types grouped here form an intermediate link between the winding and meandering structures and the true networks (M. KSIĄŹKIEWICZ, 1977). This group of fossil traces includes *Belorhapha* FUCHS and *Protopaleodictyon* KSIĄŹKIEWICZ.

Ichnogenus *Belorhappe* FUCHS, 1895

Type specimen: *Belorhappe zickzack* (HEER, 1876).

Remark: Small triangular meanders with short appendages on the apices.

***Belorhappe zickzack* (HEER, 1876)**

Plate XLV, Figs 3, 5; Plate XLVI, Figs 1, 2, 3; Text-fig. 30

Material: 14 specimens

Description: In the material collected, such meanders in well-developed specimens are aligned in first-order meanders of variable shape: some are relatively narrow, others are low and broad. The first-order triangular meanders are usually 5—6 mm high and 6—7 mm wide at the base with an apical angle of about 70°. The apical juncture of the arms of the triangular meanders is sometimes rounded in many specimens (see Text-fig. 30). The inner side of the juncture is always rounder than the outer one. The width of the string is about 1.5 mm.

In several specimens, the string suddenly ceases meandering at the termination of the trace and continues in a straight line to 2—5 cm distance (see Text-fig. 30/1, 3, 5). Samples No 74/16 and 74/24 (Text-fig. 30/5, 1) exhibit, at some points, only such straight or slightly winding traces that are also assigned to the trace of *Belorhappe zickzack*. In places, only sections of the trace, mostly forming a sinusoidal meander, occur between the sharply meandering traces. In sample No 74/28 (Liptovský Ondrej), two traces exhibit a straight 5 mm long appendage in the meander bend (Fig. 30/6). Other specimens have shown that the meander bends into an arc when the trace changes its course and that the trace continues at an angle shifted by about 100—110°.

Remark: The straight or slightly winding *Belorhappe* trace, unless in association with the typical *Belorhappe* trace, could easily be considered a part of an other trace of the same cylindrical appearance. To avoid errors, only whole and complete types specimens should be determined.

Sediment: Greenish-grey, very fine-grained calcareous thin-tabular laminated sandstone.

Association: *Agrichnium incompositum*, *Cumulusichnium incertum*, *Punctumichnium parvum* n.sp., *P. medium* n.sp., *Popradichnium minutum*, *Godulaichnium tenue*, *Planolites* sp., *Taprhelminthopsis auricularis*.

Origin: The trace is of cylindrical shape in several cases. It also crosses flute casts. This suggests that it is postdepositional (M. KSIĄŻKIEWICZ, 1970, J. PH. KERN and J. E. WARME, 1974).

***Belorhappe fabregae* (AZPEITIA, 1933)**

Text-fig. 30/8

Material: 1 specimen

Description: The trace slightly differs from that of *Belorhappe zickzack*.

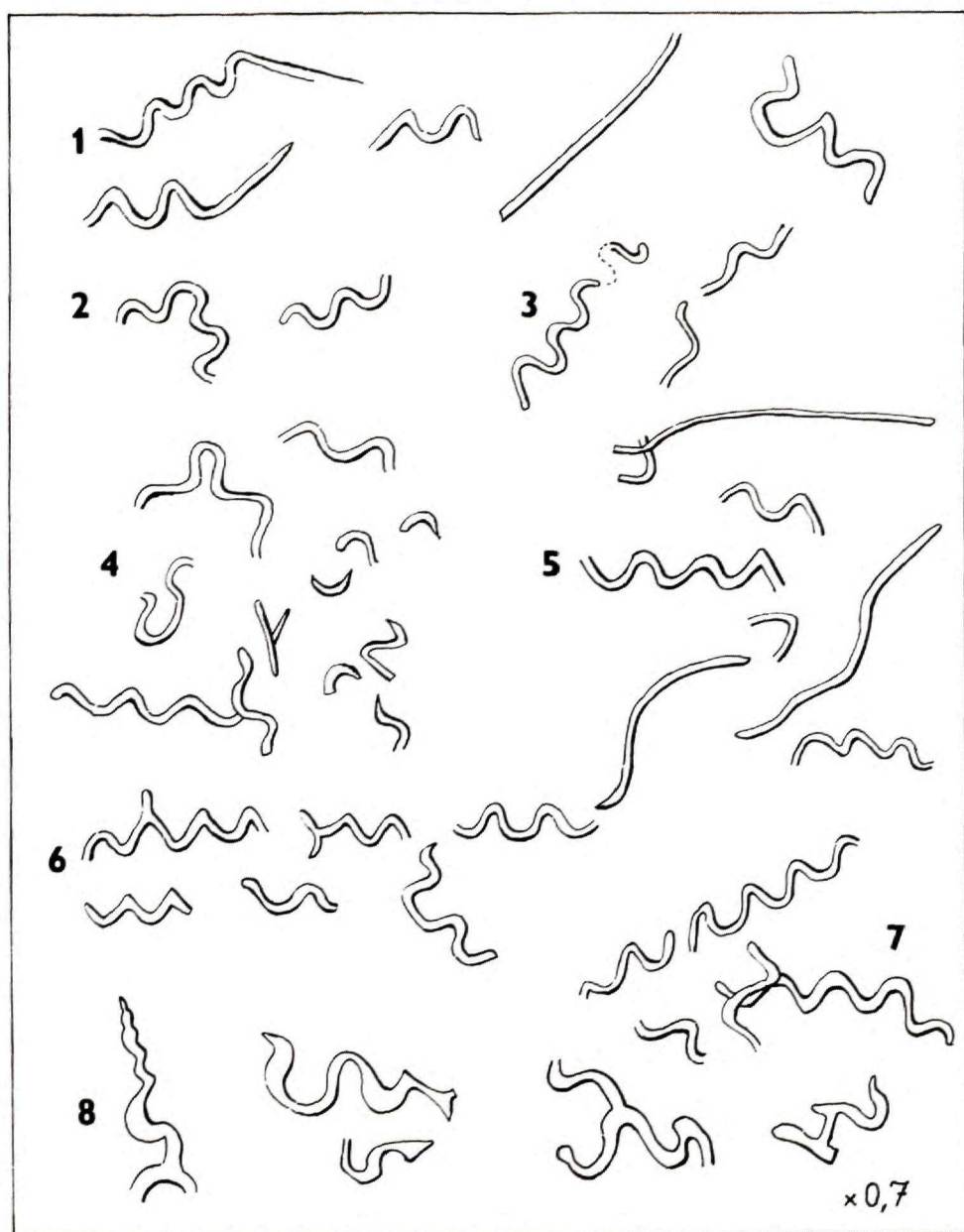


Fig. 30 — *Belorhappe zickzack* (HEER): Liptovský Ondrej (74), C. 1 — 74/24, 2 — 74/27, 4 — 74/8, 5 — 74 16, 6 — 74 28; Liptovská Mara (58), CS, 3 — 58/9, 7 — 58/3. *Belorhappe fabregae* (AZPEITIA): Vitanová (41), C. 8 — 41/2.

The triangular meanders are correspondingly larger. The apical appendages are usually small or poorly developed; the juncture of the arms is often provided with a tubercle. Some of the apical bends are sinusoidal and their inner side is round. In some specimens the meanders are not triangular but trapezoidal. The width of the string of the trace attains up to 3 mm at some points. In one instance, the appendage in the meander bend is 2.5 cm long, its course is sinusoidal and it terminates with a small nose (Fig. 30/8).

Sediment: Greenish-grey, fine-grained, calcareous tabular sandstone.

Association: *Planolites* sp., *Punctumichnium parvum* n.sp., *P. medium* n.sp., *Popradichnium minutum*.

Occurrence: C, ICP (Eocene), Vitanová locality (41).

Ichnogenus *Protopaleodictyon* KSIĄŻKIEWICZ, 1958

Type specimen: *Protopaleodictyon incompositum* KSIĄŻKIEWICZ, 1970

Remark: Hypichnial more or less regular meanders with one or two appendages usually branching from the apex of the meanders. This term was proposed by M. KSIĄŻKIEWICZ (1958), because the trace occurs in the form of an incomplete network in many cases (M. KSIĄŻKIEWICZ, 1977, p. 174).

***Protopaleodictyon minutum* KSIĄŻKIEWICZ, 1977**

Material: 1 specimen

Description: Sinuous meanders with short appendages and small tubercles on the apices. The string is about 1 mm wide and very low. The meanders are composite.

Sediment: Greenish-grey, fine-grained, calcareous sandstone of lamellar fissibility.

Association: *Paleodictyon intermedium*, *P. minimum*, *Taprhelminthopsis auricularis*, *Popradichnium minutum*, *Gordia* sp., *Planolites* sp., *Punctumichnium parvum* ichnogen n., sp. n., *Helminthoida miocenica*.

Origin: The trace was probably produced by small marine worms.

Occurrence: C, ICP (Eocene), Jakubovany locality (76).

***Protopaleodictyon submontanum* AZPEITIA, 1933**

Material: 2 samples

Description: Hypichnial string- or thread-sized casts and full burrows, irregularly winding and meandering, branching mostly at the apical bends of the meanders. The width of the string varies from 1.5 to 2.5 mm. The meandering is irregular.

Sediment: Grey, fine-grained, calcareous lamellar sandstone.

Association: *Planolites* sp., *Megagraption tenue*, *M. irregulare*, *Helminthoida miocenica*, *Gordia molassica*, *Paleodictyon minimum*, *P. minutissimum*, *P. intermedium*, *P. strozzii*, *Saportia striata*, *Subphyllochora laevis*, *Popradichnium minutum*, *Punctumichnium parvum* ichnogen. n. sp. n., *Liptovichnium dubium* ichnogen. n. sp. n.

Occurrence: CS, ICP (Eocene), Liptovský Mikuláš locality (69).

X. Networks

This group includes traces in the form of more or less complete nets with straight or almost straight strings. Here belong the fossil traces *Paleodictyon* MENEGHINI and *Megagraption* KŚIAŹKIEWICZ.

Ichnogenus *Paleodictyon* MENEGHINI, 1850

Type specimen: *Paleodictyon strozzii* MENEGHINI

Remark: The classification of *Paleodictyon* is based on the size of the meshes, the thickness of the bordering riblets, and the regularity of the meshes. The last feature seems to depend mainly on the character of the underface: on even, flat soles the meshes are on the whole more regular. A detailed analysis of the views on the origin and classification of these fossil traces has been made by M. KŚIAŹKIEWICZ (1977) and, therefore, I refer the reader to his paper.

Paleodictyon strozzii MENEGHINI, 1851

Plate XL, Fig. 5

Material: 1 specimen (69/59)

Description: The largest diameter varies between 2.5—3 mm. The bordering riblets are 0.3 to 0.8 mm wide, mostly 0.4—0.6 mm. The meshes are roughly hexagonal. The nets are of moderate size, the largest about 2.5 cm² in area.

Remark: The original definition of this type (G. MENEGHINI, 1851) is not very precise. In addition, the specimen illustrated by D. G. PERUZZI (1881) does not exactly correspond to the description of G. MENEGHINI (1851), as pointed out by VIALOV and GOLEV (1965). Specimen No 69/59 corresponds well to the mesh size of PERUZZI'S figure.

Sediment: Greenish-grey, fine-grained calcareous sandstone of tabular fissility.

Association: The trace of *Saportia striata* was found in close vicinity to the fossil trace of *Paleodictyon strozzii*.

Origin: Recently, the origin of *Paleodictyon* has been interpreted as a trace produced by small marine worms.

Occurrence: CS, ICP (Eocene), Liptovský Mikuláš, brickworks (69).

***Paleodictyon minutissimum* KSIĄŻKIEWICZ, 1970**

Plate XLVII, Figs 1, 3, 4.

Material: 6 specimens

Description: The riblets are 0.3 to 0.5 mm wide, about 0.1 to 0.2 mm high. The meshes are roughly hexagonal. Their maximum diameter varies between 0.8 to 1.2 mm.

Sediment: Greenish-grey, very fine-grained, fine-micaceous, calcareous, lamellar sandstones to siltstones, with blueish-grey patina on the lower bedding plane.

Association: *Planolites* sp., *Megagraption tenue*, *Paleodictyon minimum*, *P. medium*, *Protopaleodictyon submontanum*, *Helminthoida miocenica*, *Gordia molassica*, *Popradichnium minutum*, *Subphyllochora laevis*.

Occurrence: C, CS, ICP (Eocene), in one instance (Važec locality, 89) in the sediment immediately overlying the basal clastic sediments. Localities: Liptovský Mikuláš (69), Dovalovo (82), and Važec (89).

***Paleodictyon minimum* SACCO, 1888**

Plate XLVI, Figs 4, 6; Plate XLVII, Figs 2, 4, 7; Plate XLVIII, Fig. 2

Material: 18 specimens

Description: The meshes are 1.5–2 mm long, the riblets are 0.3 to 0.6 mm wide, about 0.3 mm high. The meshes are fairly regular, for the most part hexagonal.

Sediment: Greenish-grey, very fine-grained, calcareous, finemicaceous sandstones of lamellar fissility, with blueish-grey patina on the lower bedding plane.

Association: *Planolites* sp., *Paleodictyon minutissimum*, *P. intermedium*, *P. strozzii*, *Gordia molassica*, *Megagraption tenue*, *Popradichnium minutum*, *P. erraticum*.

Occurrence: C, CS, ICP (Eocene). Localities: Liptovský Mikuláš (69), Jakubovany (76), Dovalovo (82), Podbánske (83), Važec (91, 92), Rakúsy (212).

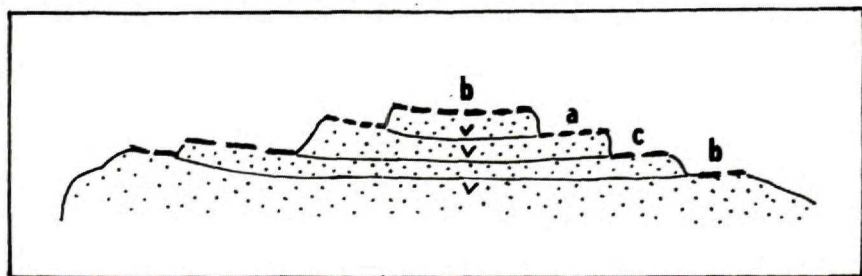


Fig. 31 — Scheme of the species sequence of the genus *Paleodictyon* MENEGHINI, 1850 in grey, laminated, fine-grained calcareous sandstone in the highway cut 500 m north of the village of Dovalovo (82): a — *Paleodictyon minutissimum*, b — *P. minimum*, c — *P. intermedium*, v — bedding plane. $\times 1$.

***Paleodictyon intermedium* KŚIAŹKIEWICZ, 1970**

Plate X, Fig. 5; Plate XI, Fig. 5

Material: 5 specimens

Description: The width of the bordering riblets ranges from 0.7 to 1.0 mm. The length of the meshes varies between 2—3 mm. The shape of the meshes is very regular, most of them are hexagonal. The size of the network decreases or increases at some points in sample No 69/36 (Liptovský Mikuláš).

Sediment: Greenish-grey, very fine-grained, fine micaceous lamellar sandstones, often with blueish-grey patina on the lower bedding plane.

Association: *Planolites* sp., *Paleodictyon minutissimum*, *P. minimum*, *Helminthoida molassica*, *Megagraption tenue*, *Gordia molassica*, *Punctumichnium minimum* n. ichnog. n. sp., *Liptovichnium dubium* n. ichnogen n. sp., *Saportia* sp., *Popradichnium minutum*, *Subphyllochora laevis*.

Occurrence: C, CS, ICP (Eocene). At Važec locality (89), *Paleodictyon intermedium* was found in the sediment immediately overlying the basal clastic sediments. Localities: Liptovský Mikuláš (69), Jakubovany (76), Dovalovo (82).

***Paleodictyon regulare* SACCO, 1886**

Plate XLVIII, Fig. 1; Text-fig. 32/2

Material: 1 specimen

Description: In sample No 98/6 (Važec), the network is relatively irregular, it is hexagonal only in one case (only a small area of the network on the sample). The riblets are for the most part 1.4 to 1.6 mm wide, some slightly thinner, while some attain 2 mm. They are relatively high, about 1 mm, and the network has a marked relief.

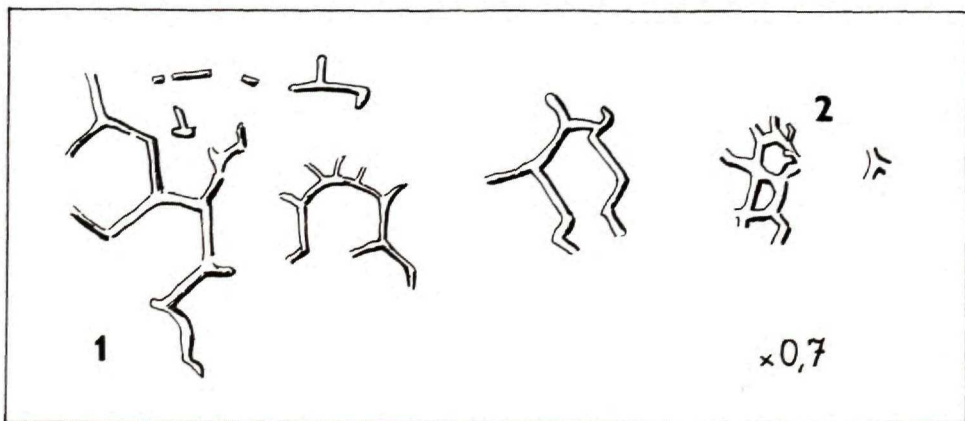


Fig. 32 — *Paleodictyon majus* MENEGHINI: 1 — Dovalovo (85), C, 85/2; 2 — *Paleodictyon regulare* SACCO: Važec (89), CS facies close to the BCS facies, 89/6.

Sediment: Greenish-grey, fine-grained, calcareous lamellar sandstone.

Association: *Planolites* sp., *Spirophycus minimus* n. sp., *Taprhelminthopsis auricularis*, *Megagraption tenue*, *Paleodictyon minutissimum*, *P. intermedium*, *Eulalites obscurus*, *Arenicolites* sp., *Aulichnites parkensis*.

Occurrence: CS, ICP (Eocene), sediments immediately overlying the basal clastic sediments, Vážec locality (89).

***Paleodictyon majus* MENEGHINI, 1851**

Plate XLVII, Fig. 6; Text-fig. 32/1

Material: 1 specimen

Description: The width of the bordering riblets is 1 to 1.5 mm. The size of the meshes varies, but most of them are longer than 9 mm. The largest network covers an area of about 30 cm² (sample 85/2, Dovalovo locality).

Sediment: Greenish-grey, fine-grained, calcareous sandstone of lamellar fissility.

Association: *Planolites* sp., *Popradichnium erraticum*, *P. minutum* n. sp., *Subphyllochora laevis*, *Scolicia prisca*, *S. plana*, *Merostomichnites beecheri*, *Taprhelminthopsis auricularis*, *Punctumichnium minutum* n. ichnogen. n. sp..

Occurrence: C, ICP (Eocene), Dovalovo locality (85).

Ichnogenus *Megagraption* KŚIAŹKIEWICZ, 1968

Type specimen: *Megagraption irregulare* KŚIAŹKIEWICZ, 1968

Diagnosis: Hypichnial straight or slightly curved burrow, string-sized, branching at approximately right angles and forming nets composed of irregular, not always closed polygons (M. KŚIAŹKIEWICZ, 1968).

***Megagraption irregulare* KŚIAŹKIEWICZ, 1968**

Text-fig. 33/5

Material: 3 specimens

Description: Light greenish-grey burrows 1.5 to 2 mm in diameter forming irregular closed polygons were found on the bedding plane of the yellowish sandstone. The angles included by the burrows vary in size.

Sediment: Yellowish-grey, fine-grained, calcareous tabular sandstones. As compared to the host rock, the burrows of *Megagraption irregulare* markedly differ in colour.

Association: *Planolites* sp., *Thalassinoides* sp., *Calixichnium häntzscheli*, *Eulalites obscurus*.

Origin: The evidently cylindrical form and intersection of sedimentary structures suggest a post-depositional origin. The abrupt breaks in the string may have been formed when the animal left the interface and descended into the clay (M. KŚIAŹKIEWICZ, 1977, p. 185).

Occurrence: BCS, ICP (Eocene) — locality: quarry near the community of Hybe (79), and CS — Liptovský Mikuláš locality (69) where the fossil trace is developed as a positive hyporelief.

***Megagraption tenue* KŚIAŹKIEWICZ, 1968**

Text-fig. 33/1—4

Material: 5 specimens

Description: Parts of irregular polygons appearing as a positive hyporelief on the lower bedding plane of the sandstone. The width of the burrows ranges from 1 to 1.5 mm. The burrows of the polygon include varying angles, up to 90° at some points, similarly as has been noted for the trace of *Megagraption irregulare*.

Sediment: Greenish-grey, fine-grained, calcareous lamellar sandstone. Localities: Liptovský Mikuláš (69) and Dovalovo (85).

Association: *Helminthoida miocenica*, *Planolites* sp., *Paleodictyon inter-*

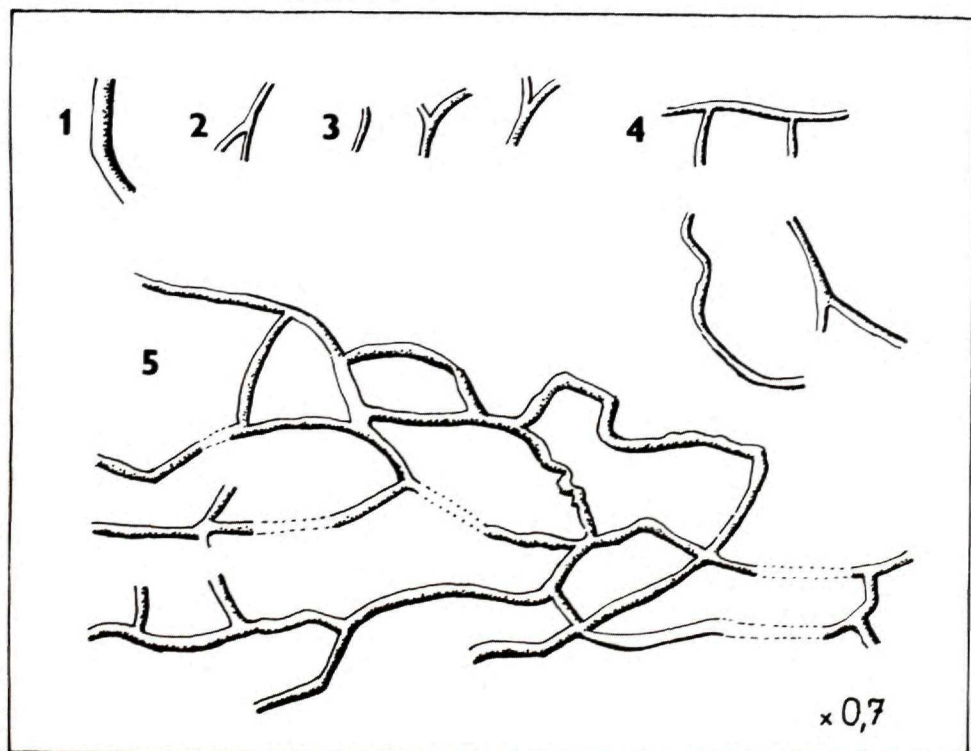


Fig. 33 — *Megagraption tenue* KŚIAŹKIEWICZ: 1—3 Liptovský Mikuláš (69), CS. 1 — 69/26, 2 — 68/26, 3 — 69/35, 4 — Dovalovo (85), C, 85/1. *Megagraption irregulare* KŚIAŹKIEWICZ: 5 — Hybe (79), BSC, 79/17.

medium, *P. minimum*, *P. minutissimum*, *Megagraption irregulare*, *Gordia molassica*, *Punctumichnium* n. ichnogen. n. sp., *Liptovichnium dubium* n. ichnogen. n. sp. *Saportia striata*, *Subphyllochorda laevis*, *Merostomichnites beecheri*, *Scolicia prisca*, *S. plana*, *Taprhelminthopsis auricularis*.

Occurrence: C, CS, ICP (Eocene) — Liptovský Mikuláš (69) and Dova-lovo (85) localities, and BSC — Vážec locality (89).

XI. Body fossils

The problematic fossil remains that W. HÄNTZSCHEL (1975) assigned to the group of "Body fossils" with uncertain classification were included by me into this group, namely *Eulalites* PLIČKA and *Carpatia* PLIČKA.

Genus *Eulalites* PLIČKA, 1984

Type specimen: *Eulalites obscurus* PLIČKA, 1984

Eulalites obscurus PLIČKA, 1984

Plate XLVIII, Figs 3, 5; Text-fig. 34

Material: 3 sandstone fragments (sample No 89/1—3)

Description: Distinct dark worm-like shapes, up to 8 cm long, (with breaks within their extent in case a specimen is partly covered with a sandstone film), appear irregularly on the upper surface of a sandstone layer. The width of the shape is up to 1.5 mm. The spread of the substance along the lateral

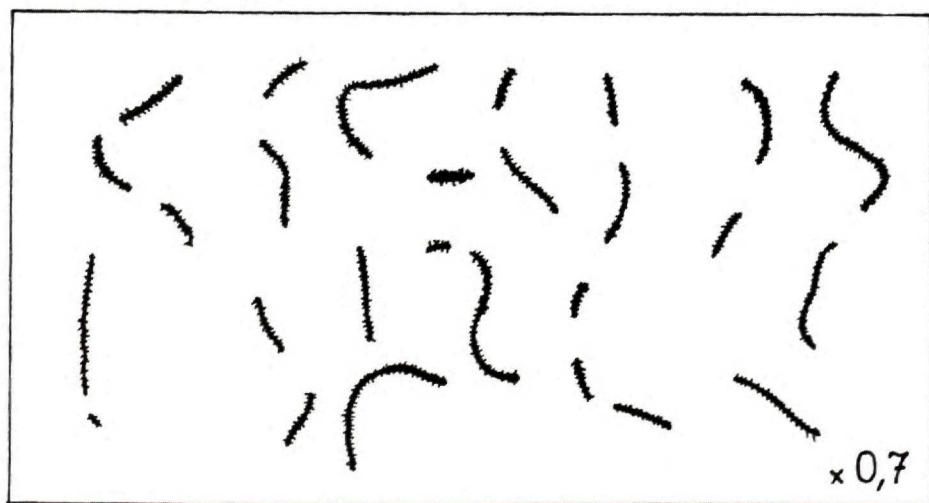


Fig. 34 — *Eulalites obscurus* PLIČKA: Vážec (89), CS facies close to the BSC facies (M. PLIČKA, 1984, Fig. 2, p. 185).

margins of the body is about 0.25 mm. By its shape the spread substance resembles limbs of a worm similar to the Recent marine worm *Eulalia viridis* (*Polychaeta*, *Errantia*, *Phyllodoctidae* — see fig. on Pl. 67 in R. RIEDL, 1963).

