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MAASTRICHTIAN, DANIAN AND THANETIAN BEDS IN DOLENJA VAS (NW DINARIDES, YUGOSLAVIA) MIKROFACIES, FORAMINIFERS, RUDISTS AND CORALS

MAASTRICHTIJSKE, DANIJSKE IN THANETIJSKE PLASTI V DOLENJI VASI (NW DINARIDI) MIKROFACIES, FORAMINIFERE, RUDISTI IN KORALE

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CONTENTS — KAZALO

ABSTRACT UDC 551.763/.781:56(497.1-16)

Maastrichtian, Danian and Thanetian Beds in Dolenja vas

On the NW part of the Dinaric carbonate platform at Dolenja vas the transition from Cretaceous to Tertiary was established. The beds in profile are about 135 m thick, and deposited without a noticeable sedimentation gap. With analysis of microfauna 4 units were defined which belong according to fossil assemblage of rudistids, foraminifers and corals to Upper Maastrichtian, Lower and Upper Danian, and Thanetian.

In the work 15 rudistid species were described (*Bournonia problematica* n. sp. *B. triangulata* n. sp.), and 11 species of corals (*Plocophyllia karstica* n. sp.) and 29 foraminifers determined.

The area at Dolenja vas had an intermedial position on the border of the carbonate platform and the basin with uninterrupted clastic sedimentation. The connection with basin permitted steady flooding of the coastal belt and continuous deposition on the margin of the platform.

Differences in deposition on the Cretaceous-Tertiary boundary are mirrored in facies change from shallow shelf to littoral environment. Faunistic vhanges are expressed by gradual reduction of rudistids and disappearance of individual porcellaneous foraminifer species. After a short interval, where only bioturbation in sediment gives indication on activity of organisms, the sea bottom becomes inhabited by tiny skeletal organisms.

Climate at the C-T boundary was warm, as indicated by traces of gypsum and phosphates, and by repeated accumulations of coal in this part of the carbonate platform.

During Maastrichtian and Lower Danian the area of Dolenja vas profile was connected with the region S and SE of the carbonate platform. During Upper Danian and Thanetian a stronger connection with the N and NE region along the platform was established.

IZVLEČEK UDK 551.763/.781:56(497.1-16)

Maastrichtijske, danijske in thanetijske plasti v Dolenji vasi

Na NW delu Dinarske karbonatne plošče je bil pri Dolenji vasi ugotovljen prehod med kredo in terciarjem. Plasti v profilu so debele ca. 135 metrov, odložene so brez opazne sedimentacijske vrzeli. Z analizo mikrofavne smo plasti opredelili na 4 enote, ki glede na fosilno združbo foraminifer, rudistov in koral pripadajo zgornjemu maastrichtiju, spodnjemu in zgornjemu daniju ter thanetiju.

V delu je opisanih 15 vrst rudistov (*Bournonia problematica* n. sp., *B. triangulata* n. sp.), 11 vrst koral (*Plocophyllia karst*ica n. sp.) ter 29 foraminifer.

Območje pri Dolenji vasi je imelo intermedialno lego na robu karbonatne plošče in bazena s sklenjeno klastično sedimentacijo. Ta zveza z bazenom je omogočala neprekinjeno preplavljanje obrežnega terena in vzdrževala kontinuirano sedimentacijo na obrobju platforme.

Razlike v sedimentaciji na meji kreda—terciar se zrcalijo v spremembi faciesa iz plitvega šelfa v litoralno okolje. Favnistične spremembe se kažejo v postopnem zakrnjevanju rudistov in izginotju posameznih porcelanskih vrst foraminifer. Po krajšem intervalu, kjer samo bioturbacija v sedimentu kaže na sledove delovanja organizmov, se ponovno oživlja morsko dno z drobnimi skeletnimi organizmi.

Klima na meji K—T je bila topla, na kar kažejo sledovi sadre in fosfatov ter večkratna nakopičenja premoga v tem predelu Dinarske karbonatne plošče.

V času maastrichtija in spodnjega danija je bilo območje profila Dolenja vas povezano s prostorom južno in jugovzhodno od karbonatne plošče. V času zgornjega danija in thanetija pa je nastopila močnejša povezava s severnim in severovzhodnim prostorom ob plošči.

Key-words: Cretaceous, Paleogene, Benthic foraminifera, Rudists, Corals, Algae, Biostratigraphy, Taxonomy, Paleoenvironment, Paleographiy, Carbonate platform, NW Yugoslavia, C—T boundary.

Kreda, paleogen, bentične foraminifere, rudisti, korale, alge, biostratigrafija, taxonomija, paleookolje, paleogeografija, karbonatna plošča, NW Jugoslavija, meja kreda—terciar.

INTRODUCTION

These days, the Cretaceous — Tertiary (C — T) boundary is widely discussed in the scientific community. Most detailed geological and paleontological arguments in this discussion are derived from deep-water sedimentary series providing almost exclusively planktonic microfossils for dating the sediments, for deciphering the biological events or for the interpretation of climatic change. These series were choosen in order to have a sedimentary record through time as complete as possible. In contrast to this kind of documents we describe here a sedimentary sequence deposited on the margin of shallow carbonate platform disconnected from any continental influence and therefore exclusively constituted by carbonates. In such a sequence, if fairly complete, benthic life has registered climatic change, sealevel — rise and fall and nutritional gradients in a different, complementary way, and, in our view, with more explanatory power than any pelagic faunal sequence could provide.

The sedimentary sequence, representing the margin at the Trieste—Komen platform, is exposed profile very convenant for study, along the road from Dolenja vas (near Senožeče) to Vrabče, along the river Raša (Fig. 1). The 135 m thick succession of perfectly concordant beds dips 15—20° towards the north or the north-east and bridges the C — T boundary without any major interruption of the sedimentation.

In this study paleontologists and sedimentologists from various institutions cooperated. From the Paleontological Institut Ivan RAKOVEC of the Center of Scientific Research of the Slovene Academy of Sciences and Arts took part Dragica TURNŠEK and Katica DROBNE; the first named investigated the Paleogene corals, and the second Cretaceous and Tertiary foraminifers, preparing the entire material for publication and coordinated the studies. From the Geological Survey of Ljubljana cooperated sedimentologist Bojan OGORELEC, and from the Chair of Geology and Paleontology of the Edvard Kardelj University in Ljubljana Rajko PAVLOVEC and Mario PLENIČAR. The latter investigated the rudistid fauna in collaboration with Maria Luisa ZUCCHI-STOLFA from the Geological-Paleontological Institut of the University in Triest. Algae were studied by Filippo BARATTOLO from the Paleontological Institute of the University of Naples. In recording the profile took part Camila PIRINI-RADRIZZANI and Nevio PUGLIESE, both from the Geological Paleontological Institute of the University in Triest. Geologist of the University in Triest cooperated with researchers from Ljubljana in the framework of the international project »Cretaceous carbonate platform on the territory of Slovenia and Italy«.

The first results of investigations of the Dolenja vas profile were reported in the poster and paper entitled »La coupe de Dolenja vas — un passage du Crétacé au Paléogène« on the international symposium »Development of the karst carbonate platform« which was held from 1st to 6th June 1987 in Triest. The paper was sent for publication to the Memorie della Società Geologica Italiana (Roma) under the title »The Dolenja vas profile, a transition from Cretaceous to Paleocene, NW Dinarides, Yugoslavia«.

The present investigation is the result of more detailed studies of sedimentology, microfacies, foraminifers, rudistids and corals. The aim of the studies was to define as accurately as possible the boundary between the Upper Cretaceous and the Paleocene, and to interpret the depositional environment of this time interval. The investigation represents only a part of the studies which are still going on.

FACIES DEVELOPMENT AND BIOSTRATIGRAPHY OF DOLENJA VAS SECTION

Bojan OGORELEC and Katica DROBNE

Figs 1—2, Pls. 1—26

The investigated profile at Dolenja vas can be subdivided according to the lithological characteristics, the facies and the fossil content into four units: of Maastrichtian, Lower and the Upper Danian, and of Thanetian age. The entire sequence of beds consists of limestones. Dolomite appears in traces only (Fig. 2).

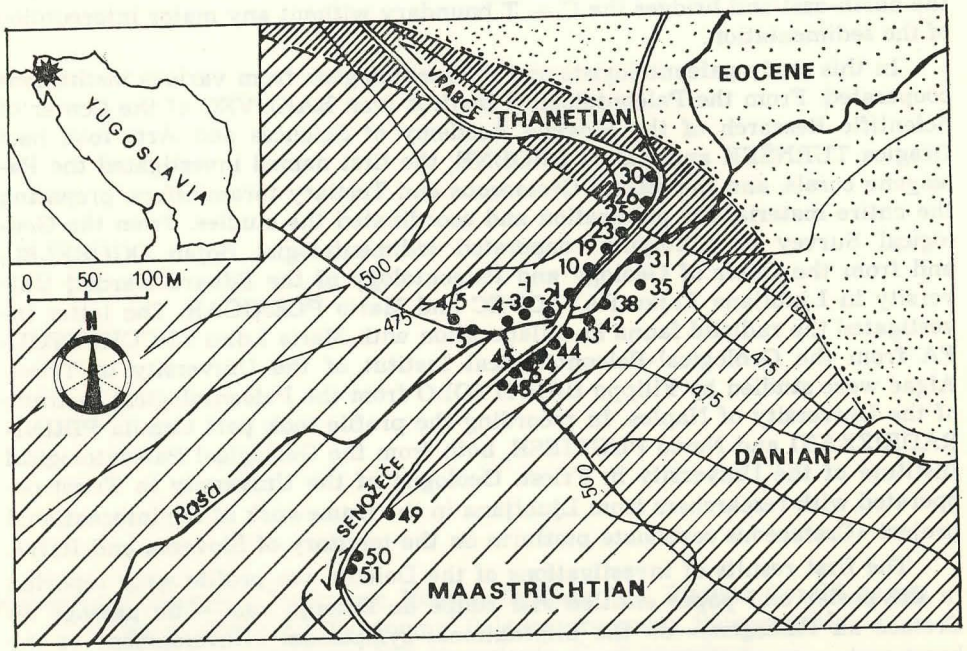


Fig. 1. Location map and geological situation of the section Dolenja vas (modified after BUSER, GRAD, PLENIČAR 1967).

Sl. 1. Položaj nahajališča in geološka situacija profila Dolenja vas (prirejeno po BUSER, GRAD, PLENIČAR 1967).

UNIT 1

MAASTRICHTIAN (Fig. 3 a, 4, Pls. 1—3, 24)

M i c r o f a c i e s : The first limestone unit of the Maastrichtian age Dv 48 to 45/1 is medium bedded and of light to moderate olive grey color. According to its texture, the rock is a biomicrite of the wackestone-packstone type. In this limestone frequent valves of rudistids occur, in synsedimentary breccias occasionally bournonias, and in its upper part also gyropleuras (Pls. 1, 2). Among the benthic foraminifers prevail porcellaneous forms. In places also tiny gastropods and thin-shelled pelecypods occur as well as fine micritic plasticlasts. The micritic groundmass often shows marks of bioturbation, and it is only in part slightly washed out. Valves of rudistids and gyropleuras were subjected to intensive endolithic activities (Pl. 1, fig. 1, Pl. 2, fig. 1).

F o s s i l a s s e m b l a g e s : Characteristic for the upper part of the succession is *Rhapydionina liburnica* (Stache). This species shows an extraordinarely wide variation of range in test diameter. Fan-like shapes were not observed in the examined samples (Dv 47, —5, Pl. 2, fig. 2, Pl. 24, fig. 8—11). Occur also *Dicyclina schlumbergeri* Munier-Chalmas (Pl. 2, fig. 1, Pl. 24, fig. 12), *Cuneolina sp., Massilina sp., Dargenioella* sp. (Pl. 24, fig. 2, 3, 4) and very numerous tests of *Moncharmontia apenninica* (De Castro) (Pl. 24, fig. 6, 7). Just below the Cretaceous-Tertiary boundary *Rhapydionina* is replaced by unidentified miliolids and *Dargenioella* sp. The latter is a larger miliolid with irregularly shaped chambers. It has been compared with the newly described genus from Paleocene of the Apennines (DE CASTRO, in press). *Thaumatoporella* sp. and tiny tubuli of *Aeolisaccus* sp. appear also.

In this Upper Maastrichtian horizon the rudists are very frequent: *Bournonia problematica* n. sp., *B. parva* Pejović, *B.* cf. *wiontzeki* Pejović, *Biradiolites baylei* Toucas and valves of *Gyropleura* sp. accumulated in several beds (Pls. 1, 2, 27, 28, textfig. 6—15).

A g e : These beds with rudistids and rhapydioninas can be correlated with many localities in Dalmatia and Herzegovina (e. g. SLIŠKOVIĆ 1983, PEJOVIĆ & RADOIČIĆ 1985/86, PLENIČAR & STOLFA-ZUCCHI in the continuation of this paper). The stratigraphic range of *Rhapydionina liburnica* in Greece is considered by FLEURY (1980, 46). On the base of its massive occurence and the position above the zone *Omphalocyclus macroporus*. He attributed the latter to the Upper Maastrichtian.

D e p o s i t i o n a l e n v i r o n m e n t : The limestones of this first units were deposited in the quiet and shallow water on a restricted shelf, with a low energy index (1—2) (Fig. 2), in an environment which was uniform in a wide area of the Slovenian part of Dinarides (Fig. 3—5).

UNIT 2

DANIAN — lower part (Pls 4—17, 25)

The transition between Maastrichtian and Danian beds was established at the road (Dv 45/1 and Dv 44/8) and at the brook (Dv —5). In the outcrop at the brook the direct contact of the two units was discovered (Fig. 1, 2). Unit 2 differ from the unit 1 in the following sedimentological and faunistical charasteristics:

— limestone becomes darker, dark olive grey to black; by texture it is biomicrite with a somehow increased amount of organic matter, and with slight bituminous smell,

— disappear rudistids and gyropleuras, as well as rhapydioninas,

— limestone shows characteristics of littoral deposition (stromatolites, shrinkage pores) and of very short emersion phases, respectively of land phases, (flat pebble conglomerate, intraformational breccia).

— first appearance of *Microcodium*.

Microfacies: The beds of unit 2 overlie in perfect concordance the Cretaceous beds. The entire part of the succession of Danian beds comprises about 60 meters of thickness in the profile, and its development is of high lithologic and paleontologic variability. Individual beds measure 10 to 50 cm. Owing to the admixture of organic matter and pyritic pigment, the limestone is of dark grey to black color. The carbonate component varies between 98.2 and 99.6 %. The wackestone and packstone types prevail, which is an indication of a low to very low energy index. The micritic matrix is washed out, entirely or partly, only in samples which were deposited along the shore »beach rocks«, e. g. Dv 3), or in tidal channels (Dv 1, 4, 11, 16) within lagoons where daily movements of sea water occured.

The number of fossil species is quite modest, but skeletons of organisms are in places so abundant that they built the rock. In particular, we find skeletal algae (Dv 2, 3, 6, 12, 13, 33; Pls. 12, 14, 16), corals (Dv 7, 8, 9; Pls. 7, 12, 17) and *Microcodium* (Dv 44/8 to Dv 35 and Dv —3 to Dv 15; Pls. 3—5, 8—10, 12), and to a less frequently small benthic foraminifers (Dv 44/2; Pl. 5).

Pelecypods shells, gastropods, ostracods and characeae are less frequent. Corals which appear in almost all varieties of limestones, belong to the dendroid type with corallites upto a few mm in diameter (Dv —2, 16, 37; Pls. 7, 12, 17). Next to fossils, in several samples, some mm large micritic intraclasts can be observed.

Fossil assemblages: In the lagoon environment appear foraminifers with tests of extremely small dimensions and thin walls from groups of discorbids and ataxophragmiids (Dv 44/8—2, 44, 43). Among the nonionids we observe bilaterally symetric tests with typical umbilical flaps (Dv 44/8—4, 44, —1; Pls. 10, 25, fig. 8). Recently the latter were revised and determined as *Protelphidium* Haynes of Thanetian age (BANNER & CULVER 1978). In the other type of limestone with washed micritic matrix appears the assemblage of small miliolids, *Pseudochrysalidina* sp. and rare *Valvulineria* sp. (Dv. 40, —4/5, 13; Pls. 7, 13, 16, 25). To the genus *Scandonea* De Castro we assigne forms with

porcelaneous, planispiral test and with thick walls (Pls. 14, 25, fig. 7). This genus was known until now from the Upper Cretaceous only. Especially interesting is the presence of the genus *Bolkarina* Sirel with a 18 mm wide, discoidal test (Dv 5; Pl. 25, fig. 1, 2). The monospecific genus with *B. aksarayi* Sirel 1981 as type species, was described from the Thanetian beds of central Turkey (SIREL 1981). Of particular interest is the occurence of a new alveolinid genus, nor even 1 mm large, and clearly more primitive than the earliest known, paleogene alveolinid, *Alveolina (Glomalveolina) primaeva* (Dv 37; Pl. 25, fig. 4, 5). In the same sample appears also *Periloculina* cf. *slovenica* Drobne (Pl. 25, fig. 3). Among algae are interesting small and tender *Clypeina* sp., *Parkerella* sp. and *Microproblematicum* sp. (Pl. 4, fig. 2, Pl. 10, Pl. 14, fig. 2). Sporadically appear also *Thaumatoporella* sp. and some charophyte, and more frequently *Cymopolia* (Pl. 12, fig. 2, Pl. 16, fig. 1). Among corals in the Unit 2 (lower part of Danian) *Haimesastraea perviana* Hennig, *Dendrophyllia candelabrum* Hennig, *D. dendrophylloides* M. Edwards et Haime, *Siderastraea* sp. and *Rhizangia* sp. were found (fig. 16, Pls. 7, 12, 15, 17, 29, 30, 33). All of them are of dendroid ramose shape and do not belong to reef builders.

Age: The generic identifications of *Protelphidium* sp., *Bolkarina* sp., Microproblematicum sp. and *Parkerella* sp. are an indication of Paleocene age. According to J. J. FLEURY (1980), in Greece the beginning of Paleocene deposition is characterized by an increase of *Pseudochrysalidina* sp. Also the complete disappearance of *Rhapydionina* and gyropleuras justifies the attribution of beds to the Earliest Tertiary. Characteristic among corals is *Dendrophyllia candelabrum* which is stratigraphycally in Scandinavia restricted to the Danian (FLORIS 1972). Therefore, we attribute Unit 2 to the Danian (see continuation of this paper by D. TURNŠEK, fig. 16).

Depositional environment: The Lower Danian time in the Dolenja vas region is characterized by shallow restricted lagoons which used to be repeatedly interruped by short phases of intratidal regime and emersion. The intratidal and supratidal depositional environments are characterized chiefly by numerous shrinkage pores (fenestral limestone), thin stromatolithic laminae, mud cracks with *Microcodium* structures, irregularly shaped vugs developed along root contours (root corrosion), and, last but not least, by local nest of thin emersion breccias. Several meters higher in the profile, between samples Dv 3 and 6, occur in a four meter thick section three 20 to 50 cm thick horizons of platy dark micritic limestone with bioturbation structure and desiccation cracks. These limestones are strongly dolomitized (40 to 55 % of dolomite), and of friable, somewhat sandy appearance on the surface. Dolomite formed in the supratidal environment during early diagenesis. The process of dolomitization can be explained by the »evaporative pumping« model. This process is characterized by supply of Mg^{2+} ions, necessary for dolomitization of the rock, in concentrated pore solutions which rise through capillaries towards the surface of the sediment which occasionally emerged above the water (SHINN et al. 1965, ILLING et al. 1965). Beside dolomite the mentioned beds contain 1 to 3 % of pyrite framboids. The origin of the pyrite is diagenetic too. It crystallized after bacterial decomposition of organic matter.

Appearance of the Microcodium

The appearance of *Microcodium* is one of the most characteristic phenomena above the passage of Cretaceous to Paleocene in the wider region of the Dinaric carbonate platform, and of Tethys in general, e. g. in Aquitania (CUVILLIER 1961, 64, figs, 1, 2). Its origin is not known with certainty. Some authors attribute *Microcodium* to problematic codiacean green algae (WRAY 1977), while more recent anlysis favour an inorganic origin of these structures. ESTEBAN (1974) and KLAPPA (1978, 1980) identify them as rhizolites, organo-sedimentary structures which form by cementation of spaces occupied by dead roots of higher plants, as a result of symbiosis between bacteria and root cells in a semiarid climate. It should be characteristic for the caliche facies.

The more recent hypothesis of the origin of *Microcodium* is supported also by the data of the Dolenja vas profile. *Microcodium* occurs only in beds which show traces of supratidal deposition, or of very short phases of emersion. They always occur in beds with numerous desiccation cracks and strong bioturbation (Dv 44/6, —3, 35). Crystallization of calcitic prisms must have occured during the time of earliest diagenesis when the carbonate mud was not yet lithified. At somewhat higher energy in the environment, *Microcodium* was disintegrated. The up to several tenths of mm large prisms were dispersed and mixed with the surrounding sediment (Pls. 8, 9). A warmer climate during the Lower Danian in the Dinaric region can be assumed also on the base of gypsum crystals and after the phosphate admixture. In the micritic mud with microcodia (Dv 44/8, Pl. 3, fig. 1) gypsum became replaced by calcite.

It should be noted that *Microcodium* occurs in facies types of littoral deposition and temporary local emersion also elsewhere in the Dinarides, as for instance on the island of Brač (JELASKA & OGORELEC 1983) an the Karst of Trieste (CILIBERTO et al. 1982).

A. CHERCHI and R. SCHÖDER (1988) followed the nomenclature ruls and renamed the genus *Microcodium* into *Paronipora*. Wenn we received this data the manuscript had already been in print. Therefore, in this paper the name *Microcodium* is used.

Phosphates in the sediment

In certain beds (Dv 5, 11, 12, 33) in traces within micrite also phosphate mineral which corresponds to collophane (microcristalline variety of apatite) occurs. It occurs as pigment in tiny brown nests. Phosphate is bound to beds of dark limestone which show microfacial indications of the intertidal environment and was at the time of deposition rich in organic matter. Occurrences of phosphate mineralization are known from the time of Upper Crecaceous and Paleogene from north Istria (ŠKERLJ, Ž. & J. 1973). Important factors in forming of collophane in carbonate rocks are, according to G. S. ODIN and R. LETOLLE (1980), climate which must be warm, and very shallow depositional environment with increased contents of organic matter. Collophane is a member of the biochemical cycle; it is formed during decomposition of the organic matter as a result of bacterial metabolism. Phosphate is precipitated from pore water (GAUDETTE & LYONS 1980). Such conditions for forming of phosphates occurred periodically in the initial period of the Paleocene lagoon deposition.

UNIT 3

DANIAN — Upper part (Pls. 17—21, 25)

Microfacies: The Unit 3 package of limestone is about 20 m thick. Its lower boundary cannot be clearly determined. In the lower few meters (Dv 17—19) the rock is moderately bedded and grey, while up it becomes thick bedded and very light in colour (Dv 2—24). Owing to the change of depositional conditions there occurs a drastic change of its texture too. Most frequent are the packstone and boundstone types. Limestones of the biosparite type prevail over biomicrite, which is an indication of the change of energy in subtidal environment. Larger ramose corals (Pls. 19, 20) and massive corals occur here. The corals are often subjected to recrystallization and bioerosion (Pl. 21, fig. 2). Red algae start to appear (Pl. 20).

