

13 104 6

mlt

no 270/86

CS ISSN 0139—7435

ZÁPADNÉ KARPATY

SÉRIA

paleontológia 10

13 107 8

ZÁPADNÉ KARPATY • PALEONTOLOGIA 10

Tematická skupina 03/9

Cena brož. výtlačku Kčs 18,—

GEOLOGICKÝ ÚSTAV DIONÝZA ŠTÚRA, BRATISLAVA 1985

Ústredná geologická knižnica SR
ŠGÚDŠ



3902001020198

ZÁPADNÉ KARPATY

Séria

Paleontológia 10

Vydal Geologický ústav Dionýza Štúra vo vydavateľskom oprávnení Vedy, vydavateľstva Slovenskej
akadémie vied v Bratislave v roku 1985

Vedecký redaktor: RNDr. Ondrej Samuel, DrSc.

Zodpovedná redaktorka: Irena Bročková

Technická redaktorka: Gabriela Šipošová

Preklad do angličtiny: Edita Jassingerová

Vytlačili ZT, n. p., závod Svornosť, Bratislava roku 1986. Náklad 650 kusov. Tem. sk. 03/9. Povolenie
SÚKK 1197/1984. Rozsah AH 10,87, VH 11,05, cena brož. výtł. Kčs 18,—

ZÁPADNÉ KARPATY

SÉRIA

paleontológia 10

Geologický ústav Dionýza Štúra
KNIŽNICA
Mlynská dolina 1
817 04 BRATISLAVA

GEOLOGICKÝ ÚSTAV DIONÝZA ŠTÚRA, BRATISLAVA, 1985

Geologický ústav Dionýza Štúra
KNIŽNICA

Signatúra:	13 104 6
kat. čís.:	270/1986
Kčs kúpa:	18.-
Kčs vým.:	—
Kčs dar:	—

ZÁPADNÉ KARPATY

SÉRIA

Paleontológia 10

Vedecký redaktor

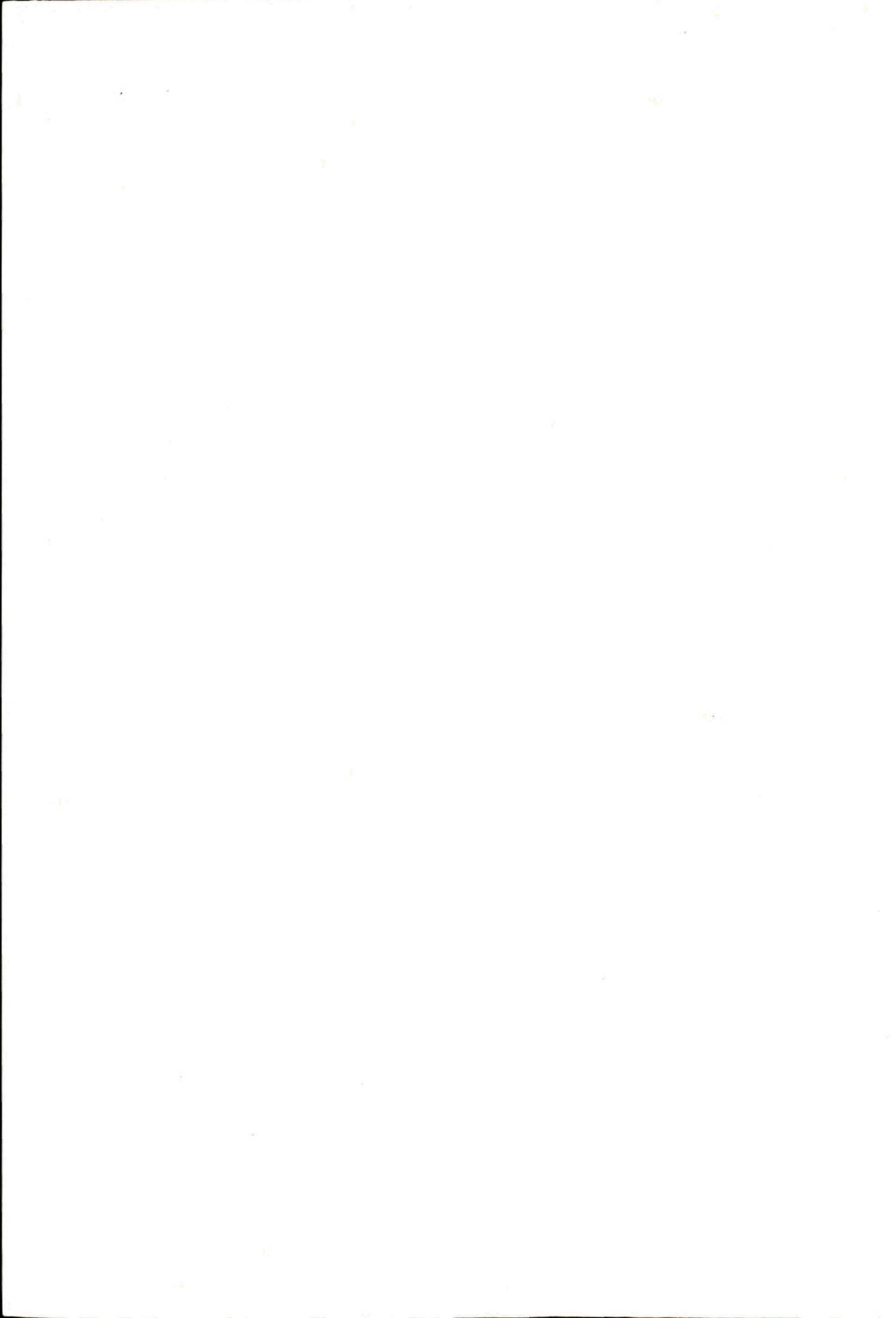
RNDr. ONDREJ SAMUEL, DrSc.

Redakčný okruh

RNDr. EVA PLANDEROVÁ, CSc., RNDr. VIERA GAŠPARÍKOVÁ, CSc., RNDr. MILOŠ RAKÚS, CSc.

OBSAH—CONTENTS—INHALT

VASS, D.: Univerzitný profesor RNDr. Jozef Švagrovský, DrSc. (1921—1985)	7
HOLEC, P.: Finds of Mastodon (Proboscidea, Mammalia) Relics in Neogene and Quaternary Sediments of Slovakia (ČSSR) — Nález zvyškov mastodontov (Proboscidea, Mammalia) v neogénnych a kvartérnych sedimentoch Slovenska	13
KOCHANOVÁ, M.: Middle Triassic Bivalvia from Area of Gemerská Hôrka in Slovak Karst (West Carpathians) — Bivalvia stredného triasu z oblasti Gemerskej Hôrky v Slovenskom krase (Západné Karpaty)	55
ELIAŠOVÁ, H.: Muranella and Fusanella, algae incertae sedis with spherulitic skeletal microstructure (Tithonian of the Outer Flysch Carpathians, Czechoslovakia) — Muranella a Fusanella, algae incertae sedis se sferulitickou vnútornou štruktúrou	75
ZLINSKÁ, A.: Lower Jurassic Foraminifers in Červený Kameň Klippe near Podbiel — Foraminifery spodnej jury v bradle Červený Kameň pri Podbieli	85
LEHOTAYOVÁ, R.: Helicosphaera porosa — new species of calcareous nannoflora from Oligocene (Miocene boundary)	103



Univerzitný profesor
RNDR. Jozef Švagrovský, DrSc.

(2. V. 1921—18. 12. 1985)



Na sklonku roku 1985 opustil rady slovenských geológov, kolektív pedagógov Prírodovedeckej fakulty Univerzity Komenského v Bratislave a svojich študentov univerzitný profesor RNDR. Jozef Švagrovský, DrSc. 18. decembra osirela jeho pracovňa, zhasol mikroskop, vyschlo pero. Profesor Švagrovský neukončil prednáškový cyklus systematickej paleontológie ani nevyskúšal svojich posledných poslucháčov, ktorým, tak ako aj tým predošlým, popri vedomostiach rozdával aj kus zo seba, svoje skúsenosti z dlhoročnej vedeckej práce paleontológa.

Profesor Švagrovský sa narodil 2. mája 1921 na Zemplíne, v mestečku Sečovce na úpätí Slanských vrchov, v rodine kováča, ktorý však pracoval ako robotník u ma-

lých firiem a podnikov. Základné vzdelanie absolvoval v rodnom meste a stredoškolské štúdium na gymnáziu v Michalovciach, kde v roku 1944 zmaturoval. Po oslobodení krátko pracoval ako tajomník MNV v Sečovciach, ale už v jeseni roku 1945 sa zapísal na Prírodovedeckú fakultu UK v Bratislave, kde študoval prírodopis a zemepis. Záujem o geologické vedy v ňom vzbudili prednášky, semináre a terénne cvičenia zosnulého akademika Andrusova. Po absolvovaní vysokoškolského štúdia v roku 1949 začal pracovať ako pomocný asistent na Geologickom ústave Prírodovedeckej fakulty. Cesta začínajúceho geológa viedla do rodného kraja, na východné Slovensko, kde skúmal neogén Košickej kotliny. Výsledky svojich prvých terénnych výskumov zhrnul v dizertačnej práci, ktorú obhájil v roku 1950 a získal titul doktora prírodných vied. Vo svojej výskumnej práci sa aj pozdejšie vracal na východné Slovensko. Skúmal geologické pomery a biostratigrafiu neogénu východoslovenskej panvy. Pracoval na západnom úpätí Slanských vrchov — v okolí Prešova (2), Varhaňoviec (1, 16), v južnej časti Košickej kotliny (8), v okolí Košíc (12, 13, 16), na úpätí masívov Hradisko (10) a Dargov (3), v medziriečí dolných tokov Torysy a Olšavy (23). Pracoval aj na východnom úpätí Slanských vrchov — medzi Kalšou a Michaľanmi (7) a v okolí rodných Sečoviec (5). Z týchto štúdií si zvláštnu zmienku

zasluhuje jeho lito- a biostratigrafická analýza vrchného bádenu v brakickom vývoji a brakického sarmatu, ktorá vyústila do definovania hranice týchto dvoch stupňov na východnom Slovensku (24). Definoval tiež niekoľko litostratigrafických jednotiek, ktorých platnosť pretrváva i podľa súčasných pravidiel československej litostratigrafickej terminológie. Definoval napr. myšlianske a olšavské vrstvy Košickej kotliny (18, 24). Spolu s J. Senešom a pozdejšie s T. Budayom v systematických prácach o neogéne východného Slovenska zhrnul výsledky prvej etapy výskumu východného Slovenska (14, 20), na ktoré úspešne nadviazala prospekcia ropy a zemného plynu.

Hlavným ťažiskom vedeckej práce profesora Švagrovského však bola paleontológia. Študoval miocénne mäkkýše, ktoré paleontologicky opísal, ale aj vyhodnocoval aj z hľadiska biotopu a pre účely biostratigrafie. Jeho prvé biostratigrafické práce o brakickej faune bádenu a sarmatu patrili spolu s prácami V. Čechoviča a L. Körössyho k pionierskym prácam na východnom Slovensku. Profesor Švagrovský sa k tejto problematike vracal po celý svoj plodný život. V prvých biostratigrafických prácach opísal faunu egenburgu z Prešova (2). Podrobne skúmal biostratografiu východoslovenského vrchného bádenu a sarmatu (4, 18, 19, 22, 25). V rozsiahlejších prácach podal paleontologický opis najdôležitejších čeladi a rodov strednomiocénnych brakických spoločenstiev mäkkýšov. Opísal čelaď *Potamididae* (6), rod *Clithon* (9) a bádenské cerítia (11) z východného Slovenska. Opísal tiež čelade *Trochoidae* (15), *Pleurotomidae* (17) z neogénu Slovenska a bádenské *Pectinidae* (32). Podal pri tom diagnostiku viacerých nových druhov. Jeho paleontologické štúdie vyústili do monografie bádenských mäkkýšov východného Slovenska (22) a vyvrcholili v rozsiahlej monografii venovanej sarmatským mäkkýšom Československa (27), v ktorej, popri spoločenstvách z východného Slovenska opísal aj sarmatské mäkkýše podunajskej a viedenskej panvy. Charakter monografie má tiež paleontologický opis a zhodnotenie biotopu vrchnobádenských mäkkýšov z Borského Mikuláša vo viedenskej panve (35—38). Podrobne spracoval fáciostatotypy chronostratigrafických stupňov bádenu (profil na Sandbergu pri Devínskej Novej Vsi (31, 34) a sarmat (Nižná Myšľa, 30).

Výsledky svojich vedeckých výskumov publikoval v početných prácach a v rozsiahlej monografii. Prednášal na mnohých sympóziách, konferenciách, zjazdoch, doma i v cudzine. Je tiež autorom početných nepublikovaných záverečných správ.

K jeho publikačnej činnosti treba prirátat recenzie významných paleontologických diel zahraničných autorov (43, 47), ako aj niekoľko vedecko-populárnych článkov, ktorými sa snažil priblížiť paleontológiu negeologickej verejnosti Slovenska (49—56).

Jeho vysoká odborná aktivita, vedecká erudícia a cieľavedomá práca mala prirodzene za výsledok získanie vysokých akademických titulov. V roku 1957, t. j. takmer bezprostredne po zavedení vedeckej kandidatury, získal hodnosť kandidáta vied a v roku 1969 hodnosť doktora vied. Ako zaslúžilý vedecký pracovník bol menovaný za člena redakčných rád odborných časopisov *Geologický zborník — Geologica carpathica* a *Acta geologica et geographica Universitatis Comenianae*. Bol tiež členom výboru Národného paleontologického komitétu ČSAV.

Profesor Švagrovský zameral svoj intelekt dvoma smermi. Na spomínaný vedecký výskum a druhý na pedagogickú prácu. Svoje pedagogické schopnosti uplatnil

a rozvíjal najprv ako asistent a odborný asistent na pôde Prírodovedeckej fakulty, pozdejšie na novozriadenej Fakulte geologicko-geografických vied, kde bol v r. 1954 menovaný za docenta paleontológie, a nakoniec v r. 1962 ako riadny profesor paleontológie. Prednášal paleontológiu geológom a istý čas aj biológom. Prakticky všetci slovenskí geológovia s univerzitným vzdelaním — terajšími päťdesiatnikmi počínajúc a končiac najmladšími vyznavačmi tejto vedy, sú jeho žiakmi. Zastával aj vysoké vysokoškolské pedagogicko-administratívne funkcie. V rokoch 1954—56 bol prodekanom pre pedagogické veci, v rokoch 1959—60 bol prodekanom pre výskum a vedeckú prácu a v rokoch 1960—62 ako dekan viedol Prírodovedeckú fakultu UK. Mnoho rokov bol členom komisie pre štátne záverečné skúšky, predsedom rigorózneho komisie pre udeľovanie hodnosti doktor prírodovedy a predsedom komisie pre obhajoby kandidátskych a doktorských dizertačných prác z paleontológie. Ako pedagóg dobre chápal potrebu vhodných vysokoškolských učebníc. Bol spoluautorom učebných textov historickej geológie (39), napísal učebné texty systematickej zoopaleontológie (40), ktoré pozdejšie upravil, prepracoval, rozšíril a vydal knižnice ako prvú slovenskú paleontologickú učebnicu „Základy systematickej zoopaleontológie — Evertebrata“ (42), ktorá sa používa ako vysokoškolská učebnica nielen na Slovensku, ale aj v českých zemiach. Kniha našla široký ohlas aj u verejnosti u milovníkov prírody a zberateľov skamenelín a bola veľmi rýchlo po vydaní rozobratá.

Profesor Švagrovský odišiel náhle a nečakane v 64. roku života. Smrť mu zabránila pokračovať v diele, ktorému ako vedec a pedagóg venoval celé tvorivé obdobie svojho života. Nezapíše už skúšku z paleontológie svojim posledným poslucháčom a nenavštívi viac svoj rodný Zemplín, jeho zádumčivé roviny a malebné podhorie Slanských vrchov, kde toľko rokov hľadal a zbieral faunu a študoval zákonitosti geologickej stavby.

Jeho pamiatka ostane živá u všetkých jeho bývalých žiakov a kolegov a jeho meno bude navždy zapísané v histórii geologického výskumu Slovenska a v histórii slovenskej paleontológie, ktorej je dôstojným spoluzakladateľom.

Dionýz Vass

ZOZNAM PUBLIKOVANÝCH PRÁC

A. Vedecké práce

- 1 Švagrovský, J. 1950: Štrková formácia pri Varhaňovciach (východné Slovensko). Geol. Sborn. Slov. akad. vied. I, 2—4, Bratislava, 247—249.
- 2 Švagrovský, J. 1952: Geologické pomery a fauna severnej časti Košickej kotliny. Geol. Sborn. Slov. akad. vied III, 3—4, Bratislava, 259—295.
- 3 Švagrovský, J. 1953: Sladkovodný neogén na úpätí vulkanického masívu Drahov. Geol. Sborn. Slov. akad. vied IV, 1—2, Bratislava, 331—352.

- 4 Švagrovský, J. 1953: Príspevok k poznaniu sarmatských uloženín východného Slovenska. Geol. Sborn. Slov. akad. vied IV, 3—4, Bratislava, 834—848.
- 5 Švagrovský, J. 1954: Zpráva o geologickom mapovaní na východnom Slovensku roku 1953. Geol. Práce, Zprávy 1, Bratislava, 97—100.
- 6 Švagrovský, J. 1954: Neogénna fauna východného Slovenska, časť I. Potamididae, Cerithiidae a Cerithiopsidae miocénu východného Slovenska. Geol. Práce, Zošit 37, Bratislava, 1—64.
- 7 Švagrovský, J. 1954: Geologické pomery východného úpätia Prešovsko-tokajských hôr medzi obcami Kalša a Michalany. Geol. Sborn. akad. vied V, 1—4, Bratislava, 369—403.
- 8 Švagrovský, J. 1955: Geologické pomery východnej časti Košickej kotliny. Geol. Práce, Zprávy 4, Bratislava, 3—31.
- 9 Švagrovský, J. 1955: Neogénna fauna východného Slovenska, časť II. Clithon (Vittocliton) pictus (Férussac) v miocéne východného Slovenska. Geol. Sborn. Slov. akad. vied VI, 3—4, Bratislava, 198—226.
- 10 Švagrovský, J. 1956: Náčrt geologických pomerov na úpätí masívov Hradová a Kösztal na východnom Slovensku. Geol. Sborn. Slov. akad. vied VII, 1—2, Bratislava, 80—85.
- 11 Švagrovský, J. 1956: Cerithium (Ptychocerithium) procrenatum Sacco z tortonu východného Slovenska. Geol. Sborn. Slov. akad. vied VII, 3—4, Bratislava, 311—320.
- 12 Švagrovský, J. 1956: Neogén širokého okolia Košíc. Geol. Práce, Zprávy 9, Bratislava, 84—102.
- 13 Švagrovský, J. 1956: In D. Andrusov et al.: Lexique stratigraphique international, Europe, 6 b, Tchécoslovaquie, Centre nat. rech. scien. Paris, 112—113.
- 14 Seneš, J.—Švagrovský, J. 1957: Neogén východného Slovenska. Geol. Práce, Zošit 46, Bratislava, 217—280.
- 15 Seneš, J.—Švagrovský, J. 1957: Niekoľko nových miocénnych zástupcov čeľade Trochidae, Geol. Sborn. Slov. akad. vied VIII, 2, Bratislava, 204—224.
- 16 Seneš, J., Šalát, J., Švagrovský, J., Radzo, V., Leško, B. 1957: Sekcia C: Sprievodca po lokalitách. Geol. Práce, Zošit 46, Bratislava, 383—392.
- 17 Švagrovský, J. 1958: Miocénne Pleurotomidae západokarpatských panví. Acta geol. et geogr. Universitatis Comenianae, Geologica 1, Bratislava, 5—56.
- 18 Švagrovský, J. 1959: Asociácia mäkkýšov brakických uloženín vrchného tortónu a spodného sarmatu východného Slovenska. Geol. Práce, Zošit 55, Bratislava, 215—254.
- 19 Švagrovský, J. 1960: Biostratigrafia miocénu a ekológia makrofauny oporného vrtu Sečovce 1. Práce ústavu pro naftový výzkum — opěrné vrtby, 15, 55—61, Brno, 53—88.
- 20 Buday, T.—Švagrovský, J. 1960: Razvitie neogena Západných Karpat na teritorii Československa. Materialy Karpatsko-Balkanskej asociácie 3, Kiev, 119—139.
- 21 Švagrovský, J. 1960: Charles Darwin 1809—1882. Geol. sborn. Slov. akad. vied. XI, Bratislava, 21—24.
- 22 Švagrovský, J. 1960: Biostratigrafia a mäkkýše tortónu východného úpätia Slanských hôr. Geol. Práce, Zošit 57, Bratislava, 1—156.
- 23 Švagrovský, J. 1962: Geológia územia medzi Torysou a Olšavou na východnom Slovensku. Geol. Práce, Zošit 63, Bratislava, 185—192.
- 24 Švagrovský, J. 1964: Zur Torton-Sarmat Grenze im ostslowakischen Neogene. Geol. Sborn. Slov. akad. vied XV, 1, Bratislava, 79—86.
- 25 Švagrovský, J. 1969: Die Bedeutung des Studiums der Mollusken für die Bestimmung der Biostratigraphie der sarmatischen Sedimente der Tschechoslowakei. Proceedings of the Plenary and section Meeting Colloquium on Neogene stratigraphy. Budapest, 229—239.
- 26 Švagrovský, J. 1970: Biostratigrafičeskoe značenie fauny molluskov, obnažených v burovoj skvažine Trstín — 1 (západná Slovakia) na hranice tortónu i sarmata. In Buglovskije sloi miocena. Izdat. „Naukova dumka“, Kiev, 176—199.
- 27 Švagrovský, J. 1971: Das Sarmat der Tschechoslowakei und seine Molluskenfauna. Acta geol. et geogr. Universitatis Comenianae, Geologica 20, Bratislava, 1—473.
- 28 Švagrovský, J. 1971: Die Bedeutung des Studiums der Mollusken für die Bestimmung der sarmatischen Sedimente der Tschechoslowakei. Földtani Közlöny, 101, Budapest, 307—311.
- 29 Švagrovský, J. 1971: Paleontologický druh a jeho vzťah k iným kategóriám druhov. In Pracovní seminář k otázce evoluce. Obor. skup. paleontologie ČSMG, geol.-pal. odd. Mor. musea, Brno, 29—42.

- 30 Švagrovský, J. 1974: Faziostratotypus: Nižná Myšľa bei Košice, südöstlicher Rand des Košiceer Kessels, Ostslowakei. In A. Papp et al: Chronostratigraphie und Neostatotypen, IV, Sarmatien, Veda, Bratislava, 182—186.
- 31 Švagrovský, J. 1978: Faziostratotypus: Devínska Nová Ves — Sandberg bei Bratislava, östlicher Rand des Wiener Beckens. In A. Papp et al: Chronostratigraphie und Neostatotypen, VI, Badenien, Veda, Bratislava, 188—194.
- 32 Švagrovský, J. 1978: Die Molluskenfauna des Badenien. Pectinidae. In A. Papp et al: Chronostratigraphie und Neostatotypen, VI, Badenien, Veda Bratislava, 340—347.
- 33 Švagrovský, J. 1980: K problému vymierania organizmov v geologických dobách. Scripta Fac. Sci. Nat. Univ. Purkyn. Brun., Geol., 10, 7, Brno, 327—330.
- 34 Švagrovský, J. 1981: Lithofazielle Entwicklung und Molluskenfauna des oberen Badenien (Miozän M_{4d}) in dem Gebiet Bratislava-Devínska Nová Ves. Západné Karpaty ser. paleont 7, Bratislava, 7—180.
- 35 Švagrovský, J. 1981: Bivalvia des Oberen Badenien (Miozän) von Borský Mikuláš (No-teil des Wiener Beckens) und ihr Lebensmilieu. Geol. Zborník — Geologica Carpathica 32, 4, Bratislava, 387—426.
- 36 Švagrovský, J. 1982: Gastropoda, Prosobranchia (teil I) Archaeogastropoda und Mesogastropoda des Oberen Badenien von Borský Mikuláš (No-teil des Wiener Beckens) und ihre stratigraphische Bedeutung. Geol. Zborník — Geologica Carpathica 33, 1, Bratislava, 3—50.
- 37 Švagrovský, J. 1982: Gastropoda, Prosobranchia (teil II) Neogastropoda des oberen Badenien von Borský Mikuláš (No-teil des Wiener Beckens) und ihre stratigraphische Bedeutung. Geol. Zborník — Geologica Carpathica, 33, 4, Bratislava, 437—462.
- 38 Švagrovský, J. 1984: Gastropoda, Eutineura, Opisthobranchia des oberen Badenien aus der Umgebung von Borský Mikuláš (NO Teil des Wiener Beckens) und ihre stratigraphische Bedeutung. Geol. Zborník, Geologica Carpathica 35, 2, Bratislava, 165—194.

B. Pedagogické práce

- 39 Maheľ, M.—Švagrovský, J. 1953: Historická geológia, časť 1. Skriptum. Štát. pedag. nakl. Bratislava, 1—1193.
- 40 Švagrovský, J. 1966: Základy systematickej zoopaleontológie. Skriptum. Slov. pedag. nakl. Bratislava, 1—333.
- 41 Švagrovský, J. 1973: Vnútroduhové a medziduhové vzťahy medzi organizmami s možnosťou aplikácie na fosílie. In V. Pokorný: Vývoj fosílnych ekosystémů a jejich složek. Univ. Karlova. Praha, 58—66.
- 42 Švagrovský, J. 1976: Základy systematickej zoopaleontológie I — Evertabrata. Slov. pedagog. nakl. Bratislava, 1—570.

C. Recenzie

- 43 Švagrovský, J. 1956: Gekker: Návod pre paleoekologické výskumy. Geol. Sborn. Slov. akad. vied VII, 3—4, Bratislava, 338—339.
- 44 Švagrovský, J. 1956: Korobkov: Opis fosílnych organizmov. Geol. Sborn. Slov. akad. vied VII, 3—4, Bratislava, 333—334.
- 45 Švagrovský, J. 1957: Kamyševa, Trojickaja: Určovateľ jurských amonitov Saratovského Povolžia. Geol. Sborn. Slov. akad. vied VIII, 1, Bratislava, 166—167.
- 46 Švagrovský, J. 1964: E. Thenius: Versteinerte Urkunden. Biológia XIX, Bratislava, 305—306.
- 47 Švagrovský, J. 1970: Em. Kojumdgieva: Les fossiles de Bulgarie, VIII. Sarmatien. Geol. Zborn. Slov. akad. vied XXI, 1, Bratislava, 206—208.
- 48 Švagrovský, J. 1982: Na päťdesiatiny doc. RNDr. Viliama Sitára CSc. Miner. slov. 14, 4, Bratislava, 382—383.

D. Populárnovedecké články

- 49 Švagrovský, J. 1952: Tajomné hlbiny zemegule. *Príroda a spoločnosť*, 1, Bratislava, 598—603.
- 50 Švagrovský, J. 1953: Pohľad do praveku zeme. „Veda Iudu“, Osveta Martin, 1—61.
- 51 Švagrovský, J. 1964: Devín a okolie — geologické múzeum v prírode. *Svet vedy* XI, 11, Bratislava, 648—655.
- 52 Švagrovský, J. 1972: Dejiny života na Zemi. In *moderná biológia*. Prednáška v čsl. rozhlase 19. 1. 1972 o 17,15 h. Bratislava.
- 53 Švagrovský, J. 1972: Rozpráva kamenná kronika Zeme. *Nové slovo*, 14, 6, Bratislava, 14.
- 54 Švagrovský, J. 1972: Od zvieracích predkov po človeka. *Nové slovo* 14, 7, Bratislava, 14.
- 55 Švagrovský, J. 1973: Pri kolíske prastarých živočíchov. *Nové slovo*, 15, 23, Bratislava, 14.
- 56 Švagrovský, J. 1974: Paleontologické dôkazy vývoja organizmov. In *Geológia a vedecký svetonázor*. Soc. akad. SSR, Bratislava, 92—107.

Peter Holec

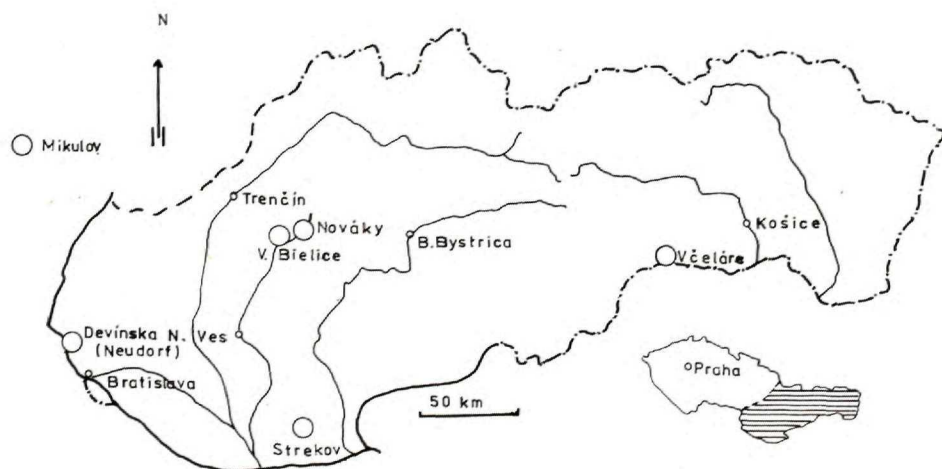
Finds of Mastodon (Proboscidea, Mammalia) Relics in Neogene and Quaternary Sediments of Slovakia (ČSSR)

17 text-figs., 20 Pls. (I—XX), Slovak summary

Abstract. Described are teeth of three mastodon species — *Zygodontodon turicensis* (SCHINZ), *Mammot borsoni* (HAYS) and *Anancus arvernensis* (CROIZET et JOBERT) from five localities in Slovakia and one locality in South Moravia. The remains were found in Neogene to Quaternary sediments.

Introduction

In the West Carpathians are many localities of fossil mammal remains. Relics of mastodons are scarcer. Mastodons were big mobile mammals, capable of inhabiting large areas in a short time. With the exception of Australia and Antartics they were in all continents. So they are important in biostratigraphy and for completing our knowledge on paleoclimate, paleoecology and fauna on our territory.



Schematic map of Slovakia. Localities are marked with circles.

RNDr. P. Holec, CSc., Katedra geológie a paleontológie PFUK, pavilón B, Mlynská dolina, Bratislava.

Brief geologic description of localities

Devínska Nová Ves — Sandberg

This locality belongs among the most important and best known localities of fossil vertebrate remains in the West Carpathian region. The locality is S of the village Devínska Nová Ves, on the NW slope of Devínska Kobyla hill (Schem. map. Fig. 1; Plate I, Fig. 1). The sand-pit consists of Neogene Upper Badenian sands, gravel-sands, sandstones, and limestones with lithotamnians (M. MIŠTĚK 1976). They found there plentiful micro- and macrofauna of non-vertebrates and vertebrates. More than 300 species were described. Fossil vertebrate remains from Sandberg were described by more authors. HÖRNES in 1948 presented a list of 19 species of *Chondrichthyes* (cartilaginous fish), 15 species of bony fish — *Osteichthyes*, one reptile and 6 species of mammals. It is seen that besides typical sea fauna of shark and fish with radial fin there are also remains of terrestrial vertebrates — mammals, transported by river flows from the adjacent dry land. Later on, in 1865 KORNHUBER presented a list of fossil fish from the vicinity of Bratislava. The list is in accordance with the Hörnes's list but KORNHUBER added 6 shark species. Ichthyofauna of Sandberg was also studied by SCHUBERT (1905 and 1906). He denoted the locality as Theben — Neudorf but it is almost sure that he meant Sandberg, because he also mentions finds of fish teeth and mammal remains from the locality. Basing on fish otholites he defined 25 fish species from the locality. PIA and SICKENBERG (1934) presented in their catalogue of mammalian fauna of Austria and of adjacent areas also 33 species (in some cases only genus or family is determined) of mammals from the locality, denoted as Neudorf a.d. March by the authors. Among other finds significant are mainly finds of monkeys — *Pliopithecus* (*Pliopithecus*) *antiquus* BLAINV. and *Sivapithecus darwini* (ABEL). Detailed and most complete description of mammalian fauna from Sandberg was presented by THENIUS (1952). He described 38 mammalian species living in different biotypes. It is the result of hundred years' collecting activities on the locality. As for ecology, the fauna is represented by lowland hydrophilous species, forest and marine species. Generally the living

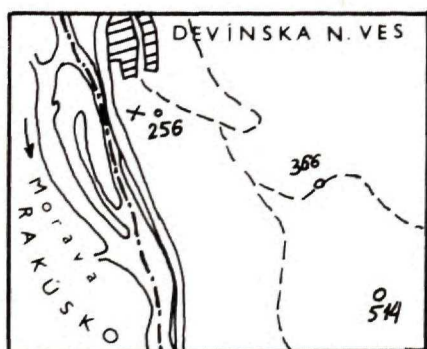


Fig. 1 Situation sketch of surroundings of locality Devínska Nová Ves — Sandberg on scale 1 : 50 000. Occurrence of fossil remains is marked with cross.

environment of mammals from the Sandberg area may be regarded as forest, littoral and fluvial. The savannah species and the species of coniferous forests, typical of the Late Miocene (THENIUS 1952) are absent. Land mammals and turtle remains of the genus *Trionyx* in marine sediments may indicate a river emptying near the finding place. The river transported the remains of the dead animals into the sea. Owing to currents and swells, the remains disintegrated further to scarce tooth remains and abraded bones. So it was with the remains of mastodon teeth in a sandstone piece containing marine bivalves. Plate V, Fig. 1, 2. The shallow sandy coast was favourable for sirens, and plentiful fish — as proved by fossil remains — served as food for seals whose remains were also found there. Geologic conditions of the surroundings of the locality were discussed by MIŠTK, GULIČKA, URVICHIAŘOVÁ (1974) and MIŠTK (1976).

Nováky Mine Mier

In Nováky, the basement of a coal seam consists of dark-brown and black clays, and dark-green tuffite clays and sandy tuffites. The overlier consists of grey and dark-grey tuffite clays (M. TAKÁČ 1970), Schem. map, Fig. 2.

History of the terrain. In the area of the Vtáčnik Mts. the first phase of volcanic activity commenced and resulted in young volcanic mountain ranges. A depression confined on the north with ancient crystalline and Mesozoic mountain range and with young volcanic ridges on the south formed. In the depression a dam-like lake formed. In the lake detrital material deposited. At the beginning the andesite detrital material (layers of tuffites and andesite conglomerates) dominated in the sediments. Because of quick material transport the lake got shallower, a peat-bog formed in the depression, and the coal seams in Handlová. Their evolution was interrupted by a new subsidence, which caused the deepening and the silting up of the lake by lacustrine pelite material (overlying marly clays and clays). The material originated in the north and south of the considerably denuded volcanic mountain range. The lake got shallower again. Local peat bogs formed with overlying coal — lignite seams in Nováky. In this coal seam the mastodon tooth (*Zygolophodon turicensis*) was found (Plate VI, Fig. 1, 2; P. VII, Fig. 1, 2)*.

* I am obliged to Director of the Museum in Bojnice Dr. Takáč for borrowing the fossil material from the localities Mier Mine and Veľké Bielice.

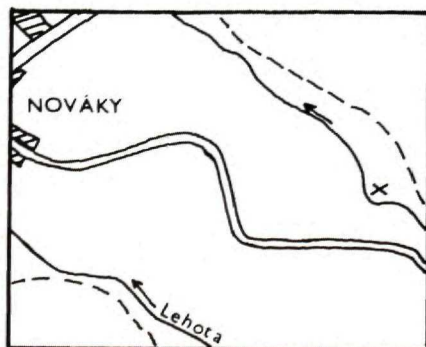


Fig. 2 Situation sketch of locality Nováky Mine Mier, scale 1 : 50 000. The locality is marked with a cross.

Flora found in Handlová, Nováky and Cígeľ indicates the subtropic climate of that time (M. TAKÁČ 1970).

In the Sarmatian time the second (main) phase of eruptive activity proceeded and resulted in the present Vtáčnik mountain range. The former depression was covered with nappes and andesite flows, and chaotically silted up by boulder-like tuffs.

In the Upper Pannonian, owing to further extensive subsidences, mostly of N—S course, shallow lakes formed. Many mountain creeks emptied into the lakes. Gravels, sands, clays, freshwater limestones, frequent in the south in the Nitra r. valley, deposited in the lakes. Almost all the area of the Pannonian (Pontian?) beds is covered with alluvium, debris and loess.

Flora of the lignite seam is mostly represented by *Taxodiaceae* and *Cupressaceae*. They are a coal-forming element. TAKÁČ (1970) also quotes the following genera: *Lycopodium*, *Keteleria*, *Tsuga*, *Cedrus*, *Pinus*, *Cryptomeria*, *Taxodium*, *Sequoia*, *Metasequoia*, *Osmunda*, *Juglans*, *Alnus*, *Betula*, *Carpinus*, *Fagus*, *Quercus*, *Ginkgo*, *Glyptostrobus*, *Magnolia*, *Myrica*, *Castanea* a.o. The flora is indicative of the natural living environment of mastodons and other terrestrial fauna.

Mikulov — Čujan sand-pit

Lithology of the Upper Badenian near Mikulov is extremely variable. The main rocks are represented by grey to greenish, partly variegated and variably sandy, mostly soft, only in bottom by layers of semi-compact unstratified, disintegrating calcareous clays. Less frequent are clays, often sandy, and grey, mostly fine-grained micaceous quartzous sands. Thickness of the Upper Badenian in the basin is 700—1000 m; 100—200 m on peripheries.

The marine deposits contain mostly bivalves — *Turitella bicarinata*, *Pleurotoma dimidiata*, *Pyrula condida*, *Columbella bellardii*, a.o.

The locality is E of Mikulov (Schem. map). JÜTTNER (in KALÁŠEK et al. 1963) found on this or other close locality the remains of mastodon *Gomphotherium angustidens* (CUV.) and ranged the beds to the Sarmatian. KALÁŠEK et al. (1963) ranged the beds to the Tortonian (Badenian). It is a right age determination.

Veľké Bielice — sand-pit

The locality is about 200 m N of the village (Schem. map, Fig. 3). In the basement of Quaternary cover formations are Upper Pontian sediments (BRESTENSKÁ 1961). Deposition proceeded in a freshwater environment. Organic remains are very scarce in these sediments. Mammal fauna is only represented by the remains of proboscideans — mastodons.

Strekov sand-pit

The locality is in the NW part of the Hronská pahorkatina upland, about 2 km SSE of the Village Strekov. (Schem. map, Fig. 4), Pl. I, Fig. 2, Pl. II, Fig. 1, 2. At the base are

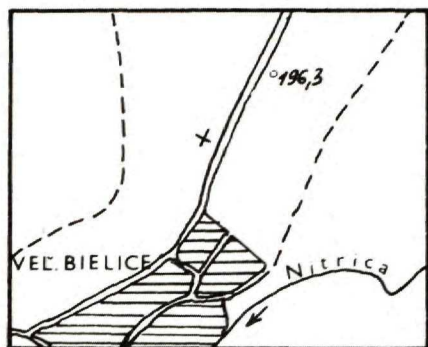


Fig. 3 Situation sketch of the area around Veľké Bielice — sand-pit; scale 1 : 20 000. The cross marks the finding place.

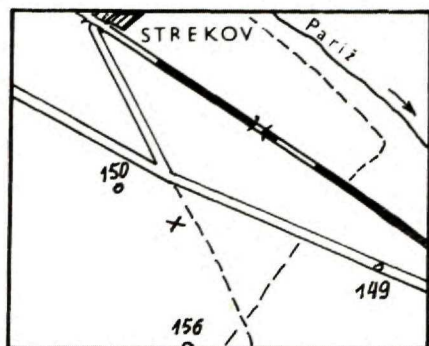


Fig. 4 Situation sketch of the area around the locality Strekov — sand-pit; scale 1 : 50 000. The sand-pit is marked with a cross.

exposed Pontian sediments, composed of light-grey quartzose lacustrine sands. Above is an unconformable fossiliferous layer of limonitized gravels containing fossil fauna. The layer is overlain by a complex of fluviolacustrine gravels and sands (GÜNZ) and the present cover sediments. (Fig. 5). Detailed geologic descriptions were presented by HARCÁR, SCHMIDT (1965), SCHMIDT—HALOUZKA (1970)*. Besides remains of mastodons there were also *Archidiskodon planifrons* (FALCONER-CAUTLEY 1846), *Dicerorhinus megarhinus* (CHRISTOL 1835), *Cervus* sp., *Alces* sp., *Bison* sp., and *Sus scrofa* L. (SCHMIDT, HALOUZKA 1970). The authors reconstructed a biotope, which consisted most likely of a plant assemblage of humid swampy foliaceous forests with rich vegetation (grass-land forests with southern subtropic floral elements), or marshy meadows favourable for the genera *Anancus*, *Mammut*, *Archidiskodon* and partly *Dicerorhinus*. Other representatives are indicative of the environment of discontinuously forested areas with the vegetation of warm steppe-forests, and mainly foliaceous or mixed forests of the mild climatic zone, frequently humid. Synthesis of ecology of the species found will result in a biotope typical of the intermediate period between the Upper Pliocene subtropical climate and the boreal climate in the time of the first Pliocene cooling indications. On the basis of paleontologic material the fossiliferous bed is ranged to the Late Villafranchian, i.e. to the initial Quaternary phase (pre-Danubian). According to the authors, the older, partly redeposited secondary faunal elements of the Plio-Pleistocene type were locally transported from the close vicinity (from older sedimentary beds). The mixed fauna represents the Villafranchian type and it is the oldest Quaternary fauna in Slovakia.

* I am obliged to Dr. Vass, Dr. Schmidt, Dr. Halouzka, Dr. Pristaš and Dr. Vaškovský for their aid in my field work at Strekov.

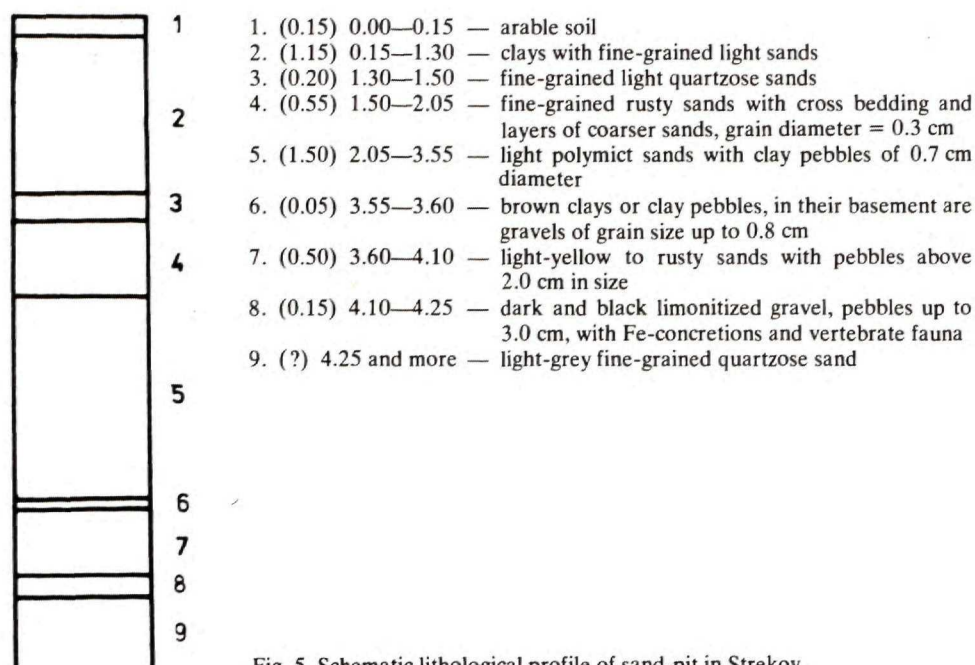


Fig. 5 Schematic lithological profile of sand-pit in Strekov.

Včeláre — quarry, filling of fissure in limestones

The locality is in the SE part of the Slovak Karst on the ridge of Dolný Vrch S of the village Včeláre, on the western slope of B.M. 469 near the Hungarian frontier. Schem. map, Fig. 6, 7, 8, Pl. III, Fig. 1, 2, Pl. IV, Fig. 1, 2. Bones and teeth of various mammals were found in Middle Triassic (Ladinian) Wetterstein limestones in the filling of a karst fissure, in terra rossa together with angular fragments and blocks of limestones (ranging in size from several cm to tens of cm). The filling contained mainly sinter, and plastic terra rossa in some layers. The fissure was 4—4.5 m broad in its upper part and might have served as a natural trap for smaller and larger

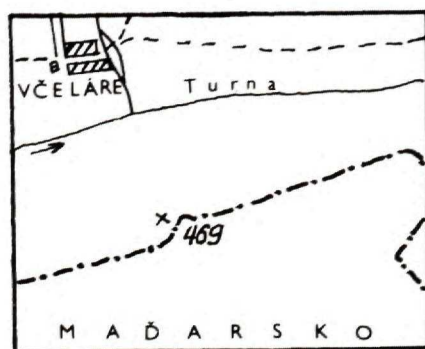


Fig. 6 Situation sketch of the vicinity of Včeláre — filling of fissure in limestones; scale 1 : 50 000. The locality is marked with a cross.

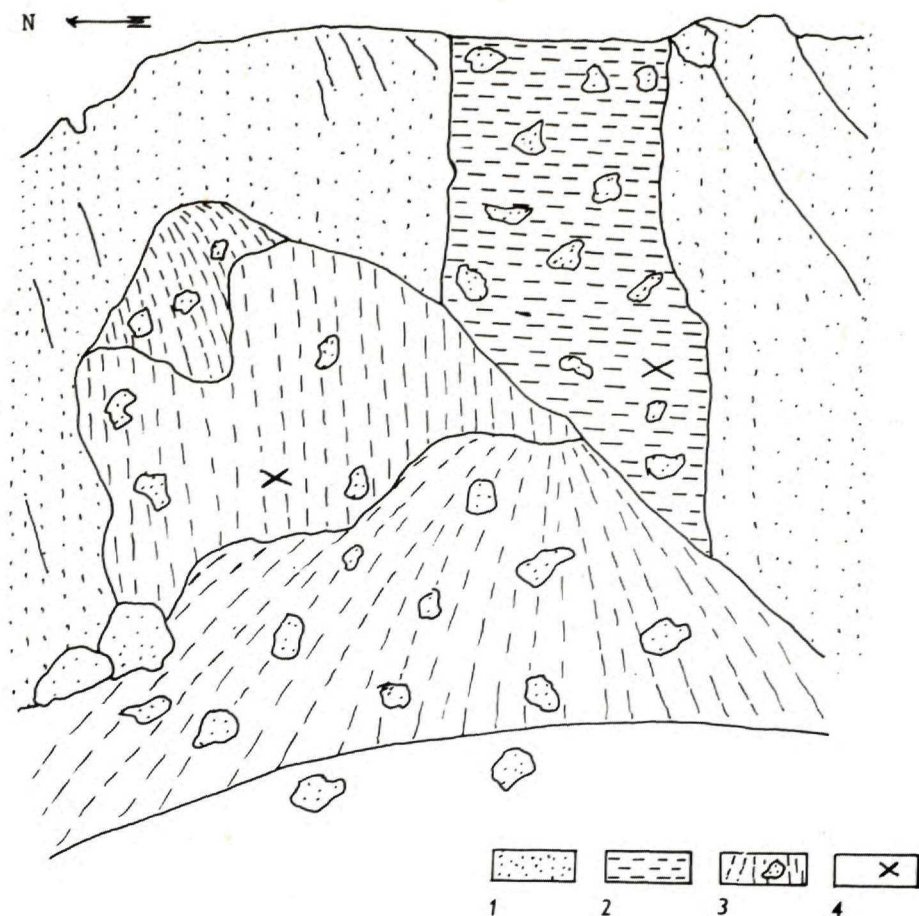


Fig. 7 Frontal view of the quarry wall on the zero level in Včeláře. 1 — Wetterstein Middle Triassic (Ladinian) limestone; 2 — fissure filled with terra rossa, 3 — debris, 4 — places of highest concentrations of mastodon remains are marked with cross. Longer lines denote faults in limestones. The narrowest part of the fissure is 4.0—4.5 m.

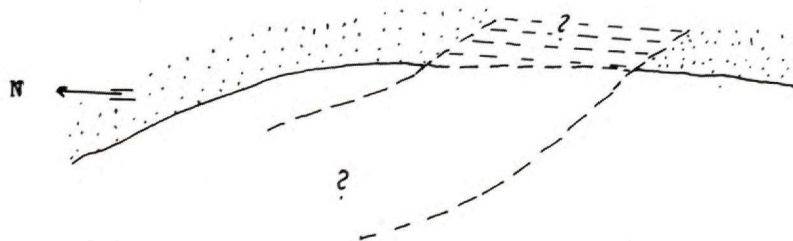


Fig. 8 Presumable course of the fissure in the quarry near Včeláře. Ground-plan view.

animals. The faunal remains are indicative of forest and jungle animals. There were remains of tapirs, mastodons, monkeys, *Ophisaurus* and other vertebrates. The bones are autochthonous, frequently influenced by pressure and movements of the sinking rock. The drawing and the photograph show the situation from the year 1977*.

General remarks on mastodons and on structure of their teeth

The term "Mastodon" causes some difficulties because of its use on the principle of priority and for the too detailed classification of these Proboscidea. So there are wrong and confusing generic names in the system (THENIUS 1969).

The entire group of mastodons have rather uniform body construction and so LEHMANN (1950) proposes to range them to the only genus *Mastodon*. It would be simple and practical, but the generic name "Mastodon" was used by CUVIER in 1817. The name is over-occupied, since in 1799 BLUMENBACH used the term *Mammut* for the remains of the zygodont mastodon. (It must not be confused with the Pleistocene hairy proboscidean mammoth with its scientific name *Mammuthus* BURNET 1830). So the generic name "Mastodon" is in the synonymy of the genus *Mammut* and cannot be used as the generic name of Miocene proboscideans. SIMPSON (1945) proposed the generic name *Gomphotherium*, BURMEISTER 1837 for the bunodont form denoted by CUVIER as *Mastodon angustidens*. The name *Gomphotherium*, BURMEISTER 1837 in its diagnosis clearly distinguished the bunodont tetrabelodont *Gomphotherium* from the zygodont dibelodont "animal" from Ohio (*Mammut americanum*). The problem is discussed in detail by TOBIEN 1973, p. 205 and I keep to his latest works. He presents a modern revision of species names of mastodons and discusses in detail the structure of teeth and tusks, as well as the evolution and migration of mastodons (see TOBIEN 1973, 1975, 1976, 1978).