Remark: A similar appearance — dark substance of the organic remains contrasting with the host rock — is characteristic of the find described by K. E. CASTER and H. K. BROOKS (1956) (W. HÄNTZSCHEL 1975, W. 149, Fig. 91/3). We can quote from their description: "...fringed ribbon reduced to carbonaceous film, with longitudinal lines" (W. HÄNTZSCHEL 1975, W. 149).

Sediment: Yellowish-grey, calcareous, fine-grained sandstone, partly flaggy and over 30 cm thick. Fossil remains found in the upper part of a large sandstone fragment.

Association: *Arenicolites* sp., *Paleodictyon regulare*, *P. intermedium*, *Megagraption tenue*, *Spirophycus minimus* n. sp.

Origin: Remains of marine worms probably belonging to the group *Polychaeta*, *Errantia*. The worms were of small size with a maximum length of 8 cm.

Occurrence: CS, in sediments immediately overlying the basal clastic sediments (Eocene), Vážec locality (89).

Genus *Carpatia* PLIČKA, 1986

Type specimen: *Carpatia tubiformis* PLIČKA, 1986

Carpatia tubiformis PLIČKA, 1986

Plate XLVIII, Fig. 4; Text-fig. 35

Material: 4 samples

Description: The lower bedding plane of the sandstone shows irregularly dispersed, relatively short, straight or slightly curved fragmental forms differing from the host rock and somewhat lighter in colour. Mostly they are about 2 mm wide, their thickness (height) is only a few tenths of millimetres. Their surfaces are smooth lacking transversal striation, the rims form longitudinal ridges at some points. These bordering longitudinal ridges remind the flattened string of a marine animal. Detailed studies of these forms have revealed indica-

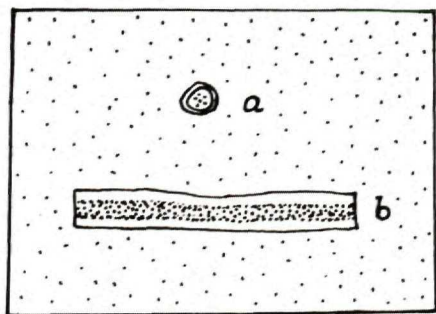


Fig. 35 — *Carpatia tubiformis* PLIČKA: Vážec (90), BCS, 90/1. $\times 2$.

tions of elliptic mounds leading into the string at the extremities of the forms, as can be seen from the holotype specimen illustrated on the Plate and from the text-figure (see M. PLIČKA, 1986), and from text-fig. 34 of the paper presented (sample No 90/1).

Remark: A striking three-dimensional spatial arrangement of the organic remains can be noted under the binocular microscope. The lighter in colour and finer sandy substance markedly differs from the host rock and forms a film of several tenths of millimetres on the lower bedding plane of the sandstone.

Sediment: Grey, fine- to medium- grained, calcareous sandstone.

Association: *Planolites* sp., *Cosmorhaphie sinuosa*, *Agrichnium incompositum*, *Subphyllochora laevis*. *Planolites* sp., and *Nummulites* sp. were determined in the Eocene beds of the Inner Carpathian Paleogene, the other associations belong to the Paleocene of the Solán series of strata of the Magura nappe.

Origin: Probably remains of the tubes of marine worms (*Polychaeta*, *Sedentaria*).

Occurrence: BCS, ICP (Eocene), Važec locality (90), and sandstones of the Solán series of strata of the Magura nappe (Paleocene), Stará Hutě locality (see M. PLIČKA, 1986).

Conclusion

The studies of fossil traces made within the Inner Carpathian Paleogene in Slovakia supply information both on the distribution of fossil traces in the mentioned region and the generic and species frequency. They also provide new data on the bathymetric conditions of the former sedimentary basin in this region as far as ichnofacies are concerned (A. SEILACHER, 1955, 1963, 1967, etc.). It could be stated in the course of the studies already that the Inner Carpathian Paleogene region in Slovakia proved to be well suited for investigations of fossil traces. The region is not affected by complex nappe structure; the geological structure and the lithofacies are relatively clearly perceptible on the surface. This enables the lithological development of the beds and the individual ichnofacies to be correlated. However, it is true that, on the scale of the general geological map, the delimitation of lithofacies is not quite exact and in accordance with the latest investigations (R. MARSCHALCO 1966, 1968, P. GROSS 1971, 1979, P. GROSS — E. KÖHLER et al. 1980) does not fully comply with reality. For this reason and for the sake of accuracy, the lithological development of the beds was also examined at the localities during our studies of fossil traces (see Fig. 4 and Fig. 5).

Recently, a new lithostratigraphic division of the Inner Carpathian Paleogene has been elaborated (P. GROSS — E. KÖHLER — O. SAMUEL, 1984). I quote it in the paper in order to allow its comparison with the individual sheets of the general map to be made. Four lithostratigraphic units have been determined: 1) the Borové Formation composed of mostly coarse-clastic material, 2) the Huty Formation consisting mostly of claystones, 3) the Zuberec Formation represent-

ing a flysch facies, 4) the Biely Potok Formation composed of a flysch facies with absolutely dominant sandstones. A particular lithostratigraphic unit is represented by the Pucov conglomerates present in various stratigraphic levels of the above formations.

The most numerous generic representation of trace fossils (24 genera) has been found in the claystone facies of the Inner Carpathian Paleogene. The claystone-sandstone facies ranges at the second place (19 genera) followed by basal clastic sediments (16 genera), the sandstone facies (7 genera), the sandstone-claystone facies (2 genera) and by the Šambroň Beds. It should be noted, however, that the basal clastic sediments include fossil traces occurring also in close proximity, but in the finer-grained sediments immediately overlying them (question concerns sandstone fragments assigned to the claystone facies). In this case, only 9 genera of trace fossils could be derived from the coarse sedimentary material, whereas the number of genera occurring in the claystone facies would increase from 24 to 31.

When proceeding, in our evaluation of fossil traces, from the south margin of the Inner Carpathian Paleogene, i.e. from the zone of the basal clastic sediments, to the north we can find there, in accordance with our knowledge on ichnofossils, traces of *Thalassinoides* sp. an *Arenicolites* sp. that evidence shallow-water environments. *Calixichnium häntzscheli* occurring in association with the above two traces in the basal clastic sediments can point to marginal shallow-water environment also in the area of Podolinec (135) ENE of the High Tatra Mountains, particularly since the fossil trace of *Arenicolites* has been found next to the mentioned new-determined trace. From the viewpoint of the surface geology of the region, the Podolinec site is situated about 4 km southeast of the basement that comes out to the day in a narrow ribbon there.

In contrast to the "*Zoophycos facies*" in the sense of A. SEILACHER (1954, 1957, etc.), in accordance with whom the presence of *Zoophycos* is indicative of deeper sedimentary environment, within the Inner Carpathian Paleogene *Zoophycos* was found in the sandstones of the basal clastic sediments (shallow-water environment) at Spišské Vlachy locality (172) and in the sandstones of the Šambroň Beds (Lipany locality — 181). The third find of *Zoophycos* comes from the claystone-sandstone facies west of Zuberec locality (218). On the other hand, fossil traces corresponding to deeper sedimentary environment, such as *Paleodictyon* and *Godulaichnium*, appear in close proximity to the basal clastic sediments.

When comparing the results of fossil trace studies within the Inner Carpathian Paleogene in Slovakia to those of the latest sedimentological investigations made in this region (R. MARSCHALKO, 1981), the basal clastic sediments have been found to represent, in compliance with the sedimentological results, a shallow-water transgressive formation situated upon the older basement. Traces of *Thalassinoides* sp. and *Arenicolites* sp. evidencing this fact have been determined. However, the discovery of *Zoophycos* in the sandstones near the railway station of the village of Spišské Vlachy (also a marginal facies) is inconsistent with this fact. This was discussed earlier. The question concerns the

Table 1

	BCS	C	CS	SC	S	Š
<i>Agrichnium incompositum</i>		•				
<i>Arenicolites</i> sp.	•					
<i>Aulichnites parkensis</i>	•					
<i>Belorhapha fabregae</i>		•				
<i>Belorhapha zickzack</i>		•	•			
<i>Buthotrephis</i> sp.		•				
<i>Calixichnium häntzscheli</i>	•			•		
<i>Capodistria vetteri</i>			•			
<i>Carpatia tubiformis</i>	•					
<i>Cumulusichnium incertum</i>		•				
<i>Eulalites obscurus</i>	•					
<i>Godulaichnium tenue</i>	•	•	•			
<i>Gordia marina</i>		•				
<i>Gordia molassica</i>		•	•		•	
<i>Gyrichnites</i> sp.		•	•			
<i>Helminthoida miocenica</i>		•	•			
<i>Helminthoida crassa</i>		•				
<i>Chondrites aequalis</i>			•			
<i>Liptovichnium dubium</i>			•			
<i>Megagraption irregulare</i>	•	•	•			
<i>Megagraption tenue</i>						
<i>Merostomichnites beecheri</i>		•				
<i>Paleodictyon intermedium</i>	•	•	•			
<i>Paleodictyon majus</i>		•				
<i>Paleodictyon minimum</i>		•	•			
<i>Paleodictyon minutissimum</i>	•	•	•			
<i>Paleodictyon regulare</i>	•					
<i>Paleodictyon strozzii</i>		•				
<i>Planolites</i> sp.	•	•	•	•	•	
<i>Popradichnium erraticum</i>	•	•	•		•	
<i>Popradichnium minutum</i>	•	•	•		•	
<i>Protopaleodictyon minutum</i>		•				

	BCS	C	CS	SC	S	Š
<i>Protopaleodictyon submontanum</i>			•			
<i>Punctumichnium medium</i>		•	•			
<i>Punctumichnium parvum</i>		•	•			
<i>Saportia striata</i>			•			
<i>Scolicia plana</i>					•	
<i>Scolicia prisca</i>		•			•	
<i>Spirophycus minimus</i>			•			
<i>Subphyllochora laevis</i>			•			
<i>Taprhelminthopsis auricularis</i>	•	•	•	•	•	•
<i>Taprhelminthopsis maeandriiformis</i>		•				
<i>Thalassionoides</i> sp.	•					
<i>Zoophycos circinnatus</i>	•		•			

contradiction in how to understand the notion of “*Zoophycos facies*”. The claystone facies of the Paleogene beds that had gradually developed from this basal transgressive facies, as reported by R. MARSCHALCO (1981), comprises fossil traces in the close vicinity (in the cover) that have been reported from deep sedimentary environment (e.g. *Paleodictyon* sp.). The flysch facies of the Šariš Upland, the Levoča Hills, and the Kapušany-Vranov nad Topľou zone are relatively poor in fossil traces. The number and species of fossil traces decrease with the increasing coarseness of the sediments, and only the trace of *Planolites* species has been preserved ultimately.

As to the presence or absence of fossil traces in the sediments (if taking into account the high degree of exploration), some areas appear to be rather poor in fossil traces. This is the case, for instance, in the area surrounding Pribiš (19, 20, 21) and northeast of the town of Dolný Kubín, where the Eocene beds are developed as claystones and sandstones, or northeast of Levoča with sandstone development of the beds. No fossil traces were found in the claystone and claystone-sandstone facies of the Eocene beds in the Spišská Magura area south and southwest of Haligovce, even though a several kilometres long section perpendicular to the beds was explored in detail. The same is true for the sandstone and conglomeratic facies of the Žipov — Radačov zone SW of Prešov.

Studies of the map of the distribution of fossil traces have shown that, at the south margin of the Inner Carpathian Paleogene in the vicinity of the basal clastic sediments with prevailing claystone and claystone-sandstone development of the beds, (the Ružomberok–Východná–Poprad area), the number of localities comprising fossil traces is high and that the generic representation of the latter covers a wide range. On the other hand, localities that follow the zone of basal clastic sediments bounding the Mesozoic formations and the crystalline complex of the High Tatra Mountains and the Mesozoic formations southeast

of Dolný Kubín, almost lack fossil traces (claystone facies, the area between the villages of Malatiná-Vitanová-Ždiar). Although lithologically identical Paleogene facies are developed in the north and south areas near the belt of basal clastic sediments, the presence or absence of fossil traces in the sediments seems to be due to other effects (oxygenation, chemism, currents, etc.). At Pribiš locality a stratigraphic sequence exceeding 70 m in thickness was investigated and revealed abundant flute casts throughout the profile, but no fossil traces. The evolution of the animals on the seabottom could have been influenced by the mentioned effects, even if the latter should not be considered the decisive factors.

When comparing the evolution of trace fossils in the beds of the Inner Carpathian Paleogene and the Outer Carpathian flysch in Czechoslovakia (the trace fossils from the latter region are under study at the present time) with the evolution in Poland (M. KSIĄŻKIEWICZ, 1977), we arrive at a very important discovery: it is only in the region of the Inner Carpathian Paleogene that the marginal flysch facies (basal clastic sediments) has been found to comprise typical trace fossils indicating shallow-water environment, namely *Thalassinoides* sp. and *Arenicolites* sp. In addition, the new-determined fossil trace of *Calixichnium häntzscheli*, can be thought to be another member of the gamut of this ichnofacies. For comparison: traces of *Thalassinoides* have also been found in the sediments of the Mulussa Formation (calcareous dolomites, Upper Triassic) and Digma Formation (limestones to marlstones, Cretaceous, immediately underlying the basal Paleogene conglomerates of the Ummer Radhuma Formation) in the western part of the Ga'ar depression in Iraq where shallow-water environment is evident (M. PLIČKA, 1980). The occurrence of *Thalassinoides* traces in beds immediately underlying the basal Paleogene conglomerates in Iraq is a certain analogy to the presence of these traces in the Inner Carpathian Paleogene in Czechoslovakia.

The following important fact should be mentioned in conclusion. After the studies of traces fossils in the Paleogene formations of Central Slovakia were terminated and the paper written, this region was found to be the only suitable to begin studies of this kind in a large areal unit. In this region it was possible to proceed from the marginal shallow-water facies of basal sediments the importance of which exceedingly increases at the present time. This is because recent geophysical deep seismic surveying throughout the Carpathian flysch zone has shown that the division into an Outer and an Inner Carpathian flysch belt loses its importance from the genetical point of view (personal communication, RNDr. Č. TOMEK CSc. Geofyzika, Brno). In this case, the basal clastic sediments of Slovakia are the only marginal basinal facies of the whole Carpathian flysch that has been exposed at the surface. For this reason, fossil traces of *Thalassinoides* sp. and *Arenicolites* sp. have not yet been found in the western or eastern areas of the Outer Carpathian flysch in Czechoslovakia during the field work conducted since 1960 (M. PLIČKA, 1968; A. NĚMCOVÁ, 1973). The same was the case in the vast region of the flysch zone in Poland where more than 3000 specimens of trace fossils were evaluated (M. KSIĄŻKIEWICZ, 1977).

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M. Plička

Fosilní stopy ve vnitrokarpatiském paleogénu na Slovensku

Resumé

Při geologických pracech, které jsem prováděl v oblasti karpatského flyše v Československu, jsem začal od r. 1960 věnovat pozornost i fosilním stopám a fosilním zbytkům organismů. Vzorky byly příležitostně sbírány a studovány. Některé nové nálezy byly již publikovány (M. PLÍČKA 1968, 1970, 1974, 1981, 1982, 1984a, 1984b, 1984c). Od roku 1976 byly zahájeny příležitostně studie fosilních stop i v oblasti vnitrokarpatiského paleogénu na Slovensku. Studium bylo provedeno a dokončeno v r. 1985 právě v této oblasti a to z toho důvodu, že oblast vnitrokarpatiského paleogénu je geologicky jednodušší než území vněkarpatiského flyše, které je tektonicky velmi silně postiženo. Systematičtěji jsem práce prováděl od r. 1978 a to v rámci prací Ústředního ústavu geologického, Praha, pobočka, Brno, v roce 1981—1982 i v rámci prací Geologického ústavu Dionýza Štúra, Bratislava.

Vzorky ze studované oblasti jsou uloženy ve sbírkách Moravského muzea v Brně. Celkem bylo navštíveno 218 lokalit a nasbíráno asi 500 vzorků fosilních stop. Do mapy (Fig. 2, Fig. 3) jsou zakresleny i lokality, na nichž fosilní stopy nebyly zjištěny. Je to proto, že na některých lokalitách byly prohlédnuty značně rozsáhlé úseky buď ve směru vertikálním (např. lokalita Pribiš/19) (nebo ve směru vrstev (např. lokalita Malatiná). Podobně tomu bylo i jinde ve studované oblasti.

Hranici studovaného území tvoří na SZ a SV bradlové pásmo, na S je omezeno státní hranicí s Polskem. Jižní hranici je mezozoikum Nizkých Tater a neogén v. Slovenska. V prostoru s. od Vysokých Tater navazují na naše území polští autoři R. RONIEWICZ—G. PIEŃKOWSKI (1977), kteří v uvedeném prostoru studovali v poslední době také fosilní stopy. Pro názornost litologického vývoje vrstev na jednotlivých lokalitách byly sestaveny litologické profily vrstev buď na základě podrobného popisu vrstev na lokalitě nebo byla provedena schematická rekonstrukce profilu dle celkové charakteristiky vývoje vrstev (Fig. 4, Fig. 5).

Aby bylo usnadněno v různých oblastech karpatského flyše studium fosilních stop (jejich vzájemná korelace, návaznost jednotlivých oblastí a pod.), přidružuji se členění fosilních stop dle M. KSIĄŻKIEWICZE (1977), který zpracoval rozsáhlou oblast karpatského flyše na území Polska. Jmenovaný autor rovněž velmi podrobně rozvedl ve všeobecné části své práce údaje, týkající se například vztahu fosilních stop k litologii, hloubce sedimentačního prostředí, jejich pozice ve vrstvě a podobně. Neuvádím zde proto znova tyto údaje a odkazuji na jeho práci. Rovněž u jednotlivých fosilních stop neuvádím (jen vyjimečně) jejich výskyt na území Polska nebo u nás v oblasti vněkarpatského flyše. Údaje by enormně narůstaly.

V seznamu fosilních stop pro úplnost uvádím i dva problematické fosilní zbytky ("Body Fossils"). V oblasti vnitrokarpatského paleogénu byl zjištěn na třech lokalitách také *Zoophycos* sp.. Uvádím jej pro úplnost také v seznamu fosilních stop, i když mám na jeho původ odlišný názor (M. PLIČKA 1968, 1969, 1970, 1974; W. HÄNTZSCHEL 1975).

Při studiu fosilních stop v oblasti vnitrokarpatského paleogénu jsem úzce navazoval na geologické práce Dr. P. GROSSA CSc, který zvláště z. část území podrobně geologicky zmapoval. Upozornil mne rovněž na lokality s bohatým výskytem fosilních stop, což mně práci velmi usnadnilo. Za tuto pomoc a zájem o moji práci mu upřímně děkuji. Děkuji také Dr. T. K. KORÁBOVI CSc za upozornění na výskyt *Zoophycos* u obce Lipany a Dr. J. NEMČOKOVI CSc a Dr. T. ĎURKOVIČOVI CSc (rovněž GÚDŠ Bratislava) a Dr. R. MARŠALKOVI DrSc (SAV Bratislava) za rady a odbornou pomoc v oblasti vnitrokarpatského paleogénu.

Jak ukázalo studium fosilních stop v oblasti vnitrokarpatského paleogénu na Slovensku, druhově jsou nejpočetněji zastoupené fosilní stopy v jílovcovém vývoji (24 druhů). Na druhém místě je jílovcovo-pískovcový vývoj (19 druhů), následují bazální klasické sedimenty (16 druhů), pak pískovcový vývoj (7 druhů), pískovcovo-jílovcový vývoj (2 druhy) a nakonec šambronské vrstvy. Je ovšem nutné připomenout, že v případě bazálních klastických sedimentů jsou do nich zahrnuty i fosilní stopy, vyskytující se sice v jejich těsné blízkosti, ale v jemnějších sedimentech v jejich těsném nadloží (jedná se totiž o úlomky pískovců, náležejících vývoji jílovcovému). V tom případě by pak z hrubého sedimentačního materiálu pocházelo jen 9 druhů fosilních stop, v jílovcovém vývoji by se počet druhů zvýšil ze 24 na 31 druhů.

Když vycházíme při hodnocení fosilních stop od j. okraje vnitrokarpatského paleogénu směrem k severu, t. j. od pruhu bazálních klastických sedimentů, v souladu s dosavadními poznatky o ichnofaciích nacházíme v nich stopu *Thalassinoides* sp. a *Arenicolites* sp., dokládající mělkovodní prostředí. Fosilní stopa *Calixichnium häntzscheli*, vyskytující se v asociaci s uvedenými dvěma stopami pak může být dokladem okrajového mělkovodního prostředí i v prostoru Podolínce (135), vsv. od Vysokých Tater, zvláště když v těsné blízkosti jmenované, nově zjištěné fosilní stopy (M. PLIČKA 1981) byla zjištěna i fosilní stopa *Arenicolites* sp. Z hlediska povrchové geologické stavby území, je lokalita Podolínce totiž vzdálená asi 4 km směrem od podloží, které tam vystupuje v úzkém pruhu na povrch.

V rozporu se "*Zoophycos facies*" ve smyslu A. SEILECHERA (1954, 1957 a další práce), kdy přítomnost *Zoophycos* dokládá hlubší sedimentační prostředí, v oblasti vnitrokarpatského paleogénu byl *Zoophycos* zjištěn v pískovcích bazálních klastických sedimentů (mělkovodní prostředí) na lokalitě Spišské Vlasy (172) a v pískovcích šambronských vrstev — lokalita Lipany (181). Třetí nálež *Zoophycos* pochází z jílovcovo — pískovcového vývoje z. od lokality Zuberec (218). Naproti tomu zase v těsné blízkosti bazálních klastických sedimentů se objevují fosilní stopy, odpovídající hlubšímu sedimentačnímu prostředí, jako je *Paleodictyon* a *Godulaichnium*.

Při srovnání výsledků studia fosilních stop v oblasti vnitrokarpatského paleogénu na Slovensku a nejnovějších sedimentologických výzkumů v této oblasti (R. MARŠALKO, 1981) zjišťujeme, že v souladu se sedimentologickými poznatky představují bezzánní klastické sedimenty mělkovodní transgresivní útvar na starším podloží. Byly zjištěné fosilní stopy *Thalassinoides* sp. a *Arenicolites*

sp., dokládající tuto skutečnost. Naproti tomu však zjištění *Zoophycos* například v pískovcích u nádraží v obci Spišské Vlachy (rovněž okrajová facie) je v rozporu s touto skutečností. O tom však již bylo diskutováno dříve. Jedná se o rozpor v pojímání významu "*Zoophycos* facies". Jilovcový vývoj paleogenních vrstev, který se z této bazální transgresivní facie pozvolna vyvíjí, jak uvádí R. MARSCHALKO (1981), v její těsné blízkosti (nadloží) obsahoval naopak zase fosilní stopy, které jsou uváděny z hlubšího sedimentačního prostředí (například *Paleodictyon* sp.). Flyšové litofacie Šarišské vrchoviny, Levočských vrchů a pásma Kapušany — Vranov nad Topľou jsou na fosilní stopy poměrně chudé. S přibýváním hrubosti zrna v sedimentech ubývá totiž počtu i druhů fosilních stop, z nichž se posléze uchovává jediné stopa *Planolites* sp.

Z hlediska přítomnosti nebo naopak nepřítomnosti fosilních stop v sedimentech (bereme-li v tomto směru v úvahu značnou prozkoumanost vrstev), se jeví některé oblasti na fosilní stopy velmi chudé. Tak je tomu například v okolí Pribiše (19, 20, 21) a sv. od města Dolný Kubín, kde jsou eocenní vrstvy ve vývoji jilovcovo — pískovcovém a jilovcovém, nebo sv. od Levoče, kde je pískovcový vývoj vrstev. Rovněž v jilovcovém a jilovcovo-pískovcovém vývoji eocenních vrstev ve Spišské Maguře j. a jz. od obce Haligovce jsou paleogenní vrstvy bez fosilních stop, přesto, že byl dobře prohlédnut úsek kolmo na vrstvy v délce několika kilometrů. Stejně je tomu i v pískovcovém vývoji žipovsko-radačovského pásma jz. od Prešova.