Fossil assemblage: Numerous dasycladaceans appear, between them: *Orioporella villattae* Segonzac and *Indopolia satyavanti* Pia. More aboundant become also corals: *Actinacis cognata* (Oppenheim), *Goniopora elegans* (Leymerie), *Litharaeopsis subepithecata* (Oppenheim), *Plocophyllia karstica* n. sp., *Stylocoenia montium* (Oppenheim) (fig. 16, Pls. 19—21, 31—35). *Dendrophyllia candelabrum* Henning persist from earlier deposits in Unit 2 (Pls. 17, 19, 20, 29). Among foraminifers predominate agglutined tests from ataxophragmiid groups. In places appear tiny miliolida, and among them already larger *Idalina* sp. (Dv 31; Pl. 18).

Age: Correlation of coral species mentioned before permits the stratigraphic dating of Montian (Upper Danian) (fig. 16), see also the chapter on corals in this paper. The first appearance in Danian has also the alga *Orioporella villattae* (cf. BARATTOLO in: DROBNE et al. in press). On help in biostratigraphic interpretation of these beds are the overlying layers containing larger forminifers of Thanetian age.

Recently several studies on benthic foraminifers of Paleocene, especially Danian age have been published. The biostratigraphic value of agglutinated foraminifers and their zones of Danian age was proposed for Carpathians of Poland by GEROCH and NOWAK (1984). In the Paris basin Danian foraminifers were investigated by BIGNOT (1987 a) with the correlation of the Danian and Montian stratotypes. Cenozoic foraminifers and their biostratigraphy in the North Sea were studied, by a group of authors (GRADSTEIN et al. 1988). The cited researchers stated in the Danian an assamblage of foraminifers of modest dimensions, simple structure and frequent agglutination of test walls in isolated material. Unfortunately in limestone, also in ours, numerous forms of benthic foraminifers are not determinable to the specific level. Special procedures of preparing and elaboration of comparative sections of isolated individuals would be necessary for more detailed determinations.

Depositional environment: At the transition from Lower to Upper Danian occured a rise of the sea level, i. e. a slow sinking of the lagoon carbonate flatland at the margin of the Dinaric shelf. In the area of Dolenja vas was established a submerged, well aerated carbonate platform (fig. 3, 4), which was connected with the open sea. No characteristics of the restricted lagoon were left. Within the platform existed areas where smaller coral patches

grew. In between these patches, coral debris accumulated, with admixtures of foraminifers, green algae, snails, and micritic plasticlasts. The carbonate platform was in certain places very shallow; there indistinct structures of the supratidal deposition can be observed (torn laminae with »flat pebble conglomerate« structure).

UNIT 4

THANETIAN (Pls. 21—23, 26)

M i c r o f a c i e s : These beds were investigated only in their lower part, having a thickness of about 25 meters. The limestone become again medium bedded and darker. All texture types of limestone (wackestone to packstone) are represented in beds with alternatively richer and poorer fossil assemblages. Among the fossils prevail red coralinacean algae (e. g. Dv 29 d, Pl. 22), while in other beds rotaliid foraminifers and corals are frequent. Bryozoans and snails are also present. In the upper part miliolids and conical foraminifers (Dv 30, Pls. 22, 23) predominate. Foraminifers and algal clasts become in places so abundant that the rock takes a biocalcarenitic character (e. g. Dv 26, Pl. 21). This limestone has a low to medium high energy index (1—3).

F o s s i l a s s e m b l a g e : Numerous rotaliids of small dimensions successfully replace other species in individual horizons. Among them appears *Kathina selveri* Smout (Pl. 21, Pl. 26, fig. 6), numerous forms of A and B generations belong to the new species of the genus *Miscellanea* sp. 2 (LEPPIG 1988) (Dv 29, 30; Pl. 22, 23, 26). Rare are *Discocyclina seunesi* Douvillé (transfered to *Orbitoclypeus seunesi* by LESS, 1987) (Pl. 21). In horizons with red algae (Pl. 22) and corals (Pl. 21) sessile foraminifers *Planorbulina* sp., *Miniacina* sp., *Haddonia* sp. (Pl. 26, fig. 5) and *Schlosserina* sp. are frequent (Pl 26, fig. 5, 6). In younger horizons, the miliolids *Idalina sinjarica* Grimsdale (Pl. 22), conical foraminifers *Coskinon rajkae* Hottinger et Drobne (Pl. 22, Pl. 26, fig. 7, 8), *Cribrobulimina carniolica* Hottinger et Drobne (Pl. 26, fig. 10, 11, Pl. 22) are more abundant, while *Broeckinella arabica* Henson is rare. Also the new alveolind genus (Pl. 22, Pl. 26, fig. 12) appears repeatedly. In this facies *Fallotella alavensis* Mangin and *Glomalveolina primaeva* (Reichel) do not occur. Abundant are corals accumulates in individual agglomeration, they correspond to genera *Goniopora* sp. and *Rhizangia* sp. (Pl. 19, Pl. 33, 34). The dendroid coral species *Dendrophyllia candelabrum* and *D. dendrophylloides* persists (Pl. 20).

A g e : This assemblage of larger formaninifers may be correlated with the fauna from the Petite Pyrenées (TAMBAREAU 1972, REICHEL 1935/36), from the Ebro valley (LEPPIG 1987) and with the Yugoslav Paleocene profiles from the NW part of the Dinaric carbonate platforme, e. g. Koboli and Golež (DROBNE 1974, DROBNE & PAVLOVEC 1979, HOTTINGER & DROBNE 1980). Therefore we are attributed this Unit 4 to the Thanetian. Similar uninterrupted developments can be found also in the central part of Turkey (SIREL et al. 1986).

D e p o s i t i o n a l e n v i r o n m e n t : During the Lower Thanetian in the Dolenja vas area the deposition continued on the very shallow part of the carbonate platform which was connected to the open sea (Fig. 3 c, 5). Numerous

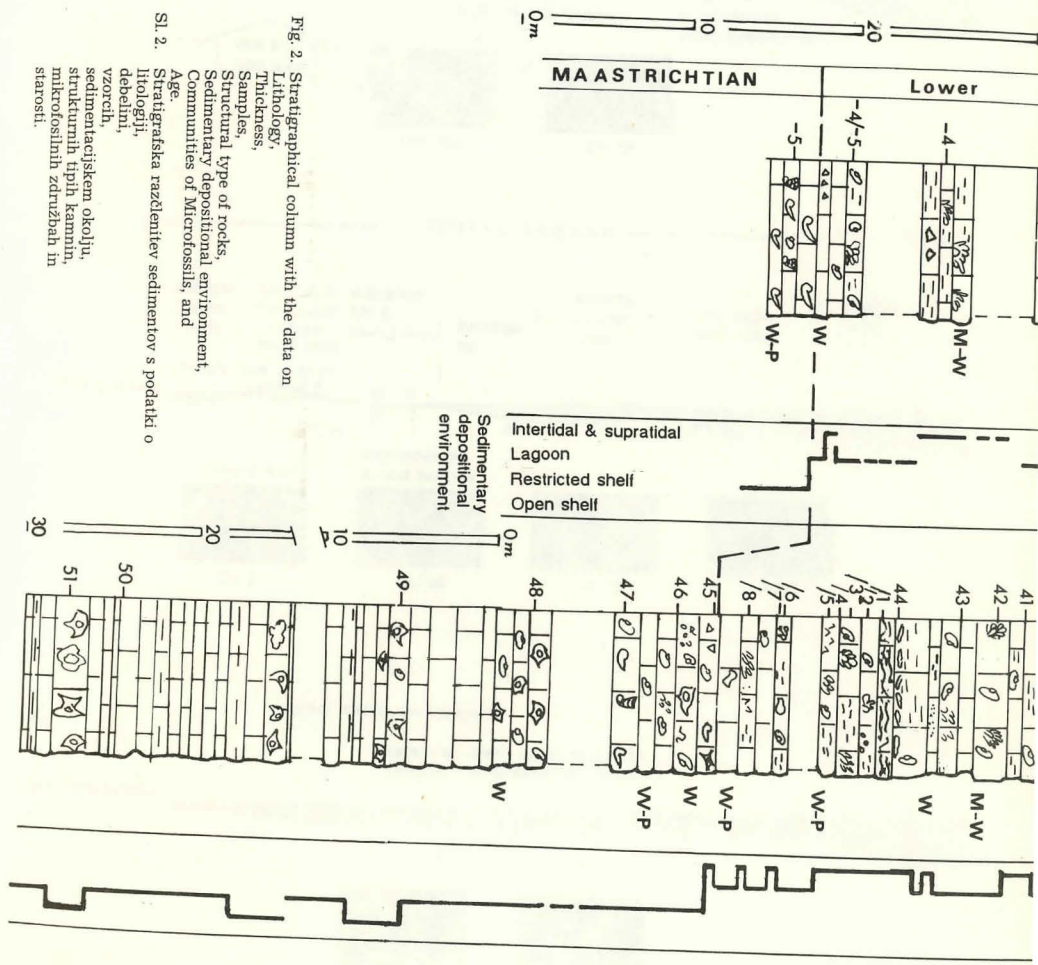
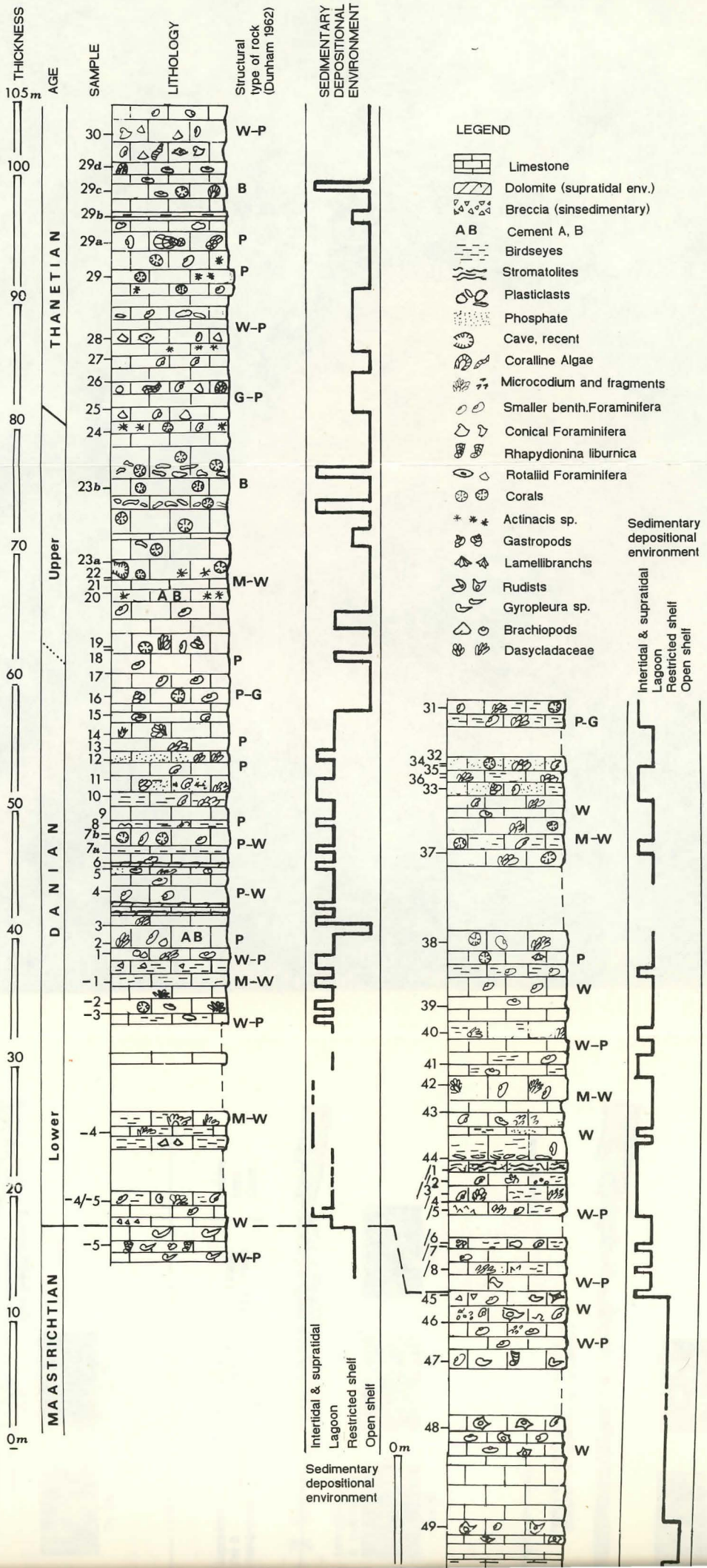


Fig. 2. Stratigraphical column with the data on Lithology, Thickness, Samples, Structural type of rocks, Sedimentary depositional environment, Communities of Microfossils, and Age.
Sl. 2. Stratigrafska razčlenitev sedimentov s podatki o litologiji, debelini, vzorcih, sedimentacijskem okolju, strukturnih tipih kamnin, mikrofosilnih združbah in starosti.


THICKNESS
105m
100
90
80
70
60
50
40
30
20
10
0m
AGE
MAASTRICHTIAN
DANIAN
Lower
Upper
THANETIAN
SAMPLE
LITHOLOGY
Structural type of rock (Dunham 1962)
SEDIMENTARY DEPOSITIONAL ENVIRONMENT
Intertidal & supratidal
Lagoon
Restricted shelf
Open shelf
Sedimentary depositional environment
LEGEND
Limestone
Dolomite (supratidal env.)
Breccia (sinsedimentary)
A B Cement A, B
Birdseyes
Stromatolites
Plasticlasts
Phosphate
Cave, recent
Coralline Algae
Microcodium and fragments
Smaller benth.Foraminifera
Conical Foraminifera
Rhapydionina liburnica
Rotaliid Foraminifera
Corals
Actinacis sp.
Gastropods
Lamellibranchs
Rudists
Gyropleura sp.
Brachiopods
Dasycladaceae
Sedimentary depositional environment
Intertidal & supratidal
Lagoon
Restricted shelf
Open shelf

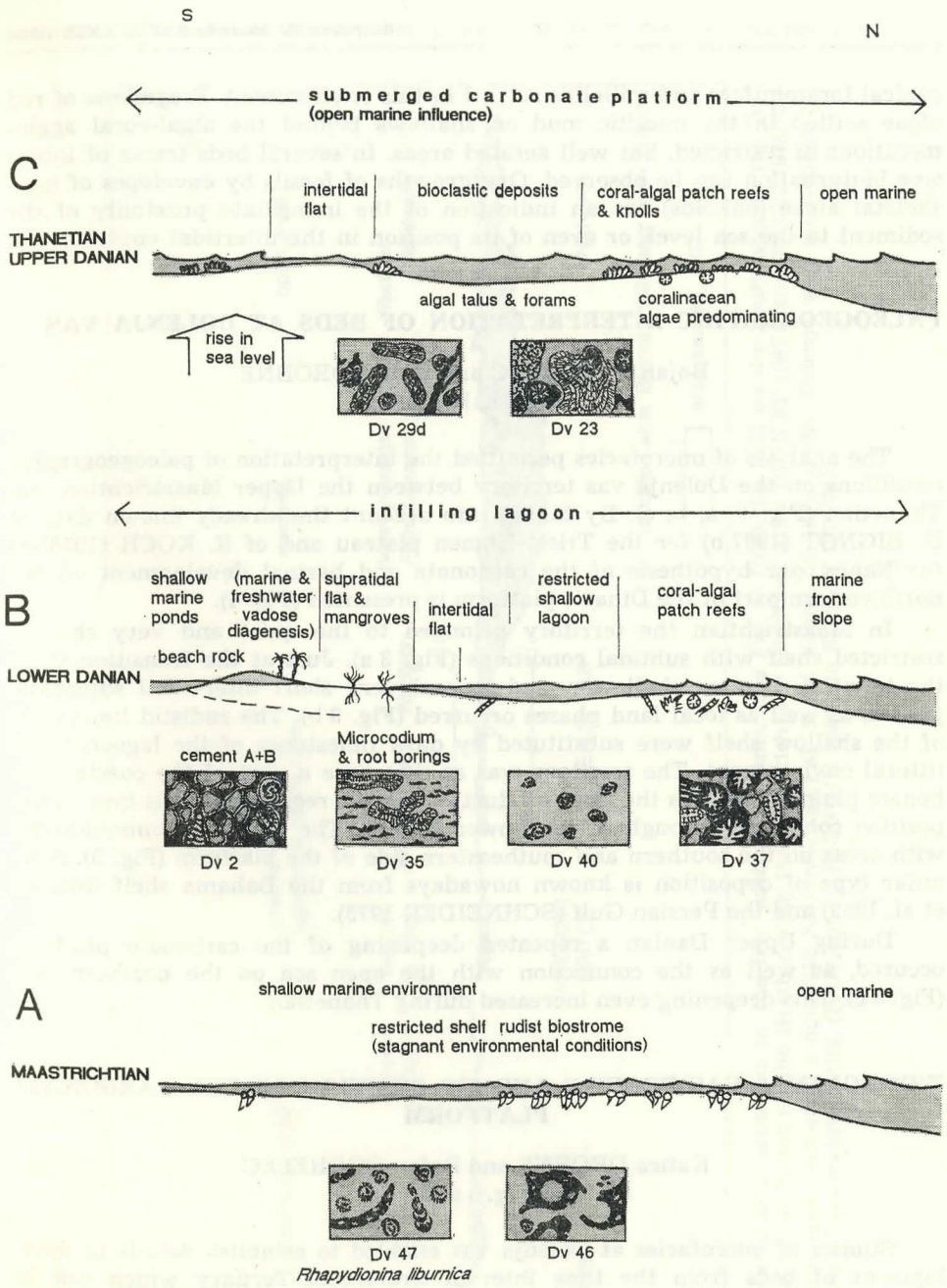


Fig. 3. Paleoenvironmental situation on the area of Dolenja vas during the:
A — Maastrichtian
B — Danian
C — Thanetian

Sl. 3. Paleoekološka situacija na območju Dolenje vasi v času:
A — maastrichtija
B — danija
C — thanetija

conical foraminifers and miliolids settled in this environment. Fragments of red algae settled in the micritic mud on shallows behind the algal-coral agglomerations in restricted, but well aerated areas. In several beds traces of intensive bioturbation can be observed. Overgrowths of fossils by envelopes of non-skeletal algae (onkoids) are an indication of the immediate proximity of the sediment to the sea level, or even of its position in the intertidal environment.

PALEOGEOGRAPHIC INTERPRETATION OF BEDS AT DOLENJA VAS

Bojan OGORELEC and Katica DROBNE
(Fig. 3 a, b, c, 4, 5)

The analysis of microfacies permitted the interpretation of paleogeographic conditions on the Dolenja vas territory between the Upper Maastrichtian and Thanetian (Fig. 3, a, b, c). By taking into account the already known data of G. BIGNOT (1987 b) for the Triest-Komen plateau and of R. KOCH (1978/79) for Nanos, our hypothesis of the carbonate and basinal development on the northwestern part of the Dinaric platform is presented (Fig. 4).

In Maastrichtian the territory belonged to the quiet and very shallow restricted shelf with subtidal conditions (Fig. 3 a). Just at the transition C—T the territory became shallower, and several very short inter- and supratidal phases, as well as local land phases occurred (Fig. 3 b). The rudistid limestones of the shallow shelf were substituted by dark limestones of the lagoonal and littoral environment. The territory was at that time a part of the coastal carbonate plain which was the final product of the sea regression. This type of deposition continued throughout the Lower Danian. The territory communicated with areas on the southern and southeastern side of the platform (Fig. 5). A similar type of deposition is known nowadays from the Bahama shelf (SHINN et al. 1969) and the Persian Gulf (SCHNEIDER 1975).

During Upper Danian a repeated deepening of the carbonate platform occured, as well as the connection with the open sea on the northern side (Fig. 3 c). This deepening even increased during Thanetian.

THE DOLENJA VAS PROFILE AND ITS POSITION ON THE CARBONATE PLATFORM

Katica DROBNE and Bojan OGORELEC
(Fig. 5 a, b)

Studies of microfacies at Dolenja vas enabled to establish details in development of beds from the time interval Cretaceous-Tertiary which can be compared with paleontologically and sedimentologically investigated profiles and localities on the Dinaric platform and its margins (Fig. 5 a, b).

Results of comparison of developments lead to establishment of connections of the Dolenja vas area with more open marine regions during the times from Maastrichtian to Thanetian in various directions:

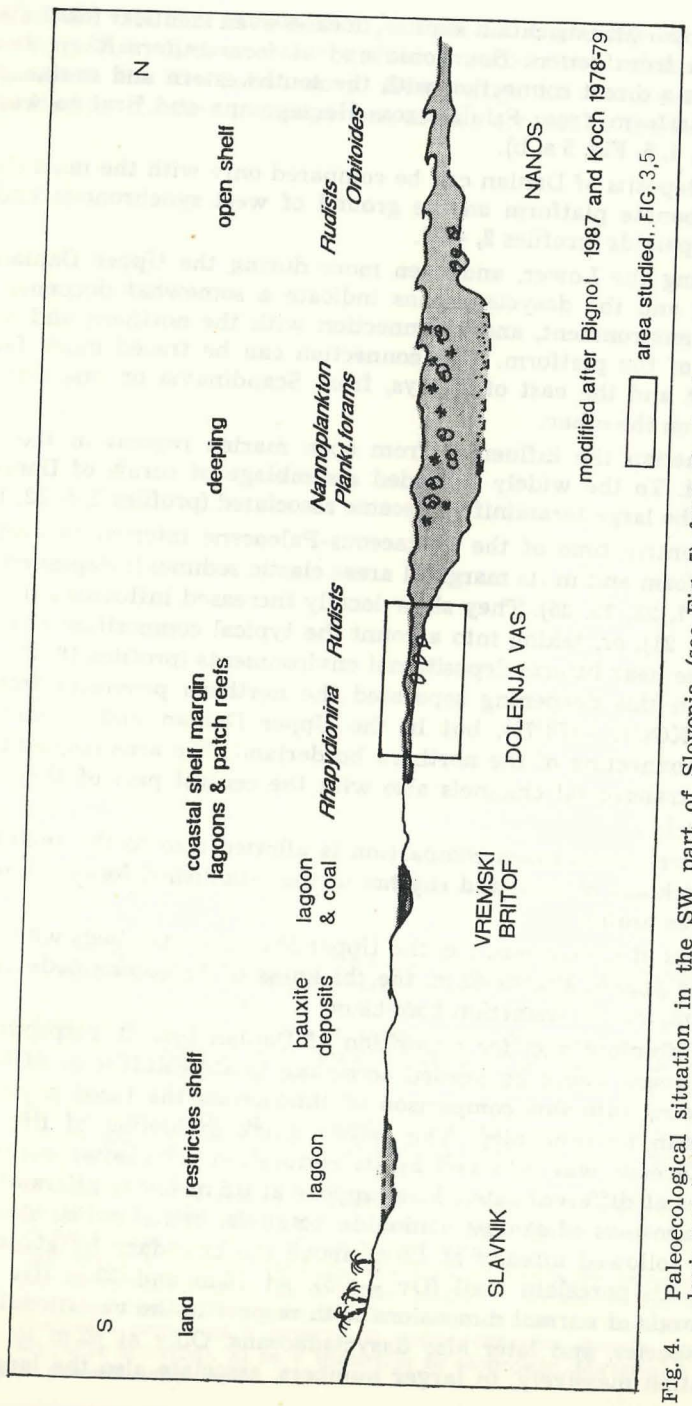


Fig. 4. Paleoecological situation in the SW part of Slovenia (see Fig. 5) from the land on the South accross the Dolenja vas to Nanos on the North during the Maastrichtian. (Modified after BIGNOT 1987 a and KOCH 1978/79.)