Mastodon teeth from the Western Carpathians represent two types: zygodont (formerly zygolophodont) and bunodont (formerly bunolophodont) teeth. There are also trilophodont and tetralophodont types of mastodon teeth. Their middle molars D4, M1, M2 ("intermediate molars") show three vertical ridges; four ridges are characteristic of tetralophodonts. The third upper and lower molars show four ridges; more advanced genera are characterized by five and last molars of tetralophodonts even have six or seven ridges.

In older literature, in the sense of CUVIER 1817 the last, incomplete ridge was regarded as talon or talonid of lower teeth. Modern authors, especially TOBIEN 1975, 1973, regard the entire distal part of the tooth behind the first two ridges as the talon of upper or talonid of lower teeth. Tobien distinguishes protocon, hypocon, paracon

* I am grateful to Ing. Janek and Mr. Mrozek for their aid in protecting the fossil material, and to Dr. Sýkora for his aid in my field researches, as well as to Mr. I. Takáč, Mr. B. Orth, Mr. M. Žák and Mr. J. Bukera for their work on the locality Strekov.

and metacon on the first two ridges. On lower teeth are distinguished protoconid, hypoconid, metaconid and entoconid (see Fig. 9). Talon (talonid), i.e. other back crest of the tooth are more-or-less exact copies of the first two ridges.

The zygodont type of a tooth (Fig. 9) has sharp, smoothwalled ridges running along the width of the crown. They are in one line. Vertical valleys — synclines — are open; only in some cases the anterior and posterior ridges are developed. They run downward from the peak of the main ridges. The bunodont type of teeth has the crown formed of single, broad-conical knolls, arranged in vertical ridges aligned almost in one line. Advanced types have alternant half-ridges. Then the valleys between ridges are closed by the anterior or posterior, crescentoid, or by the alternant half-ridges.

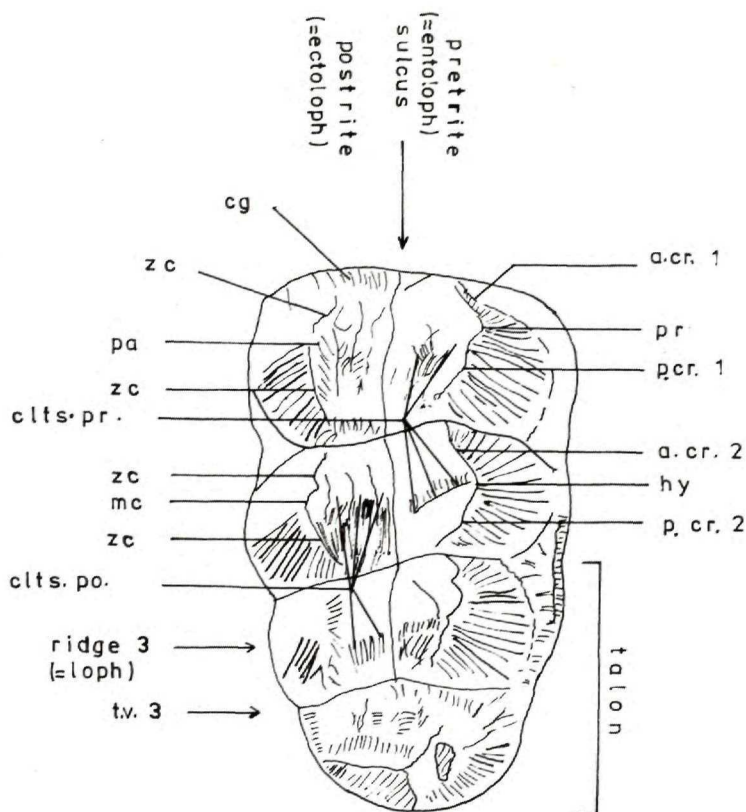


Fig. 9 *Zygalophodon turicensis* (SCHINZ, 1833), M³dext., Miocene-Lower Badenian, Devínska Nová Ves — fissure filling (Neudorf a.d. March). From ZAPFE 1954, pl. 1 and TOBIEN, 1975, fig. 1, occlusal view, magn 0,64×. Abbreviations used in this figure: a.cr. — anterior crescentoid, cg — cingulum, clts. po. — adaxial (secondary) conelets on the posttrite, clts. pr. — adaxial (secondary) conelets on the pretrite, hy — hypocon, me — metacon, pa — paracon, p. cr — posterior crescentoid, pr. — protocon, t.v. — transverse valley (syncline), zc — zygodont crest.

Along the central part of the tooth crown is the median sulcus dividing the individual ridges into half-ridges. Half-ridges of the zygodont type of teeth are much more symmetric than on the bunodont type. The median sulcus divides the crown into two approximately equal parts: the inner (palatal) part of the chewing surface of the upper tooth, called pretrite or the pretrite part (entoloph), and the outer part called posttrite or the posttrite part (ectoloph). The inner part of the chewing surface of the lower tooth is denoted as posttrite (entolophid), the outer part is pretrite (ectolophid). The pretrite part of the upper and lower teeth is more abraded than the posttrite part: See Fig. 9

There are the following differences between the upper and lower teeth: the upper teeth are usually broader and their mesial and distal margins make an almost right angle with the lingual and bucal margins. The contour of the base of the tooth crown is rectangular. The lower teeth are usually narrower and the contour of the tooth crown is slightly rhomboidal. Transversal ridges and valleys of the upper teeth are almost perpendicular to the sagittal axis of the tooth whereas on the lower teeth cut diagonally the sagittal tooth axis.

Dimensions of the individual teeth are in tables following their descriptions. Statistic evaluation was impossible because of few fossil remains.

***Zygodon turicensis* (SCHINZ, 1833)**

Figs. 10—14, Pl. V—X

- 1877 *Mastodon tapiroides* CUVIER. — M. VACEK: Über Österreichische Mastodonten etc., p. 4—6, tab. 7, fig. 4.
- 1877 *Mastodon Borsoni* HAYS. — M. VACEK: Über Österreichische Mastodonten etc., p. 6—8, tab. 6, fig. 3, 3a.
- 1879 *Mastodon tapiroides*, CUVIER—LORTET et E. CHANTRE: Recherches aux les Mastodontes etc., p. 24, tab. 9, fig. 1—10.
- 1891 *Mastodon turicensis* — A. GAUDRY: Les Mastodontes, p. 4, tab. 1, fig. 2, 2a.
- 1891 *Mastodon turicensis (tapiroides)* — A. GAUDRY Ibidem, p. 4, tab. 2, fig. 6.
- 1909 *Mastodon turicensis* SCHINZ — L. MAYET: Étude sommaire Mammifères fossiles etc., p. 45, fig. 21.
- 1917 *Mastodon (Zygodon) tapiroides* CUVIER. — G. SCHLESINGER: Die Mastodonten etc., p. 146, tab. 21, fig. 1—8, tab. 22, fig. 1—4.
- 1922 *Mastodon (Zygodon) tapiroides* CUVIER. — G. SCHLESINGER: Die Mastodonten der Budapester Sammlungen etc., p. 84—87 tab. 13, fig. 3, 4, tab. 14, fig. 4.
- 1954 *Mastodon (Zygodon) turicensis* SCHINZ — H. ZAPFE: Die Fauna der miozänen Spaltenfüllung in Neudorf p. 75—82, tab. 1—2, text tab. 1—2.
- 1975 *Zygodon turicensis* (SCHINZ, 1833) — TOBIEN: The Structure of the Mastodon Molar etc., p. 197, fig. 1—16.
- 1976 *Zygodon turicensis* (SCHINZ, 1833) — H. TOBIEN: Zur paläontologischen Geschichte der Mastodonten etc., p. 158, fig. 9, fig. 25.
- 1978 *Zygodon turicensis* — H. TOBIEN: An advanced zygodont mastodont etc., p. 239—248 (242), fig. 3.

Holotype: Second left lower molar M_{2sin} . Described as "*Mastodon*" *turicensis* by SCHINZ 1833, pl. 1. Deposited in Zürich, Universität, Paläont. Institut u. Museum, under No. A IV 40.

Type locality: Ellg, Kanton Zürich, Switzerland.

Type level: Upper Miocene (upper freshwater molasse).

Material: Fragment of maxilla with P^4 , M^1 dext. (locality Devínska Nová Ves — Sandberg; deposited at Department of Geology and paleontology).

M_3 dext. without mesial part (locality Nováky coal mine Mier, coal seam; deposited in Museum in Bojnice).

Fragment of mesial part of M^2 sin. (locality: Nováky coal mine Mier, coal seam, in private collection).

Incomplete M_1 dext. and crown parts of M_2 dext. and M_3 dext. (locality Mikulov — Čujan sand-pit; deposited in Department of geology and paleontology).

In a sandstone block with marine fauna is preserved a fragment of the maxilla with P^4 and M^1 dext. in situ. It might have been a young specimen as indicated by the preservation state of P^4 dext. and M^1 dext. (Fig. 10a, b, Pl. V, Fig. 1, 2).

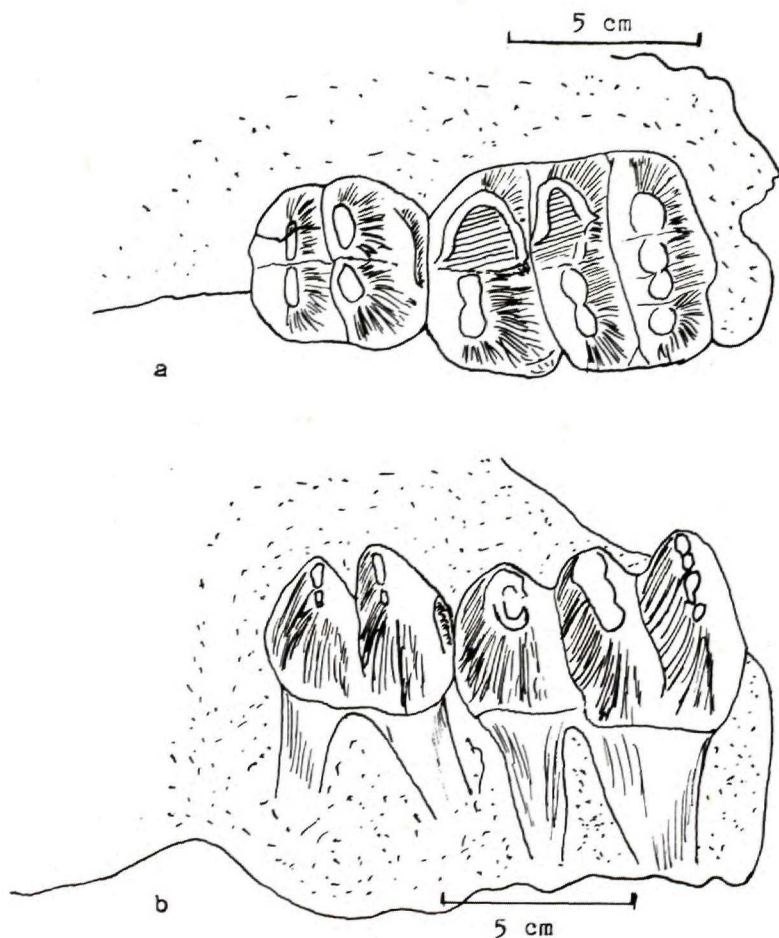


Fig. 10 *Zygodolophodon turicensis* (SCHINZ) — P^4 - M^1 dext. view of a — occlusive surface, b — diagonal view of occlusion and bucal surfaces of teeth. (Locality Devínska Nová Ves — Sandberg).

P⁴dext. The crown is oval, its length is somewhat greater than width in the place of the second ridge. The tooth has two transversal ridges and one transversal valley (syncline). On the mesial margin of the crown are several bucal low cingular glassy conelets. Peaks of ridges are abraded but the dentine layer is not exposed. Along the tooth, across both ridges a narrow prominent median sulcus is running. The axis of the transversal valley is lingual, partly mesial (oral), and bucal and distal on the other side. The valley bottom in the pretrite part (between protocon and hypocon) is steeper than in the posttrite part (between paracon and metacon). The distal part of the crown ends with a horizontal surface with indication of cingular knolls. The lingual margin of the tooth is shorter than the bucal margin. In the place of the valley bottom (transversal syncline) meeting the crown margins are small cingular knolls. The ridges are comparatively sharp and their mesial walls slope down to the transversal valley more steeply than distal walls. On ridges on the lingual and bucal sides, i.e. farther from the median sulcus are partly abraded main cusps, closer to the median sulcus are adaxial cusps, also abraded. On the mesial wall of pretrite of the main cusp is a secondary crack passing across protocon to the distal posterior wall of pretrite. Distal from paracon mesial and distal from metacon are vague small ridges extending down from the cusp. The second ridge (yoke) is broader than the first.

Dimensions /mm/ :

Table 1

length max.	width max.	l/w
50,0	49,0	1,02
ridge number	1	2
width of ridges	40,5	49,0
height of crown on posttrite	32,4	35,0
height of crown on pretrite	unmeasurable	

M¹dext. It has three transversal ridges (yokes) on the chewing surface. The yokes separate two valleys (synclines). The tooth is intensely abraded, mostly on pretrite. It is partly damaged — enamel is broken off in the middle of the bucal side, at the base of the crown. Enamel is also broken off from the distal margin of the crown. The contour of the crown is almost rectangular in the front but rounded. The mesial margin of the tooth crown is straight, passing into the bucal margin with which it forms almost right angle. It makes an obtuse angle with the lingual margin. The mesial part of the tooth crown is rounded. The lingual margin of the tooth is shorter than the bucal. Horizontal axes of ridges and valleys are lingual mesial and bucal distal.

The tooth is intensely abraded mostly on the pretrite part of the 1st and the second ridges. There dentin is so exposed that it forms a "trefoil" structure. Mesial abrasion

extends to the level of cingulum. Posttrites of the first and the second half-ridges are abraded so that dentin is exposed. On the third ridge only the main cusp of pretrite is exposed to dentin. On the whole crest smoothed enamel may be seen. Prominent median sulcus is running along the tooth. On the last, third broadest ridge (yoke) are distinct short cuts parallel to the yoke (on posttrite and pretrite) dividing every half-ridges into two adaxial and one main cusps. The base of the first ridge is broader than the bases of the second and the third ridges. Distal to the back wall of the third ridge (talon) are lateral broadened margins of knolls and furrows in enamel. Impressions of roots of the adjacent tooth are behind M¹dext.

Incomplete M₃dext. The mesial part of the tooth is missing, perhaps the whole first ridge (yoke). Locality: The Nováky coal mine Mier, coal seam. Plate VI, Fig. 1, 2.

Preserved is the distal part of M₃dext. with three ridges (Fig. 11b). The tooth is brownblack. The pretrite part of the first preserved tooth is broken off. Also the inner part (from median sulcus) of posttrite is damaged. The tooth shows distal narrowing and rounding. The crown is intensely abraded, dentin is exposed on the periultimate yoke. Median sulcus is indistinct. The last transversal ridge and talonid show two parallel cuts. There is a larger pit without enamel behind the last ridge and

Dimensions /mm/ :

Table 2

length max.	width max.	l/w
81,0	61,8	1,31

ridge number	1	2	3
width of ridges	57,0	59,9	61,8
height of crown on posttrite	34,4	35,4	37,8
height of crown on pretrite	unmeasurable		

before talonid. It may be mechanical damage caused by biting into a too hard object (stone), or caries. It is most likely to occur after the animal's death because peripheries of the pit are rounded.

Ridges and longitudinal axes of synclines are not perpendicular to sulcus, they cut it so that individual axes of synclines are slightly mesial on the lingual side, and slightly distal on the bucal side. From the first ridge only the inner cusp with exposed dentin preserved. The cusp on posttrite of the central ridge is more abraded than on pretrite. The tooth is more damaged in the middle of the crest near median sulcus. The last ridge is less damaged, dentin is not exposed. The occlusion surface is on the distal wall of this ridge. The ridge is crossed with two parallel cuts. Talonid is terminated with three cusps. Transversal valleys are broad, straight (open). The anterior valley on the lingual sides is more sharply downcut than the valley behind it on the same side. There is no cement. Roots are partly preserved with a bone

fragment from the lower mandible. The view of the lingual side shows that roots are running backwards and down. Below every ridge the root part of the tooth is thickened.

Dimensions /mm/ :

Table 3

length max.	width max.	l/w	
136,6 ⁺	85,4	1,60	
ridge number	1	2	3
width of ridges	85,4	82,6	55,3
height of crown on postrite	54,1	53,1	41,2
height of crown on pretrite	unmeasurable	41,7	36,4

Fragment of mesial part of M²sin. with two transversal ridges. Locality: Nováky coal mine Mier.

Only two first ridges are preserved. The tooth is broken off in the place of the second syncline (Fig. 12, P. VII, Fig. 1, 2). The roots are missing. Enamel is black, small pyrite crystals are on the broken root part.

Pretrite on the first ridge is intensely abraded, protocon is worn and trefoil. Paracon is more abraded than metacon. Dentin is exposed on both. The ground-plan of the tooth fragment is square but the palatinal part of the tooth is shorter than the bucal part. A prominent median sulcus is running along the tooth. Mesial slopes of half-ridges are steeper than distal and the half-ridges on postrite (outer half of tooth) are mesial. Vertical axes of crests and synclines are almost perpendicular to the sagital axis of the tooth. The transversal valley between the two crests is deep and its bottom is deeply downcutting where it is cut by the median sulcus. On the bottom of the syncline a prominent knoll is formed on the postrite.

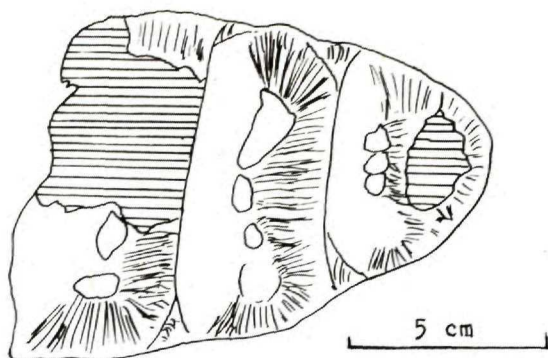
Dimensions /mm/ :

Table 4

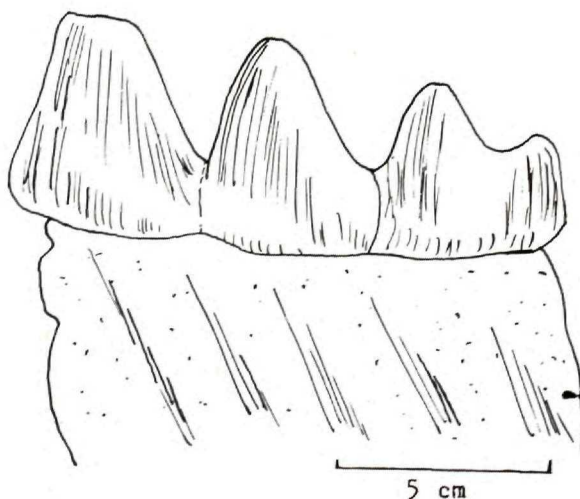
length max.	width max.	l/w
77,6 ⁺	81,3 ⁺	-
ridge number	1	2
width of ridges	80,3	81,3
height of crown on postrite	23,2	32,4
height of crown on pretrite	46,6	49,0

Material: M₁dext., M₂dext., M₃dext. Mesial part of tooth with two yokes (crests).

Locality: Čujan sand-pit E of Mikulov. Mesial part of the tooth M₂dext. with two ridges is preserved. Pl. VIII, Fig. 1, 2. The surface of the third tooth is visible behind the second syncline. The mesial margin of the tooth is slightly concave. The tooth is broadest in the place of the second ridge. The tooth is intensely abraded. Enamel on ridge is damaged so as to expose dentin. Its thickness is about 3.0 mm. Protoconid and hypoconid are more abraded than metaconid and entoconid. Near the median



a



b

Fig. 11 *Zygodolophodon turicensis* (SCHINZ) fragment M₃dext. View of a — occlusion surface, b — lingual surface. Locality: Nováky Mine Mier.

sulcus the anterior crescentoid runs out from the anterior part of protoconid and the posterior crescentoid from the posterior part of protoconid. It is similar on hypoconid.

Synclines on posttrite are steep, with sharp bottoms. Bottoms on pretrite are widened. Mesial walls of synclines are less steep than distal. No cement.

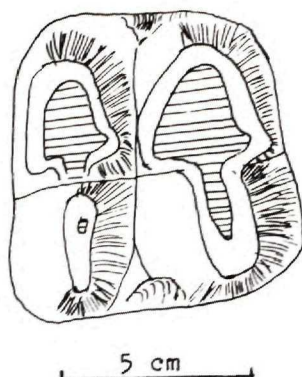


Fig. 12 *Zygolophodon turicensis* (SCHINZ) — fragment of M_2^{sin} .
View of occlusion surface of tooth.
Locality Nováky coal mine Mier.

Dimensions /mm/ :

Table 5

length max.	width max.	l/w
62,0 ⁺	51,7 ⁺	-
ridge number	1	2
width of ridges	47,4	51,7
height of crown on posttrite	31,6	35,7
height of crown on pretrite	21,3	27,2

Locality: Čujan sand-pit E of Mikulov M_2^{dext} .

The crown part of the tooth is preserved, roots are broken off below the crown neck. They are partly preserved below the posterior inner side and the anterior outer side (Fig. 13a, b, c, Pl. IX, fig. 1, 2). The crown base on mesial side is narrower, rounded-rectangular, broadening backwards, closer to median sulcus are two less prominent cusps. On posttrite the inner (main) cusp is highest. Closer to median sulcus are 2—3 adaxial lowering cusps, crescentoids run out backwards and forwards from the mesial surface of protoconid. The posterior crescentoid of the first ridge on pretrite touches the anterior crescentoid of the second half-ridge of pretrite. So is it between the second and the third ridges of pretrite and thus a horizontal low crest forms on pretrite along median sulcus. The low crest divides synclines of posttrite from those of pretrite. Bottoms of synclines on pretrite are not smooth, enamel is rough. The knolls form a small cingulum on the bucal side of the tooth. The cingulum is also on the frontal part of pretrite. The posterior margin of the tooth is terminated with a series of about 6—7 tiny knolls. On the bucal base of the tooth crown and on the first third of crests are horizontal step-like grooves. The tooth is darkbrown to black. No cement. Thickness of enamel was impossible to measure because of insufficient abrasion of the tooth.

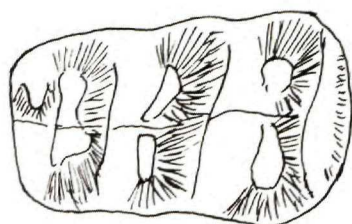
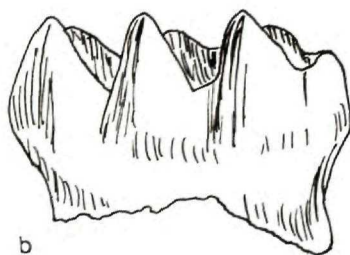
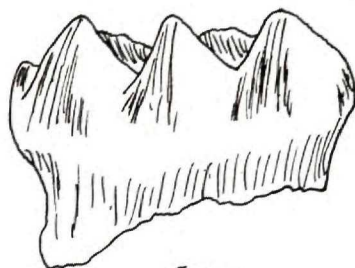


Fig. 13 *Zygotaphodon turicensis* (SCHINZ) — M_2 dext., view of a — occlusion surface of tooth crown, b — lingual, c — bucal surface of tooth. Locality Mikulov, Čujan sand-pit.

a

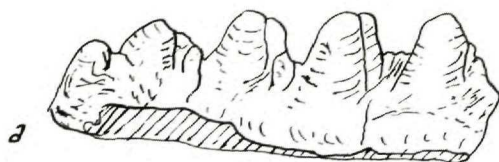


b



c

5 cm



a



b

5 cm

Fig. 14 *Zygotaphodon turicensis* (SCHINZ) — M_3 dext. Views of a — bucal, b — occlusion surface of the tooth crown. Locality Mikulov, Čujan sand-pit.

Dimensions /mm/ :

Table 6

length max.	width max.	l/w
114,0	71,5	1,96

ridge number	1	2	3
width of crown	62,0	66,5	71,5
height of crown on postrite	48,0	52,0	51,0
height of crown on pretrite	43,5	48,5	52,0

Locality: Čujan sand-pit E of Mikulov M₃dext.

The tooth crown is well preserved. (Figs. 14a, b, Pl. X, Fig. 1, 2). Mesial margin of the tooth crown forms almost right angles with bucal and lingual margins of the crown. Its distal part is rounded. The zygodont tooth is unabraded without cement. The main cusps of posttrite on the first three crests are higher than those of pretrite. On the last fourth ridge the main cusp of posttrite is higher than that of pretrite. Horizontal axes of crests and synclines form a sharp angle with the median axes on the lingual side, and an obtuse angle on the bucal side. It looks as a mesial shift of pretrite in relation to posttrite.

Bottoms of synclines on posttrite are sharp; those on pretrite are wider and flatter. On the bucal side of the bottom of the first syncline of pretrite is a group of knolls on enamel. Similar formations, only less prominent are also in the valley of the second syncline of pretrite. On pretrite there is the main (outer) cusp on each half-ridge and two adaxial cusps are closer to median sulcus. It is similar on posttrite, only there are two-three lower adaxial cusps besides the main cusps. The anterior and posterior crescentoids run out from the main cusp on pretrite. The posterior crescentoid of the first half-ridge on pretrite touches the anterior crescentoid on the second half-ridge of pretrite. So it is between the third and fourth half-ridges pretrite. Thus a continuous low horizontal ridge is formed, dividing synclines of posttrite from synclines of pretrite. (It divides the synclines into posttrite and pretrite synclines like median sulcus divides). There is a series of four cusps on the distal margin of the tooth. The crown surface is mostly horizontally grooved almost to a half of ridge height. The tooth is brown-green. It is perhaps from the same specimen as the preceding tooth.

Remarks

Zygodont turicensis belongs among zygodont trilophodont tetrabelodont longirostrinus mastodons (z-3-4-1). Their teeth are zygodont. On the chewing surface

Dimensions /mm/ :

Table 7

length max.	width max.	l/w
171,0	79,8	2,14

ridge number	1	2	3	4
width of ridges	76,5	79,8	79,5	67,4
height of crown on posttrite	54,0 ⁺	54,5 ⁺	58,5	46,6
height of crown on pretrite	56,6	59,0	49,8	42,0

Remark: Symbol + means that the measured values are not exact because of too damaged tooth crown.

P ⁴ <i>Zygodontophodon turicensis</i>		l	w
L.Mayet, 1909	Touraine	45,0	44,0
P.Holec	Devínska N.Ves	50,0	49,0

M ₂ <i>Zygodontophodon turicensis</i>		l	w
M.Vacek, 1877	Murinsel	113,0 ?	73,0 ?
	Neudorf a.d. March /Devínska N.Ves/	92,0 ?	77,0 ?
G.Schlesinger, 1922	Köbánya	110,0 ?	80,0 ?
P.Holec	Mikulov	114,0	71,5

M ₃ <i>Zygodontophodon turicensis</i>		l	w
G.Schlesinger, 1922	Szakai	172,0?	84,0
	Batka	132,0	72,0
P.Holec	Mikulov	171,0	79,8

Table 8 Comparison of dimension of our finds of teeth to dimensions presented by other authors on *Zygodontophodon turicensis* (Schinz).

of the crown are transversal ridges separated by synclines (valleys). The ridges are in one line and the valleys are open. There is no alternation of half-ridges. Their D₄, M₁ and M₂ have three ridges and the last third molar has four. Three ridges of zygodont mastodon is a permanent number. It does not vary in contrast to bunodont mastodons where the number of ridges is variable — three, four, five and more (TOBIEN 1973, p. 129). The stableness indicates the archaic character of zygodont (H. TOBIEN 1975, p. 197).

Zygodontophodon turicensis is ancestor of the species *Mammuth borsoni* (G. SCHLESINGER 1922). It was living in the Miocene time with bunodont mastodon *Gomphotherium angustidens*, from which *Tetralophodon longirostris* developed followed with *Anancus arvernensis*. See Tab. 16.

Ancestors of zygodont and bunodont mastodons lived in Africa. There in the Fayum depression are oldest remains of mastodons (from Oligocene). There they found two species of *Phiomia* with indications of bunodont teeth, and *Palaeomastodon* with indications of zygodont teeth (H. TOBIEN 1976, p. 156).

In Europe no pre-Miocene mastodon remains were found. Two immigrant genera from Africa are known from the Upper "Burdigalian" (= Eggenburgian). The

zygodont type is represented by the genus *Zygodontophodon* (VACEK 1877) with the typical species *Z. turicensis* (SCHINZ, 1833). The bunodont type is represented by the genus *Gomphotherium* BURMEISTER, 1837 with the species *G. angustidens* (CUVIER 1917).

VACEK, 1877 dealt with the history of the names "M" *tapiroides* and "M" *turicensis*. He kept to CUVIER's denomination "tapiroides" although it was based on one lost, poorly developed milk tooth from the locality Montabuzard. Later on in 1833 SCHINZ described from Ellg (Zürich Kanton, Switzerland) the species "M". *turicensis*. It is deposited in polytechnical museum in Zürich. VACEK introduced the generic name *Zygodontophodon*.

Our finds were compared to descriptions by MAYET (1909). They are almost identical (P^4). There were no substantial differences. The tooth from the locality Devínska Nová Ves — Sandberg is somewhat larger and its posterior margin is less dentated than that described and depicted by MAYET. ZAPFE (1954, p. 75) describes the finds M^2 and M^3 of this species from Devínska Nová Ves (Neudorf a.d. March) from quarry cracks. There are well developed zygodont crests ("*Zygodontencrista*") on the tooth. Both teeth from this locality belong most likely to one specimen (ZAPFE 1954, p. 76). They resemble the teeth from Mikulov. According to MAYET (1909, p. 47) *Z. turicensis* appeared at the beginning of the Miocene, its evolution continued up to the Pliocene. Then it is replaced by the species *Mammuth borsoni*. Whereas the upper tusks of the first species are bent down and the lower tusks are smaller, well developed, circular in section, protruding horizontally from the lower mandible, the final evolutionary forms, known mainly from the end of the Pliocene and from the beginning of the Pleistocene (Vilafranchian) have straight large upper tusks. Their lower tusks are absent or rudimentary. Symphyse is adequately reduced. Molars are zygodont, the number of ridges does not increase during their 25 million years' evolution (TOBIEN, 1976, p. 158). Reduction of lower tusks and their extinction are also seen on bunodont mastodons. The evolution was parallel but in contrast to zygodont mastodons the number of ridges on molars grows from 3—4 to five and more on bunodont mastodons. Lower tusks of stegotetrabelodonts, bunodont mastodons preserved, and even thickened on the species *Stegotetrabelodon grandincisivus* (SCHLESINGER). In our country the species was described by SCHMIDT (1963).

Paleogeographic and stratigraphic range

Remains of *Zygodontophodon turicensis* originate from many European localities. They were found in France on the localities Soblay, Villars de Lans, Poumiers, Saint Martin du Mont (LORTET et CHANTRE 1879), Gers — Middle Miocene (GAUDRY 1891), Faluns de la Touraine (MAYET 1909); Switzerland: Ellg (Kanton Zürich) — Upper Miocene (in TOBIEN 1975); Kaprouh near Horgen (LORTET et CHANTRE 1879), Pontlevoy — Lower "Helvetian" Franc Simorre (France) — Upper "Helvetian". France: Sables de l'Orleanais — Burdigalian; Switzerland: Käpfnach —

"Tortonian" (= Badenian), in ZAPFE (1954); Germany: Freising and Tutzingen near Munich — Sarmatian (in ZAPFE 1954); Austria: Fischau-Wöllersdorf — Badenian-Miocene, Göriach near Au (Steiermark), Helvetian (= Ottnangian) Klein Hadersdorf bei Poysdorf — Miocene-Karpatian; Mistelbach — Miocene, Türkenschanze, Wien XVIII — Miocene-Sarmatian, Ameis near Staatz — Miocene — "Helvetian" (= Karpatian), brown-coal mines near Ullrich (Wies) — Miocene — Lower "Helvetian" (= Ottnangian), Kalksburg, Steinbruch (quarry) "Tortonian" (= Badenian), Ottakring, Wien XVI — Miocene (SCHMESINGER 1917), Hungary: Kőbánya (Steinbruch), (quarry) — Miocene-Sarmatian, Szakál — Miocene, Batta (surroundings), age unknown (SCHLESINGER 1922), Devínska Nová Ves (Neudorf a.d. March), fissure filling; age first unknown, than Lower Badenian according to FEJFAR (1974, p. 110—111) on the basis of small mammals. See text plate 21 — "Helvetian" (+ = Ottnangian), (ZAPFE 1954).

***Mammut borsoni* (HAYS 1834)**

Fig. 16, Pl. XI—XV

- 1877 *Mastodon Borsoni* HAYS — M. VACEK: Über Österreichische Mastodonten etc., p. 6—11, tab. 6, fig. 1, 2, 4, 5.
 1877 *Mastodon Borsoni* HAYS — M. VACEK: Über Österreichische Mastodonten etc., tab. 6, fig. 3, 3a (= *Zygalophodon turicensis*).
 1879 *Mastodon Borsoni*, HAYS — LORTET et E. CHANTRE: Recherches sur les Mastodontes etc., p. 20, tab. 1, fig. 1—6, tab. 12, fig. 1—6, tab. 16, fig. 1, 1a.
 1891 *Mastodon borsoni* — A. GAUDRY: Les Mastodontes, p. 6, tab. 2, fig. 8.
 1894 *Mastodon Borsoni* VACEK — M. PAVLOW: Les Mastodontes de la Russie etc., p. 14—22, tab. 2, fig. 1, 2, 4, 6, 7, tab. 3, fig. 1—3, 5—7.
 1894 *Mastodon ohioiticus* CUV. — M. PAVLOW: Ibidem, p. 8—13, tab. 1, fig. 1—4, tab. 2, fig. 2.
 1911 *Mastodon Borsoni* HAYS — F. TOULA: Oberkieferbackzähne von *Mastodon Borsoni* Hays etc., p. 46, tab. 5, fig. 1a, b, 2a, b.
 1917 *Mastodon (Zygalophodon) Borsoni* HAYS — G. SCHLESINGER: Die Mastodonten etc., p. 163, tab. 22, fig. 5.
 1922 *Mastodon (Mammut) Borsoni* HAYS — G. SCHLESINGER: Die Mastodon reste der Budapester Sammlungen etc., p. 116—141, tab. 13, fig. 5, tab. 14, fig. 6, tab. 15, fig. 5, tab. 16, fig. 3, tab. 17, fig. 2—4, tab. 18, fig. 1, tab. 19, fig. 1, tab. 20, fig. 3.
 1922 *Mastodon (Mammut) americanus* PENNANT forma praetypica SCHLESINGER — G. SCHLESINGER: Die Mastodonten der Budapester Sammlungen etc., p. 101—116, tab. 14, fig. 5, tab. 15, fig. 1—4, tab. 16, fig. 1, 2, tab. 17, fig. 1, tab. 18, fig. 5, tab. 19, fig. 2.
 1964 *Mastodon borsoni* HAYS, 1834 — O. FEJFAR: The Lower Villafranchien Vertebrates from Hajnáčka etc., p. 61—65, tab. 5, fig. 1, 2.
 1970 *Zygalophodon borsoni* (HAYS, 1834) — Z. SCHMIDT et R. HALOUZKA: Nová fauna vertebrát etc., p. 176, tab. 19, 20.
 1975 *Mammut borsoni* — H. TOBIEN (HAYS, 1834): The Structure of the Mastodon Molar etc., p. 207, fig. 17, 19, 20, 22.
 1976 *Mammut borsoni* (HAYS, 1834) — H. TOBIEN: Zur paläontologische Geschichte der Mastodonten etc., p. 158, fig. 10.

Holotype: Incomplete third upper molar M³ (without distal part), depicted by BORSON 1823, p. 31, pl. II, determined and described by HAYS 1834, p. 334.

Type locality: Villanova, province Asti, Piedmont, Italy.

Type level: Upper Pliocene — Astian or Early (Earliest) Pleistocene.

Material: M²dext. (locality Velké Bíelice — sand-pit; deposited at Department of geology and paleontology). M³sin. and M₃sin. (locality Strekov — sand-pit; in private collection).

The crown of M²dext. (Pl. XI, Fig. 1, 2) is well preserved. The root part is broken off immediately below the crown. The crown is zygodont, little abraded. Mesial and distal margins of the tooth at the base of the crown are provided with surfaces resulting from friction — with M¹ in the front, with M³dext. behind. The mesial margin of the crown is slightly concave, the distal margin is convex. The general shape of the crown is approximately rectangular, the tooth broadens slightly backwards, the second ridge is somewhat narrower than the third. The first is evidently narrowest. Above the base of the crown at the base of ridges is a partly elevated cingular margin composed of tiny knolls on enamel. The margin is continuous on the mesial, palatal and distal margins of the tooth. The margin is almost inconspicuous at the base of the bucal side of the third ridge. It is not developed at the base of the bucal side of the second ridge. Whereas its course is straight along palatal margins of the first and the second transversal valleys, on the bucal side the cingular margin is partly impressed into the valleys. Abrasion of the crown is best seen on paracon: dentin is exposed, there on a small surface. Enamel on cusps of other ridges is smoothed. The tooth is transversally divided by two deep transversal valleys into three ridges — a trilophodont tooth. Median sulcus is prominent. It divides the crown longitudinally into the inner part — pretrite (entoloph) and the outer part — posttrite (ectoloph). The inner half-ridge consists of a higher cusp shifted laterally toward the inner margin of the tooth and a lower cusp near median sulcus. Anterior crescentoid 1 is running mesially and buccally from protocon, anterior crescentoid 2 is running mesially from hypocon; posterior crescentoid is running distally and buccally. They are also distinct on the third inner half-ridge.

On pretrite are two crests on each half-ridge. Because of abrasion the cusp near median sulcus is not distinct but the inner cusp of the second and third half-ridges is as large as the outer or it is higher on the talon. There are two special characteristic marks which are absent on other teeth. On mesial surfaces of pretrite of the first and

Dimensions /mm/ :

Table 9

length max.	width max.	l/w
88,2	67,0	1,31

ridge number	1	2	3
width of ridges	62,4	66,8	67,0
height of crown on posttrite	39,4	47,0	50,3
height of crown on pretrite	38,0	42,0	42,8

the second half-ridges indistinct grooves are running. The second "anomaly" is the irregular surface at the base of the crown on bucal margin of the second ridge. It ranges to the cingular margin of the tooth which is damaged in this part. No cement.

Material: M³sin., M₃sin. Locality Strekov — sand-pit. The material is in private collections (leaders of cooperative forms in Strekov and Dubník).

The tooth is well preserved. It is lightgreen. (Fig. 15b, Pl. XII, Fig. 1, 2; Pl. XIII, Fig. 1, 2, pl. XIV, Fig. 1, 2). The mesial part of the tooth is almost rectangular, the distal part is widely rounded. It has four prominent ridges and an incomplete ridge behind. The first ridges are intensely abraded, dentin is exposed. The fourth ridge is most abraded on pretrite. Posttrite is partly abraded only in mesial part. A small anterior crescentoid 1 runs out from protocon near median sulcus. Pretrite and posttrite are in one line and axes of individual ridges almost perpendicular to the median axis of the tooth. Synclines are free in the whole width of the tooth. They are not barred with anterior or posterior crescentoids. The crown is low owing to abrasion. The tooth is strikingly wide. Median sulcus is running along the whole tooth so that it divides the first ridge into two parts: the posttrite half-ridge is wider than the pretrite half-ridge. So it is on the second and the third ridges. The fourth ridge is divided so that the pretrite half-ridge is evidently broader. Each half-ridge of pretrite and posttrite has two cusps. The larger one is farther from median sulcus. It may also be seen on the intensely abraded tooth. Mesial walls of the individual transversal valleys are steeper than distal. On margins at the base of the crown are more-or-less horizontal lines. On the lingual sides of the first, second and the third synclines are groups of knolls on enamel. They are almost completely abraded at the first syncline. No cement on crown.

M₃sin. (Fig. 15, Pl. XII, Fig. 1, 2; Pl. XIII, Fig. 1, 2, Pl. XV, Fig. 1, 2). The contour of the base of the tooth crown is elongated oval, slightly narrowed and rounded at the distal end. The crown is black. The distal margin is rounded, the mesial margin is damaged. A part of the crown before the first half-ridge of posttrite is broken off. The lingual margin is almost straight whereas the bucal margin is slightly convex. The tooth is occluded on the first two ridges. The third half-ridge of pretrite is partly

Dimensions /mm/ :

Table 10

length max.	width max.	l/w
162,8	96,8	1,68

number of ridge	1	2	3	4
width of ridges	88,7	96,8	96,7	84,3
height of crown on postrite	36,4	34,0	37,7	38,0
height of crown on pretrite	34,4	34,7	36,5	36,4

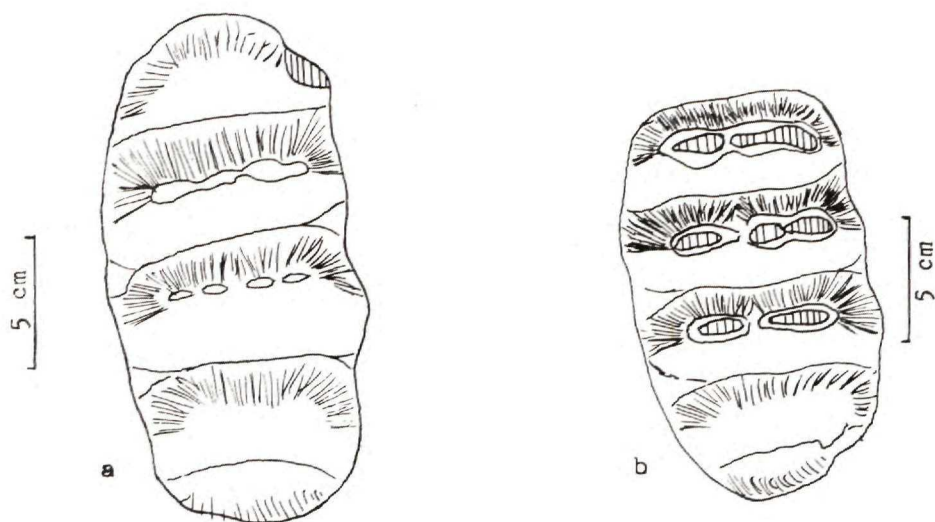


Fig. 15 *Mammut borsoni* (HAYS)

View of occlusion surface of the tooth crown a — $M_3sin.$, b — $M^3sin.$ Locality Strekov — sand-pit.

bruised on the part distal from the main cusp. The posttrite half-ridge and the whole fourth ridge are not damaged. In the approximate centre of the tooth is median sulcus. It is not identic with median axis but it declines from it lingually in the front and buccally behind. The arrangement of cusps on individual half-ridges of posttrite and pretrite is similar like on the preceeding tooth, only on the third and fourth half-ridges of posttrite are three cusps. (Between the usual two cusps is one small cusp). From protoconid, hypoconid and other main cusps of pretrite half-ridges are running mesial and lingual indistinct crescentoids. Mesial and distal zygodont crests are running out from main cusps of posttrite half-ridges. The tooth has four complete ridges. The third ridge is broadest. Transversal valleys (synclines) are broad. There is a small knoll on the lingual margin of the syncline. Otherwise the valleys are free, with steep walls. Cement is not developed.

Table 11

length max.	width max.	l/w
210,5	102,2	2,05

ridge number	1	2	3	4
Width of ridges	92,6 ⁺	101,6	102,2	88,7
height of crown on posttrite	51,9	54,8	53,4	46,0
height of crown on pretrite	47,3 ⁺	47,0	48,6	49,0

Table 12

M ² Mammut borsoni		l	w
M.Pawlov, 1894	Nikolaev	84,0 ?	73,0 ?
F.Toula, 1911	Rákos	118,0	88,5
O.Fejfar, 1964	Hajnačka	108,0	91,5
Z.Schmidt, 1970	Strekov	122,4	97,4
		106,4	87,1

M ₃ Mammut borsoni		l	w
G.Schlesinger, 1922	Hajnačka	195,0	91,6
	Hidvég	199,0	100,0
	Szabadka	160,0	85,0
	Vác	200,0	90,0
O.Fejfar, 1964	Hajnačka	197,0	104,0
Z.Schmidt, 1970	Strekov	147,6	87,1
P.Holec	Strekov	210,5	102,2

Table 12 Comparison of size of tooth of our finds to the size of dimensions quoted by other authors on the species *Mammut borsoni* (HAYS).

Remarks

Mammut borsoni (HAYS, 1834) belongs to zygodont trilophodont dibelodont longirostrine mastodons (2-3-2-1).

Already SCHLESINGER (1922) derived this species from the Miocene species "*Mastodon tapiroides*" (= *Zygodon turicensis*) through the intermediate form *M. tapiroides* (*americanus*) divided into *M. borsoni*, *M. americanus* forma *praetypica* and *M. americanus* forma *typica*. They lived during the "Levantine" together with "*M.* *borsoni*". At the end of that time they migrated to North America, according to SCHLESINGER. So he assumed that the American mastodon had developed from European ancestors and migrated across the Bering pass to North America. Later explorers, particularly LEHMAN (1950) and TOBIEN (1976) assumed that the American mastodon might have developed from zygodont mastodons existing on the American continent on the Miocene/Pliocene boundary. This might concern the genera *Serridentinus* or *Pliomastodon* (LEHMAN, 1950). Also TOBIEN (1976) assumed that *M. americanus* (OSBORN 1936) developed from populations of

zygodont mastodons parallelly to Eurasian populations of *M. borsoni*. Molars of the animals are so similar that TOBIEN (1976) ranges them to one genus — *Mammut*. This opinion may be accepted.

Differences between the "species" *M. borsoni* and *M. americanus* forma *praetypica* cannot be regarded as species differences. It was already mentioned by VENJUKOV (1902) who found the characters differing two forms on one specimen. SCHLESINGER (1917) too described both forms together from several localities of the former Austria-Hungary. PAVLOVA (1894) denoted the progressive form as *ohioticus* and the conservative form as *borsoni*.

During the evolution from *Zygodon turicensis* to *Mammut borsoni* their lower tusks got reduced. *Zygodon turicensis* has normally developed lower tusks but those of *Mammut borsoni* are markedly reduced, rudimentary. PAVLOVA (1901 ex FEJFAR 1964) regarded the absence of tusks on the American mastodon as a deciding character to differ it from the Eurasian mastodon. There is a problem because it is not always possible to meet a complete find with lower tusks and molars preserved. We also know how variable the tusks of present elephants are. Especially females have thin tusks or any at all, so this is an unreliable character. SCHLESINGER also assumes that lower tusks may in some cases occur as atavism also on progressive forms, i.e. on the American mastodon. FEJFAR (1964) was right to range the "progressive" form denoted by SCHLESINGER (1922) as *Mastodon (Mammut) americanus* PENNANT forma *praetypica* SCHLESINGER to *Mammut borsoni*, as a descendant of a typical Pliocene species.

So if we agree with TOBIEN (1976), then *Mammut borsoni* and *Mammut americanus* are terminal lines of the zygodont branch of mastodons which extinguished in Eurasia at the beginning of the Quaternary and lived in North America from the Upper Pliocene through the Pleistocene and extinguished in the Holocene.

Paleogeographic and stratigraphic range

Remains of this species were found on many localities of West, Central and East Europe and Asia. In France it was found in Perpignan (Pliocene-Astian) together with *Anancus arvernensis* (CROIZET et JOBERT). Now the locality is ranged to the 15th zone according to MEIN (1975). LORTET and CHANTRE (1879) described the species from other ten localities, mostly from the vicinity of Lyon. TOULA (1911) found some remains on the locality Rákös near Budapest and in the vicinity of Arad (Belveder gravels and sands). ATHANASIU (1909), (ex TOULA 1911) described finds from South Moldavia together with *Anancus arvernensis* from the Upper Pliocene. In our country the species is known from Hajnačka (Lower Villafranchian-Pliocene) (FEJFAR 1964). Schmidt found it in the Middle Villafranchian at Strekov in South Slovakia. In Germany the species occurred in the Upper Pliocene at Wölfersheim, in Russia it was described by PAVLOVA (1894) from the locality Pesčany in the vicinity of villages Gmerinka and Jaroshenka (perhaps Pliocene), and from other localities. TOBIEN (1975) depicted a molar from an unknown level in the province Shansi in

China. The find in France may belong among oldest. LORTET at CHANTRE (1879) described a find from the locality Soblay (Ain) in France. It is ranged to the Vallesian — Lower Pliocene. The tooth is deposited in the Museum of natural history in Basel (a cast). See text table 16.

***Anancus arvernensis* (CROIZET et JOBERT, 1828)**

Fig. 16, 17, Pl. XVI—XX

- 1877 *M. arvernensis* CROIZET et JOBERT — M. VACEK: Über Österreichische Mastodonten etc., p. 33—39, Tab. 7, fig. 2, 3.
1879 *Mastodon dissimilis*, JOURDAN — LORTET et E. CHANTRE: Les mastodontes etc., p. 13, (13—19), tab. 1—7.
1890 *Mastodon arvernensis* CROIZET et JOBERT — CH. DEPÉRET: Les animaux pliocènes de Rousillon, p. 61—67, tab. 5, fig. 1.
1891 *Mastodon arvernensis* — A. GAUDRY: Les mastodontes, p. 3, tab. 2, fig. 4.
1894 *Mastodon arvernensis* CROIZET et JOBERT — M. MAVLOW: Les mastodontes de la Russie etc., p. 21, tab. 2, fig. 5.
1911 *Mastodon arvernensis* CROIZET et JOBERT — T. TOULA: Über Säugetierreste etc., p. 36, tab. 4, fig. 1a, b.
1917 *Mastodon (Dibunodon) arvernense* CROIZET et JOBERT — G. SCHLESINGER: Die Mastodonten etc., p. 129, tab. 20, fig. 1—3.
1922 *Mastodon (Dibunodon) arvernensis* CROIZET et JOBERT — G. SCHLESINGER: Die Mastodonten der Budapester Sammlungen etc., p. 61—76, tab. 10, fig. 4—7, tab. 11, fig. 2—8, tab. 12, fig. 1—4, tab. 13, fig. 1, 2.
1964 *Mastodon arvernensis* CROIZET et JOBERT, 1828 — O. FEJFAR: The Lower Villafranchian Vertebrates from Hajnačka etc., p. 65—68, tab. 3, fig. 1—3.
1970 *Anancus arvernensis* (CROIZET et JOBERT, 1828) — Z. SCHMIDT, R. HALOUZKA: Nová fauna vertebrát etc., p. 176, tab. 21.
1973 *Anancus arvernensis* CROIZET et JOBERT, 1828 — H. TOBIEN: The structure of Mastodon Molar etc., p. 130, fig. 15, 17, 18.
1975 *Anancus arvernensis* (CROIZET et JOBERT, 1828) de Desnes (Jura) — M. BEDEN et M. CAMPY: Nouvelles découvertes mastodontes etc., p. 78, tab. 1, fig. 1—D.
1976 *Anancus arvernensis* — H. TOBIEN: Zur paläontologischen Geschichte der Mastodonten etc., p. 183, fig. 32, 43.
1978 *Anancus arvernensis* (CROIZET et JOBERT, 1828) — H. TOBIEN: On the Evolution of Mastodonts etc., p. 168, tab. 17, fig. 11a, b, 12, tab. 18, fig. 13

Lectotype: $M^1_{sin.}$, described and depicted by CROIZET and JOBERT 1828, p. 139—140, Pl. 13, Fig. 1.