Při celkovém pohledu na mapu rozšíření fosilních stop je nápadné, že při j. okraji prostoru vnitrokarpatského paleogénu v blízkosti bazálních klastických sedimentů, kde převládá jilovcový a jilovcovo-pískovcový vývoj (prostor Ružomberok — Východná — Poprad) je počet lokalit s fosilními stopami značný a jejich druhové zastoupení má velký rozsah. Naproti tomu lokality, sledující pruh bazálních klastických sedimentů, lemuující mezozoikum a krystalinikum Vysokých Tater a mezozoikum jv. od města Dolný Kubín, jsou téměř bez fosilních stop (jilovcový vývoj, prostor mezi obcemi Malatiná — Vitanová — Ždiar). Přesto, že v s. a j. oblasti při pruhu bazálních klastických sedimentů se jedná litologicky o stejní vývoje paleogénu, bude přítomnost nebo nepřítomnost fosilních stop v sedimentech podmíněna jinými vlivy (prokysličení, chemizmus, proudění a pod.). Jak se ukázalo na lokalitě v obci Pribiš, kde byl prohlédnut vrstevní sled o mocnosti přes 70 metrů, byly v celém úseku profilu zaznačeny hojné proudové stopy, fosilní stopy však zjištěny nebyly. Na rozvoj organismů na mořském dně může mít zřejmě vliv i tento činitel, i když nemusí být rozhodující.

Při srovnání rozvoje fosilních stop ve vrstvách vnitrokarpatského paleogénu, vněkarpatského flyše na území Československa (v současné době fosilní stopy z této oblasti zpracovávám) a území Polska (M. KSIAŹKIEWICZ, 1977) docházíme k velmi závažnému poznatku. V oblasti vnitrokarpatského paleogénu jako jediné nacházíme okrajovou facii s typickými fosilními stopami mělkovodního prostředí, tj. *Thalassinoides* sp. a *Arenicolites* sp.. Kromě toho nově zjištěná fosilní stopa *Calixichnium häntzscheli*, jak se prozatím ukazuje, může být dalším členem spektra této ichnofacie. Pro srovnání: fosilní stopy *Thalassinoides* jsem zjistil i v sedimentech Mulussa Formace (vápenné dolomity, svrchní trias) a Digma Formation (vápence až slínovce, křída, těsně podloží bazálních paleogenních slepenců formace Ummer Radhuma) v západní části Ga'arské deprese v Iraku, kde je prokazatelné mělkovodní prostředí (M. PLÍČKA, 1980). V případě výskytů *Thalassinoides* sp. v těsném podloží bazálních paleogenních slepenců v Iraku se jedná o určitou analogii s výskyty těchto stop ve vnitrokarpatském paleogénu v Československu.

Závěrem je třeba uvést, že se nakonec ukázalo, že jediné tato oblast byla vhodná pro zahájení studia tohoto druhu na větším územím celku. Bylo zde totiž možné vycházet od okrajové mělkovodní facie bazálních sedimentů. Význam těchto bazálních sedimentů se v současné době ještě zvyšuje a to proto, že na základě nejnovějších geofyzikálních hlubinných seismických měření přes celé karpatské flyšové pásmo ztrácí z genetického hlediska význam členění na vně- a vnitrokarpatské flyšové pásmo (dle ústního sdělení RNDr. Č. TOMKA CSc, Geofyzika n. p. Brno). V tom případě jsou bazální klastické sedimenty na Slovensku jedinou okrajovou facií pánve celého karpatského flyše, odkrytou na povrchu. Proto nebyly dosud zjištěny fosilní stopy *Thalassinoides* sp. a *Arenicolites* sp. ani v západní ani ve východní oblasti vněkarpatského flyše na území naší republiky během výzkumů od r. 1960 (M. PLÍČKA, 1968; A. NĚMCOVÁ, 1973). Stejně tak tomu bylo i v rozsáhlé oblasti flyšového pásma na polském území, kde bylo hodnoceno přes 3000 vzorků fosilních stop (M. KSIAŹKIEWICZ, 1977).

Obr. 1 Vymezení oblasti studia fosilních stop ve vnitrokarpatiském paleogénu na Slovensku.

Obr. 2 Fosilní stopy ve vnitrokarpatiském paleogénu na Slovensku (Československo). Schematická mapa sestavena na podkladě geologických generálek listů: M-34-XX Trstená (Z. ROTH, 1960), M-34-XXVI Banská Bystrica (M. MAHEL, 1964), M-34-XXVII Vysoké Tatry (O. FUSÁN, 1964), M-34-XXI Spišská Stará Ves (A. MATĚJKA, 1960) a M-34-XXVIII Košice, M-34-XXII Zborov (A. MATĚJKA, 1964).

Obr. 3 Vysvětlivky: 1 — neogén. Vnitrokarpatiský paleogén: 2 — pískovcové souvrství (pískovec v absolutní převaze nad jílovci); 3 — přechodné pískovcové souvrství (pískovec v převaze nad jílovci); 4 — slepencové a pískovcové vrstvy žipovsko-radačovského pásma; 5 — jílovcové souvrství severní a jižní facie (jílovce v převaze nad pískovci); 6 — vrstvy menilitového typu (jílovce, pískovec, vzácně rohovec); 7 — šambronské vrstvy (pískovec, jílovce s vložkami slepenců a brekcií); 8 — jílovco-pískovcové souvrství (jílovce v převaze nebo v rovnováze s pískovci); 9 — bazální karbonátové souvrství (slepence, brekcie, pískovec, podřadné písčité vápence); 10 — bazální souvrství — nevápnitý vývoj (slepence, pískovec). 11 — Vněkarpatiský flyš — magurská skupina příkrovů. 12 — Krystalinikum, mezozoikum centrálních Karpat a obalové serie; 13 — zlomy; 14 — lokalita bez fosilních stop; 15 — lokalita s fosilními stopami; 16 — území, v němž studovali fosilní stopy R. Roniewicz a G. Pienkowski (1977); 17 — státní hranice. Polička, označená písmenem t (jv. od Levoče) jsou výskyty travertínů.

Obr. 4 Litologické profily studovaných lokalit — jílovcovo-pískovcový vývoj (CS).

Obr. 5 Litologické profily studovaných lokalit — jílovcový (C), pískovcový (S), pískovcovo — jílovcový vývoj (SC) a bazální klastické sedimenty (BCS).

Obr. 4 a obr. 5 Vysvětlivky: 1 — jílovec; 2 — pískovec jemně až středně zrnitý; 3 — pískovec středně až hrubě zrnitý; 4 — pískovec velmi hrubozrnitý až drobně slepencový; 5 — slepenec; 6 — pískovec s nerovnostmi na spodní vrstevní ploše; 7 — tabulkovitá dělitelnost ve svrchní části pískovce; 8 — jílovec, vyklínající v pískovci; 9 — pískovec, vyklínající v jílovci; 10 — konvolutní zvrstvení; 11 — jílovcové závalky v pískovci; 12 — zuhelnatělé rostlinné zbytky v pískovci; 13 — fosilní stopa *Calixichnium häntzscheli* při svrchní vrstevní ploše pískovce; 14 — +75 m mocnosti — obdobný litologický vývoj; 15 — číslo lokality nad kolonkou s výskytem fosilních stop, litologický profil dle podrobného popisu vrstev na lokalitě; 16 — číslo lokality s výskytem fosilních stop, schéma profilu, rekonstrukce dle písemné celkové litologické charakteristiky odkryvu; 17 — číslo lokality nad kolonkou bez přítomnosti fosilních stop; T — *Taprhelminthopsis*, Pa — *Paleodictyon*; H — *Helmintoida*; G — *Gordia*; S — *Scolicia*; P — *Planolites*; C — *Calixichnium*; Ch — *Chondrites*; Th — *Thalassinoides*; TF — vymezení části litologického profilu s výskytem fosilních stop.

Obr. 6 Schematický náčrt nové fosilní stopy *Punctumichnium* n. ichnogen. *Punctumichnium parvum* n. ichnosp. Pohled na svrchní (A) a spodní A₁ vrstevní plochu; příčný řez vrstvou: 2Aa — svrchní vrstevní plocha, 2Ab spodní vrstevní plocha. *Punctumichnium medium* n. ichnosp. Pohled na svrchní (B) a spodní B₁ vrstevní plochu; příčný řez vrstvou: 2Ba — svrchní vrstevní plocha, 2Bb — spodní vrstevní plocha.

Obr. 7 *Litpovichnium dubium* n. ichnogen. n. ichnosp., lokalita Liptovský Mikuláš, jílovco-pískovcový vývoj vnitrokarpatiského paleogénu (eocén). Jednotlivé vzorky z této lokality: a, b — 69/24, c — 69/47, d — 69/29, e — 69/47, f, h — 69/3, g — 69/58 × 1,7.

Obr. 8 *Planolites* sp. obr. 1—12: 1 — Bzenov (192) CS, 192/1; 2 — Poprad (103), C, 103/25; 3 — Rešov (205), C, 205/1; 4 — Liptovský Mikuláš (69), CS, 69/32; 5 — dtto, 69/37; 6 — dtto, 69/32; 7 — dtto, 69/6; 8 — dtto, 69/27; 9 — dtto, 69/38; 10 — Olšavica (158), S. 158/5; 11 — Liptovský Mikuláš (69), CS, 69/44; 12 — Vážec (90), BCS, 90/1.

Obr. 9 Schematické nákresy poznatků o fosilní stopě *Planolites* sp. ve vztahu k sedimentu. A — stopa *Planolites* sp. často jako pozitivní hyporelief se náhle prohýbá do nadloží (snaha o únik směrem vzhůru po náhlém přínosu písčitého materiálu na jílovitý povrch mořského dna?). Lokality:

60, 94, 103, 146, 215; B — v původním pozitivním hyporeliefu na jílovitém povrchu mořského dna se často zadržuje hrubší frakce písčitého sedimentu (např. lokalita Hrabušice (140) a Jakubovany (17); C — v hrubozrnných sedimentech (BCS) červ při pronikání sedimentem vtlačí větší ploché částice do okolní horniny a vytváří tak trubicovitou chodbu (např. lokalita Liptovské Kláčany (203), kde zrna sedimentu dosahovala průměru až 5 mm, případně místy i více). Vysvětlivky: P — *Planolites*, v — vrstevní plocha.

Obr. 10 *Gyrichnites gaspensis* WHITEAVES v jemně až středně zrnitém vápnitém pískovci na lokalitě Jamník (73), C, vzorek č. 73/1.

Obr. 11 *Popradichnium erraticum* PLIČKA na úlomcích tabulkovitých pískovců na lokalitě Poprad (103), C. Jednotlivé vzorky: 1 — 103/6; 2 — 103/5; 3 — 103/14; 4 — 103/2; 5 — 103/11; 6 — 103/35; 7 — 103/4; 8 — 103/3; 9 — 103/31; P — *Planolites*.

Obr. 12 *Popradichnium erraticum* PLIČKA, lokalita Poprad (103), C, holotyp, vzorek č. YA 1475 (M. PLIČKA, 1983, Pl. I). P — *Planolites*.

Fig. 13 *Agrichnium incompositum* PLIČKA, schéma průběhu stop dle vzorku č. 74/1 z lokality Liptovský Ondrej (74), C (M. PLIČKA 1984, Pl. LXXXIX, fig. 2).

Obr. 14 *Merostomichnites beecheri* PACKARD, spodní vrstevní plocha tabulkovitého pískovce se stopou na lokalitě Dovalovo (85), C, 85/11.

Obr. 15 *Calixichnium hantzscheli* PLIČKA při svrchní vrstevní ploše pískovce na lokalitě Podolinec (135), SC (M. PLIČKA 1981, Pl. I, fig. 1).

Obr. 16 *Saportia striata* (SQUINABOL), Liptovský Mikuláš (69), CS. 1 — 69/59, 2 — 69/60.

Obr. 17 Rozdíly v uspořádání struktury doupěte *Thalassinoides* A, trojrozměrná stopa, nejčastěji se větví v tvaru T: *T. paradoxicus* B, v podstatě plošný systém chodeb, větví se ve tvaru Y: *T. suevici* (R. W. FREY—S. G. PEMBERTON, 1985, p. 89, Fig. 23).

Obr. 18 *Thalassinoides* sp.: 1 — Hybe (79), BCS, 79/19; 2 — 79/21; 3 — 79/20; 4 — 79/15; 5 — 79/32; 6 — 79/16; 7 — 79/10; 8 — 79/5.

Fig. 19 *Godulaichnium tenue* PLIČKA: 1 — Podbanské (83), C, 83/3; 2 — Vitališovce (71), CS, 71/2; 3 — Liptovský Ondrej (74), C, 74/20.

Obr. 20 *Capodistria vettersi* VIALOV: Lokalita Vážec (88), CS, 88/5. Stopa je na spodní vrstevní ploše zelenavěšedého, jemnozrného, vápnitého pískovce, tabulkovitě dělitelného. × 2.

Obr. 21 *Aulichnites parkensis* FENTON and FENTON: 1 — Vážec (88), CS vývoj v těsné blízkosti vývoje BCS (88/6); 2 — Vážec (89), CS vývoj v těsné blízkosti vývoje BCS (88/6); 2 — Vážec (89), CS vývoj v těsné blízkosti vývoje BCS, 89/14.

Obr. 22 *Scolicia prisca* DE QUATREFAGES (1a, 1b, 2a) a *Scolicia plana* KSIĄZKIEWICZ (26, 3a—d).

Obr. 23 *Taprhelminthopsis auricularis* SACCO: 1 — Jakubovany (76), C, 76/6; 2 — Vitanová (44), C, 44/2; 3 — Dovalovo (85) C, 85/6; 4 — Ostružná (118), CS, 118/1; 5 — Habovka (32), S, 32/11; 6 — Olšavica (158), S, 158/5; 7 — Hrabušice (140), C, 140/1; 8 — Ostružná (118), CS, 118/2; 9 — Jakubovany (76), C, 76/18; 10 — Olšavica (158), S, 158/6.

Obr. 24 *Taprhelminthopsis auricularis* SACCO: 1 — Hybe (79), CS vývoj v blízkosti vývoje BCS; 2 — Jakubovany (76), C, 76/4.

Obr. 25 *Taprhelminthopsis maeandriiformis* n. ichnosp., Nová Lubovňa (173), C, 173/2 (holotype).

Obr. 26 *Spirophycus minimus* n. ichnosp.: Liptovský Mikuláš (69), CS, 69/36.

Obr. 27 *Gordia molassica* (HEER, 1865): Bachledová (115), C, 115/3.

Obr. 28 *Gordia molassica* (HEER): 1—5 Liptovský Mikuláš (69), CS, 69/11; 69/16; 69/29, 69/1, 69/50. 6 — Liptovská Mara (58), CS, 58/10; 7 — Dovalovo (82), C, 82/10; 8 — Liptovská Mara (58), CS, 58/18. *Gordia marina* EMMONS; 9 — Bachledová (115), C, 115/1.

Obr. 29 *Helminthoida miocenica* SACCO: Liptovský Mikuláš (69), CS, 1 — 69/20; 2 — 69/13; 3 — 69/4; 4 — 69/39; 5 — 69/43. *Helminthoida crassa* SCHAFFHÄUTEL: Liptovský Mikuláš (69), CSc.

Obr. 30 *Belorhapha zickzack* (HEER): Liptovský Ondrej (74), C, 1 — 74/24; 2 — 74/27; 4 — 74/8; 5 — 74/16; 6 — 74/28; Liptovská Mara (58), CS; 3 — 58/9; 7 — 58/3. *Belorhapha fabregae* (AZPEITIA): Vitanová (41), C; 8 — 41/2.

Obr. 31 Schéma sledů druhů rodu *Paleodictyon* MENEGHINI, 1850 v šedém, laminovaném jemnozrnném, vápnitém pískovci v zářezu dálnice 500 m s. od obce Dovalovo (82). a — *Paleodictyon minutissimum*; b — *P. minimum*; c — *P. intermedium*; v — vrstevní spára. $\times 1$.

Obr. 32 *Paleodictyon majus* MENEGHINI: 1 — Dovalovo (85), C, 85/2; 2 — *Paleodictyon regulare* SACCO: Važec (89), CS v těsné blízkosti vývoje BCS, 89/6.

Obr. 33 *Megagraption tenue* KSIAŹKIEWICZ: 1—3 Liptovský Mikuláš (69), CS; 1 — 69/26; 2 — 68/26; 3 — 69/35; 4 — Dovalovo (85), C, 85/1. *Megagraption irregulare* KSIAŹKIEWICZ; 5 — Hybe (79), BCS, 79/17.

Obr. 34 *Eulalites obscurus* PLIČKA: Važec (89), CS v těsné blízkosti vývoje BCS (M. PLIČKA, 1984, fig. 2, p. 185).

Obr. 35 *Carpattia tubiformis* PLIČKA: Važec (90), BCS, 90/1. $\times 2$.

Explanations of plates XXXVII—XLVIII (Photo VI. Skala)

Plate XXXVII

- 1 *Punctumichnium medium* n. ichnogen., n. sp., Liptovská Mara (58), CS, 58/12.
- 2 *Liptovichnium dubium* n. ichnogen., n. sp., Liptovský Mikuláš, brick-factory (69), CS, 69/47, $\times 1$.
- 3 *Liptovichnium dubium* n. ichnogen., n. sp., Liptovský Mikuláš, brick-factory (69), CS, 69/3, $\times 1$.
- 4 *Liptovichnium dubium* n. ichnogen., n. sp., Liptovský Mikuláš, brick-factory (69), CS, 69/29, $\times 1$.
- 5 *Liptovichnium dubium* n. ichnogen., n. sp., Liptovský Mikuláš, brick-factory (69), CS, 69/3, $\times 1$.
- 6 *Liptovichnium dubium* n. ichnogen., n. sp., Liptovský Mikuláš, brick-factory (69), CS, 69/24 (holotype), $\times 0,6$.
- 7 *Punctuichnium parvum* n. ichnogen., n. sp., Hrabušice (140), C, 140/1.
- 8 *Cumulusichnium incertum* PLIČKA, Liptovský Ondrej (74), C, 74/9.
- 9 *Planolites* sp., Hybe (80), BCS, $\times 0,5$.
- 10 *Planolites* sp., Liptovské Kľačany (203), BCS, 203/2.
- 11 *Planolites* sp., Liptovské Kľačany (203), BCS, 203/1, $\times 0,5$.

Plate XXXVIII

- 1 *Planolites* Sp., Zuberec (218), CS, 218/2, $\times 0,5$.
- 2 *Planolites* sp., Dovalovo (78), C, 78/1.
- 3 *Planolites* sp., Olšavica (158), S, 158/5, $\times 0,5$.
- 4 *Planolites* sp., Liptovská Mara (58), CS, 58/6, $\times 0,8$.
- 5 *Planolites* sp., Važec, BCS, 90/1.
- 6 *Gyrichnites* sp., Myslina (198), CS, 198/1.
- 7 *Gyrichnites* sp., Podbanske (83), C, 83/1.

Plate XXXIX

- 1 *Popradichnium erraticum* PLIČKA, Poprad (103), C, 103/1 (holotype).
- 2 *Popradichnium erraticum* PLIČKA, Poprad (103), C, 103/2.
- 3 *Agrichnium incompressum* PLIČKA, Liptovský Ondrej (74), C, 74/3.
- 4 *Popradichnium minutum* PLIČKA, Liptovská Mara (58), CS, 58/23.
- 5 *Popradichnium minutum* PLIČKA, Dovalovo (82), C, 82/12, $\times 0,6$.
- 6 *Arenicolites* sp., Važec (89), BCS.

Plate XL

- 1 *Merostomichnium beecheri* PACKARD, Dovalovo (85), C, 85/11 b.
- 2 *Calixichnium häntzscheli* PLIČKA, Podolíneč (135), SC, 22146, Moravian Museum in Brno, Holotype, $\times 0,7$.
- 3 *Calixichnium häntzscheli* PLIČKA, Podolíneč (135), SC, 22146, Moravian Museum in Brno, Holotype $\times 0,5$.
- 4 *Saportia striata* (SQUINABOL), Liptovský Mikuláš, brick-factory (69), CS, 69/60, $\times 0,5$.
- 5 *Saportia striata* (SQUINABOL), *Paleodictyon strozzii* MENEGHINI, Liptovský Mikuláš, brick-factory (69), CS, 69/59, $\times 0,7$.
- 6 *Buthotrephis* sp. indet., Liptovský Mikuláš, brick-factory (69), CS, 69/57.
- 7 *Chondrites aequalis* (BRONGNIART), Jasenová (8), CS, 8/1.

Plate XLI

- 1 *Thalassinoides* sp., Hybe (79), BCS, 79/20.
- 2 *Thalassinoides* sp., Hybe (79), BCS, 79/16.
- 3 *Thalassinoides* sp., Hybe (79), BCS, 79/22.
- 4 *Godulaichnium tenue* PLIČKA, Važec (88), CS, near BCS, 88/3.
- 5 *Thalassinoides* sp. Hybe (79), BCS, 79/10, $\times 0,8$.
- 6 *Saportia striata* (SQUINABOL), Osturňa (117), CS, 117/1.

Plate XLII

- 1 *Capodistria vettersi* VIALOV, Važec (88), CS, near BCS, 88/5.
- 2 *Zoophycos circinnatus* (BRONGNIART), Zuberec (218), CS, 218/1.
- 3 *Aulichnites parkensis* FENTON and FENTON, Važec (88), BCS, 88/6.
- 4 *Scolicia prisca* DE QUATREFAGES, Dovalovo (85), C, 85/13.
- 5 *Scolicia plana* KSIAZKIEWICZ, Dovalovo (85), C, 85/3, $\times 0,8$.
- 6 *Scolicia plana* KSIAZKIEWICZ, Dovalovo, (85), C, 85/8.

Plate XLIII

- 1 *Scolicia prisca* DE QUATREFAGES, Levoča (146), S, 146/2.
- 2 *Scolicia prisca* DE QUATREFAGES, Dovalovo, C, 85/12, $\times 0,4$.
- 3 *Taprhelminthopsis auricularis* SACCO, Habovka (32), S, 32/11, $\times 0,5$.
- 4 *Taprhelminthopsis auricularis* SACCO, Jakubovany (76), C, 76/20, $\times 0,5$.
- 5 *Taprhelminthopsis auricularis* SACCO, Vitanová (44), C, 44/2, $\times 0,6$.
- 6 *Taprhelminthopsis auricularis* SACCO, Liptovská Mara, (58), CS, 58/14.
- 7 *Taprhelminthopsis auricularis* SACCO, Jakubovany (76), C, 76/6, $\times 0,6$.
- 8 *Subphyllochorda laevis* KSIAZKIEWICZ, Liptovský Mikuláš, brick-factory (69), C, 69/2.

Plate XLIV

- 1 *Gordia molassica* (HEER), Liptovský Mikuláš, brick-factory (69), C, 69/1.
- 2 *Spirophycus minimus* n. ichnosp., Liptovský Mikuláš, (69), C, 69/36, $\times 1$.
- 3 *Taprhelminthopsis maeandriiformis* n. ichnosp., Nová Ľubovňa (173), C, 173/2.
- 4 *Taprhelminthopsis auricularis* SACCO, Jakubovany, C, 76/12, $\times 0,4$.
- 5 *Gordia molassica* (HEER), Liptovský Mikuláš, brick-factory (69), C, 69/19, $\times 1$.
- 6 *Subphyllochorda laevis* KSIAZKIEWICZ, Dolný Kubín (4), CS, 4/1.
- 7 *Gordia molassica* (HEER), Liptovská Mara (58), CS, 58/10, $\times 0,5$.

Plate XLV

- 1 *Helminthoida crassa* SCHAFFHÄUTL, Liptovský Mikuláš, brick-factory (69), C, 69/13.
- 2 *Helminthoida crassa* SCHAFFHÄUTL, Liptovský Mikuláš, brick-factory (69), C, 69/4.
- 3 *Belorhapha zickzack* (HEER), Liptovská Mara (58), CS, 58/3.
- 4 *Helminthoida miocenica* SACCO, Jakubovany (76), C, 76/10, $\times 0,6$.
- 5 *Belorhapha zickzack* (HEER), Liptovský Ondrej (74), C, 74/28.
- 6 *Taprhelminthopsis auricularis* SACCO, Habovka (32), S, 32/3.

Plate XLVI

- 1 *Belorhaphé zickzack* (HEER), Liptovská Mara (58), CS, 58/3, $\times 0,5$.
- 2 *Belorhaphé zickzack* (HERR), Liptovská Mara (58), CS, 58/3.
- 3 *Belorhaphé zickzack* (HEER), Liptovský Ondrej (74), C, 74/26.
- 4 *Paleodictyon minimum* SACCO, Podbanská (83), C, 83/4.
- 5 *Paleodictyon intermedium* KSIAZKIEWICZ, Liptovský Mikuláš, brick-factory (69), C, 69/36, $\times 1,2$.
- 6 *Paleodictyon minimum* SACCO, Dovalovo (82), C, 82/5, $\times 0,4$.

Plate XLVII

- 1 *Paleodictyon minutissimum* KSIAZKIEWICZ, Liptovský Mikuláš, brick-factory (69), C, 69/34 a, $\times 2,5$.
- 2 *Paleodictyon minimum* SACCO, Dovalovo Vážec (91), CS, 91/1, $\times 1$.
- 3 *Paleodictyon minutissimum* KSIAZKIEWICZ, Liptovský Mikuláš, brick-factory, (69), C, 69/34 b, $\times 2,5$.
- 4 *Paleodictyon minimum* SACCO, (82), C, 82/3.
- 5 *Paleodictyon intermedium* KSIAZKIEWICZ, Liptovský Mikuláš, brick-factory (69), C, 69/8, $\times 1$.
- 6 *Paleodictyon majus* MENEGHINI, Dovalovo (85), C, 85/2, $\times 0,6$.
- 7 *Paleodictyon minimum* SACCO, Liptovský Mikuláš, brick-factory (69), C, 69/46.