Sl. 4. Paleoekološka situacija v delu SW Slovenije (glej sl. 5) od kopna na jugu preko Dolenje vasi do Nanosa na severu v času maastrichtija. (Prirejeno po BIGNOJU 1987 a in KOCHU 1978/79.)

During the Upper Maastrichtian similar, in cases even identical fossil assemblage of rudistids from genera *Bournonia* and of foraminifers *Rhapydionina liburnica* indicates a direct connection with the southwestern and southeastern margins of the platform, from Friuli across Herzegovina and Brač to western Greece (profiles 3, 4, 5, Fig. 5 a, b).

The earliest deposits of Danian can be compared only with the most closest areas on the carbonate platform on the ground of west synchronous finds of nonionids and clypeinids (profiles 2, 4, 6).

Already during the Lower, and even more during the Upper Danian the coral assemblage and the dasycladaceans indicate a somewhat deepened and constant marine environment, and a connection with the northern and northeastern margins of the platform. This connection can be traced much farther towards the west and the east of Tethys, from Scandinavia on one side, and the Volga region on the other.

During Thanetian the influences from open marine regions in the north further increased. To the widely extended assemblage of corals of Danian in these times also the large foraminifers became associated (profiles 2, 6, 12, 13).

During the entire time of the Cretaceous-Paleocene interval in deepened parts of the platform and in its marginal areas clastic sediments deposited (profiles 14, 15, 16, 17, 22, 23, 26). They show locally increased influences from the land (profiles 27, 21), or, taking into account the typical composition of nannoplankton, also the near littoral depositional environments (profiles 19, 20). During Maastrichtian this deepening separated the northern provinces from the southern ones (KOCH 1978/79), but in the Upper Danian and Thanetian it served for interconnecting of the northern borderland. The area communicated through deeper transversal channels also with the central part of the Dinaric platform (profile 24).

A shorter, very generalized comparison is allotted also to the relations of absolute age, thickness of beds and rhythm of the established fossil life in beds of the Dolenja vas profile.

The thickness of Cretaceous, i. e. the Upper Maastrichtian beds which were described in this profile attains 42 m, the thickness of Paleocene beds 87 m, of Danian beds 62 m, and of Thanetian beds 25 m.

In view of absolute age, for deposition of Danian beds 3, respectively at most 6 million years would be needed according to CAVELIER & POMEROL (1983). If including into this comparison of thicknesses the fossil populations, the following can be concluded. The rather quick extinction of life at the closing of Cretaceous was followed by its restoration. The latter occurred in different groups at different rates. First appear at 0.5 m foraminifers of extremely small dimensions of groups nonionids, rotaliids, ophtalmidiis, also ostracods. They are followed already at 1.0 m above the boundary by ataxophragmiids, forms with porcelain wall (Dv —4/5). At 18 m and 20 m (Dv —2, 1) appear more corals of normal dimensions with respect to the variational ranges of individual species, and later also dasycladaceans. Only at 62 m to the described population massively, in larger numbers, associate also the large foraminifers. It can be deduced thereof that the beginning of restoration of the marine benthic population on the shallow carbonate platform started relatively early above the C—T boundary. How early this occurred will have to be established by further investigations of this contact in the Dolenja vas profile.

Fig. 5. Sketch map of selected profiles and locations with paleontological documentations on the A carbonate platform and B deeper basins during the Maastrichtian, and Lower, partly Middle Paleocene.
Sediments in the section of Dolenja vas reflected an intensive connection with the Southern and Southeastern part of Carbonate platform (*Rhapydionina* communities, Apennine and Helenides) in the Maastrichtian, but during the Danian on this area intensiver connection with the Northern and Northeastern side of Carbonate platform prevailed (Corals communities) which was still stronger in Thanetian. Material from the sections 1 and 10 is reworked.

Sl. 5. Pregledna karta izbranih profilov in nahajališč s paleontološko dokumentacijo na A karbonatni plošči in B v poglobljenih bazenih v maastrichtiju in spodnjem, mestoma srednjem paleocenu.
Sedimenti v profilu Dolenja vas kažejo močnejšo povezavo z južnim in jugovzhodnim robom karbonatne plošče v maastrichtiju (združba rhapydionin, Apenini, Helenidi), medtem ko v daniju prevladuje na tem prostoru močnejša povezava s severno in severovzhodno stranjo karbonatne plošče (koralna združba), ki se v thanetiju še stopnjuje. Material v profilih 1 in 10 je presedimentiran.

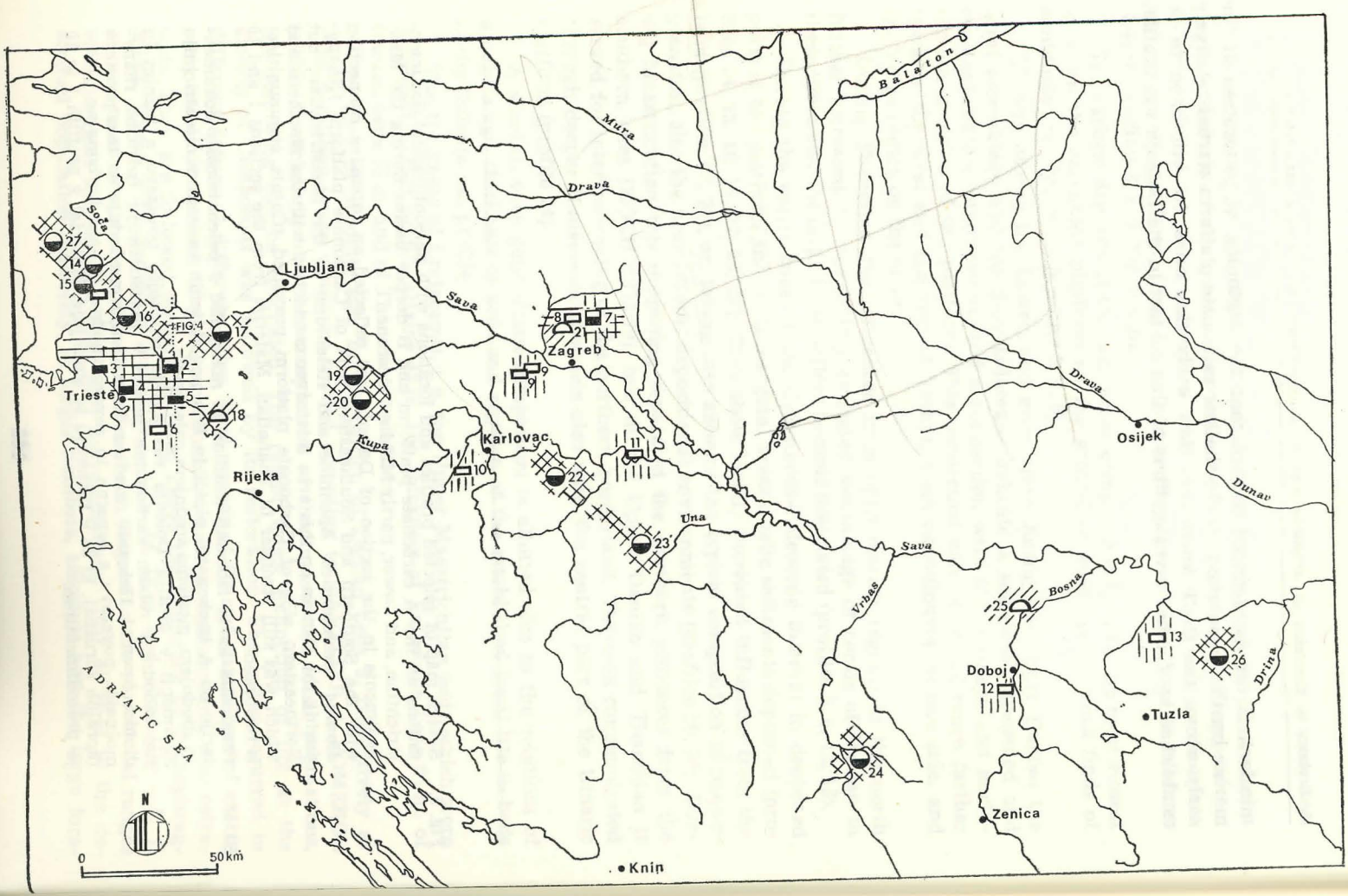


Fig. 5 a, b (explanation see on the page 165)
Sl. 5 a, b (razlaga na strani 165)

CARBONATE PLATFORM (KARBONATNA PLOŠČA)

1	Plave	(Deloffre & Radoičić 1976)	PALEOCENE
2	Dolenja vas	(Drobne et al. in press)	PALEOCEN
4	Villa Opicina (Opčine)	(Masoli et al. 1979)	
6	Golež	(Drobne et al. 1987)	
7	Vidovec - Planina	(Polšak 1985)	
8	Medvednica, W del	(Gušić & Babić 1973)	
9	Samobor	(Šikić K. & L. 1978)	
10	Dobra pri Karlovcu	(Gušić 1973)	
11	Banija	(Babić, Gušić, Zupanič 1976)	
12	Doboj pri Tešnju	(Blanchet & Neuman 1967; Stojčić 1968)	
13	W Majevica	(Drobne 1984)	

Fossil assemblages: Algae, Foraminifera, Corals
fosilna združba: alge, foraminifere, korale

2	Dolenja vas	(Drobne et al. in press)	MAASTRICHTIAN
3	Aurisina (Nabrežina)	(Masoli et al. 1979)	MAASTRICHTIJ
4	Villa Opicina (Opčine)	(Masoli et al. 1979)	
5	Vremski Britof	(Hötzl & Pavlovec 1979)	
7	Vidovec - Planina	(Polšak 1985)	

Fossil assemblages: *Rhapydionina liburnica* and *Bournonia* or Corals
fosilna združba: *Rhapydionina liburnica* in *Bournonia* ali korale

Isolated localities
posamezna nahajališča

Continuous transition Cretaceous - Paleocene
postopen prehod kreda - paleocen

CLASTIC DEVELOPMENT (KLASTIČNI RAZVOJ)

27	Calla	(Pririni - Radrizzani et al. 1986)	PALEOCENE
14	Lig	(Pavšič 1977, 1981)	PALEOCEN
15	Podsabotin	(Šribar 1965, Pavšič 1977, 1981)	
16	Lijak	(Pavšič 1979, 1981)	
17	Kališe	(Pavšič 1981)	
18	Ilirska Bistrica	(Šribar 1967)	
19	Hinje	(Šribar 1967)	
20	Kunč	(Pavšič 1987, MS)	
21	W Medvednica	(Crnjaković 1987, MS)	
22	Tukleć	(Babić & Zupanič 1976)	
23	Stupnica	(Babić & Zupanič 1976)	
24	Bešpelj	(Polšak et al. 1982)	
25	Trebovac	(Jelaska 1978)	
26	NE Majevica	(Bulić et al. 1978)	

27	Calla	(Pirini - Radrizzani et al. 1986)	MAASTRICHTIAN
14	Lig	(Pavšič 1977, 1981)	MAASTRICHTIJ
15	Podsabotin	(Šribar 1965, Pavšič 1977, 1981)	
16	Lijak	(Pavšič 1979, 1981)	
17	Kališe	(Pavšič 1981)	
19	Hinje	(Šribar 1967)	
20	Kunč	(Pavšič 1987, MS)	
22	Tukleć	(Babić & Zupanič 1976)	
23	Stupnica	(Babić & Zupanič 1976)	
24	Bešpelj	(Polšak et al. 1982)	
26	NE Majevica	(Bulić et al. 1978)	

Fossil assemblages: Nannoplankton or Planktonic Foraminifera
fosilna združba: nanoplankton ali planktonske foraminifere

Isolated localities
posamezna nahajališča

Continuous transition Cretaceous - Paleocene
postopen prehod kreda - paleocen

RUDISTID FAUNA FROM MAASTRICHTIAN IN DOLENJA VAS SECTION

Mario PLENIČAR and † Maria Luisa ZUCCHI-STOLFA

Fig. 6—15, Pls. 27, 28

INTRODUCTION

In the Dolenja vas profile near Senožeče the Creataceous beds were found between the field observation points 51 and 45. The oldest beds occur at point 51. Between points 45 and 44/8 Cretaceous beds pass into Tertiary beds. The Cretaceous beds at points 51 to 49 consist of grey to dark grey, brown to almost black micritic limestone and synsedimentary calcareous breccia. The section between points 49 to 45 belongs to the lower part of the Liburnian Formation which is attributed to Maastrichtian in its lower part. These beds have characteristics of rhythmites and bioturbidites, and they dip northeast (30°) at 15°. In grey micritic and sparitic limestone were found at point 51 rudistids of genera *Radiolitella, Kuehnia, Pseudopolyconites, Biradiolites* as well as species *Bournonia judaica* and *B. adriatica*. Higher in profile were found individual remains of valves of genus *Biradiolites*. At observation point 49, where limestones of the Liburnian Formation start, occur in the black brown limestone of probable lagoon environment frequent species of rudistid valves of genera *Bournonia* and *Biradiolites*. At point 47 were found next to valves of genus *Gyropleura* foraminifers of species *Rhapydionina liburnica*. At points 49 to 47 occur in several beds accumulations of valves of pelecypods of genus *Gyropleura*. Especially interesting is the synsedimentary breccia composed of fragments of micritic limestone with bournonias at point 45.

The strata at points 49 to 45 belong to »Vreme Beds« (PAVLOVEC, 1963), and they are attributed to the Upper Maastrichtian. The depositional environment on the carbonate platform, which was uplifted and disintegrated at the end of the Cretaceous times, was strongly saline, the water warm and quiet, and chemical sedimentation intensive. The limy mud was formed in great quantities, and in it occur preserved organic remains. In this environment lived small species of genus *Bournonia* characterized by narrow and long cylindrical shapes of their lower valves which were strengthened by strong longitudinal ribs. The valves consist of an interior and an exterior lamellar layer. The interior lamellar layer is 0,1 to 0,2 mm thick, and the exterior one 1 to 1,5 mm. Between lamellae of the exterior layer are situated transverse partitions. Such structure can be called lamellar-prismatic. Lamellae with partitions are in the transverse section of valves in the region of ribs (siphonal and others) anticlinally bent. The top of anticlines is mostly bent outwards, towards the anterior side of the valve. In certain species the top of anticlines in the siphonal rib *S* is turned towards the interior part of the valve. The partitions between lamellae are thinner than lamellae. The siphonal zone consists as a rule of two ribs. The posterior siphonal rib *S* is usually stronger than the anterior rib *E*. In the anterior part of valve appears in certain species the pedal rib *V* (as, among others, in genus *Eoradiolites*). The ligamental ridge is not developed.

Special forms of genus *Bournonia*, as found on the Triest-Komen plateau in the lower part of the Liburnian Formation, presented in their works from the region of Montenegro, island of Hvar, island of Brač and from Novi Pazar DESANKA PEJOVIĆ in 1968, 1978, 1979 and 1988, and from south Herzegovina, Bešpelj near Jajce and Stolac in Herzegovina TEOFIL SLIŠKOVIĆ in 1968 and 1983. There are especially the species *Bournonia wiontzeki* Pejović, *Bournonia* n. sp. (PEJOVIĆ, 1978), *B. dinarica* Slišković, *B. adriatica* Pejović, *B. quadripinnae* Pejović, *B. parva* Pejović, *B. bournoni* (Des Moulins) Fischer and *B. hercegovinica* Slišković.

The work was founded by the Research Community of Slovenia. In determination of fossils helped DESANKA PEJOVIĆ. Preparation and photographs of fossils were done by the technical collaborator at the Chair of Geology and Paleontology of the University Edvard Kardelj in Ljubljana MARJAN GRM. Warmest thanks to them. Certain thin sections were made also at the Paleontological Institute of the University in Triest. These thin sections served the second author M. L. ZUCCHI-STOLFA for drawing the illustrations which appear in Figures [6—15] of this work. The fossil material is preserved at the Chair for Geology and Paleontology of the University Edvard Kardelj in Ljubljana and at the Istituto di Geologia e Paleontologia dell'Universitá di Trieste.

PALEONTOLOGICAL PART

Familia Radiolitidae Gray 1848
Genus *Biradiolites* d'Orbigny 1847
Biradiolites baylei Toucas 1908
Fig. 6 in text

1908 *Biradiolites baylei* n. sp.; TOUCAS H., 119, Pl. 24, fig. 9 a.
1957 *B. baylei* Toucas; ASTRE G., 57—58, fig. 14 in text.

Fossil material: Transversal section of lower or right valve.

Description: The transversal section of the lower valve measures 0,5 cm in the direction cardinal zone — siphonal zone, and 1 cm perpendicularly to this direction. The transversal section of the valve is of triangular habitus, and it is limited on both sides by two strong ridges closing between them an angle of 180°; they lie consequently in a straight line with the cardinal zone. Almost symmetrically in the central part of the valve lies the strong triangular central ridge of the intersiphonal zone. On both sides of this ridge occur concavelly shaped siphonal grooves *E* and *S*. The ligamental ridge is not developed, and the cardinal apparatus is not preserved. The valve structure is indicated by regularly oriented square prisms which is characteristic of genera *Biradiolites, Eoradiolites* and *Bournonia*.

Similarities and differences: The species *Biradiolites baylei* belongs, according to ASTRE (1957), to his 5th group, respectively to the group of the type *fissicostatus* of *Biradiolites* genus. Typical for this group is the flat valve in the cardinal part; however, the valve in the species *B. baylei* appears still slightly convex, which is observed also in the transversal section of our specimen. In the transversal section of the valve in species *B. baylei* further

a relatively symmetrical distribution of the two principal ridges and both siphonal grooves can be seen, which is not that pronounced in other species of the *B. fissicostatus* group. Also the central ridge of the intersiphonal zone is strong and of regular triangular shape in species *B. baylei*, almost as in the TOUCAS's species *B. canaliculatus*.

Stratigraphical position and extension: According to TOUCAS (1908) the species *B. baylei* is characteristic for the Upper Campanian of the Dordogne region, France. According to PEJOVIĆ (1968) the representatives of the group *fissicostatus* in Montenegro are typical for Maastrichtian. The same is true for similar species in Herzegovina (SLIŠKOVIĆ, 1968). Also our specimen was found in the Maastrichtian succession (the lower part of the Liburnian Formation, or the »Vreme Beds«) in the area of the Triest-Komen plateau.

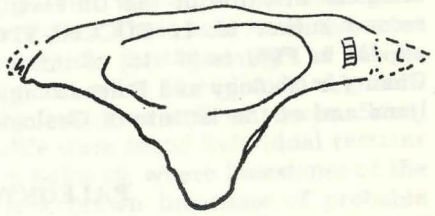


Fig. 6. *Biradiolites baylei* Toucas; transverse section through the lower valve; 3 X.

Sl. 6. *Biradiolites baylei* Toucas; prečni presek spodnje lupine; 3 X.

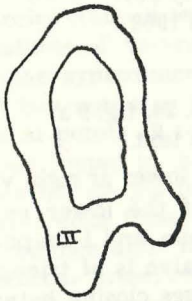


Fig. 8. *Bournonia adriatica* Pejović; transverse section through the lower valve; 3 X.

Sl. 8. *Bournonia adriatica* Pejović; prečni presek spodnje lupine; 3 X.

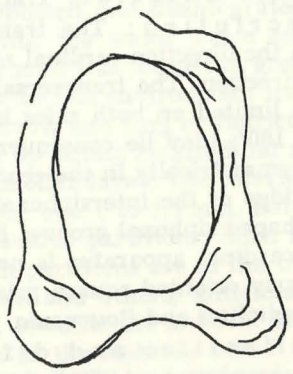


Fig. 7. *Bournonia adriatica* Pejović; transverse section through the lower valve; 3 X.

Sl. 7. *Bournonia adriatica* Pejović; prečni presek spodnje lupine; 3 X.

Locality: The specimen was found in the synsedimentary limestone breccia (in a limestone fragment in breccia) in the profile Dolenja vas; observation point 45.

Genus *Bournonia* Fischer 1887
Bournonia adriatica Pejović 1970
Fig. 7—8 in text

1970 *Bournonia adriatica* n. sp.; PEJOVIĆ D., 244—246, 4 figures in text.
1972 *B. adriatica* Pejović; CAMPOBASSO V., 366, fig. 1/3.

Fossil material: Two transversal sections of the lower valve in black brown limestone from synsedimentary breccia in the lower part of Liburnian Formation.

Description: The transversal section of valves is of oval shepe having the diameter of about 1 cm. The siphonal ridge *E* is somewhat narrover and shorter than the siphonal ridge *S*. In transversal section of the valve the elements of the cardinal apparatus are not visible. The ligamental ridge is not developed. Partly visible is the prismatic texture of the valve which is typical also for the *Bournonia* genus. It consists of lamellae and transversal partitions. In both specimens also the pedal ridge is visible.

Similarities and differences: The transversal section of the lower valve is somewhat similar to the species *Bournonia excavata* (d'Orbigny); however, the latter form is usually larger than the *B. adriatica* species, and it is typical for the older Senonian beds.

Stratigraphic position and extension: According to PEJOVIĆ the species *B. adriatica* is characteristic for Maastrichtian of the Brač island, of Montenegro, west and east Serbia, Fruška gora and Metohija PEJOVIĆ, 1970). Presently the species has been determined also in area of the Triest-Komen plateau in the lower part of the Liburnian Formation which is now being attributed to Maastrichtian.

Locality: The specimen was found in a limestone fragment from synsedimentary breccia in the Liburnian Formation at observation point 45, and in limestone occuring 55 m lower at point 51 of the Dolenja vas profil.

Bournonia judaica Blanckenhorn 1934
Figure 9 in text

1934 *Bournonia judaica* n. sp.; BLANCKENHORN M., 161—296, Taf. 7, Fig. 107.
1972 *B. judaica* Blanckenhorn; CAMPOBASSO V., 366, fig. 1/2.

Fossil material: Transversal section of the lower valve in black brown limestone of the lower part of the Liburnian Formation.

Description: Transversal section of the lower valve measures less than 1 cm and is almost circular. Visible on it are mainly the two siphonal ridges of which the siphonal ridge *S* is longer and narrower in base than the siphonal ridge *E*. At the end the ridge *S* is pointed. The siphonal ridge *E* is wider and has a concave indentation at the top. The intersiphonal zone is concave and about the width of the siphonal ridge *S* at the base. On the interior part of the valve, closer to the siphonal ridge *E*, a weak pedal ridge *V* can be observed.

Similarities and differences: In the transversal section of the lower valve both specimens i. e. that on fig. 1/2 in CAMPOBASSO's work from 1972 and our specimen, correspond very well in almost all details.

Stratigraphical position and extension: BLANCKENHORN's specimen was found in Upper Cretaceous beds of Syria and Palestine, and our specimen in the Maastrichtian beds of the Triest-Komen plateau.