Paratypes: Tens of isolated molars with fragments of upper and lower mandibles described and depicted by CROIZET and JOBERT 1828, p. 133—138, Pl. 1, Fig. 1, 4, Pl. 2, Fig. 7 and by Osborn 1936, p. 632—633, Fig. 596 (denoted as cotypes).

Type locality: Perrier, Auvergne, France.

Type level: Lower Villafranchian, Upper Pliocene.

Material: $M^3_{dext.}$ (locality: velké Bielice — sand-pit; deposited in the Bojnice Museum). A fragment of the lower mandible with $M^3_{sin.}$, $M^2_{dext.}$ (locality: Včeláre-quarry, fissure filling in Wetterstein limestones).

Fragments of upper and lower teeth, fragment of tusks, basipodia and finger segments (locality: Včeláre-quarry, fissure filling in limestones).

The tooth is elongated (Fig. 16a, b, Pl. XVI, Fig. 1, 2). Its front is wide, it is narrowing backwards. The root part is broken off and the crown part is worn out. On the chewing surface of the molar are 5 1/2 ridges. The first four ridges are abraded so that dentin is largely exposed. On the palatinal side the first and the second halfridges pretrite are abraded down to cingular knolls near the tooth crown base. A part of enamel on the mesial margin towards the labial margin is broken off. The root is partly preserved. The course of median sulcus cannot be traced on the first, second and third ridges (lopes) because of intense abrasion. There are two longitudinal grooves on the fourth and the fifth ridges. The last sixth ridge consists of four cusps. Two of them are separated by horizontal grooves and the other two by a transversal groove. Enamel on walls of distal slopes of half-ridges of posttrite and on bottoms of synclines show tiny irregular knolls, pits and grooves. They are distinct on the 1st and 2nd synclines in the bucal part of the tooth, and less distinct on the distal area of ridge

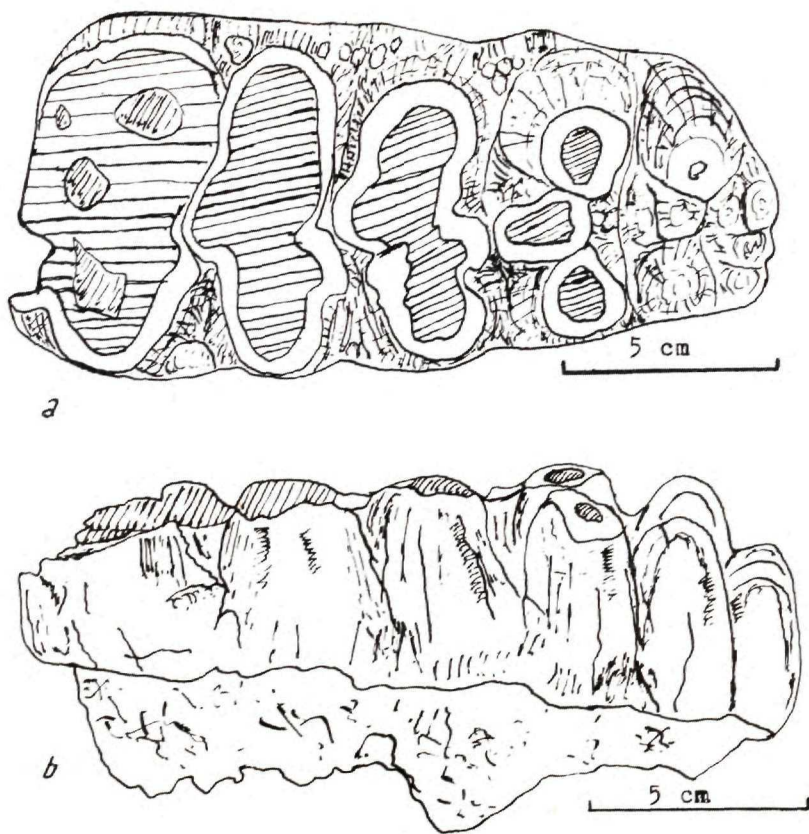


Fig. 16 *Anancus arvernensis* (CROIZET et JOBERT), M³dext., a view of a — occlusion surface, b — bucal surface of the tooth crown. Locality Velké Bělčice.

Dimensions /mm/ :

Table 13

length max.	width max.	l/w
186,7	89,3	2,09

ridge number	1	2	3	4	5	6
width of ridges	88,7	88,3	84,6	81,5	68,4	45,2
height crown on postrite	28,2	37,0	44,8	45,8	49,3	36,7
height of crown on pretrite	25,2	21,8	32,7	44,8	52,7	41,3

slopes. Enamel is rough on posttrite at the ends of synclines. It is best seen on posttrite of the first syncline and on pretrite of the first, second and third synclines. The tooth is most abraded in the frontal pretrite part. There the abrasion surpasses the circular thickening on the first syncline. The valleys are closed with frontal and back crescentoids.

Thin cement coat is preserved on the bottoms of the fourth and fifth synclines.

Thickness of tooth enamel is variable in different parts of the tooth crown. It ranges from 6,1 to 7,3 mm.

Material: M_3 sin. with a fragment of the mandible; M_2 dext. os dentale in cavity, more tooth fragments. Locality: Včeláre — quarry.

An incomplete M_3 sin. is preserved in situ in a fragment of the distal branch of the left mandible (Fig. 17a, b, Pl. XVII, Fig. 1, 2). The mesial part of the tooth with the first two ridges is broken off. Fragments of the root are in the lower mandible. The crown base is elongated (in ground-plan). The lingual line is slightly convex, the bucal line is concave. It is a bunodont type of tooth. Pretrite is distally shifted in relation to posttrite so half-ridges get alternant position and the valleys get closed. LEHMAN (1950, p. 215) and FEJFAR (1964, p. 66) found out that the tooth crown was enlarging during its evolution. The mandible did not enlarge. The occlusion surface of the crown got prolonged and narrowed. All ridges are intensely abraded; the last crest of talonid has only smoothed enamel. Pretrite half-ridges are more abraded. The backward shift of half-ridges is less conspicuous. The last ridge of talonid shows no signs of shift. Mesial walls of individual ridges are steep, almost vertical; their distal walls dip diagonally downwards and backwards. Owing to alternant half-ridges the median sulcus is not seen, the last ridge of talonid divides it into two almost equal parts terminated with a rounded crest. Individual semi-synclines are narrow with steep walls. Bottoms of synclines among ridges and cusps are coated with cement as well as the crown base and especially its distal part. Thickness of enamel ranges from 6.0 to 7.0 mm.

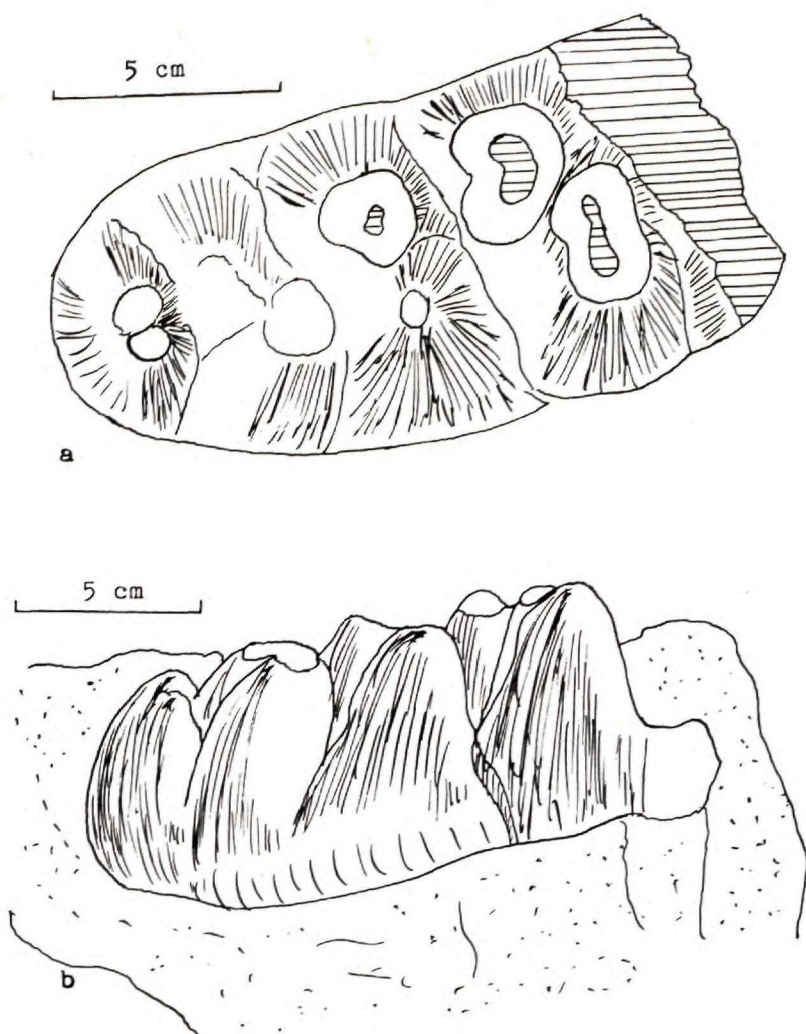


Fig. 17 *Anancus arvernensis* (CROIZET et JOBERT) M_3 sin. View of a — occlusion surface, b — lingual surface of tooth crown. Locality: Včeláre — quarry.

M_2 dext. The tooth is in a block of terra rossa penetrated by sinter. Locality: Včeláre — quarry. No roots, no cutting. The tooth is inside the right mandibule (Plate XVIII, Fig. 1, 2, Pl. XIX, Fig. 1). The crown base seems oval. The tooth has four complete ridges. The fourth ridge is followed by an incomplete knoll. The first syncline is interrupted by the back crescentoid 1 and the frontal crescentoid 2. They close it completely. The second syncline is interrupted by the second back crescentoid (pqr 2), situated distally from the main cusp of pretrite — hypoconid. The third syncline is not interrupted but its course is pointed. Half synclines of pretrite are

Dimensions /mm/ :

Table 14

length max.	width max.	l/w
160,0 ⁺	83,4	-

ridge number	3	4	5	6
width of ridges	83,4	82,5	73,8	56,6
height of crown on postrite	64,6	62,2	60,8	53,2
height of crown on pretrite	37,0	43,2	44,6	48,6

broader than of posttrite. Half-ridges of pretrite are shifted distally in relation to half-ridges of posttrite. It is best seen on the second and third half-ridges. Mesial walls of half-ridge are steeper than distal. Each half-ridge has two cusps. The main cusp is laterally distal from median sulcus. The adaxial cusp is close to median sulcus. The whole tooth is covered with a layer of CaCO_3 crystals and I could not find cement. The crystals are also in the inner tooth cavity — see Pl. XIX, Fig. 1.

Fragment of $M_{3\text{sin}}$. (Včeláre — quarry) Pl. XX, Fig. 1a, b. Preserved is the last ridge of talonid with two cusps. Base of cusp on pretrite conelet is shifted mesially in relation to the posttrite post. On the lingual surface of the tooth crown base a thin cement coat is preserved. Cusps of talonid are abraded so the tooth must have belonged to an old animal. The cusps are 57.0 mm high (from the crown base).

The last crest of $M_{3\text{dext}}$. Locality Včeláre — quarry; Pl. XX, Fig. 2a, b. It was a massive tooth. The last ridge consists of three massive rounded cusps. The main cusp on posttrite is partly abraded. No cement is visible; perhaps it dissolved in acid at the release of fossil remains from the rock. Fragment of the left $M_{2,3\text{sin}}$. Locality Včeláre — quarry, Pl. XIX, Fig. 2a, b, 3a, b. The first two ridges are preserved on the chewing surface. The bucal part of the first half-ridge of pretrite is not preserved. The main cusp on pretrite is tightly connected to the anterior crescentoid (acr. 1) in the mesial part. The posterior crescentoid (pcr. 1) is damming the syncline. So it is on the second half-ridge of pretrite — on hypoconid. Anterior crescentoid (acr. 2) is lingual and mesial and posterior crescentoids (pcr. 2) are lingual and distal. Half ridges of pretrite are distally shifted in relation to half-ridges of posttrite. Semi-syncline on the lingual side has a sharply downcut bottom, less steep and sharp on the bucal side. Width of the second ridge is 63.3⁺. Tooth crown on the second half-ridge of pretrite is 51.0⁺.

Material from Včeláre comprises further tooth fragments of this species of mastodon. Interesting are fragments of quite small teeth of mastodons. They are likely to represent the pre-natal (late embryonal) stage.

M ₃	Anancus arvernensis	l	w
G.Schlesinger, 1922	Hajnačka	250,0	85,0
		189,0	78,0
O.Fejfar, 1964	Rákoskeresztúr	215,0?	98,0
	Hajnačka	214,0	80,0
M.Beden, M.Campy, 1975		224,0	81,0
	Desnes	210,0	82,0
P.Holec		230,0	87,0
	Včeláre	160,0 ?	83,4

M ³	Anancus arvernensis	l	w
Z.Schmidt, 1970	Strekov	194,0	90,0
P.Holec	Veř.Bielice	186,7	89,3

Table 15. Comparison of tooth dimensions of our finds to dimensions of *Anancus arvernensis* (CROIZET et JOBERT) quoted by other authors.

Remarks

In contrast to previous species, *Anancus arvernensis* belongs among bunodont tetralophodont dibelodont brevirostrinous mastodons (B-4-2-b). So their D4, M1 and M2, denoted in odontology of mastodons as "intermediate molars", (TOBIEN, 1973, p. 204) have four ridges; the third molar may have five and more transversal ridges. These mastodons have two tusks in the maxilla. Lower tusks disappeared and the lower mandible is cradleshaped like that of the present elephants. The species is characterized by alternation of half-ridges on molars, mainly on M3. This phenomenon is unknown on zygodont mastodons. They are characterized by open transversal valleys (synclines) all over the width of the tooth crown. In the evolution line from *Gomphotherium angustidens* through *Tetralophodon longirostris* to *Anancus arvernensis* the alternation of half-ridges proceeds from milk teeth to permanent teeth (FEJFAR 1964). The typical form of *Tetralophodon longirostris* from the Lower Pannonian shows a slight shift of half-ridges of D4 and M1 on intermediate forms (*T. longirostris* — *A. arvernensis*). Alternation of half-ridges of D4, M1 and M2 from the Middle and Upper Pannonian is regular; M3 is variable in this respect. The typical form *A. arvernensis* from the end of the Pliocene shows complete alternation of half-ridges on M3. The process is continuous, there are no sudden changes, so it is impossible to put distinct lines among the individual species (cf. FEJFAR, 1964, p. 66).

Alternation of half-ridges on more advanced forms is explained by LEHMAN

(1950) by the tendency of molars to elongate their crown without the enlargement of mandibula and maxilla where the process took place. The teeth also have a cement layer covering mostly the distal and the lateral parts of the crown. The cement layer is more frequent among ridges — in synclines. According to FEJFAR (1964) it was damaged both mechanically and chemically according to acidity of food.

The progressive form of *Anancus arvernensis* may be distinguished from the typical form according to the number of transversal ridges on M3. There are six of them on the progressive form. The two forms are also differing in the thickness of the cement coat on the crown enamel. So our find from Včeláre is regarded as the progressive — terminal form and the form from Veľké Bielice is regarded as older. Its cement layer is thinner and the sixth ridge is small. FEJFAR (1964) ranges also specimens from Hajnačka among progressive forms of *Anancus arvernensis*.

Anancus perimensis FALCONER et CAUTLEY, 1847 and *Pentalophodon sivalensis* CAUTLEY, 1836 (cf. ATHANASIU, 1909, p. 426, and O. FEJFAR 1964, p. 66) from the geographically distant Pliocene of India are very similar to our species in the alternation of half-ridges and in the cement coat on the tooth crown. In accordance with SCHLESINGER (1922) *A. perimensis* may be identic with *A. arvernensis* whereas *P. sivalensis* resembles more to the genus *Elephas*.

Paleogeographic and stratigraphic range

Anancus arvernensis was frequent in Europe and in Asia during the Pliocene and at the beginning of the Quaternary time. LORTET et CHANTRE (1879) described plentiful remains, especially teeth of animals from many French localities. The animals are denoted as “*Mastodon dissimilis*”. Following are some of the localities: Villeneuve at Dousure, Pompignan at Montpellier Baternay, Mirabel, Vaucluse, a.o. Sands containing remains of the mastodon are ranged to the Lower Pliocene — Messinian. Now it is Upper Pliocene — Pontian. VACEK (1877) mentioned the locality Bribir in Croatia where they found remains of *A. arvernensis* in lignite. TOULA (1911) described it from the lignite formation at Illyefalva in Hungary (Szent-Király). SCHLESINGER (1922) mentioned the locality Mühlbach at Massian (Niederösterreich) of uncertain, perhaps Middle Pliocene age. PAVLOVA (1894) mentioned the locality Cherson, depicted M³ whose remains were also found in Besarabia.

In our country the species was described by FEJFAR (1964) from the Upper Pliocene at Hajnačka and by SCHMIDT (1970) from the Lower Pleistocene of South Slovakia — from Strekov (see text, pl. 21). DEPÉRET (1890) mentioned a tusk of *Anancus arvernensis* found at Perpignan in the Upper Pliocene — Astian. MEIN (1975) ranged the finds from this locality to his 15th zone.

Remarks on paleoecology of mastodons

According to literature and data on our localities, mastodons lived most likely in a humid forest environment with a rich vegetation. Mastodon remains were found in

coal seams, lacustrine and fluvial sediments. The species *Zygodontomys turicensis* from the locality Devínska Nová Ves — Sandberg shows distinct forest- and hydrophilous characters. From this locality plentiful mammalian fauna was described by THENIUS (1952) who characterized the environment as forest, littoral and fluvial. On the same locality also *Deinotherium* and other thermophilous forest genera like: *Potamotherium*, *Amphicyon*, *Listriodon*, *Dorcatherium*, *Lagomeryx*, *Anchitherium*, *Tapirus*, *Sivapithecus*, a.o. lived. The following fauna lived on the locality Strekov with *Anancus arvernensis*: *Archidiskodon*, *Dicerorhinus*, *Cervus* *Alces* *Bison*. According to SCHMIDT and HALOUZKA (1970) the biotope might have been formed of a plant assemblage of humid swamp foliaceous forests with rich vegetation or of swamp meadows for the species *Anancus*, *Mammut*, *Archidiskodon*, and partly for *Dicerorhinus*. Other species were more frequent in the environment of discontinuous forest areas with vegetation of warm steppe-forests and mainly of foliaceous or mixed forests of the moderate climatic zone, frequently humid.

Big terrestrial mammals like elephants are more endangered by warming than cooling (VESELOVSKÝ 1977) because of the relation of the great body volume to its surface. The present African elephant *Loxodonta africana* lives in bush and steppes with few trees. Its main food is grass. The cooling of its body is provided by large ears and by looking for shade. Indian elephants (*Elephas maximus*) living in jungle environment like mastodons, have smaller ears, perhaps because in the shadowy jungle the body can cool well alone. Mastodons were smaller than present elephants; they lived in woods at flowing or stable waters and ate most likely plant shoots, sprouts of shrubs and trees. Their ears were perhaps small because they were not endangered by overwarming in that environment. There was a forest retreat at the end of the Pliocene and at the beginning of the Pleistocene. Mastodons partly adapted to the changed living conditions, the structure of teeth of bunodont mastodons changed a little but according to my opinion they still kept to the forest environment as proved by *Anancus arvernensis* found in Včeláre. In fact, there also was typical forest-and jungle fauna — *Tapirus*, *Macaca*, *?Sciropetaurista*, *Ophisaurus*.

Although it is proved that mastodons, especially *Zygodontomys turicensis*, were forest animals, we must admit that with respect to the vast area which they lived in they could not be restricted to one biotope. Mainly terminal types of mastodons *Anancus arvernensis*, *Mammut borsoni* and its relative from the American continent — *Mammut americanus* might also had lived in steppe-forest, partly arid environment and under colder climatic conditions (in contrast to *Deinotheria*) because they lasted up to the Pleistocene, and *M. americanus* even to the Holocene.

Biostratigraphical conclusions

Devínska Nová Ves — Sandberg (Theben Neudorf) is the oldest studied locality of the remains of mastodon *Zygodontomys turicensis* (SCHINZ). The Miocene — Upper Padenian — age of the locality is documented by many avertebrate and vertebrate

[illegible]

Table 16 Evolution of European mastodons, stratigraphic range of their occurrence and stratigraphic position of fossiliferous beds localities.

fossils. Most typical mammals are represented by *Anchitherium aurelianense* (CUV.), *Palaeomeryx eminens* H. V. MEYER, *Dicroceros elegans* LART, a.o. (cf. THENIUS 1952, p. 27—28). It corresponds to the sixth biozone of Mein (1975; see Table 16).

No attending fauna was found at the localities Nováky and Mikulov. The sediments can only be ranged to the Middle-Upper Miocene according to finds of *Zygodontomys turicensis* (SCHINZ). TAKAČ (1970) basing on flora at the locality Nováky, came to similar conclusion.

On the locality Veľké Bielice teeth of mastodons *Mammuth borsoni* (HAYS) and *Anancus arvernensis* (CROIZET et JOBERT) were found. These species are most frequent in the Pliocene. I think they are not the terminal progressive forms but their predecessors, because they have no cement layer on their teeth, only *Anancus arvernensis* shows some cement in the last synclines of the tooth crown. I range the locality to the Lower Pliocene.

The Middle-Upper Villafranchian age of sediments at Strekov was determined by SCHMIDT and HALOUZKA (1970) according to larger mammals. It is also proved by progressive forms of mastodons *Mammuth borsoni* and *Anancus arvernensis*. Strekov is the oldest paleontologically evidenced Quaternary locality in Slovakia.

On the locality Včeláre — quarry the progressive form of mastodon *Anancus arvernensis* (CROIZET et JOBERT) with well developed cement coat on its tooth crown occurs together with interesting forest — and jungle fauna. It is represented by species of the genera *Tapirus*, *Macaca*, *Ophisaurus* a.o., indicative of the Pliocene/Pleistocene boundary. I think it is Upper Villafranchian or younger fauna. It is coeval with or younger than the fauna from Strekov (tab. 16).

References

- ATHANASIU, S. 1909: Beiträge zur Kenntnis der tertiären Säugetierfauna Rumäniens II. Ann. Inst. geol. Roman I, Bucuresti, 424—434.
- BEDEN, M.—CAMPY, M. 1975: Nouvelles découvertes des mastodontes dans les cailloutis silences de Desnes, Jura. Ann. Sc. de l'Université de Besancon, Géologie, 3 ser. fasc. 23, Besancon, 77—83.
- BRESTENSKÁ, E. 1961: Present knowledge and problems of the Pliocene of the West-Carpathians. Geol. Práce, Zošit 60, Geol. Úst. D. Štúra, Bratislava, 149—157.
- DEPÉRET, CH. 1890: Les animaux pliocènes du Roussillon. Mém. de la Soc. Geol. de France, № 13, Paris, 1—194.
- FEJFAR, O. 1974: Die Eomyiden und Cricetiden (Rodentia, Mammalia) des Miozäns der Tschechoslowakei. Palaeontographica, Sonder Abdruck, Abt. A, 146, Stuttgart, 100—180.
- FEJFAR, O. 1974: Die Eomyiden und Cricetiden (Rodentia, Mammalia) des Miozäns der Tschechoslowakei. Palaeontographica, Sonder Abdruck, Abt. A, 146, Stuttgart, 100—180.
- GAUDRY, A. 1891: Quelques remarques sur les mastodontes a propos de l'animal du Chericira. Mém. Soc. géol. de France, Paléontologie, Mémoire, 8, Paris, 1—6.
- HARČAR, J.—SCHMIDT, Z. 1965: Kvartér v okolí Strekova na Hronskej pahorkatine. Geol. Práce, Správy 34, Geol. Úst. D. Štúra, Bratislava.
- HÖRNES, M. 1848: Verzeichniss der Fossil— Reste aus 135 Fundorten des Tertiär-Becken von Wien. In: Erläuterungen zur Geognostischen Karte der Umgebung Wiens-Johann Cžizek, Wien, 1849.

- KALÁŠEK, J. et al. 1963: Vysvětlivky k přehledné geologické mapě ČSSR 1 : 200 000 M-33-XXIX Brno. ÚÚG Praha, Naklad. Čs. Akad. Věd, Praha, 5—256.
- KORNHUBER, G. H. 1865: Adalékok Pozsonymégye Természettani földrajzához. Pozsony és Környéke.
- LEHMANN, U. 1950: Über Mastodontenreste in der bayerischen Staatsammlung in München. *Palaeontographica*, 99, A, 4—6, Stuttgart, 121—228.
- LORTET, L.—CHANTER, E. 1897: Études des paléontologiques dans le Bassin du Rhône. *Période tertiaire. Recherches sur les mastodontes et les faunes mammalogiques quiles accompagnent.* Arch. Mus. Hist. natur. Lyon, II, Lyon, 285—311.
- MAYET, L. 1909: Étude sommaire des Mammifères fossiles des Faluns de la Touraine. *Annales du l'Université de Lyon, Nouvelle série I. Sciences, Médecine, Fasc. 26*, Lyon.
- MEIN, P. 1975: Résultats du Groupe de Travail des Vertébrés. In: Seneš, J. Report on activity of the R.C.M.N.S. Working Groups 1971—1975, Bratislava, 78—81.
- MIŠÍK, M.—GULICKA, J.—URVICHAROVÁ, E. 1974: Devínska Kobyla. (Geologické pomery, kvetena a fauna). *Obzor*, Bratislava, 1—102.
- MIŠÍK, M. 1976: Geologické exkurzie po Slovensku. Slovenské pedagogické nakladateľstvo Bratislava, Bratislava, 359.
- OSBORN, H. F. 1936: Proboscidea. A Monograph of the Discovery, Evolution, Migration and Extinction of the Mastodonts and Elephants of the World Vol. I. *Moeritherioidea, Deinotherioidea, Mastodontoida.* Amer. Mus. Nat. Hist. New York, 802.
- OSBORN, H. F. 1836: Proboscidea. A Monograph of the Discovery, Evolution, Migration and Extinction of the Mastodonts and Elephants of the World Vol. O. *Moeritherioidea, Deinotherioidea, Mastodontoida.* Amer. Mus. natur. Hist. New York, 1—802.
- PAVLOVA, M. 1894: Les mastodontes de la Russie at leur rapports avec les mastodontes des autres pays. *Mém. Acad. Imp. Sci. Pétersbourg* (8), I. 3, Pétersbourg, 1—43.
- PAVLOVA, M. 1901: Nouvelles trouvaillies des Mastodonte Borsoni, Lart. au Sud de la Russie. *Ann. Geol. Min. Russ.* V, 2—3, Pétersbourg, 9—18.
- PIA, J.—SICKENBERG, O. 1934: Katalog der in den österreichischen Sammlungen befindlichen Säugetierreste des Jungtertiärs Österreichs und der Randgebiete. *Denkschriften des Naturhistorischen Museums in Wien*, Band 4, Geologisch—Paleontologische Reihe, Leipzig.
- SCHLESINGER, G. 1917: Die Mastodonten der k.k. Naturhistorisches Hofmuseums 1, Wien, 230.
- SCHLESINGER, G. 1922: Die Mastodonten der Budapester Sammlungen. *Geologic. hung.* II. 1 Budapest, 1—284.
- SCHMIDT, Z. 1963: *Tetralophodon grandincisivus* Schlesinger, 1917 z pliocénu (pontu) v Kuzmiciach pri Topoľčanoch. *Geol. Práce, Správy* 27, Geol. Úst. D. Štúra, Bratislava, 169—174.
- SCHMIDT, Z.—HALOUZKA, R. 1970: Nová fauna vertebrát villafranchienu zo Strekova na Hronskej pahorkatine (Podunajská nížina). *Geol. práce, Správy* 51, Geol. Úst. D. Štúra, Bratislava, 173—183.
- SCHUBERT, R. J. 1905: Die Fischotolithen des österr-ungar. Tertiärs III. *Jb. K. Kön. geol. Reichsanst.* Bd. 55, Wien, 613—638.
- SCHUBERT, R. J. 1906: Die Fischotolithen des österr-ungar., Tertiärs III. *Jb. K. Kön. geol. Reichsanst.* Bd. 56, Wien, 623—706.
- SIMPSON, G. G. 1945: The principles of classification and a classification of mammals. *Bull. Amer. Mus. Nat. Hist.*, 85, New York, 1—350.
- TAKÁČ, M. 1970: Miocénna flóra na hornej Nitre (Dizertačná práca). *Manuskript—Geofond*, Bratislava.
- THENIUS, E. 1952: Die Säugetierfauna aus dem Torton von Neudorf an der March (ČSR). *Neues Jb. Geol. u. Paläont. Abh.* 96, 1, Stuttgart, 27—136.
- THENIUS, E. 1969: Phylogenie der Mammalia Stammesgeschichte der Säugetiere (einschließlich der Hominiden). Berlin, Walter de Gruyter and Co., 1—722.
- TOBIEN, H. 1973: The Structure of the Mastodont Molar (Proboscidea, Mammalia) Part 1: The Bunodont Pattern. *Maizer geowiss. Mitt.* 2, Mainz, 115—147.
- TOBIEN, H. 1975: The Structure of the Mastodont Molar (Proboscidea, Mammalia) Part 2: The Zygodont and Zygebunodont Patterns. *Maizner geowiss. Mitt.* 4, Mainz, 195—233.
- TOBIEN, H. 1976: Zur paläontologischen Geschichte der Mastodonten (Proboscidea, Mammalia). *Maizner geowiss. Mitt.* 5, Mainz, 143—225.
- TOBIEN, H. 1978: On the Evolution of the Mastodonts (Proboscidea, Mammalia) Part 2: The bunodont tetralophodont Groups. *Geol. Jb. Hessen*, 106 Wiesbaden, 159—208.

- TOULA, F. 1911: Paläontologische Mitteilungen aus den Sammlungen von Kronstadt in Siebenburgen. Abhandl. der k.k. Geol. Reichsanst. Bd. XX, Heft 5, 1—49.
- VACEK, M. 1877: Über Österreichische Mastodonten und ihre Beziehungen zu den Mastodonarten Europas. Abh. Geol. Reichsanst. Bd. VII, H. 4 Wien, 1—45.
- VENJUKOV, P. 1902: Die Säugetierfauna der Sandschichten von Balta in Gouvernement Podolien. Mat. Geol. Russl., XXI, St. Pétersbourg.
- VESELOVSKÝ, Z. 1977: Sloni a jejich příbuzní. Stát. zemědel. nakl. Praha, Edícia: Zvířata celého světa. Praha, 7—123.
- ZAPFE, H. 1954: Die Fauna der miozänen Spaltenfüllung von Neudorf a.d. March (ČSR) Proboscidea. Sitz.-Ber. österr. Akad. Wiss., Math.-naturwiss. Kl., Abt. I, 163 Wien, 71—87.

P. Holec

Nálezky zvyškov mastodontov (Proboscidea, Mammalia) v neogénnych a kvartérnych sedimentoch Slovenska

Resumé anglického textu

Zuby mastodontov nájdené v oblasti Západných Karpát patria k zygodontnému aj bunodontnému typu. Okrem toho sú trilofodontné aj tetralofodontné, to znamená, že ich prostredné moláre ("intermediate molars") D4, M1 a M2 majú tri priečne hrebene, resp. u tetralofodontov sú štyri. Posledný tretí molár vrchný i spodný (M3) má u trilofodontov štyri, u vývojove pokročilejších až päť priečných hrebeňov, zatiaľ čo u tetralofodontov má päť, šesť, dokonca až sedem hrebeňov. V starších prácach sa v zmysle CUVIERA (1817) považuje za talón, resp. za talonid neúplne vyvinutý posledný hrebeň. V novších prácach najmä TOBIEN (1973, 1975) považuje za talón u vrchných, resp. talonid u spodných zubov celú distálnu časť zuba za prvými dvoma hrebeňmi. Na týchto prvých hrebeňoch rozoznáva protokon, hypokon, parakon a metakon, resp. u spodných zubov protokonid, hypokonid, metakonid a entokonid. Talón (talonid), teda ostatné za ním idúce hrebene na zube si viac-menej vernou kópiou prvých dvoch hrebeňov.

U zygodontných zubov sú hrebene prebiehajúce po šírke zubnej korunky ostré s hladkými stenami a ležia v jednej línii. Priečne údolia — synklinály, oddeľujúce priečne hrebene, sú otvorené, len v niektorých prípadoch sú vyvinuté predné a zadné hrebenky tiahnuce sa od vrcholu hlavného hrebeňa smerom dolu. Naproti tomu u bunodontného typu zuba je korunka tvorená jednotlivými, pomerne širokokužeľovitými hrbolmi, ktoré môžu stáť v jednej línii, alebo u vývojove pokročilejších sú polhrebene navzájom posunuté, alternujú ce. U tohto typu zuba údolia, ktoré oddeľujú jednotlivé hrebene, nebývajú otvorené, ale v strede sú prehradené predným alebo zadným hrebenkom (anterior, posterior crescentoid = conulus) alebo priamo alternujúcim polhrebeňom.

Od predného okraja k zadnému okraju zuba sa približne v strednej časti tiahne mediálny sulcus — tenký zárez deliaci hrebene na polhrebene. Súmernosť polhrebeňov u zygodontného zuba je výraznejšia ako u bunodontného typu. Vnútná alebo palatinálna časť žuvacej plochy vrchného zuba sa nazýva pretrit alebo pretritová časť (entoloph), vonkajšia časť sa nazýva postrit, postritová časť (ectoloph). Vnútna polovica žuvacej plochy spodného zuba je označovaná ako postrit (entolophid), vonkajšia časť ako pretrit (ectolophid). Pretritová časť vrchného i spodného zuba býva viac obrúsená žuvaním ako postritová časť.

Vrchné zuby od spodných sa líšia tým, že sú obvykle širšie a ich mesiálny (predný) a distálny (zadný) okraj zviaza takmer pravý uhol s linguálnym (okraj smerom k jazyku) a bukálnym (licným) okrajom. Obrys bázy zubnej korunky je takmer obdĺžnikový. Spodné zuby bývajú užšie a obrys zubnej korunky je mierne kosoštvorcový. Okrem toho priečne hrebene a údolia u vrchných zubov sú takmer kolmé na sagitálnu os zuba, zatiaľ čo u spodných zubov pretínajú sagitálnu os zuba šikmo.

Predkovia zygodontných aj bunodontných mastodontov žili v Afrike. Vyvinuli sa z okruhu rodu *Moeritherium*, ktorý žil v strednom a vrchom eocéne. Vo Fayumskej depresii (z oligocénu) boli nájdené zvyšky dvoch rodov mastodontov — *Phiomia*, s nábehom k bunodontným zubom a *Palaeomastodon*

s nábehom k zygodontnému typu zubov (TOBIEN 1976, p. 156). V Európe sa pred miocénom zvyšky mastodontov nenašli. Až od Egenburgu ("burdigal") ako prístahovalci z Afriky sú známe dva druhy — zygodontný typ predstavuje *Zygodontodon turicensis* (SCHINZ) a bunodontný *Gomphotherium angustidens* (CUVIER). Oba druhy mali vyvinuté spodné aj vrchné kly. Vo vrchnom miocéne sa zo zygodontného druhu vyvinul *Mammuth borsoni* (HAYS), ktorý vyhynul začiatkom kvartéru. Počas vývoja týchto mastodontov je zreteľná tendencia k zväčšovaniu tela a k redukcii spodných klov. Z druhu *Gomphotherium angustidens* (CUVIER) sa koncom stredného a začiatkom vrchného miocénu vyvinuli dva rody. Bol to rod *Stegotetrabelodon*, u ktorého dochádzalo k zmohutneniu spodných klov, a rod *Tetralophodon*, z ktorého sa cez prechodnú formu vyvinul rod *Anancus*. V tejto linii dochádza k postupnej redukcii až úplnému vymiznutiu klov v spodnej čeľusti u koncového druhu *Anancus arvernensis* (CROIZET et JOBERT). Veľmi charakteristické pre tento druh je aj striedanie polhrebenešov na stoličkách, najmä na M3. Ak sledujeme evolučný rad od *Gomphotherium* cez *Tetralophodon* k rodu *Anancus* môžeme zistiť, že striedanie polhrebenešov postupuje od mliečnych zubov k trvalým. U typickej formy *Tetralophodon longirostris* (KAUP) zo spodného panónu je badať nepatrný posuv polhrebenešov u D4 a M1. U prechodných foriem *T. longirostris* k *A. arvernensis* zo stredného a vrchného panónu je striedanie polhrebenešov u D4, M1 a M2 pravidelné, ale M3 je z tohto hľadiska nestály. Napokon u typickej formy *A. arvernensis* z konca pliocénu je striedanie polhrebenešov úplne vyvinuté aj u M3. Tento postup je spojitý, bez náhlých prechodov, takže nie je možné viesť ostrú hranicu medzi jednotlivými druhmi a prechodnými formami (porovnaj FEJFAR, 1964, p. 66).

Explanations to Plates I—XX

Pl. I

Fig. 1 Loc. Devínska N. Ves — Sandberg. General view from W. Photographed by Osvald.

Fig. 2 Loc. Strekov — sand-pit. Viewed from SE. Arrow-head marks position of fossiliferous bed. Photographed by author.

Pl. II

Fig. 1 Loc. Strekov — sand-pit. Exposure of fossiliferous bed. Photographed by author.

Fig. 2 Detail of sandy formation. Dark bed at bottom is fossiliferous bed. Photographed by author.

Pl. III

Fig. 1 Locality Včeláre — quarry in Wetterstein limestones. Western view of zero level with terra rossa-filled fissure, with fossil vertebrate fauna. Photographed by author.

Fig. 2 Loc. Včeláre — quarry. Detail of cavern in limestones. Photographed by author.

Pl. IV

Fig. 1 Loc. Včeláre — quarry. White spots between men and left of them are bones of larger mammals (1977). Photographed by author.

Fig. 2 Loc. Včeláre — quarry. Detail of bones in fissure walls. Photographed by author.

Pl. V

Fig. 1 *Zygodontodon turicensis* (SCHINZ), P⁴-M¹ in sandstone block with fauna of marine bivalves 1 — view of occlusion surface, 2 — view of bucal surface of tooth. Loc. Devínska N. Ves — Sandberg Magn. 0.38×. Photographed by Osvald.

Pl. VI

Zygodontodon turicensis (SCHINZ), fragment of M₃dext. 1 — view of occlusion surface, 2 — view of bucal surface of tooth crown. Loc. Nováky Mine Mier. Magn. 0.7× Photographed by Osvald.

Pl. VII

Zygodolophodon turicensis (SCHINZ), fragment of M^2_{sin} . 1 — view of occlusion surface, 2 — view of lingual surface of tooth crown. Loc. Nováky Mine Mier. Magn. $0.89\times$. Photographed by Osvald.

Pl. VIII

Zygodolophodon turicensis (SCHINZ), fragment of M_1_{dext} . 1 — view of occlusion surface, 2 — view of bucal surface of tooth crown. Locality Mikulov — Čujan sand-pit. Magn. $1.1\times$. Photographed by Osvald.

Pl. IX

Zygodolophodon turicensis (SCHINZ), M_2_{dext} . 1 — view of occlusion surface, 2 — bucal surface of tooth crown. Loc. Mikulov — Čujan sand-pit. Magn. $0.95\times$. Photographed by Osvald.

Pl. X

Zygodolophodon turicensis (SCHINZ), M_3_{dext} . 1 — view of occlusion surface, 2 — view of lingual surface of tooth crown. Loc. Mikulov — Čujan sand-pit. Magn. $0.67\times$. Photographed by Osvald.

Pl. XI

Mammut borsoni (HAYS), M^2_{dext} . 1 — view of occlusion surface, 2 — view of palatinal surface of tooth crown. Loc. Vělké Bielice — sand-pit. Magn. $0.96\times$. Photographed by Osvald.

Pl. XII

Mammut borsoni (HAYS). At left M^3_{sin} , at right M_3_{sin} . 1 — view of occlusion surface, 2 — view of bucal surface of tooth crown. Loc. Strekov — sand-pit. Photographed by author.

Pl. XIII

Mammut borsoni (HAYS), M^3_{sin} , M_3_{sin} . 1 — view of lingual surface, 2 — view of mesial surfaces of teeth. Loc. Strekov — sand-pit. Photographed by author.

Pl. XIV

Mammut borsoni (HAYS), M^3_{sin} . 1 — view of occlusion surface, 2 — view of palatinal surface of tooth crown (cast). Loc. Strekov — sand-pit. Photographed by Osvald. Magn. $0.66\times$.

Pl. XV

Mammut borsoni (HAYS), M_3_{sin} . 1 — view of occlusion surface, 2 — view of bucal surface of tooth crown (cas). Loc. Strekov — sand-pit. Magn. $0.55\times$. Photographed by Osvald.

Pl. XVI

Anancus arvernensis (CROIZET et JOBERT), M^3_{dext} . 1 — view of occlusion surface, 2 — view of bucal surface of tooth crown. Locality Vělké Bielice — sand-pit. Magn. $0.6\times$. Photographed by Osvald.

Pl. XVII

Anancus arvernensis (CROIZET et JOBERT), fragment of lower mandibule with incomplete M_3_{sin} . 1 — view from above, 2 — view from lingual side. Loc. Včeláre — quarry. Magn. $0.3\times$. Photographed by Osvald.

Pl. XVIII

Anancus arvernensis (CROIZET et JOBERT), M^2_{dext} in cavity of right mandibule. 1 — view from bucal side, 2 — detail view without mesial part of tooth crown. Tooth crown and tooth cavity are covered with calcite crystals. 1 — Magn. $0.27\times$, 2 — Magn. $0.4\times$. Photographed by Osvald.

Pl. XIX

Fig. 1 *Anancus arvernensis* (CROIZET et JOBERT), mesial part in cavity of mandible. M_2^{dext} . Detail of section of tooth enamel, and outer and inner calcite crystal coats. Loc. Včeláře — quarry. Magn. $0.95\times$. Photographed by Osvald.

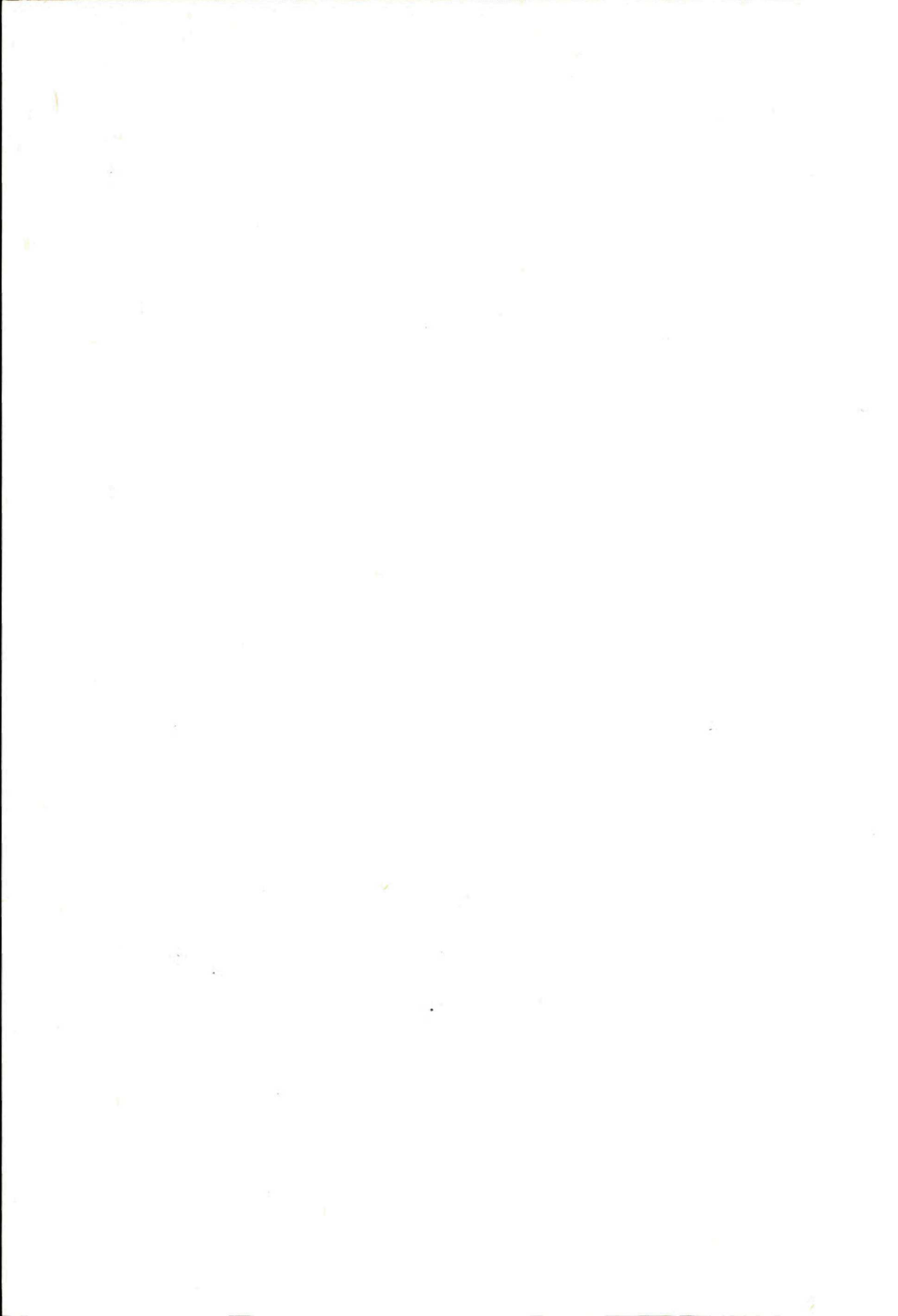
Fig. 2 *Anancus arvernensis* (CROIZET et JOBERT) fragment, of tooth crown. a — view of occlusion surface, b — view of lateral surface of tooth crown. Loc. Včeláře — quarry. Magn. $0.55\times$. Photographed by Osvald.

Fig. 3 *Anancus arvernensis* (CROIZET et JOBERT), fragment of tooth crown, a — view of occlusion surface, b — lateral surface of tooth crown. Loc. Včeláře — quarry. Magn. $0.6\times$. Photographed by Osvald.

Pl. XX

Fig. 1 *Anancus arvernensis* (CROIZET et JOBERT); fragment of M_3^{sin} . — last crest of talonid with two conelets; a — view of occlusion surface, b — view of distal surface. Loc. Včeláře — quarry. Photographed by Osvald.

Fig. 2 *Anancus arvernensis* (CROIZET et JOBERT); fragment of distal part of talon of M_3^{dext} . a — view of occlusion surface, b — view of distal surface. Loc. Včeláře — quarry. Magn. $0.56\times$. Photographed by Osvald.



Mária Kochanová

Middle Triassic Bivalvia from Area of Gemerská Hôrka in Slovak Karst (West Carpathians)

4 text-figs, 7 Pls. (XXVIII—XXXIX), Slovak summary

Abstract. The paper deals with the problem of stratigraphic position of lumachelle limestones situated amidst Nádaška limestones of the Silica nappe in the Slovak Karst in the area of the village Gemerská Hôrka. The problem could not be solved in spite of numerous conodonts and bivalves in the limestones and dasycladaceans in their basement. Macrofauna was represented mostly by bivalves.

Introduction

The studied bivalves originate from the area of Hôrka from its southern slopes, and from the valley in the area of B. M. 292. Geographically the area belongs to the Slovak Karst and is situated NW of the village Gemerská Hôrka.

Fossils were found there for the first time by BYSTRICKÝ during mapping. The information was published in "Slovenský kras" (1964). Light-coloured Upper Anisian limestones contained "a species resemblant to *Veldidenella dieneri* Alma", and dark-grey bedded limestones from B. M. 306 (= 292 in new topographic basis) contained the species *Daonella tyrolensis* MOJSISOVICS. Biostratigraphic researches of this area revealed further localities of lumachelle limestones containing a rich paleontologic material, described and pictured in this paper.



The studied area was visited by participants of the working meeting in Bratislava 1980 within the International correlation programme (IGCP — Project 4: Triassic of the Tethys Realm; BYSTRICKÝ and KOCHANOVÁ 1980, pp. 22—25).

Geological situation

The area belongs geologically to the southern limb of the Koniart geosyncline as a part of the Silica nappe. The structure of the large karren field in the studied area comprises three lithostratigraphic units, namely 1. Steinalm limestones, 2. "atypical Schreyeralm limestones", 3. pseudo-Reifling limestones (Bystrický 1980, manuscript map 1 : 2000).

The Steinalm limestones are light coloured, massive, with sporadic lumachelle layers. Fossils are mostly represented by dasycladaceans, of which the following species are quoted by BYSTRICKÝ (1980): *Physoporella pauciforata* GÜMB. v. *pauciforata*, *Ph. varicans* PIA, *Oligoporella pilosa* PIA v. *intussannulata* and *O. pilosa* PIA cf. *varicans*. On the basis of these fossils BYSTRICKÝ ranges the limestones to the Pelsonian — Lower Illyrian. Bivalves are represented by the species *Veldidenella dieneri* ALMA, *Camptonectes (Annulinectes) subconcentricus* (KITTL) and *C. (A.) delorenzoi* (WILCKENS), stratigraphically ranged to the Anisian and the Ladinian.