Plate XLVIII

- 1 *Paleodictyon regulare* SACCO, Vážec (89), CS, near BCS, 89/6.
- 2 *Paleodictyon minimum* SACCO, Vážec (91), CS, 91/1.
- 3 *Eulalites obscurus* PLÍČKA, Vážec (89), CS, near BCS.
- 4 *Carpatia tubiformis* PLÍČKA, Habovka (32), S, 32/4.
- 5 *Eulalites obscurus* PLÍČKA, Vážec (89), CS, near BCS.

ZÁPADNÉ KARPATY

SÉRIA

paleontológia 12

Vydal Geologický ústav Dionýza Štúra vo vydavateľskom oprávnení Vedy, vydavateľstva Slovenskej akadémie vied v Bratislave v roku 1987

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Technická redaktorka: Gabriela Šipošová

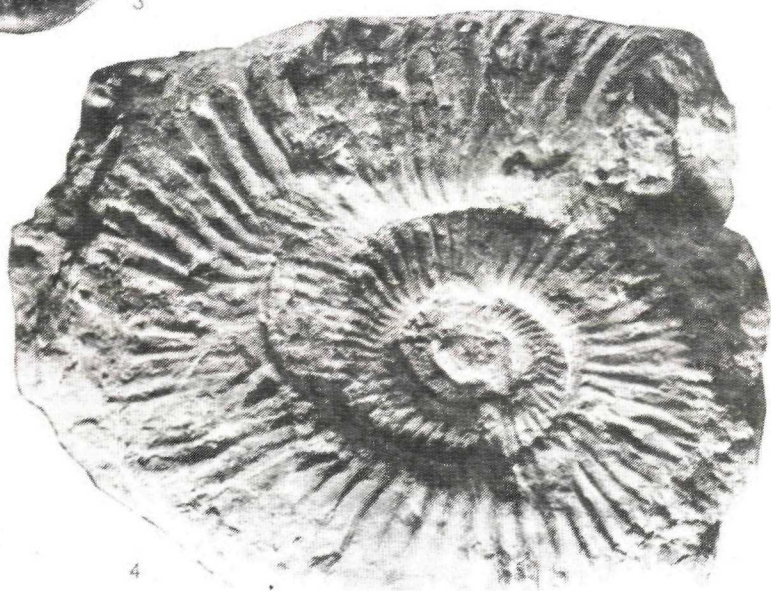
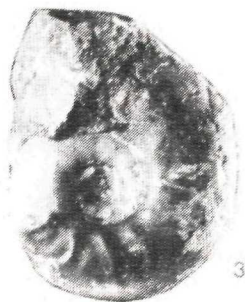
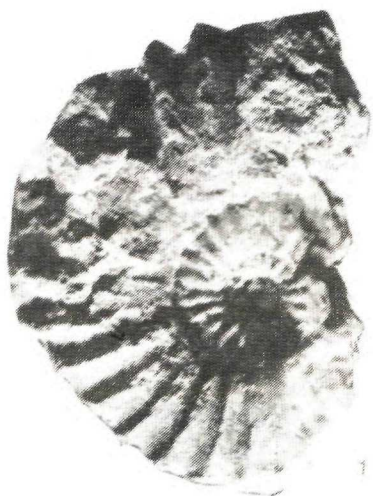
Preklad do angličtiny: RNDr. Lubomír Böhmer

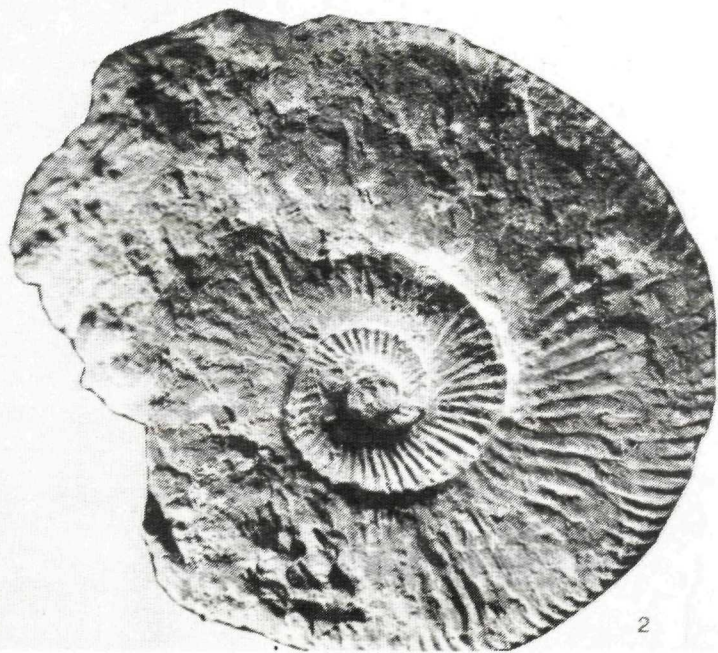
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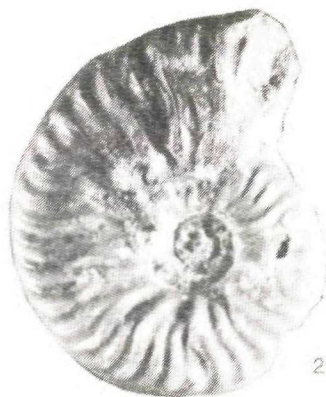
PHOTOGRAPHS
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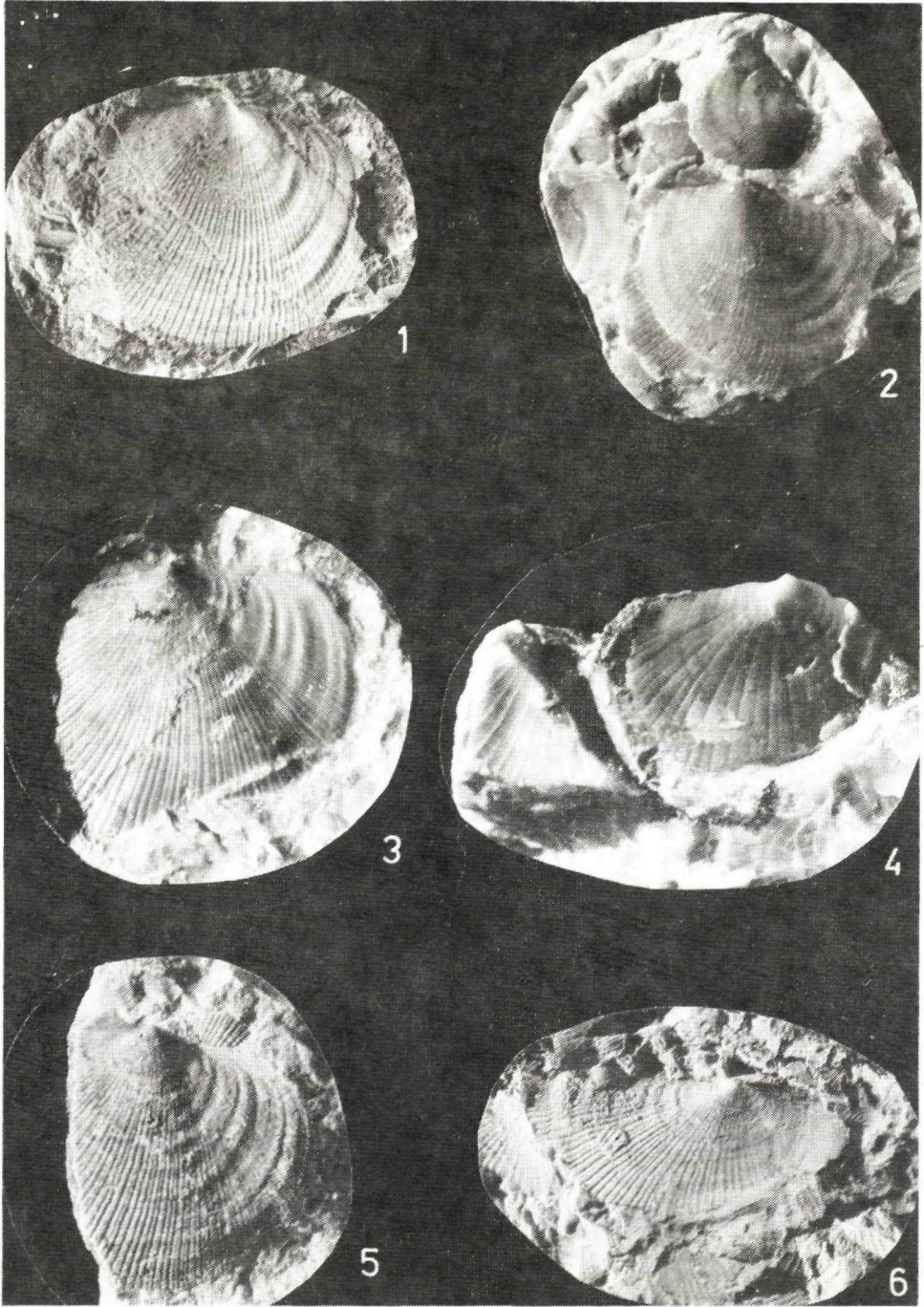
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ODBOROVÉ INFORMAČNÉ STREDISKO
Mlynská dolina 1
617 04 BRATISLAVA

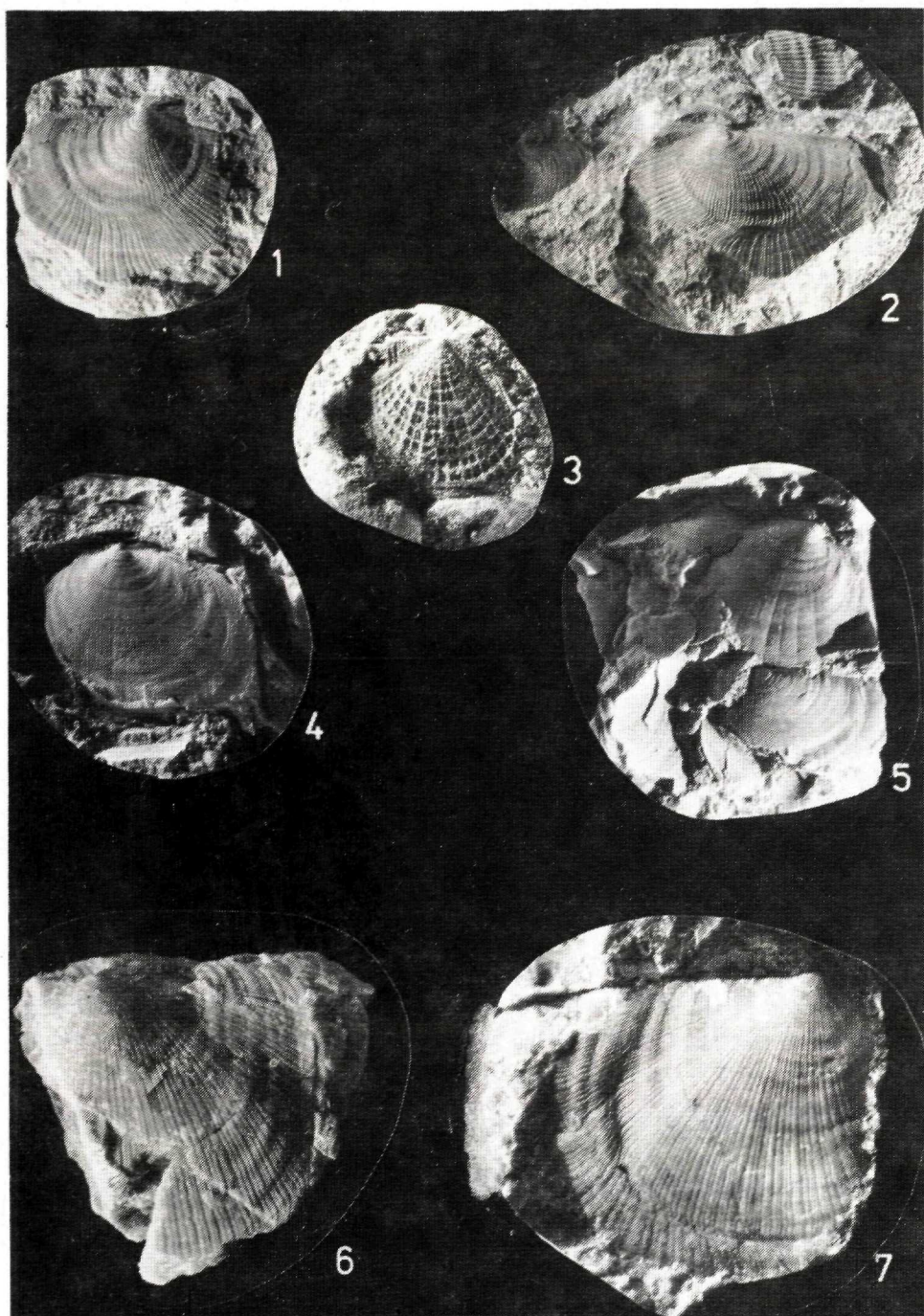


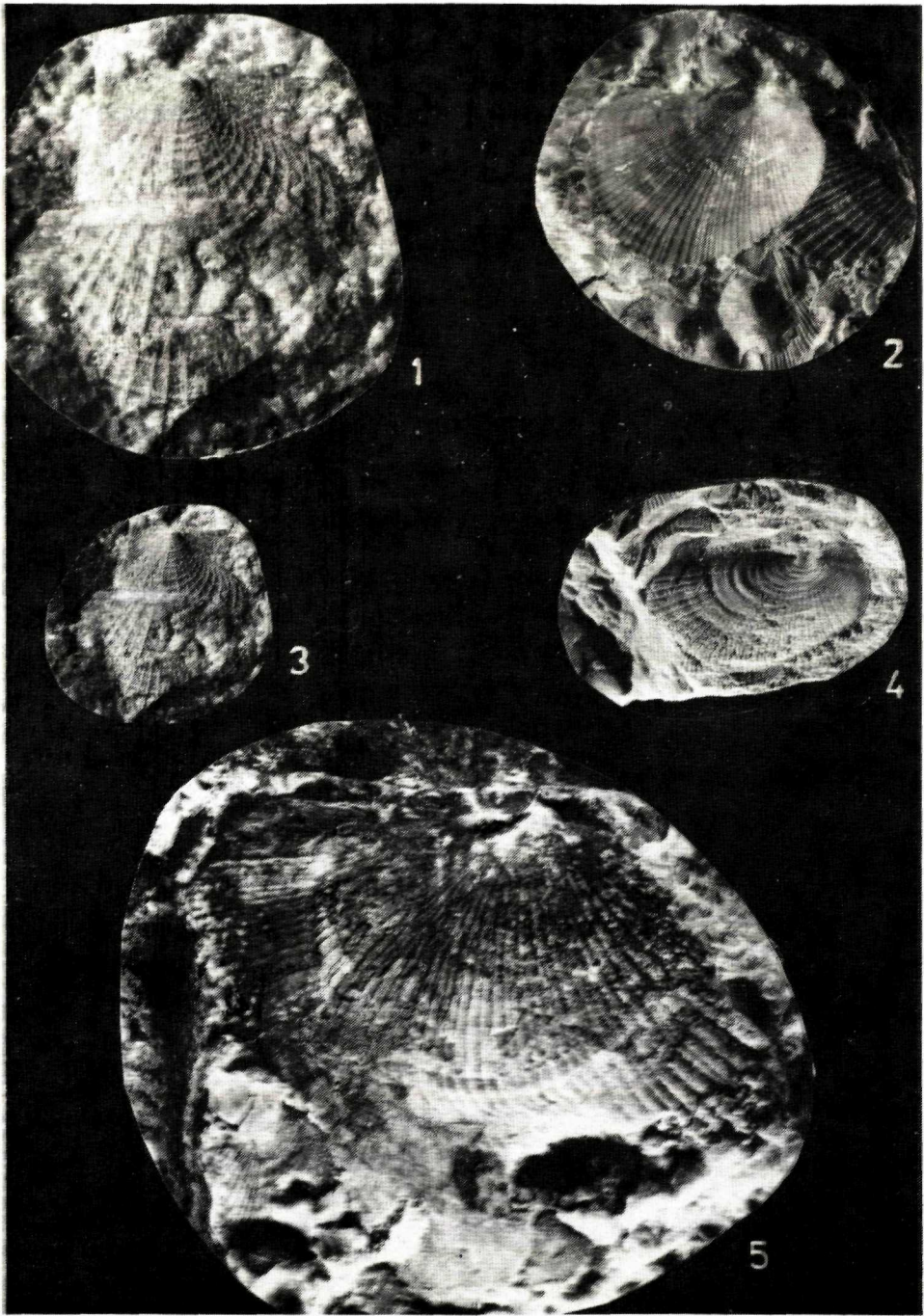










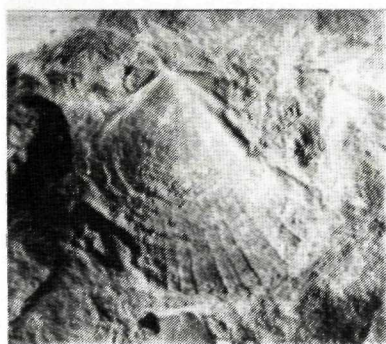




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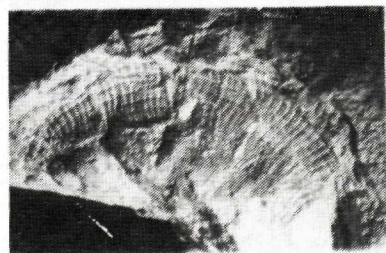
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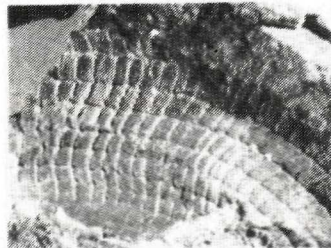
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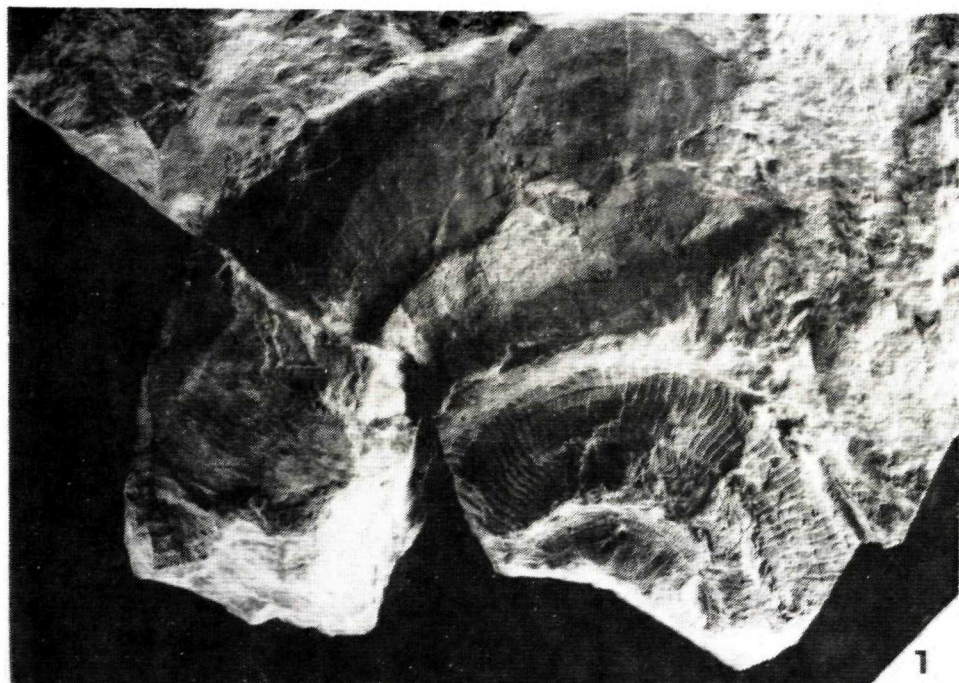
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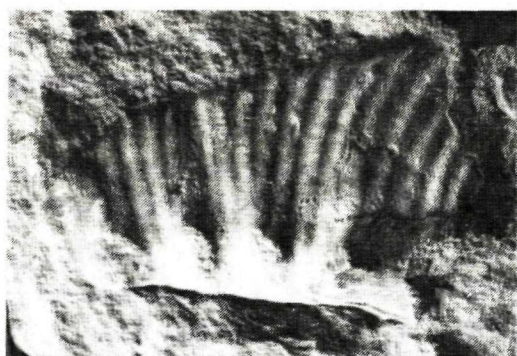




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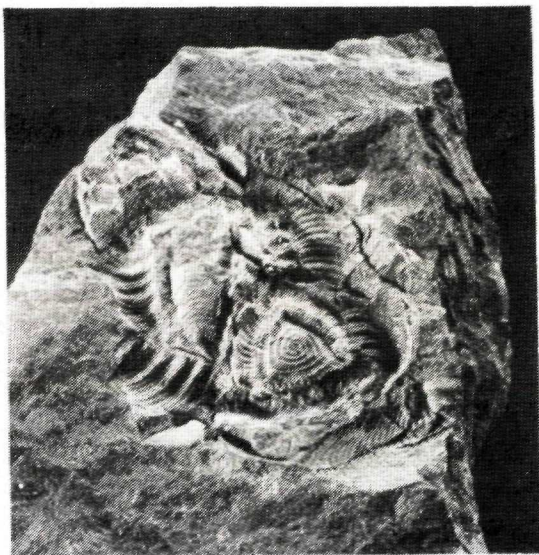
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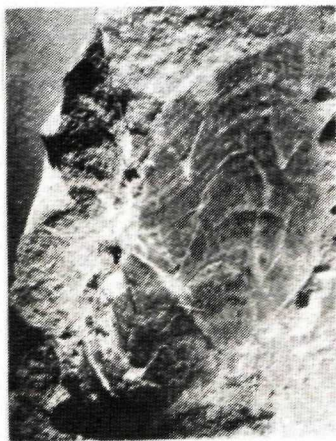
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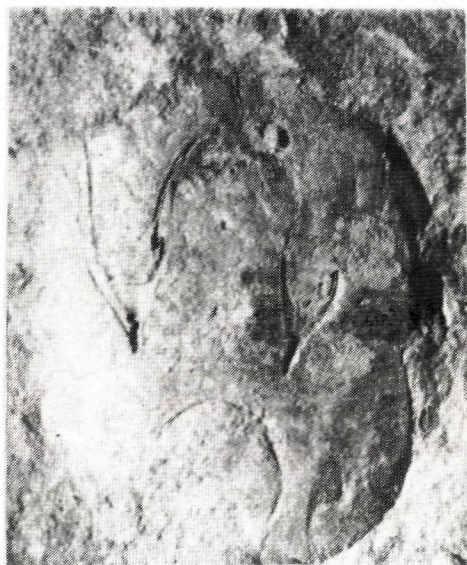
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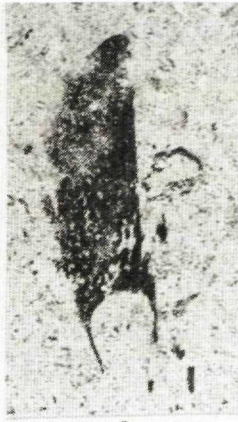
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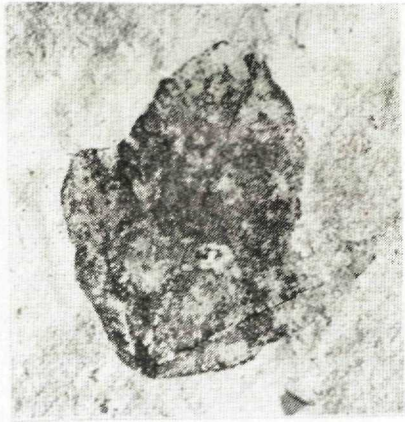
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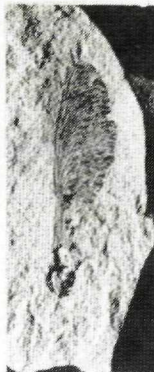
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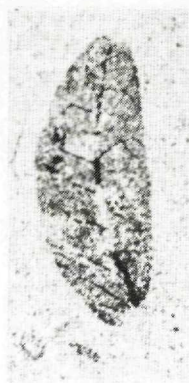
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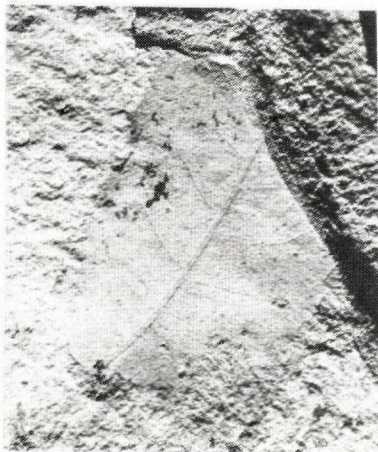
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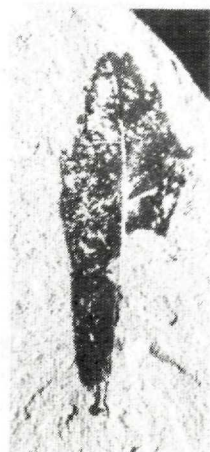
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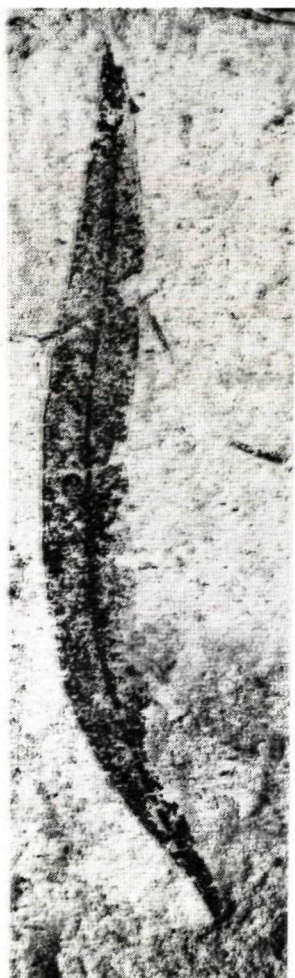
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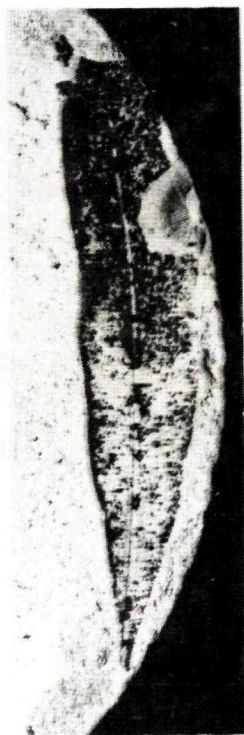
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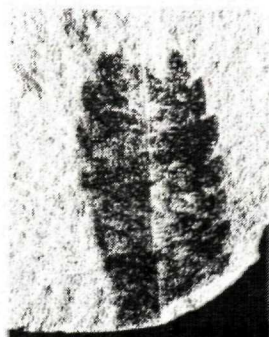
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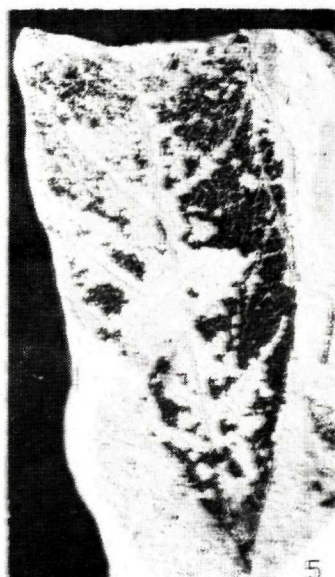
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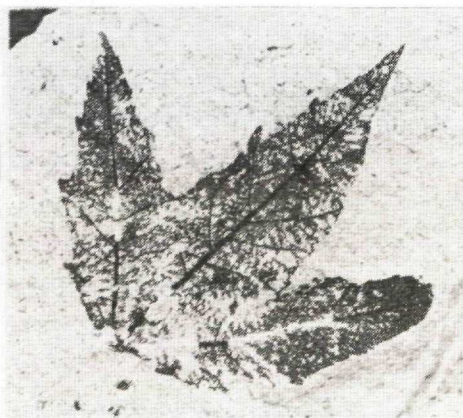