Locality: Grey limestone at observation point 51 in profile Dolenja vas.

Bournonia parva Pejović 1988
Pl. 27, Fig. 1

1988 *Bournonia parva* n. sp.; PEJOVIĆ D., 43—44, Pl. 1, figs. 2, 3.

Fossil material: Transversal section of the lower valve in a fragment of limestone from the lower part of the Liburnian Formation in profile Dolenja vas; observation point 46/1.

Description: In transversal section of the lower valve both siphonal ridges are visible, of which the ridge *S* is stronger. The valve is rather small as compared to other specimens of genus *Bournonia* in profile Dolenja vas. It measures 4 to 6 mm in diameter as compared with 9 to 13 mm in other specimens. The valve is also quite damaged by parasites. On siphonal ridge *S* the valve structure is visible. Lamellae are bent anticlinally with the anticlinal top turned outwards. A similar anticlinal structure is observable also in the cardinal part of the valve. The intersiphonal space is wide. The siphonal ridges form a 90° angle, similarly to the specimen in PEJOVIĆ's treatise. The ends of siphonal ridges are suboval. The cardinal part of the valve is rounded on the exterior side and without any ridge. In this part of the valve the valve of species *B. parva* is intruded by a valve of another species of bournonia. Both individuals were possibly grown together during their life.

Locality: Dolenja vas near Senožeče on Triest-Komen plateau; profile Dolenja vas; observation point 46/1. Elsewhere this species has been found on island Brač and in Luštica in Boka Kotorska.

Stratigraphic horizon: Lower part of the Liburnian Formation, or »Vreme beds«, Maastrichtian. The new species *B. parva* Pejović was found by DESANKA PEJOVIĆ on the Brač island in Lower Campanian beds.

Bournonia aff. *parva* Pejović 1988
Pl. 27, Fig. 2

aff. 1988 *Bournonia parva* Pejović; PEJOVIĆ D., 43—44, Pl. 1, figs. 2, 3.

Fossil material: Transversal section of the lower valve in a fragment of dark grey limestone from synsedimentary breccia. Profile Dolenja vas; observation point 45.

Description: The specimen measures transversally 1 cm in diameter, which is close to the size of the specimen described by PEJOVIĆ as holotype of species *B. parva*. The valve is damaged by parasites. A part of the valve has been damaged during manufacturing of preparation, and therefore the presence of the rib there cannot be established. However, the pedal rib *V* is weakly developed. In the section of both sides of siphonal ribs the structure of the valve is visible. Lamellae are anticlinally bent in both ribs with tops turned outwards.

Similarities and differences with holotype of species *B. parva* Pejović: The angle between the siphonal ribs is about 90° in

our and in PEJOVIĆ's specimen. Both specimens differ especially by the presence of the pedal rib *V* in our specimen; this part is not visible on the specimen in PEJOVIĆ's work.

Stratigraphic horizon: The specimen was found in the lower part of the Liburnian Formation which is attributed to Maastrichtian.

Bournonia problematica n. sp.
Pl. 27, Fig. 3

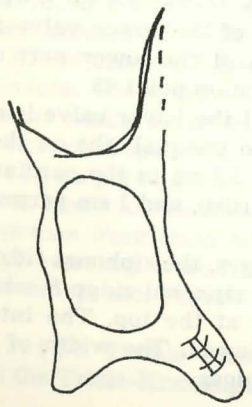
Derivation of name: »*problematica*« due to the unusually massive rib on the cardinal side of the valve.

Fossil material: Several transversal sections of the lower or right valve in black brown limestone in breccia of Liburnian Formation at Dolenja vas.

Holotype: Pl. 27, Fig. 3, transversal section of the lower or right valve. Holotype as thin section is kept in the collection of the Chair for Geology and Paleontology of the University Edvard Kardelj in Ljubljana. Inventary number 5461.

Diagnosis: In the transversal section of the lower valve appears as the mostconspicuous feature the rib on the cardinal side of the valve. Its lenght attains almost the diameter of the valve, and its width at least a third of the valve. The structure of this rib consists of oriented square prisms, or of lamellar-cellular pattern with anticlinally folded lamellae. The top of the anticline is opening outwards. The siphonal ridge are well expressed and of approximately equal size. The siphonal ridge *S* is only slightly narrower than the ridge *E*. The latter is wider, especially in the basal part, the angle between both siphо-

Fig. 9. *Bournonia judaica* Blanckenhorn; transverse section through the lower valve; 3 X.
Sl. 9. *Bournonia judaica* Blanckenhorn; prečni presek spodnje lupine; 3 X.



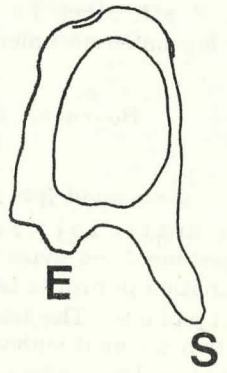


Fig. 10. *Bournonia* aff. *quadripinnae* Pejović; transverse section through the lower valve; 3 X.
Sl. 10. *Bournonia* aff. *quadripinnae* Pejović; prečni presek spodnje lupine; 3 X.

nal ridges is about 45°. The intersiphonal zone is narrow and concave. Its width corresponds approximately to the width of the siphonal ridge *S*. Well expressed is the pedal ridge *V* in which the structure of the valve, consisting of oriented square shaped prisms, is similar to that in both siphonal ridges and in the massive rib on the cardinal side of the valve, i. e. the anticlinally folded lamellarcellular structure with the top of anticlines turned outwards. The cardinal apparatus is not preserved, the ligamental ridge is not developed. In the transversal section the anterior part of the valve with the pedal ridge is convex.

Description: The diameter of the transversal section in the direction intersiphonal zone — cardinal zone amounts to 1,6 cm including the large (principal) rib, and perpendicular to this direction to 1,1 cm. The large rib excluded, the shape of the valve in transversal section is suboval. The valve is relatively thin, attaining the thickness of only 1,1 mm. In its entire extent it is built of oriented square shaped prisms which is a characteristics of the *Bournonia* genus. The specimen belongs to the association of small bournonias which are typical for the lagoon living environment. In the thin section it is of light gray color, in contrast to the dark color of the enclosing rock, the limestone. The upper or the left valve is not preserved.

Similarities and differences: Especially doe to its strong rib on the cardinal side, the new species does not resemble any of the known species. In the siphonal part it is to a certain extent similar to the species *B. retrolata* (Astre) as presented on Pl. 3, fig. 1 in the treatise by PEJOVIĆ from 1978.

Locus typicus: Profile Dolenja vas, observation point 45; Triest-Komen plateau.

Stratum typicum: The lower part of the Liburnian Formation (»Vreme Beds«) which is attributed to Maastrichtian. Along with this species also the species *Bournonia* cf. *retrolata* (Astre), *Bournonia* sp. secundo PEJOVIĆ 1978, *B.* aff. *parva* Pejović were found. All these forms are characteristic for the lagoon environment, at least at the Triest-Komen plateau.

Bournonia aff. *quadripinnae* Pejović 1988
Figure 10 in text

aff. 1988 *Bournonia quadripinnae* n. sp.; PEJOVIĆ D., 42—43, Pl. 1, fig. 1.

Fossil material: Transversal section of the lower valve in a fragment of limestone from synsedimentary breccia of the lower part of the Liburnian Formation in profile Dolenja vas; observation point 45.

Description: The transversal section of the lower valve is of suboval shape with two unequal siphonal ridges and two unequal ribs on the cardinal side of the valve. The diameters of valve attain 1.5 cm in the cardinal zone — siphonal zone direction (without considering the ribs), and 1 cm perpendicularly to it.

The siphonal zone consists of two strong ridges, the siphonal ridge *S* which is stronger (longer and rounded at top), and the siphonal ridge *E* which is half the length of the first, and somewhat sharper at the top. The intersiphonal space is quite large, smooth and concavely hollowed. The width of this space is about twice the width of individual siphonal ridges.

The exterior part of the valve consists of square shaped prisms and is very thin between ribs and siphonal ridges. Both strong ribs on the cardinal side of the valve are narrow and pointed at end. Their lengths are quite different. The rib on the posterior side of the valve is twice the length of the rib on the anterior side. The distance between these ribs is approximately equal to that between the siphonal ridges, and also the shape of the space between them resembles closely the intersiphonal zone on the opposite side of the valve.

Similarities and differences: The disposition of ribs is the same as in holotype from PEJOVIĆ's work of 1988. Ribs in our specimen are somewhat shorter, possibly also due to the poor preservation state. The angle between the siphonal ridges is 25° in PEJOVIĆ's specimen, and about 30° in our specimen (only a rough estimate due to bending of ridges).

Stratigraphic horizon and extension: The PEJOVIĆ's specimen was found at Selca on the island of Brač in Lower Campanian beds. Our specimen was found in Maastrichtian beds in the Dolenja vas profile on the Triest-Komen plateau.

Bournonia aff. *retrolata* (Astre 1929)
Pl. 27, Fig. 4

aff. 1929 *Biradiolites retrolatus* n. sp.; ASTRE G., 230, Pl. 20, fig. 6, 7.
aff. 1972 *B. retrolata* (Astre); CAMPOBASSO V., 366, fig. 1/4.
aff. 1978 *B. retrolata* (Astre); PEJOVIĆ D., Tab. 3, sl. 1.

Fossil material: Transversal section of the lower valve from a limestone fragment from synsedimentary breccia in Dolenja vas profile; observation point 45.

Description: The diameter of the transversal section of the lower valve is 1.1 cm in the direction cardinal zone — siphonal zone, and 1.2 cm perpendicularly to that direction. The valve consists of oriented square shaped prisms. The ridge *E* is short, truncated, but at the base of equal width as the ridge *S*.

Similarities and differences: In external habitus this specimen resembles considerably the specimen on Pl. 3, fig. 1 of PEJOVIĆ's treatise from 1978, and also the specimen fig. 1/4 in CAMPOBASSO's work from 1972. Closer similarities with remaining known species from literature were not found. In our case we might have matter also with a new subspecies of species *B. retrolata*. There are namely small differences in the form of the intersiphonal zone which looks in our specimen straighter and broader than in known specimens of species *B. retrolata* (Astre).

Stratigraphical position and extension: This specimen was found in black brown limestone in the limestone breccia in the lower part of the Liburnian Formation which is attributed to Maastrichtian. Along with species *B.* cf. *retrolata* were found also remains of species *B.* aff. *parva* Pejović and *Bournonia* sp. sec. Pejović 1978 which was found by PEJOVIĆ near Novi Pazar.

Locality: Profile along the road Dolenja vas—Vrabče; observation point 45 on the Triest-Komen plateau.

Bournonia triangulata n. sp.
Pl. 28, Fig. 1

Derivation of name: »*triangulata*« due to the triangular shape in the transversal section of the lower valve.

Fossil material: Several transversal sections of the lower, or right valve in fragments of limestone from synsedimentary breccia in profile Dolenja vas; obs. point 45.

Holotype: Pl. 28, fig. 1, transversal section of the lower valve — thin section which is kept in paleontological collection of the Chair for Geology and Paleontology of the University Edvard Kardelj in Ljubljana; inventory number 5462.

Diagnosis: Along with the two ridges which represent the siphonal zone occur on the outher side of the valve two additional ribs. The first of them is triangular, strong, broad and well expressed, while the other, which represents the pedal rib *V*, is less convex. However, this rib still can be clearly distinguished due to shallow concave grooves on both sides of the rib. The siphonal ribs in transversal section of the valve are expressive and of triangular shape. The structure of the valve differs to a certain extent among the two ridges. In the siphonal ridge *E* in the transversal section of the valve the oriented square shaped prisms bend towards the interior side of the valve. They form in this manner a sort of anticlines with tops turned towards the external side of the valve. In the siphonal ridge *S* the oriented prisms are bent towards the external side of the valve, they form in this manner anticlinal forms open outwards, or turned with tops towards the inner side of the valve. The intersiphonal area is a broad concave groove. The angle between the siphonal ridges is about 90°. The ligamental ridge is not developed.

Description and comparison with similar species: The transversal section of the lower or right valve measures 1.1 cm in diameter which is oriented from the intersiphonal zone to the cardinal zone, and also 1.1 cm in the direction transversal to the former. The outwardly turned anticlinal structures in the builtup of the valve were known earlier in the species *Bournonia dinarica* Slišković.

There they appear in the builtup of the valve of the intersiphonal zone and the siphonal ridge *S* (SLIŠKOVIĆ, 1968, Pl. 10, fig. 1, and Pl. 11, fig. 2). There this structure is partly observable also in other parts of the valve. In our specimen the structure of remaining parts of the valve is not visible, as they are recrystallized. The cardinal apparatus is not preserved. The ligamental ridge is not developed. The left valve is not preserved.

The form is similar to the specimen shown on Pl. 10, fig. 1, of the treatise by CAMPOBASSO V.: Rudiste del Cretaceo superiore delle Murge sud-orientali from 1972. The specimen is there described as *Bournonia* sp.; it differs however, of our species *B. triangulata* by stronger pedal rib and by the position of the ridges. On the illustration in CAMPOBASSO's treatise the structure of both siphonal ridges cannot be seen.

The new species *B. triangulata* is also similar to species *B. parva* Pejović 1988. In both species the angle between the siphonal ridges in the transversal

section of the valve amounts to about 90°. Our species differs from *B. parva* by an expressed triangular rib on the cardinal side of the valve absent in *B. parva*, and by pedal rib *V* which is also lacking in species *B. parva*.

Locus typicus: Dolenja vas near Senožeče, Triest-Komen plateau.

Stratum typicum: The lower part of the Liburnian Formation, or the »Vreme Beds« — Maastrichtian.

Bournonia cf. *wiontzeki* Pejović 1968
Pl. 28, fig. 2

cf. 1968 *Bournonia wiontzeki* n. sp.; PEJOVIĆ D., 168—169, tab. 1, sl. 1, 2, tab. 2, sl. 1—3.

Fossil material: Part of slightly oblique section of the lower valve (thin section) from a fragment of limestone from synsedimentary breccia in the Dolenja vas profile; observation point 45.

Description: The diameter of the slightly oblique section of the lower valve (thin section) is about 1 cm (not regarding the ribs). Visible are three well expressed ridges respectively ribs. In two ridges the structure of the valve is visible. In the ridge which is only partly preserved the top of the lamellar anticline is turned inward the valve, and in the other ridge outwards. There are no traces of the cardinal apparatus.

Similarities and differences: Our specimen can be compared with the specimens which are depicted in the PEJOVIĆ's work from 1968, especially in well expressed pointed ridges.

Stratigraphical horizon and extension: Species *B. wiontzeki* was found in Montenegro in Maastrichtian beds. A similar species was mentioned already by WIONTZEK in 1934 in this treatise on rudistids of the Soča valley (WIONTZEK, 1934). He attributed it to Senonian. At Dolenja vas the specimen was found in Maastrichtian synsedimentary breccia.

Bournonia sp. sensu Pejović 1978
Pl. 28, fig. 3

1978 *Bournonia* sp.; PEJOVIĆ D., Pl. 3, fig. 2.

Fossil material: Several transversal and oblique sections across the right valve in a piece of black brown limestone from a synsedimentary breccia in the lower part of the Liburnian Formation near Dolenja vas; obs. point 45.

Description: Transversal section of lower valves measure from 1.0 to 1.2 cm in diameter. In transversal section the shape of the lower valve is of the lower valve is of almost square habitus. This shape is a consequence of the distribution of the siphonal ridges and two ribs. The orientation of the valve is difficult because the cardinal apparatus is not preserved, the ligamental ridge absent (it is not developed in this genus), and both siphonal ridges are developed very similarly to the two ribs on the opposite side of the valve. As

siphonal ridges were chosen, and out of the two the stronger one is selected as the siphonal ridge *S*. The anterior side of the valve should be indicated by the convexely formed part of the valve, which is therefore on the inner side concavely shaped. We selected this way of orientation on the basis of the orientation of the specimen presented in figure 2 on Pl. 3 of PEJOVIĆ's treatise from 1978, although there the siphonal ridges *E* and *S* are not marked. On our illustration (Pl. 28, Fig. 3) the structure of oriented prisms is visible in both siphonal ridges and in both ribs. Both siphonal ridges are at top considerably damaged by erosion, which is rather usual in genus *Bournonia,* since the structure of both siphonal ridges is quite delicate.

Also in this species the intersiphonal zone is broad and concave. The internal layer of the valve is not well preserved in any of the specimens.

Stratigraphic position and extension: The specimens were found in a fragment of black brown limestone belonging to the synsedimentary breccia in the lower part of the Liburnian Formation (»Vreme Beds«) which is attributed to Maastrichtian. Triest-Komen plateau; Dolenja vas. According to PEJOVIĆ a similar specimen was found near Novi Pazar in the Upper Cretaceous beds.

Genus *Fossulites* Astre 1954
Fossulites undesaltus Astre 1954
Figure 11 in text

1954 *Medeela undesaltus* Astre; ASTRE G., 41, fig. 14 in text.
1957 *Medeela (Fossulites) undesaltus* Astre; ASTRE G., 25—48, figures 6 a—c, 12 h—k in text.
1968 *Fossulies undesaltus* Astre; POLŠAK A., 101—102, Fig. 27 in text.

Fossil material: Transversal section of lower valve in grey limestone.

Description: The transversal section of the valve is suboval with 2 cm in diameter. The siphonal ridges are almost equally developed. With respect to the position of the ligamental ridge which is always situated in the posterior part of the valve, i. e. closer to the siphonal ridge *S*, the dats on broader ridge *E* would suit, since the ridge *E* is in fact broader. In both siphonal ridges also channels are visible which are believed by ASTRE to be important for circulation of water. The ligamental ridge is short and subtriangular. The valve structure is pronounced by prismatical. The pseudopillars on the inner side of the valve are not developed in the siphonal part.

Similarities and differences: From the similar genus *Medeela* the genus *Fossulites* differs especially by the characteristical structure of the siphonal zone and by pronounced prismatical structure of the valve.

Stratigraphical position and extension: ASTRE attributed this species from the area of Moulin de l'Agly to Coniacian. In our case the stratigraphic level is clearly higher, probably Maastrichtian. The specimen was found together with species and genera *Radiolitella, Kuehnia* aff. *serbica* and *Pseudopolyconites* near Dolenja vas.

Locality: Profile Dolenja vas near Senožeče; obs. point 51.

Fig. 11. *Fossulites undesaltus* Astre; transverse section through the lower valve; 3 X.
Sl. 11. *Fossulites undesaltus* Astre; prečni presek spodnje lupine; 3 X.

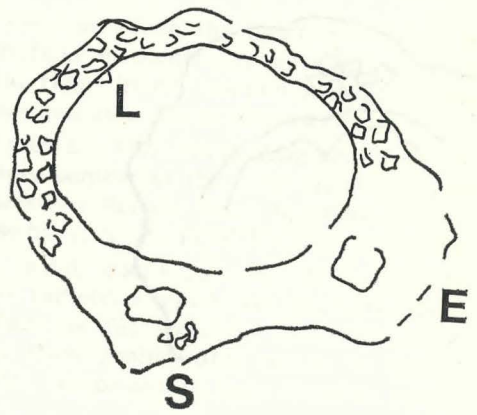


Fig. 12. *Kuehnia* aff. *serbica* Milovanović; transverse section through the lower valve; 3 X.
Sl. 12. *Kuehnia* aff. *serbica* Milovanović; prečni presek spodnje lupine; 3 X.

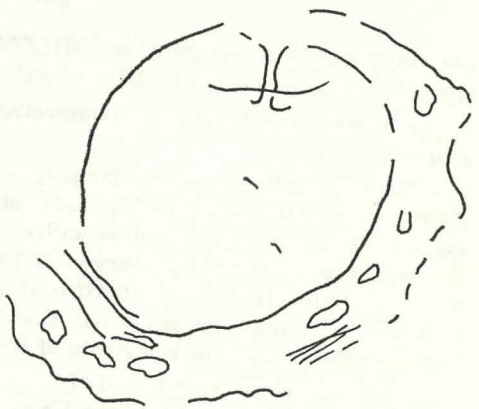


Fig. 13. *Pseudopolyconites* sp. Milovanović; transverse section through tle lower valve; 3 X.
Sl. 13. *Pseudopolyconites* sp. Milovanović; prečni presek spodnje lupine; 3 X.

Fig. 14. *Radiolitella* sp. Douvillé; transverse section through the lower valve; 3 X.
Sl. 14. *Radiolitella* sp. Douvillé; prečni presek spodnje lupine; 3 X.

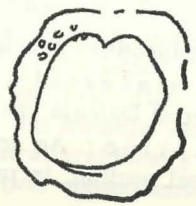


Fig. 15. *Radiolitella* sp. Douvillé; transverse section through the lower valve; 3 X.

Sl. 15. *Radiolitella* sp. Douvilé; prečni presek spodnje lupine; 3 X.

Genus *Kuehnia* Milovanović 1956
Kuehnia aff. *serbica* Milovanović 1956
Figure 12 in text

aff. 1956 *Kuehnia serbica* n. sp.; MILOVANOVIĆ B., 131—144, Tab. 1, sl. 1.
aff. 1968 *Kuehnia serbica* Milovanović; PEJOVIĆ D., 171, Tab. 4, sl. 1, 2.

Fossil material: Transversal section of lower valve in grey limestone.

Description: The transversal section of the lower valve measures 2 cm in diameter, and is of suboval shape. On the posterior part of the valve occur quite well expressed »osculi«, while the anterior part of the valve is worse preserved. Well preserved is the ligamental ridge, which is at the end abruptly truncated. The structure of the exterior layer is not preserved in its totality, so it may be supposed that the structure is partly also prismatical. Pseudopillars on the interior side of the valve are not developed.

Similarities and differences: The specimen is very similar to the individual on Plate 4, figure 1 and 2 in PEJOVIĆ's treatise from 1968.

Stratigraphical position and extension: The species *Kuehnia serbica* was found in Serbia and in Montenegro, and also at the Triest-Komen plateau near Dolenja vas. In Serbian and Montenegrian localities it is characteristical for the upper part of Campanian, respectively for the lower part of Maastrichtian, in Slovenia was found in Maastrichtian beds.

Locality: Profile Dolenja vas; obs. point 51.

Genus *Pseudopolyconites* Milovanović 1935
Figure 13 in text

1935 *Pseudopolyconites parvus* n. gen., n. sp.; MILOVANOVIĆ B., 1—79.

Fossil material: Transversal section of a valve fragment from grey limestone at Dolenja vas.

Description: As only a single fragment of valve, and even that in the transversal section, is present, the species cannot be determined. Fortu-

nately that part of the valve is preserved, on which the ligamental ridge is visible, which is one of the characteristical elements for determination of genus *Pseudopolyconites*. The ligamental ridge in our section is split in the form of a double slipper. The size of the section amounts to about 3 cm.

Similarities and differences: Our valve fragment, respectively the ligamental ridge on it resembles somewhat the ridge of the species *P. laskarevi* Milovanović-Sladić from western Serbia. Such ligamental ridge can be seen on Plate 2, fig. 1 of the treatise by SLADIĆ-TRIFUNOVIĆ from 1971.