"Atypical Schreyeralm" limestones (BYSTRICKÝ 1964) correspond according to Kovács (who visited the area) to the lithostratigraphic unit of the Nádaška limestones which KOVÁCS (1979) determined as an intermediate lithofacies between the Schreyeralm and Reifling limestones. They are bedded, partly nodular limestones of brownish, grey and violet-red colours in the Gemer-Turňa karst. On the basis of conodonts it is ranged to the Pelsonian-Cordevolian. In the studied area they are also in the form of dark-grey micrite limestones with irregular layers of red limestones. The underlying Steinalm limestones are connected with the former by a continuous transition. They contain sporadic Anisian dasycladaceans.

The boundary with the overlying pseudo-Reifling limestones (in which no fossils are known at present) whose bedding is wiped out owing to karstification, is problematic.

Localities and fauna

Distribution of localities in the lumachelle limestones of the studied area is shown in Fig. 1 and 2.

Locality LB-1 : about 360 m SSW of Hôrka in Steinalm limestones.

? *Daonella (Daonella)* sp.

Locality LB-2 : about 106 m NE of the locality LB-1 in Steinalm limestones (original locality of BYSTRICKÝ, 1964).

a) *Veldidenella dieneri* ALMA, 1926 ; *Camptonectes (Annulinectes) delorenzoi* (WILCKENS, 1909).

b) *Camptonectes (Annulinectes) subconcentricus* (KITTL, 1903).
 Locality LB-3: about 122 m SW of Hôrka in ? Nádaška limestones.
Daonella (Daonella) pichleri (MOJSISOVICS, 1874), *Daonella (Daonella) cf. pauli* KITTL, 1912.
 Locality LB-4: about 40 m NE of the locality LB-2 in Steinalm limestones.

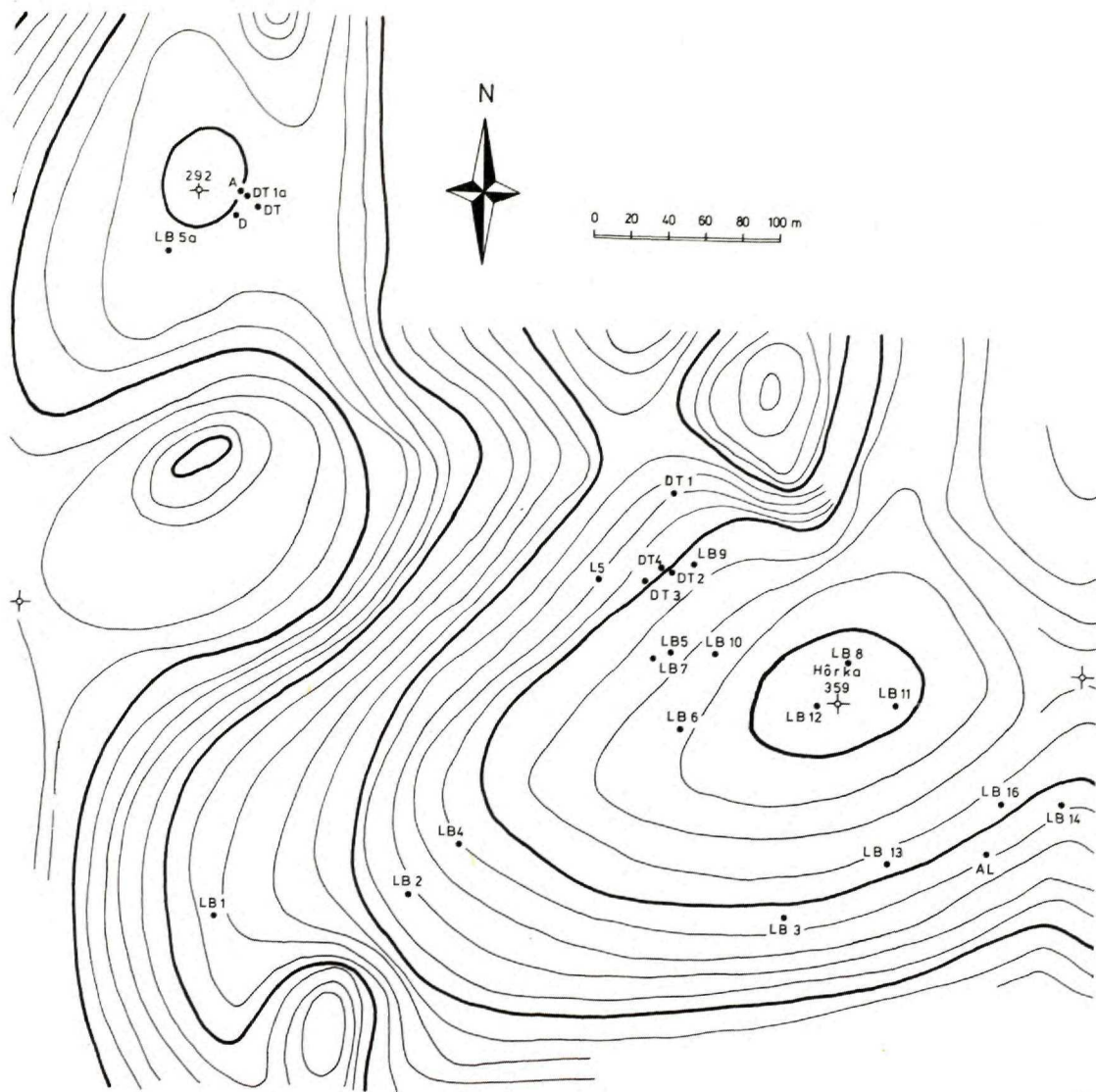


Fig. 1 Sketch map of localities in the area NW of the village Gemerská Hôrka on the Koniart plateau in the Slovak Karst. (Compiled by BYSTRICKÝ 1 : 2000, modified and completed by the author).

a) *Daonella* (*Daonella*) sp. 1, ? *Posidonia* sp.,

b) from fissure filling: *Veldidenella dieneri* ALMA, 1926; *Daonella* (*Daonella*) cf. *lommeli* (WISSMANN, 1841).

Locality LB-5: about 24 M W of the locality LB-10 in Nádaška limestones.

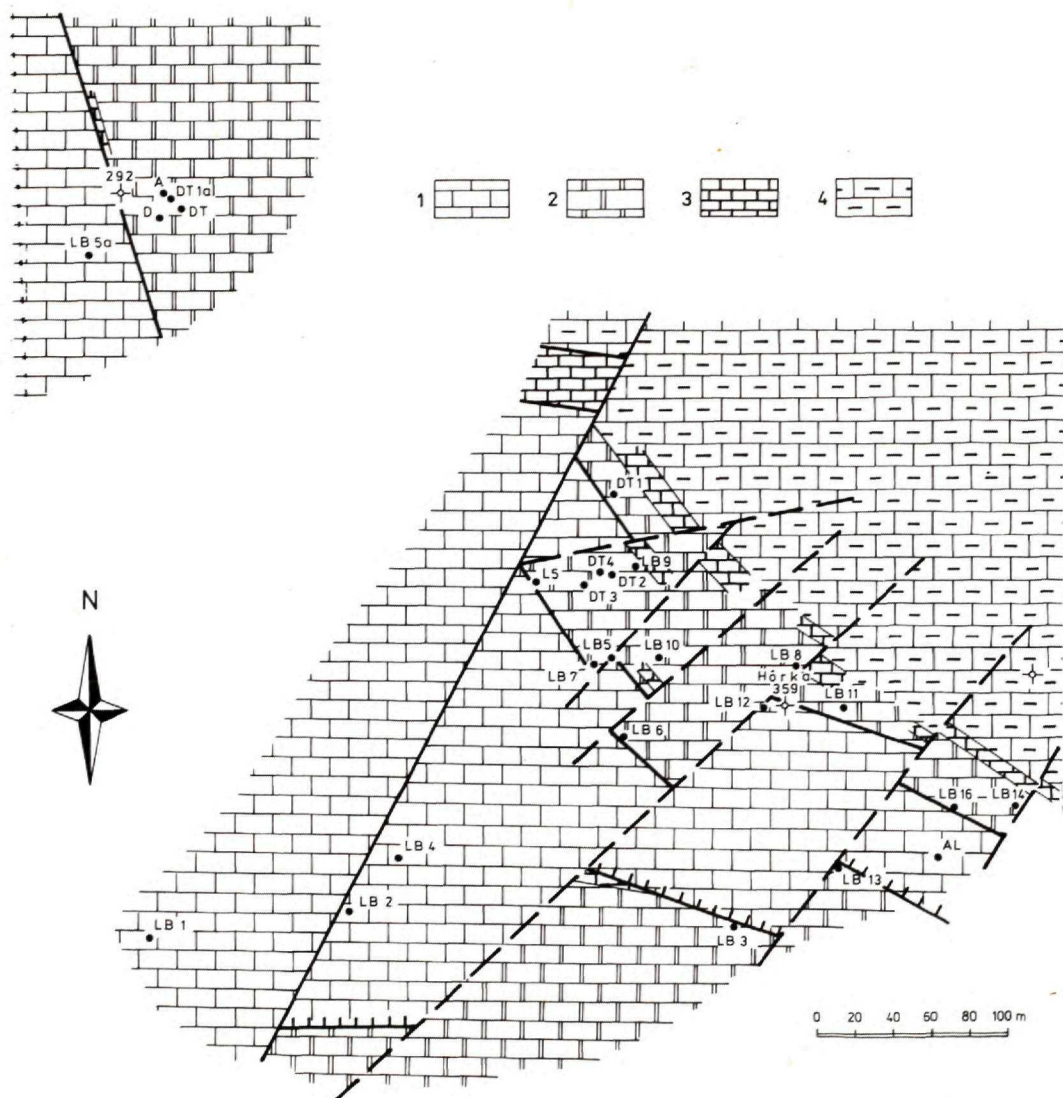


Fig. 2 Geological sketch of the area NW of the village Gemerská Hôrka on the Koniart plateau in the Slovak Karst with localities of bivalves. (Modified on the basis of manuscript geological map compiled by BYSTRICKÝ 1980 in scale 1 : 2000).

1 — Steinalm limestones; 2 — Nádaška limestones; 3 — red limestones amidst the Nádaška limestones; 4 — pseudo-Reifling limestones.

- a) *Daonella* (*Daonella*) cf. *indica* BITTNER, 1899, *Daonella* (*Daonella*) ex gr. *tyrolensis* MOJSISOVICS, 1874.
 - b) *Daonella* (*Daonella*) cf. *lommeli* (WISSMANN, 1841)
 - c) *Daonella* (*Daonella*) sp., ? *Posidonia* sp., *Camptonectes* (*Annulinectes*) cf. *delorenzoi* (WILCKENS, 1909).
- Locality LB-6: about 40 m S of the locality LB-5 in Nádaška limestones.
Daonella (*Daonella*) *pichleri* MOJSISOVICS, 1874, *Camptonectes* (*Annulinectes*) sp.
- Locality LB-7: about 10 m W of the locality LB-5 in Nádaška limestones.
 ? *Daonella* (*Daonella*) sp.
- Locality LB-8: about 22 m N of Hôrka in Nádaška limestones.
- a) *Daonella* (*Daonella*) *pichleri* MOJSISOVICS, 1874, *Daonella* (*Daonella*) cf. *tyrolensis* MOJSISOVICS, 1874.
 - b) *Veldidenella dieneri* ALMA, 1926.
- Locality LB-9: about 100 m NW of the locality LB-10 in Nádaška limestones.
Daonella (*Daonella*) cf. *lommeli* (WISSMANN, 1841), *Posidonia* sp.
- Locality LB-10: about 72 m NW of Hôrka in Nádaška limestones.
- a) *Daonella* (*Daonella*) *pichleri* MOJSISOVICS, 1874.
 - b) *Daonella* (*Daonella*) cf. *bulogensis* KITTL, 1904, *Daonella* (*Daonella*) cf. *tyrolensis* MOJSISOVICS, 1874, *Camptonectes* (*Annulinectes*) sp.
 - c) *Daonella* (*Daonella*) cf. *lommeli* (WISSMANN, 1841)
- LB-10 furrow:
- a) *Daonella* (*Daonella*) *pichleri* MOJSISOVICS, 1874.
 - b) *Daonella* (*Daonella*) *indica* BITTNER, 1899, *Daonella* (*Daonella*) cf. *tyrolensis* MOJSISOVICS, 1874, *Daonella* (*Daonella*) ex gr. *tyrolensis* MOJSISOVICS, 1874.
- Locality LB-11: about 10 m E of Hôrka in Nádaška limestones.
- a) *Daonella* (*Daonella*) sp.
 - b) *Daonella* (*Daonella*) cf. *pichleri* MOJSISOVICS, 1874.
 - c) *Veldidenella dieneri* ALMA, 1926.
- Locality LB-12: about 10 m W of Hôrka in Nádaška limestones.
Veldidenella dieneri ALMA, 1926.
- Locality LB-13: about 92 m SE of Hôrka in ? Nádaška limestones.
Daonella (*Daonella*) *pichleri* MOJSISOVICS, 1874, *Daonella* (*Daonella*) cf. *noduligera* BITTNER, 1895, *Camptonectes* (*Annulinectes*) sp.
- Locality LB-14: about 32 m E of the locality LB-16, fissure filling in Nádaška limestones:
Daonella (*Daonella*) cf. *bassanii* DE LORENZO, 1894.
- Locality LB-16: about 68 m NE of the locality LB-13 in Nádaška limestones.
Daonella (*Daonella*) cf. *lommeli* (WISSMANN, 1841).
- Locality DT: about 32 m SE of B. M. 292 (= B. M. 306, original locality of BYSTRICKÝ, 1964).
Daonella (*Daonella*) *tyrolensis* MOJSISOVICS, 1874, *Daonella* (*Daonella*) *indica* BITTNER, 1899, *Daonella* (*Daonella*) cf. *tyrolensis* MOJSISOVICS, 1874.
- Locality DT-1a: about 8 m NW of the locality DT in Nádaška limestones.
Daonella (*Daonella*) *indica* BITTNER, 1899, *Daonella* (*Daonella*) *tyrolensis*

- MOJSISOVICS, 1874, *Daonella* (*Daonella*) ex gr. *tyrolensis* MOJSISOVICS, 1874.
 Locality DT-1: about 42 m NW of the locality LB-9 in Nádaška limestones.
Daonella (*Daonella*) *indica* BITTNER, 1899.
 Locality DT-2: about 16 m SW of the locality LB-9 in Nádaška limestones.
Daonella (*Daonella*) cf. *tyrolensis* MOJSISOVICS, 1874.
 Locality DT-3: about 14 m SW of locality DT-2 in Nádaška limestones.
Daonella (*Daonella*) *indica* BITTNER, 1899, *Daonella* (*Daonella*) *pichleri* MOJSISOVICS, 1874, *Daonella* (*Daonella*) cf. *tyrolensis* MOJSISOVICS, 1874.
 Locality DT-4: about 6 m W of the locality DT-2 in Nádaška limestones.
Daonella (*Daonella*) cf. *tyrolensis* MOJSISOVICS, 1874.
 Locality L-5: about 24 m W of the locality DT-3 in Nádaška limestones.
 a) *Daonella* (*Daonella*) *pichleri* MOJSISOVICS, 1874.
 b) *Daonella* (*Daonella*) cf. *tyrolensis* MOJSISOVICS, 1874.
 c) *Daonella* (*Daonella*) sp. 1, *Camptonectes* (*Annulinectes*) sp.
 Locality AL: about 50 m SW of the locality LB-14 in Steinalm limestones.
Daonella (*Daonella*) cf. *lommeli* (WISSMANN, 1841).
 Locality D: about 10 m SW of the locality DT in Nádaška limestones.
 a) *Daonella* (*Daonella*) *bulogensis* KITTL, 1904
 b) *Daonella* (*Daonella*) cf. *lommeli* (WISSMANN, 1841)
 c) *Veldidenella dieneri* ALMA, 1926

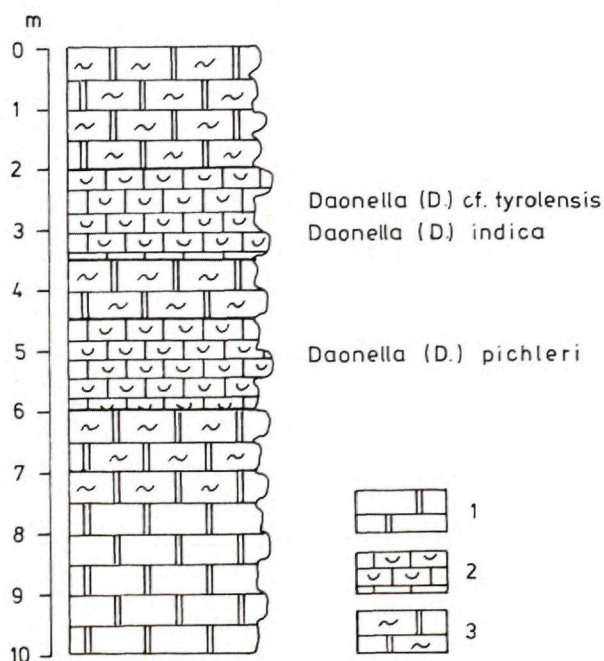


Fig. 3 Furrow LB-10

1 — grayish red Nádaška limestones; 2 — lumachelle limestones with bivalves and conodonts; 3 — gray micritic Nádaška limestones.

Furrow D:

a) *Daonella (Daonella) bulogensis* KITTL, 1904

b) *Daonella (Daonella) lommeli* (WISSMANN, 1841).

Locality LB-5a: about 26 m SW of B. M. 292 in Steinalm limestones.

Daonella (Daonella) sp.

Locality A: about 4 m NW of the locality DT-1a in Nádaška limestones.

Parallelodon sp.

Protrachyceras sp.

Systematic part

The bivalvian macrofauna from the lumachelle limestones is represented by mostly incomplete valves, fragments and impressions. It is because the shells were broken prior to deposition and it was scarcely possible to get complete specimens from overfilled lumachelles. The material is unsorted, consisting of juvenile, young and adult specimens.

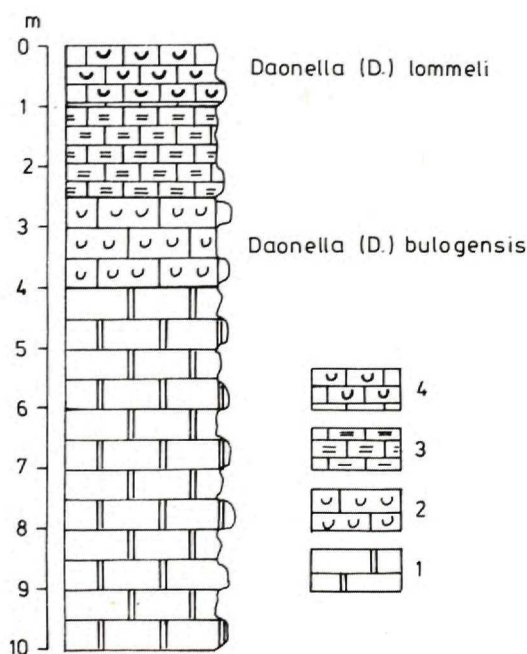


Fig. 4 Furrow D

1 — grayish red Nádaška limestones; 2 — light coloured limestones; 3 — pink compact limestones; 4 — light coloured lumachelle limestones with bivalves.

***Parallelodontidae* DALL, 1898**

Parallelodon MEEK et WORTHEN, 1866

Type species: *Macrodon rugosus* BUCKMANN, 1845. Middle Jurassic — England.

***Parallelodon* sp.**

Material: Incomplete moulds of 7 valves, fragments and impressions from Nádaška limestones.

Remarks: The specimens resemble the species *Parallelodon esinensis* STOPPANI, only their valves are narrowed on the anterior margin, widened in the posterior part, and sinusoid-depressed in the middle part. The surface is concentrically rugose.

Occurrence: Locality A.

***Posidoniidae* FRECH, 1909**

Posidonia BRONN, 1828

Type species: *Posidonia becheri* BRONN, 1828. Lower Carboniferous — Germany.

***Posidonia* sp.**

Pl. XXIII, Fig. 3

Material: 9 incomplete moulds and fragments from lumachelle limestones amidst Steinalm and Nádaška limestones.

Remarks: According to the shape of valves with more or less preserved concentric sculpture the specimens belong to *Posidonia* sp. More exact determination — due to their bad preservation is impossible.

Occurrence: Locality LB-4, LB-5, LB-9

Daonella MOJSISOVICS, 1874

Type species: *Halobia lommeli* WISSMANN, 1841. Middle Triassic (Ladinian) — Austria.

Daonella s. s.

Type species: *Daonella (Daonella) lommeli* (WISSMANN, 1841). Middle Triassic (Ladinian) — Austria.

***Daonella (Daonella) cf. bassanii* DE LORENZO, 1894**

Pl. XXVII, Fig. 4

1894 *Daonella Bassanii* — G. DE LORENZO, p. 43 (non vidi) (fide P. DE CAPOA BONARDI)

1896 *Halobia Bassanii* m. — G. DE LORENZO, p. 25—26, Pl. 19, Fig. 1—6

1970 *Daonella (Daonella) bassanii* DE LOR.—P. DE CAPOA BONARDI, p. 44—46, Pl. 7, Fig. 1—9 (cum syn.).

Material: Incomplete moulds of one left and two right valves, fragments and impressions from lumachelle limestones from the fissure filling in Nádaška limestones.

Dimensions: Right valve: Height = 39 mm, Length = 56 mm; Left valve: Height = 19 mm, Length = 26 mm.

Remarks: Diagonal elongated valves with slightly projecting beak near the anterior margin show sculpture from flat radial ribs, separated by narrow intercostal grooves. Their anterior part is broader, undivided, in the central part some ribs are divided in two, the ribs in the posterior part are fading out. The smaller specimen shows concentric rugosity in the anterior and central parts. The rugosity crosses the radial ribs. The specimens mostly resemble to the quoted figures by De Capoa Bonardi.

Occurrence: Ladinian — South Appennines (Lagonegro). Locality LB-14.

***Daonella (Daonella) bulogensis* KITTL, 1904**

Pl. XXIII, Fig. 5; Pl. XXIV, Fig. 1—4; Pl. XXVI, Fig. 6

1904 *Daonella* n. f. — E. KITTL, p. 733.

1912 *Daonella bulogensis* n. f. — E. KITTL, p. 43—44, Pl. 3, Fig. 5—10.

Material: Moulds of about 40, mostly incomplete specimens from lumachelle limestones amidst Nádaška limestones.

Remarks: Valves of medium size about 37 mm high, are incomplete or covered with rock, so their dimensions cannot be determined exactly. Their characteristic sculpture consists of radial ribs, first wide and convex then divided in three, seldom in two equal secondaries. At hinge margins, especially the posterior one the ribs are thinner or absent, so there is a smooth triangular field. In this feature they differ from specimens ranged to *Daonella (Daonella) tyrolensis* MOJSISOVICS, although their general morphology is similar.

Occurrence: Ladinian — Dinarides and Northern Alps. Localities D and LB-10 (cf.).

***Daonella (Daonella) indica* BITTNER, 1899**

Pl. XXV, Fig. 1, 5

1899 *Daonella indica* nov. spec. — A. BITTNER, p. 39—41, Pl. 7, Fig. 4—11.

1980 *Daonella indica* BITTNER — B. CAFIERO et P. DE CAPOA BONARDI, p. 186—188, Pl. 2, Fig. 1—8 (cum syn.).

Material: About 100 incomplete moulds, fragments and impressions from lumachelle limestones amidst Nádaška limestones.

Dimensions: Right valve: Height = 39 mm, Length = 51 mm; Height =

= 46 mm, Length = 52 mm; Height = 57 mm, Length = ?; Left valve: Height = 53 mm, Length = 57 mm.

Remarks: The valves are semicircular, longer than high. A small beak slightly protruding beyond the straight long hinge line is situated nearer to the anterior margin. The sculpture consists of thin, dense radial ribs, mostly bi — occasionally tripartial. They extend to both hinge margins, only near the anterior one they are broader and undivided. DE CAPOA BONARDI (l.c.), basing upon his own, as well as KITTLE'S (1912) and KUTASSY'S (1930) information about the similarity of the species *Daonella* (*Daonella*) *indica* and *Daonella* (*Daonella*) *tyrolensis* does not exclude the possibility, that they may be synonyms, characterized by considerable variability, particularly as regards sculpture.

The material at our disposal shows that both species occur frequently on the same localities and we can prove their similarity and variability in sculpture. Sometimes it is really difficult to range some specimens to the right species. But some of them show distinct differences in sculpture. For the time being the specimens with sculpture consisting from radial, narrow, dense bipartial ribs are ranged to the species *Daonella* (*D.*) *indica*.

Occurrence: Ladinian — Lower Carnian: Himalaya, South China, Indochina, Japan, New Zealand, Northern Alps, Hungary, Romania, Yugoslavia, Turkey. Locality LB-10, DT, DT-1, DT-1a, DT-3 and LB-5 (cf.).

***Daonella* (*Daonella*) *lommeli* (WISSMANN, 1841)**

Pl. XXI, Fig. 1—6; Pl. XXII, Fig. 3—4

1841 *Halobia Lommeli* WISSMANN — H. L. WISSMANN in G. v. MÜNSTER, p. 22—23, Pl. 16, Fig. 11

1970 *Daonella* (*Daonella*) *lommeli* (WISSM.) — P. DE CAPOA BONARDI, p. 46—49, Pl. 5, Fig. 1—18, text. fig. 3 (cum syn.)

1974 *Daonella lommeli* (WISSMANN) — B. GRUBER, p. 283—285, text. fig. 2a, b.

Material: About 50 incomplete specimens and fragments from lumachelle limestones amidst the Nádaška limestones, and from Steinalm limestones from the fissure filling.

Remarks: Valves are flat, their head-like umbo projects above the straight, long hinge line. At the posterior hinge margin is a sunken triangular area. Characteristic is mainly the sculpture of surface and we base on it the description also of some incomplete specimens, or of their fragments, denoted as *Daonella* (*D.*) cf. *lommeli*. The sculpture consists of radial ribs arranged in bundles consisting of 8—12 ribs separated by narrow and distinct primary grooves. In the umbonal region the ribs are subdivided in two and toward the lower margin in further approximately equal ribs.

Occurrence: Ladinian (Longobardian) — Northern and Southern Alps, South Appennines, Yugoslavia, Greece, Hungary, Romania, Bulgaria, Spain, Balears, Himalaya and Indonesia. There is only one known Anisian species in Turkey (ZANINETTI et DAGÉR, 1978). Locality D, LB-4 (cf.), LB-5 (cf.), LB-9 (cf.), LB-10 (cf.), LB-16 (cf.) and AL (cf.).

***Daonella (Daonella) cf. noduligera* BITTNER, 1895**

Pl. XXIV, Fig. 5

1895 *Daonella noduligera* nov. spec. — A. BITTNER, p. 78—79, Pl. 9, Fig. 24

1912 *Daonella noduligera* BITTN. — E. KITTL, p. 83, Pl. 4, Fig. 9

Material: An incomplete left valve from lumachelle limestones amidst the Nádaška limestones.

Dimensions: Height = 48 mm, Length = ?

Remarks: DE CAPOA BONARDI (1980, p. 188) (with question-mark) ranges the species into synonymy of the species *Daonella (Daonella) pichleri* MOJSISOVICS. As regards the described specimen, it seems that there is some difference, because in the valve dimensions the height dominantes, radial ribs are thicker and show traces of nodes. Thus the described species differs from many specimens of *Daonella (D.) pichleri*, together with which it occurs and resembles more to the above mentioned Bittner's species.

Occurrence: Ladinian — Southern Alps. Locality LB-13.

***Daonella (Daonella) cf. pauli* KITTL, 1912**

Pl. XXIV, Fig. 6

1912 *Daonella Pauli* (MOJSISOVICS mscr.). KITTL n. f. — E. KITTL, p. 82, text.fig. 15, 16

Material: The mould of the right valve, whose umbo, the anterior and the hinge margins are poorly preserved. The material comes from lumachelle limestones amidst the Nádaška limestones.

Dimensions: Height = ? 24 mm, Length = 33 mm.

Remarks: The specimen resembles considerably to *Daonella (D.) pichleri* and occurs at the same locality. It is less elongated, and the ribs are undivided, equal on the whole surface. Since we have only one specimen, we cannot comment DE CAPOA BONARDIS opinion about the species ranged to the synonymy of *Daonella (D.) pichleri*. We range it preliminarily to the species determined by KITTL, because it is most resemblant to it.

Occurrence: Ladinian — Yugoslavia. Locality LB-3.

***Daonella (Daonella) pichleri* MOJSISOVICS, 1874**

Pl. XXII, Fig. 2; Pl. XXIII, Fig. 1, 4, 6—8; Pl. XXVI, Fig. 4

1874 *Daonella Pichleri* GÜMBEL sp. — E. MOJSISOVICS, p. 16, Pl. 2, Fig. 3

1980 *Daonella pichleri* MOJSISOVICS — B. CAFIERO et P. DE CAPOA BONARDI, p. 188—189, Pl. 1, Fig. 1—7 (cum syn.).

Material: About 150 specimens from lumachelle limestones amidst the Nádaška limestones.

Dimensions: Height = 8 mm, Length = 13.5 mm, Height = 13 mm, Length = 25 mm, Height = 33 mm, Length = 49 mm.

Remarks: Asymmetrical valves are elongated. Young specimens have more diagonal, arcuate valves, narrow, anteriorly broadening backwards. Prosogyric umbo is in the anterior third of the long straight hinge margin, so that the posterior part is three times longer than the anterior. Sculpture is variable, especially in thickness and number of radial ribs, covering the whole surface. They are more dense in the anterior part than in the posterior, where they are separated by broader interspaces. The ribs are simple, with one bipartite, intercalated with them at times. Regular concentric wrinkles cause undulating of posterior ribs on younger specimens.

As already mentioned, DE CAPOA BONARDI (l.c.) assumes that *Daonella* (D.) cf. *noduligera* and *Daonella* (D.) cf. *pauli* should be regarded as synonyms to *Daonella* (D.) *pichleri*. Our studied material shows that in their form and details of sculpture the specimens differ from *Daonella* (D.) *pichleri* as well as from each other. We only have one specimen of each species and so we cannot say unambiguously whether the differences are accidental within the species variability or if they are permanent characters to allow determination of various species or at least subspecies.

Occurrence: The Ladinian — Northern and Southern Alps, Bakony Mts., Dinarides, Dobrudja, Bulgaria; the Upper Ladinian — Malaysia; the Ladinian — Lower Carnian — Yugoslavia. According to BECHSTÄDT et MOSTLER (1974) the species might originate from the zones Avisianus and ? Reitzi in the Tirolian Northern Limestone Alps. Localities LB-3, LB-6, LB-8, LB-10, LB-11 (cf.), LB-13, L-5 and DT-3.

***Daonella* (*Daonella*) *tyrolensis* MOJSISOVICS, 1874**

Pl. XXV, Fig. 2—4, 6; Pl. XXVI, Fig. 7

1874 *Daonella tyrolensis* E. v. MOJSISOVICS — E. MOJSISOVICS p. 14—15, Pl. 1, Fig. 8, 10

1912 *Daonella tyrolensis* MOJS. — E. KITTL, p. 45—46, text. fig. 6, 7.

Material: About 30 incomplete specimens, many fragments and impressions in lumachelle limestones amidst the Nádaška limestones.

Remarks: As mentioned above, the described specimens agree in general form with those denoted as *Daonella* (D.) *indica*. They differ in sculpture which consists at *Daonella* (D.) *tyrolensis* of thicker, predominantly tripartite ribs. The subdivision of those ribs is not regular. In some specimens it appears simultaneously or at different height from the umbo.

As far as redefinition of *Daonella* (D.) *indica* and *tyrolensis* on the basis of direct comparison of BITTNER'S and MOJSISOVICS'S originals is not solved, the species are ranged to *Daonella* (D.) *tyrolensis*. Incomplete specimens may only be described according to their structure which seems to be a transition from *indica* to *tyrolensis*, and they are denoted as *Daonella* (D.) ex gr. *tyrolensis*.

Occurrence: Anisian — Ladinian — Southern Alps; the Ladinian — Dobrodgea and South Appennines. Localities DT, DT-1a, LB-5 (ex gr.), LB-8 (cf.), LB-10 (cf., ex gr.), DT-2 (cf.), DT-4 (cf.), L-5 (cf.) and DT-3 (cf.).

Daonella (Daonella) sp.

Pl. XXII, Fig. 1

Material. Many moulds of mostly younger evolutionary stages and fragments from lumachelle limestones amidst the Steinalm and Nádaška limestones.

Remarks: The radial sculpture of the *Daonella* type is the only criterion for the determination of these specimens. Only generic range is determinable. With some doubts also some other specimens are ranged to this genus, even only the form of their valves corresponds to that of the mentioned genus, but the surface sculpture consists only of concentric wrinkles.

Occurrence: Localities LB-1 (?), LB-5, LB-7 (?), LB-5a, LB-11.

Daonella (Daonella) sp. 1

Pl. XXVII, Fig. 2

Material: Many moulds of incomplete single valves, fragments and impressions from lumachelle limestones amidst the Steinalm and Nádaška limestones.

Remarks: The best preserved specimen, 16 mm high, 25 mm long is the right, incomplete, elongated valve with long straight hinge margin. The umbo is slightly excentric, protruding. Its part near the posterior hinge margin is somewhat depressed. The surface is covered with radial ribs divided by a deep secondary and shallow tertiary grooves in the same way as on *Daonella (Daonella) fascicostata* RIEBER, only they are narrower. The umbilical area shows traces of concentric wrinkles. Most valves preserved as moulds, have rather flattened ribs. In their sculpture they differ from *Daonella (D.) sturi* BENECKE to which they resemble in their outline. They do not agree with any of the known species but because of their poor preservation they cannot be described as new species.

Occurrence: Localities LB-4 a L-5.

Veldidenella ALMA, 1926

Type species: *Veldidenella dieneri* ALMA, 1926. Middle Triassic — Austria.

***Veldidenella dieneri* ALMA, 1926**

Pl. XXIII, fig. 2; Pl. XXVI, Fig. 1; Pl. XXVII, Fig. 1, 5

1926 *Veldidenella Dieneri* sp. nov. — FR. H. ALMA, p. 119, Pl. 10, Fig. 7.

Material: Many specimens from juvenile through young to adult, preserved mostly as moulds from lumachelle limestones amidst the Steinalm and Nádaška limestones.

Dimensions: Right valve: Height = 10,5 mm, Length = 16 mm; Height = 6.5 mm, Length = 9 mm; Height = 6.0 mm, Length = 13.5 mm.

Left valve: Height = 8.5 mm, Length = 17.0 mm; Height = 7.0 mm, Length = 15 mm.

Remarks: Elongated valves are narrow in the anterior, broadened in the posterior part and convex in their umbonal region. Posterior hinge line is more than three times longer than the anterior one. The surface is ornamented by concentric waves and fine dense radial ribs. The sculpture in the posterior area is radial, in the rest of surface it is concentric. Young evolutionary stages are similar to those of *Daonella* (*D.*) *pichleri*, so it is difficult to distinguish them.

Occurrence: Upper Anisian — Northern Alps. The authors LEIN and SIBLIK (1978, p. 211) described from Southern Alps the species *Daonella* cf. *dieneri* ALMA from the Upper Longobardian. Since ALMA does not mention *Daonella dieneri*, we assume that it is the species *Veldidenella dieneri* and then its stratigraphic range would be Upper Anisian — Upper Ladinian. Localities LB-2, LB-4, LB-8, LB-11, LB-12 and D.

***Entoliidae* KOROBKOV, 1960**

Camptonectes AGASSIZ in MEEK, 1864

Type species: *Pecten lens* SOWERBY, 1818. Upper Jurassic — England.

Annulinectes ALLASINAZ, 1972

Type species *Pecten annulatus* SOWERBY, 1826. Bath — England.

***Camptonectes* (*Annulinectes*) *delorenzoi* (WILCKENS, 1909)**

Pl. XXVI, Fig. 2, 3

1909 *Pecten De Lorenzoi* nov. spec. — R. WILCKENS, p. 211—213, Pl. 7, Fig. 15a, b

1972 *Camptonectes* (*Annulinectes*) *delorenzoi* (WILCKENS) — A. ALLASINAZ, p. 223

Material: Two left valves and a mould without umbo from lumachelle limestones amidst Steinalm and Nádaška limestones.

Dimensions: Height = 6.25 mm, Length = 5.25 mm.

Remarks: Small valves with outlines of *Entolium* are gently convex, with pointed, slightly excentric umbo. The anterior ear is more distinctly divided from the valve body than the posterior which is the continuation of the valve. The valve surface is covered with narrow, dense, regular concentric ribs. They also pass on the posterior ear. Under magnifying glass they look as fine, dense, vertical growth lines. The valves are narrower in comparison to the species *Camptonectes* (*Annulinectes*) *subconcentricus* (KITTL).

Occurrence: Ladinian — Southern Alps. Localities LB-2, LB-5 (cf.).

***Camptonectes* (*Annulinectes*) *subconcentricus* (KITTL, 1903)**

Pl. XXVI, Fig. 5

1903 *Pecten subconcentricus* KITTL n. f. — E. KITTL, p. 712, text. fig. 40

1972 *Camptonectes* (*Annulinectes*) *subconcentricus* (KITTL) — A. ALLASINAZ, p. 320—321, Pl. 43, Fig. 4 (cum syn.).

Material: A partly damaged core of the left valve from lumachelle limestones amidst the Steinalm limestones.

Dimensions: Height = 13 mm, Length = 16.5 mm.

Remarks: In contrast to *Camptonectes* (A.) *delorenzoi* the length is dominant, so the valve is semicircular and also flatter. The smaller anterior ear is distinctly separated from the valve body. The surface sculpture consists of regular concentric ribs. They are narrow and dense at the anterior margin of the valve, and wider and less dense on the mould.

Occurrence: Anisian — Yugoslavia and Dobrodgea. Locality LB-2.

Remarks on stratigraphy

The stratigraphic position of the lumachelle limestones amidst the Nádaška limestones and their base is difficult to determine on most localities of the studied area near the village Gemerská Hôrka. Lumachelle limestones, which contained the described fauna form both the filling of fissures and normal layers. They occurred as fissure filling on the locality LB-4 in the Steinalm limestones, and on the locality LB-14 in the Nádaška limestones. Continuous profiles and detailed mapping showed that the lumachelle limestones in the Nádaška limestones occur in their basal part, somewhat above the upper boundary of the Steinalm limestones (BYSTRICKÝ 1980).

Fossils of lumachelle limestones comprise bivalvians and conodonts, and scarce, poorly preserved Cephalopoda. On some localities the species form two or three different assemblages, frequently various monoassemblages, as mentioned in the part on "Localities and fauna". We tried to explain this phenomenon by deepened furrows on localities LB-10 and D. The situation was the same as on the surface in both cases. Individual species or assemblages occur in separated layers of lumachelle limestones. It was impossible to reveal mutual relations among all surface species in any of the furrows, because some species were missing; namely *Daonella* (D.) *lommeli* in the furrow LB-10 and *Veldidenella dieneri* in the furrow D (see fig. 3, 4). Most frequent bivalvians in the lumachelle limestones are: *Veldidenella dieneri* ALMA, *Daonella* (*Daonella*) *bassanii* DE LORENZO, *D.* (D.) *bulogensis* KITTL, *D.* (D.) *indica* BITTNER, *D.* (D.) *lommeli* (WISSMANN), *D.* (D.) cf. *noduligera* BITTNER, *D.* (D.) cf. *pauli* KITTL, *D.* (D.) *pichleri* MOJSISOVICS and *D.* (D.) *tyrolensis* MOJSISOVICS. *Veldidenella dieneri* occurs on the locality LB-2 together with Anisian *Physoporella* and in the fissure filling on the locality LB-4 in assemblage with *Daonella* (D.) cf. *lommeli*. So in the West Carpathians it may be regarded not only as Anisian but also as Ladinian like in the Austrian Southern Alps. *Daonelles* represented by the above mentioned species, are generally ranged to the Ladinian, and *Daonella* (D.) *lommeli* is even regarded as index fossil of the Longobardian. But on the localities LB-8, LB-11 and DT-1 in the immediate nearness of daonelles occur also Anisian dasycladaceans and foraminifers (BYSTRICKÝ 1980, JENDREJÁKOVÁ, 1980). Conod-

onts treated by PEVNÝ (oral communication) and ammonites by ANDRUSOVÁ (1980) do not mean any considerable contribution to the solution of the problem. Conodonts — because of their wide stratigraphical range, and from generally poorly preserved ammonites only one fragment was determined as *Protrachyceras* sp. from the Nádaška limestones on the locality A. In accordance with the latest division of the Middle Triassic (KRYSTYN 1983) they may be Ladinian. But no daonelles were found on this locality.

Conclusion

A summary of data on stratigraphic position of the lumachelle limestones in the studied area shows that they are insufficient. It is not clear whether the existing stratigraphic range of the species studied is valid or whether it is wider, or whether the differences are due to insufficient sedimentologic knowledge. So it is inevitable to perform there detailed sedimentologic research.

Since we did not meet any similar situation in available literature, we cannot apply foreign data upon the studied area in the West Carpathians. So far we only can present factologic material and point out to problems with its evaluation.

Translated by E. Jassingerová

Literatúra

- ALLASINAZ, A. 1972: Revisione dei Pettinidi triassici. — Riv. ital. Paleont. Stratigr., 72, 2, Milano, 189—428.
- ALMA, FR. 1926: Eine Fauna des Wettersteinkalkes bei Innsbruck. Ann. Naturhist. Mus., 40, Wien, 111—129.
- ANDRUSOVÁ, V. 1980: Ammonity triasu Západných Karpát a ich biostratigrafický význam. I časť. Záverečná správa. Manuskript-archív SAV, Bratislava.
- BECHSTÄDT, T.—MOSTLER, H. 1974: Mikrofazies und Mikrofauna mitteltriadischer Beckensedimente der Nördlichen Kalkalpen Tirols. Geol.-paläont. Mitt., 4, 5—6, Innsbruck, 1—74.
- BENECKE, E. W. 1868: Ueber einige Muschelkalk-Ablagerungen der Alpen. Geogn. Pal. Beitr., 2, 1, München, 1—67.
- BITTNER, A. 1895: Lamellibranchiaten der alpinen Trias. I Theil. Revision der Lamellibranchiaten von St. Cassian. Jb. K. — Kön. geol. Reichsanst., 41, 1, Wien, 97—116.
- BITTNER, A. 1899: Trias Brachiopoda and Lamellibranchiata. Palaeont. indica, 8, 2, Calcutta, 1—76.
- BYSTRICKÝ, J. 1964: Slovenský kras. Stratigrafia a Dasycladaceae mezozoika Slovenského krasu. Geol. Úst. D. Štúra, Bratislava, 1—204.
- BYSTRICKÝ, J. 1980: Záverečná správa o triase Západných Karpát. (Dasycladaceae). Manuskript-archív SAV, Bratislava.
- BYSTRICKÝ, J. et al. 1973: Triassic of the West Carpathians Mts. Guide to excursion D, Xth. Cong. KBGA. Geol. Úst. D. Štúra, Bratislava, 1—137.
- BYSTRICKÝ, J.—KOCHANOVÁ, M. 1980: Triassic of the Tethys Realm. Working meeting. Guide-book abstracts. Bratislava, 1—30.
- CAFIERO, B. et. DE CAPOA BONARDI, P. 1980: Stratigraphy of the pelagic Triassic in the Budva-Kotor area (Crna Gora, Montenegro Yugoslavia). Boll. Soc. paleont. ital., 19, 2, Modena.
- DE CAPOA BONARDI, P. 1970: Le Daonelle e le Halobie della serie calcareo-siliceo-marnosa della Lucania (Appennino Meridionale). Mem. Soc. Natur. Napoli, Suppl. al Boll., 78, Napoli, 1-127.

- DE LORENZO, G. 1894: Le montagne mesozoiche di Lagonegro. Atti Acc. Sc. fis. e mat., s. 2, 6, 15, Napoli, 1—124.
- DE LORENZO, G. 1896: Fossili del Trias medio di Lagonegro. Palaeontogr. italica, 2, Pisa, 113—148.
- JENDREJÁKOVÁ, O. 1980: Stratigrafia triasu na základe foraminifer. Záverečná správa. Manuskript-archív SAV, Bratislava.
- KITTL, E. 1904: Geologie der Umgebung von Sarajevo. Jb. K. — Kön. geol. Reichsanst., 53, 4, Wien, 515—747.
- KITTL, E. 1912: Materialien zu einer Monographie der Halobiidae und Monotidae der Trias. Res. Wiss. Erf. Balatonsees, 1, Palaeont. Anh., Wien, 1—229.
- KOVÁCS, S. 1979: A Dél-Gömöri Alsóhegy Magyarországi részének földtani felépetése. Ősl. viták (Discus. Pal.), 24, Budapest, 33—58.
- KRYSTYN, L. 1983: Das Epidaurus-Profil (Griechenland) — ein Beitrag zur Conodonten-Standardisierung des tethyalen Ladin und Unterkarn. Schr.-Reihe Erdwiss. Komm., Österr. Akad. Wiss., 5, Wien, 231—258.
- KRYSTYN, L. et GRUBER, B. 1974: Daonella Lommeli (Wissmann) im Hallstätter Kalk der Nördlichen Kalkalpen. (Österreich). Neu. Jb. Geol. Paläont., Abh.; Mh., Jg. 1974, 5, Stuttgart, 279—286.
- KUTASSY, A. 1930: Triadische Fossilien von portugiesischen Timor. Földt. Közl., 60, Budapest, 200—209.
- LEIN, R. et SIBLIK, M. 1978: A brachiopod fauna from the Spielkogel (Muerztaler Alpen, Styria): New data concerning the stratigraphic emplacement of Tetractinella (?) dyactis (Bittner). Mitt. Ges. Geol. Bergbaustud., 25, Wien, 205—221.
- MOJŠISOVICS, E. 1874: Über die triadischen Pelecypoden-Gattungen Daonella und Halobia. Abh. K. — Kön. geol. Reichsanst., 7, 2, Wien, 1—38.
- MOORE, R. C. 1969: Treatise on Invertebrate Paleontology. Part N, 1, Mollusca 6, Bivalvia, Kansas, 1—1952.
- MÜNSTER, G. et WISSMANN, R. 1841: Beiträge zur Geognosie und Petrefactenkunde des südöstlichen Tirols vorzüglich der Schichten von St. Cassian. Bayreuth, 1—152.
- RIEBER, H. 1969: Daonellen aus der Grenzbitumenzone der mittleren Trias des Monte San Giorgio (Kt. Tessin, Schweiz). Eclogae geol. Helv., 62, 2, Basel, 657—683.
- WILCKENS, R. 1909—1910: Paläontologische Untersuchung triadischer Faunen aus der Umgebung von Predazzo in Südtirol. Verh. Naturhist.-Med. Ver. Heidelberg, 10, 2, Heidelberg, 81—221.
- ZANINETTI, L. et DAGÈR, Z. 1978: Biostratigraphie intégrée et paléoécologie du trias de la péninsule de Kocaeli (Turquie). Eclogae geol. Helv., 71, 1, Basel, 85—104.
- ZAPFE, H. 1983: Das Forschungsprojekt "Triassic of the Tethys Realm" (IGCP Proj. 4). Abschlussbericht. Schr.-Reihe Erdwiss. Komm., Österr. Akad. Wiss., 5, Wien, 1—16.

M. Kochanová

Bivalvia stredného triasu z oblasti Gemerskej Hôrky v Slovenskom krase (Západné Karpaty)

Résumé

Príspevok sa zaoberá zatiaľ nevyriešeným problémom stratigrafickej pozície lumachelových vápencov, ktoré sa nachádzajú uprostred nádašských vápencov silického príkrovu na planine Koniar v Slovenskom krase severozápadne od obce Gemerská Hôrka. Našli sa v nich početné lokality lastúrníkov, konodontov a ojedinele i zle zachovaných hlavonožcov. Lumachelové vápence, z ktorých opisovaná fauna pochádza tvoria jednak výplne puklín a jednak normálne polohy. Najčastejšie sa vyskytujúci lastúrníky v týchto vápencoch sú: *Veldidenella dieneri* ALMA, *Daonella* (*Daonella*) *bassanii* DE LORENZO, *D. (D.) bulogenis* KITTL, *D. (D.) indica* BITTNER, *D. (D.) lommeli* (WISSMANN), *D. (D.) cf. noduligera* BITTNER, *D. (D.) cf. pauli* KITTL, *D. (D.) pichleri* MOJŠISOVICS, a *D. (D.) tyrolensis* MOJŠISOVICS. Pokiaľ ide o stratigrafické rozpätie druhu *Veldidenella dieneri*, táto sa vyskytuje v sprievide aniských physoporel,

ale aj v spoločenstve s *D. (D.) lommeli*. Možno preto predpokladať, že podobne ako v Južných Alpách Rakúska, aj v Západných Karpatoch sa vyskytuje nielen v anise ale aj v ladine. *Daonella* zastúpené uvedenými druhmi sú nateraz v celosvetovom meradle považované za formy prevážne ladinské, *D. (D.) lommeli* dokonca za vedúcu fosíliu longobardu. Na niektorých lokalitách tejto oblasti sa však v bezprostrednej blízkosti uvedených *Daonella* vyskytujú ešte dasycladacee a foraminifery anisu. (BYSTRICKÝ 1980, JENDREJÁKOVÁ 1980).

Nie je teda jasné, či stratigrafické rozpätie uvedených druhov je širšie ako platilo dosiaľ, alebo nezrovnalosti vyplývajú z neznalosti sedimentologických pomerov skúmanej oblasti.

Sprievodná fauna konodontov spracovaná orientačne PEVNÝM (ústne zdelenie) a ammonitov (ANDRUSOVÁ, 1980) k riešeniu problému významnejšie neprispievajú. Prvé preto, že zistené druhy majú pomerne široké stratigrafické rozpätie, u druhých mohol byť určený jediný exemplár *Protrachyceras* sp., na základe ktorého by mohlo ísť o ladin. Lenže spolu s ním sa lastúrniky nenašli. Nakolko v dostupnej literatúre sme sa s podobnou aplikovateľnou situáciou nestretli, uvádzame zo Západných Karpát len faktologický materiál a poukazujeme na problémy, ktoré pri jeho vyhodnocovaní vyvstali.