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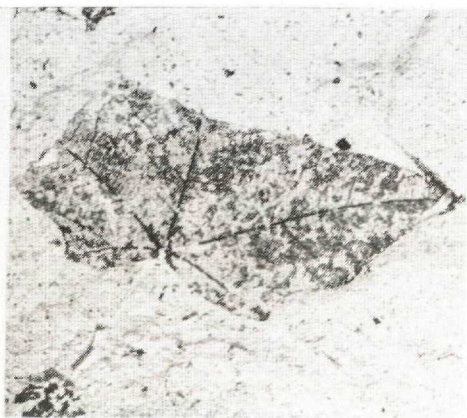


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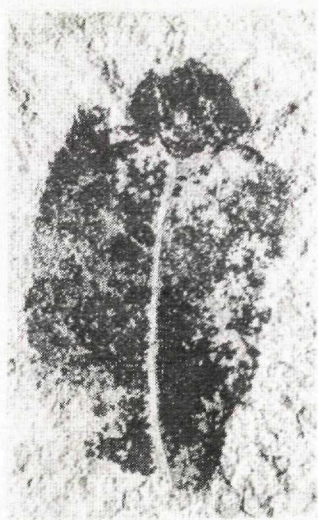




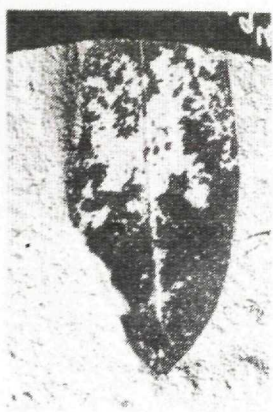
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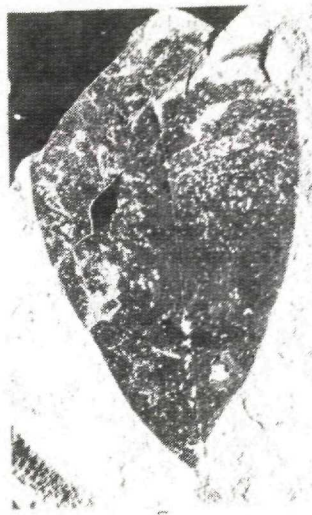
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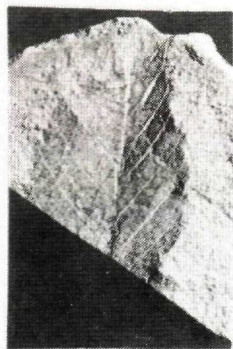
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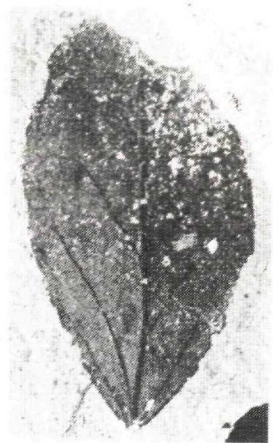
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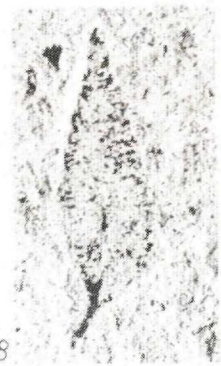
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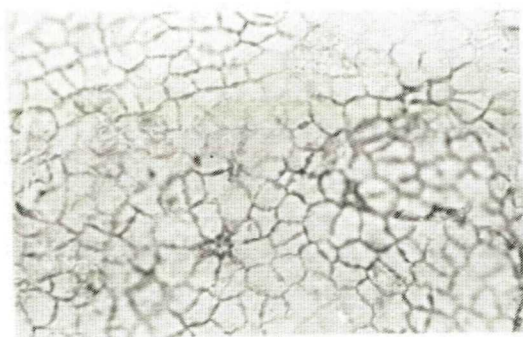
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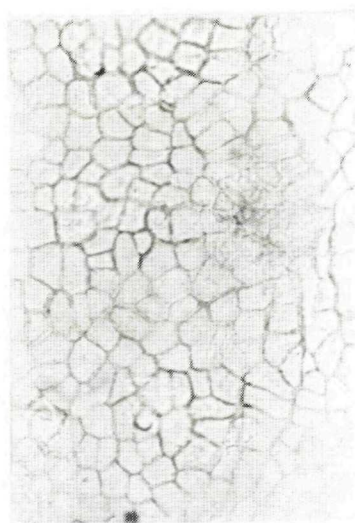
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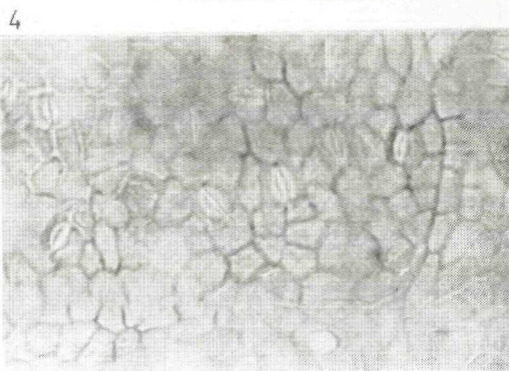
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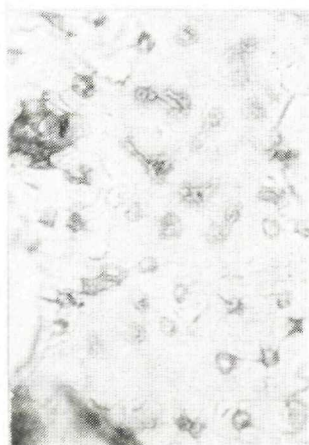
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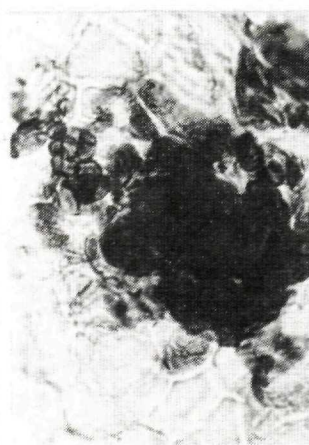
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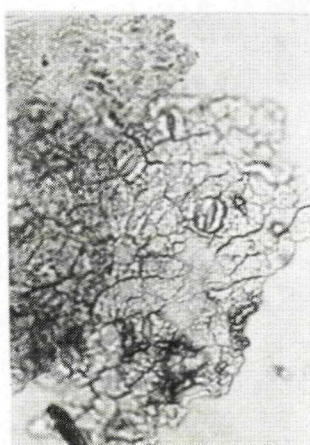
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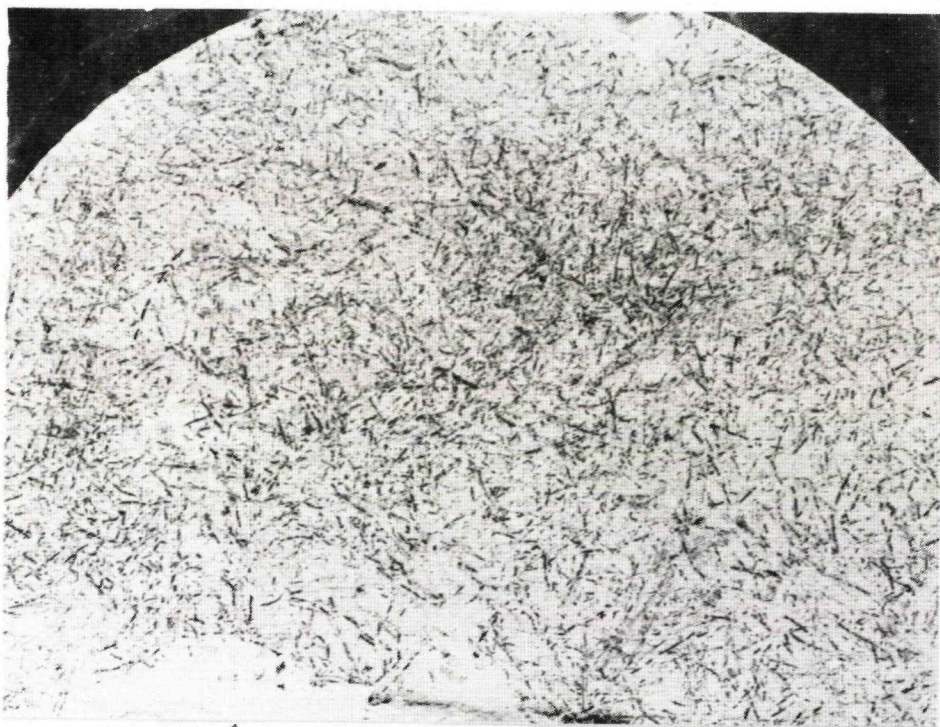
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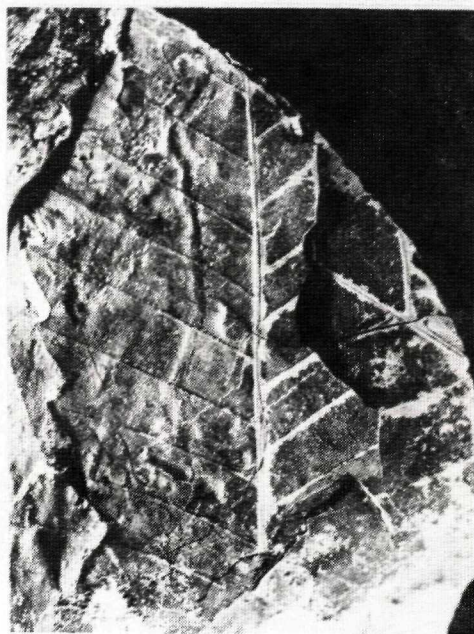
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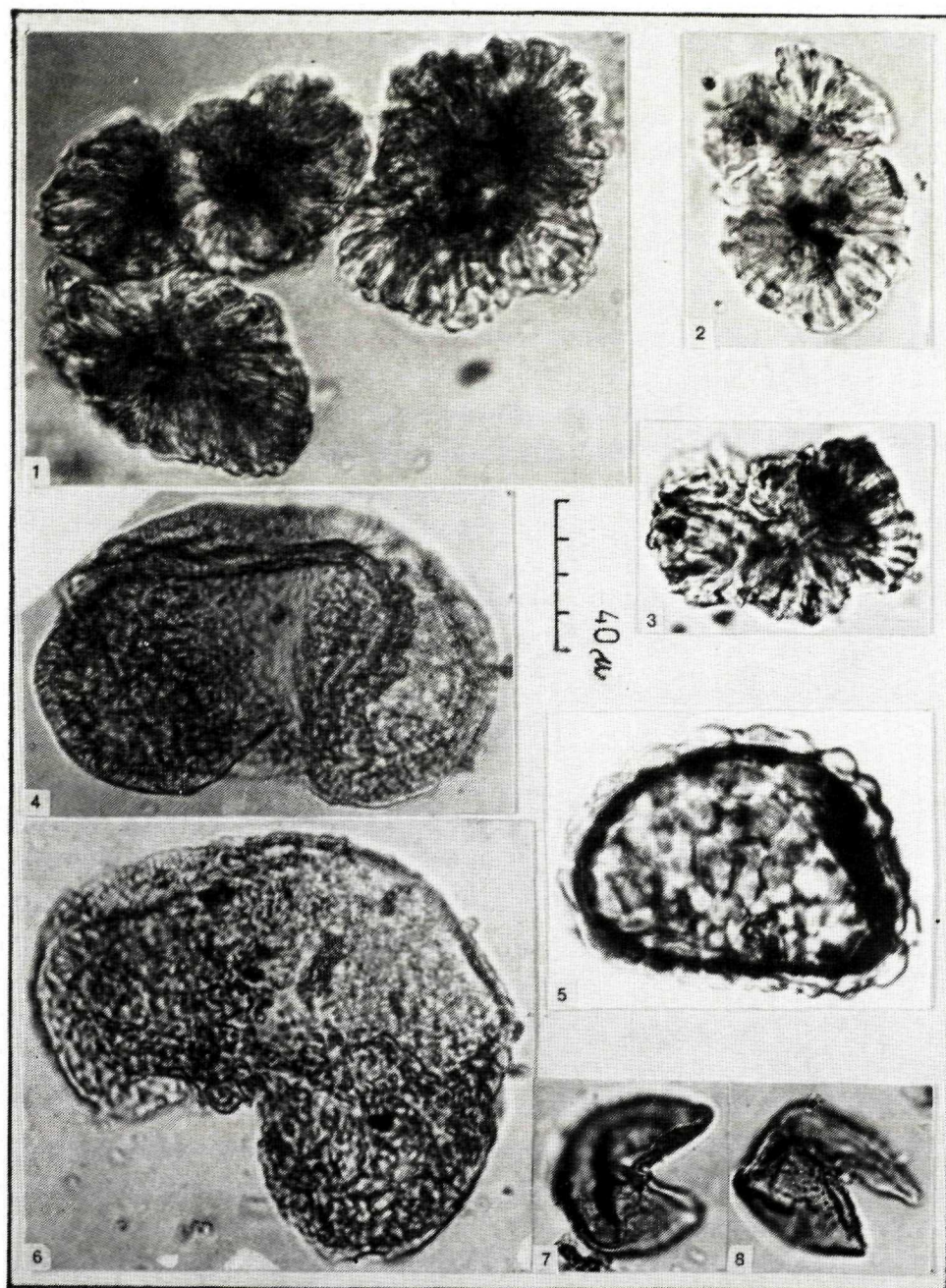
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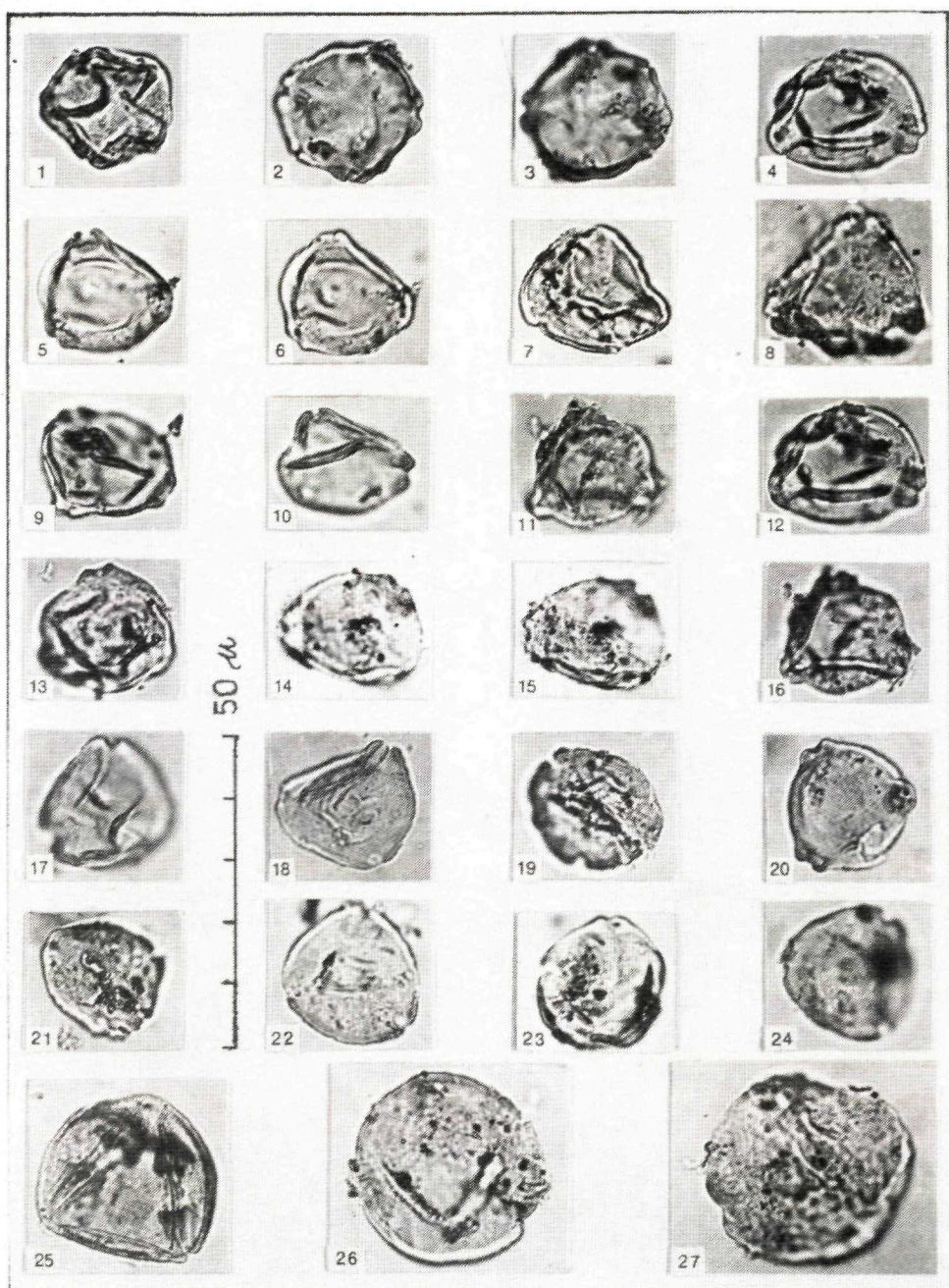


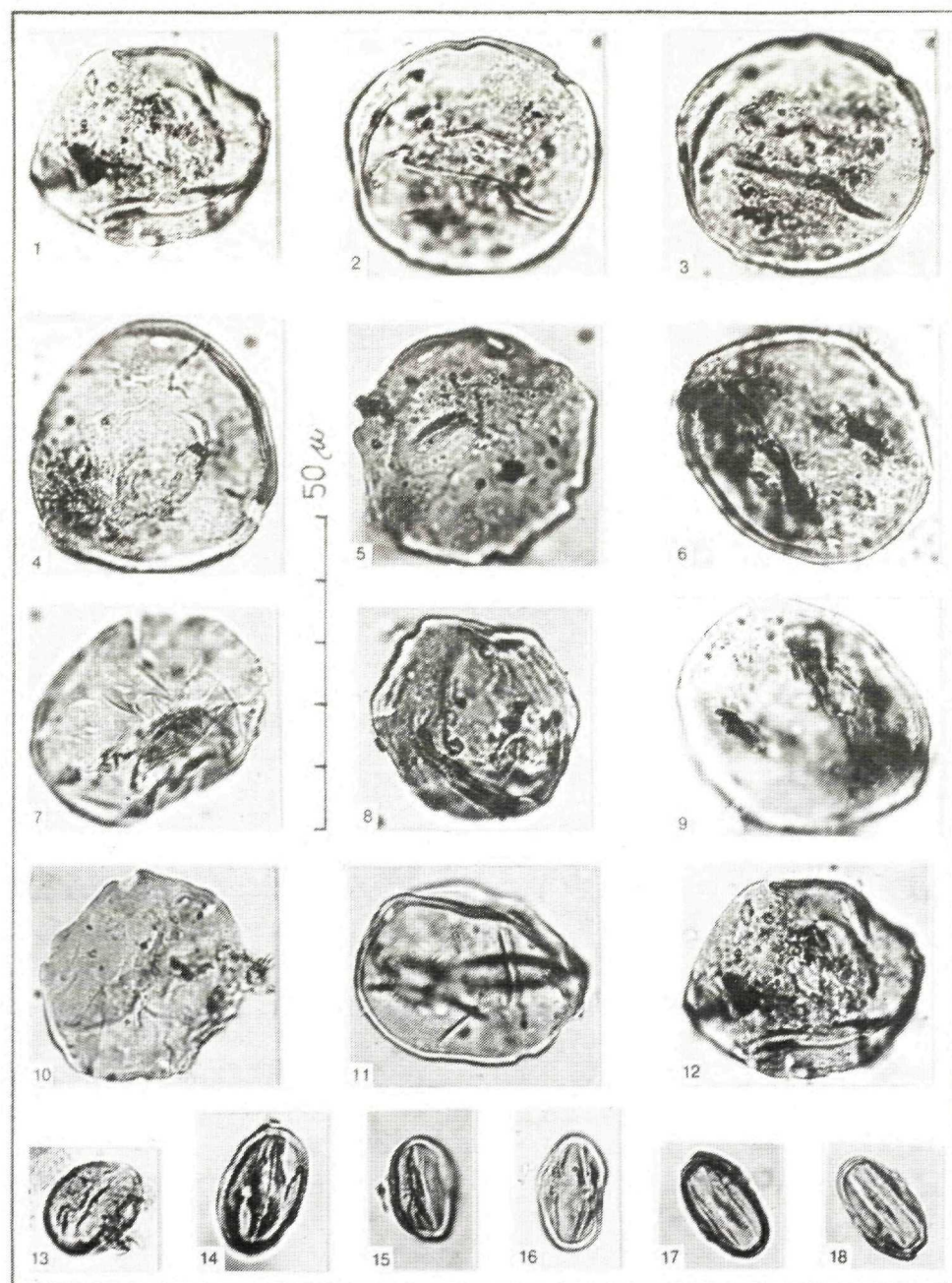
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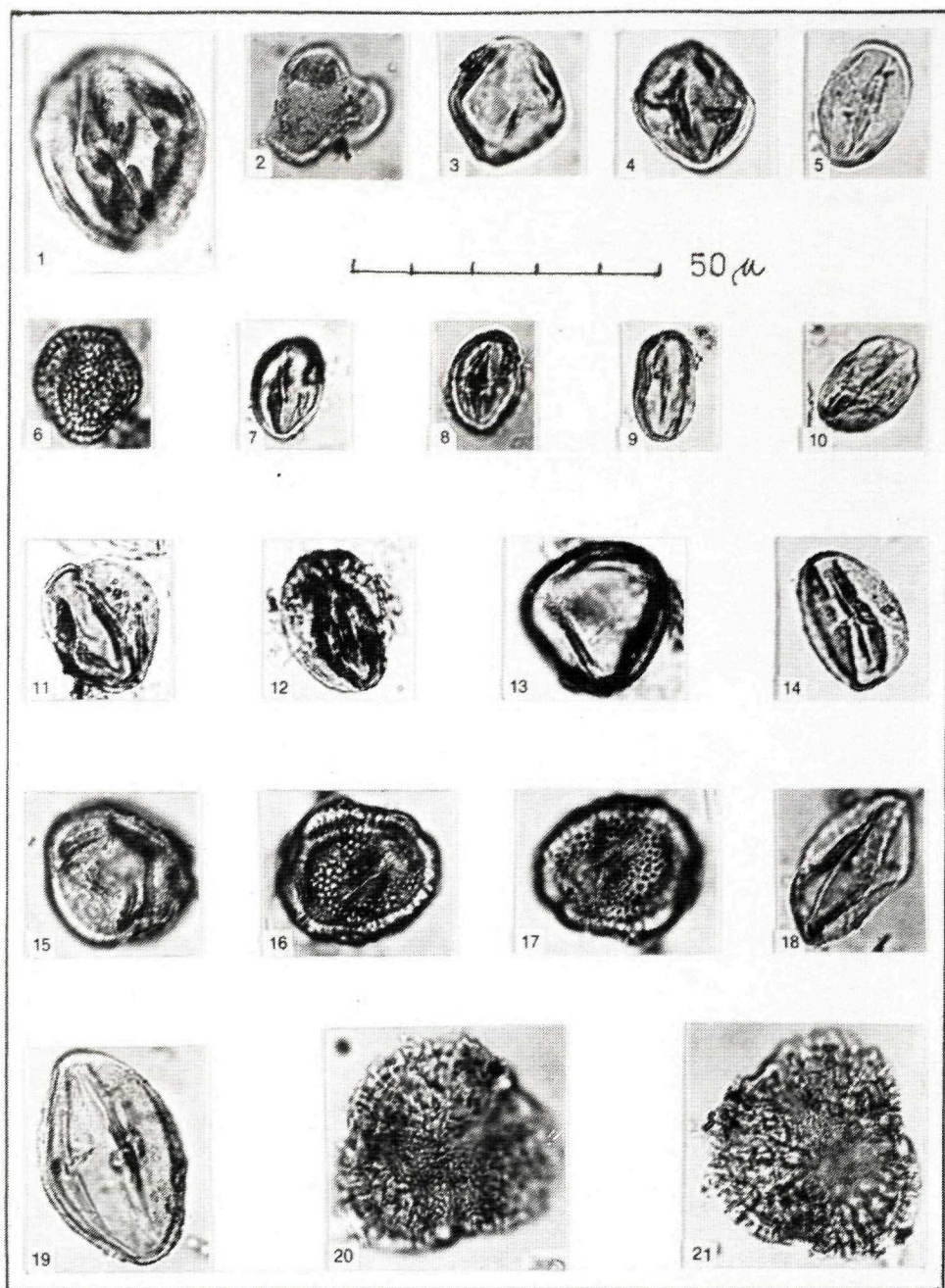