Stratigraphical position and extension: The specimen was found in beds containing also other radiolites which are characteristical for Upper Senonian, resp. Maastrichtian, as for example *Radiolitella* sp., *Kuehnia* aff. *serbica* and others. Genus *Pseudopolyconites* occurs in Serbia, on the Brač island, and it was found on Mt. Nanos and in Italy (Apulia), everywhere in the youngest Senonian beds.

Locality: Profile Dolenja vas; obs. point 51.

Subgenus *Radiolitella* Douvillé 1904
Figures 14 and 15 in text

1904 *Radiolitella forojuliensis* Pirona; DOUVILLÉ H., 535—537, Pl. 14, fig. 1, 2, 3.

Fossil material: Two transversal sections of lower valve, one among them only in the area of the cardinal zone of the valve.

Similarities and differences: One oft he specimens (figure 14) approaches closely DOUVILLÉ's species *R. forojuliensis* by its shape, as well as by the size of the ligamental ridge.

Stratigraphical position and extension: Specimens of this genus were found on Mt. Nanos and on Colle di Medea. According to DOUVILLÉ this species is characteristic for Maastrichtian. Now it was found also on the Triest-Komen plateau in beds which also were attributed to Maastrichtian.

Locality: Dolenja vas; observation points 45 and 51.

CONCLUSIONS

In the lower part of the profile Dolenja vas below the Tertiary beds the Cretaceous beds containing rudistid fauna have been established. These beds are composed in their lower part of grey micritic and sparitic limestones, and higher, just below the Tertiary beds, of dark grey, brown and black micritic limestones and synsedimentary calcareous breccia. The latter limestones and calcareous breccia belong to the lower part of the Liburnian Formation or »Vreme beds«. All described Cretaceous beds in the Dolenja vas profile, also the lower part of the Liburnian Formation, are stratigraphically attributed to the Upper Maastrichtian. The Liburnian Formation consequently belongs in

part to Cretaceous (Maastrichtian), and in part to Tertiary (Paleocene). While the grey micritic and sparitic limestones underlying the Liburnian sequence formed in open marine shelf, the Liburnian beds deposited partly in lagoons and partly already in fresh water environment, as indicated by remains of fresh water snails in certain beds. Small forms of genera *Bournonia* and *Gyropleura,* which lived in the lower part of the Liburnian Formation, had to adapt at the end of Cretaceous to those extraordinary circumstances. In the middle part of the Liburnian Formation, i. e. in the Kozina beds, there is no trace left of rudistids. The Kozina beds are attributed to Tertiary (Danian ?).

Gyropleuras unfortunatelly could not be prepared from the enclosing rocks nowhere in the Dolenja vas profile for a more accurate determination, their cross sections not being characteristical enough for determination. As a consequence, the question of gyropleuras remains still open from the paleontological aspect.

In no specimen of bournonias the cardinal apparatus (teeth), myophoria, etc.) was preserved. In genus *Bournonia* also the ligamental ridge is not developed. All this seems to indicate the calmness of the environment in which the pelecypods lived, and the low energy index of water. Rudistids did not need a strong apparatus for closing the valves.

Bournonias had a relatively long and narrow cylindrical shape with a diameter of 1 to 2 cm, and therefore they needed for support quite strong ribs, respectively ridges. On the whole, the question on the height of these pelecypods remains open, since no complete valve is preserved, and they are known only from sections in the mother rock (limestone). They certainly could not have been higher than a few centimeters. Individual subjects lived most probably buried in limy mud which at that time abundantly formed as chemical precipitate. Strong ribs served to bournonia also for fixation in the mud.

Characteristical for valves of all organisms living during those times was that they were rather thin. In thin sections one may see that the valves of rudistids are quite damaged (bored) by parasites. Possibly these were sea sponges, or perhaps other parasites. This is an interesting question for a separate study.

It can be further stated that no united settlements of rudistid pelecypods — mats — existed at those times. Individual subjects lived in a solitary way. They did not build bioherms.

On the ground of these considerations it can be stated that the Cretaceous rudistid fauna, which was characterized still in the Lower and Middle Senonian by large, numerous bizarre forms, was extinguishing on the Karst carbonate platform of the Triest-Komen plateau as thin, quite primitive species which lived in a calm lagoon environment.

CORAL FAUNA FROM PALEOCENE OF DOLENJA VAS SECTION

Dragica TURNŠEK

Fig. 16
(Pl. 29—35)

INTRODUCTION

In the Dolenja vas section corals were found in 18 samples. Eleven species were determined which are attributed to 9 genera. They were classified in the following system:

Scleractinia

Subordo: Archaeocoeniina Alloiteau 1952
Familia: Stylocoeniidae Alloiteau 1952
Genus: *Stylocoenia* Milne Edwards & Haime 1848
Stylocoenia montium (Oppenheim 1912)
Subordo: Dendrophylliina Vaughan et Wells 1943
Familia: Dendrophylliidae Gray 1847
Genus: *Dendrophyllia* Blainville 1830
Dendrophyllia candelabrum Hennig 1899
Dendrophyllia dendrophylloides M. Edv. & Haime 1850
Familia: Acroporidae Verrill 1902
Genus: *Haimesastraea* Vaughan 1900
Haimesastraea peruviana Vaughan 1922
Subordo: Meandriina Alloiteau 1952
Familia: Phyllocaeniidae Alloiteau 1952
Genus: *Plocophyllia* Reuss 1868
Plocophyllia karstica n. sp.
Subordo: Fungiina Verrill 1865
Familia: Siderastraeidae Vaughan & Wells 1943
Genus: *Siderastraea* Blainville 1830
Siderastraea sp.
Genus: *Rhizangia* M. Edw. & Haime 1848
Rhizangia sp.
Familia: Actinacidiidae Vaughan & Wells 1943
Genus: *Actinacis* d'Orbigny 1849
Actinacis cognata Oppenheim 1901
Familia: Poritidae Gray 1842
Genus: *Goniopora* Blainville 1830
Goniopora elegans (Leymerie 1846)
Familia: Astraraeidae Beauvais 1982
Genus: *Litharaeopsis* Beauvais 1982
Litharaeopsis subepithecata (Oppenheim 1912)

In the systematics I take into account the establishments and revisions of newer investigators (ALLOITEAU 1952, 1957, VAUGHAN & WELLS 1943,

WELLS 1956, BARTA-CALMUS 1973, FLORIS 1972, FROST & LANGENHEIM 1974, KUZMICHEVA 1975, RUSSO 1979, BEAUVAIS 1982 and others).

Genus *Stylocoenia* has been ranged, following BARTA-CALMUS (1973), to suborder Archaeocoeniina and not to Meandriina after ALLOITEAU (1952), owing to absence of synapticulae. Names for suborders Faviina and Dendrophylliina were taken from VAUGHAN & WELLS (1943), owing to their priority with respect to names Astraeoina and Eupsammina after ALLOITEAU 1952. Genus *Plocophyllia* I attribute, following BARTA-CALMUS, into Meandriina (not into Caryophyliia according to RUSSO 1979) due to its strongly developed endotheca; with its microstructure, excentric axial structure and peculiar reproduction it closely approaches to suborder Amphiastraeina. Genus *Rhizangia* is attributed according to BEAUVAIS (1982) to suborder Fungiina, and not to Faviina, where it was ranged by ALLOITEAU (1952) and WELLS (1956), owing to the presence of synapticulotheca. Genus *Haimesastraea* is attributed owing to the presence of synapticulae into family Acroporidae. Genera of this family were attributed by RONIEWICZ (1976) into Eupsammina (Dendrophylliina), whereas ALLOITEAU (1952) and WELLS (1956) attributed this family still to Archaeocoeniina, respectively Astrocoeniina.

Already these few examples indicate the urgent necessity of the revision of the system, owing to the lack of unique criteria even for the highest systematic categories as suborders.

DESCRIPTION OF SPECIES

Subordo: Archaeocoeniina Alloiteau 1952
Familia: Stylocoeniidae Alloiteau 1952
Genus: *Stylocoenia* Milne Edwards & Haime 1848
Stylocoenia montium (Oppenheim 1912)
Pl. 29, Fig. 1—3

1912 *Stylophora montium* n. sp. OPPENHEIM: 132, Taf. 14, Fig. 14—14 a.
1975 *Stylocoenia montium* (Oppenheim). KUZMICHEVA: 18, Tab. 1, fig. 4.

Revision of the genus was made by ALLOITEAU (1957: 58—59), description of the species by KUZMICHEVA (1975: 18).

Our specimen is a massive subcerioid colony with polygonal corallites, septa compact in hexameral system, columella styliform, large and joined with the first cycle septa. Wall is septotheca, dissepiments tabulate. Microstructure is not preserved. The very similar *Stylophora* differs in having wider peritheca.

Dimensions:	Dv	OPPENHEIM	KUZMICHEVA
d	1.5—2 mm	2 mm	1.5—2 mm
s	12	12	12

Distribution: ? Lower Eocene of Rosići in northern Bosnia, Montian-Thanetian of Luzanovka in Ukraine.

Material: Dv 22, Upper part of Danian (Montian).

Subordo: Dendrophylliina Vaughan & Wells 1943
Familia: Dendrophylliidae Gray 1847
Genus: *Dendrophyllia* Blainville 1830
Dendrophyllia candelabrum Hennig 1899
Pl. 29, Fig. 4—6

1899 *Dendrophyllia candelabrum* n. sp. HENNIG: n. v.
1972 *Dendrophyllia candelabrum* Hennig. FLORIS: 92—98, Pl. 6, Fig. 35—37, Pl. 7, Fig. 2, 5, 6, ? 1, ? 3 A, ? 3 B (synonymy).
1985 *Dendrophyllia* cf. *dendrophylloides* Milne Edw. & Haime. POLŠAK: 9, Tab. 13, sl. 2.

Modern description of species was made by FLORIS (1972). Our specimens are subdendroid colonies with different density of corallites. Septa subcompact, with rare pores, laterally smooth or rarely granulated. Inner septal margins prolongate somewhere into trabecular columella. In some levels they become thickned and free, so columella seems to be absent. Costae distinct. Wall is synapticulotheca, or septotheca. Dissepiments thin, tabulate.

Our specimens fit with Floris description of lectotype (FLORIS 1972: Pl. 7, Fig. 2, 5, 6). Microstructure is poorly preserved.

Dimensions:	Dv	FLORIS
d	2—3 (3.5) mm	2—3 (also 4—5) mm
s	24 (+ s)	24

Distribution: Lower Danian of Greenland, Danian of Denmark, Lower and Middle Danian of Sweden (see FLORIS 1972), Paleocene of Medvednica.

Material: Dv 1, 7, 8, 16, 18, 21, 28, 32, 37, 38, Danian (with Montian) and Thanetian.

Dendrophyllia dendrophylloides Milne Edwards & Haime 1850
Pl. 30, Fig. 1—2

1850 *Dendrophyllia dendrophylloides*. M. EDWARDS & HAIME: 36—37, Tab. 6, Fig. 2, 2 a, b, c.
1975 *Dendrophyllia dendrophylloides* M. Edw. et Haime: KUZMICHEVA: 28, Tab. 4, fig. 2, 3.

Modern description of species was given by KUZMICHEVA (1975). In our material specimens of this species are not common. They are dendroid colonies with ramifying corallites, septa costate, in four cycles, hexameral, columella parietal, in some levels absent, synapticulotheca, dissepiments tabulate and long. Microstructure seems to have simple trabeculae, poorly preserved.

Our specimens fit with Kuzmicheva's descriptions. This species differs from *D. candelabrum* in larger corallites and more septa.

Dimensions:	Dv	KUZMICHEVA
d	4—6 mm	4—5 mm
s	44—48	42—48

Distribution: Lower Eocene (London Clay) of Bracklesham Bay in England, Montian-Thanetian of Luzanovka in Ukraine, Paleocene of Middle Volga region in USSR.

Material: Dv 7, 8, 28, 32, 37, Danian (with Montian) and Thanetian.

Familia: Acroporidae Verrill 1902
Genus: *Haimesastraea* Vaughan 1900

Genus *Haimesastraea* has very unclear position in systematics. WELLS (1956) attributed it (with question mark) to suborder Astrocoeniina, family Stylinidae; the same did FLORIS (1972: 23). FROST & LANGENHEIM (1974: 193) attributed it to the same suborder, but family Acroporidae, ALLOITEAU (1952: 652) to the suborder Caryophylliina, family Parasmiliidae.

Because of synapticulae the genus does not fit to Astrocoeniina (Archaeocoeniina), because of dissepiments not to Caryophyllina. In structure of septa and wall with rare synapticulae it mostly fits with Acroporidae, attributed by RONIEWICZ (1976) to suborder Eupsammina (Dendrophylliina).

Haimesastraea peruviana Vaughan 1922
Pl. 30, Fig. 3

1922 *Haimesastraea peruviana* n. sp. VAUGHAN: n. v.
1974 *Haimesatraea (Haimesastraea) peruviana Vaughan. FROST & LANGENHEIM*: 193—194, Pl. 59, Fig. 1—5.

In our material there is a single colony which is ramose in shape, with plocoid to almost cerioid corallites. Wall is incomplete synapticulotheca; tabular dissepiments are sparse, septa hexameral in 3 cycles, first prolongate into parietal columella, or thicken in axial part. Microstructure is not preserved.

Dimensions:	Dv	FROST & LANGENHEIM
d	1.5—2 mm	1.5—2.1 mm
s	16—20	17—20

Distribution: Middle Eocene of Mexico and NW Peru defined by FROST and LANGENHEIM (1974) was ascribed to Paleocene-lower Eocene by FLORIS (1972: 25).

Material: Dv 9 (Lower part of Danian).

Subordo: Meandriina Alloiteau 1952
Familia: Phyllocaeniidae Alloiteau 1952
Genus: *Plocophyllia* Reuss 1868
Plocophyllia karstica n. sp.
Pl. 31, Fig. 1—3, Pl. 32, Fig. 1—3

Name: After karstic region of finging place
Holotypus: Dv 23 b/1
Locus typicus: Dolenja vas
Stratum typicum: Upper part of Danian (Montian)
Material: 9 colonies, 5 thin sections (Dv 23 b/1—9)
Diagnosis: *Plocophyllia* with irregularly phaceloid, mono- to polycentric corallites, excentric fossula, compact septa, all cycles equal, tabulate and vesicular large dissepiments, microstructure with clear median line. d = 8—20 mm, s = ca 48.

Description: Colony is irregularly phaceloid with mono- to polycentric coralites which bud peculiarly, intracalicinal, by vesicular pockets tending to be similar to Donacosmilidae. Septa are compact, in 4—5 cycles, almost equal in width, laterally smooth or rarely dentate; axially prolongate into parietal columella, or end free. Endotheca abundant of vesicular and tabulate dissepiments, long and bent. Wall is paratheca. Microstructure well preserved, with median dark line and orthogonal fibres.

Remarks: In colony, septa and wall structure our specimens are very close to *Plocophyllia bartai* (RUSSO 1979: 76—77, Tav. 14, fig. 2—3). Also dimensions are similar (d = 6—22, s = 60—75). *P. karstica* differs in tabulate dissepiments and in septa being equal in all cycles. In species *P. calyculata* and *P. catulli* wall is septothecate and endotheca is poorly preserved (BARTA-CALMUS 1973: 372—376).

Systematic: RUSSO (1979) attributed *Plocophyllia* to Caryophyliina, BARTA-CALMUS (1973) to Meandriina. Because of presence of dissepiments I think the later arrangement is justified. Because of special budding and excentric axial structure I suppose that *P. bartai* and our new species *P. karstica* seem to approache Amphiastraeina.

Subordo: Fungiina Verrill 1865
Familia: Siderastraeidae Vaughan & Wells 1943
Genus: *Siderastraea* Blainville 1830
Siderastraea sp.
Pl. 33, Fig. 1

Massive encrusting colony with subconfluent septa has roundish to polygonal corallites, subconfluent thamnasterid septa, incomplete synapticulotheca and parietal columella. Septa are porous, in 3—4 cycles, d= 2—3 mm. Poorly preserved.

Similar forms in Tertiary are species of *Siderofungia* (BARTA-CALMUS 1973: 510—518) which differ in confluent septa.

Material: Dv 32/1, Uppermost part of Lower Danian.

are subcerioid. Skeletal elements studied in our spceimens in thin sections show all characteristics of *Litharaeopsis*. They fit with *L. subepithecata*, and differ from very similar *L. katzeri* Oppenheim 1912 in larger corallites.

Distribution: ?Lower Eocene of Rosići in Bosnia.

Material: Dv 24, Uppermost part of Danian (Montian).

STRATIGRAPHICAL SIGNIFICANCE OF DISCOVERED CORALS

Comparison with other localities elswhere in the world

Paleocene corals in the world do not comprise many species, but they have a wide geographical extension. They were described from various localities in Greenland, Sweden, Denmark, Belgium (FLORIS 1972), from Haunsberg near Salzburg in Austria (KÜHN & TRAUB 1967), from Minor Pyrenees in Spain (ALLOITEAU & TISSIER 1958), from various localities in Africa, as in Ivory Coast (BARTA-CALMUS 1969), Libya (WANNER 1902), Somalia (RUSSO, in manuscript), from Luzanovka in Ukraine and Middle Volga region in USSR (KUZMICHEVA 1975), and from elswhere. In Yugoslavia they were determined in Mt. Medvednica near Zagreb (POLŠAK 1985). Corals were found also in other areas, as for example in Abruzzi in Italy (BARATOLLO 1982), in Paris basin (CAVELIER et POMEROL 1983), in Yugoslavia in Banija near Petrinje (BABIĆ et al. 1976), and in other localities, but they have not been paleontologically examined.

The coral species from Dolenja vas could be compared to Scandinavian and Sowiet localities and to Medvednica. Common with Scandinavian localities is species *Dendrophyllia candelabrum* which is very abundant, and there stratigraphically precisely limited to Danian. With Sowiet localities four species are common: *Dendrophyllia dendrophylloides, Stylocoenia montium, Goniopora elegans* and *Actinacis cognata*. The first one was attributed in USSR to the entire Paleocene, and the remaining three to Montian-Thanetian. Common with Medvednica are two species: *Dendrophyllia dendrophylloides* and *Actinacis cognata*. This locality is attributed to Paleocene. With these comparisons the Paleocene age of corals in Dolenja vas is confirmed.

Certain species from Dolenja vas were reported next to Paleocene also to Lower Eocene: four species in Rosići in north Bosnia (OPPENHEIM 1912), and one each in Frioul (OPPENHEIM 1901) and in Carpathians (ELIAŠOVA 1974).

With respect to the very detailed stratigraphical subdivision of the Dolenja vas section on the basis of a number of fossil groups, and confirmation of the Paleocene age of corals by comparison with Scandinavian and Ukrainian localities there exists the possibility of incorrect stratigraphical attribution of the Rosići locality into Eocene. It may reach still into Paleocene, because according to recent investigations the Paleocene reef sediments were being discovered right in the wider region of Mt. Majevica in north Bosnia (see BABIĆ et al. 1976).

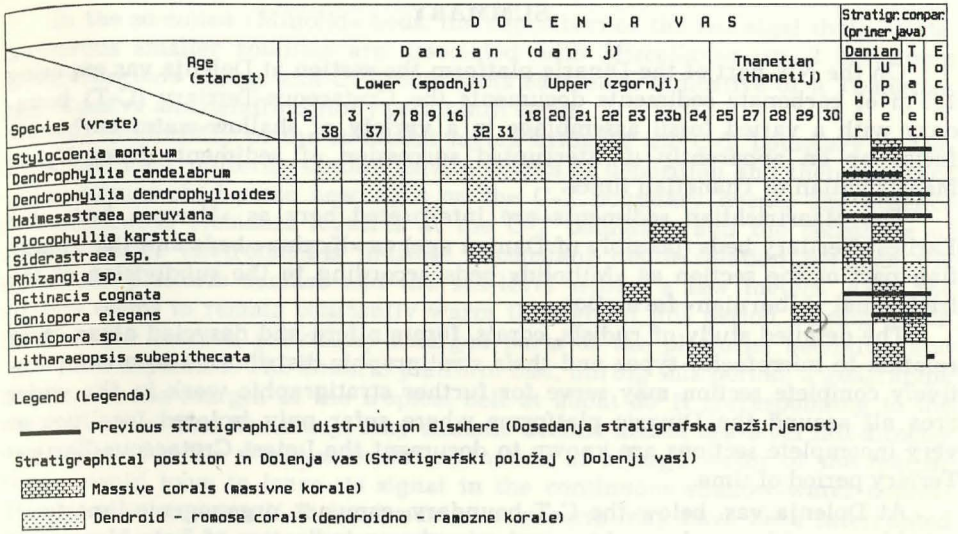


Fig. 16. Situation of coral species in Dolenja vas section and their previous stratigraphical distribution elsewhere.

Sl. 16. Položaj koralnih vrst v profilu Dolenja vas in njihov dosedanji stratigrafski položaj drugje.

Stratigraphical position of individual coral species in Dolenja vas

The study of the Dolenja vas section revealed the temporal restriction of certain coral species to narrow horizons which could perhaps serve as stratigraphic base for corals in the wider area.

Dendrophyllia candelabrum, D. dendrophylloides and *Rhizangia* sp. occur throughout Paleocene, and do not have a more distinct stratigraphic position. *Stylocoenia montium* is associated with horizon Dv 22, *Plocophyllia karstica* with Dv 23 b, *Actinacis cognata* with Dv 23, *Goniopora elegans* with Dv 18, 20, 22, and *Litharaeopsis* subepithecata with Dv 24, all of which are situated within the Upper Danian (Montian). Species *Goniopora* sp. appears with numerous individuals in horizon Dv 29, in Upper Thanetian.

Paleoecology of corals in Dolenja vas

The corals of Dolenja vas can be subdivided according to the shape of colonies into two major types. The first are of dendroid ramose shapes, and the second type of massive-encrusting-bulbous shapes. The latter are reef-builders. However, the colonies are small and they formed patch-reefs only. It is interesting to note that the dendroid corals occurred from the beginning of Danian throughout the entire Paleocene. Favorable conditions for growth of patch-reefs with massive corals appeared only during the Upper Danian (Montian), and later again in Upper Thanetian (Fig. 16).

SUMMARY

On the NW part of the Dinaric platform the section at Dolenja vas exposing 135 m of carbonate sediments documents the Cretaceous-Tertiary (C-T) boundary with a varied fossil assemblage in a variety of shallow-water carbonate facies by an apparently uninterrupted succession of sediments from Upper Maastrichtian to Thanetian times.

The Maastrichtian sediments are interpreted here as »Vreme« beds, the Earliest Tertiary beds (possibly of Danian age) as »Kozina« beds and the Thanetian part of the section as »Miliolid« beds according to the subdivision of the traditional »Liburnian« formation.

The detailed study of rudists, corals, foraminifera and dasyclad algae, their relation to microfacies types and their stratigraphic distribution in a comparatively complete section may serve for further stratigraphic work in the wider area all around the Dinaric platforms where sofar only isolated localities or very incomplete sections are known to document the Latest Cretaceous-Earliest Teriary period of time.

At Dolenja vas, below the C-T boundary, compact, organogenic limestones provide assemblages of a makro- and microfauna indicative of Late Maastrichtian. Overgrown skeletal parts and the traces of activitiy of endoliths reflect low rates of deposition. Layers of synsedimentary breccias with »hermatypic« rudistids indicate local water energy of high levels in the proximity of the littoral zone, while the more abundant micrites were deposited in a restricted, lagoonal environment.