Explanations to Plates XXI—XXVII

Pl. XXI

- Fig. 1 *Daonella (Daonella) lommeli* (WISSMANN). Locality D; $\times 1,5$
 Fig. 2 *Daonella (Daonella) cf. lommeli* (WISSMANN). Locality D; $\times 1$
 Fig. 3 *Daonella (Daonella) cf. lommeli* (WISSMANN). Locality LB-4; $\times 0,8$
 Fig. 4 *Daonella (Daonella) cf. lommeli* (WISSMANN). Locality LB-4; $\times 1$
 Fig. 5 *Daonella (Daonella) cf. lommeli* (WISSMANN). Locality LB-10; $\times 2$
 Fig. 6 *Daonella (Daonella) cf. lommeli* (WISSMANN). Locality D; $\times 1,7$
 Photo: fig. 1, 2, 4, 5, 6 — Fr. Martančík, Fig. 3 — H. Jendeková

Pl. XXII

- Fig. 1 *Daonella (Daonella) sp.* Locality D; $\times 1$
 Fig. 2 *Daonella (Daonella) pichleri* MOJSISOVICS. Locality LB-10; $\times 1,4$
 Fig. 3 *Daonella (Daonella) cf. lommeli* (WISSMANN). Locality LB-10; $\times 2,2$
 Fig. 4 *Daonella (Daonella) cf. lommeli* (WISSMANN). Locality D; $\times 2,2$
 Photo: Fr. Martančík

Pl. XXIII

- Fig. 1 *Daonella (Daonella) pichleri* MOJSISOVICS. Locality LB-8; $\times 1$
 Fig. 2 *Veldidenella dieneri* ALMA. Locality LB-4; $\times 2,6$
 Fig. 3 *Posidonia sp.* Locality 1; $\times 2$
 Fig. 4 *Daonella (Daonella) pichleri* MOJSISOVICS. Locality LB-10; $\times 2,4$
 Fig. 5 *Daonella (Daonella) cf. bulogensis* KITTL. Locality LB-10; $\times 1,5$
 Fig. 6 *Daonella (Daonella) pichleri* MOJSISOVICS. Plaster cast. Locality LB-13; $\times 1,5$
 Fig. 7 *Daonella (Daonella) pichleri* MOJSISOVICS. Locality LB-13; $\times 1,5$
 Fig. 8 *Daonella (Daonella) pichleri* MOJSISOVICS. Locality LB-13; $\times 1,5$
 Photo: Figs 1, 3—8 Fr. Martančík, Fig. 2 — H. Jendeková

Pl. XXIV

- Fig. 1 *Daonella (Daonella) bulogensis* KITTL. Locality D; $\times 0,7$
 Fig. 2 *Daonella (Daonella) bulogensis* KITTL. Locality D; $\times 1,4$

- Fig. 3 *Daonella (Daonella) bulogensis* KITTL. Locality D; $\times 1,1$
 Fig. 4 *Daonella (Daonella) bulogensis* KITTL. Locality D; $\times 1,4$
 Fig. 5 *Daonella (Daonella)* cf. *noduligera* BITTNER. Locality LB-13; $\times 1$
 Fig. 6 *Daonella (Daonella)* cf. *pauli* KITTL. Locality LB-3; $\times 1,6$

Photo: Figs. 1—5 Fr. Martančík, Fig. 6 — H. Jendeková

Pl. XXV

- Fig. 1 *Daonella (Daonella) indica* BITTNER. Locality LB-10; $\times 1,3$
 Fig. 2 *Daonella (Daonella) tyrolensis* MOJSISOVICS. Locality DT; $\times 1,4$
 Fig. 3 *Daonella (Daonella)* cf. *tyrolensis* MOJSISOVICS. Locality DT; $\times 1$
 Fig. 4 *Daonella (Daonella) tyrolensis* MOJSISOVICS. Locality LB-10; $\times 1$
 Fig. 5 *Daonella (Daonella) indica* BITTNER. Locality DT; $\times 1,1$
 Fig. 6 *Daonella (Daonella)* ex gr. *tyrolensis* MOJSISOVICS. Locality DT-3; $\times 1,3$

Photo: Figs. 1, 4, 6 — Fr. Martančík, Fig. 2, 3, 5 — H. Jendeková

Pl. XXVI

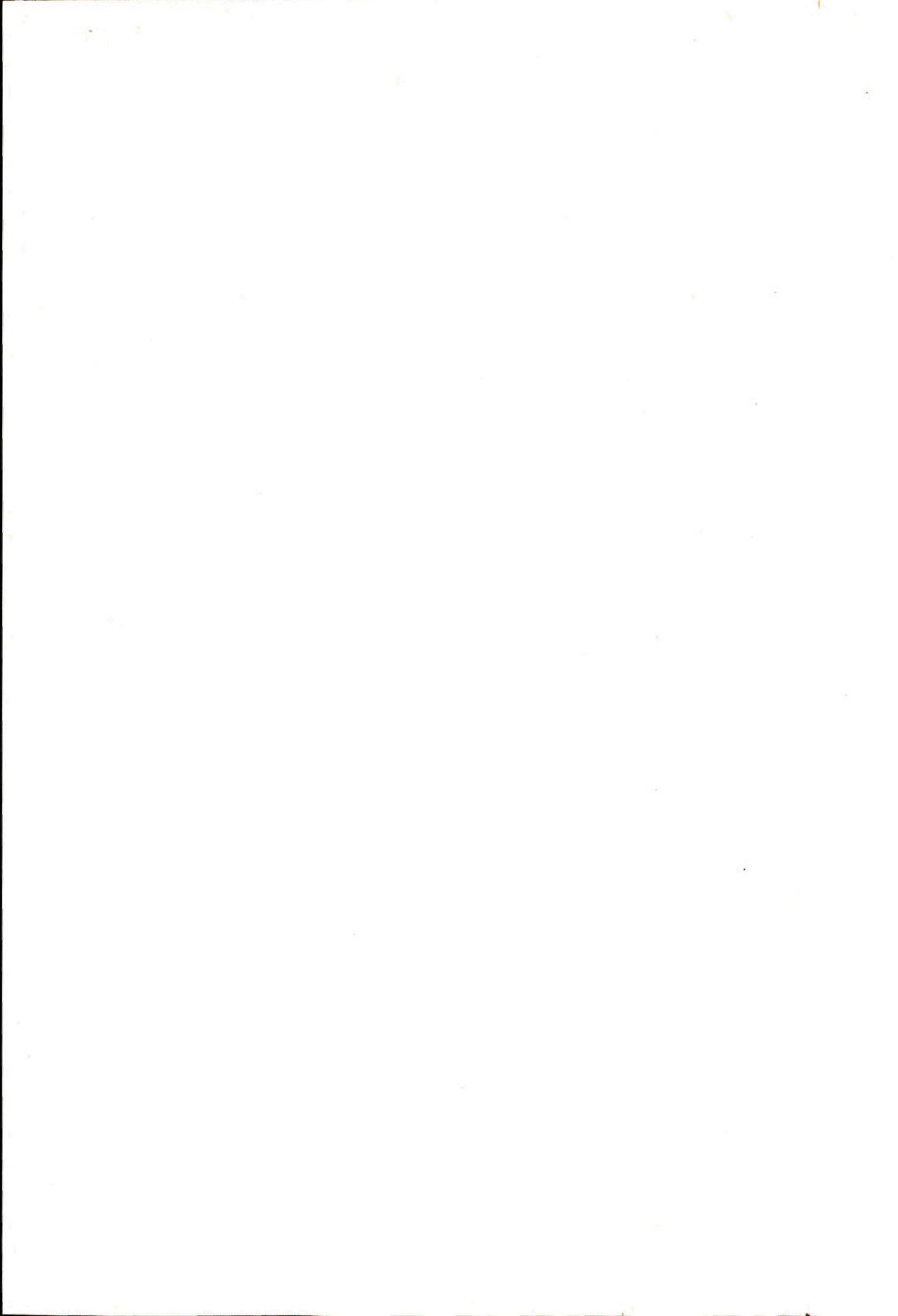
- Fig. 1 *Veldidenella dieneri* ALMA. Locality LB-11; $\times 1,6$
 Fig. 2 *Camptonectes (Annulinectes) delorenzoi* (WILCKENS). Locality LB-2; $\times 3$
 Fig. 3 *Camptonectes (Annulinectes)* cf. *delorenzoi* (WILCKENS). Locality LB-10; $\times 4$
 Fig. 4 *Daonella (Daonella) pichleri* MOJSISOVICS. Locality LB-10; $\times 1,4$
 Fig. 5 *Camptonectes (Annulinectes) subconcentricus* KITTL. Locality LB-2, $\times 3$
 Fig. 6 *Daonella (Daonella)* cf. *bulogensis* KITTL. Locality LB-10; $\times 2$
 Fig. 7 *Daonella (Daonella)* cf. *tyrolensis* MOJSISOVICS. Locality LB-10, $\times 1,1$

Photo: Fr. Martančík

Pl. XXVII

- Fig. 1 *Veldidenella dieneri* ALMA. Locality LB-11; $\times 2,8$
 Fig. 2 *Daonella (Daonella)* sp. 1. Locality LB-4; $\times 1,2$
 Fig. 3 *Protrachyceras* sp. To the right the mould, to the left its cast Locality A $\times 1$
 Fig. 4 *Daonella (Daonella)* cf. *bassanii* DE LORENZO. Locality LB-14; $\times 1,5$
 Fig. 5 *Veldidenella dieneri* ALMA. Locality LB-2; $\times 2,2$

Photo: Figs. 1, 3, 4 — Fr. Martančík, Figs. 2, 5 — H. Jendeková



Helena Eliášová

Muranella and Fusanella, algae incertae sedis with spherulitic skeletal microstructure

(Tithonian of the Outer Flysch Carpathians, Czechoslovakia)

7 Pls. (XXVIII—XXXIV), Czech summary

Abstract. Two taxa of calcareous algae incertae sedis, *Muranella parvissima* (DRAGASTAN, 1966) and *Fusanella bona* gen. nov. sp. n. from the Štramberk Limestone are the subject of this paper. The manner of crystallization of the skeleton of these algae is discussed and their spherulitic microstructure is compared with the internal structure of the *Scleractinia trabeculae*. Diagenetic changes of the thalli in the algae are also considered.

Introduction

Full calcite bodies without wall are fairly common in Mesozoic sediments of the Tethys. They occur either isolated or in aggregates and exhibit an identical internal microstructure: spheroids composed of radial fibrous crystals which display under polarized light an axial cross.

Two closely related taxa from this group discussed in this paper, are present in Jurassic limestones of the Outer Flysch Carpathians: *Muranella parvissima* (DRAGASTAN, 1966) which has been described under the generic name *Enigma* in H. ELIÁŠOVÁ 1981 and *Fusanella bona* gen. nov. sp. n. which has so far not been known. These aggregates are assigned to algae because their shape excludes another systematic classification.

Problem

Similar spheroids with a variously modified spherulitic structure are present in the skeleton of the representatives of several groups of organisms: isolated fossil bodies were, e.g., described as "*Stomiosphaera*" (M. DURAND DELGA 1957, W. NOWAK 1968) or as ascidian spicules, i.e. representatives of *Chordata* (e.g., F. BONET, N. BENVENISTE-VELASQUEZ 1971; M. MIŠÍK, K. BORZA 1978). Fragments of aggregates were interpreted as fragments of *Sclerosporgia* (M. MIŠÍK, K. BORZA 1978) or as

algae (R. RADOIČIĆ 1969; O. DRAGASTAN 1971; D. ANDRUSOV, A. SCHALEKOVA 1972; H. ELIAŠOVA 1981). Moreover, skeletal tissue containing spherulitic elements also occurs in *Hydrozoa* and *Scleractinia*.

The principal morphologic features of the spheroids are in common to all the groups cited and therefore the systematic classification of the remnants of the fossil organisms with a spherulitic internal microstructure is a matter of some difficulty.

On the basis of the study of the internal microstructure in the spheroids of the algae described and its comparison with the structure of the trabeculae of recent *Scleractinia*, several principles are presented in this paper which elucidate the cause of the mutual resemblance of spherulitic aggregates in various groups of organisms as it ensues from the general principles of biocrystallization and crystallogeny. Moreover, possible diagenetic changes which might affect their appearance, are also mentioned.

Model of biocrystallization, analogy with *Scleractinia*, diagenesis

The model of biocrystallization of spherulitic aggregates, to which also the studied aggregates from the Mesozoic sediments belong, was worked out on the exoskeleton of recent *Scleractinia* (W. H. BRYAN et D. HILL 1941; T. GOREAU 1961; J. E. SORAUF 1972, and others). The research results of these authors indicate that the basic structural unit of the skeleton of recent corals is a bundle of aragonite crystals. The aragonite crystals in the form of elongated needles are oriented in such a manner that the c-axis of the crystal coincides with the long axis of the needle. The radiating cluster of crystals is due to the tendency of the aragonite needles to deviate from the ideal growth direction, which is normal to the tangent to the surface of the body so as to fill the free space. The neighbouring clusters mutually hinder the free growth of the crystals. D. J. BARNES 1970 explained this phenomenon as a result of the competitive growth of interfering three dimensional fans of crystals (= cluster = spherulite). He drew attention to the general validity of this mode of crystal growth also in other groups of organisms. The individual spherulites associate in various ways, either into spheroids, or they are variously modified and produce, for instance, trabeculae of the corals *Scleractinia* or skeletal elements of other groups of organisms. The microstructure of the spherulites and their configuration is controlled by the genetic code of organisms.

The mode of accretion, i.e. in phases, of the fibrous aragonite crystals (origin of lamellae) and the mutual relation of the fibrous and lamellar structures on the base of the bonding energy of crystals (aragonite crystals are more coherent along the c-axis than along the a, b axes which leads to the formation of lamellae) are demonstrated, for example, by E. MONTANARO GALLITELLI on corals of the order *Hexanthiniaria* (in E. MONTANARO GALLITELLI 1973). Similar accretionary layers of fibrous aragonite crystals which are concentric in the spheroids may, for instance be observed in spicules of recent ascidians [*Cystodytes dellechiaiei* (Della Valle) in F. BONET, N. BENVENISTE-VELASQUEZ 1971, Pl. IX/4, 5].

The analogy between the aggregates studied and the trabeculae of the *Scleractinia* is also apparent in the presence of minute crystals and their random arrangement in the central part of the spheroids (in the trabeculae, the space between these minute crystals was filled with organic substance—centre of calcification). In both instances, in the trabeculae as well as in the spheroids studied, the light refracted and reflected at numerous boundaries and planes of these small crystals causes dispersion of light—the light passing through these parts of the specimen makes them appear dark (Pl. XXVIII, Fig. 1; Pl. XXX, Fig. 1 lower part).

Diagenetic changes must always be taken into account in fossil material. Exceptionally, enlarged crystals of aragonite which formed the original skeleton are only observable. These crystals represent the substitute for a whole bundle of the original aragonite needles, for instance in the fibrolamellar structure of corals from the Triassic (E. MONTANARO GALLITELLI 1973) or in *Scleractinia trabeculae* from the Jurassic (E. RONIEWICZ 1982) and from the Upper Cretaceous of Gosau (M. BEAUVAIS 1982). Generally, however, pseudomorphs of low-magnesium calcite which replaced the aragonite, or high-magnesium calcite are found in the skeletal structure of the fossils. As in the aragonite skeletons, diagenetic enlargement of the grain takes place also in the skeletons both from low- and high-magnesium calcite (aggrading neomorphism according to R. G. BATHURST 1975).

In the material studied, low-magnesium calcite which forms pseudomorphs after aragonite has been identified in the crystals of the spheroids.

During aggrading neomorphism, gradual suppression of the lamellae (of the increment lines) takes place and the fibrous component in the microstructure ("fibration process" in E. MONTANARO GALLITELLI 1973, pp. 14, 20, description of recrystallization of spherulitic structures during diagenesis of the trabeculae of *Scleractinia* in B. F. SPIRO 1971) is more accentuated.

Nor is the process of diagenesis in the coral trabeculae incidental. N. P. JAMES 1974 determined that the already mentioned minute crystals with empty interspace in the centre of the trabeculae are the first affected by leaching (a relatively large surface of the crystals and space for movement of fluids). In the spheroids studied, the middle portions are also often dissolved and replaced by sparite (Pl. XXVIII, Fig. 2 right), or the cavities produced by leaching are filled with the surrounding sediment (Pl. XXVIII, Fig. 2 the middle body; Pl. XXIX, Fig. 1). In the initial phase of neomorphism (weaker diagenesis), the fineness of the crystals is preserved in a certain degree, and the centre of the spheroids remains darker (Pl. XXX, Fig. 1 lower part). During stronger diagenetic changes, even complete sparitization of the skeleton takes place (Pl. XXX, Fig. 2).

There is no difference between a biocrystal and an anorganic crystal from the structural and crystallographic aspects. After the death of the organism, more or less complete syntaxial increments take place on the biocrystal. The correspondence in appearance (behaviour, crystallization) in both crystal types is so conspicuous in some cases that spheroids analogous to the aggregates studied may develop partly also by a diagenetic process, for instance by perfect syntaxial increments of carbonate crystals on the inner wall of the foraminiferal chamber (drusy fibrous calcite in A. S. HOROWITZ—P. E. POTTER 1971). During this process, the wall of the

foraminiferal or other shell disappears more or less. The increment in the crystals occurs here centripetally and thus in opposite direction than, for instance, in the trabeculae, in which this process is centrifugal. The crystals whose grain size diminishes towards the spheroid centre, where the fineness is controlled by the reduced space available for the growth of the crystals, give in transmitted light the same darker picture (*Lenticulina* sp., Pl. XXIX, Fig. 2a, b).

Systematics

As indicated by the preceding discussion, the isolated spheroids provide morphologically inadequate diagnostic features for a precise systematic classification. Presumably, they represent disintegrated parts of higher organisms. Even if smaller fragments of the aggregates are available, the taxonomic assignment is mostly difficult. Apart from the spherulitic microstructure, additional other features are essential for the understanding of the character of the skeleton in question, as e.g., in the *Sclerospongia* fragment, longitudinal sections of spicules or pores in the skeleton, etc., which distinguish the tissue of sponges from algae or from the skeleton of other groups of organisms.

The algae with the spherulitic microstructure described differ from spheroid aggregates of other groups of organisms in the following:

- a. Shape of thalli
- b. The thalli are built only of spheroids (no additional other structural elements are present)
- c. The spheroids in the thallus are not differentiated
- d. The spheroids of individual genera have a typical microstructure and shape
- e. The segmentation of the bodies (corresponding to clusters ?) is specific for single genera. It is probably controlled genetically.

The characteristics described above indicate a higher taxonomic category.

In view of the problematic spherulitic structure, the systematic questions can so far not be resolved, for example, by studying the isomorphic admixtures in the crystallographic aragonite lattice. It seems that the Sr ratio is close in recent organisms even in such distinctive groups as are corals and ascidians (0.7—0.9% Sr in corals, 0.82% Sr in the *Ascidia* according to J. MILLIMAN 1974). Moreover, the Sr proportion in fossil material may be affected by diagenesis.

The representation of the C and O isotopes in the skeletons of the individual groups of organisms in the Jurassic of the Outer Flysch Carpathians is the subject of a separate research (J. HLADÍKOVÁ et al. in press).

Systematic part

Algae incertae sedis

Muranella BORZA, 1975

Type species: *Muranella sphaerica* BORZA, 1975

1981 *Enigma* gen. nov. — H. ELIAŠOVÁ: Some binding microorganisms etc., p. 30

Diagnosis of the genus is given in K. Borza 1975, p. 228

Muranella parvissima (DRAGASTAN, 1966)

Pl. XXVIII, Fig. 1, 2; Pl. XXIX, Fig. 1a, 1b; Pl. XXX, Fig. 1; Pl. XXXIII, Fig. 1, 2; Pl. XXXIV, Fig. 1

1959 problematicum — M. MARKOVÁ: Sur le gisement de galets etc., p. 275, pl. XIII/2, 3

1966 *Clypeina parvissima* n. sp. — O. DRAGASTAN: Microfaciesurile Jurasicului etc., p. 44, pl. I/2—7

1972 *Alga incertae sedis* — D. ANDRUSOV—A. SCHALEKOVÁ: Corps arrondis phytogènes etc., p. 345, figs. 14, 15

1978 *Bellidispongia* sp. — M. MIŠÍK—K. BORZA: Gemeridella, Didemnoidea etc., p. 324, pl. V/5

1981 *Enigma parvissima* (DRAGASTAN) — H. ELIAŠOVÁ: Some binding microorganisms etc., p. 31, pl. III/1a, b; pl. IV/1 (cum synonym.)

Dimensions: those of the fragments of the colonies: $n \cdot 10^{-1}$ — $n \cdot 10^1$ mm diameter of the spheroids (in a single crust): 0.060—0.152 mm

Supplements to the original description: The general habit of the thalli — the irregularly recurring crusts or the carpet-like shape attest to the binding properties of this alga (Pl. XXVIII, Fig. 1). The dimensions of the spheroids are considerably variable even within the same crust. The radial fibrous crystals in the spheroids are very fine, arranged into spherulites (Pl. XXXIII, Fig. 1, 2; Pl. XXXIV, Fig. 1). In the axial part of the spherulites the crystals are appreciably longer and therefore they produce tips and corners on the surface of the spheroids which are characteristic of the species. In cross section, the spheroids have the form of a wheel with pointed tips (Pl. XXVIII, Fig. 2).

Preservation: The syntaxial increments in the spheroids which are dispersed in the sediment, increase the $\varnothing$ of the spheroids to as much as 0.330 mm (syntaxial rim thickness 0.060 to 0.12 mm). The syntaxial increment is mostly lighter, brighter (less contaminated by calcite) and its attachment to the crystals of the skeleton is commonly imperfect (Pl. XXX, Fig. 1).

Relations: The new species differs from the type species *M. sphaerica* in the greater diameter of the spheroids and the somewhat coarser acicular crystals. The isolated spheroids of the species *M. parvissima* cannot be distinguished from the bodies described as *Stomiosphaera moreti* DURAND DELGA, e.g., in W. NOWAK 1968, pl. XXVI/3, 4, or *Didemnoidea moreti* (DURAND DELGA), *Ascidia*, e.g., in M. MIŠÍK, K. BORZA 1978, Pl. II/1—19, Pl. III/1—9.

Occurrence: Upper Jurassic of Czechoslovakia, Upper Jurassic to Lower Cretaceous of Yugoslavia and Rumania, Miocene of Bulgaria.

***Fusanella* gen. nov.**

Type species: *Fusanella bona* sp. n.

Derivatio nominis: In honour of Dr. OTO FUSAN.

Diagnosis: Massive globular colonies composed of tightly packed, on the surface smooth, undifferentiated spheroids with a spherulitic inner structure. Massive axial cross under crossed nicols.

Relations: The new genus differs from the closely related genus *Muranella* in the shape of the thallus and smooth surface of the spheroids.

Just as in the genus *Muranella* the systematic classification of this new genus is also problematic. The genera described have no analogy in the Recent. R. RADOIČIĆ 1969 suggested the possibility of assigning the latter genus to green algae. This assignment seems probable for both taxa in view of the acicular shapes of the crystals in the spheroids which are in particular characteristic of aragonite (the skeletons of all recent marine green algae are composed of aragonite).

Composition of the genus: Only a single species, *Fusanella bona* sp. n. is so far known.

Stratigraphic range: As in the type species.

***Fusanella bona* sp. n.**

Pl. XXX, Fig. 2; Pl. XXXI, Fig. 1a, 1b; Pl. XXXII, Fig. 1, 2

Holotype: Specimen on thin section No. 23914/II ÚÚG, figured on Pl. XXX, Fig. 2; Pl. XXXI, Fig. 1a, 1b, deposited in the ÚÚG Collections, Praha.

Locus typicus: Skalička near Kelč, Moravia.

Stratum typicum: Štramberg Limestone, Tithonian

Material: 1 thin section with cross sections of 6 colonies

Derivatio nominis: Bonus = good in Latin

Diagnosis: The species is characterized by a globular shape of the colony and dimensions of the spheroids which range from 0.003 to 0.054 mm.

Dimensions: $\varnothing$ of the colonies: 1.0—1.5 mm; $\varnothing$ of the spheroids: 0.003—0.054 mm; longer dimensions of the elongated spheroids = 0.066—0.10 mm.

Description: Massive globular colonies of closely packed spheroids. The spheroids have a smooth surface, the internal structure is spherulitic (Pl. XXXII, Fig. 2). Under polarized light the spheroids exhibit a distinct axial cross (Pl. XXXI, Fig. 1b). The colonies exhibit weak coherence, the spheroids tend to become loosened from the colony. Some marginal spheroids are elongated by as much as half the

diameter (primarily?, secondarily?; Pl. XXXII, Fig. 1) in the direction normal to the colony surface.

Preservation: The colonies are leached out in the middle portions and filled with sparite or a micritic sediment. The individual spheroids are best preserved in the surficial layer of the colony, where they were partly protected from the diagenetic processes by the surrounding micrite. They are however distinguishable as ghosts in the recrystallized substance as far as the secondary infilling of the colony (Pl. XXXI, Fig. 1a).

Relations: The new species is closely related to the species *Muranella parvissima*. The dimensions of the spheroids in both species overlap partially. There are, however, generic differences in the shape of the colonies and structure of the spheroids: in *M. parvissima* the irregular crusts, spheroids with acicular ornamentation (in cross section having the shape of a wheel with pointed tips); in *F. bona*, the colonies are globular and the spheroids smooth. Isolated spheroids of the species *F. bona* strongly resemble in shape, structure and size the bodies described from the Upper Tithonian to Lower Hauterivian of Mexico as spicules of the *Ascidians* (*Cystodytes similis* B., BENV.-VELASQ. in F. BONET, N. BENVENISTE-VELASQUEZ 1971, p. 14, pl. VIII/1—4).

Ecology and stratigraphic range: According to the more or less circular sections in all six colonies, a globular shape and planktonic mode of life in the vicinity of a reef (they occur in association with hermatypic corals) are presumed. The accompanying *Tintinnines* indicate both the facies- front side of the reef — and the Upper Tithonian age of the sediment (*Calpionella alpina* LORENZ, 1902, *Cras-sicolaria* cf. *brevis* REMANE, 1962).

Occurrence: Upper Tithonian of Czechoslovakia.

Translated by E. Česánková

References

- ANDRUSOV, D.—SCHALEKOVÁ, A. 1972: Corps arrondis phytogènes du Miocène de la région Ponto-Caspéenne. Geol. Zborn. Slov. Akad. Vied, 23, 2, Bratislava, 331—351.
- BARNES, D. J. 1970: Coral skeletons: an explanation of their growth and structure. Science, 170, Washington, D. C., 1305—1308.
- BATHURST, R. G. 1975: Carbonate sediments and their diagenesis. Elsevier, Amsterdam, Oxford, New York, 1—658.
- BEAUVAIS, M. 1982: Révision systématique des Madréporaires des couches de Gosau (Crétacé supérieur, Autriche). Travaux du Laboratoire de Paléontologie des Invertébrés, Université Pierre et Marie Curie, Paris, 1—262.
- BONET, F.—BENVENISTE-VELASQUEZ, N. 1971: Repículas de ascidias fósiles y actuales. Rev. Inst. Mexic. Petrol., 3, 4, Mexico, 8—33.
- BORZA, K. 1975: Mikroproblematika aus der oberen Trias der Westkarpaten. Geol. Zbor. Geologica carpath., 26, 2, Bratislava, 199—236.
- BRYAN, W. H.—HILL, D. 1941: Spherulitic crystallization as a mechanism of skeletal growth in Hexacorals. Proc. Roy. Soc. Queensland, 52, Brisbane, 78—91.
- DRAGASTAN, O. 1966: Microfaciesurile Jurasicului superior și Cretacicului inferior din Munții Apuseni. An. Univ. Buc., Ser. Stiint. natur., Geol. Geogr., 15, 2, Bucuresti, 37—47.

- DRAGASTAN, C. 1971: New algae in the Upper Jurassic and Lower Cretaceous in the Bicaz valley East Carpathians (Romania). Rev. esp. Micropaleont., 3, 2, Madrid, 155—192.
- DURAND DELGA, M. 1957: Quelques remarques sur les fibrosphères. Publ. Serv. Carte géol. de l'Algérie. Nouv. Sér., Bull. 13, Trav. Collab. (1956), Alger, 153—164.
- ELIAŠOVÁ, H. 1981: Some binding microorganisms of the Štramberg reef limestones (Tithonian, Czechoslovakia). Věst. Ústř. Úst. geol., 56, 1, Praha, 27—32.
- GOREAU, T. 1961: Wachstum und Kalkanlagerung bei Riffkorallen. Endeavour, 20, 77, London, 32—39.
- HLADÍKOVÁ, J.—ELIAŠOVÁ, H.—ELIAŠ, M.: Isotopic characteristic of the Tithonian reef Štramberg Limestone. Leipzig. In press.
- HOROWITZ, A. S.—POTTER, P. E. 1971: Introductory petrography of fossils. Springer. Berlin, Heidelberg, New York, 1—302.
- JAMES, N. P. 1974: Diagenesis of scleractinian corals in the subaerial vadose environment. J. Palaeont. 48, 4, Menasha, 785—799.
- MARKOVÁ, M. 1959: Sur le gisement de galets de roches jurassiques dans les conglomérats tertiaires près du bord SW du Karst slovaque. Geol. Práce, Zošit 55, Geol. Úst. D. Štúra, Bratislava, 267—278.
- MILLIMAN, J. D. 1974: Marine carbonates. (Recent sedimentary carbonates, Part 1), Springer, Berlin, Heidelberg, New York, 1—375.
- MIŠÍK, M.—BORZA, K. 1978: Gemeridella, Didemnoidea, Didemnum und Körperchen ähnlichen Gestalt aus dem Mesozoikum der Westkarpaten. Geol. Zbor. Geologica carpath., 29, 2, Bratislava, 307—326.
- MONTANARO GALLITELLI, E. 1973: Microstructure and septal arrangement in a primitive Triassic corals. Boll. Soc. paleont. ital., 12, 1, Modena, 8—22.
- NOWAK, W. 1968: Stomiosferidy warstw cieszyńskich (kimeryd- hoteryw) polskiego Śląska cieszyńskiego i ich znaczenie stratygraficzne. Roczn. Pol. Tow. Geol., 38, 2—3, Kraków, 275—314.
- RADOIČIĆ, R. 1969: A new lower Cretaceous Dasycladacea, Clypeina pejovici and note on some Clypeinae. Geologica romana, 8, Roma, 71—84.
- RONIEWICZ, E. 1982: Pennular and non-pennular Jurassic scleractinians- some examples. Acta Palaeont. pol., 27, 1—4, Warszawa, 157—193.
- SORAUF, J. E. 1972: Skeletal microstructure and microarchitecture in Scleractinia (Coelenterata). Palaeontology, 15, 1, London, 88—107.
- SPIRO, B. F. 1971: Diagenesis of some scleractinian corals from the Gulf of Elat, Israel. Bull. Geol. Soc., Den. 21, 1, Copenhagen, 1—30.

Helena Eliášová

Muranella a Fusanella, algae incertae sedis se sferulitickou vnitřní strukturou

Resumé

V předkládané práci jsou studovány dva taxony vápnitých řas incertae sedis: *Muranella parvissima* (Dragastan, 1966) a *Fusanella bona* gen. nov. sp. n. Materiál pochází ze štramberských vápenců (tithon vnějších flyšových Karpat).

Sferulitická mikrostruktura tělísek, která skládají stélky těchto řas je analogická s mikrostrukturou trabekul scleractinních korálů. Tato podobnost se projevuje: a) ve sferulitickém uspořádání acikulárních krystalů (model biokrystalisace u *Scleractinia* a sferulitická krystalisace viz W. H. BRYAN—D. HILL 1941, T. GOREAU 1961, D. J. BARNES 1970, J. E. SORAUF 1972 a j.), b) v přítomnosti drobnějších všesměrně uspořádaných krystalů v centru jednotlivých tělísek (sferoidů) studovaných řas podobně jako u trabekul, c) v preferenčním rozpouštění těchto drobnějších krystalů při diagenesi.

Agregáty řas se sferulitickou vnitřní strukturou se liší od sferulitických mikrostruktur skeletu jiných skupin organismů (např. *Sclerospongia*, *Hydrozoa*, *Ascidia*) tvarem agregátů sferoidálních tělísek, t.j. stélek. Sferoidy jsou v nich jedinými stavebními elementy. Sferoidy ve stélce nejsou diferencované. U jednotlivých rodů řas mají sferoidy typickou mikroarchitekturu, tvar a segmentaci. Tyto znaky pravděpodobně spojují popisované řasy do společného taxonu vyššího řádu.

V systematické části je popsán nový rod a druh *Fusanella bona*. K druhu *Muranella parvissima* (DRAGASTAN, 1966) jsou uvedeny doplňky.

Diagnosa nového rodu: *Fusanella* gen. nov. vytváří masivní kulovité kolonie složené z těsně nahloučených, na povrchu hladkých nediferencovaných sferoidů se sferulitickou vnitřní strukturou. Ve zkřížených nikolech se objevuje masivní osní kříž.

Explanations of plates XXVIII—XXXIV

Pl. XXVIII

Fig. 1 *Muranella parvissima* (DRAGASTAN, 1966). Thin section. Part of a thallus binding the sediment. Isolated spheroids loosened from the crust are dispersed in surrounding micrite. Jasenice near Valašské Meziříčí, Štramberské Limestone, Tithonian. $\times 17.25$.

Fig. 2 *Muranella parvissima* (DRAGASTAN, 1966). Thin section. Aggregate of spheroids in micrite. Acicular crystals in spherulites (clusters) of the spheroids are recrystallized and in varying degree affected by dissolution (outer margin; cavity filled with micrite). Štramberské, Štramberské Limestone, Tithonian. $\times 97.5$.

Pl. XXIX

Fig. 1a *Muranella parvissima* (DRAGASTAN, 1966). Thin section. Radial fibrous microstructure of spheroids. Roštín near Kroměříž. Pebbles of Jurassic limestones in Palaeogene conglomerate of the Magura flysch. $\times 352.5$.

Fig. 1b The same thin section as in fig. 1a. Crossed nicols. Massive axial cross is apparent. $\times 352.5$.

Fig. 2a *Lenticulina* sp. Thin section. Chamber of a foraminifer infilled with secondary fibrous calcite. Štramberské, Štramberské Limestone, Tithonian. $\times 195$.

Fig. 2b The same thin section as in fig. 2a in crossed nicols. Massive axial cross also observable. $\times 195$.

Pl. XXX

Fig. 1 *Muranella parvissima* (DRAGASTAN, 1966). Thin section. Aggregate of spheroids with syntaxial increments. Štramberské, Štramberské Limestone, Tithonian. $\times 135$.

Fig. 2 *Fusanella bona* gen. nov. sp. n. Thin section. Group of colonies (thalli) in sediment. (Holotype above the middle part of the picture, see Pl. XXXI/1). Skalička near Kelč, Štramberské Limestone, Tithonian. $\times 33.75$.

Pl. XXXI

Fig. 1a *Fusanella bona* gen. nov. sp. n. Thin section No. 23914/II ÚÚG. Holotype. (Magnified thallus from Pl. XXX, Fig. 2 in the upper part of the picture in the middle.) Skalička near Kelč, Štramberské Limestone, Tithonian. $\times 81$.

Fig. 1b The same thin section as in Fig. 1a in crossed nicols (axial cross). $\times 81$.

Pl. XXXII

Fig. 1 *Fusanella bona* gen. nov. sp. n. Thin section. Elongated spheroids at the margin of a colony. (Detail of the colony figured on Pl. XXX, Fig. 2 upper part right side). Skalička near Kelč, Štramberg Limestone, Tithonian. $\times 135$.

Fig. 2 *Fusanella bona* gen. nov. sp. n. Thin section. Spheroids and their "ghosts" in recrystallized substance of the colony. Details of spherulitic microstructure in spheroids. Skalička near Kelč, Štramberg Limestone, Tithonian. $\times 195$.

Pl. XXXIII

Fig. 1 *Muranella parvissima* (DRAGASTAN, 1966). Scan. A single spheroid with apparent spherulitic microstructure. Jasenice, Štramberg Limestone, Tithonian. $\times 400$.

Fig. 2 *Muranella parvissima* (DRAGASTAN, 1966). Scan. Detail of spherulitic microstructure (calcite crystals of spherulite enlarged by aggrading neomorphism, cleavage apparent). Jasenice, Štramberg Limestone, Tithonian. $\times 600$.

Pl. XXXIV

Fig. 1 *Muranella parvissima* (DRAGASTAN, 1966). Scan. Magnified spheroid from Pl. XXXIII, Fig. 1 $\times 1200$.

(All photographs: K. Navrátilová)

Liassic Foraminifers from Červený Kameň Klippe near Podbiel

Adriana Zlinská

3 text-figs, 8 Pls. (XXXV—XLII) Slovak summary

The locality Červený Kameň (Fig. 1) in the Podbiel facies was studied three Liassic horizons to find the technique of extracting free microfossils from solid sediments. We obtained mainly foraminifers, studied from the paleontologic and biostratigraphic views.

In Slovakia more attention was paid to Jurassic foraminifers. Some authors treated the problem but it was not accomplished: V. SCHEIBNEROVÁ (1959, 1962, 1965, 1968), A. BEGÁN—V. KANTOROVÁ (1961), E. HANZLÍKOVÁ (1964), A. BEGÁN—V. GAŠPARIKOVÁ (1979). The authors described foraminifers from marly rocks. Thin sections of Jurassic foraminifers were studied by M. MIŠÍK (1961) and K. BORZA (1969).

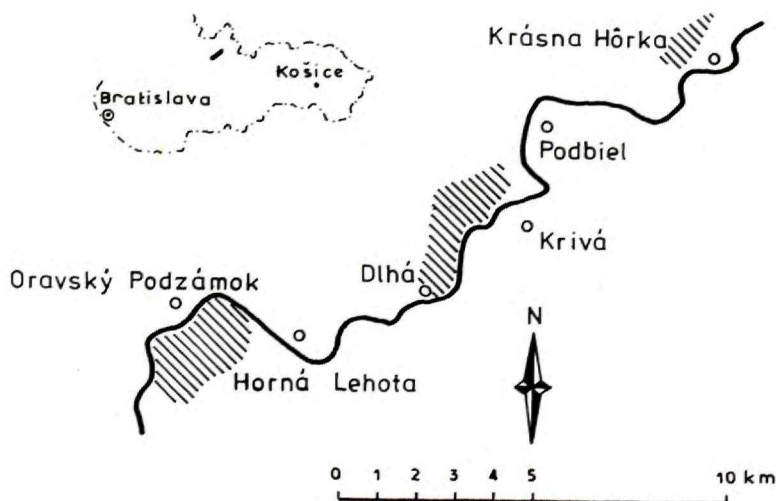


Fig. 1 Situation map of locality

Methods applied

Separation of microelements from limestones was performed by several methods.

Positive results were obtained by freezing, by hydrogen peroxide, HCl-acid, acetic acid.

Moulds of calcareous foraminifers, agglutinated foraminifers, holothurian sclerites, sponge spicules, fish teeth, spines of echinoderms, small gastropods a.o. were separated by applying the 5 % and 10 % concentrations of acetic acid.

At the application of 5 % concentration of HCl-acid the residuum contained mostly agglutinated foraminifers, and lagenid forms of calcareous foraminifers.

At the application of hydrogen peroxide upon limestones most frequent were elements from calcium hypophosphate — fish teeth and nodosariid foraminifers.

Taxonomic identification of foraminifers is based on diagnostic characters of separated specimens, complemented by characters of thin sections. I have mostly studied cores of foraminifers.

Stratigraphy

The Oravian klippe represent the sub-Pieninian and Pieninian facies. In the Pieninian facies are klippen in the Pieninian facies alone and in the transitive facies — the Kysuca and the Podbiel facies.

The Červený Kameň klippe was distinguished by D. ANDRUSOV (1938) as the Podbiel facies. The bed sequence commences with Lotharingian spotty limestones and terminates with Upper Senonian marls (Fig. 2). Studied were three Liassic horizons in the upper parts of the klippe (Fig. 2).

Lotharingian — Lower Pliensbachian

The beds consist of light-grey massive or almost massive limestones. Their surface is leached by weathering. The limestones pass gradually into light massive green and red marly limestones. They contain plentiful brachiopods: *Cirpa fronto* (QUENSTEDT) bivalves: *Oxytoma inaequivalvis sinemuriensis* (D'ORBIGNY), ammonites and especially belemnites — *Passaloteuthis virgatus* (MAYER), *Passaloteuthis aff. elegans* (PHILLIPS), *Nannobelus acutus* (MILLER) (Pl. XLI, XLII).

Microscopic study shows that the groundmass is biomicritic with echinoderm lamellae, scarce ostracods, radiolarians, various types of foraminifers, sponge spicules, spines of echinoderms, holothurian sclerites, fish teeth, clastic quartz, grains of galena, sphalerite and calcite.

Carixian — Domerian

The beds consist of red, green, grey limestones with dark-grey chert concretions. Macrofossils are scarcer. There are mostly fragments of belemnites — *Passaloteuthis*

aff. *apicicurvatus* (BLAINVILLE), *Passaloteuthis* aff. *seatownensis* LANG and ammonites — *Leptaleoceras* sp. (Pl. XLI, XLII).

The thin section shows, that groundmass consists of partly recrystallized biomicrite. The biomicrite contains plentiful echinoderms, foraminifers, holothurian sclerites, fragments of bivalves, radiolarians, sponge spicules, crinoides, aptychs, globochaetes, quartz grains, lamellae of muscovite and biotite.

Toarcian

The Toarcian horizon is represented by red marly limestones and thin-bedded red crinoidal limestones. Thickness: 4—5 m. Macrofauna is represented by the belemnite *Salpingoteuthis* aff. *tricissus* (JANENSCH) and ammonite *Calliphyloceras* ex gr. *nilssoni* (HÉBERT), Pl. XLII.

The thin section shows that groundmass consists of biomicrite, partly recrystallized, passing into biomicrosparite and biosparite, with crinoid segments, bivalves, foraminifers, spines of echinoderms, fish teeth, sponge spicules, scarce ostracods, radiolarians, globochaetes, quartz grains and muscovite lamellae. Total thickness of the Liassic: 100—130 m.

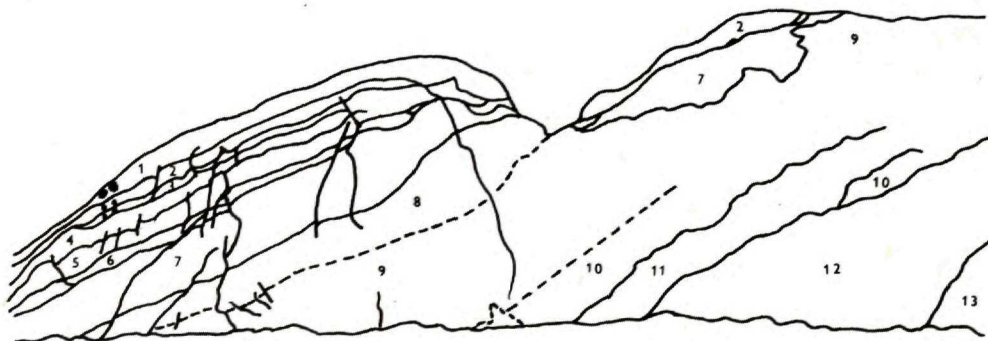


Fig. 2 Červený Kameň near Podbiel (according to D. ANDRUSOV, 1959).

1 — Lotharingian spotty limestones, 2 — Middle Liassic cherty limestones, 3 — Toarcian red marls and crinoidal limestones, 4 — ? Dogger microcrystalline limestones, 5 — Dogger — Malmian nodular limestone, 6 — Dogger — Malmian red and green jaspers, 7 — Lower Malmian cherty limestones, 8 — Lower Tithonian variegated marly limestones, 9 — Tithonian — Berriasian light-coloured bedded limestones of "biancone" type, 10 — Upper Neocomian bedded radiolarian limestones, 11 — Albian marly schists, 12 — Middle Senonian conglomerates and sandstones of Upohlav beds, 13 — Upper Senonian variegated marls.

● sampling localities

Systematic part

Jaculella BRADY, 1879

Jaculella cf. *liassica* Brand, 1937

Pl. XXXV, Fig. 1

1937 *Jaculella liassica* n. sp. — H. BARTENSTEIN—E. BRAND, p. 129, Pl. 2B, Fig. 1, Pl. 3, Fig. 4A, B, Pl. 4, Fig. 3, Pl. 5, Fig. 4, Pl. 7, Fig. 5, non vidi (fide E. PIETRZENUK 1961)

1961 *Jaculella liassica* BRAND — E. PIETRZENUK, p. 51, Pl. 9, Fig. 4 (cum syn.)

Remark: The material studied comprised incomplete specimens of this species. The test wall is a thicker, agglutinated pipe, narrowing in the proximal part. All tests found are depressed on sides.

Stratigraphic range established: Lotharingian.

In the klippe studied: Lotharingian — Domerian.

Ammodiscus REUSS, 1862

Ammodiscus cf. *asper* (TERQUEM, 1863)

Pl. XXXV, Fig. 2, Pl. XL, Fig. 2

1863 *Ammodiscus asper* O. TERQUEM, sér. 2, année 11, pt. 2, non vidi (fide J. BROUWER, 1969)

1960 *Involutina aspera* O. TERQUEM—G. BIZON, p. 4, Pl. 1, Fig. 1

1969 *Ammodiscus asper* O. TERQUEM—J. BROUWER, p. 24, Pl. 1, Fig. 6—9

Remark: The species was most frequent in the material studied. The test is agglutinated, planispiral, consisting of 4—5 whorls.

Stratigraphic range established: Sinemurian.

In the klippe studied: Lotharingian-Toarcian.

Ammodiscus cf. *incertus* (D'ORBIGNY, 1839)

Pl. XXXV, Fig. 3

1839 *Ammodiscus incertus* D'ORBIGNY, p. 86, Pl. 5, non vidi (fide E. DREXLER, 1958)

1958 *Ammodiscus incertus* (D'ORBIGNY) — E. DREXLER, p. 490, Pl. 20, Fig. 2 (cum syn.)

Remark: The test is agglutinated planispiral, consists of protoconch and pipe-shaped chamber forming most frequently 5 whorls. E. DREXLER (1958) agrees with J. WEIHMANN (1952) regarding *Ammodiscus incertus* (D'ORB.) and *Ammodiscus asper* (TERQ.) as one species.

Stratigraphic range established: Sinemurian.

In the klippe studied: Lotharingian-Toarcian.

***Citharina* D'ORIBIGNY in DE LA SAGRA, 1839**

***Citharina* cf. *colliezi* (TERQUEM, 1866)**

Pl. XXXV, Fig. 4

1866a *Marginulina colliezi* O. TERQUEM, p. 430, Pl. XVII, Fig. 10a, b, c, non vidi (fide J. BROUWER, 1969)

1969 *Citharina colliezi* (TERQUEM) — J. BROUWER, p. 32, Pl. 2, Fig. 16

1976 *Citharina colliezi* (TERQUEM) — CH. RUGET, p. 63, Fig. 1—3 (cum syn.)

Remark: The assemblage studied contained several cores of this species. The test is triangular, the core is formed of seven chambers. Intercameral sutures are depressed, distinct. In contrast to the L-like profile of chambers of typical specimens this one is loop-shaped. But in this case it is the profile of the core, not of the test.

Stratigraphic range established: Domerian-Toarcian.

In the klippe studied: Carixian-Domerian.

***Nodosaria* LAMARK, 1812**

***Nodosaria* cf. *claviformis* TERQUEM, 1866**

Pl. XXXVIII, Fig. 3, Pl. XXXIX, Fig. 1

1866b *Nodosaria claviformis* O. TERQUEM, p. 477, Pl. 19, Fig. 17, 18a, b, non vidi (fide Ch. Ruget, 1976)

1976 *Nodosaria claviformis* TERQUEM — CH. RUGET, p. 111—112, Pl. 14, Fig. 1—8 (cum syn.).

Remark: One incomplete specimen was recovered. A part of the test consists of gradually enlarging five chambers. The first chambers are tight and broader than high. The last two chambers are globular separated by a deep suture. The initial chamber and the aperture are not preserved.

Stratigraphic range established: Hettangian-Carixian

In the klippe studied: Lotharingian-Toarcian.

***Nodosaria* cf. *nitida* TERQUEM, 1858**

Pl. XXXV, Fig. 5

1858 *Nodosaria nitida* O. TERQUEM, p. 590, Pl. 1, Fig. 7a—k, non vidi (fide CH. RUGET, 1976)

1976 *Nodosaria nitida* O. TERQUEM — CH. RUGET, p. 117, Pl. 16, Fig. 1—8 (cum syn.)

Remark: The test consists of two chambers. The first is larger, globular, the other is by 1/3 smaller, narrowed in the proximal part. The aperture is most likely on the elongated end of the chamber.

According to CH. RUGET (1976) who revised O. TERQUEM's foraminiferal collection, this species does not represent *Nodosaria nitida* but the genus *Pseudoglandulina*. We only had a core to our disposal, so we cannot solve the problem.

Stratigraphic range established: Lotharingian-Carixian.
In the klippe studied: Toarcian.

***Nodosaria* sp. 1**

Pl. XXXVIII, Fig. 2

Remark: The thin section shows the profile of a nodosariid foraminifer. The test consists of 6 chambers. They are almost globular, gradually enlarging. The profile is not sufficient for species determination.

Stratigraphic range in the klippe studied: Carixian-Domerian.

***Nodosaria* sp. 2**

Pl. XXXV, Fig. 6

Remark: The test is small, uniserial, consisting of three irregular chambers. Aperture is not preserved on the core. Exact species identification is impossible for the lack of diagnostic characters.

Stratigraphic range in the klippe studied: Toarcian.

***Vaginulina* D'ORBIGNY, 1826**

***Vaginulina* cf. *listi* (BORNEMANN, 1854)**

Pl. XXXV, Fig. 7

1854 *Cristelaria listi* m. J. G. BORNEMANN, p. 77, Pl. 4, Fig. 28, non vidi (fide G. RABITZ, 1963)
1963 *Vaginulina listi* (BORNEMANN) — G. RABITZ, p. 206—207, Pl. 16, Fig. 14 (cum syn).

Remark: The fragment consisting of four chambers belongs most likely to *Vaginulina listi* (BORNEMANN). Initial chambers and aperture are not preserved. Chambers are thrice so wide as high and gradually enlarging. They are separated by diagonal sutures. The test profile is oval.

Stratigraphic range established: Lotharingian-Aalenian.

In the klippe studied: Toarcian.