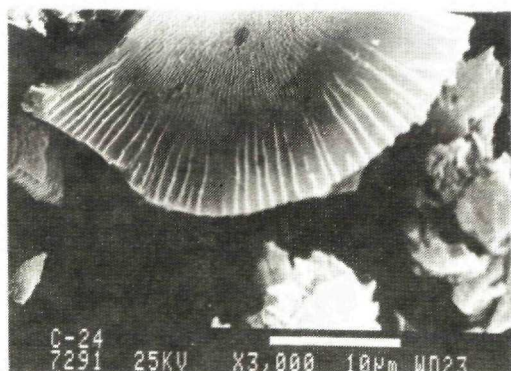
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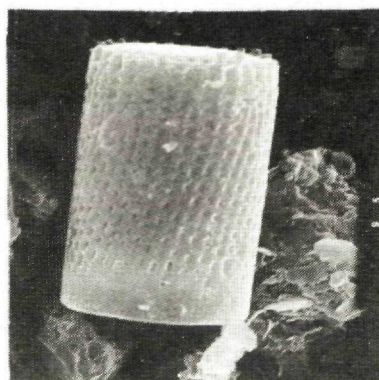




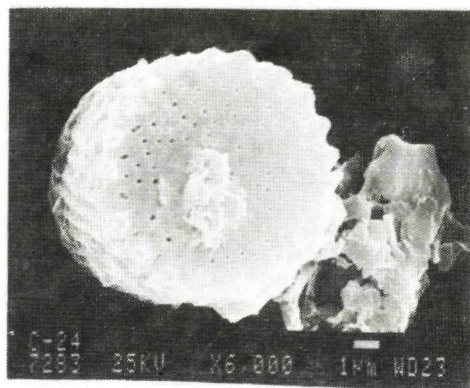




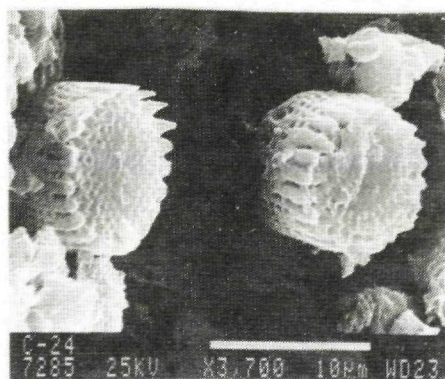
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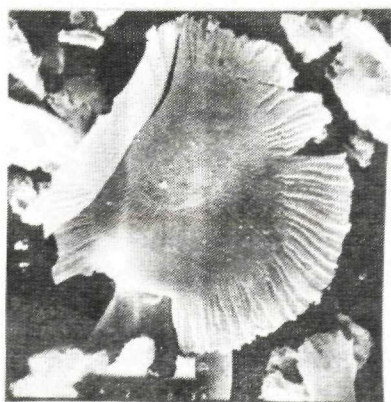
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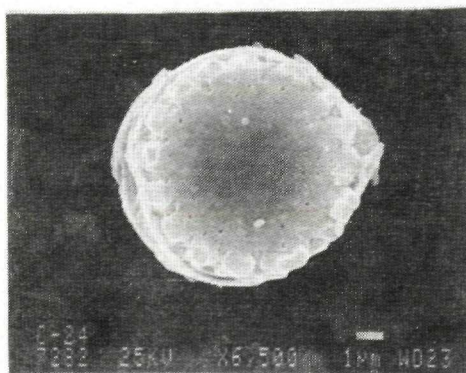
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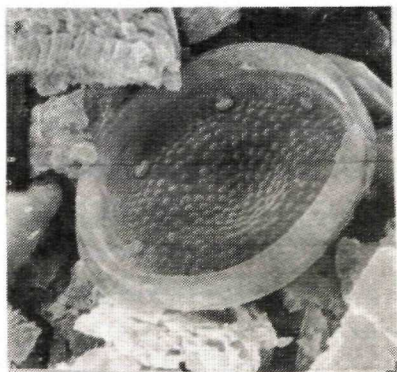
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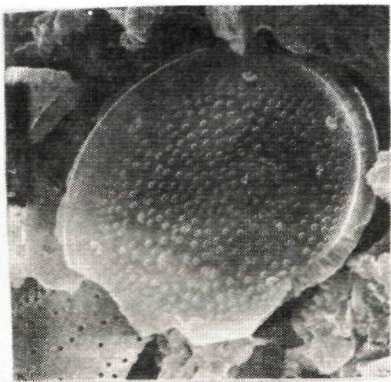
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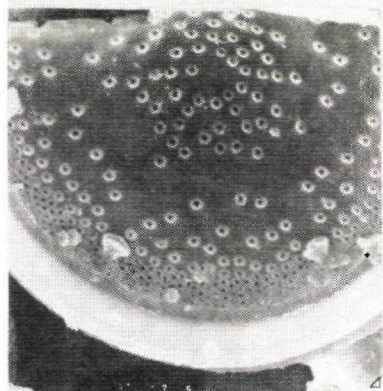
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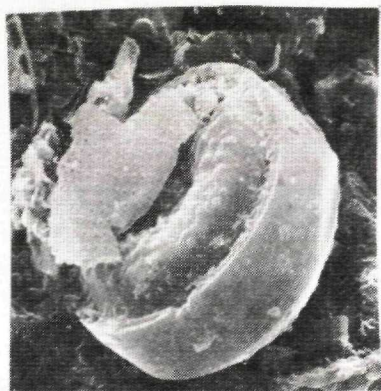
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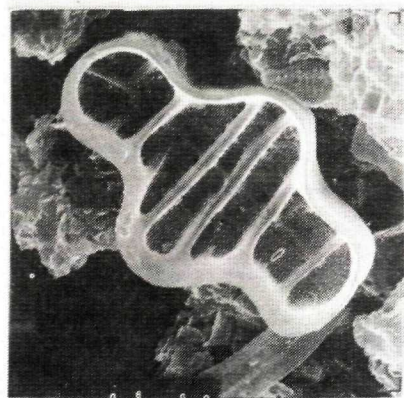
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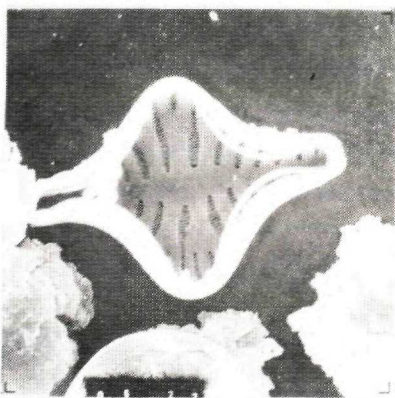
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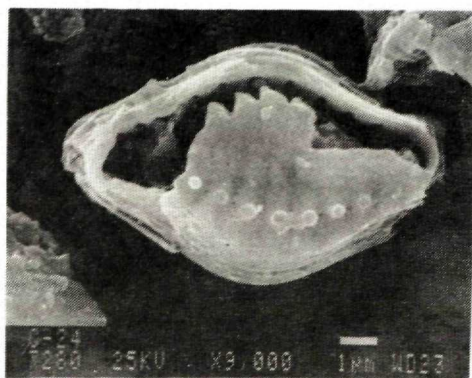
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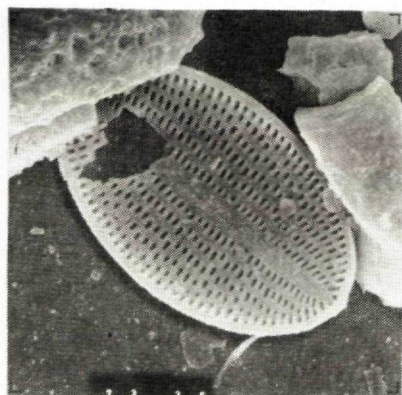
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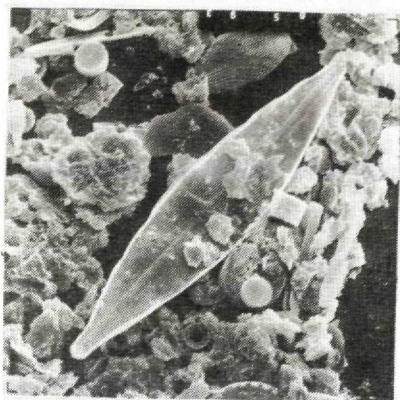
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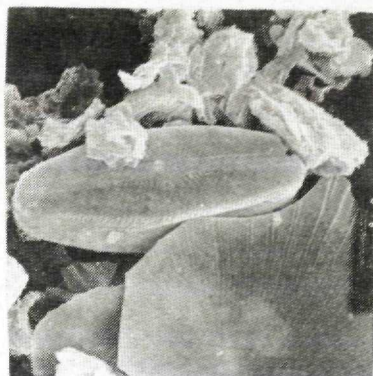
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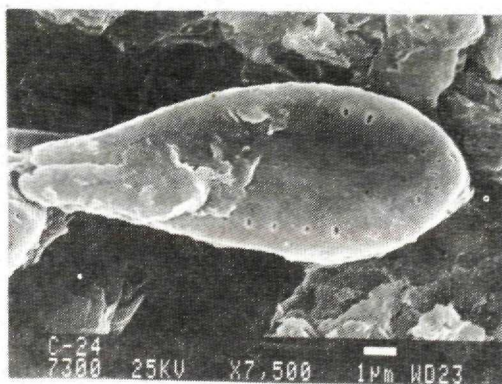
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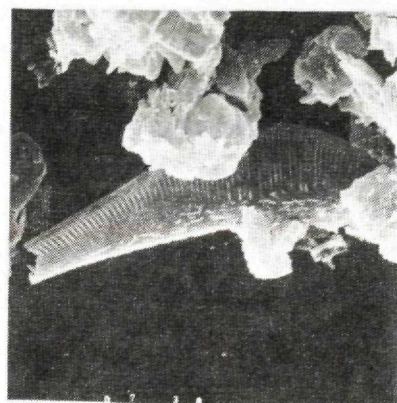
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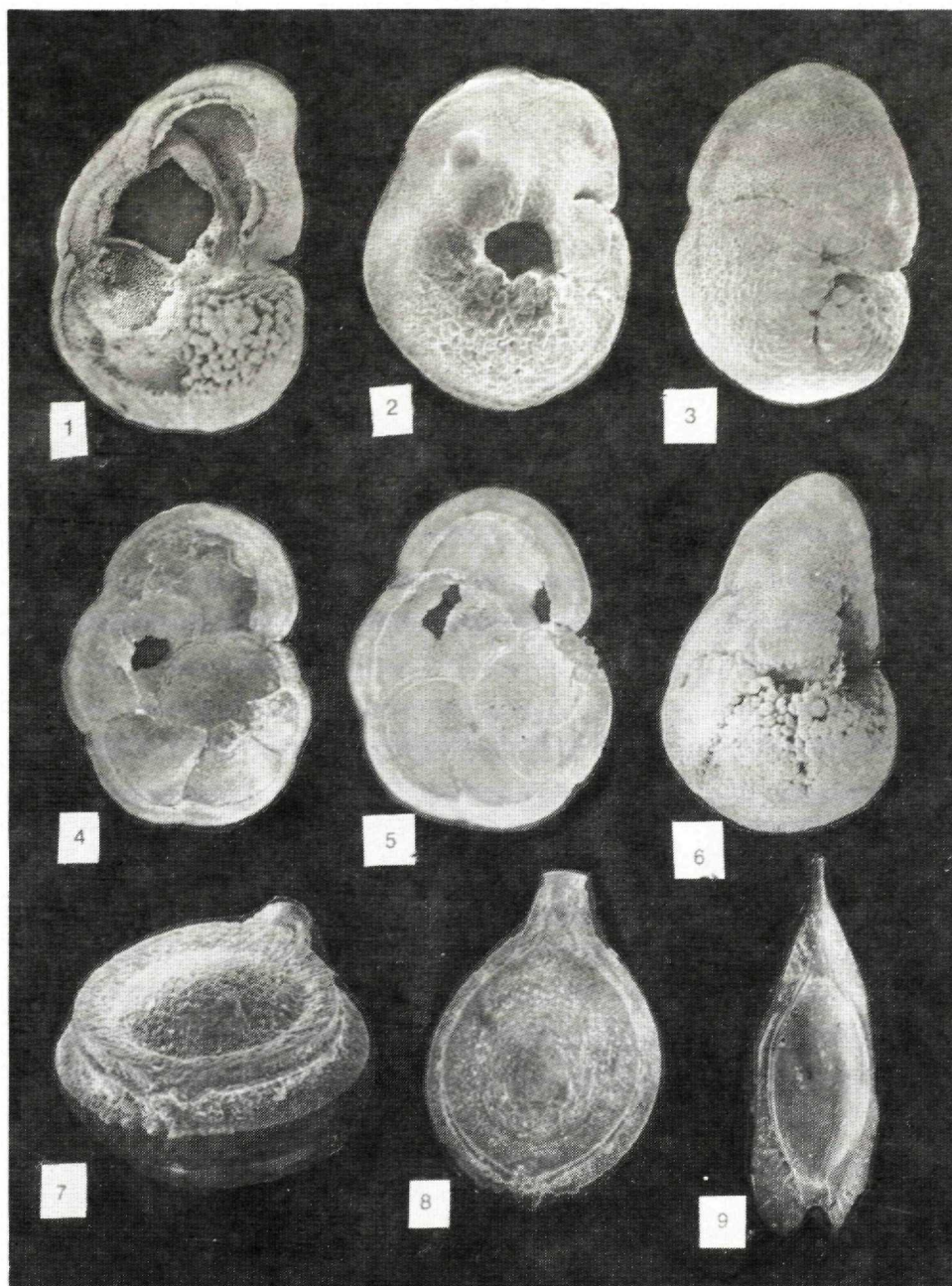
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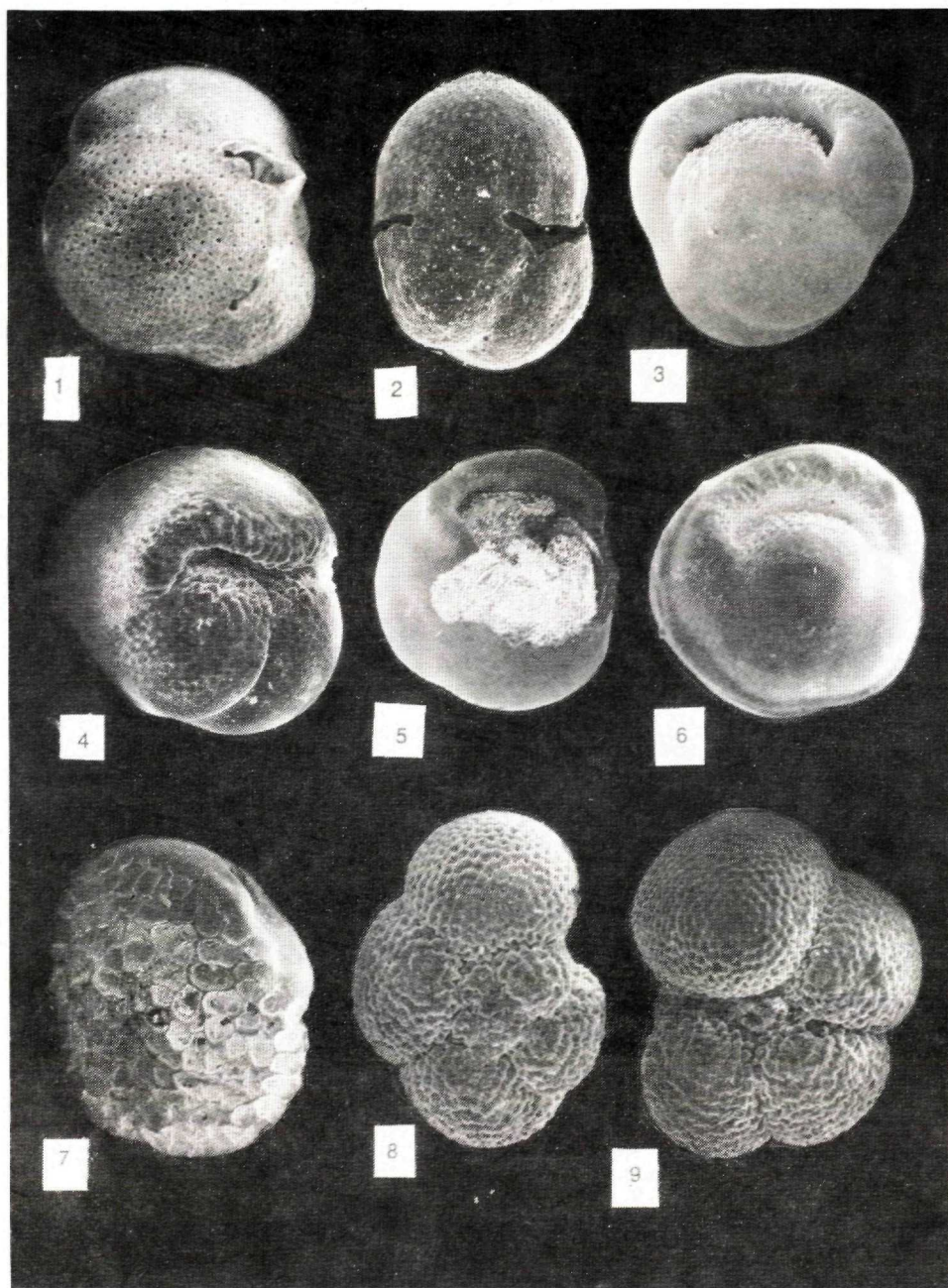


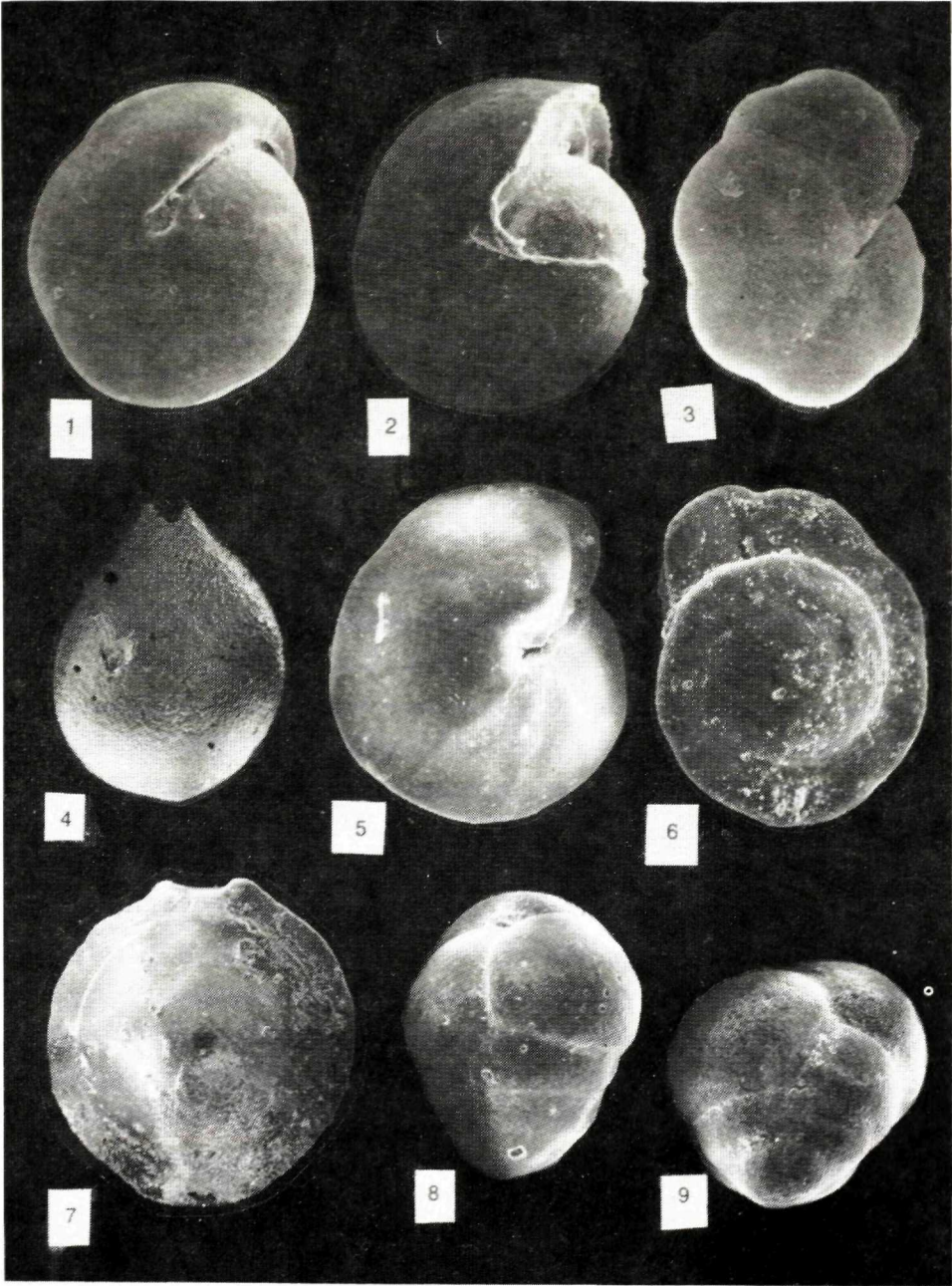
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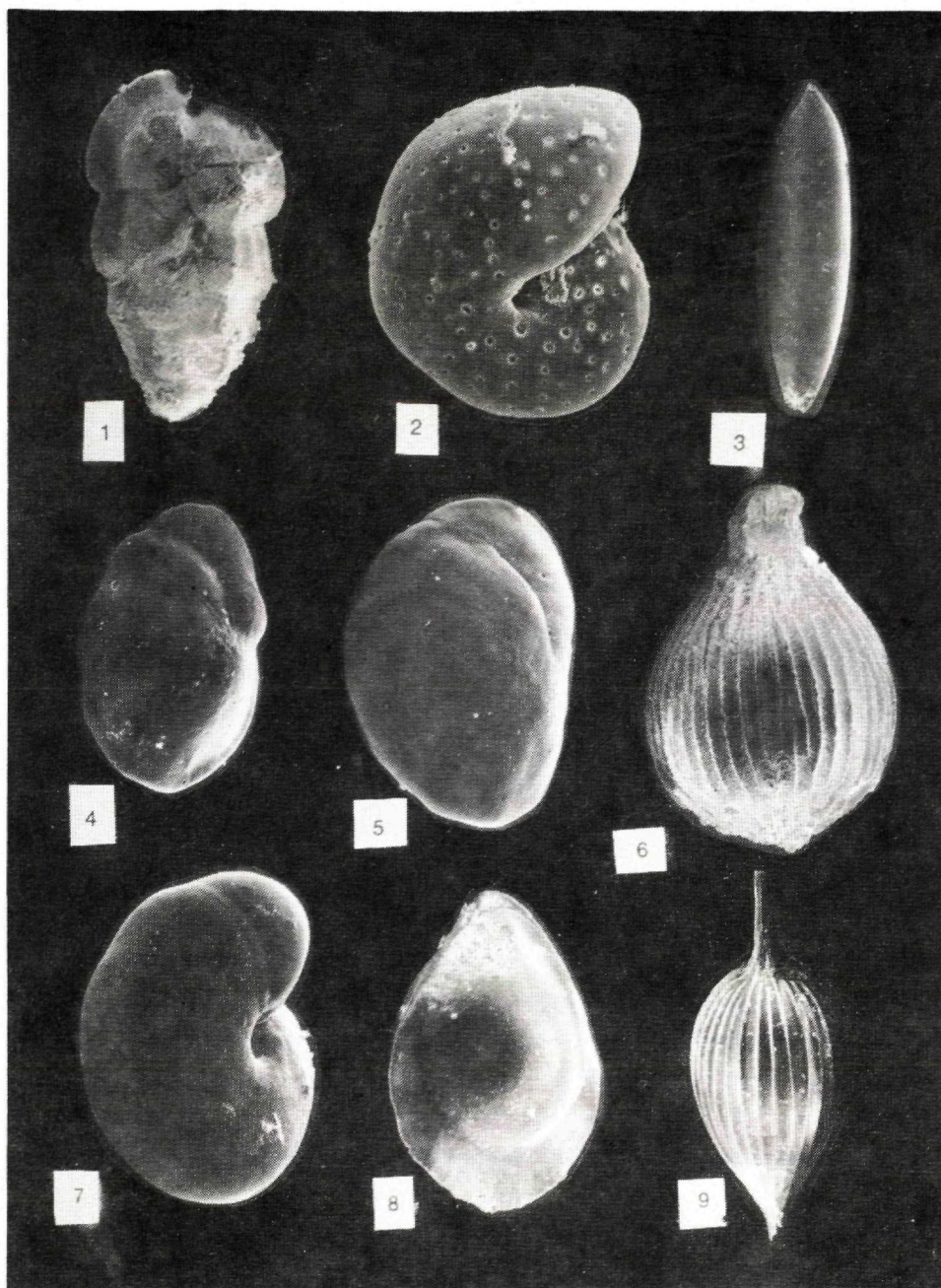