Above the C-T boundary, micritic limestones of dark colour were deposited in conformity over the Cretaceous deposits. They contain abundant plasticlasts, stromatolithes and shrinkage pores. Fossils are rare and of small dimensions. In some levels, »Microcodium« forms crusts while single crystals or crystal aggregates may be dispersed in the micritic sediment. These sediments were deposited in intertidal and supratidal environments. Later deposits, dated as Thanetian by larger foraminifera, show a slow, transgressive tendency by deepening upwards to clearly subtidal, normal marine shallow-water carbonates.

The fossil assemblages of the Late Cretaceous »Vreme« beds are characterized by the foraminifer *Rhapydionina liburnica* and by rudists of the genus *Bournonia, B. parva* and *B. problematica* n. sp. associated to *Gyropleura lumachellas.*

The lower part the »Kozina« beds contain small and thin-shelled fossils such as *Clypeina* sp. and *Protelphidium* sp. followed by miliolids, ataxophragmiids *(Pseudochrysalidina), Bolkarina* sp. and numerous horizons with »Microcodium«. In narrowly limited intervals of this part of the section, the dasyclad alga *Parkerella* and the dendroid and ramosa corals *Haimesastraea peruviana, Dendrophyllia dendrophylloides* and *D. candelabrum* occur.

The upper part of the »Kozina« beds bears massive *Stylocoenia montium, Actinacis cognata, Goniopora elegans, Plocophyllia karstica* n. sp. and *Litharaeopsis subepithecata* in addition to the dendroid forms. *Orioporella villattae, Cymopolia paronai* and *C. mayaense* represent the dasyclad flora. *Idalina* sp. and *Periloculina* sp. are the first larger porcelaneous foraminifera to appear after the C-T boundary.

In the so-colled »Miliolid« beds, the deposition of the red algal thalli starts. Numerous smaller rotaliids are associated with *Miscellanea* (sp. 2 of Leppig 1988), *Coskinon rajkae* and *Cribrobulimina carniolica* indicative of a Thanetian age. Massive and dendroid stony corals still occur.

The conformity of the sediment layers bridging the C-T boundary at Dolenja vas, their uniform, shallow environments of deposition and their constant tropic faunas shed some new light on the C-T boundary event: The absence of conspicuous erosional features at the C-T boundary and the constance of shallow-water environments indicate a constant depth relation between the carbonate platform surface and the sea-level within a few meters. Also, the climate seems to remain constantly warm throughout this period, during which all over the central, previously emerged parts of the platform, beauxites and coal were deposited. The Dinaric platform had, during this period, a geographic position at the margin of the tropical belt at about 30° N corresponding to the position of the Red Sea today. Any climatic decline and/or sea-level fall directly responsible for the world-wide extermination of a large sector of the marine fauna would have to leave its signal in the continnous shallow-water depositional sequence, even if the sedimentation process may have been interrupted for some period of time between the single beds of the section exposed. No such signals have been found sofar in the Dolenja vas section nor any other trace of some particularely violent event.

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POVZETEK

MAASTRICHTIJSKE, DANIJSKE IN THANETIJSKE PLASTI V DOLENJI VASI (NW DINARIDI)
MIKROFACIES, FORAMINIFERE, RUDISTI IN KORALE

UVOD

Dandanes je med raziskovalci zelo razširjena diskusija o meji kreda—terciar. Večina podrobnejših geoloških in paleontoloških dokazov izvira iz sedimentne serije globljih morij. Predvsem planktonski organizmi služijo za datiranje teh sedimentov, kakor tudi za razpoznavanje bioloških pojavov ali za interpretacijo klimatskih sprememb. To serijo so raziskovalci izbrali zato, da bi dobili kar se da popoln dokument o sedimentaciji v tem obdobju. V nasprotju s temi podatki opazujemo mi tukaj sedimentni niz kamnin odložen na robu plitve karbonatne plošče. Ta je ločen od kakršnihkoli vplivov s kopnega in zaradi tega sestavljen samo iz karbonatov. V tem zaporedju plasti, če je res celovito, bentoško življenje zrcali klimatske spremembe, spuščanje in dviganje morske gladine, porast prehrambenih snovi na različen, a dopolnilen način, po našem mnenju še bolj prepričljivo kot katerikoli niz pelagične favne.

Skladovnica sedimentov, predstavljena na obrobju Tržaško-Komenske planote, leži lepo razgaljena in primerna za študij v profilu ob cesti, ki vodi iz Dolenje vasi proti Vrabčam (blizu Senožeč), vzdolž reke Raše (sl. 1). Zaporedno odložene plasti v debelini 135 m so nagnjene za 15—20° proti severu in severovzhodu ter prečkajo mejo kreda—terciar brez večjih opaznih prekinitev v sedimentaciji.

Pri delu so sodelovali paleontologi in sedimentologi iz različnih inštitucij. S Paleontološkega inštituta Ivana Rakovca ZRC SAZU sta sodelovali Dragica TURNŠEK in Katica DROBNE; prva je obdelala paleogenske korale, druga kredne in terciarne foraminifere, pripravila mikroskopsko gradivo za obdelavo in koordinirala raziskave. Z Geološkega zavoda Ljubljana je sodeloval Bojan OGORELEC. S Katedre za geologijo in paleontologijo Univerze Edvarda Kardelja v Ljubljani sta delala na tem profilu Rajko PAVLOVEC in Mario PLENIČAR. Drugi je obdelal rudistno favno s sodelovanjem Marie Luise ZUCCHI-STOLFA z Geološko-Paleontološkega inštituta univerze v Trstu. Alge je obdelal Filippo BARATTOLO s Paleontološkega inštituta univerze v Neaplju. Pri snemanju profila sta še sodelovala Camila PIRINI RADRIZZANI in Nevio PUGLIESE, oba z Geološko Paleontološkega inštituta univerze v Trstu. Geologi s tržaške univerze so sodelovali z ljubljanskimi raziskovalci v okviru mednarodnega projekta »Kredna karbonatna platforma na območju Slovenije in Italije«.

O prvih rezultatih raziskav na profilu Dolenja vas so avtorji poročali v referatu z naslovom »La coupe de Dolenja vas un passage du Crétacé au Paléogène« na mednarodnem simpoziju: »Razvoj kraške karbonatne plošče; primerjava z ostalimi periadriatskimi karbonatnimi ploščami«, ki je bil v dneh od 1.—6. junija 1987 v Trstu. Ta referat je bil poslan v tisk v Memorie della Societa Geologica Italiana (Roma), pod naslovom »The Dolenja vas, a transition from Cretaceous to Paleocene, NW Dinarides, Yugoslavia«.

Sedanja raziskava je rezultat podrobnejših raziskav s področja sedimentologije, mikrofaciesa, foraminifer, rudistov in koral. Cilj naših raziskav je bil, da čimbolj

točno določimo mejo med zgornjo kredo in paleocenom ter interpretiramo sedimentacijske razmere v tem obdobju. Ta razprava predstavlja le del raziskovanj, ki se bodo še nadaljevala.

FACIALNI RAZVOJ IN BIOSTRATIGRAFIJA PLASTI V PROFILU DOLENJA VAS

Bojan OGORELEC in Katica DROBNE

(tabele 1—26, sl. v tektu 1—5)

Raziskani profil pri Dolenji vasi lahko glede na litološke značilnosti, facies in fosile razdelimo v štiri enote: maastrichtijsko, spodnjo in zgornjo danijsko in thanetijsko. Celotno zaporedje plasti je razvito popolnoma karbonatno in sicer kot apnenec. Dolomit se javlja le v sledovih (sl. 2).

1. ENOTA

MAASTRICHTIJ (Sl. 3 a, 4, tab. 1—3, 24)

Mikrofacies: Apnenec prve enote maastrichtijske starosti (vzorci Dv 48 do 45, Tab. 1—3) je srednje plastovit in svetlo do srednje olivno sive barve. Po strukturi je to biomikrit tipa wackestone — packstone, v katerem se javljajo pogostne lupine rudistov, v sinsedimentni breči pa le mestoma burnonije, v njegovem zgornjem delu pa tudi giroplevre (Tab. 1 in 2). Med bentičnimi foraminiferami prevladujejo porcelanske forme. Mestoma se javljajo še drobni gastropodi in tankolupinaste školjke ter drobni mikritni plastiklasti. Mikritna osnova kaže pogosto znake bioturbacije in je le mestoma rahlo izprana. Lupine rudistov in giroplever so bile podvržene intenzivnemu delovanju endolitov (Tab. 1., sl. 1, Tab. 2, sl. 1).

Fosilne združbe: V vrhnjem delu plasti je značilna *Rhapydionina liburnica* (Stache). Ta kaže izjemno veliko variacijsko širino premera hišice. Pahljačaste oblike v teh vzorcih ne zasledimo (Dv 47, —5, Tab. 2, sl. 2, Tab. 24, sl. 8—10). Nastopajo še *Dicyclina schlumbergeri* Munier-Chalmas (Tab. 2, sl. 2, Tab. 24, sl. 12), *Cuneolina* sp., *Massilina* sp., *Dargenioella* sp., in zelo številne hišice *Moncharmontia apenninica* (De Castro) (Tab. 24, sl. 6—7). Tik pod mejo kreda-paleocen se *Rhapydionina* ne pojavlja več, pač pa preostanejo samo neopredeljive miliolide in *Dargenioella* sp. Slednja je večja miliolida z nepravilno oblikovanimi kamrami (Tab. 24, sl. 2—4). Primerjamo jo z novo opisanim rodom iz paleocena Apeninov (DE CASTRO, in press). Med algami se pojavljajo *Thaumatoporella* sp. in drobni tubuli *Aeolisaccus* sp.

V tem zgornjem maastrichtijskem horizontu so zelo pogosti rudisti *Bournonia problematica* n. sp., *B. parva* Pejović, *B.* cf. *wiontzeki* Pejović, *Biradiolites baylei* Toucas ter v več polah nakopičene lupine *Gyropleura* sp. (Tab. 1, Tab. 27, sl. 1—4, Tab. 28, sl. 1—3; sl. 6—15).

Starost: Korelacije teh plasti z rudisti in rhapidioninami so možne na mnogih mestih v Dalmaciji in Hercegovini (npr. SLIŠKOVIĆ 1983, PEJOVIĆ & RADOIČIĆ 1985/86, PLENIČAR & STOLFA-ZUCCHI v nadaljevanju te razprave). Stratigrafsko pojavljanje in razširjenost vrste *Rhapydionina liburnica* obravnava tudi J. J. FLEURY v Grčiji (1980, 46). Na podlagi njenega masovnega nastopanja in superpozicije s cono *Omphalocyclus macroporus* smatra zelo verjetno, da pripada zgornjemu maastrichtiju.

Okolje sedimentacije: Apnenec 1. enote se je odlagal na mirnem in plitvem zatišnem šelfu z nizkim energijskim indeksom (1—2), (sl. 2) v okolju, ki je bilo enotno na širšem prostoru slovenskega dela Dinaridov (sl. 3, 4, 5).

13*

2. ENOTA

DANIJ — spodnji del (Tab. 4—17, 25)

Prehod med maastrichtijskimi in danijskimi plastmi smo ugotovili ob cesti med točkama Dv 45/1 in 44/8 in v golici ob potoku (Dv — 5). Tam smo odkrili direktni kontakt obeh enot. Plasti 1. enote se ločijo od plasti 2. enote po naslednjih sedimentoloških in favnističnih karakteristikah:

— apnenec postane temnejši, temno olivno siv do črn; po strukturi je biomikrit z nekoliko povečano vsebnostjo organske snovi in z rahlim vonjem po bitumnu,

— izginejo rudisti in gyroplevre ter rhapydionine,

— apnenec kaže značilnosti litoralne sedimentacije in zelo kratkotrajnih emerzijskih faz oziroma okopnitev,

— prvo pojavljanje strukture *Microcodium*.

Mikrofacies: Plasti 2. enote leže nad krednimi popolnoma konkordantno. Celotni del zaporedja danijskih plasti obsega okrog 60 debelinskih metrov profila in je litološko in paleontološko pestro razvit. Plasti so debele od 10 do 50 cm, zaradi primesi organske snovi in piritnega pigmenta pa je apnenec temno sive do črne barve. Delež karbonata se giblje med 98,2 in 99,6 %. Po strukturi prevladujeta tipa wackestone in packstone, kar govori za nizek do zelo nizek energijski indeks okolja. Mikritna osnova je izprana ali delno izprana le v tistih vzorcih, ki so bili odloženi na obrežju (»beach rocks«, npr. Dv 3) ali pa v medplimskih kanalih (Dv 1, 4, 11, 16) znotraj lagun, kjer je prišlo do dnevnega gibanja morske vode.

Število fosilnih vrst je sicer dokaj skromno, so pa zato skeleti organizmov mestoma tako pogostni, da so kamenotvorni. To velja zlasti za skeletne alge (Dv 2, 3, 6, 12, 13, 33, Tab. 12, 14, 16), korale (Dv 7, 8, 9; Tab. 7, 12, 17) in *Microcodium* (Dv 44/8 do 35 in —3 do 15; Tab. 3—5, 8—10, 12), nekoliko manj pa so zastopane bentične foraminifere. V več vzorcih se pojavljajo tudi rotaliidne foraminifere (Dv 44/2, Tab. 5). Bolj poredke so med fosili školjčne lupine, polži, ostrakodi in haraceje. Korale, ki se javljajo praktično v vseh različkih apnenca, pripadajo dendroidnemu tipu z nekaj mm velikimi koraliti (Dv-2, 16, 37; Tab. 7, 12, 17). Razen fosilov opazujemo v več vzorcih do nekaj mm velike mikritne intraklaste.

Fosilne združbe: V lagunarnem okolju se pojavljajo foraminifere s hišicami izredno majhnih dimenzij in tankih sten iz skupin diskorbid, ataksofragmiid (Dv 44/8 do 2, 44, 43). Med nonionidami smo ugotovili oblike bilateralno simetričnih hišic z značilnimi popkovnimi krpami »umbilical flap« (Dv-1, 44/8 do 4/44; Tab. 10, Tab. 25, sl. 8—11). V novejšem času so revidirane in vključene v rod *Protelphidium* Haynes thanetijske starosti (BANNER & CULVER 1978). V drugem tipu apnenca s sprano mikritno osnovo se predstavlja združba drobnih miliolid, *Pseudochrysalidina* sp., redka *Valvulineria* sp. (Dv 40, 13, 4/5; Pl. 7, 13, 16, 25). V rod *Scandonea* De Castro smo uvrstili obliko s porcelansko hišico, planspiralno zavito z debelo steno, znano doslej samo iz zgornje krede (Dv 3, Tab. 14, Tab. 25, sl. 7). Zlasti je zanimiva najdba rodu *Bolkarina* Sirel z 18 mm široko in tenko diskoidalno hišico (Dv 5, Tab. 25, sl. 1, 2). Rod z edino vrsto *B. aksarayi* Sirel je opisan iz thanetijskih plasti v centralni Turčiji (SIREL 1981). Zanimiva je najdba novega alveolinidnega rodu s komaj 1 mm veliko porcelansko hišico, znatno bolj primitivno od prve znane paleogenske alveolinide *Alveolina (Glomalveolina) primaeva* (REICHEL) (Dv 37, Tab. 25, sl. 4, 5). V isti plasti se pojavlja tudi *Periloculina* cf. *slovenica* Drobne (Tab. 25, sl. 3).

Med algami so zanimive majhne in nežne *Clypeina* sp., *Parkerella*, sp., Microproblematicum sp. (Tab. 4, 10, 14). Sporadično nastopajo še *Thaumatoporela* sp. in *Charophyta*, bolj pogosto *Cymopolia* sp. (Tab. 12, 16).

Od koral so v spodnjem delu 2. enote najdene vrste *Dendrophyllia candelabrum* Hennig, *D. dendrophylloides* M. Edwards et Haime, *Haimesastraea peruviana* Vaughan, *Siderastrea* sp. in *Rhizangia* sp. Vse so dendroidne in niso grebenotvorne (Tab. 7. 12, 15, 17).

Starost: Po generični pripadnosti nekaterih oblik, npr. *Protelphidium* sp., *Bolkarina* sp., alge *Microproblematicum* sp., in *Parkerella* sp. lahko sklepamo na paleocen. V Grčiji po J. J. FLEURY-ju (1980) številnejše foraminifere *Pseudochrysalidina* sp. karakterizirajo začetek paleocenske sedimentacije. Tudi popolno izginotje rhapydionin in gyroplever je eden od dokazov za uvrščanje teh plasti starejšemu terciarju. Od koral je značilna *Dendrophyllia candelabrum*, ki je v Skandinaviji stratigrafsko razširjena v daniju (FLORIS 1972). Zato uvrščamo 2. enoto v danij (: TURNŠEK v tem delu, sl. 16).

Okolje sedimentacije: Za obdobje spodnjega dela danija je na območju Dolenje vasi značilna sedimentacija v zaprti plitvi laguni, ki je bila večkrat prekinjena s kratkotrajnimi fazami medplimskega okolja in osušitvami. Medplimsko in nadplimsko okolje sedimentacije karakterizirajo predvsem številne izsušitvene pore, tanke stromatolitne lamine, izsušitvene razpoke s strukturami mikrokodija, nepravilne votlinice, nastale po konturah korenin ter lokalna gnezda drobne emerzijske breče. Nekoliko metrov više v profilu, med vzorcema Dv 3 in Dv 6 se na 4 metre debelem odseku javljajo trije, od 20 do 50 cm debeli horizonti ploščatega temnega mikritnega apnenca s teksturo bioturbacije ter z isušitvenimi razpokami. Apnenec je močno dolomitiziran (40 do 55 % dolomita) na površini pa kaže prhek, nekoliko peščen izgled. Dolomit je nastal v nadplimskem okolju v času zgodnje diageneze. Proces dolomitizacije lahko tolmačimo z »evaporative pumping« modelom. Zanj je značilno, da Mg++ ioni, potrebni za dolomitizacijo kamnine, prihajajo s koncentriranimi pornimi raztopinami, ki se kapilarno dvigajo proti površju sedimenta, ki je občasno nad vodo (SHINN et al. 1965, ILLING et al. 1965). Razen dolomita vsebujejo omenjene plasti še 1 do 3 % piritnih framboidov. Izvor pirita je tudi diagenetski, nastal pa je pri razpadu organske snovi s sodelovanjem bakterij.

Pojav strukture Microcodium

Nastopanje mikrokodija je eden najbolj značilnih pojavov nad prehodom krede v paleocen in to na širšem prostoru dinarske karbonatne platforme in Tetide (npr. Akvitanije, CUVILLIER 1961, Tab. 64, sl. 1, 2). Še danes pa ni z gotovostjo rešen njegov nastanek. Nekateri avtorji ga uvrščajo med problematične zelene alge iz skupine kodiacej (WRAY 1977), medtem ko v novejšem času prevladuje mišljenje, da je anorganskega nastanka. ESTEBAN (1974) in KLAPPA (1978, 1980) ga uvrščata med rhizolite, organo-sedimentne strukture, ki nastanejo s cementacijo prostorov odmrlih korenin više razvitih rastlin, kot rezultat simbioze med bakterijami in koreninskimi celicami v semiaridni klimi. Značilen naj bi bil za facies »caliche«.

Novejši teoriji nastanka *Microcodium* v prid kaže tudi profil pri Dolenji vasi. *Microcodium* se pojavlja le v tistih plasteh, ki kažejo znake nadplimske sedimentacije ali zelo kratkotrajnih faz emerzije. Vedno se javljajo v plasteh s številnimi izsušitvenimi porami in z močno bioturbacijo (Dv 44/6, 3, 35). Kristalizacija kalcitnih prizem mora biti še v času najbolj zgodnje diageneze, ko karbonatno blato še ni litificirano. Pogosto opazujemo, da ob nekoliko višji energiji v okolju *Microcodium* razpade in do nekaj desetink mm velike prizme se raztresejo in pomešajo z okolnim sedimentom (Tab. 8, 9). Na toplejšo klimo v obdobju spodnjega danija na prostoru Dinaridov sklepamo tudi po kristalih sadre. V mikritnem blatu z mikrokodiji (Dv 44/8, Tab. 3, sl. 1) je prišlo do nadomeščanja sadre s kalcitom. Omenimo naj, da se

Microcodium pojavlja v sedimentih litoralnega faciesa in pri občasnih lokalnih okopnitvah tudi drugod v Dinaridih, npr. na Braču (JELASKA & OGORELEC 1983) in na Tržaškem Krasu (CILIBERTO et al. 1982).

A. CHERCHI in R. SCHROEDER (1988) sta glede na nomenklaturna pravila preimenovala rod *Microcodium* v *Paronipora*. Ko smo zvedeli za ta podatek, je bil rokopis že oddan. Zato uporabljamo v tem delu še naziv *Microcodium*.

Fosfati v sedimentu

V nekaterih plasteh (Dv 5, 11, 12, 33) se med mikritom javlja v sledovih tudi fosfatni mineral, po sestavi kolofan (mikrokristalna oblika apatita). Nastopa kot pigment v drobnih rjavih gnezdih. Fosfat je vezan na plasti temnega apnenca, ki kaže mikrofacijalne značilnosti medplimskega okolja ter je bil v času nastanka bogat z organsko snovjo. Pojavi fosfatne mineralizacije so iz obdobja zgornje krede in paleogena znani iz severne Istre (Ž. & J. ŠKERLJ, 1973). Pomemben faktor za nastanek kolofana v karbonatnih kamninah sta po G. S. ODINU in R. LETOLLE (1980) klima, ki mora biti topla ter zelo plitvo sedimentacijsko okolje s povečano količino organske snovi. Kolofan je člen biokemičnega cikla; nastaja med razgradnjo organske snovi kot posledica bakterijskega metabolizma. Fosfat se izloča s precipitacijo iz porne vode (GAUDETTE & LYONS 1980). Taki pogoji za nastanek fosfata so bili občasno v začetnem obdobju paleocenske lagunske sedimentacije.

3. ENOTA

DANIJ — zgornji del (Tab. 17—21, 25)

Mikrofacies: Paket apnenca iz 3. enote je debel okoli 20 m. Njegova spodnja meja se ne da jasno omejiti. V spodnjih nekaj metrih (Dv 17—19) je še srednjeplastovit in sive barve, nato pa postane debeloplastovit in zelo svetel (Dv 20—24). Zaradi spremembe sedimentacijskih razmer se spremeni tudi njegova struktura. Prevladuje apnenec biosparitnega tipa nad biomikritom, kar kaže na menjavanje energije morske vode; po strukturi pa sta najbolj pogostna tipa packstone in boundstone. Med fosili so zastopane večje razvejane in masivne korale (Tab. 19, 20). Korale je pogosto zajela rekristalizacija in bioerozija (Tab. 21). Pojavljajo se tudi rdeče alge (Tab. 20).

Fosilna združba: Pojavljajo se številne dasikladaceje, med njimi *Orioporella villattae* Segonzac in *Indopolia satyavanti* Pia. V večjem številu nastopajo tudi korale: *Actinacis cognata* (Oppenheim), *Goniopora elegans* (Leymerie), *Litharaeopsis subepithecata* (Oppenheim), *Plocophyllia karstica* n. sp., *Stylocoenia montium* (Oppenheim), ki so vse omejene na 3. enoto. Kot v 2. enoti se *Dendrophyllia candelabrum* (Tab. 19, 20, 21) pojavlja tudi v tej skladovnici apnenca.