***Dentalina* RISSO, 1826**

***Dentalina* cf. *ectadia* LOEBLICH et TAPPAN, 1950**

Pl. XXXV, Fig. 8

1950 *Dentalina ectadia* A. R. LOEBLICH—H. TAPPAN, p. 47, Pl. 13, Fig. 3—5
1970 *Dentalina ectadia* LOEBLICH et TAPPAN—W. FUCHS, p. 80, Pl. 3, Fig. 16 (cum syn).

Remark: The test is uniserial, elongated, slender. The initial chamber is small, globular. Further chambers are higher than wide. The aperture is asteroid.

Stratigraphic range established: Domerian-Toarcian.

In the klippe studied: Toarcian.

***Dentalina cf. glandulosa* TERQUEM, 1862**

Pl. XXXV, Fig. 9

1862 *Dentalina glandulosa* O. TERQUEM, p. 440, Pl. 5, Fig. 15, non vidi (fide CH. RUGET, 1976)

1976 *Dentalina glandulosa* TERQUEM—CH. RUGET, p. 17, Fig. 1—3 (cum syn.)

Remark: The specimen studied consists of a uniserial, slender, elongated test with three chambers. The chambers are gradually enlarging, the aperture is asteroid. The chambers are separated by a slim neck.

Stratigraphic range established: Carixian.

In the klippe studied: Carixian-Domerian.

***Dentalina cf. ornata* TERQUEM, 1858**

Pl. XXXVI, Fig. 10

1858 *Dentalina ornata* O. TERQUEM, p. 44, Pl. 2, Fig. 13, non vidi (fide CH. RUGET, 1976)

1976 *Dentalina ornata* TERQUEM—CH. RUGET, p. 28, Fig. 1—3 (cum syn.).

Remark: The test is elongated, uniserial, consisting of four enlarging circular chambers. Longitudinal ribs and aperture are not preserved.

Stratigraphic range established: unspecified Liassic.

In the klippe studied: Carixian-Domerian.

***Dentalina cf. tenuistriata* TERQUEM, 1866**

Pl. XXXVII, Fig. 1

1866a *Dentalina tenuistriata* O. TERQUEM, p. 405, Pl. XV, Fig. 5, non vidi (fide J. BROUWER, 1969).

1969 *Dentalina tenuistriata* TERQUEM — J. BROUWER, p. 34, Pl. 2, Fig. 27 (cum syn.).

Remark: The material studied comprised cores of this species mostly with three slender, elongated chambers with an asteroid aperture in upper parts.

According to G. BIZON (1960) the species is limited to the occurrence with *Dentalina varians* TERQUEM.

Stratigraphic range established: Lotharingian—Malmian.

In the klippe studied: Carixian-Domerian.

***Dentalina cf. varians* TERQUEM, 1866**

Pl. XXXVI, Fig. 11

- 1866a *Dentalina varians* O. TERQUEM, p. 9, Pl. 3, Fig. 3a, b, Pl. 4, Fig. 19, non vidi (fide Ch. Ruget, 1976)
1976 *Dentalina varians* TERQUEM — CH. RUGET, p. 48—49, Pl. 5, Fig. 1—4 (cum syn.)

Remark: The material studied contained incomplete cores with 3—4 irregular chambers. The two initial chambers are separated by a deep suture, other chambers show a short neck. Longitudinal ribs and aperture are not preserved.

Stratigraphic range established: Lotharingian-Carixian.

In the klippe studied: Carixian-Domerian.

***Dentalina* cf. *vetustissima* D'ORBIGNY, 1850**

Pl. XXXVI, Fig. 12

- 1850 *Dentalina vetustissima* D'ORBIGNY, p. 242, non vidi (fide W. FUCHS, 1970)
1970 *Dentalina vetustissima* D'ORBIGNY—W. FUCHS, p. 88, Pl. 4, Fig. 8, 18 (cum syn.).

Remark: The test is uniserial, slender, consisting of four chambers. The chambers are higher than broad. Aperture is asteroid.

Stratigraphic range established: Lotharingian, Domerian-Toarcian.

In the klippe studied: Toarcian.

***Frondicularia* DEFRANCE in D'ORBIGNY, 1826**

***Frondicularia* cf. *sulcata* BORNEMANN, 1854**

Pl. XXXVI, Fig. 13

- 1854 *Frondicularia sulcata* J. G. BORNEMANN, p. 37, Pl. 3, Fig. 22, non vidi (fide W. FUCHS, 1970)
1970 *Frondicularia sulcata* BORNEMANN — W. FUCHS, p. 90, Pl. 5, Fig. 3 (cum syn.).

Remark: Medium-sized test, 4 chambers. The initial chamber is globular, further chambers are broader than high, gradually enlarging.

Frondicularia sulcata BORNEMANN has variable morphology. The microspherical generation is slender, tests of megalospherical generations are broader. Our specimen represents the megalospherical generation.

Stratigraphic range established: Sinemurian, Lotharingian, Domerian, Toarcian.

In the klippe studied: Carixian-Domerian.

***Frondicularia* cf. *intumescens* BORNEMANN, 1854**

Pl. XXXVI, Fig. 14

- 1854 *Frondicularia intumescens* m. J. G. BORNEMANN, p. 36, Pl. 3, Fig. 19a—c, non vidi (fide G. RABITZ, 1963)
1963 *Frondicularia intumescens* BORNEMANN — G. RABITZ, p. 207, Pl. 17, Fig. 21 (cum syn.).

Remark: The test is uniserial, elongated, consisting of 6 chambers. The initial globular chamber is not preserved. The species depicted by G. RABITZ (1963) has 8 chambers; the species described by A. FRANKE (1936) have 5—8 chambers.

Stratigraphic range established: Domerian-Toarcian.

In the klippe studied: Toarcian.

***Frondicularia* ex gr. *major* BORNEMANN, 1854**

Pl. XXXVII, Fig. 3

1854 *Frondicularia major* m. J. G. BORNEMANN, p. 36, Pl. 3, Fig. 21, a—c, non vidi (fide G. RABITZ, 1963)

1963 *Frondicularia major major* BORNEMANN — G. RABITZ, p. 209, Pl. 17, Fig. 18 (cum syn.).

Remark: The material studied comprised pentacameral specimens, not 7—8-cameral like on typical material. The specimens may be ranged to this species according to the initial chamber, the form of the further chambers and their general form. According to G. RABITZ (1963) the species occurs mostly with the species *Plectofrondicularia brizaeformis* (BORNEMANN) with which it is frequently confused or given into synonymy.

Stratigraphic range established: Sinemurian, Domerian-Toarcian.

In the klippe studied: Carixian-Domerian, Toarcian.

***Plectofrondicularia* LIEBUS, 1903**

***Plectofrondicularia* cf. *brizaeformis* (BORNEMANN, 1854)**

Pl. XXXVII, Fig. 2

1854 *Frondicularia brizaeformis* m. J. G. BORNEMANN, p. 36, Pl. 3, Fig. 17, 18 non vidi (fide G. RABITZ, 1963)

1963 *Plectofrondicularia brizaeformis* (BORNEMANN) — G. RABITZ, p. 215, Pl. 17, Fig. 26—27 (cum syn.).

Remark: The species is very frequent in the material studied. The specimens show all diagnostic characters quoted by J. G. BORNEMANN (1854) and confirmed by G. RABITZ (1963). The initial chamber is globular, the further chambers show biserial alternant arrangement. The following chambers are typical frondicularian, i.e. they have the form of reversed broad V. The aperture is on a small neck. V. POKORNÝ (1954) and A. R. LOEBLICH—H. TAPPAN (1964) wrote that the genus *Plectofrondicularia* appeared in the Paleogene and the genus *Frondicularia* in the Permian.

The studied specimens show biserial arrangement of chambers in the initial stage, so it is right to range it to *Plectofrondicularia*.

Stratigraphic range established: Sinemurian, Carixian-Domerian.

In the klippe studied: Carixian-Domerian.

***Pseudonodosaria* BOOMGAART, 1949**

***Pseudonodosaria* sp.**

Pl. XXXVI, Fig. 15

Remark: The test is uniserial, short, small. It consists of 3 chambers. The initial and the second chambers are broader than high. The last chamber is large, inflated, semiglobular.

Stratigraphic range in the klippe studied: Carixian-Domerian.

***Marginulina* D'ORBIGNY, 1826**

***Marginulina* cf. *interrupta* TERQUEM, 1866**

Pl. XXXVIII, Fig. 1

1866a *Marginulina interrupta* O. TERQUEM, Pl. 17, Fig. 4a—c, non vidi (fide CH. RUGET, 1976)

1976 *Marginulina interrupta* TERQUEM — CH. RUGET, p. 78—79, Fig. 1—4 (cum syn.).

Remarks: The species comprises besides washed specimens also a specimen from thin section (Pl. XXXVIII). The test consists of 8 chambers connected with necks. All chambers are separated, the initial are compressed. The thin section does not show all diagnostic characters but according to the general form of the test and chambers the specimen may be ranged to this species.

Stratigraphic range established: Lotharingian-Carixian.

In the klippe studied: Lotharingian-Carixian.

***Marginulina* cf. *prima* D'ORBIGNY, 1849**

Pl. XXXVI, Fig. 16

1849 *Marginulina prima* D'ORBIGNY, p. 242, fig. 262, non vidi (fide W. FUCHS, 1970)

1970 *Marginulina prima* D'ORBIGNY — W. FUCHS, p. 101, Pl. 6, Fig. 10, Pl. 8, Fig. 9 (cum syn.).

Remark: The material studied comprises some specimens of this species. The number of chambers ranged from 4 to 7. The chambers are provided with keel ornamentation. The initial chambers are smaller. The test is uniserial, the aperture on a short neck is asteroid.

Stratigraphic range established: Hettangian-Sinemurian. Domerian-Toarcian.

In the klippe studied: Carixian-Toarcian

***Lenticulina* LAMARK, 1804**

***Lenticulina cf. acutiangulata* (TERQUEM, 1864)**

Pl. XXXVI, Fig. 17

1864 *Robulina acutiangulata* O. TERQUEM, p. 220, Pl. X, Fig. 20, non vidi (fide E. PIETRZENUK, 1961)

1961 *Lenticulina acutiangulata* (TERQUEM) — E. PIETRZENUK, p. 67, Pl. 5, Fig. 1a, b (cum syn.).

Remark: The test is involute discoid. The initial chamber is globular, the others are almost triangular. On cores nine chambers are preserved in most cases.

Stratigraphic range established: Domerian, Toarcian, Lower Malm.

In the klippe studied: Toarcian.

***Lenticulina cf. muensteri* (ROEMER, 1839)**

Pl. XXXVII, Fig. 5

1839 *Robulina muensteri* F. R. ROEMER, p. 48, Pl. 20, Fig. 29, non vidi (fide E. PIETRZENUK, 1961)

1961 *Lenticulina muensteri* (ROEMER) — E. PIETRZENUK, p. 67, Pl. 5, Fig. 3 (cum syn.).

Remark: More specimens are bilaterally symmetrical, some are asymmetrical. The test is involute, composed of 9—10 chambers. The initial chamber is globular, the others are triangular. The species differs from *Lenticulina acutiangulata* (TERQUEM) which has a keel-like marginal rim.

Stratigraphic range established: Lotharingian, Domerian, Dogger.

In the klippe studied: Carixian-Domerian.

***Lenticulina cf. varians* (BORNEMANN, 1854)**

Pl. XXXVI, Fig. 18

1854 *Cristelaria varians* m. J. G. BORNEMANN, p. 41, Pl. 4, Fig. 32—34, non vidi (fide E. PIETRZENUK, 1961)

1961 *Lenticulina varians* (BORNEMANN) — E. PIETRZENUK, p. 66, Pl. 5, Fig. 2, 8a, b (cum syn.).

Remark: The test is involute, elongated, consisting of 6 chambers. The initial chamber is globular, the others are triangular.

The species is highly variable. A. FRANKE (1936) regards the Lower Sinemurian specimens as *Cristelaria (Lenticulina) varians suturalis-costata* FRANKE.

Stratigraphic range established: Hettangian-Sinemurian, Domerian, Dogger, Lower Malm.

In the klippe studied: Lotharingian-Carixian, Toarcian.

***Lingulina* D'ORBIGNY, 1826**

***Lingulina cf. camerata* LOEBLICH et TAPPAN, 1950**

Pl. XXXVI, Fig. 19

1950 *Lingulina camerata* A. R. LOEBLICH—H. TAPPAN, p. 50, Pl. 13, Fig. 28a, b.

Remark: The test is slender, elongated, consists of 6 chambers. The initial chamber is globular, the others are broader than high. Deep sutures are curved. The aperture is not preserved.

Lingulina camerata LOEBLICH et TAPPAN differs from *Lingulina dentaliniformis* TERQUEM because it is by 1/3 narrower and its sutures are more curved. It differs from *Lingulina furcillata* BERTHELIN in smaller size, narrow chambers and more circular than slot-like aperture.

Stratigraphic range established: American Oxfordian.

In the klippe studied: Carixian-Domerian

***Lingulina cf. laevisissima* (TERQUEM, 1866)**

Pl. XXXVI, Fig. 20

1866c *Frondicularia laevisissima* O. TERQUEM, p. 481, Pl. 19, Fig. 19a, b, non vidi (fide W. BIELECKA, 1960)

1956 *Lingulina laevisissima* (TERQUEM) — T. BARNARD, p. 272, Pl. 1, Fig. 5a, b.

1960 *Lingulina laevisissima* (TERQUEM) — W. BIELICKA, p. 74, Pl. 6, Fig. 46 (cum syn.).

Remark: The test consists of 5 chambers. The initial chamber is globular, the following are broader than high, gradually enlarging. The ultimate chamber is thrice so wide as high. The test is approximately triangular, the aperture on the core is not preserved.

Stratigraphic range established: Hettangian-Lotharingian, Lower Malm.

In the klippe studied: Carixian-Toarcian.

***Lingulina cf. tenera* BORNEMANN, 1854**

Pl. XXXVII, Fig. 4

1854 *Lingulina tenera* J. G. BORNEMANN, p. 38, Pl. 111, Fig. 24a—c, non vidi (fide W. FUCHS, 1970)

1970 *Lingulina tenera tenera* BORNEMANN, p. 108, Pl. 8, Fig. 1, 12, 15 (cum syn.).

Remark: The test is elongated, composed of 5 chambers. The initial chamber is globular, the others are low and wider. The ultimate chamber is thrice so wide as high. The test is triangular. The aperture is on the short neck of the last chamber.

Stratigraphic range established: Hettangian-Sinemurian, Dogger.

In the klippe studied: Carixian-Toarcian.

***Lingulina cf. testudinaria* FRANKE, 1936**

Pl. XXXVI, Fig. 21

1936 *Lingulina testudinaria* A. FRANKE, p. 63, Pl. 6, Fig. 19, non vidi (fide W. FUCHS, 1970)

1970 *Lingulina testudinaria* FRANKE — W. FUCHS, p. 109, Pl. 8, Fig. 19 (cum syn.).

Remark: The test is small, thick, composed of 6 chambers. The chambers are broad and low. The initial chambers are smaller. The test is triangular.

Stratigraphic range established: Domerian-Toarcian.
In the klippe studied: Carixian-Toarcian.

Conclusion

Foraminiferal assemblages from three Liassic horizons show qualitative and quantitative differences. Twenty-nine described species belong to twelve genera from three families.

Eight of these species were mentioned in our literature, namely: *Nodosaria nitida* TERQUEM, *Dentalina tenuistriata* TERQUEM, *Dentalina vetustissima* D'ORBIGNY, *Fronicularia sulcata* BORNEMANN, *Lenticulina muensteri* (ROEMER) (V. SCHEIBNEROVÁ, 1965), *Marginulina prima* D'ORBIGNY (V. SCHEIBNEROVÁ, 1959, 1965, A. BEGAN—V. GAŠPARIKOVÁ, 1979), *Lenticulina acutiangulata* (TERQUEM), *Lenticulina varians* (BORNEMANN) (V. SCHEIBNEROVÁ, 1965, A. BEGAN—V. GAŠPARIKOVÁ, 1979). Other species were found for the first time in the Liassic of the West Carpathians.

Separated species represent only a fragment of the original assemblage. Each Liassic horizon studied contained thanatocenoses differing in species and quantity, so they can be used for detailed stratigraphic division of the Middle and Upper Liassic.

Horizon 1 (Lotharingian — Lower Pliensbachian) shows the poorest species representation — 6, the horizon 3 (Toarcian) contains 16 species. Horizon 2 (Carixian — Domerian) contains 20 species.

Fig. 3 shows that the assemblage contains species characteristic of certain horizons: *Marginulina* cf. *interrupta* TERQUEM in the Lotharingian — Lower Pliensbachian; in the Carixian-Domerian: *Citharina* cf. *colliezi* (TERQUEM), *Nodosaria* sp.₁, *Dentalina* cf. *glandulosa* TERQUEM, *Dentalina* cf. *ornata* TERQUEM, *Dentalina* cf. *tenuistriata* TERQUEM, *Dentalina* cf. *variens* TERQUEM, *Fronicularia* cf. *sulcata* BORNEMANN, *Plectofronicularia* cf. *brizaeformis* (BORNEMANN), *Pseudonodosaria* sp., *Lenticulina* cf. *muensteri* (ROEMER), *Lingulina* cf. *camerata* LOEBLICH et TAPPAN; in the Toarcian: *Nodosaria* cf. *nitida* TERQUEM, *Nodosaria* sp.₂, *Vaginulina* cf. *listi* (BORNEMANN), *Dentalina* cf. *ectadia* LOEBLICH et TAPPAN, *Dentalina* cf. *vetustissima* D'ORBIGNY, *Fronicularia* cf. *intumescens* BORNEMANN, *Lenticulina* cf. *acutiangulata* (TERQUEM).

Three of the species occur in all the Liassic horizons: *Ammodiscus* cf. *asper* (TERQUEM), *Ammodiscus* cf. *incertus* (D'ORBIGNY) and *Nodosaria* cf. *claviformis* TERQUEM. Some species were found in two horizons: *Jaculella* cf. *liassica* BRAND (Lotharingian — Domerian), *Fronicularia* ex gr. *major* BORNEMANN, *Marginulina* cf. *prima* D'ORBIGNY, *Lingulina* cf. *laevissima* (TERQUEM), *Lingulina* cf. *tenera* BORNEMANN, *Lingulina* cf. *testudinaria* FRANKE (Carixian-Toarcian), *Lenticulina* cf. *variens* (BORNEMANN) (Lotharingian — Lower Pliensbachian, Toarcian).

The assemblages from limestones differ in species from assemblages found by other authors in marly sediments, so the fact may be used in paleoecological study and for paleogeographical conclusions.

Species

Jacullella cf. *liassica**Ammodiscus* cf. *asper**Ammodiscus* cf. *incertus**Citharina* cf. *collezi**Nodosaria* cf. *claviformis**Nodosaria* cf. *nitida**Nodosaria* sp.₁*Nodosaria* sp.₂*Vaginulina* cf. *listi**Dentalina* cf. *ectadia**Dentalina* cf. *glandulosa**Dentalina* cf. *ornata**Dentalina* cf. *tenuistriata**Dentalina* cf. *varians**Dentalina* cf. *vetustissima**Frondicularia* cf. *sulcata**Frondicularia* cf. *intumescens**Frondicularia* ex gr. *major**Plectofrondicularia* cf. *brizaeformis**Pseudonodosaria* sp.*Marginulina* cf. *interrupta**Marginulina* cf. *prima**Lenticulina* cf. *acutiangulata**Lenticulina* cf. *muensteri**Lenticulina* cf. *varians**Lingulina* cf. *camerata**Lingulina* cf. *laevissima**Lingulina* cf. *tenera**Lingulina* cf. *testudinaria*

Fig. 3 List of the foraminifers species described from Červený Kameň Klippe and its stratigraphic distribution. Explanations: --- stratigraphic range according to literary data; ——— occurrences in Červený Kameň Klippe; || || || || inspecified Lias

References

- ANDRUSOV, D. 1938: Geologický výzkum vnútrošného bradlového pásma v Západných Karpatoch, 3, Tektonika. Rozpr. Stát. geol. Úst. Čs. Republ., 9, Praha, 3—132.
- ANDRUSOV, D. 1959: Geológia Československých Karpát, II, Bratislava, 5—376.
- BERNARD, T. 1956: Some Lingulinae from the Lias of England, Micropaleontology, 2, 3, New York, 271—282.
- BARTENSTEIN, H.—BRAND, E. 1937: Mikropaläontologische Untersuchungen zur Stratigraphie des nordwest-deutschen Lias und Doggers. Abh. Senckenberg. naturforsch. Gesell. 439, Frankfurt/M., 1—224.
- BEGAN, A.—GAŠPARIKOVÁ, V. 1979: Príspevok ku stratigrafii jury czorsztýnskej sukcesie, Geol. Práce, Správy 73, 71—74.
- BEGAN, A.—KANTOROVÁ, V. 1961: Krieda bradlového pásma Považia v území Púchov—Bošacka dolina, Geol. Práce, Správy 22, 69—83.
- BIELECKA, W. 1960: Stratygrafia mikropaleontologiczna dolnego malmu okolic Chrzanowa, Prace Inst. geol. 31, Warszawa, 7—155.
- BIZON, G. 1960: Révision de quelques espèces-types de Foraminifères du Lias Bassin parisien de la collection Terquem, Rév. Micropaléont., 3, 1, Paris, 3—19.
- BORZA, K. 1969: Die Mikrofazies und Mikrofossilien des Oberjuras und der Unterkreide der Klippenzone der Westkarpaten, Bratislava, 9—301.
- BROUWER, J. 1969: Foraminiferal assemblages from the Lias of North-Western Europa, North-Holland publishing Company, Amsterdam-London.
- DREXLER, E. 1958: Foraminiferen und Ostracoden aus dem Lias alpha von Siebeldingen/Pfalz, Geol. Jb., 75, Hannover, 475—554.
- ELLIS, B. F.—MESSINA, A. 1940: Catalogue of Foraminifera, Am. Mus. Nat. History, New-York.
- FRANKE, A. 1936: Die Foraminiferen des deutschen Lias, Abh. preuss. geol. Landesanst. N. F., 169, Berlin, 1—138.
- FUCHS, W. 1970: Eine alpine, tiefliasische Foraminiferenfauna von Hernstein in Niederösterreich, Verh. Geol. Bundesanst., 1, Wien, 66—145.
- HANZLÍKOVÁ, E. 1964: The Foraminifera of the Klentnica beds (Malm) Sbor. geol. věd, Paleont. 5, Praha, 39—107.
- LOEBLICH, A. R.—TAPPAN, H. 1950: North American jurassic Foraminifera: I. The type redwater shale (oxfordian) of south Dakota, J. Paleont., 24, 1, 39—60.
- LOEBLICH, A. R.—TAPPAN, H. 1964: Treatise on Invertebrate Paleontology, Protista C 2/1, 2; Geological Society of America University of Kansas Press.
- MIŠŤK, M. 1961: Mikrofácia s Involutina liassica (Jones) z liasu Veľkej Fatry, Acta geol. geogr. Univ. Comen, Geol. 5, 177—187.
- ORBIGNY D', A. 1839: Voyage dans l'Amerique Méridionale Foraminifères 5, Paris et Strassbourg, 1—86.
- ORBIGNY D', A. 1849 (1850): Prodrôme de paléontologie stratigraphique universelle des animaux mollusques rayonnés: V. Masson Paris, 1, ix+392 (1849), 2, 427 (1850) (fide Ellis, B. F.—Messina, A. 1940, p. 181).
- PIETRZENUK, E. 1961: Zur Mikrofauna einiger Liasvorkommen in der DDR, Freiberg. Forsch. — C, 113, 1—129.
- POKORNÝ, V. 1954: Základy zoologické mikropaleontologie, Praha, 5—650.
- RABITZ, G. 1963: Foraminiferen des Göttinger Lias, Paläont. Z., 37, 3—4, Stuttgart, 198—225.
- ROEMER, F. R. 1839: Die Versteinerungen des norddeutschen Oolitengebirges. Ein Nachtrag. (fide Ellis, B. F.—Messina, A. 1940).
- RUGET, CH. 1976: Révision des Foraminifères de la collection Terquem I-Lias, Cah. Micropaleont. 4, Paris.
- SCHEIBNEROVÁ, V. 1959: Nález mikrofauny v liase bradlového pásma v okolí Zázrivej, Geol. Sbor. Slov. Akad. Vied 10, 2, Bratislava, 335.
- SCHEIBNEROVÁ, V. 1962: Nové výsledky stratigrafie jury a kriedy bradlového pásma, Geol. Práce, Zošit 62, Bratislava, 261—266.

- SCHEIBNEROVÁ, V. 1965: An outline of the Jurassic and Lower Cretaceous Microbiostratigraphy of the Klippen belt of the West Carpathians on the Basis of Foraminifera, Geol. Sbor. Geol. carpath. XVI-1, Bratislava, 287—298.
- SCHEIBNEROVÁ, V. 1968: On the Discovery of Microfauna in the Opalinus Beds (Klippen Belt, W. C.), Mitt. Bayer. St.-Samml. Paläont. hist. Geol., 8, 51—65.
- TERQUEM, O. 1858: Mémoire sur les Foraminifères du Lias du Département de la Moselle, Partie I., Mém. acad. Imp. 39, Metz, 563—656 (fide Pokorný, V. 1954, p. 558).
- TERQUEM, O. 1862: Recherches sur les Foraminifères de l'étage moyen et de l'étage inférieur du Lias, Mém. Acad. Imp. 42, Metz, 415—466 (fide Pokorný, V. 1954, p. 558).
- TERQUEM, O. 1863: Troisième Mémoire sur les Foraminifères du Lias des départements de la Moselle, de la Côte d'Or du Rhône, de la Vienne et du Calvados, Mém. Acad. Imp. 44, Metz, 361—438 (fide Pokorný, V. 1954, p. 558).
- TERQUEM, O. 1864: Quatrième mémoire sur les Foraminifères du Lias comprenant les Polymorphines des départements de la Moselle, de la Côte d'Or et de l'Indre, Metz (fide Pokorný, V. 1954, p. 559).
- TERQUEM, O. 1866a: Cinquième Mémoire sur les Foraminifères du Lias des départements de la Moselle, de la Côte d'Or et de l'Indre, Metz, 313—454 (fide Pokorný, V. 1954, p. 559).
- TERQUEM, O. 1866b: Sixième Mémoire sur les Foraminifères du Lias des départements de l'Indre et de la Moselle, Metz, 459—532 (fide Pokorný, V. 1954, p. 559).
- TERQUEM, O. 1866c: Les Foraminifères et les Ostracodes du Fullersearth des environs de Varsovie, Mém. Soc. géol. France (3), 4, (fide Pokorný, V. 1954, p. 591).
- WEIHMANN, J. 1952: Stratigraphie und Mikrofauna des Lias alpha 3 (Arietenschichten) zwischen dem Ostrand des Fildergebietes und Schwäbisch Gmünd-Ms.-Diss., T. H., Stuttgart.

A. Zlinská

Liasové foraminifery z bradla Červený Kameň pri Podbieli

Resumé

Na lokalite Červený Kameň, v podbielskom vývoji, boli študované 3 liasové horizonty za účelom zistenia a overenia techniky extrahovania voľných mikrofosílií z vápencov. Získané boli hlavne foraminifery, spracované z paleontologického i biostratigrafického aspektu. Bolo determinovaných a opísaných 29 druhov, ktoré patria do 12 rodov a 3 čeladi.

Zo zistených druhov bolo doteraz spomínaných v našej literatúre 8 druhov, a to: *Nodosaria nitida* TERQUEM, *Dentalina tenuistriata* TERQUEM, *Dentalina vetustissima* D'ORBIGNY, *Fronicularia sulcata* BORNEMANN, *Lenticulina muensteri* (ROEMER) (V. SCHEIBNEROVÁ, 1965), *Marginulina prima* D'ORBIGNY (V. SCHEIBNEROVÁ, 1959, 1965, A. BEGAN—V. GAŠPARIKOVÁ, 1979), *Lenticulina acutiangulata* (TERQUEM), *Lenticulina varians* (BORNEMANN) (V. SCHEIBNEROVÁ, 1965, A. BEGAN—V. GAŠPARIKOVÁ, 1979). Ostatné druhy boli v liase Západných Karpát zistené po prvýkrát.

Vyseparované druhy predstavujú len fragment pôvodného spoločenstva. Asociácie foraminifer získané z 3 horizontov liasu (lotaring-sp. plienbach, karix-domér, toark) sa líšia kvalitatívne i kvantitatívne, čo naznačuje možnosť využitia pre jemnejšiu stratigrafiu stredného a vrchného liasu.

Vzhľadom na to, že zistené spoločenstvá pochádzajúce z vápencov sa druhy líšia od asociácií uvádzaných inými autormi zo slienitých sedimentov, bude možné tento poznatok využiť pre paleoekologické štúdium, a tým aj pre paleogeografické závery.

Explanations to Plates XXXV—XLII

Pl. XXXV

- 1 *Jaculella* cf. *liassica* BRAND, Lotharingian — Lower Pliensbachian, 60×
- 2 *Ammodiscus* cf. *asper* (TERQUEM), Lotharingian — Lower Pliensbachian, 60×
- 3 *Ammodiscus* cf. *incertus* (D'ORBIGNY), Carixian-Domerian, 60×
- 4 *Citharina* cf. *colliezi* (TERQUEM), Carixian-Domerian, 60×
- 5 *Nodosaria* cf. *nitida* TERQUEM, Toarcian, 80×
- 6 *Nodosaria* sp.₂, Toarcian, 60×
- 7 *Vaginulina* cf. *listi* (BORNEMANN), Toarcian, 60×
- 8 *Dentalina* cf. *ectadia* LOEBLICH et TAPPAN, Toarcian, 60×
- 9 *Dentalina* cf. *glandulosa* TERQUEM, Carixian-Domerian, 60×

Pl. XXXVI

- 10 *Dentalina* cf. *ornata* TERQUEM, Carixian-Domerian, 60×
- 11 *Dentalina* cf. *varians* TERQUEM, Carixian-Domerian, 60×
- 12 *Dentalina* cf. *vetustissima* D'ORBIGNY, Toarcian, 60×
- 13 *Fronicularia* cf. *sulcata* BORNEMANN, Carixian-Domerian, 60×
- 14 *Fronicularia* cf. *intumescens* BORNEMANN, Toarcian, 60×
- 15 *Pseudonodosaria* sp., Carixian-Domerian, 60×
- 16 *Marginulina* cf. *prima* D'ORBIGNY, Carixian-Domerian, 60×
- 17 *Lenticulina* cf. *acutiangulata* (TERQUEM), Toarcian, 60×
- 18 *Lenticulina* cf. *varians* (BORNEMANN), Toarcian, 60×
- 19 *Lingulina* cf. *camerata* LOEBLICH et TAPPAN, Carixian-Domerian, 80×
- 20 *Lingulina* cf. *laevissima* (TERQUEM), Toarcian, 60×
- 21 *Lingulina* cf. *testudinaria* FRANKE, Carixian-Domerian, 60×

Pl. XXXVII

- 1 *Dentalina* cf. *tenuistriata* TERQUEM, Carixian-Domerian, 120×
- 2 *Plectofronicularia* cf. *brizaeformis* (BORNEMANN), Carixian-Domerian, 100×
- 3 *Fronicularia* ex gr. *major* BORNEMANN, Toarcian, 170×
- 4 *Lingulina* cf. *tenera* BORNEMANN, Toarcian, 150×
- 5 *Lenticulina* cf. *muensteri* (ROEMER), Carnian-Domerian, 110×

Pl. XXXVIII

- 1 *Marginulina* cf. *interrupta* TERQUEM, Lotharingian — Lower Pliensbachian, 88×
- 2 *Nodosaria* sp.₁, Carixian-Domerian, 88×
- 3 *Nodosaria* cf. *claviformis* TERQUEM, Lotharingian — Lower Pliensbachian 88×
- 4 *Nodosaria* sp., Carixian-Domerian, 88×
- 5 *Lingulina* sp., Lotharingian — Lower Pliensbachian, 88×

Pl. XXXIX

- 1 *Nodosaria* cf. *claviformis* TERQUEM, Carixian-Domerian, 88×
- 2 *Nodosaria* sp., Carixian-Domerian, 88×
- 3 *Nodosaria* sp.₁, *Nodosaria* sp.₂, Carixian-Domerian, 88×
- 4 *Lingulina* sp., Carixian-Domerian, 88×

Pl. XL

- 1 *Lingulina* sp., Carixian-Domerian, 770×
- 2 *Ammodiscus* cf. *asper* (TERQUEM), Lotharingian — Lower Pliensbachian, 88×
- 3 ammonite — juvenile stage, Carixian-Domerian, 28×
- 4 *Lingulina* sp., Carixian-Domerian, 88×
- 5 profile of holothurian sclerite, Toarcian, 88×

Pl. XLI

1 : 1

- 1 *Passaloteuthis* cf. *apicicurvatus* (BLAINVILLE), Carixian-Domerian
- 2 *Passaloteuthis* sp., Lotharingian — Lower Pliensbachian
- 3 *Passaloteuthis virgatus* (MAYER), Lotharingian — Lower Pliensbachian
- 4 *Passaloteuthis* cf. *seatownensis* LANG, Carixian-Domerian
- 5 *Passaloteuthis* cf. *elegans* (PHILLIPS), Lotharingian — Lower Pliensbachian
axial part of rostrum with the back part of alveole
- 6 *Passaloteuthis virgatus* (MAYER), Lotharingian — Lower Pliensbachian
- 7 *Passaloteuthis* cf. *elegans* (PHILLIPS), Lotharingian — Lower Pliensbachian
back end of rostrum
- 8 *Oxytoma* cf. *inaequivalvis sinemuriensis* (D'ORBIGNY), Lotharingian — Lower Pliensbachian

Pl. XLII

1 : 1

- 1 *Calliphyloceras* cf. *nilssoni* (HÉBERT), Toarcian
- 2 *Leptaleoceras* sp., Carixian-Domerian
- 3, 4 *Passaloteuthis* sp., Lotharingian — Lower Pliensbachian
- 5 *Cirpa fronto* (QUENSTEDT), Lotharingian — Lower Pliensbachian

Pl. XXXV—XXXVI — photograph reconstructions

Pl. XXXV—XXXVI — Photo by L. Osvald

Ružena Lehotayová

Helicosphaera porosa — new species of calcareous nannoflora from Oligocene/Miocene boundary

2 Pls. (XLIII—XLIV)

Abstract. A new species of calcareous nannoflora — *Helicosphaera porosa* is described from the West Carpathians (Sheet Fíľakovo). The species occurs in nannoassemblages corresponding to the nannoplanktic biozone NN 1 — *Triquetrorhabdulus carinatus* to NN 2 — *Discoaster druggi* from the Oligocene/Miocene boundary.

Introduction

The study of calcareous nannoflora in sediments of wide surroundings of Lučenec—Fíľakovo, the Cerová vrchovina upland (samples F-106, F-108, AN-171) revealed a new species of the genus *Helicosphaera* KAMPTNER 1954. It is a significant species because of its narrow stratigraphic range.

Systematic evaluation

Helicosphaera KAMPTNER 1954

Type species: *Helicosphaera carteri* (WALLICH) KAMPTNER (1954)

***Helicosphaera porosa* sp. n.**

Pl. XLIII, Fig. 1, 2, Pl. XLIV, Fig. 1, 2, 3, 4

Holotype: Scanning electron micrograph N 1753/84, Pl. XLIII, Fig. 1

Dimensions of holotype: length 7.5 μ , width 5 μ

Paratype: SEM . . . N 6125/84

Type locality: Fíľakovo — sample F-108, South Slovakia, Czechoslovakia

Type level: Oligocene/Miocene, nannoplanktic biozone NN 1 *Triquetrorhabdulus carinatus* to NN 2 *Discoaster druggi*.

Denomination: According to porous perforation of central area of *Helicosphaera*.

Diagnosis: A large form of *Helicosphaera* with porous perforation of central area.

Description: A large form of helicosphaere of oval shape. On the proximal side is an interesting porous perforation of the central area. Individual pores are small, irregularly arranged. Their shape is subcircular and circular. Along the longer axis of ellipse there is a slot in the porous central area in the middle. Longitudinal lamellate, narrow calcite segments are perpendicular to the central area. They form a proximal disc, spiral-coiled on the proximal side into the flange.

This part is already a part of the distal side of the taxon mentioned.

On the distal side a large, empty oval central area may be seen. Sometimes it shows remains of broken perforated central area on the proximal side (Pl. XLIV, Fig. 3). The central area is surrounded by a distal disc with increasing width, extending into the flange. The flange is semi-circular and wider than the distal disc.

Remark: Some damaged specimens of *Helicosphaera porosa* with the broken central area remind of *Helicosphaera ampliaperta*. The new species *Helicosphaera porosa* has a narrow stratigraphic range. It was found in sediments on the Oligocene/Miocene boundary, in the nannoplanktic biozones NN 1 — *Triquetrorhabdulus carinatus*, NN 2 — *Discoaster druggi*. So the species is stratigraphically significant.

Assemblages, comprising the new species, consist of the following species: *Cyclicargolithus floridanus* (ROTH et HAY) BUKRY, *Discoaster deflandrei* BRAMLETTE et RIEDEL, *Helicosphaera carteri* (WALLICH) KAMPTNER, *Helicosphaera perchnielsenense* HAQ, *Helicosphaera transilvanica* GHETA, *Pontosphaera multipora* (KAMPTNER) ROTH, a.o.

Explanations of plates XLIII—XLIV

Plate XLIII

Fig. 1 *Helicosphaera porosa* n. sp., loc. Filakovo (F-108), proximal view (holotype).

Fig. 2 *Helicosphaera porosa* n. sp., loc. Filakovo (F-108), proximal view (paratype).

Plate XLIV

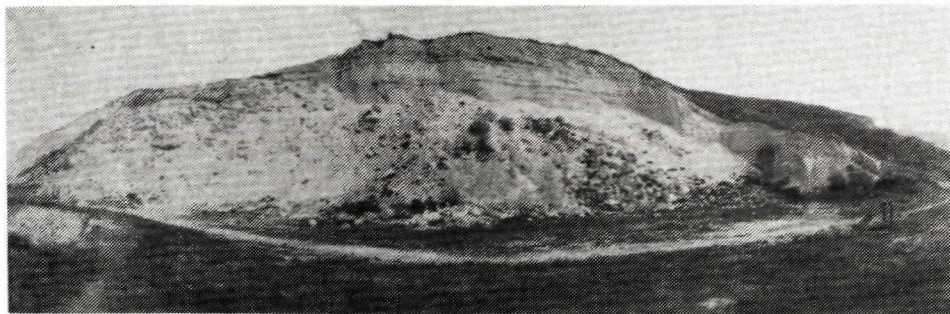
Fig. 1 *Helicosphaera porosa* n. sp., loc. W of Radzovice (AN-171), distal view, magnification 7000×.

Fig. 2 *Helicosphaera porosa* n. sp., loc. Filakovo (F-106), proximal view.

Fig. 3 *Helicosphaera porosa* n. sp., loc. W of Radzovice (AN-171) proximal view, magnification 3000×.

Fig. 4 *Helicosphaera porosa* n. sp., loc. W of Radzovice (AN-171) distal view, magnification 3500×.