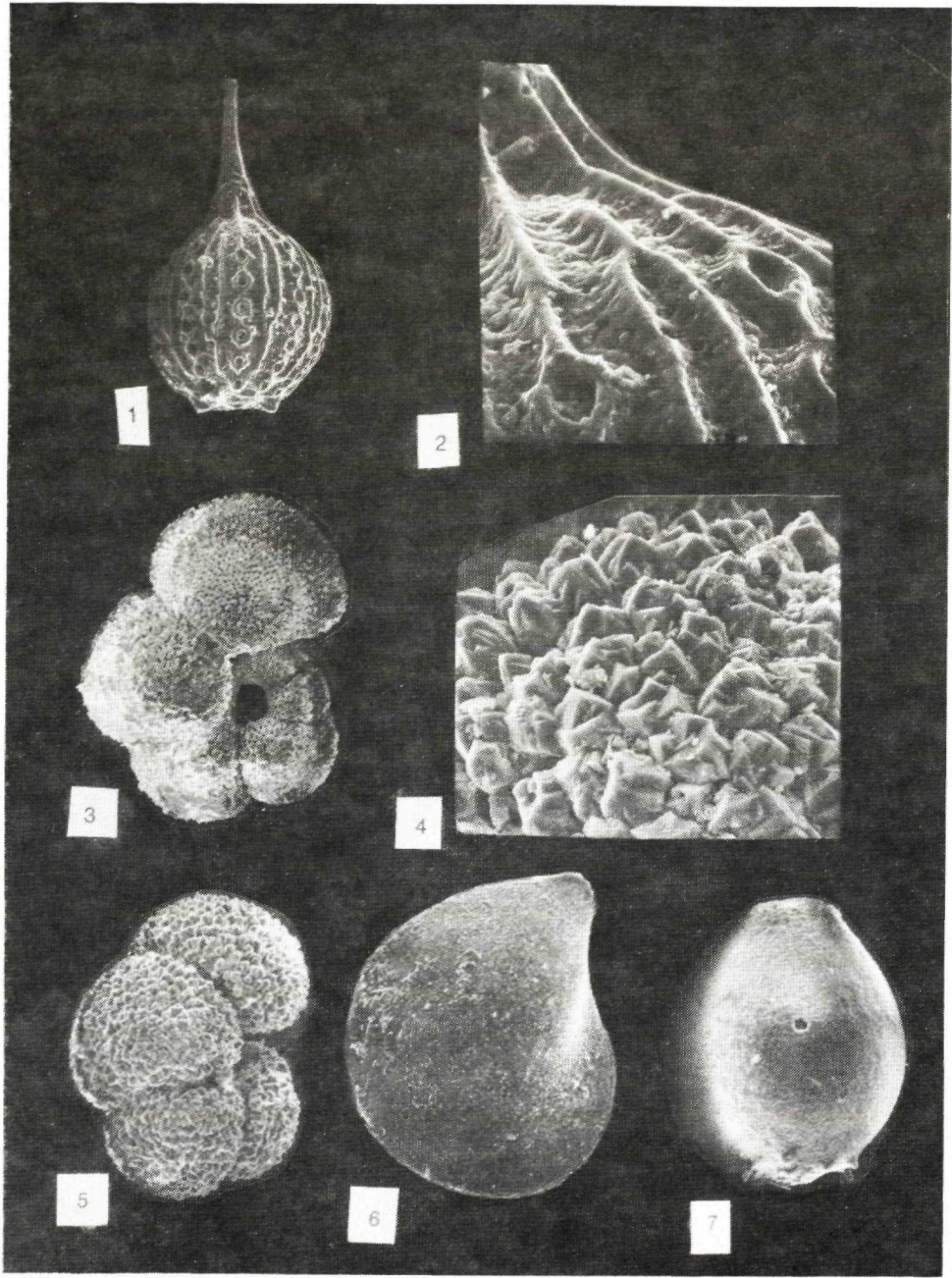
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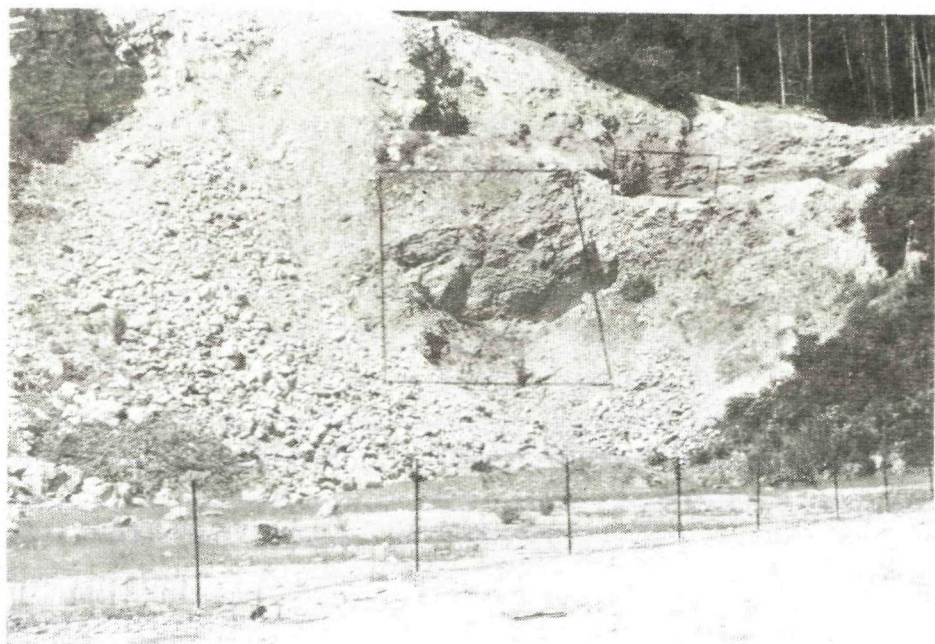








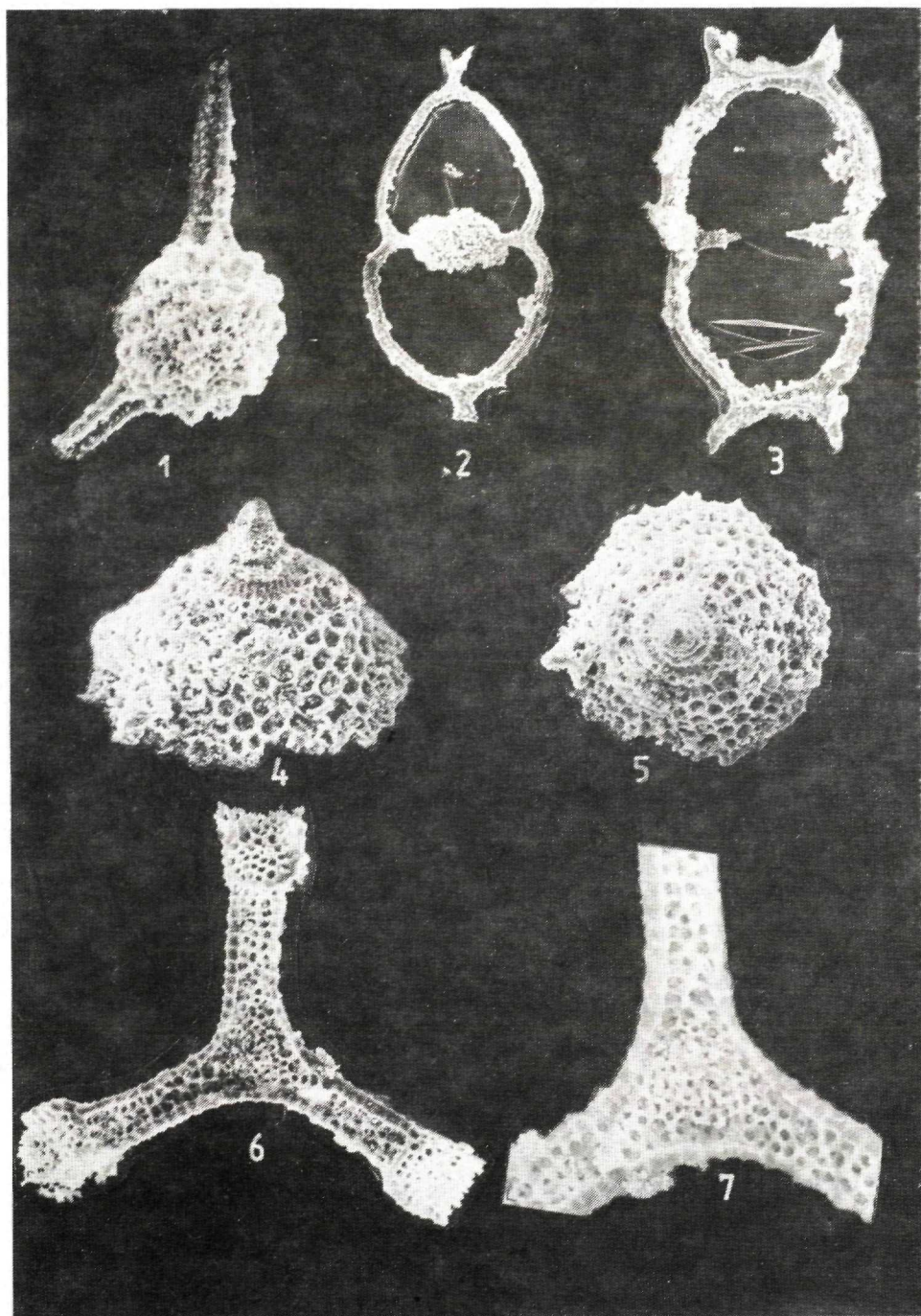


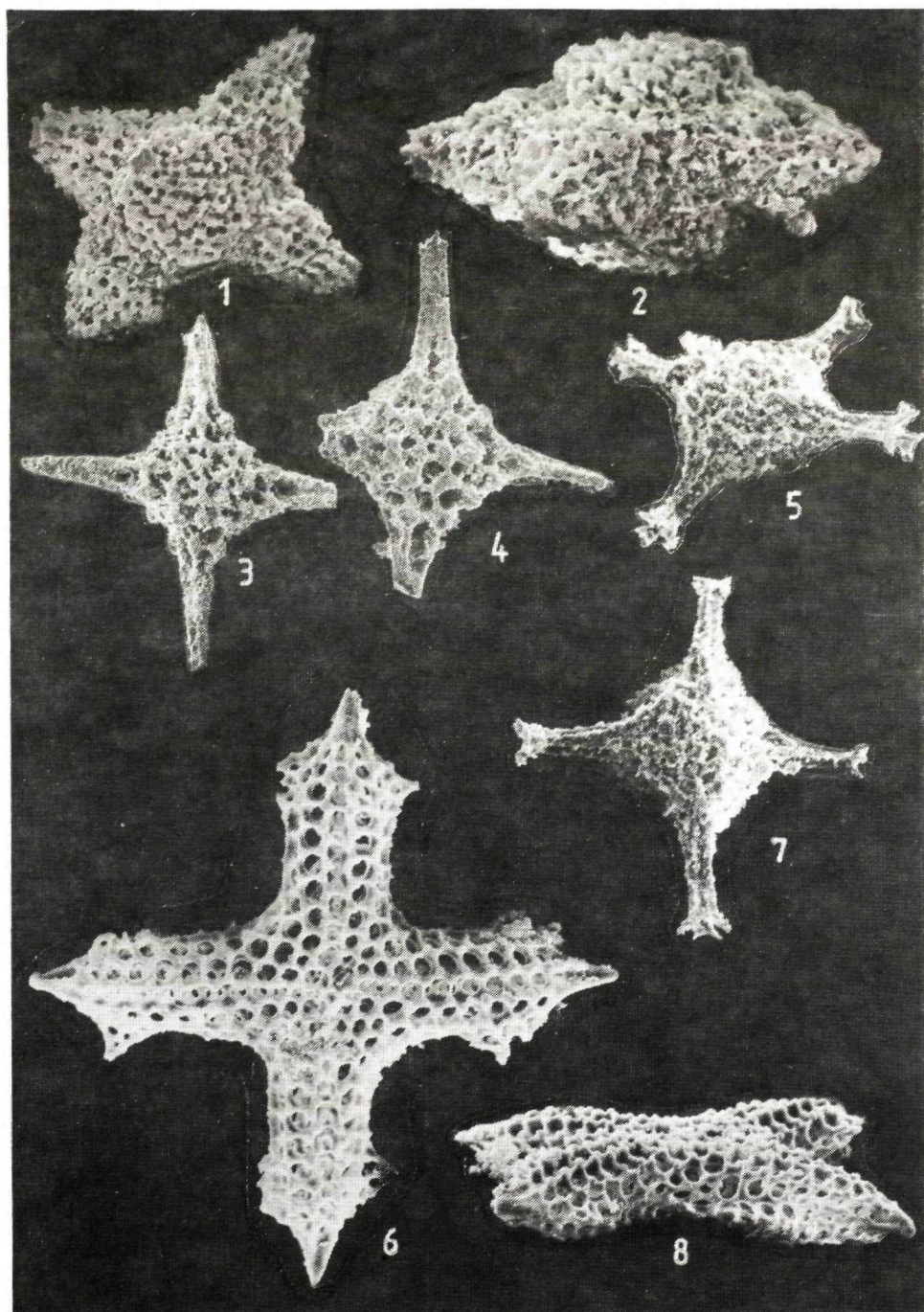


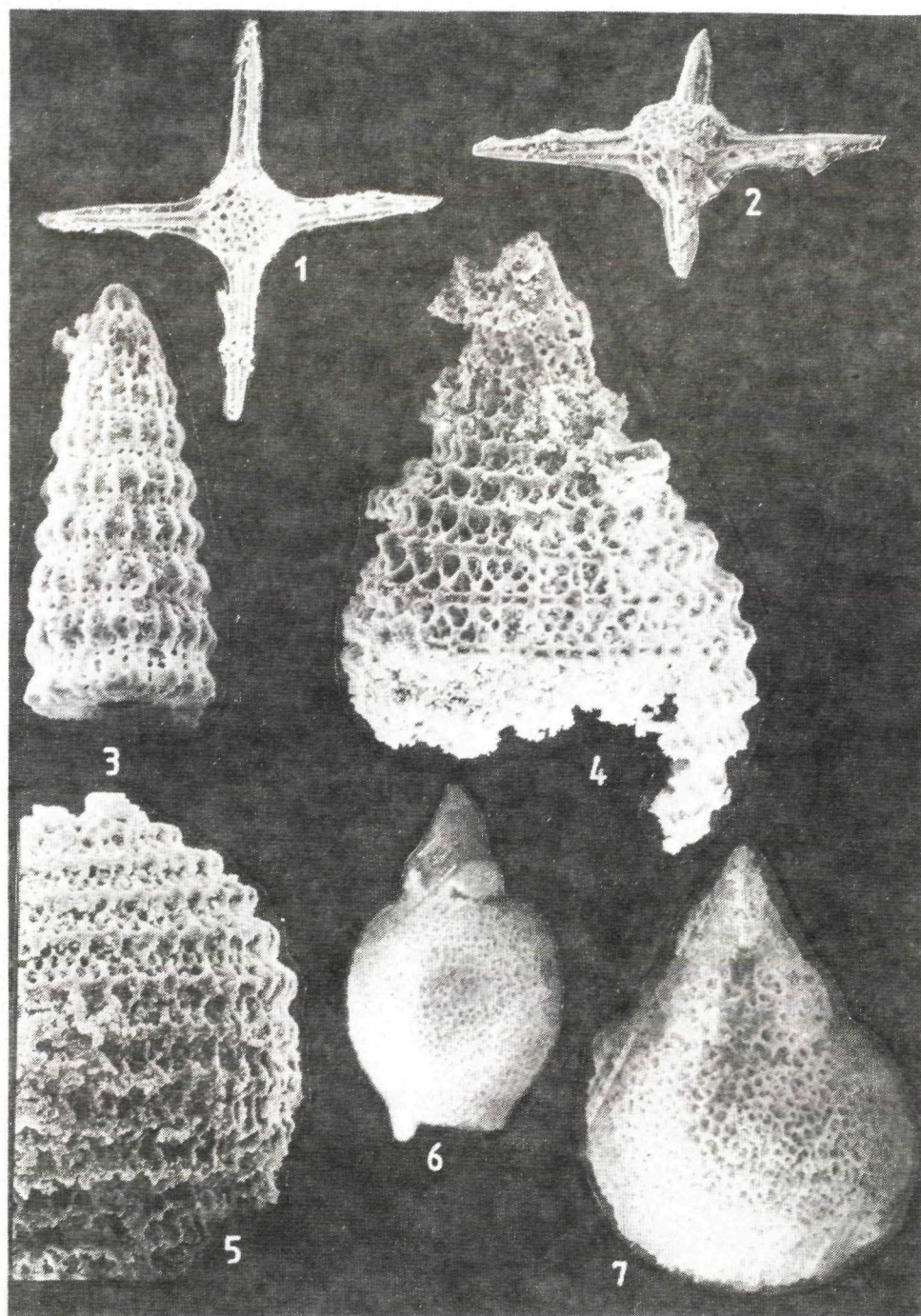
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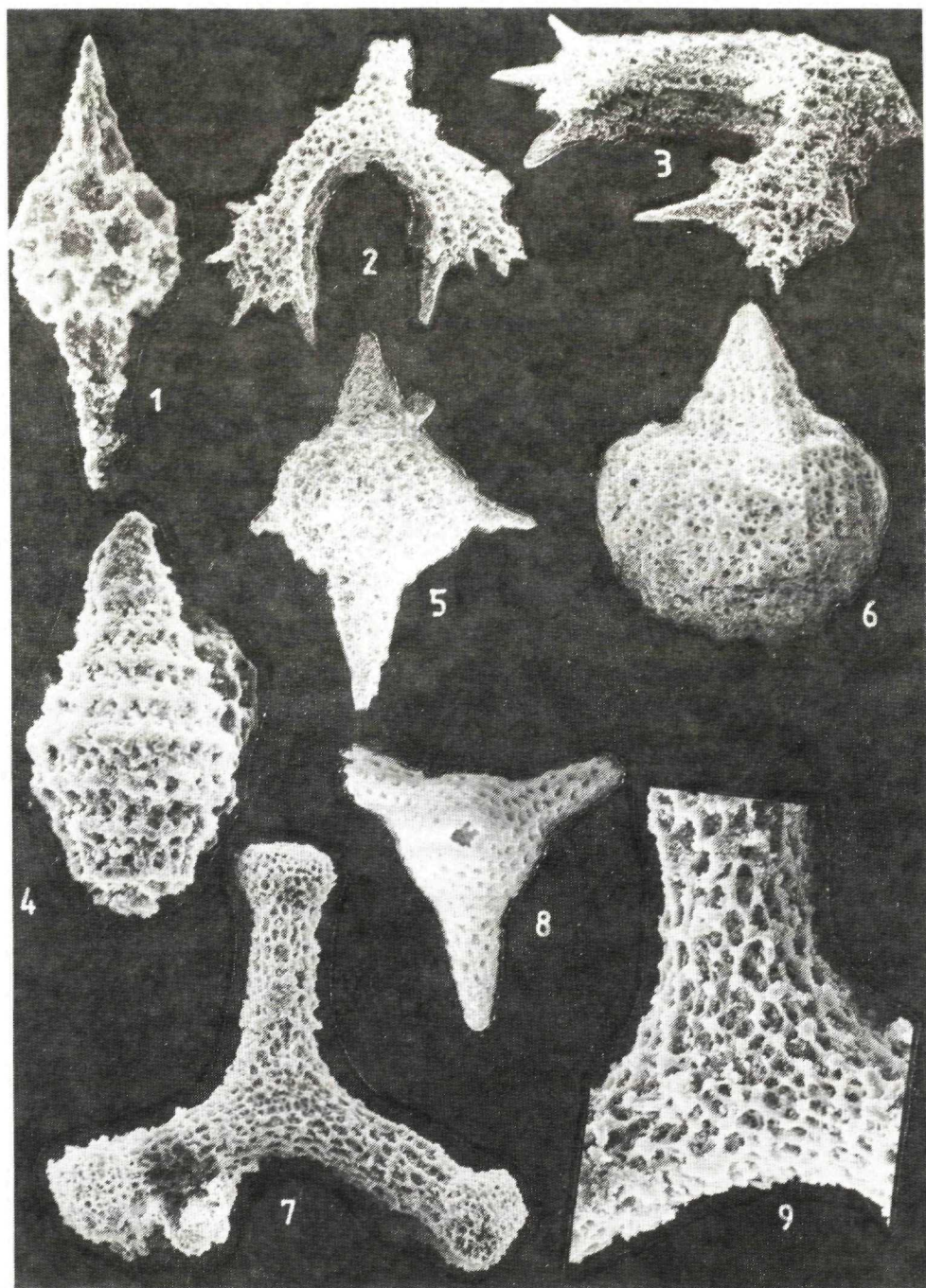


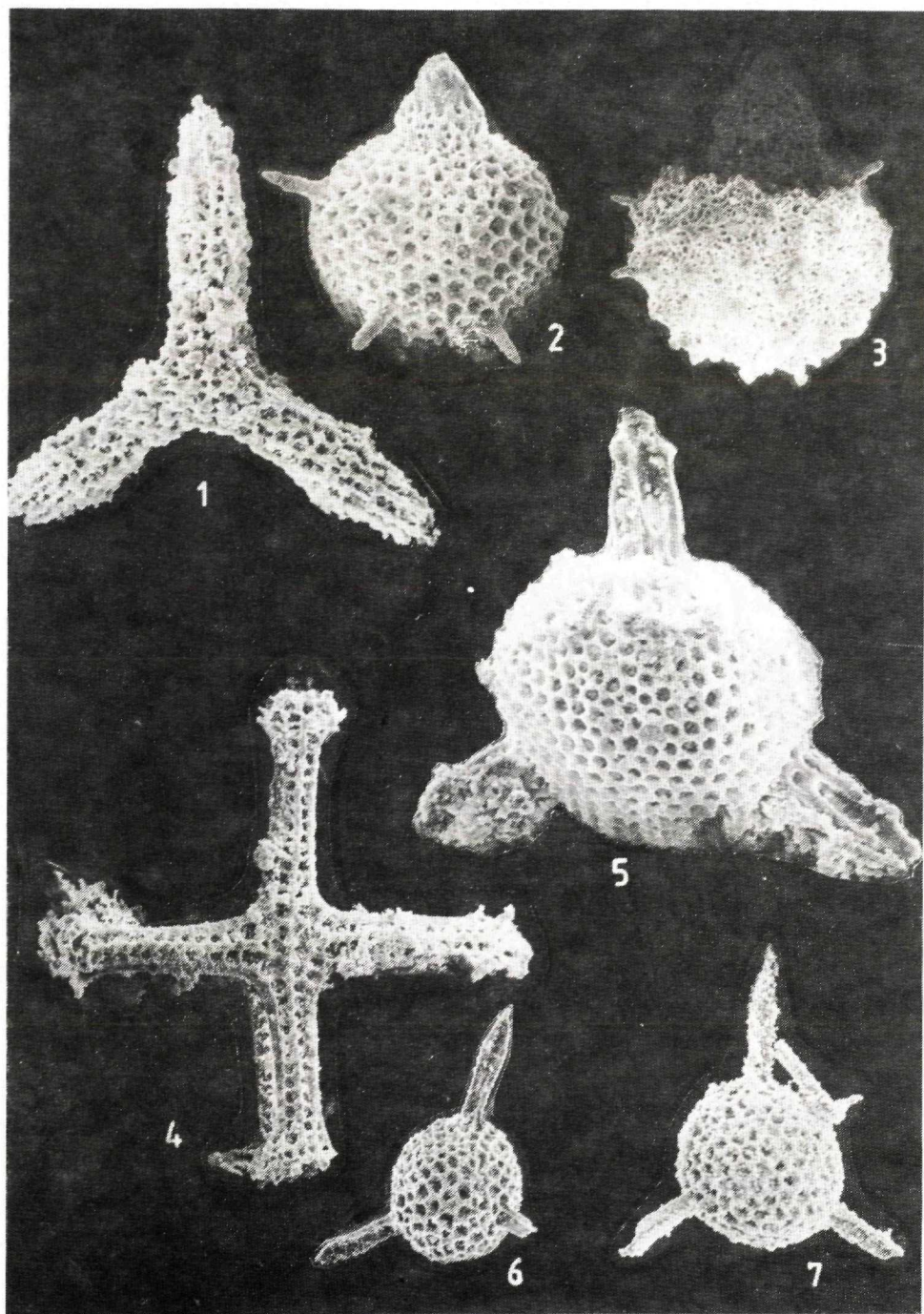
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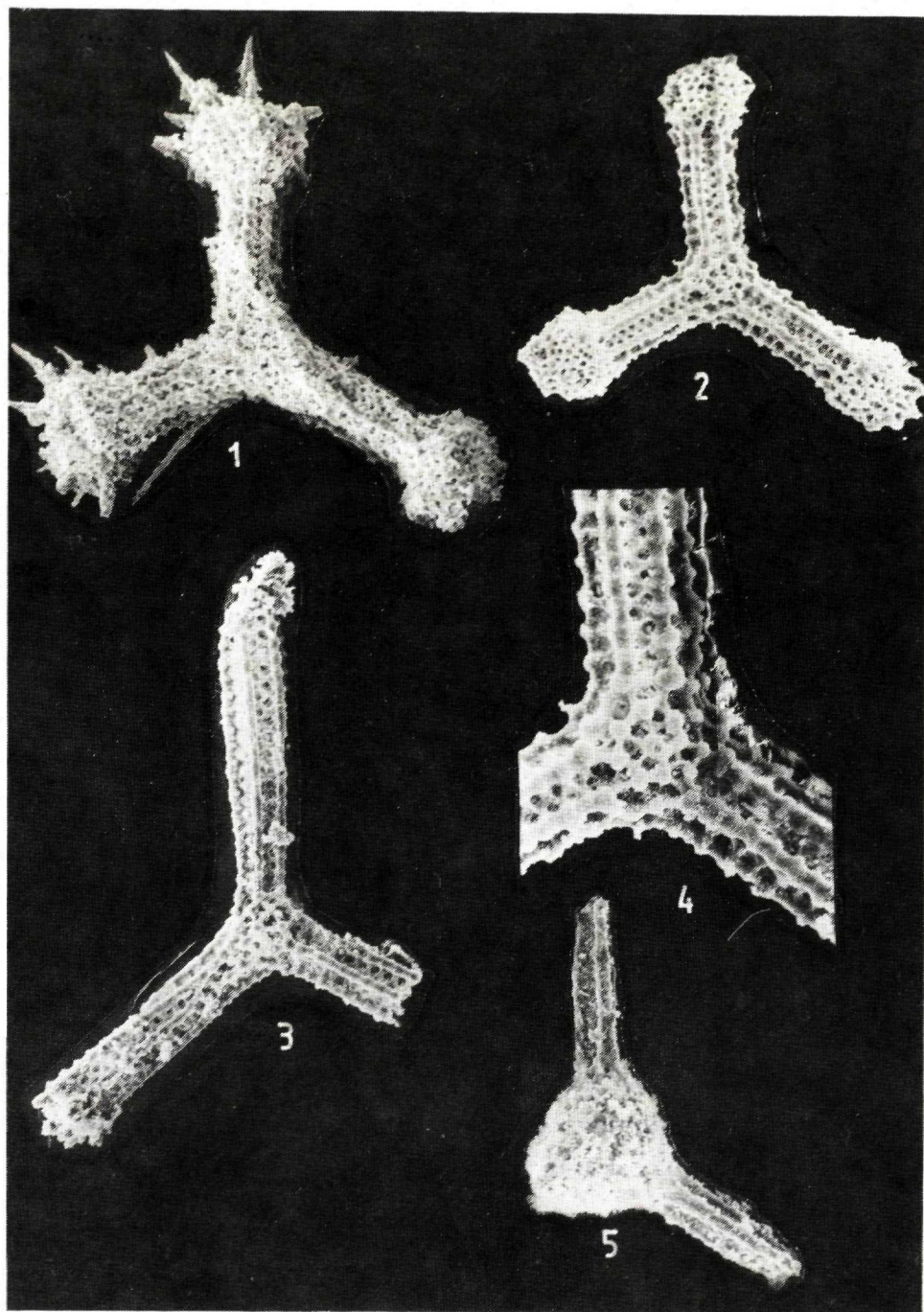