Med foraminiferami prevladujejo aglutinirane hišice iz skupin ataxophragmiid. Mestoma se pojavljajo drobne miliolide, med njimi tudi že večje, *Idalina* sp. (Dv 31, Tab. 18).

Starost: Korelacija zgoraj omenjenih vrst koral omogoča stratigrafsko datacijo montija (zgornjega danija) (glej poglavje o koralah, sl. 16). Prvo pojavljanje v daniju ima tudi alga *Orioporella villattae* (cf. BARATTOLO in DROBNE et al., v tisku). Pomoč pri biostratigrafski interpretaciji je krovnina tem plastem z velikimi foraminiferami thanetijske starosti.

V novejšem času je objavljenih več študij o bentičnih foraminiferah paleocenske, še posebej danijske starosti. Biostratigrafsko vrednost aglutiniranih foraminifer in

njihovih con, tudi danijske starosti, sta predlagala za Poljske Karpate GEROCH in NOVAK (1984). Iz Pariške kotline je obdelal danijske foraminifere BINGNOT (1987 a) s primerjavo stratotipskih plasti danija in montija. Kenozojske foraminifere in njih biostratigrafijo iz Severnega morja je pripravila skupina avtorjev (GRADSTEIN et al. 1988). Omenjeni raziskovalci ugotavljajo v daniju na izoliranih hišicah združbo foraminifer majhnih dimenzij, enostavne zgradbe in mnogo predstavnikov z aglutinirano steno hišice. Žal pa so v apnencu, tudi našem, sicer številne oblike bentoničnih foraminifer v zbruskih nedoločljive do nivoja vrste. Zahtevale bi posebne postopke prepariranja in priprave komparativnih prerezov iz izoliranih primerkov.

Okolje sedimenticije: Na prehodu iz spodnjega v zgornji danij je prišlo do dviga morske gladine oziroma do počasnega tonjenja lagunske karbonatne ravnice ob robu dinarskega šelfa. Na ozemlju Dolenje vasi je nastala potopljena, dobro prezračena karbonatna plošča (sl. 2 b, 4), ki je imela povezavo z odprtim morjem. Znakov zaprte lagune ne opazujemo več. Znotraj ravnice so uspevale manjše koralne kopuče. V medprostorih teh grebenskih kopuč se je odlagal koralni drobir, med katerega so se pomešale še foraminifere, zelene alge, polži in mikritni plastiklasti. Karbonatna plošča je bila na nekaterih mestih zelo plitva, saj mestoma opazujemo neizrazite teksture nadplimske sedimentacije (raztrgane lamine s teksturo »flat pebble conglomerate«).

4. ENOTA

THANETIJ (Tab. 21—23, 26)

Mikrofacies: Te plasti smo zajeli samo v njihovem spodnjem delu in sicer v debelini okrog 25 metrov. Apnenec postane zopet srednjeplastovit in temnejši. Menjavajo se plasti z bolj ali manj bogato združbo fosilov, tako da so zastopani vsi strukturni tipi apnenca (wackestone do packstone). Med fosili prevladujejo rdeče koralinacejske alge (npr. Dv 29 d, Tab. 22), v nekaterih plasteh so številne zopet rotalidne foraminifere in korale. Prisotni pa so še briozoji in polži. V zgornjem delu prevladujejo miliolide in konične foraminifere (Dv 30, Tab. 22, 23). Foraminifere in algni klasti so mestoma tako pogostni, da ima kamnina značaj biokalkarenita (npr. Dv 26, Tab. 21). Ta apnenec kaže nizek do srednje visok energijski indeks (1—3).

Fosilna združba: Številne rotalide majhnih dimenzij v posameznih horizontih močno izpodrivajo druge vrste. Med njimi se pojavlja *Kathina selveri* Smout (Tab. 21, Tab. 26, sl. 9) številne oblike A in B generacije pripadajo novi vrsti rodu *Miscellanea* sp. 2 (LEPPIG 1980) (Dv 29, 30; Tab. 22, 23, Tab. 26, sl. 1—4). Redke so *Discocyclina seunesi* Douvillé, preimenovana v *Orbitoclypeus seunesi* (LESS 1987) (Tab. 21). V horizontih z rdečimi algami in koralami (Tab. 22, 21) so pogostne sesilne foraminifere *Planorbulina* sp., *Miniacina* sp., *Haddonia* sp. (Tab. 26, sl. 5) ter redke vrste *Schlosserina* sp. (Tab. 26, sl. 5, 6). Še v mlajših horizontih je več miliolid *Idalina sinjarica* Grimsdale (Tab. 22)) konične foraminifere *Coskinon* rajkae Hottinger et Drobne (Tab. 22, Tab. 26, sl. 7, 8), *Cribrobulimina carniolica* Hottinger et Drobne (Tab. 22, Tab. 26, sl. 10, 11) in redka *Broeckinella arabica* Henson. Ponovno se pojavi tudi nov rod alveolinidnega tipa (Tab. 22, Tab. 26, sl. 12). V tem faciesu ne nastopata *Fallotella alavensis* Mangin in *Glomalveolina primaeva* (Reichel). Pogosto so korale združene v posameznih čokih, ki pripadajo rodovoma *Goniopora* sp. n. *Rhizangia* sp. (Tab. 19). Med dendroidnimi koralami nastopata še vrsti *Dendrophyllia candelabrum* in D. *dendrophylloides* (Tab. 20).

Starost: Korelacija združbe velikih foraminifer je mogoča s favno v Malih Pirenejih (TAMBAREAU 1972, REICHEL 1935/36), v dolini Ebro (LEPPIG 1987) in

z našimi paleocenskimi profili na NW delu dinarske karbonatne plošče, npr. Koboli in Golež (DROBNE 1974, DROBNE & PAVLOVEC, 1979, DROBNE 1980), ki vsi potrjujejo uvrstitev v thanetij. Podobne sklenjene razvoje je mogoče najti tudi v osrednjem delu Turčije (SIREL et al. 1986).

O k o l j e s e d i m e n t a c i j e : V spodnjem thanetiju se je na ozemlju Dolenje vasi nadaljevala sedimentacija na zelo plitvem delu karbonatne platforme, ki je imela zvezo z odprtim morjem (sl. 3/c, 5). V tem okolju so se naselile številne konične foraminifere in miliolide. Na plitvinah za algalno-koralnimi kopučami so se v zatišnih predelih, a kljub temu dobro prezračenih, odlagali v mikritno blato okruški rdečih alg. V nekaj plasteh opazujemo tudi sledove intenzivne bioturbacije. Po obraščanju fosilov z ovoji neskeletnih alg (onkoidi) sklepamo, da je bil sediment občasno zelo blizu morski gladini ali celo v medplimskem okolju (intertidalu).

PALEOGEOGRAFSKA INTERPRETACIJA PLASTI V DOLENJI VASI

Bojan OGORELEC in Katica DROBNE

(Sl. 3 a, b, c, 4, 5)

Analiza mikrofaciesa nam je omogočila interpretacijo paleogeografskih razmer na ozemlju Dolenje vasi v intervalu med zgornjim maastrichtijem in thanetijem (sl. 3 a, b, c). Ob upoštevanju že znanih podatkov G. BIGNOTJA (1987 b) za Tržaško-Komensko planoto in R. KOCHA (1978/79) za Nanos, podajamo našo hipotezo karbonatnega in bazenskega razvoja na severozahodnem delu Dinarske plošče (sl. 4).

V maastrichtiju je ozemlje pripadalo mirnemu in zelo plitvemu zatišnemu šelfu s podplimskimi pogoji (sl. 3a). Prav na prehodu K — T je prišlo do poplitvitve morja in do več zelo kratkotrajnih med- in nadplimskih faz ter lokalnih okopnitev (sl. 3 b). Rudistne apnence plitvega šelfa so zamenjali temni apnenci lagunskega in litoralnega okolja. Ozemlje je bilo takrat sestavni del obrežne karbonatne ravnice, ki je končni produkt morske regresije. Taka sedimentacija se je nadaljevala skozi celoten spodnji danij. Ozemlje je komuniciralo s prostori na južni in južnovzhodni strani plošče (sl. 5). Podoben tip sedimentacije je znan danes iz Bahamskega šelfa (SHINN et al. 1969) in iz Perzijskega zaliva (SCHNEIDER 1975).

V zgornjem daniju je prišlo zopet do poglobitve karbonatne plošče in do povezave z odprtim morjem s severne strani (sl. 3 c). Ta poglobitev se je v thanetiju samo še stopnjevala.

PROFIL DOLENJA VAS IN NJEGOV POLOŽAJ NA KARBONATNI PLOŠČI

Katica DROBNE in Bojan OGORELEC

(Sl. 5 a, b)

Jugozahodna Slovenija v geološkem smislu predstavlja NW del Dinarske karbonatne plošče. V zgornjem delu krednega obdobja so ugotovljeni različni sedimenti iz plitvega šelfnega okolja: spodnji del liburnijskih plasti = vremske plasti (STACHE 1889, PAVLOVEC 1963) premoške plasti (HAMRLA, 1959, 1960) ter klastični sedimenti iz obrobja karbonatne platforme (ŠRIBAR 1967, PAVŠIČ 1977, KOCH 1978/79), Precejšnji del plošče je koncem krede okopnel. Ponekod se je odlagala substanca za boksit (BUSER & DELVALLE 1987).

Študij mikrofaciesa v Dolenji vasi je pokazal nadrobnosti v razvoju plasti iz časovnega razpona kreda—terciar, ki jih lahko primerjamo s paleontološko in sedimentološko obdelanimi profili in nahajališči na Dinarski plošči in na njenem

obrobju (sl. 5 a, b). Razvoje smo predstavili v treh skupinah in sicer najprej tiste iz NW dela plošče, nato iz severnega in NE obrobja ter tiste iz poglobljenih delov na ali ob plošči.

Dinarska karbonatna plošča in njen severozahodni rob

(profili 1, 2, 3, 4, 5, 6; sl. 5 a, b)

V obmorskem pasu na Tržaškem Krasu so italijanski geologi sistematično raziskali 19 profilov. Njihov namen je bil odkriti petrografske, paleontološke, kronostratigrafske ter paleogeografske značilnosti liburnijskih plasti (MASOLI et al. 1979, 21, sl. 1). Ugotovili so do 900 metrov sedimentov, 9 tipov kamnin in 3 biostratigrafske enote. Meja med kredo in terciarjem, ki nas pri sedanjih raziskavah najbolj zanima, je tam ostala neopredeljena v kompleksu B (MASOLI et al. 1979, 25—26, tabela 1). Iz spodnjih liburnijskih plasti, v kompleksu A in delno v kompleksu B je predstavljena *Rhapydionina liburnica*. Ta nam služi za primerjavo oz. horizontiranje s plastmi maastrichtija v profilu Dolenja vas. Nežna alga *Clypeina* sp. pa se pojavlja že v daniju (CILIBERTO et al. 1982, sl. 17).

Vzdolž tržaške sinklinale in južnega oboda reške sinklinale ne moremo zasledovati prehoda med krednimi in paleocenskimi skladi, ker manjkajo maastrichtijske plasti (PLENIČAR 1961, BIGNOT 1972, DROBNE 1977, BUSER & RADOIČIĆ 1985/86, DROBNE et al. 1987). Paleocenske plasti so paleontološko dokazane s foraminiferami thanetijske starosti na profilu Golež (DROBNE & PAVLOVEC 1979). Pod njimi ležeče plasti mestoma vsebujejo bogato združbo alg dasikladacej. To združbo, z eno novo vrsto, je opisala R. RADOIČIĆ pri Materiji na južnem obodu reške sinklinale (BUSER & RADOIČIĆ 1985/86). Nekatere teh vrst je F. BARATTOLO ugotovil tudi v profilu Dolenja vas. Prav tako je v Dolenji vasi ugotovljen horizont s thanetijskimi foraminiferami kot njegov ekvivalent v tržaški in reški sinklinali.

Na razvoju osrednjega dela reške sinklinale ob Vremah temelji razčlenitev liburnijske stopnje G. BIGNOJA (1972, 1987 a). V svojih raziskavah zagovarja erozijsko diskordanco med krednimi in paleocenskimi plastmi. Na maastrichtijskem horizontu z rhapydioninami naj bi se šele v thanetiju odložili jezerski apnenci s harofiti in *Microcodium*. To je »Formation de Kozina« (BIGNOT 1987 a, 186). Nad njimi ležeče plasti z *Glomalveolina primaeva* prav tako pripadajo thanetiju. Iz tega sledi, da naj bi paleocenska diskordanca trajala ves danij. Toda sedanje raziskave v profilu Dolenja vas kažejo, da regresija ni zajela vse karbonatne plošče, ampak je sedimentacija mestoma potekala tudi v času danija.

M. PLENIČAR in R. PAVLOVEC sta l. 1981 povzela dotedanje biostratigrafske ugotovitve za spodnji del liburnijskih plasti. Ugotovila sta, da pripadajo maastrichtiju. V maastrichtij sta uvrstila tudi vremske plasti (PAVLOVEC 1963), toda samo njihov spodnji del (HÖTZL & PAVLOVEC 1979), kar velja za NW del karbonatne platforme. Horizontu z rhapydioninami sledimo vzdolž južnega in južnovzhodnega roba plošče še v Hercegovino (SLIŠKOVIĆ 1983), na otok Brač (JELASKA & OGORELEC 1983, GUŠIĆ et al. 1988) vse do Grčije — Klokova (FLEURY 1980). Na vseh nahajališčih velja *Rhapydionina* za vodilni fosil maastrichtija, celo samo za njegov zgornji del (sl. 5).

Iz raziskav kredno/paleocenskih nahajališč na severnem in severovzhodnem robu Dinarske karbonatne plošče (sl. 5)

Primerjave in iskanje vzporednih profilov na prehodu kreda/terciar so nas vodile ob severnem robu karbonatne plošče proti zahodu. Sistematične sedimentološke in facielne raziskave italijanskih kolegov so potekale na krajnem robu karbo-

natne platforme, imenovane Friulano, pod antiklinalo Mia-Matajur. Ugotovili so razvoj flišnih plasti (Flysch di Calla) že na prehodu iz maastrichtija v paleocen. To so dokazale mikropaleontološke analize redkih planktonskih foraminifer. Ugotovili so tudi razpadanje roba platforme in odnašanje kosov v smeri proti severu in severovzhodu (PIRINI-RADRIZZANI et al. 1986, 353, 355, Fig. 12). V klastičnih sedimentih blizu Plav v dolini Soče so najdeni kot produkt razpadanja in odnašanja z roba te platforme med drugimi tudi kosi apnenca z algami in koralami. R. DELOFFRE in R. RADOIČIĆ (1978) sta v njih ugotovila bogato združbo paleocenskih dasikladacej, prvič na tem prostoru. Primerjava tega klastičnega razvoja s tistim v Dolenji vasi pokaže na majhni razdalji dva povsem različna faciesa na prehodu iz krede v paleocen. Podobnost, celo delna enakost, se zrcali v faciesu z algami in koralami (profila 27, 1).

Z raziskavami paleocenskih plasti v »notranjih« Dinaridih oz. na severnem obodu Dinarske plošče je začel I. GUŠIĆ. Leta 1973 je opisal nepričakovane najdbe paleocenskih alg (*Broeckella belgica* in *Parachaetetes asvapatii*) v apnenčevih lečah med flišnimi plastmi v okolici Karlovca. Te apnence je uvrstil v »dano-moncij«. Nato so se zvrstila odkritja še novih nahajališč v primarni legi tako grebenskega kot flišnega tipa sedimentacije. Številna nahajališča paleocenskih apnencev in drugih sedimentov sta na južnem robu Panonske kotline odkrila LJ. BABIĆ in J. ZUPANIČ, paleontološko pa jih je obdelal I. GUŠIĆ (GUŠIĆ & BABIĆ 1973, BABIĆ et al. 1976, BABIĆ & ZUPANIČ 1976, 1981). L. in K. ŠIKIĆ (1978) sta skrbno opisala in predstavila združbe mikrofosilov iz detritičnih in grebenskih apnencev iz Samoborskega gorja. Predstavljajo algalno-koralni greben in področje ob grebenu z bentonskimi foraminiferami paleocenske starosti. Združba kaže povečan energijski indeks morske vode v priobalnem pasu. Prav tak tip faciesa pa moremo primerjati z delom danijskih in thanetijskih plasti na profilu Dolenja vas in še širše v zahodnih Karpatih (SAMUEL et al. 1977). V Medvednici, NE od Zagreba, so po ugotovitvah A. POLŠAKA in sodelavcev razviti zgornjekredni rudistni in paleocenski koralni otočni loki (POLŠAK 1981, 1985) (profili 7, 8, 9, 10, 11).

Ob vseh grebenskih apnencih so navedeni avtorji odkrili in opisali tudi klastične sedimente. Najnovejše so analize težkih mineralov iz paleocenskih sedimentov na Medvednici (CRNJAKOVIĆ 1987, disertacija). Zaenkrat pa še niso v obdelavi primerjalne analize nanoplanktona iz celotnega bazena, ki bi lahko dale trdnejše dokaze o povezavi teh prostorov (profili 21, 22, 23).

Še dalje proti vzhodu, Bešpelj pri Jajcu (POLŠAK et al. 1982) in v severni Bosni, natančneje na Trebovcu, so odkriti profili klastičnih sedimentov z domnevnim kontinuiranim prehodom iz krede v paleocen (JELASKA et al. 1976, BULIĆ et al. 1978). Južno od tod, na izoliranem delu karbonatne platforme pri Doboju in Beli reki v zahodni Majevici pa so razviti apnenci z bogato združbo velikih foraminifer, ki so uvrščene v thanetij (BLANCHET & NEUMAN 1967, STOJČIĆ 1968, HOTTINGER & DROBNE 1980, DROBNE 1984). Prav te plasti moremo z vso gotovostjo vzporejati s plastmi vrhnjega dela profila v Dolenji vasi, tako po faciesu kot po fosilni združbi (profili 12, 13; 24, 25, 26; sl. 5 a, b).

Severozahodni profili s klastično sedimentacijo (sl. 5 a, b)

Na NW delu Dinarske karbonatne plošče se vleče ožja depresija ob njenem severovzhodnem in vzhodnem delu. Zapolnjena je s klastičnimi sedimenti. Po letu 1965, ko je L. ŠRIBARJEVA prvič odkrila pri nas prehod krednih v paleocenske plasti in ga dokazala s planktonskimi foraminiferami na območju Goriških Brd, so odkrili cel niz profilov s prehodnimi plastmi ali bodisi samo maastrichtijskimi ali samo paleocenskimi (ŠRIBAR 1967, PAVŠIČ 1976, 1977, 1979). Sistematične raziskave na-

noplanktona iz teh plasti so pokazale zaporedje biocon iz maastrichtija v paleoncen, z izjemo mejne paleocenske cone (PAVŠIČ 1976, 1979, 1981). Po J. PAVŠIČU (1977, 56) povzemamo, da je ločnica med maastrichtijsko in danijsko stopnjo izražena v vseh profilih v obliki nekaj milimetrske špranje. Ta špranja pa ne pomeni daljše prekinitve v sedimentaciji. Med Kočevjem in Novim mestom se najdejo tanke plasti klastičnih sedimentov iz prehodnega obdobja krede v paleocen (npr. Hinje, Kunč; PAVŠIČ 1976, 1977, 1987, PLENIČAR & ŠRIBAR 1986). Ob njih so odkrita številna nahajališča samo paleocenske starosti (PAVŠIČ 1976), na območju Gorjancev pa še nahajališča senonske starosti (PLENIČAR & ŠRIBAR 1986). Ti sedimenti so nastajali v različnih delih bazena in imajo raznolik paleogeografski značaj (ZUPANIČ 1976), (sl. 5).

Za razvoj plasti v profilu Dolenja vas je ta poglobitev ob NE strani karbonatne plošče zelo pomembna. Predstavlja neprestano možno povezavo z odprtim morjem. Vpliv odprtega morja je narekoval različne hidrografske prilike, ki se zrcalijo v številnih litoloških in mikrofacielnih spremembah apnencev ob neposrednem robu platforme (sl. 3 a, b, c, 4).

Primerjava in ugotovitve

Primerjava razvojev na karbonatni plošči nam je pokazala, da se je območje Dolenje vasi v času od maastrichtija do thanetija v različnih smereh povezovalo z bolj odprtimi morskimi prostori:

1. V zgornjem maastrichtiju nam podobna, mestoma celo enaka fosilna združba rudistov iz rodov *Bournonia* in foraminifer *Rhapydionina liburnica* kaže na neposredno povezavo z jugozahodnim in jugovzhodnim obrobjem plošče, od Furlanije preko Hercegovine in Brača do zahodne Grčije (profili 3, 4, 5, sl. 5 a, b).

2. Najzgodnejše sedimente danija je mogoče vzporediti le z najbližjimi območji na karbonatni plošči ob istočasnih najdbah nonionid in klipein (profili 2, 4, 6).

3. Že v spodnjem, a še bolj pa v zgornjem daniju kaže koralna združba in dasikladaceje nekoliko poglobljeno in konstantno morsko okolje ter povezavo s severnim in severovzhodnim obrobjem plošče. Ta povezava poteka še precej dlje proti zahodu in vzhodu Tetide, od Skandinavije na eni strani, do Podvoložja na drugi.

4. V thanetiju se vplivi iz odprtih morskih prostorov na severu še stopnjujejo. Široko razširjeni združbi koral iz danija se v tem obdobju pridružijo še velike foraminifere (profili 2, 6, 12, 13).

5. Ves čas kredno-paleocenskega obdobja so se usedali v poglobljenih delih na plošči in ob njenem obrobju klastični sedimenti (profili 14, 15, 16, 17, 22, 23, 26). Mestoma kažejo povečane vplive s kopnega (profil 27, 21) ali pa glede na tipično sestavo nanoplaktona tudi priobrežne pogoje sedimentacije (profil 19, 20). V času maastrichtija je ta poglobitev ločevala severne province od južnih (KOCH 1978/79), toda v zgornjem daniju in thanetiju je služila za medsebojno povezavo severnega obrobja. Po globljih prečnih kanalih je komunicirala še s centralnim delom Dinarske plošče (profil 24).

6. Krajšo zelo poenostavljeno primerjavo namenjamo tudi odnosom absolutne starosti, debelini plasti in ritmu ugotovljenega fosilnega življenja v plasteh na profilu pri Dolenji vasi.

Debelina krednih, to je zgornje maastrichtijskih plasti, opisanih v tem profilu, znaša 48 m, debelina paleocenskih 87 m, od tega danijskih 62 m in thanetijskih plasti 25 m.