PHOTOGRAPHS
I—XLIV



1



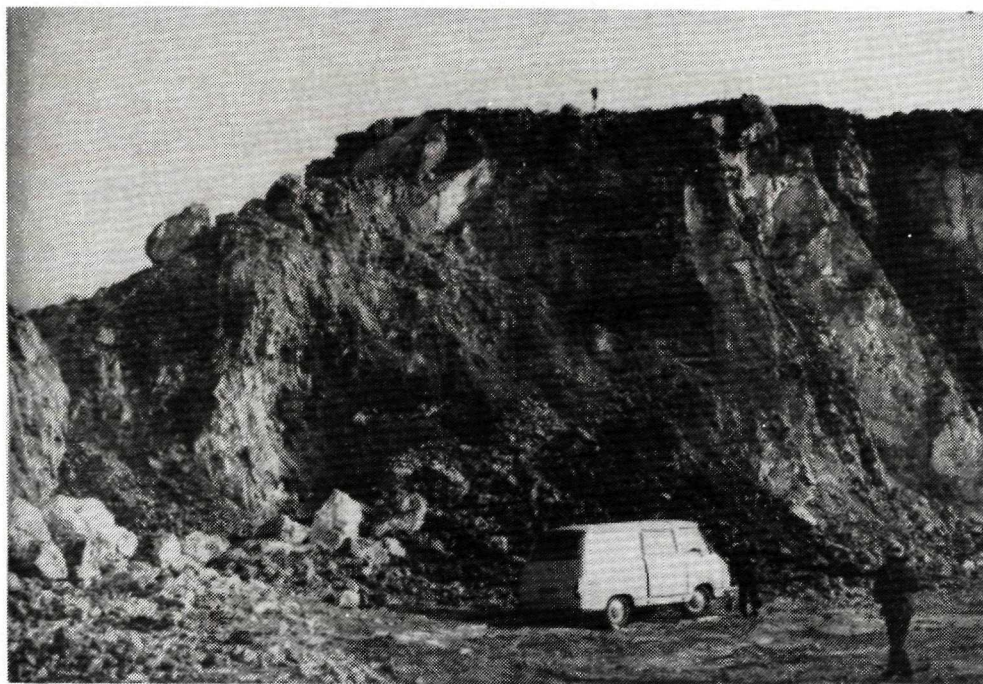
2



1



2



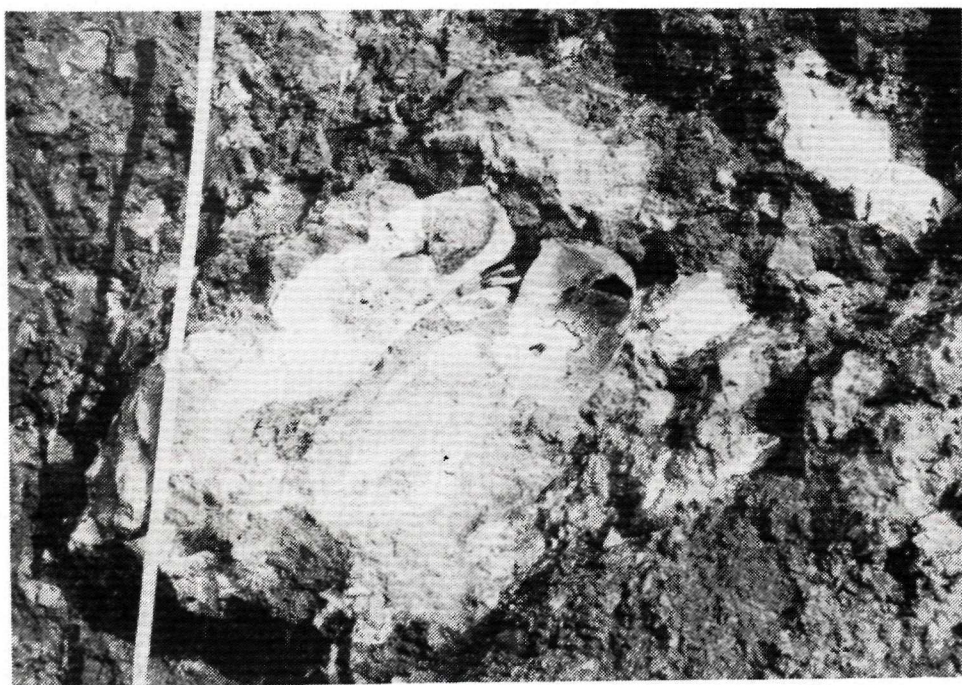
1



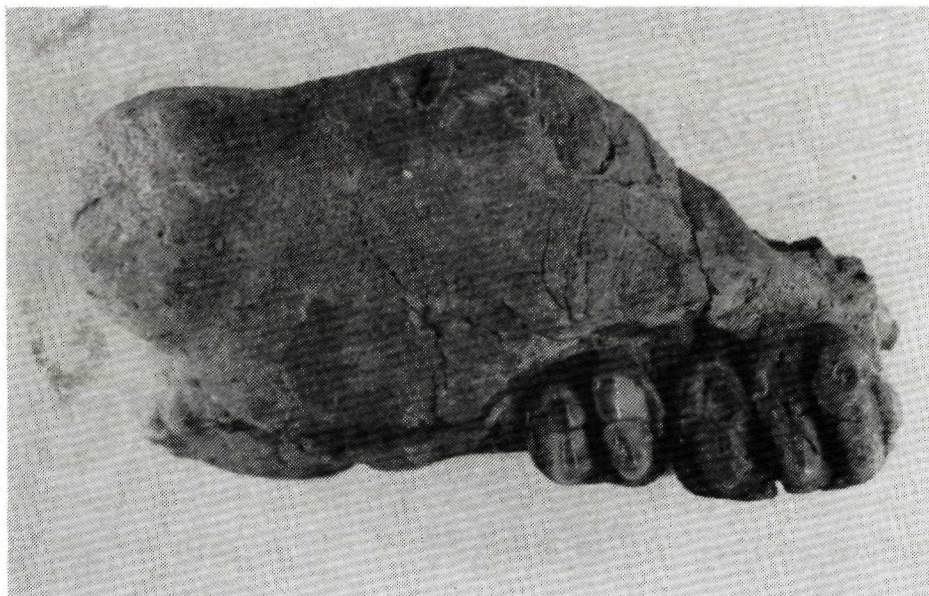
2



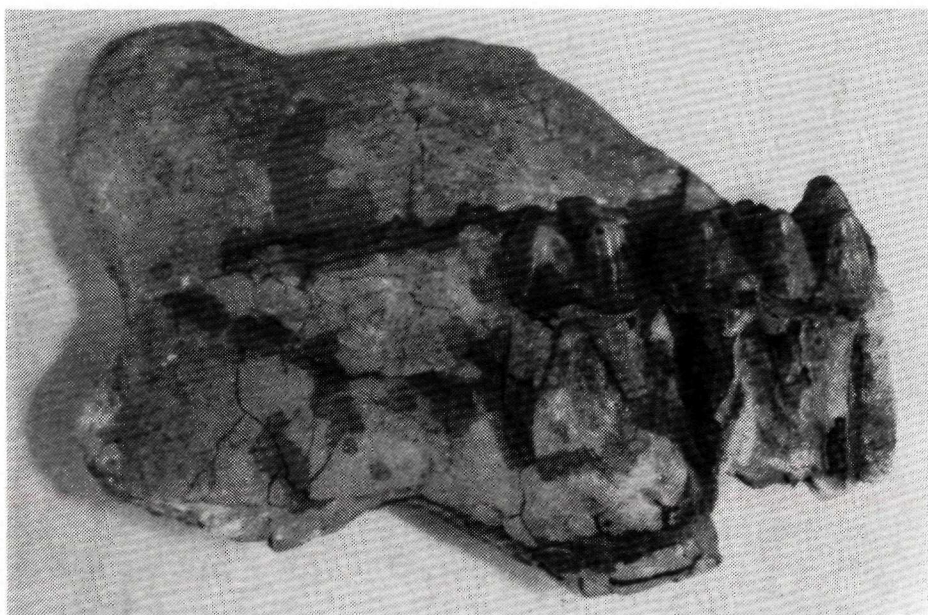
1



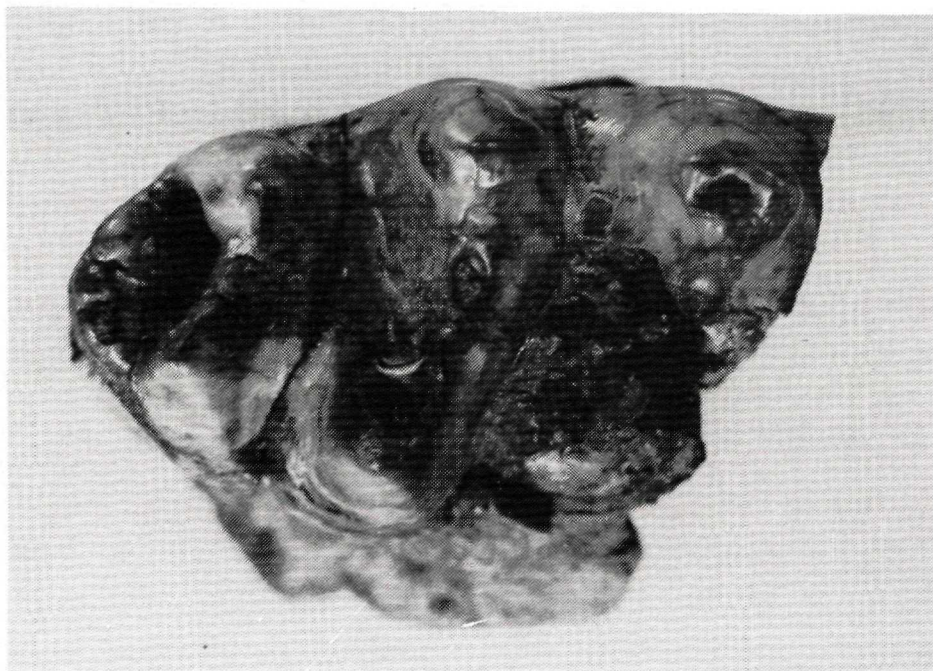
2



1



2

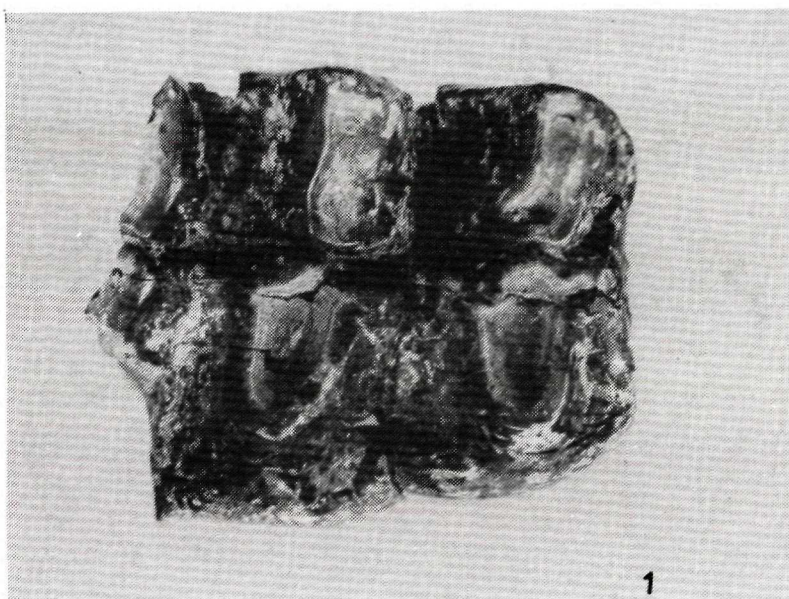


1



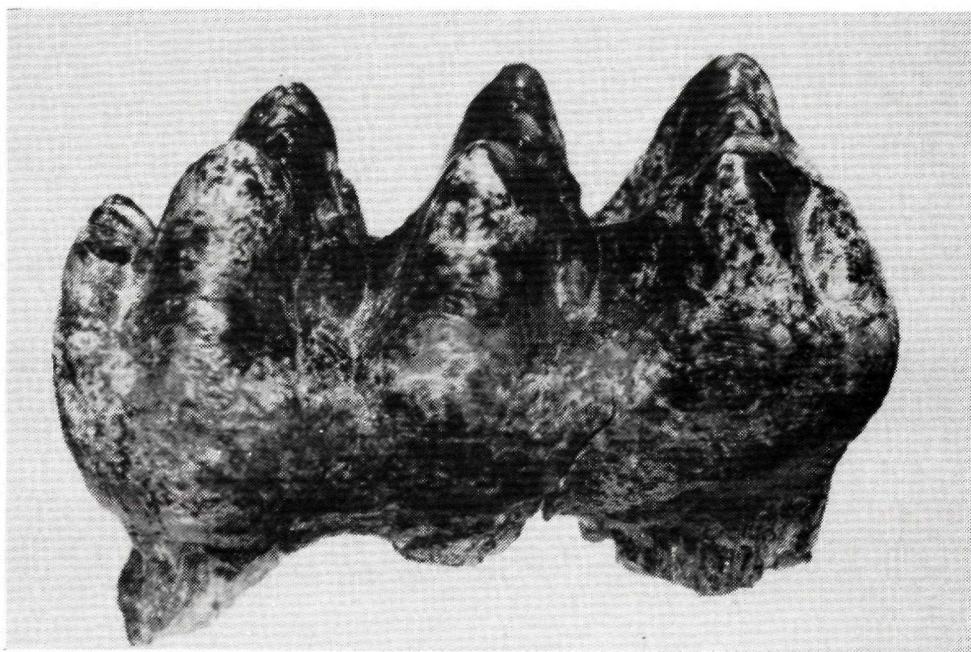
2



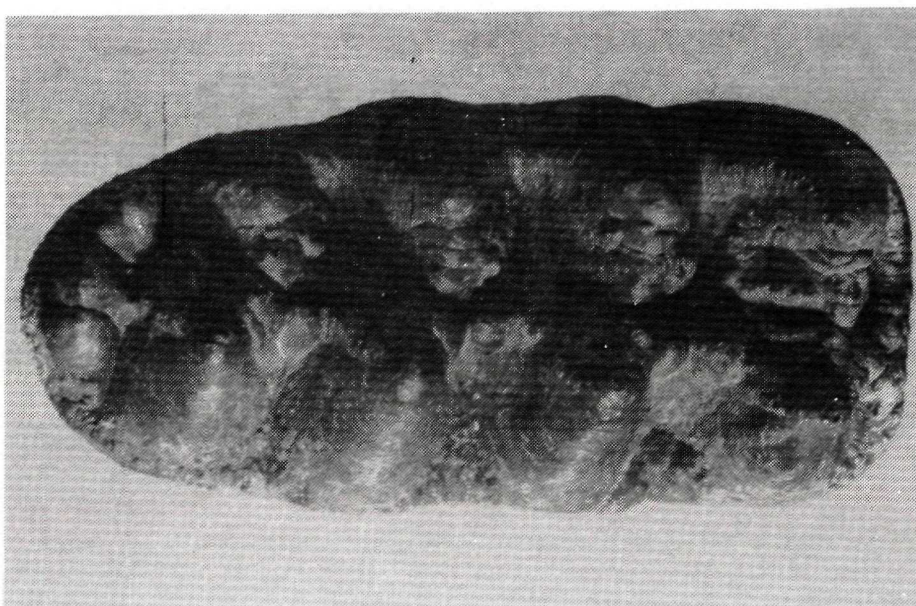




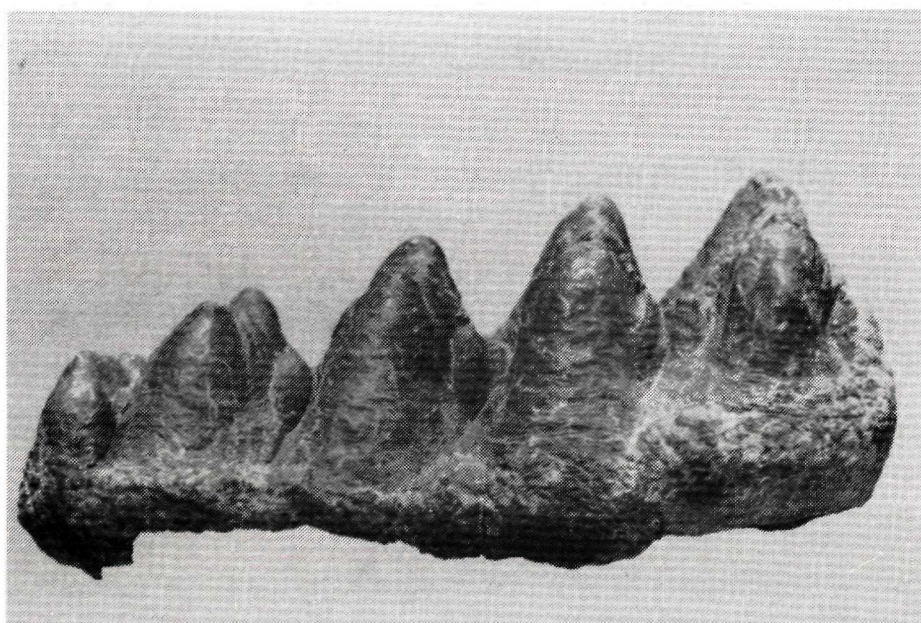
1



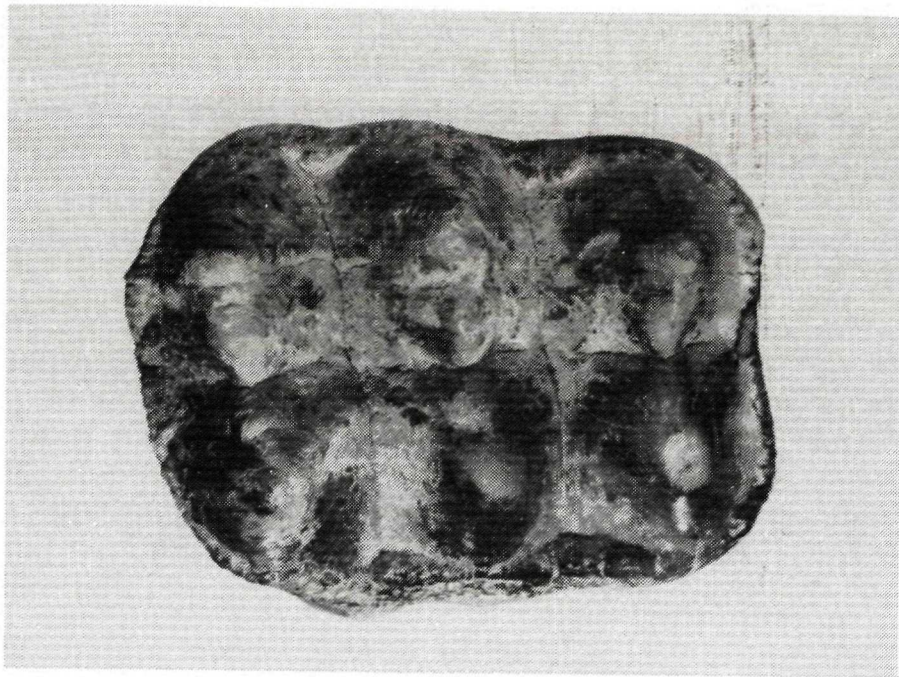
2



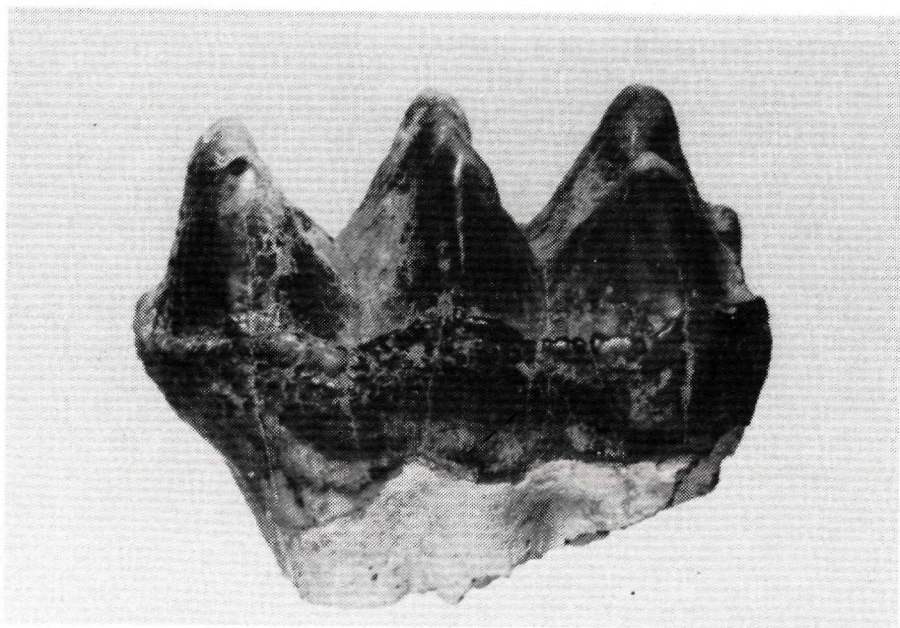
1



2



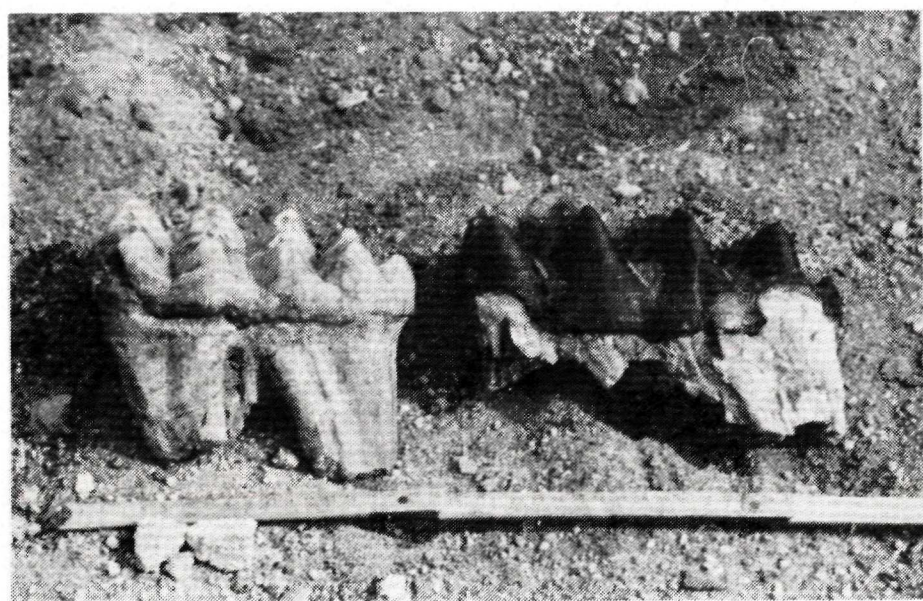
1



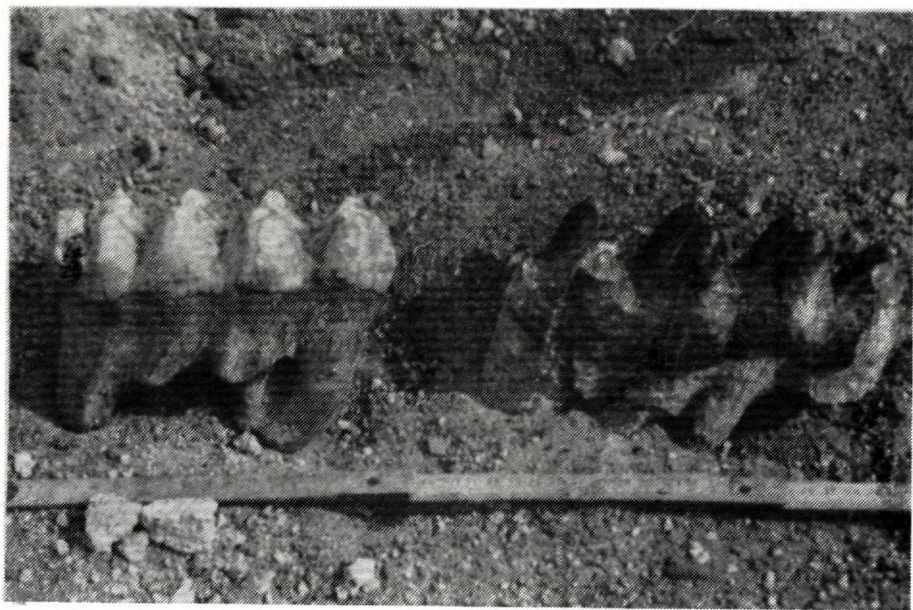
2



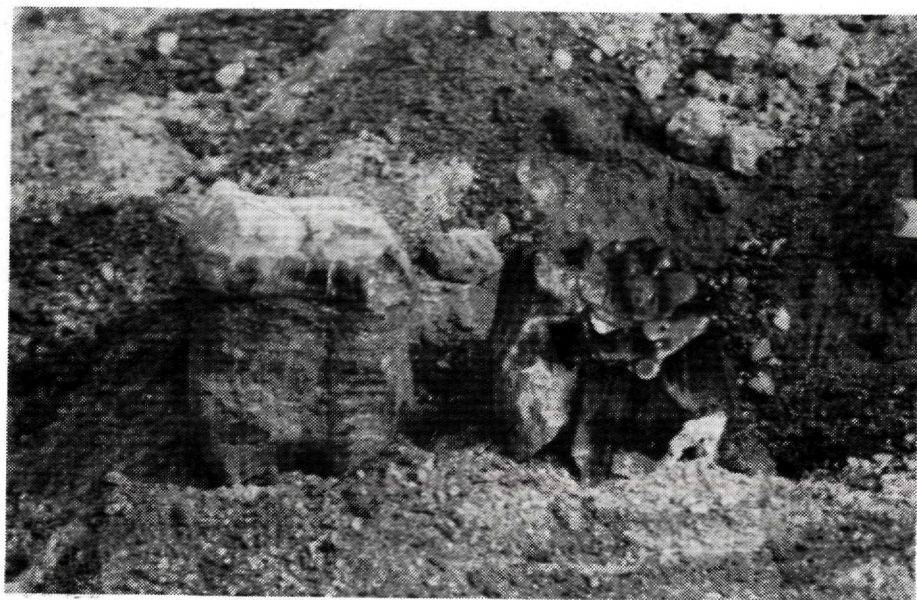
1



2



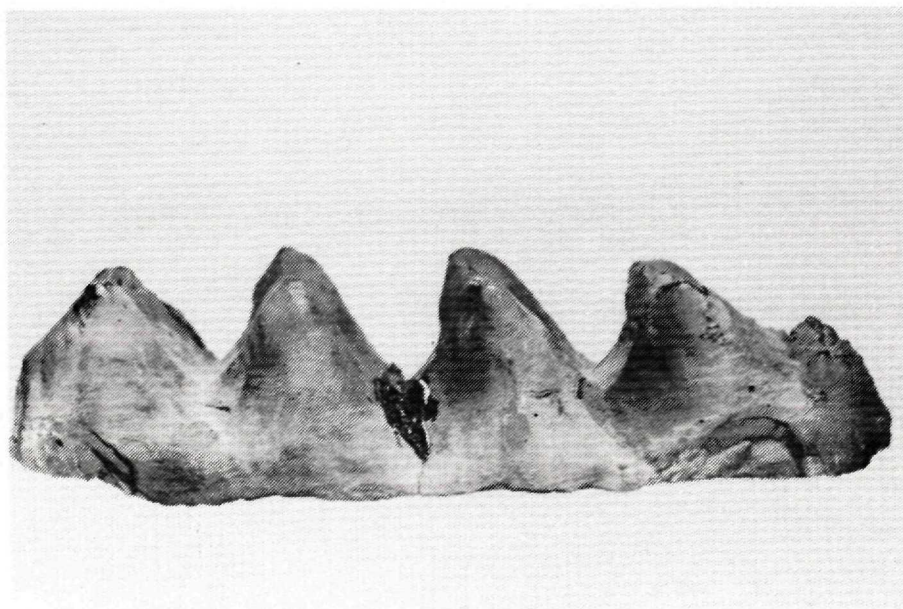
1



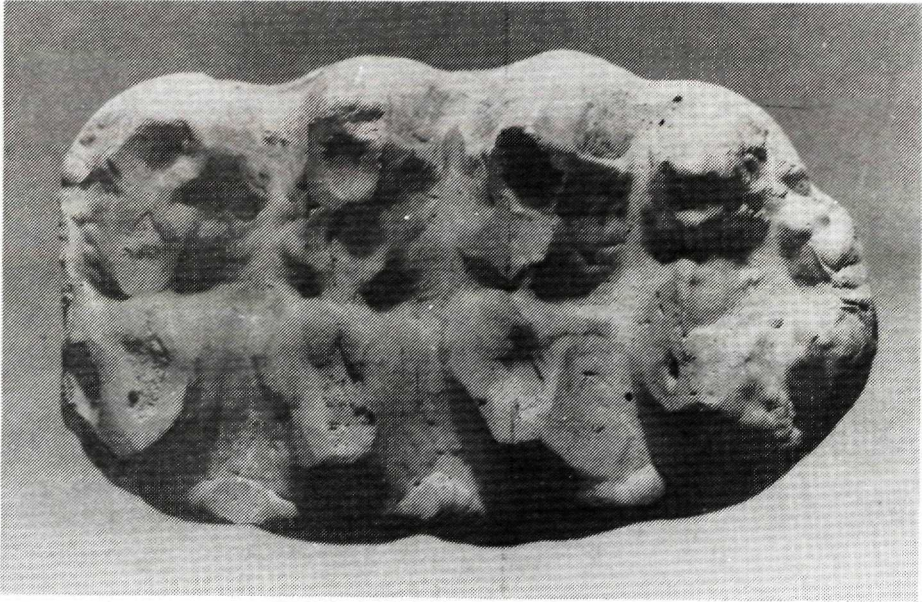
2



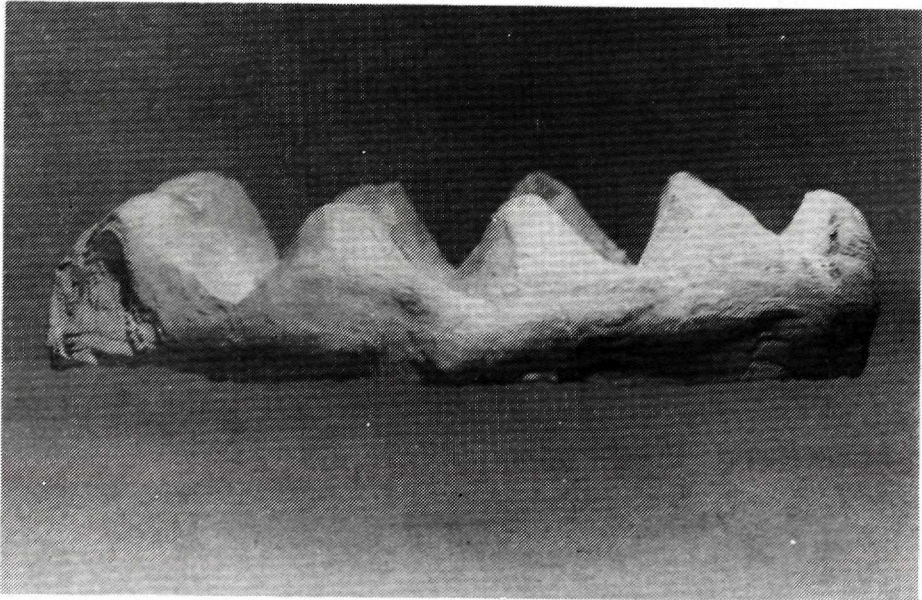
1



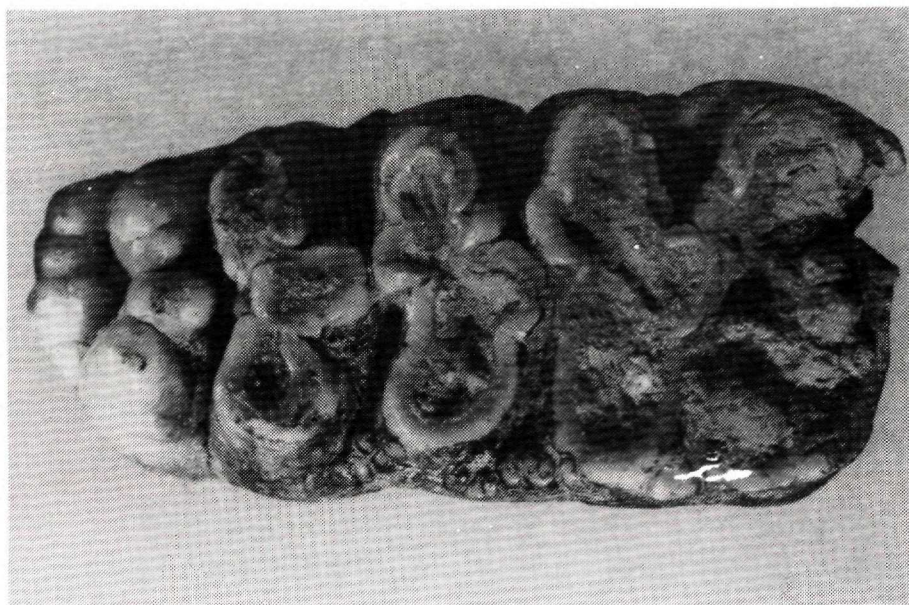
2



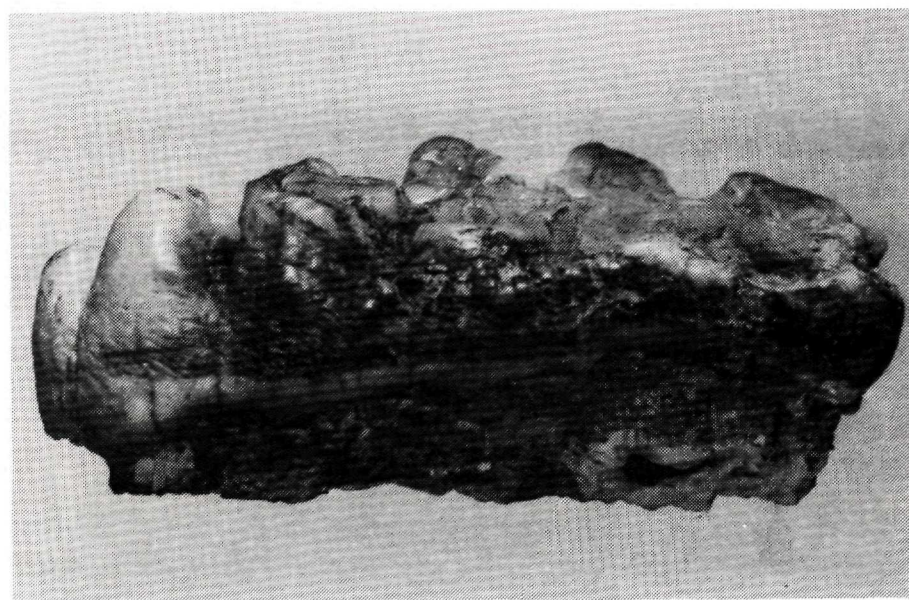
1



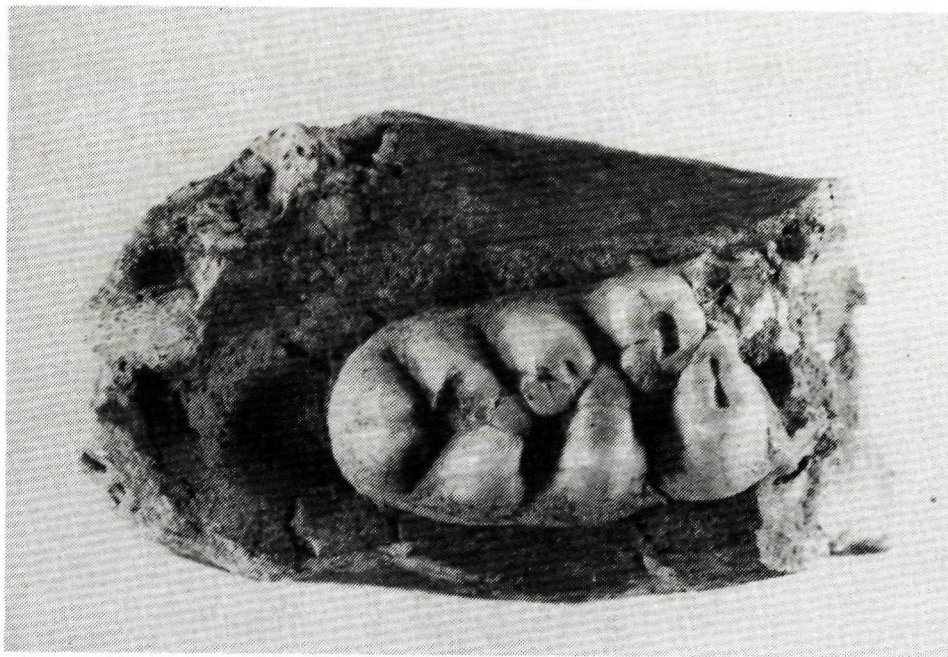
2



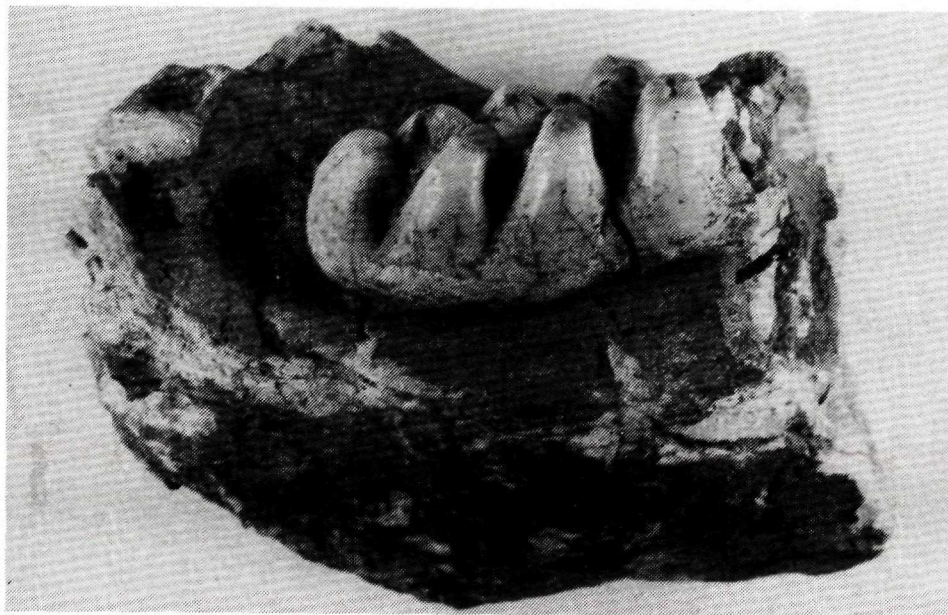
1



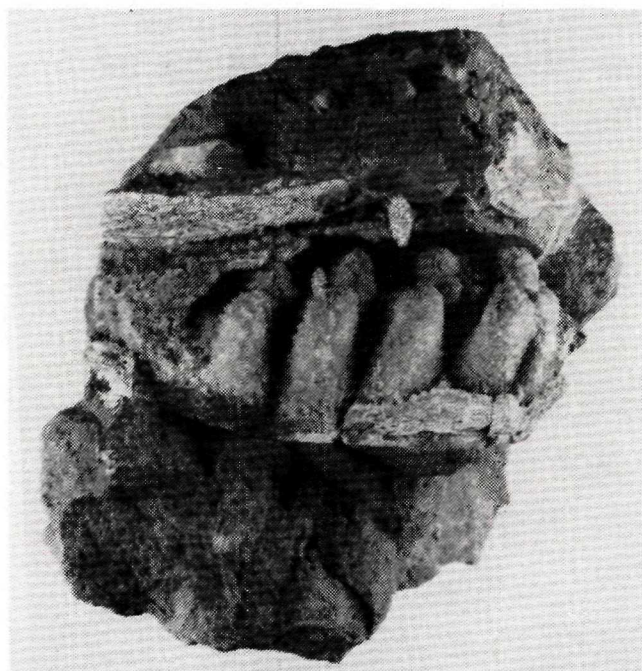
2



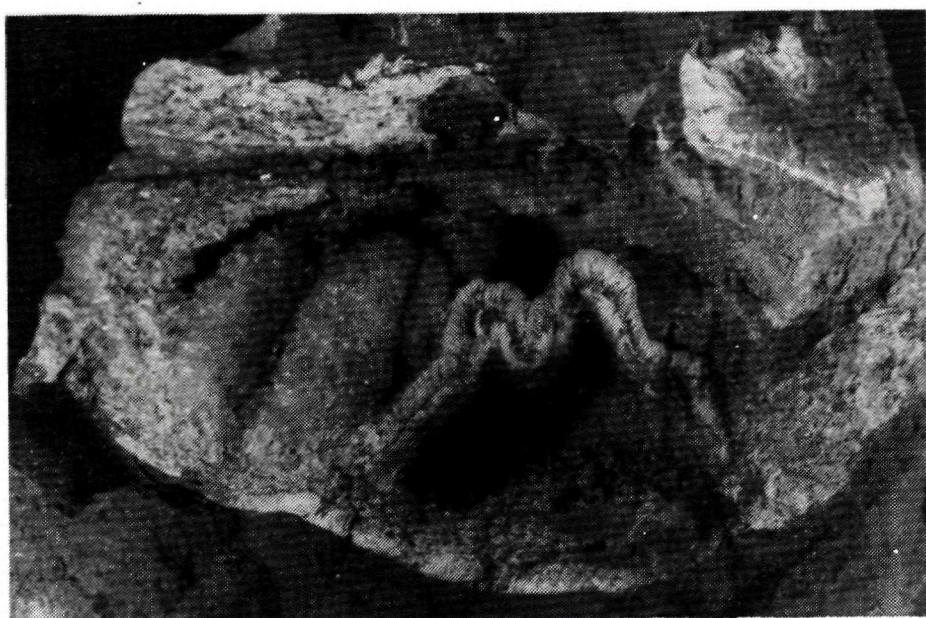
1



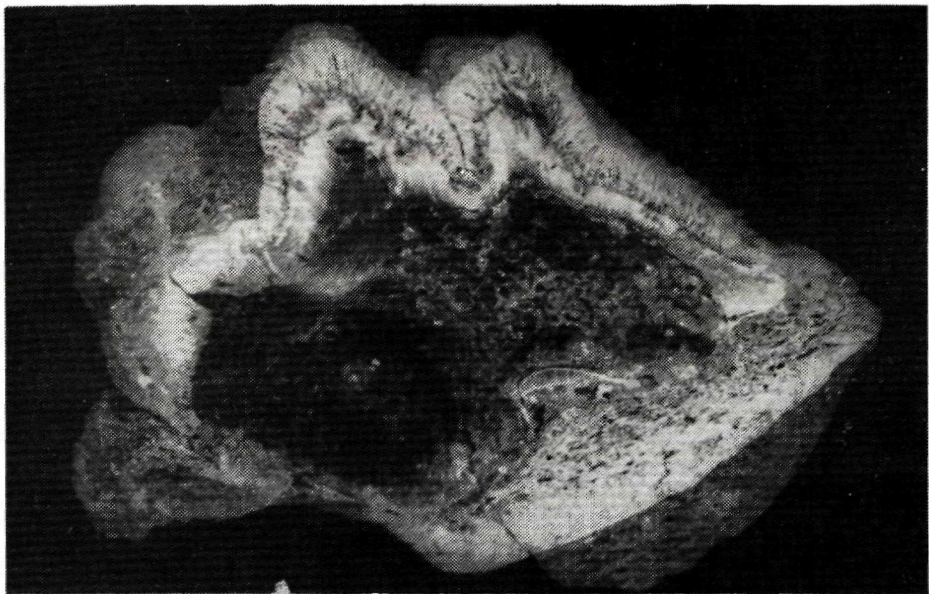
2



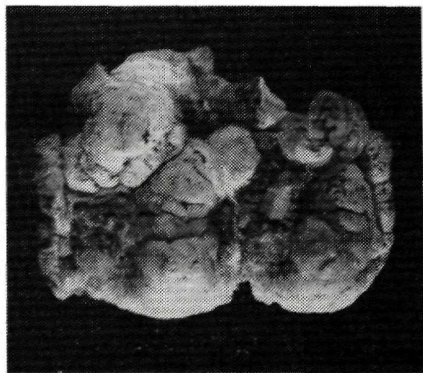
1



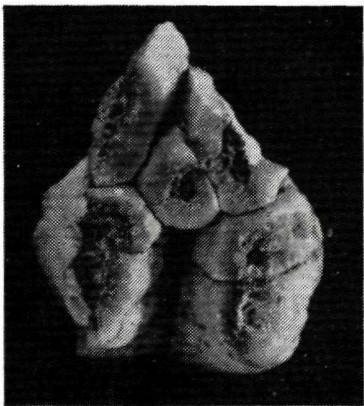
2



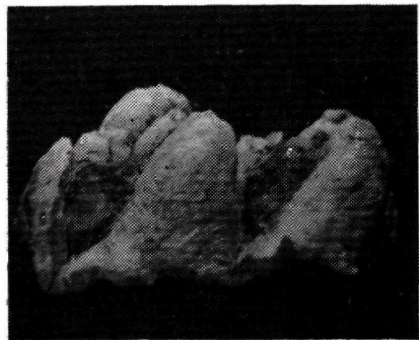
1



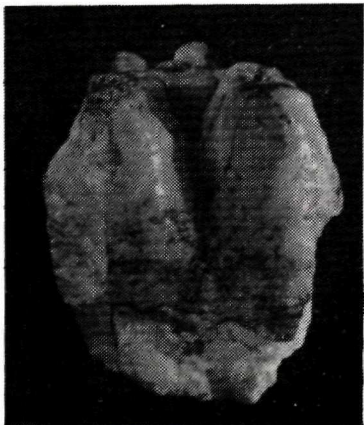
2a



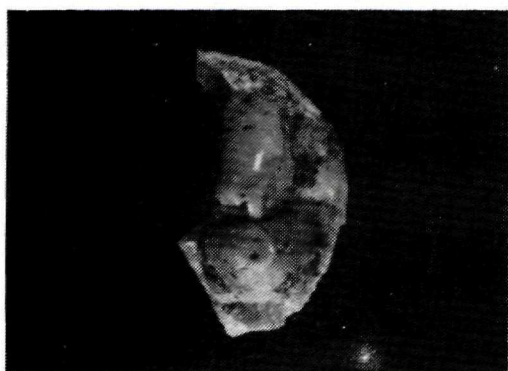
3a



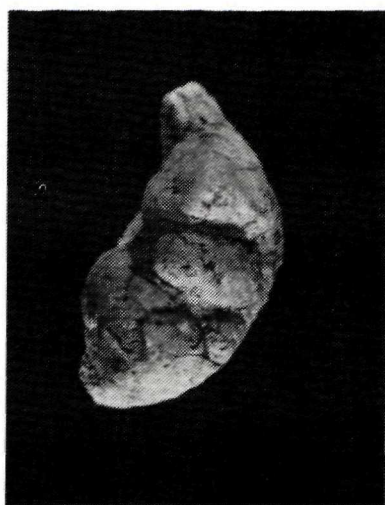
2b



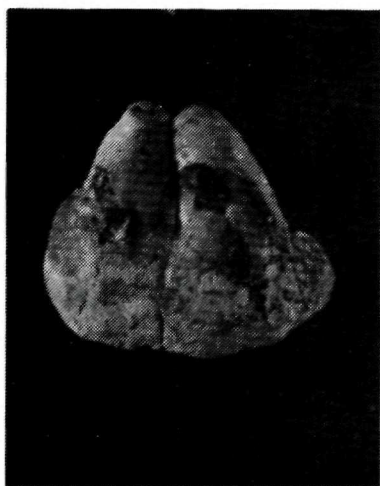