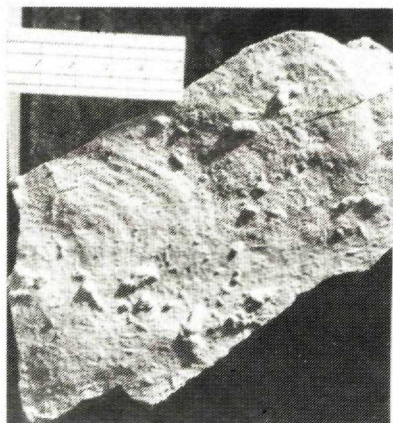












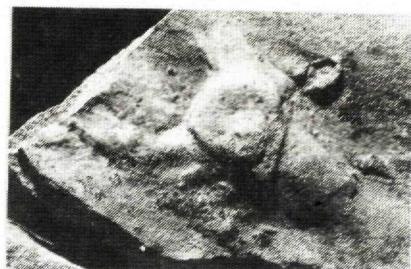
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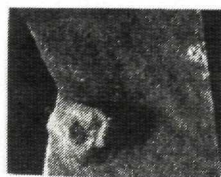
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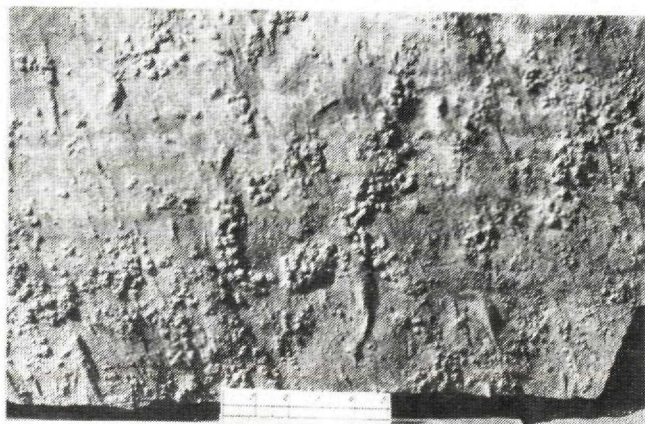
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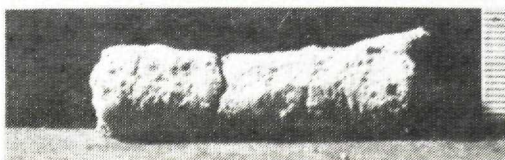
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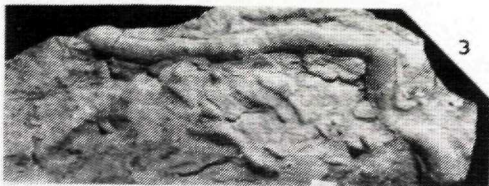
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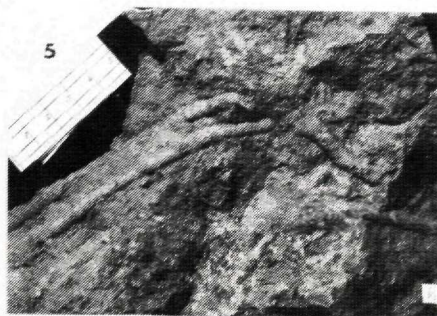


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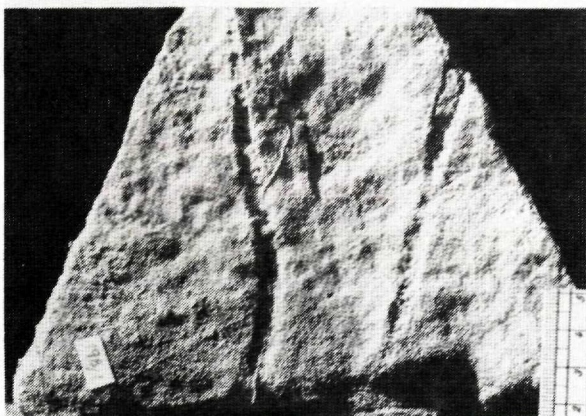
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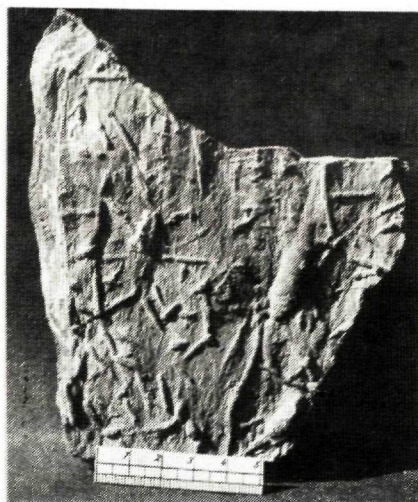


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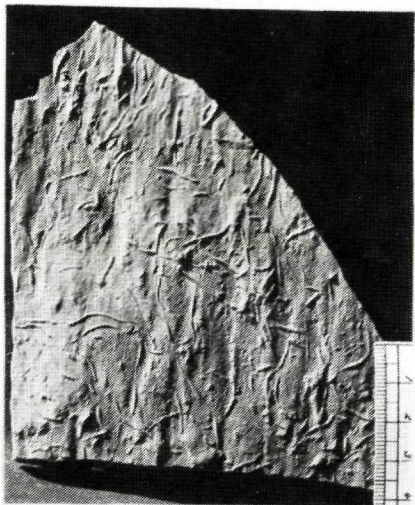




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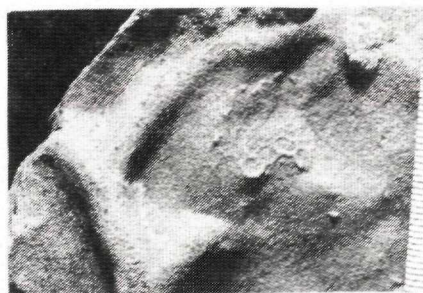
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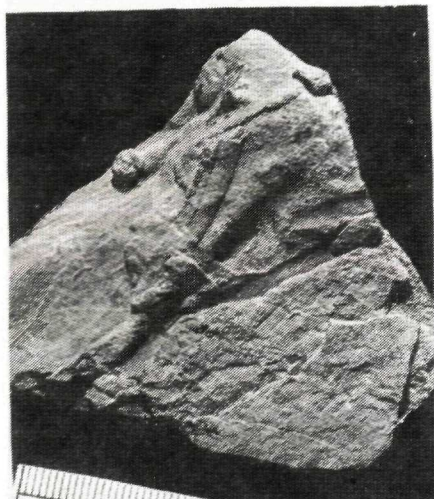
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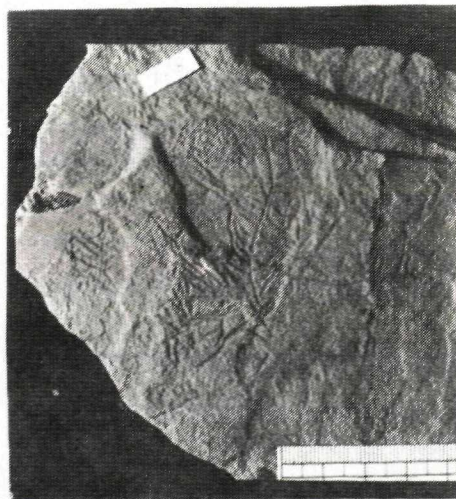
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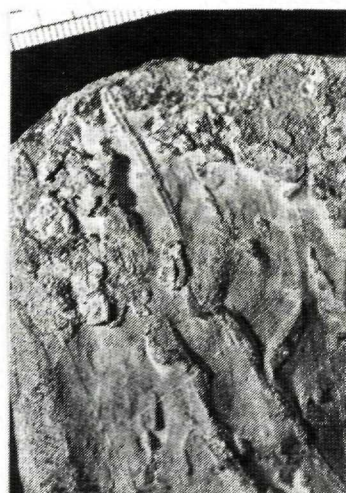
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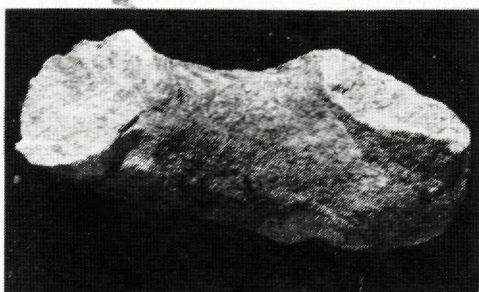
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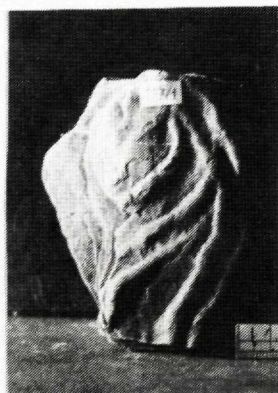
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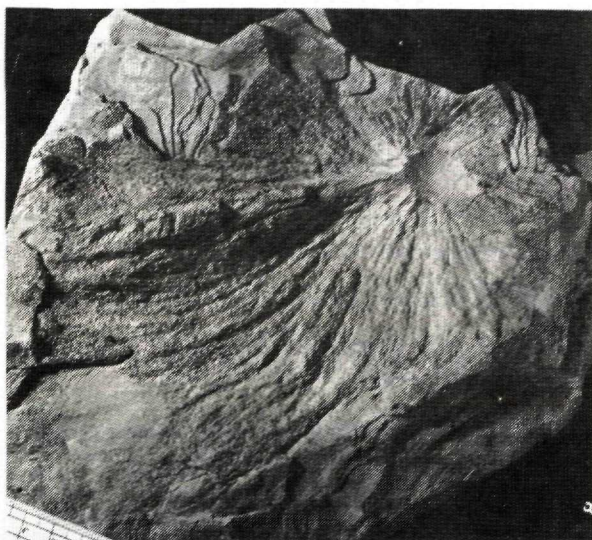


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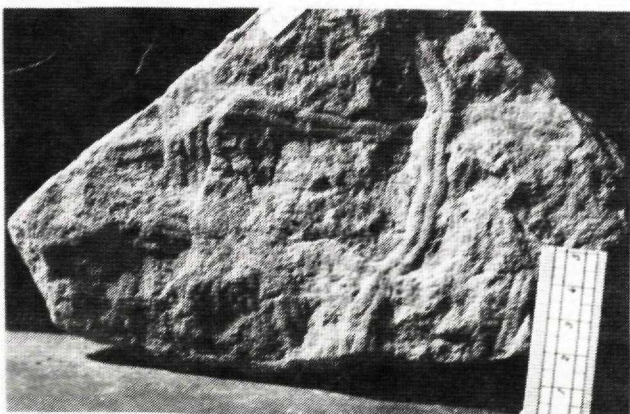


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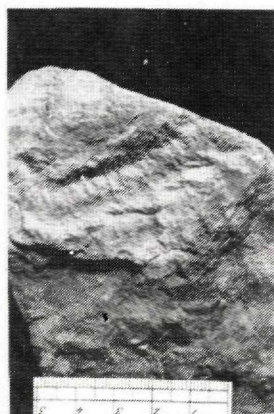
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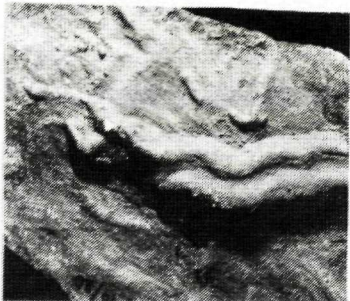


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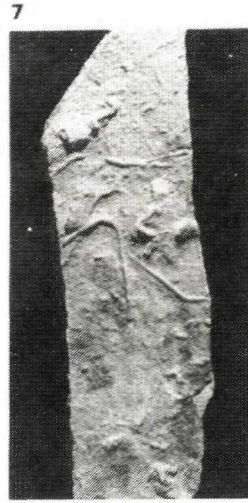
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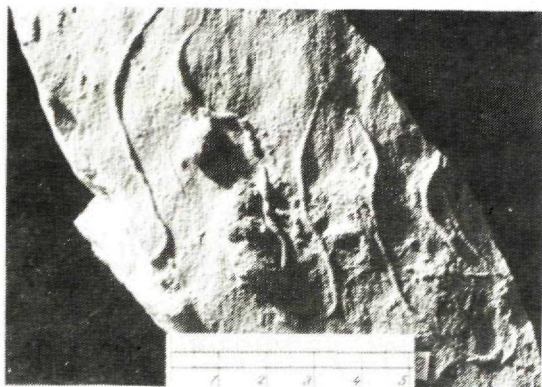
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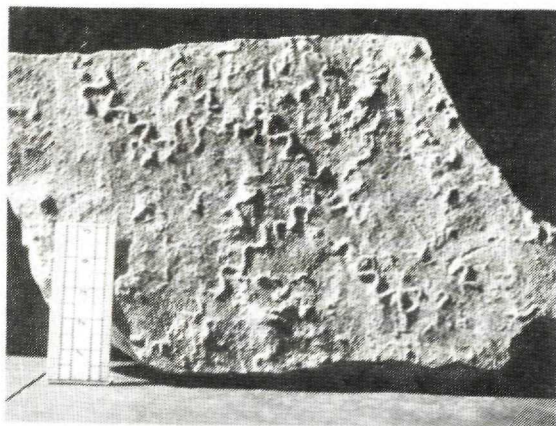
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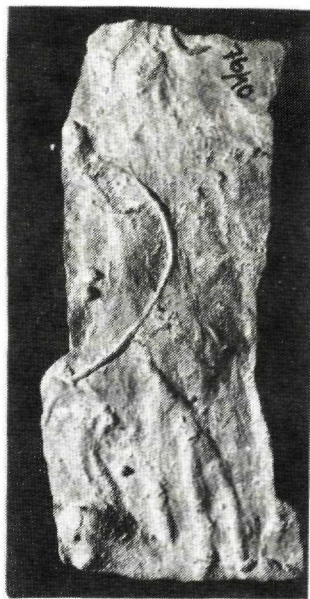
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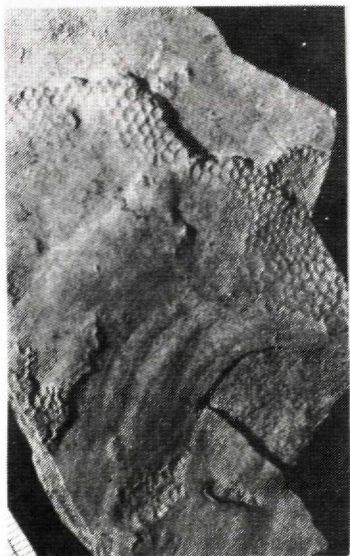
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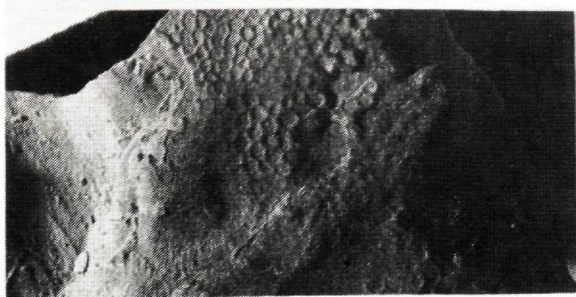
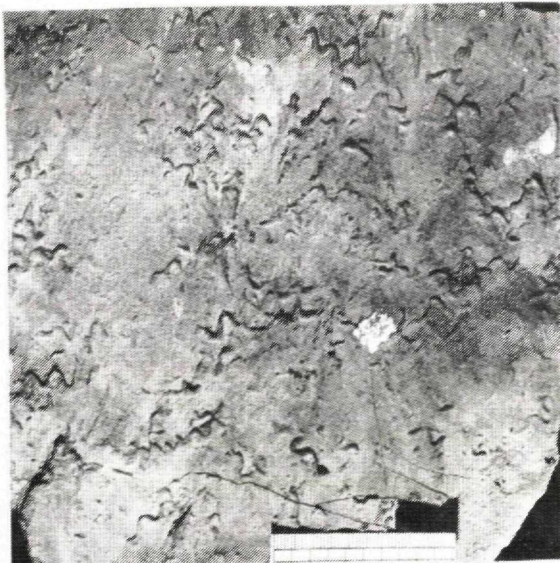
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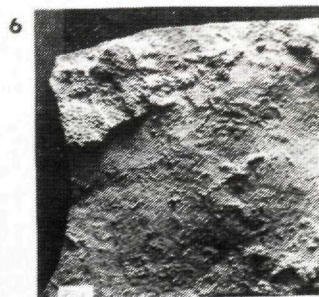
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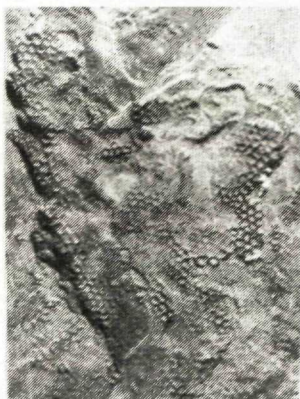
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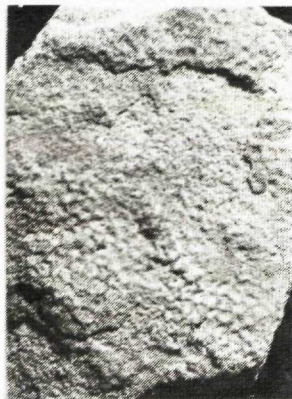
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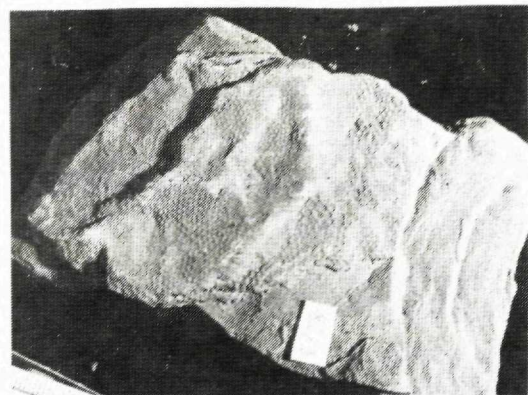
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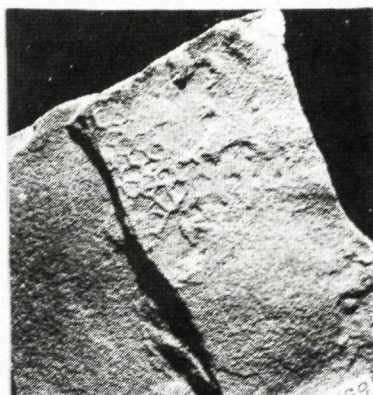
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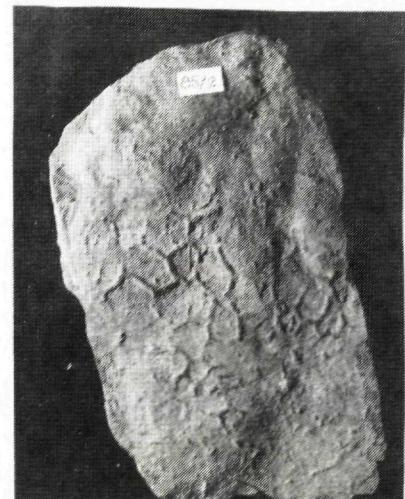
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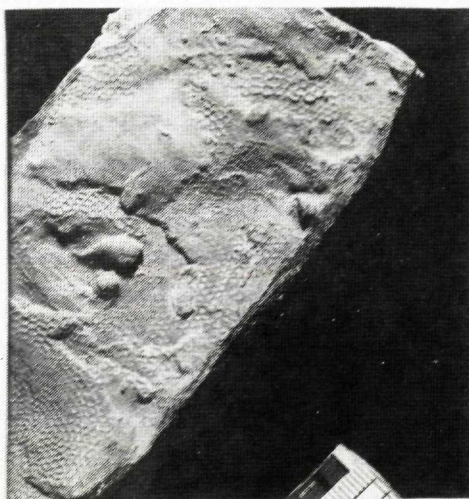
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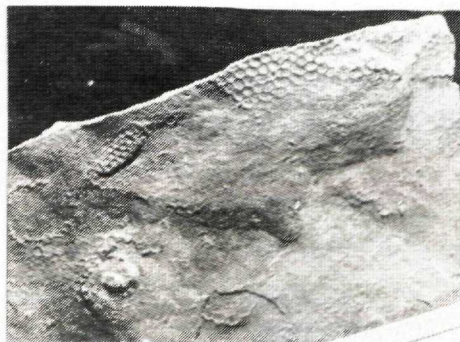


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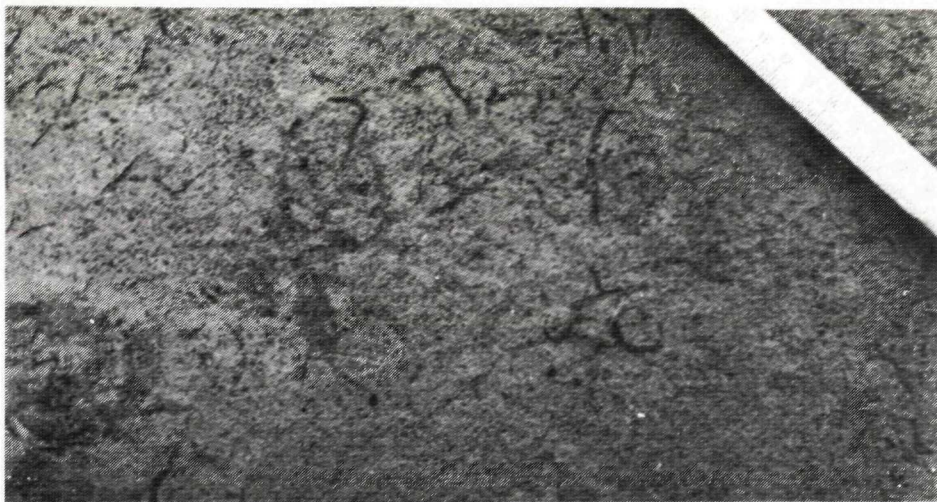




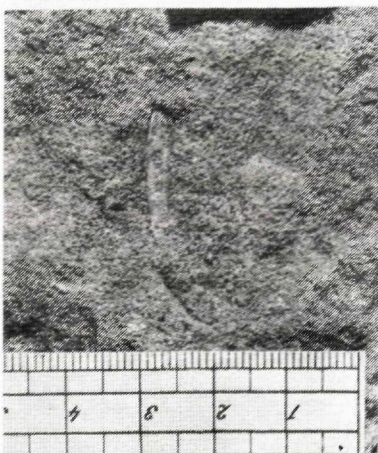
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Geologický ústav Dionýza Štúra
INFORMAČNÉ STREDISKO
naša doňa
BRATISLAVA