3b



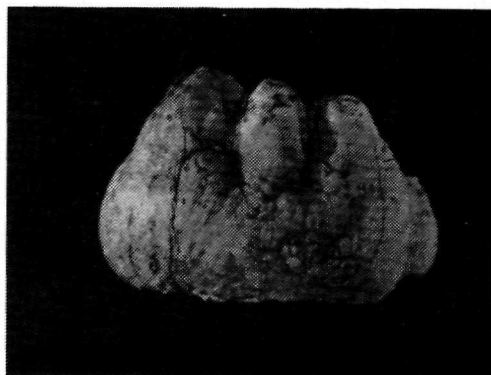
1a



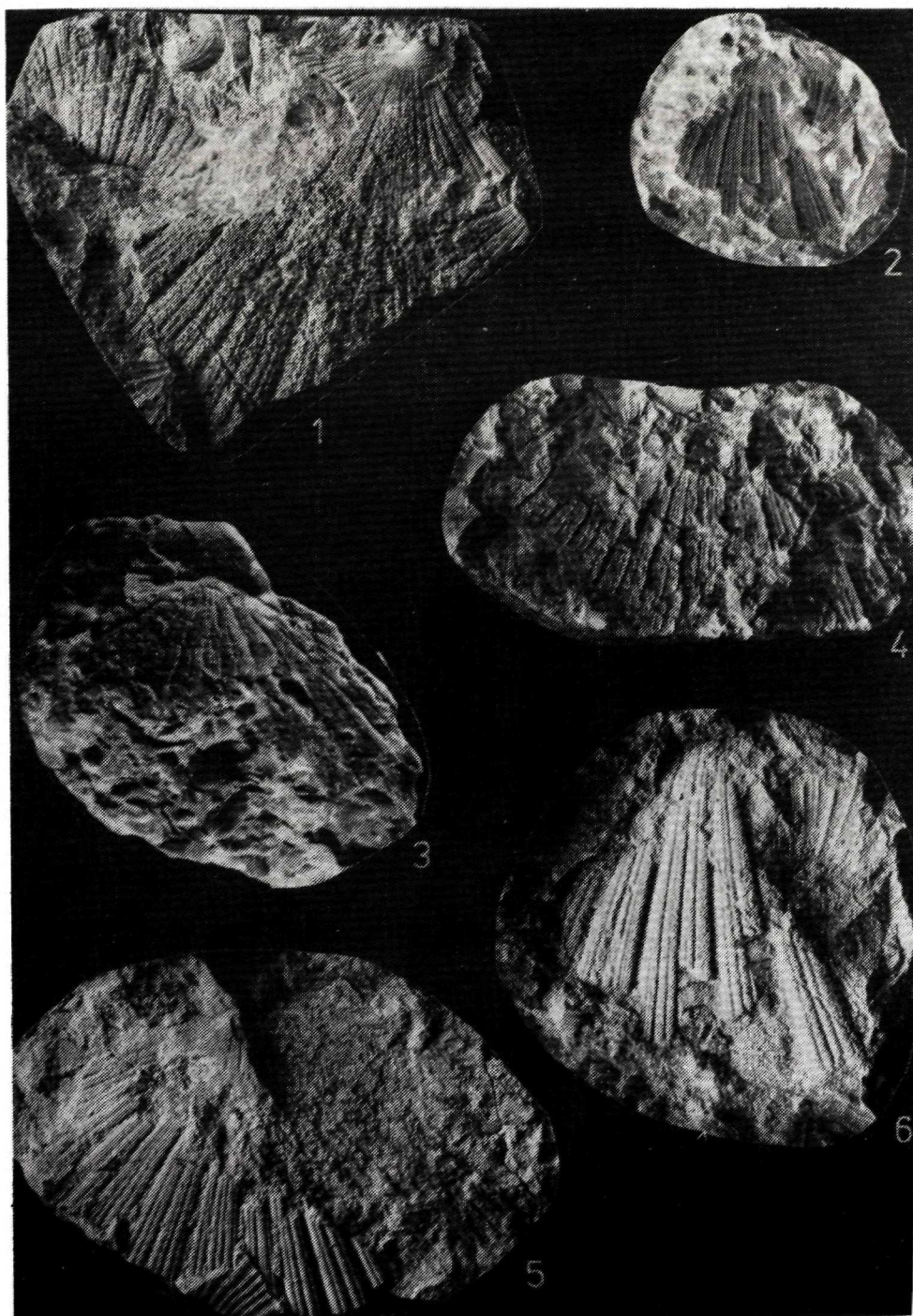
2a

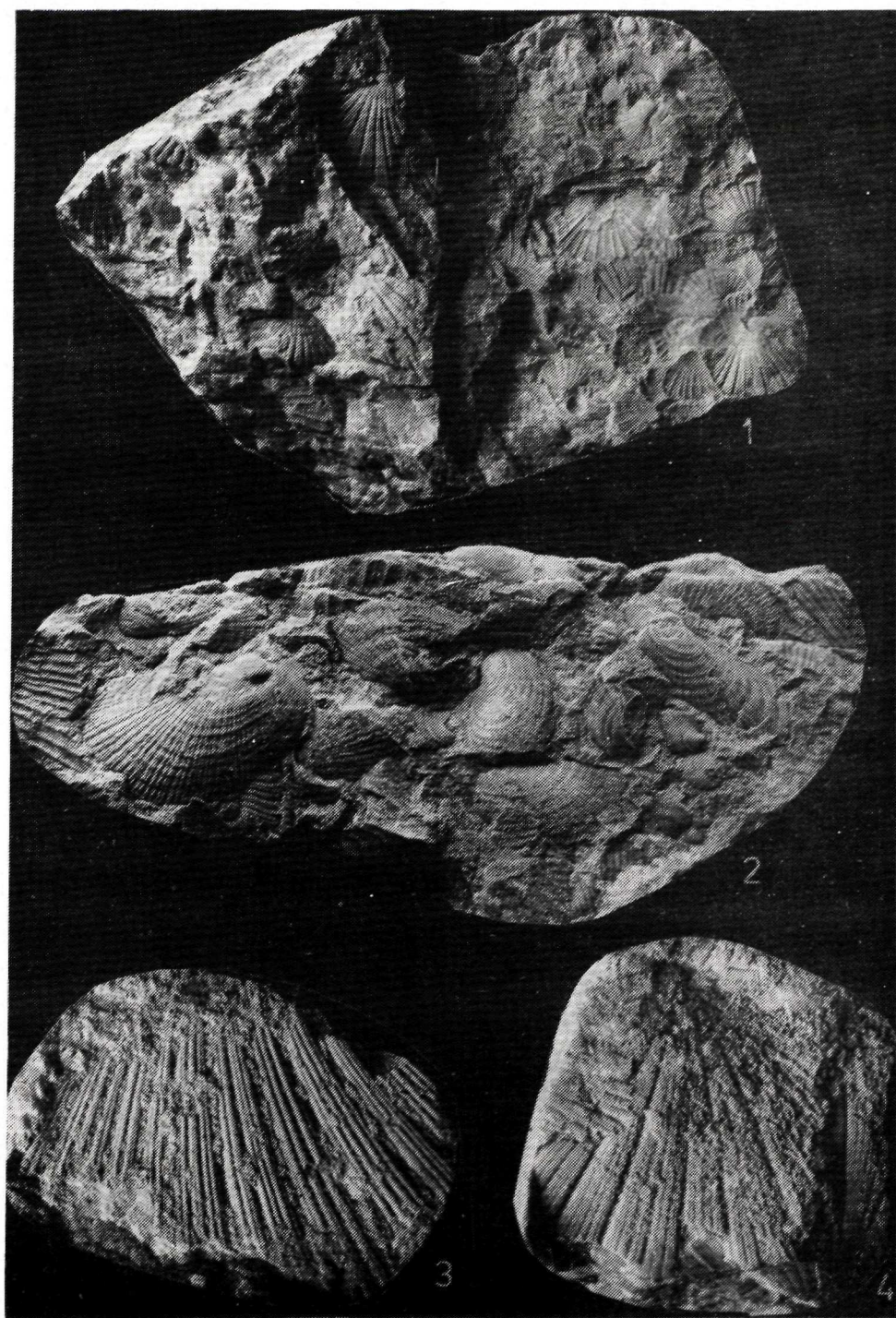


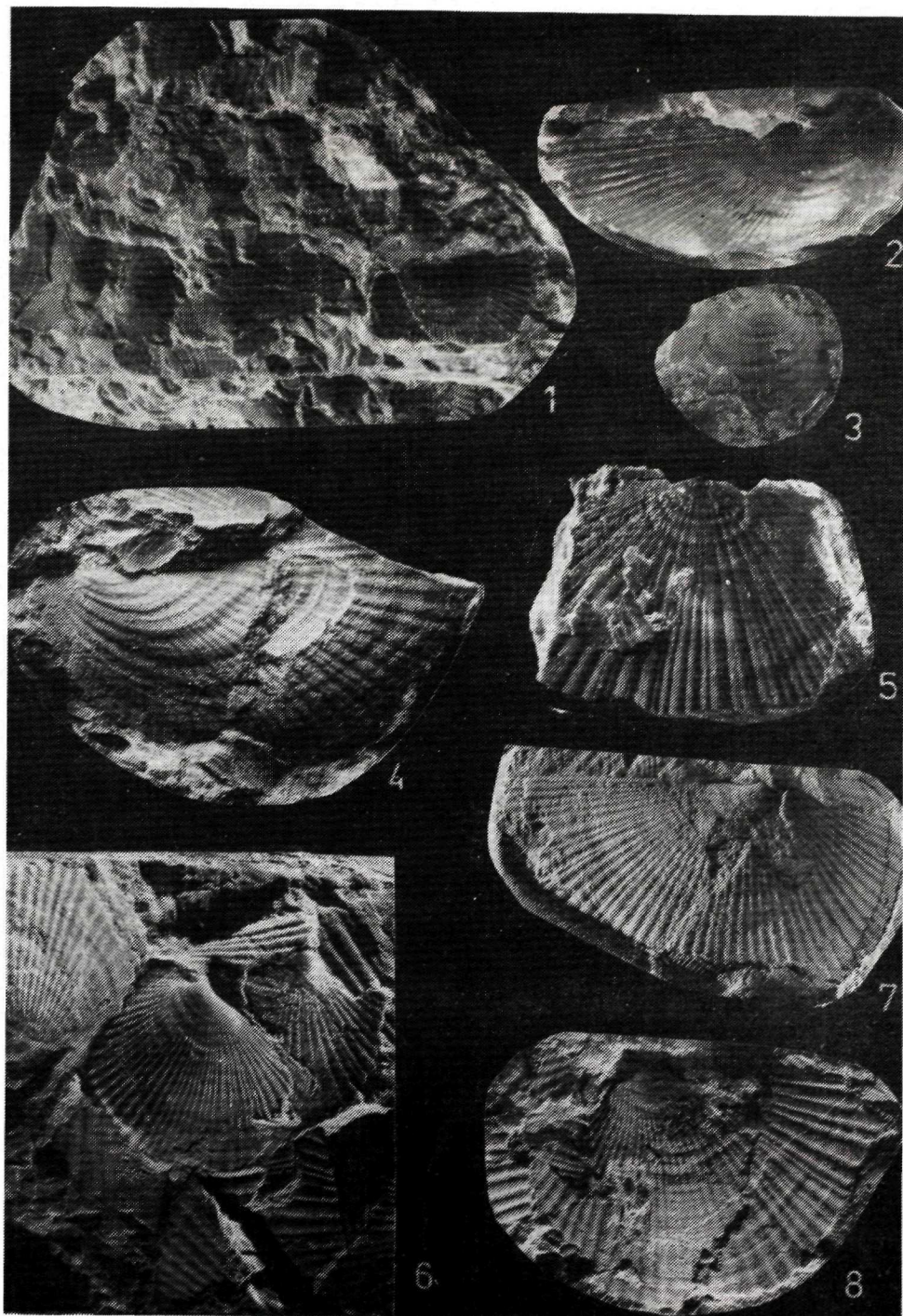
1b

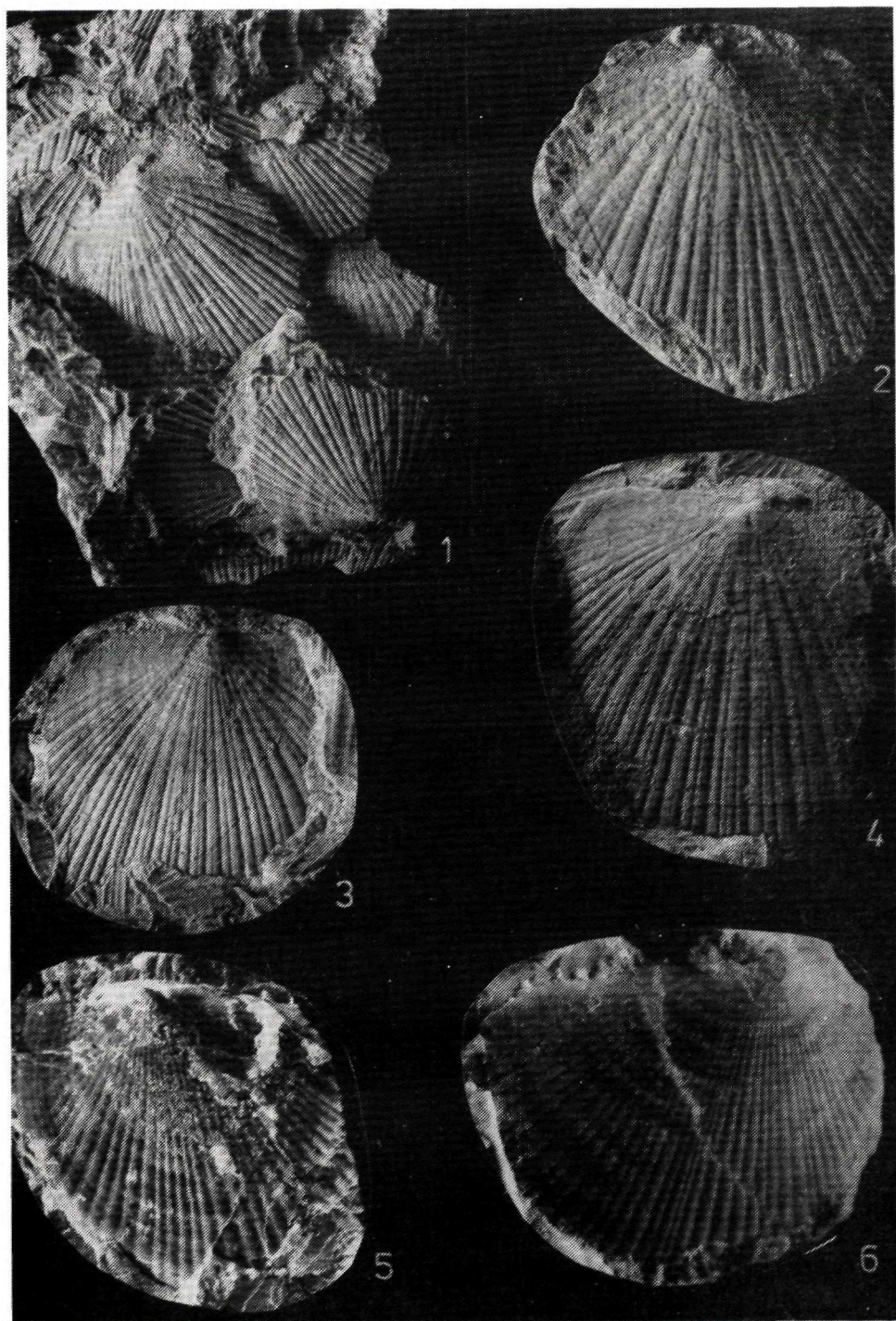


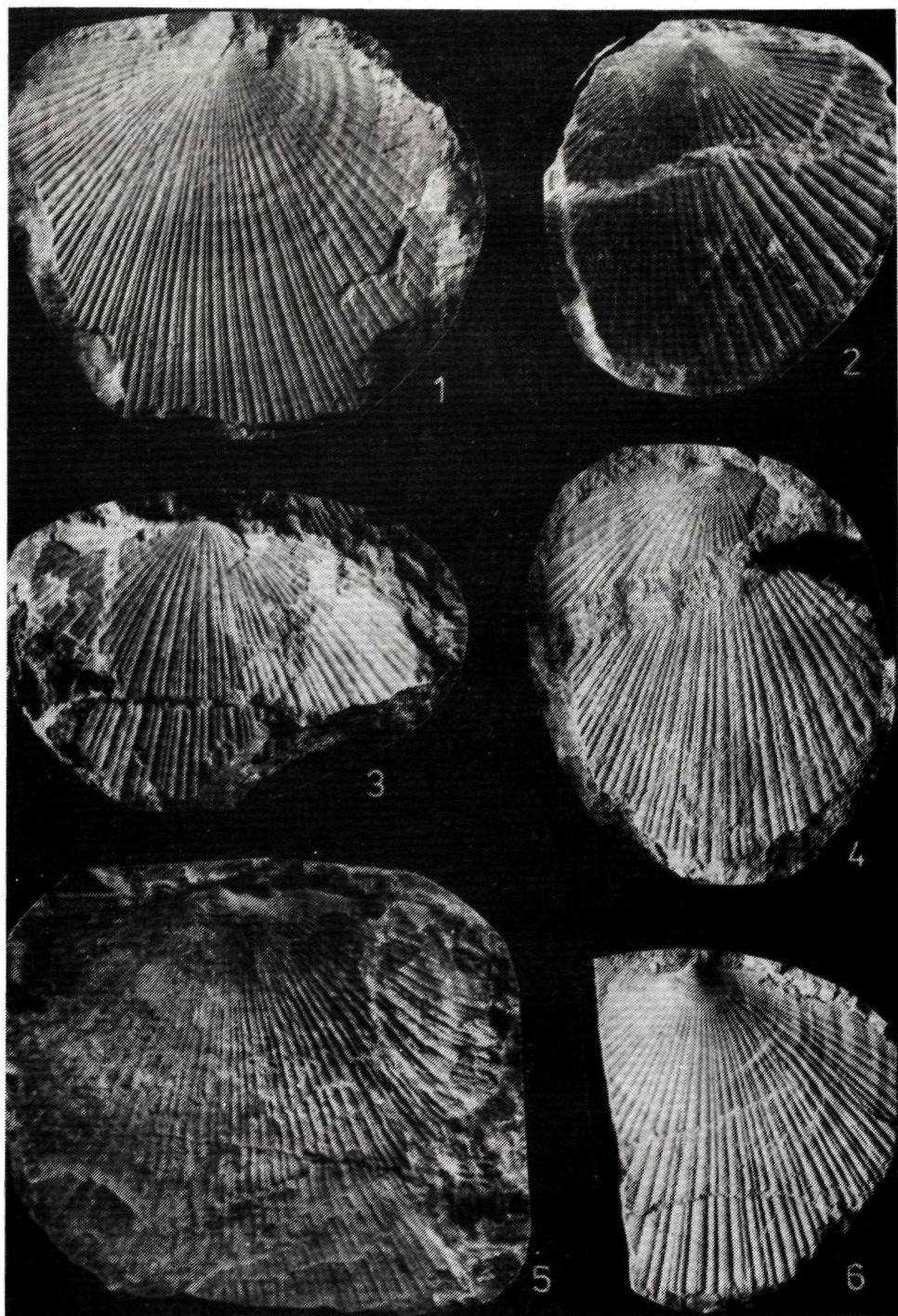
2b

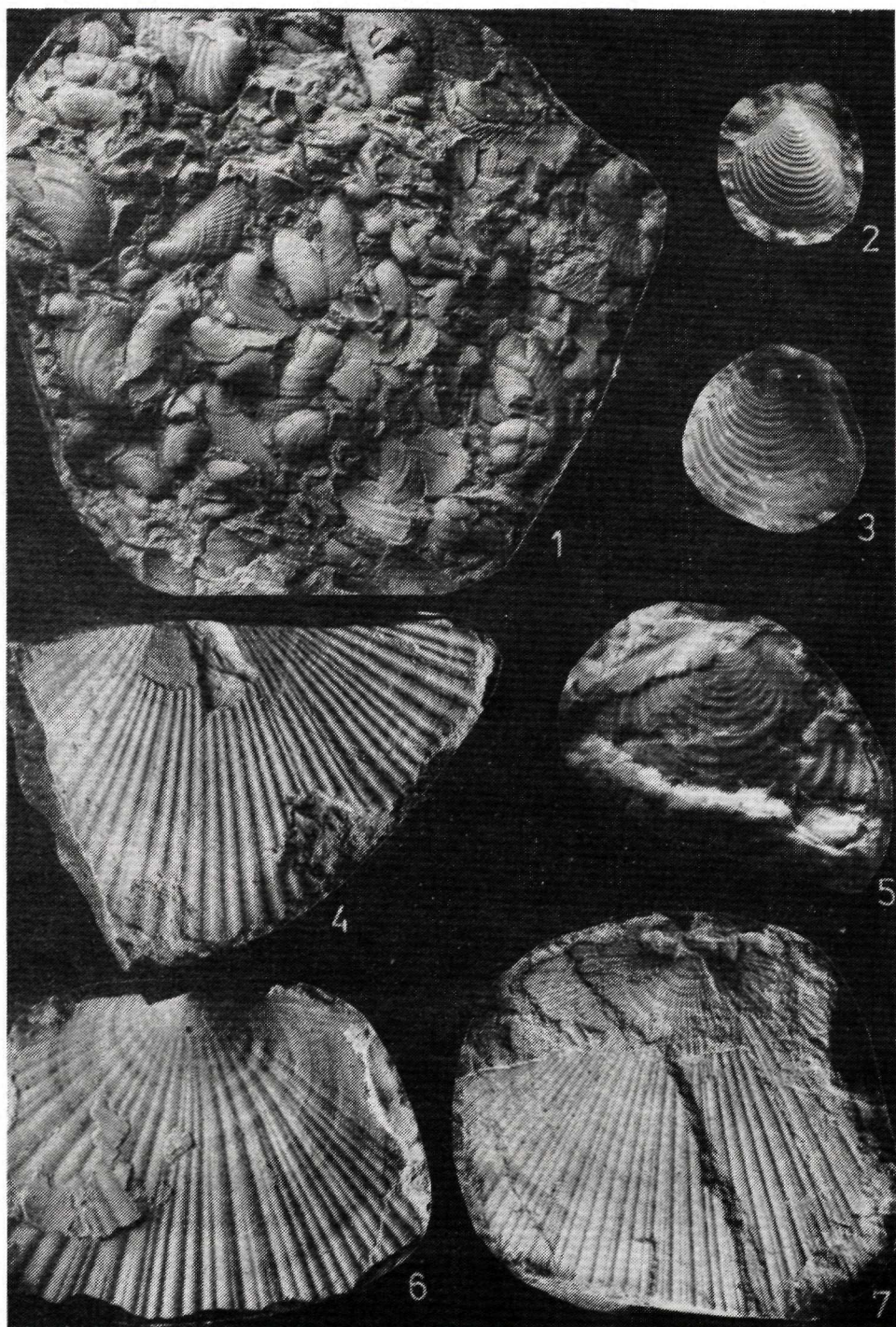


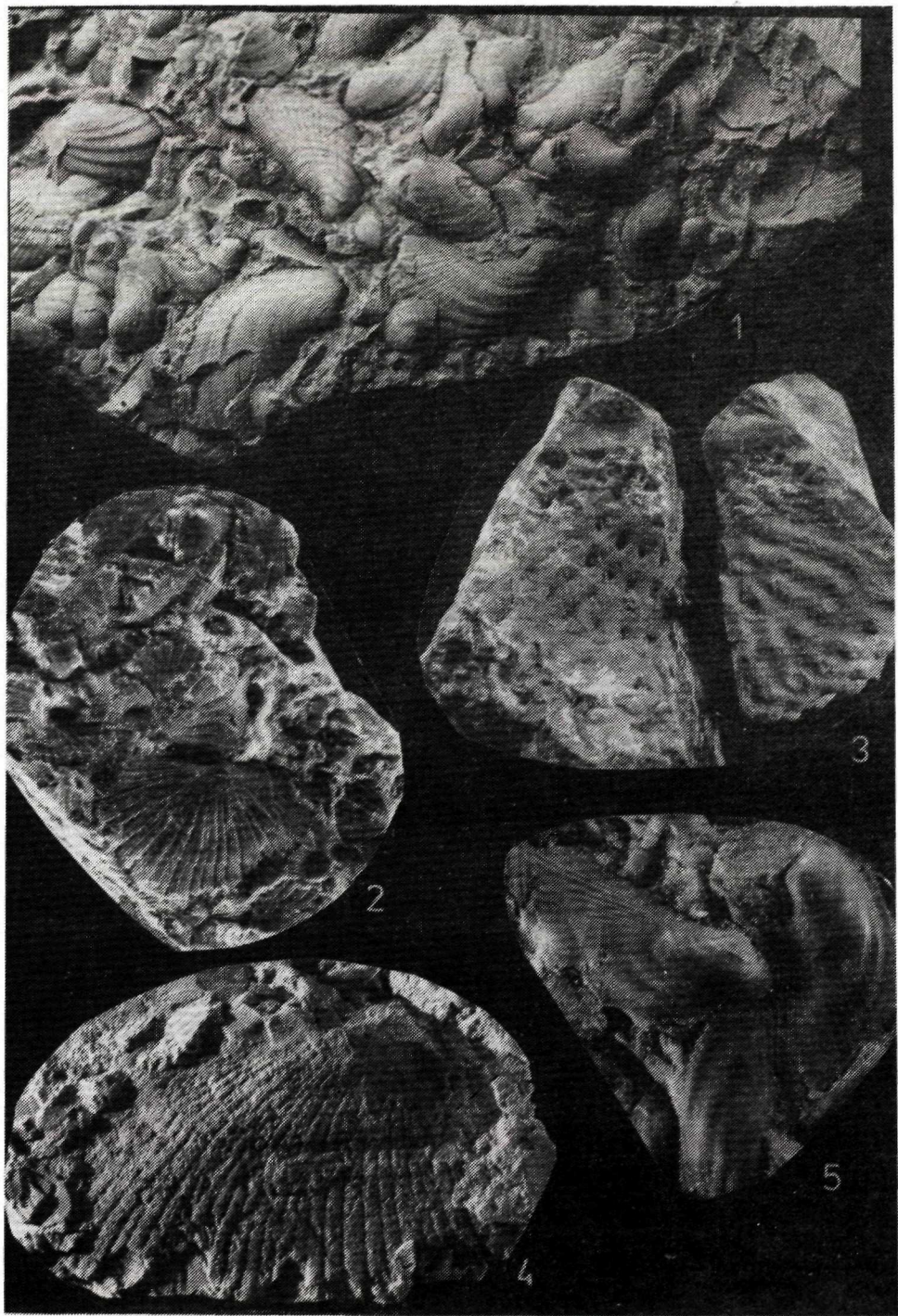


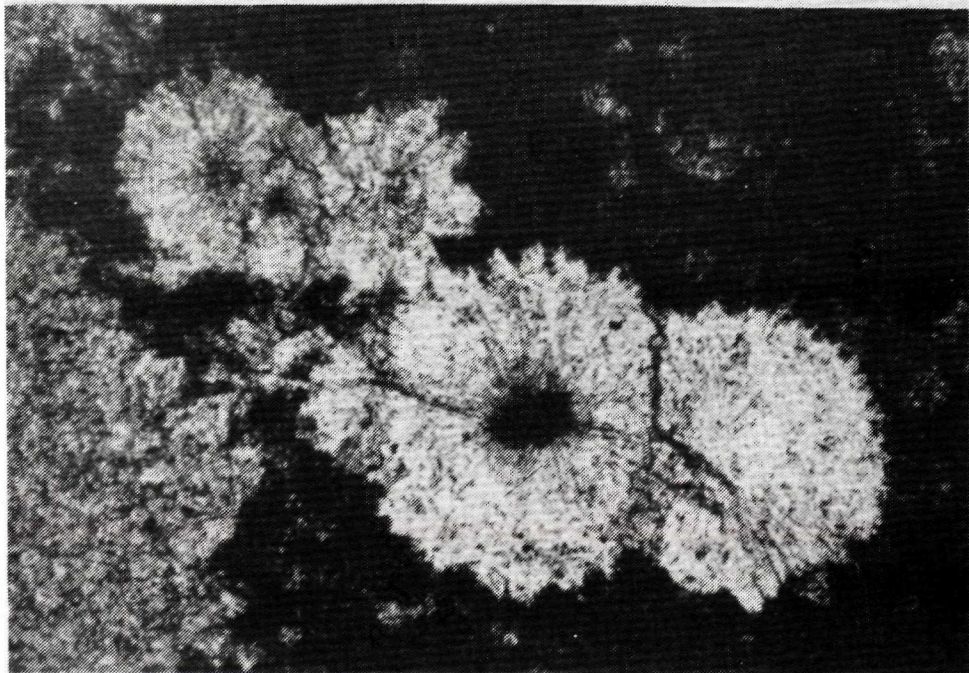
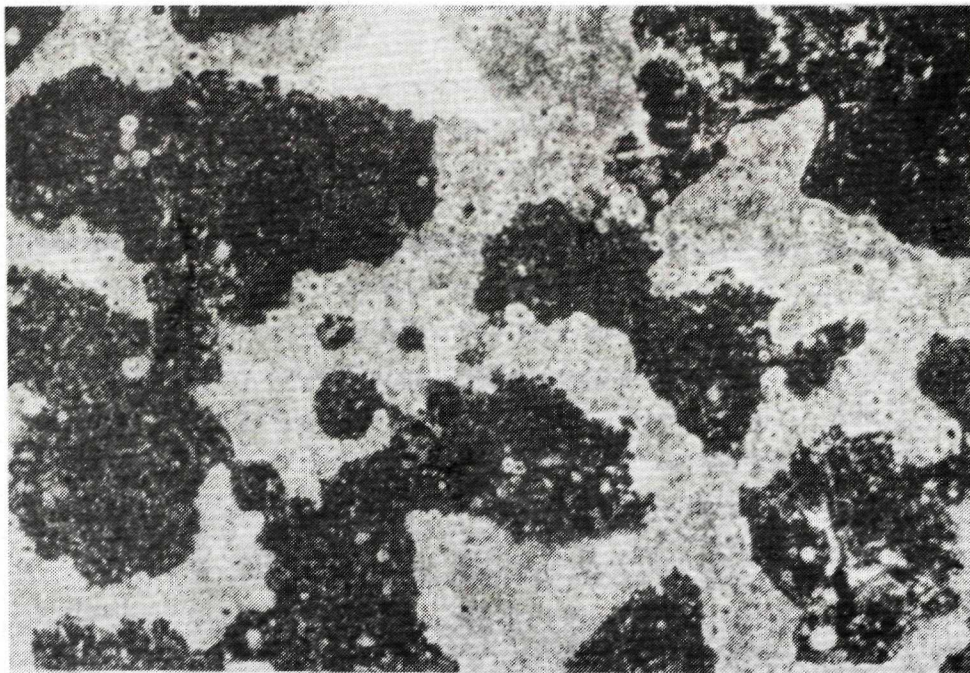


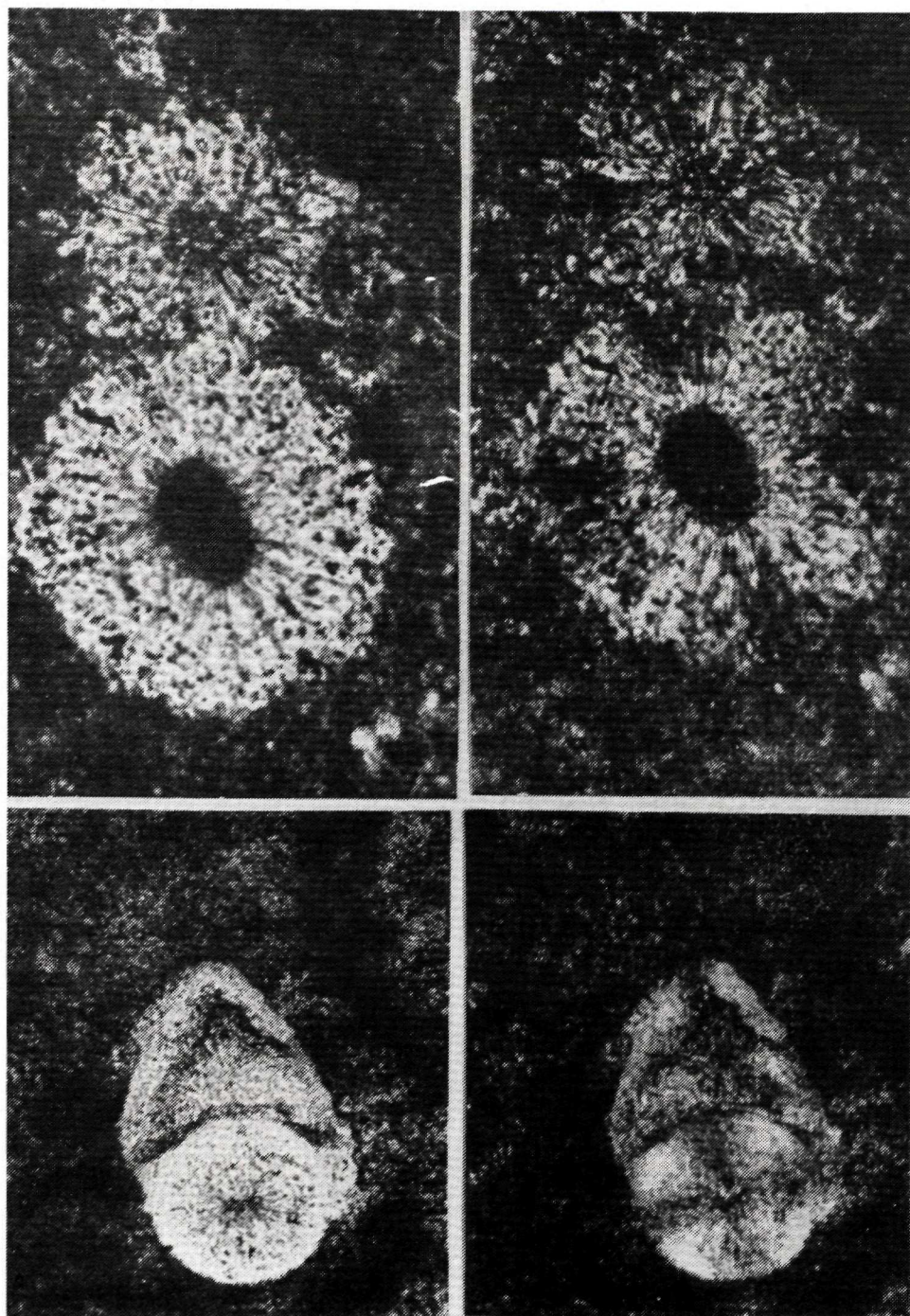


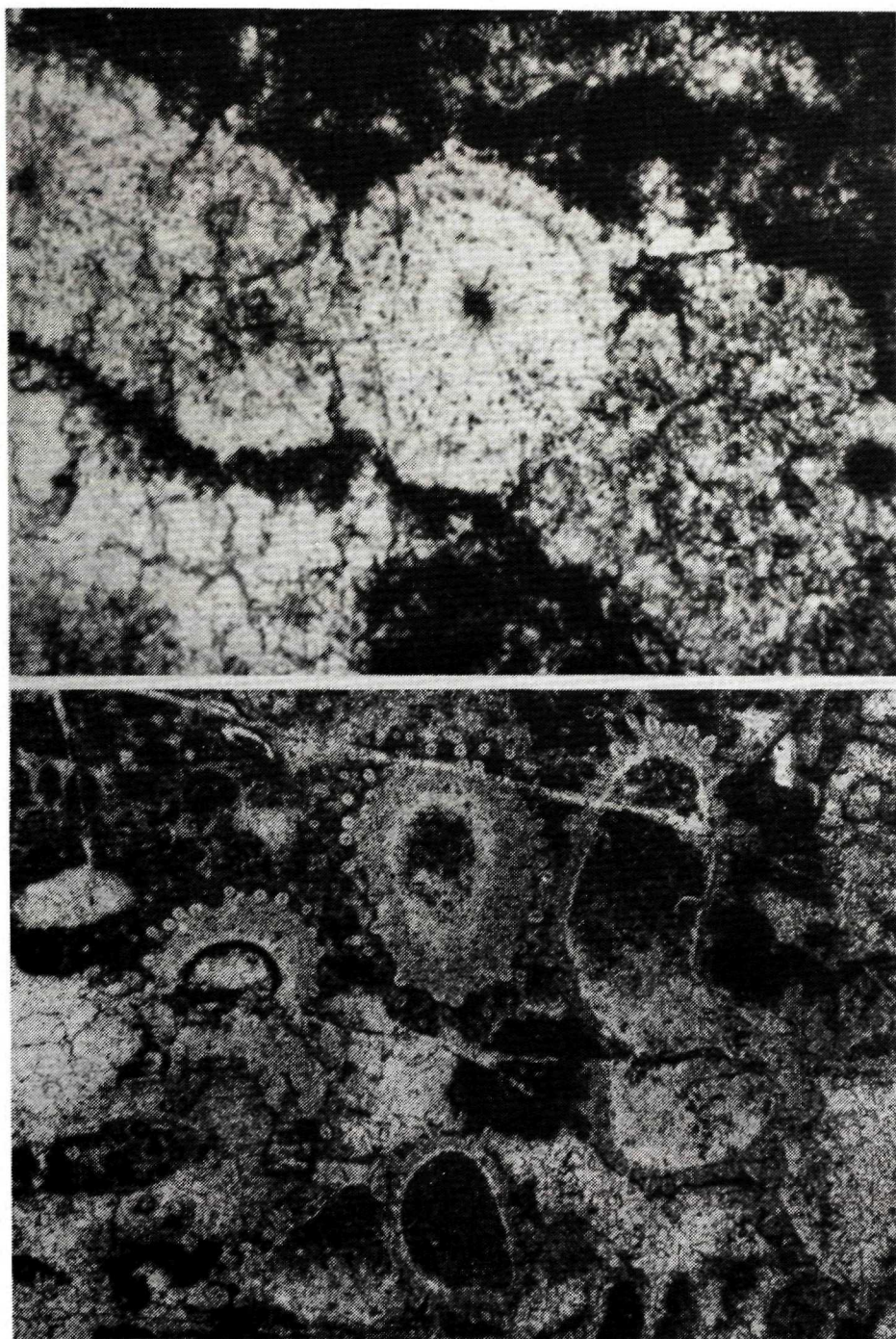


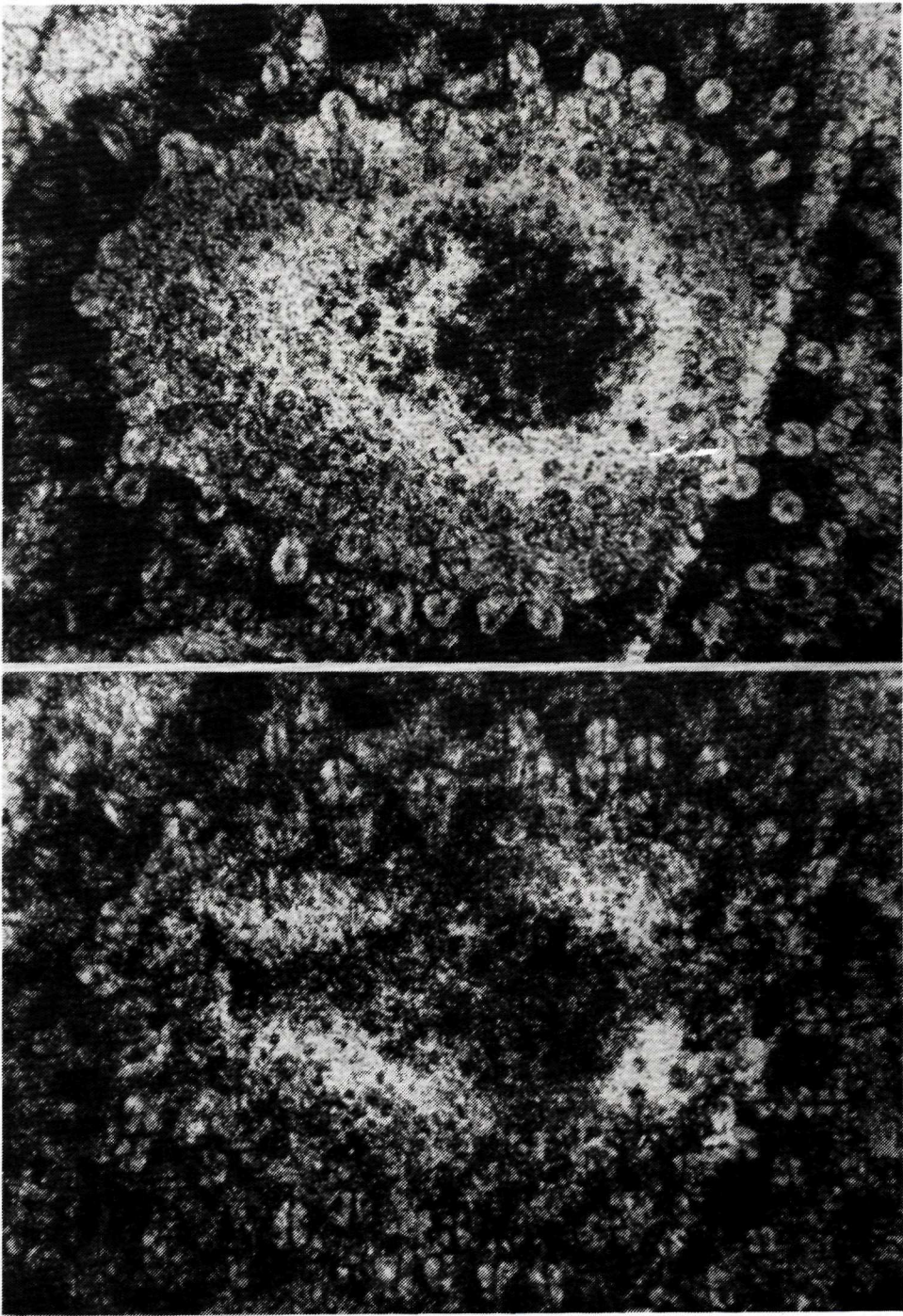


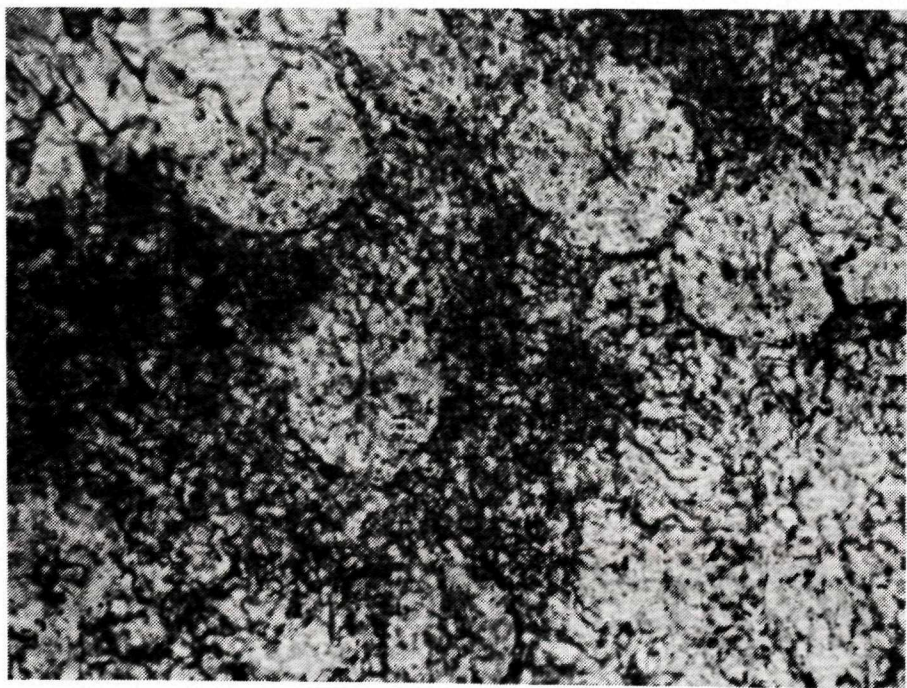


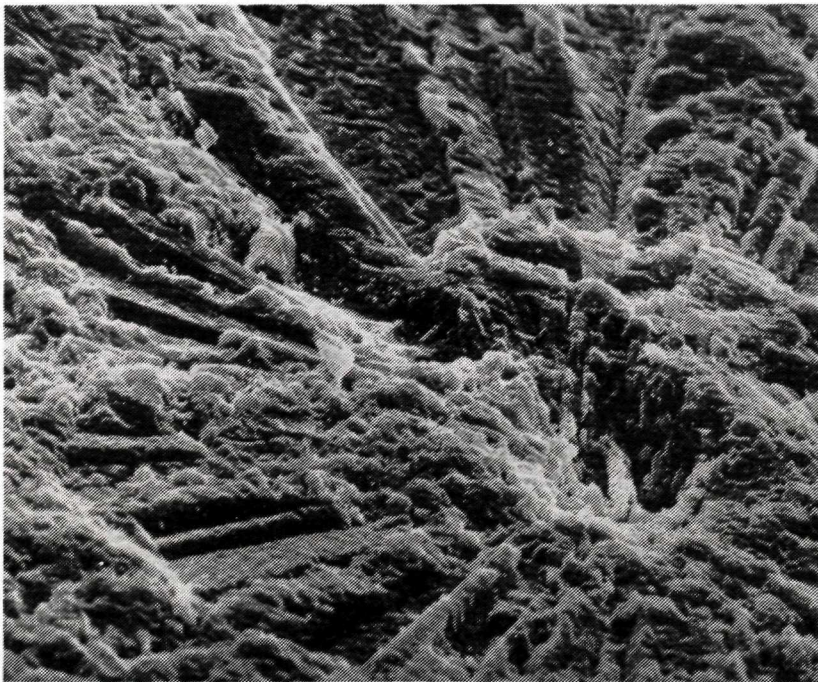




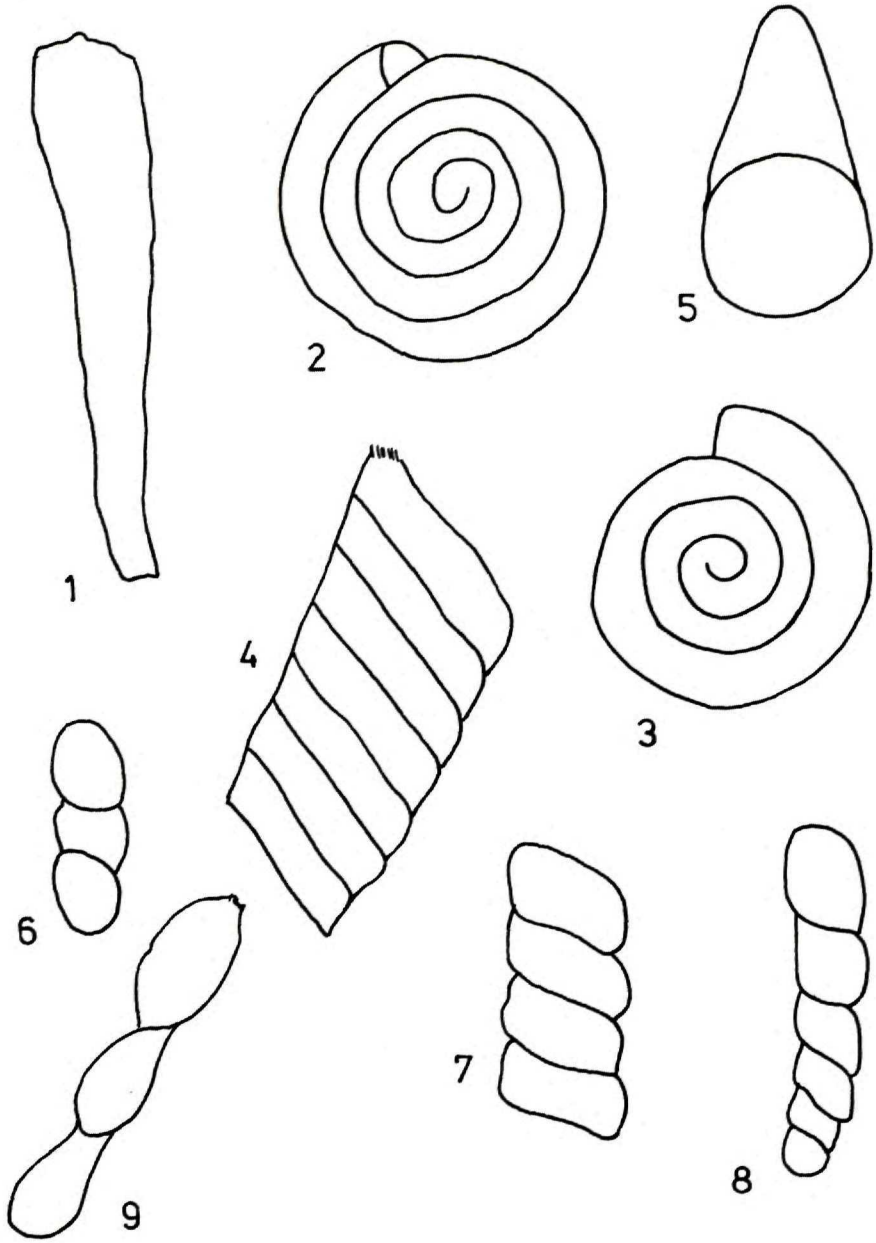


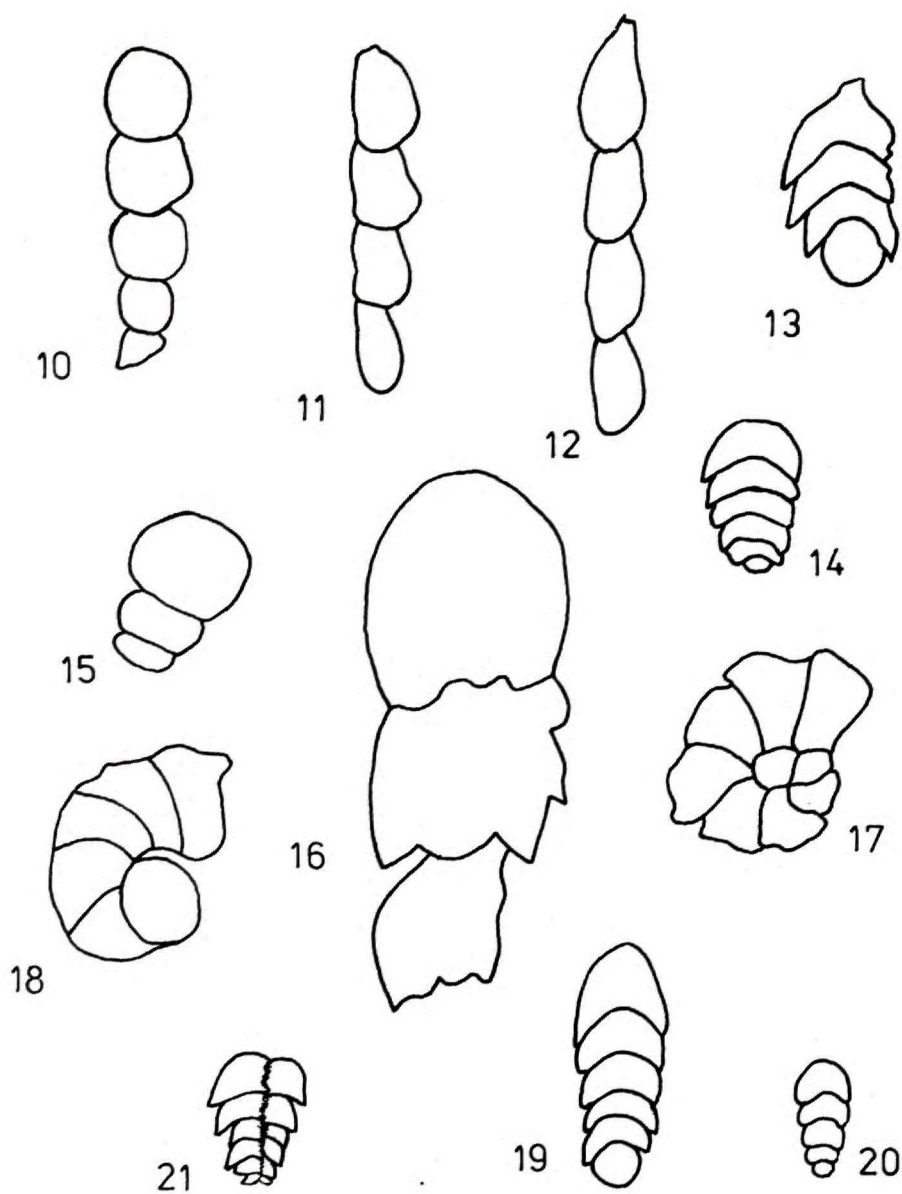


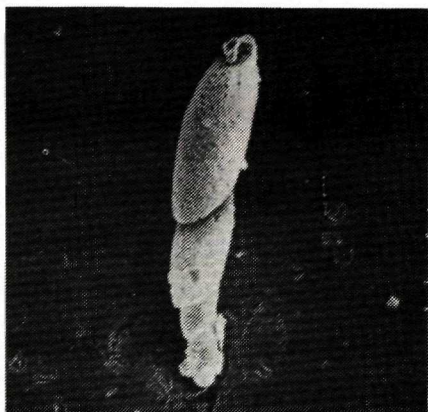




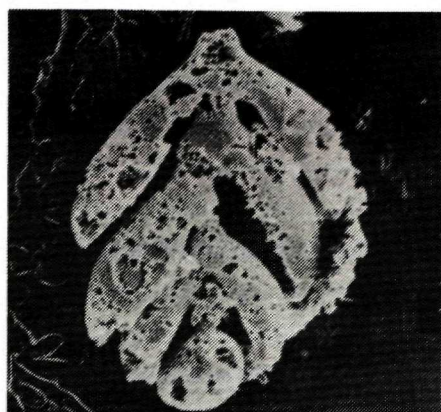




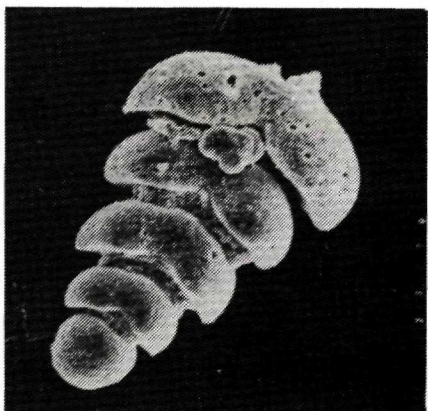




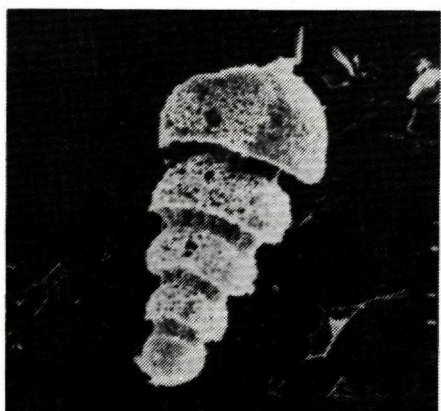
1



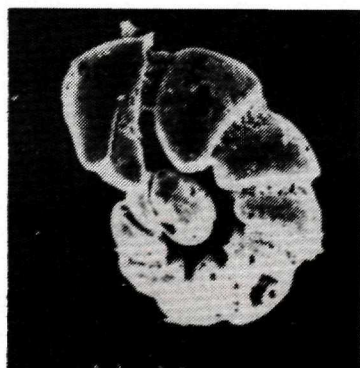
2



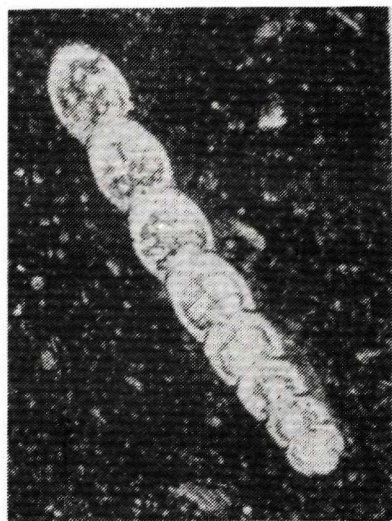
3



4



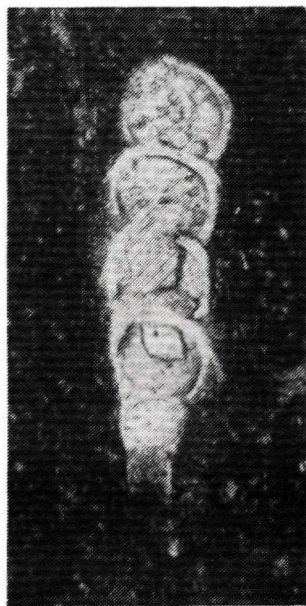
5



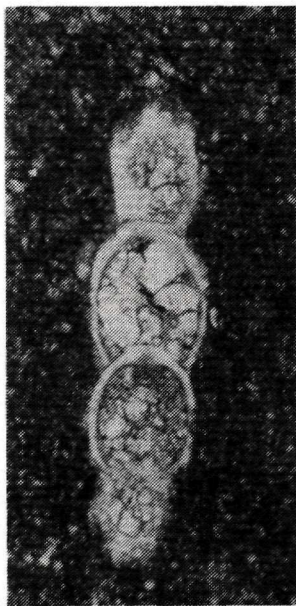
1



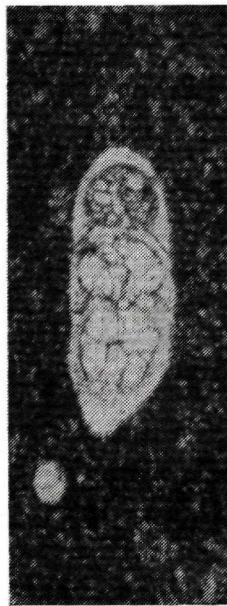
2



3



4



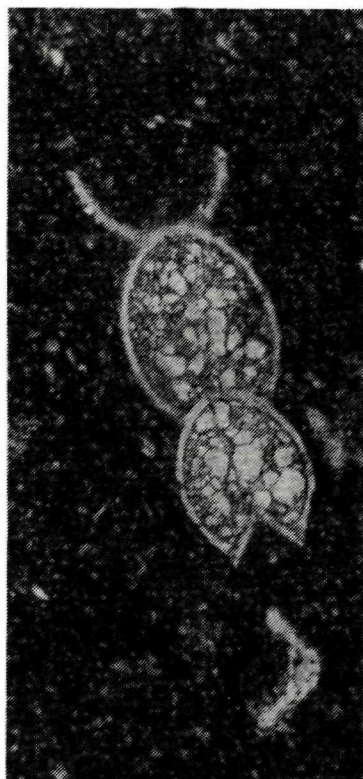
5



1



3



2



4



1



3



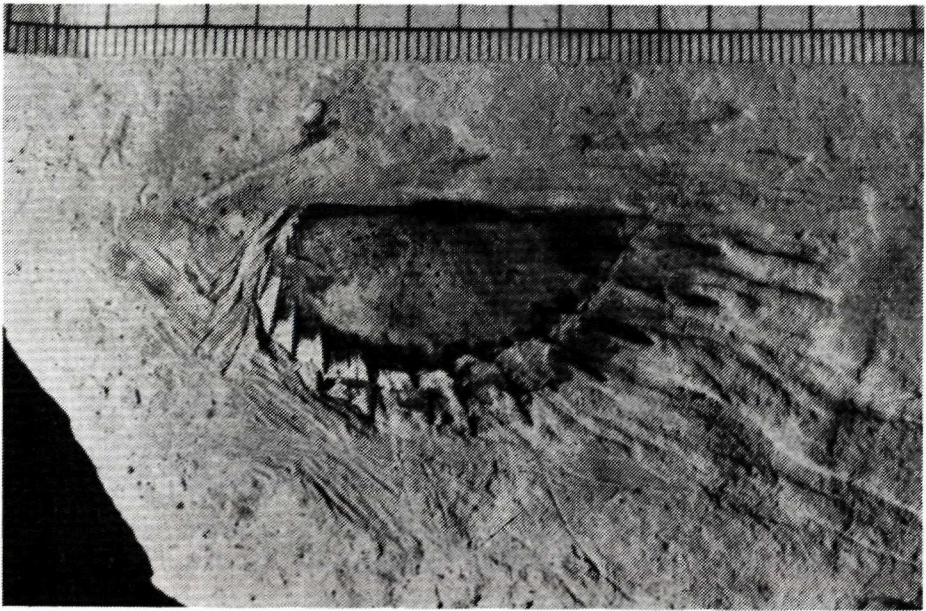
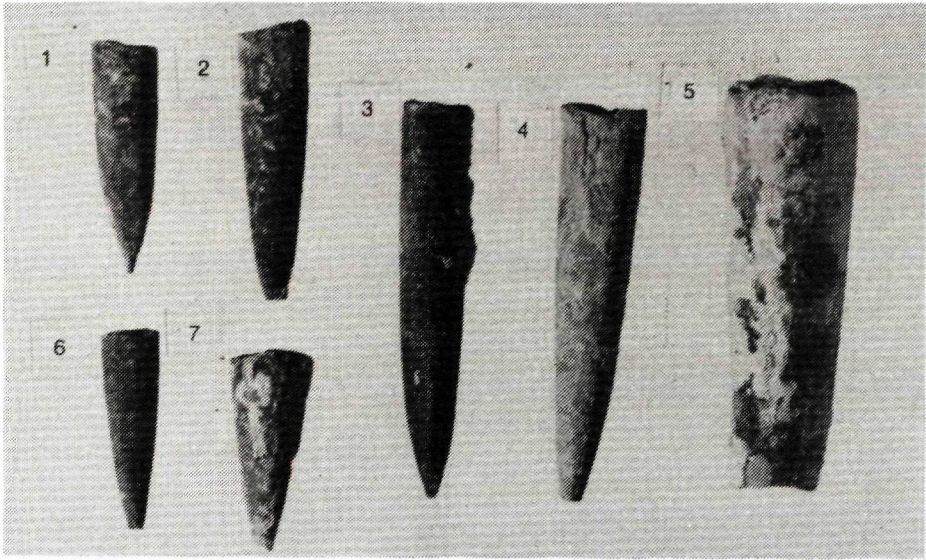
4

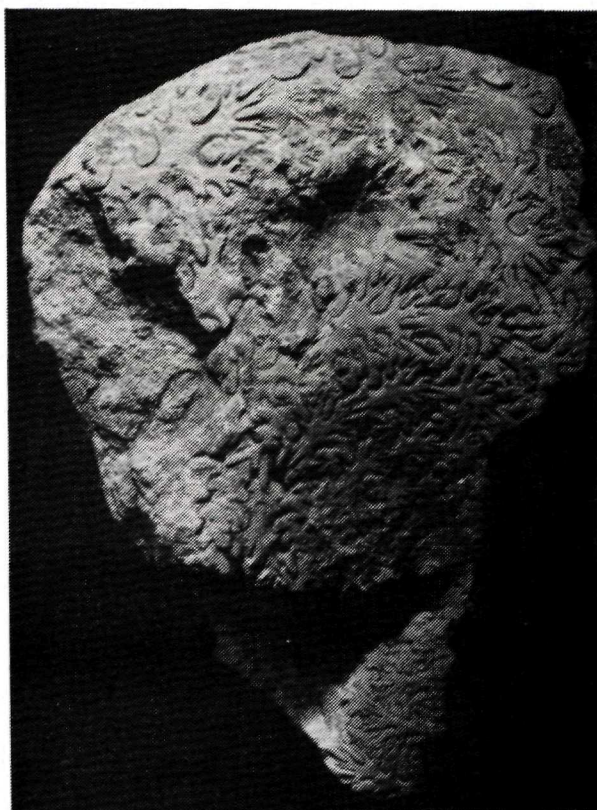


2



5





1



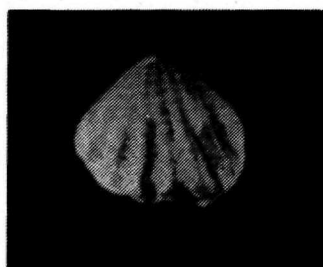
3



4



2



5