Glede na absolutno starost bi bilo potrebnih za odložitev danijskih plasti 3 oziroma največ 6 milijonov let po CAVELIER & POMEROL (1983). Če v to razmerje debelin vključimo fosilno populacijo, lahko opazimo naslednje: usihanju življenja ob

koncu krede je sledilo njegovo obnavljanje. Le-to je različne skupine zajelo različno hitro. Najprej se pojavijo na 0,5 m foraminifere izredno drobnih dimenzij iz skupin nonionid, rotaliid, ophthalmidiid, tudi ostrakodi. Njim slede že na 1,0 m od meje ataxophragmiide, oblike s porcelansko steno (Dv —4/5). Na 18 m in 20 m (Dv —2, 1) nastopi več koral, normalnih velikosti glede na variacijske širine posameznih vrst, nato še dasikladaceje. Šele na 62 m se opisani populaciji masovneje, v večjem številu pridružijo velike foraminifere. Iz tega lahko sklepamo, da se je začetek obnavljanja morske bentoške populacije na plitvi karbonatni plošči začel dokaj zgodaj po meji K — T. Kako hitro, pa bomo natančneje skušali ugotoviti z nadaljnjimi raziskavami prav tega kontakta v profilu Dolenja vas.

RUDISTNA FAVNA IZ MAASTRICHTIJA V PROFILU DOLENJA VAS

(Mario PLENIČAR in † Maria Luisa ZUCCHI-STOLFA)

Sl. 6—15; Tab. 27—28

UVOD

V profilu Dolenja vas pri Senožečah smo ugotovili kredne plasti med terenskimi točkami 51 in 45. Najstarejše plasti so pri točki 51. Med terenskima točkama 45 in 44/8 prehajajo kredne plasti v terciarne. Kredne plasti so pri terenskih točkah 51 do 49 iz sivega mikritnega in sparitnega apnenca, od točke 49 do 45 pa je siv do temno siv, rjav in skoraj črn mikritni apnenec in sinsedimentna apnenčeva breča. Odsek med točkami 49 do 45 spada v spodnji del liburnijske formacije, ki jo v tem spodnjem delu štejemo v maastrichtij. Te plasti imajo značaj ritmitov in bioturbiditov in vpadajo proti severovzhodu (30°) pod kotom 15°. V sivem mikritnem in sparitnem apnencu so pri terenski točki 51 bili najdeni rudisti iz rodov *Radiolitella, Kuehnia, Pseudopolyconites, Biradiolites* ter vrsti *Bournionia judaica* in *B. adriatica*. Više v profilu so bili najdeni posamezni ostanki lupin iz rodu *Biradiolites*. Pri terenski točki 49, kjer se pričnejo apnenci liburnijske formacije, so v črno rjavem apnencu, ki je nastajal verjetno v lagunskem okolju, pogostne vrste rudistnih školjk rodov *Bournonia* in *Biradiolites*. V točki 47 so poleg lupin iz rodu *Gyropleura* bile najdene foraminifere vrste *Rhapydionina liburnica*. Pri točkah 49 do 47 najdemo v več plasteh nakopičene lupine školjk rodu *Gyropleura*. Posebno zanimiva je sinsedimentna breča, v kateri so kosi mikritnega apnenca z burnonijami v točki 45.

Skladi apnenca med točkami 49 in 45 pripadajo »vremskim plastem« (PAVLOVEC, 1963) in jih uvrščamo v zgornji maastrichtij. Okolje sedimentacije na karbonatni plošči, ki se je ob koncu krednega obdobja dvigala in razpadala, je bilo močno slano, voda topla in mirna, kemična sedimentacija intenzivna. Apnenčevo blato je nastajalo v velikih količinah in v njem so ohranjeni organski ostanki. V takem okolju so uspevale male vrste rodu *Bournonia*, značilne po ozkih in dolgih valjastih oblikah spodnjih lupin, ki so jih ojačevala močna podolžna rebra. Lupine so zgrajene iz notranje in zunanje lamelaste plasti. Notranja lamelasta plast je debela 0,1—0,2 mm, zunanja pa 1—1,5 mm. Med lamelami zunanje plasti so prečne pregrade. Tako strukturo lahko imenujemo lamelasto-prizmatsko strukturo. Lamele s pregradami so v prečnem preseku lupin na območju reber (sifonalnih in drugih) antiklinalno zavite. Teme antiklinal je večinoma obrnjeno navzven proti zunanji strani lupine. Pri nekaterih vrstah je v sifonalnem rebru *S* teme antiklinal obrnjeno proti notranjemu delu lupine. Pregrade med lamelami so tanjše od lamel. Sifonalna cona je praviloma iz dveh reber. Zadnje sifonalno rebro *S* je navadno močnejše

od prednjega rebra *E*. Na prednjem delu lupine se pri nekaterih vrstah pojavlja nožno rebro *V* (kot npr. pri rodu *Eoradiolites*). Ligamentna guba ni razvita.

Podobne oblike rodu *Bournonia*, kot jih dobimo na Tržaško-komenski planoti v spodnjem delu liburnijske formacije, sta podala v svojih razpravah z območja Črne gore, otoka Hvara, otoka Brača in Novega Pazara DESANKA PEJOVIĆ v letih 1968, 1978, 1979 in 1988 ter TEOFIL SLIŠKOVIĆ iz južne Hercegovine, Bešpelja pri Jajcu in Stoca v Hercegovini v letih 1968 in 1983. To so zlasti vrste *Bournonia wiontzeki* Pejović, *Baurnonia* n. sp. (Pejović, 1978), *B. dinarica* Slišković, *B. adriatica* Pejović, *B. quadripinnae* Pejović, *B. parva* Pejović, *B. bournoni* (Des Moulins) Fischer in *B. hercegovinica* Slišković.

Delo je financirala Raziskovalna skupnost Slovenije. Pri determinacijah fosilov je precej pomagala DESANKA-PEJOVIĆ. Prepariranje in fotografiranje fosilov je izvršil tehnični sodelavec pri Katedri za geologijo in palentologijo na Univerzi E. Kardelja v Ljubljani MARJAN GRM. Vsem iskrena hvala. Nekaj zbruskov je bilo napravljenih tudi na paleontološkem inštitutu univerze v Trstu. Po teh zbruskih je soavtorica M. L. ZUCCHI-STOLFA napravila risbe, ki so v tej razpravi podani na slikah 6—15. Fosilni material je spravljen na Katedri za geologijo in paleontologijo Univerze E. Kardelja v Ljubljani in na Istituto di Geologia e Paleontologia dell'Universitá di Trieste.

PALEONTOLOŠKI DEL

Familia Radiolitidae Gray 1848
Genus *Biradiolites* d'Orbigny 1847
Biradiolites baylei Toucas 1908
Slika 6 v tekstu

1908 *Biradiolites baylei* n. sp.; TOUCAS H., 119, Pl. 24, fig. 9 a.
1957 *B. baylei Toucas;* ASTRE G., 57—58, fig. 14 m v tekstu.

Fosilni material: Prečni presek spodnje ali desne lupine.

Opis: Prečni presek spodnje lupine meri 0,5 cm v smeri kardinalna cona — sifonalna cona in 1cm pravokotno na to smer. Prečni presek lupine ima trikotno obliko in ga na obeh straneh omejujeta dva močna grebena, ki oklepata med seboj kot 180°, ležita torej v ravni črti s kardinalno cono. Skoraj simetrično v sredi na sifonalnem delu lupine je močan trikoten osrednji greben medsifonalne cone. Na obeh straneh tega grebena sta konkavno oblikovani sifonalni brazdi *E* in *S*. Ligamentna guba ni razvita, kardinalni aparat ni ohranjen. Struktura lupine kaže na nepravilno orientirane kvadratne prizme, kar je značilno za rodove *Biradiolites, Eoradiolites* in *Bournonia*.

Podobnosti in razlike: Vrsta *Biradiolites baylei* spada po ASTRE (1957) v njegovo 5. skupino, oziroma v skupino tipa *fissicostatus* rodu *Biradiolites*. Za to skupino je značilna sploščena lupina na kardinalnem delu, vendar je pri vrsti *B. baylei* videti še vedno rahlo konveksna, kar opazimo tudi na našem primerku v prečnem preseku. Na prečnem preseku lupine je pri vrsti *B. baylei* nadalje vidna dokaj simetrična razporeditev obeh glavnih grebenov in obeh sifonalnih brazd, kar pri drugih vrstah skupine *B. fissicostatus* ni tako izrazito. Tudi osrednji greben medsifonalne cone je pri vrsti *B. baylei* močan in lepo trikoten, skoraj kot pri TOUCAS-ovi vrsti *B. canaliculatus*.

Stratigrafski položaj in razširjenost: po TOUCASU (1908) je vrsta *B. baylei* značilna za zgornji campanij območja Dordogne v Franciji. Po PEJOVIĆEVI (1968) so zastopniki skupine *fissicostatus* v Črni gori značilni za maastrichtij. Isto velja za podobne vrste v Hercegovini (SLIŠKOVIĆ, 1968). Tudi naš primerek je

bil najden v skladih maastrichtija (spodnji del liburnijske formacije ali v »vremskih plasteh«) na območju Tržaško-komenske planote.

Nahajališče: Primerek je bil najden v sinsedimentni apnenčevi breči (v kosu apnenca v breči) v profilu Dolenja vas; ter. točka 45.

Genus *Bournonia* Fischer 1887
Bournonia adriatica Pejović 1970
Sliki 7—8 v tekstu

1970 *Bournonia adriatica* n. sp.; PEJOVIĆ D., 244—246, 4 slike v tekstu.
1972 *B. adriatica* Pejović; CAMPOBASSO V., 366, fig. I/3.

Fosilni material: Dva prečna preseka spodnje lupine v črno rjavem apnencu iz sinsedimentne breče v spodnjem delu liburnijske formacije.

Opis: Prečni presek lupin je ovalne oblike s premerom okoli 1 cm. Sifonalni greben *E* je nekoliko ožji in krajši od sifonalnega grebena *S*. V prečnem preseku lupine niso vidni elementi kardinalnega aparata. Ligamentna guba ni razvita. Delno je vidna prizmatska struktura lupine, ki je značilna tudi za rod *Bournonia*. Sestavljena je iz lamel in prečnih prekatov. Pri obeh primerkih je viden tudi nožni greben *V*.

Podobnosti in razlike: Prečni presek spodnje lupine je nekoliko podoben vrsti *Bournonia exacavata* (d'Orbigny), vendar je slednja oblika navadno večja in značilna za starejše senonijske plasti kot vrsta *B. adriatica*.

Stratografski položaj in razširjenost: Po PEJOVIĆEVI je vrsta *B. adriatica* značilna za maastrichtij otroka Brača Črne gore, zahodne in vzhodne Srbije, Fruške gore in Metohije (PEJOVIĆ, 1970). Sedaj je bila ta vrsta ugotovljena tudi na območju Tržaško-komenske planote v spodnjem delu liburnijske formacije, ki jo štejemo v maastrichtij.

Nahajališče: Primerek je bil najden v kosu apnenca iz sinsedimentne breče v liburnijski formaciji v terenski točki 45 in v apnencu, ki leži 55 m niže pri terenski točki 51 v profilu Dolenja vas.

Bournonia judaica Blanckenhorn 1934
Slika 9 v tekstu

1934 *Bournonia judaica* n. sp.; BLANCKENHORN M., 161—296, Taf. 7, Fig. 107.
1972 *B. judaica* Blanckenhorn; CAMPOBASSO V., 366, fig. 1/2.

Fosilni material: Prečni presek spodnje lupine v črno rjavem apnencu spodnjega dela liburnijske formacije.

Opis: Prečni presek spodnje lupine meri manj kot 1 cm in je skoraj okrogel. Na njem sta vidna predvsem oba sifonalna grebena, od katerih je sifonalni greben *S* daljši in v bazi ožji kot sifonalni greben *E*. Ob koncu je greben *S* koničast. Sifonalni greben *E* je širši in s konkavno zajedo na vrhu. Medsifonalna cona je konkavna in približno enako široka kot sifonalni greben *S* v bazi. Na prednji strani lupine, to je bliže sifonalnega grebena *E* lahko zasledimo šibek nožni greben *V*.

Podobnosti in razlike: V prečnem preseku spodnje lupine se oba primerka, namreč tisti na sliki 1/2 v CAMPOBASSOVEM delu iz leta 1972 in naš primerek zelo dobro ujemata skoraj v vseh podrobnostih.

Stratigrafski položaj in razširjenost: BLANCKENHORNOV primerek je iz zgornjekrednih skladov Sirije in Palestine, medtem ko je naš iz maastrichtijskih plasti Tržaško-komenske planote.

Nahajališče: Siv apnenec pri terenski točki 51 v profilu Dolenja vas.

Bounonia parva Pejović 1988
Tab. 27, sl. 1

1988 *Bournonia parva* n. sp.; PEJOVIĆ D., 43—44, Pl. 1, figs. 2, 3.

Fosilni material: prečni presek spodnje lupine v kosu apnenca iz spodnjega dela liburnijske formacije v profilu Dolenja vas; ter. točka 46/1.

Opis: Na prečnem preseku spodnje lupine vidimo oba sifonalna grebena, od katerih je greben *S* močnejši. Lupina je v primeri z ostalimi primerki rodu *Bournonia* v profilu Dolenja vas dokaj majhna. V premeru meri le 4-6 mm, medtem ko ostali primerki merijo v premeru 9—13 mm. Lupina je tudi precej poškodovana od zajedalcev. Na sifonalnem grebenu *S* je videti strukturo lupine. Lamele so tu antiklinalno upognjene tako, da je teme antiklinale obrnjeno navzven. Podobno antiklinalno strukturo vidimo tudi na kardinalnem delu lupine. Medsifonalni prostor je širok. Sifonalna grebena tvorita med seboj kot 90°, podobno kot pri primerku v PEJOVIĆEVI razpravi. Konca sifonalnih grebenov sta subovalna. Kardinalni del lupine je na zunanji strani zaokrožen in brez vsakega grebena. Na tem delu lupine se vriva v lupino vrste *B. parva lupina* neke druge vrste burnonije. Oba individua sta bila morda v življenju zrasla skupaj.

Nahajališča: Dolenja vas pri Senožečah na Tržaško-komenski planoti; profil Dolenja vas; ter točka 46/1. Razen tega je bila ta vrsta najdena na otoku Braču in v Luštici v Boki Kotorski.

Stratigrafski horizont: Spodnji del liburnijske formacije ali »vremske plasti«, maastrichtij. Novo vrsto *B. parva* Pejović je avtorica našla na otoku Braču v plasteh spodnjega campanija.

Bournonia aff. parva Pejović 1988
Tab. 27, sl. 2

aff. 1988 *Bournonia parva* Pejović; PEJOVIĆ D., 43—44, Pl. 1, figs. 2, 2.

Fosilni material: Prečni presek spodnje lupine v kosu temno sivega apnenca iz sinsedimentne breče. Profil Dolenja vas; ter. točka 45.

Opis: Primerek ima v prečnem preseku premer 1 cm in se torej približuje velikosti primerka, ki ga je PEJOVIĆEVA opisala kot holotip vrste *B. parva*. Lupina je precej nagrizena od zajedalcev. Del lupine je poškodovan pri izdelavi preparata in zato ni vidno, če tam obstaja rebro. Vsekakor je šibko razvito nožno rebro *V*. Na preseku obeh sifonalnih reber je vidna struktura lupine. Lamele se povijajo v obeh rebrih antiklinalno s temenom obrnjenim navzven.

Podobnosti in razlike s holotipom vrste *B. parva* Pejović: Kot med sifonalnima rebroma znaša okoli 90° pri našem in pri PEJOVIĆEVEM primerku. Oba primerka pa se razlikujeta zlasti po tem, da ima naš primerek nožno rebro V, ki ga pri primerku v razpravi PEJOVIĆEVE ni videti.

Stratigrafski horizont: Primerek je bil najden v spodnjem delu liburnijske formacije, ki ga štejemo v maastrichtij.

Bournonia problematica n. sp.
Tab. 27, sl. 3

Izvor imena: *»problematika«* zaradi nenavadno močnega rebra na kardinalni strani lupine.

Fosilni material: Nekaj prečnih presekov spodnje ali desne lupine v črno rjavem apnencu v breči liburijske formacije pri Dolenji vasi.

Diagnoza: Poleg obeh grebenov, ki predstavljata sifonalno cono, sta na zunanji strani lupine še dve močni rebri, od katerih je prvo trikotno, močno izrazito in široko, drugo pa manj izbočeno in predstavlja nožno rebro *V*. To rebro se lahko še jasno razloči, ker sta na obeh straneh tega rebra plitva konkavna jarka. Sifonalna grebena sta v prečnem preseku lupine izrazita in trikotna. Struktura lupine je v obeh grebenih nekoliko različna. V sifonalnem grebenu *E* se v prečnem preseku lupine povijajo usmerjene kvadratne prizme proti notranji strani lupine. Tvorijo torej nekake antiklinale s temenom obrnjenim na zunanjo stran lupine. V sifonalnem grebenu *S* se usmerjene prizme povijajo proti zunanji strani lupine, tvorijo torej antiklinalne oblike odprte navzven ali s temenom obrnjenim na notranjo stran lupine. Medsifonalni prostor je širok konkavni jarek. Kot med sifonalnima grebenoma znaša približno 90°. Ligamentna guba ni razvita.

Opis in primerjava s podobnimi vrstami: Prečni presek spodnje ali desne lupine ima premer, ki poteka od kardinalne cone do sifonalne cone, 1,1 cm in prečno na to smer tudi okoli 1,1 cm. Navzven odprte antiklinalne strukture v zgradbi lupine so bile doslej znane pri vrsti *Bournonia dinarica* Slišković in se tam javljajo v zgradbi lupine medsifonalne cone in sifonalnega grebena *S* (SLIŠKOVIĆ, 1968, Tab. 10, sl. 1 in Tab. 11, sl. 2). Delno je tam taka struktura lupine vidna tudi v ostalih delih lupine. Pri našem primerku strukture ostalih delov lupine ne vidimo, ker so prekristaljeni. Kardinalni aparat ni ohranjen. Ligamentna guba ni razvita. Leva lupina ni ohranjena.

Oblika je podobna primerku, upodobljenem na Tab. 10, sl. 1 v razpravi CAMPOBASSO V.: Rudiste del Cretaceo superiore della Murge sud-orientali iz leta 1972. Primerek je tam opisan kot *Bournonia* sp., vendar se razlikuje od naše vrste *B. triangulata* po močnejšem nožnem rebru in po legi grebenov. Na sliki pri COMPOBASSU ni mogoče videti struktur v obeh sifonalnih grebenih.

Nova vrsta *B. triangulata* je tudi podobna vrsti *B. parva* Pejović 1988. Pri obeh vrstah znaša kot med sifonalnima grebenoma v prečnem preseku lupine okoli 90°. Naša vrsta se loči od vrste *B. parva* po izrazitem trikotnem rebru na kardinalni strani lupine, ki ga vrsta *B. parva* nima in po nožnem rebru *V*, ki ga tudi ni opaziti pri vrsti *B. parva*.

Locus typicus: Dolenja vas pri Senožečah; Tržaško-pomenska planota.

Stratum typicum: Spodnji del liburnijske formacije ali »vremske plasti« — maastrichtij.

Bournonia cf. *wiontzeki* Pejović 1968
Tabla 28, sl. 2

cf. 1968 *Bournonia wiontezki* n. sp.; PEJOVIĆ D., 168—169, Tab. 1, sl. 1, 2, Tab. 2, sl. 1—3.

Fosilni material: Del nekoliko poševnega preseka spodnje lupine (zbrusek) iz kosa apnenca iz sinsedimentne breče v profilu Dolenja vas; ter. točka 45.

Opis: Nekoliko poševni presek spodnje lupine (zbrusek) ima približno premer 1 cm (ne upoštevajoč reber). Vidni so trije izraziti grebeni oziroma rebra. V dveh grebenih je vidna struktura lupine. V grebenu, ki je le delno ohranjen, je teme antiklinale lamel obrnjeno navznoter lupine, pri drugem grebenu pa navzven. O kardinalnem aparatu ni sledov.

Podobnosti in razlike: S primerki, ki so upodobljeni v razpravi PEJOVIĆEVE iz leta 1968 lahko primerjamo naš primerek predvsem po izrazitih šiljastih grebenih.

Stratigrafski horizont in razširjenost: Vrsta *B. wiontzeki* je bila najdena v Črni gori v skladih maastrichtija. Podobno vrsto je omenjal že

WIONTZEK leta 1934 v razpravi o rudistih v dolini Soče (WIONTZEK, 1934) Prišteval jo je v senonij. Pri Dolenji vas je bil primerek najden v maastrichtijski sinsedimentni breči.

Bournonia sp. *sensu* Pejović 1978
Tabla 28, sl. 3

1977 *Bournonia* sp.; PEJOVIĆ D., Tab. 3, sl. 2.

Fosilni material: Več prečnih in poševnih presekov čez spodnjo ali desno lupino (zbrusek) v kosu črno-rjavega apnenca iz sinsedimentne breče v spodnjem delu liburnijske formacije; ter. točka 45.

Opis: Prečni preseki spodnjih lupin imajo premer okoli 1,0—1,2 cm. V prečnem preseku ima spodnja lupina skoraj kvadratni habitus. Ta oblika prihaja od razporeda sifonalnih grebenov in dveh reber. Ker ni ohranjen niti kardinalni aparat, niti nimamo ligametne gube, ki pri tem rodu ni razvita, oba sifonalna grebena pa sta zelo podobno razvita kot obe rebri na nasprotni strani lupine, je orientacija lupine težavna. Kot sifonalna grebena smo vzeli močnejša dva grebena in od teh dveh zopet izbrali močnejšega kot sifonalni greben *S*. Sprednjo stran lupine naj bi nakazoval konveksno izbočeni del lupine, ki je zato znotraj konkavno vdolben. Za tako orientacijo smo se odločili na podlagi orientacije primerka podanega na sliki 2 na tablli 3 v razpravi PEJOVIĆEVE iz leta 1978, čeprav tam nista označena sifonalna grebena *E* in *S*. Na naši sliki (Tab. 28, sl. 3) je vidna struktura orientiranih prizem v obeh sifonalnih grebenih in v obeh rebrih. Oba sifonalna grebena sta pri vrhu precej razpadla zaradi erozije, kar je pri rodu *Bournonia* dokaj pogosten primer, ker imata sifonalna grebena precej občutljivo strukturo. Tudi pri tej vrsti je medsifonalna cona široka in konkavna. Notranja plast lupine ni na nobenem primerku lepo ohranjena.

Stratigrafski položaj in razširjenost: Primerki so bili najdeni v kosu črno-rjavega apnenca, ki pripada sinsedimentni breči v spodnjem delu liburnijske formacije (»vremskih plasti«), ki jih štejemo v maastrichtij. Dolenja vas, Tržaško-komenska planota. Po PEJOVIĆEVI je bil najden podoben primerek pri Novem Pazaru v plasteh zgornje krede.

Genus *Fossulites* Astre 1954
Fossulites undesaltus Astre 1954
Slika 11 v tekstu

1954 *Medeela undesaltus* Astre; ASTRE G., 41, slika 14 v tekstu.
1957 *Medeela (Fossulites) undesaltus* Astre; ASTRE G., 25—48, slike 6 a—c, 12 h—k v tekstu.
1967 *Fossulites undesaltus* Astre; POLŠAK A., 101—102, slika 27 v tekstu.

Fosilni material: Prečni presek spodnje lušine v sivem apnencu.

Opis: Prečni presek lupine je subovalen s premerom 2 cm. Sifonalna grebena sta skoraj enako razvita; po podatkih iz literature naj bi bil greben *E* širši. Glede na lego ligamentne gube, ki leži vedno v zadnjem delu lupine, torej bliže sifonalnemu grebenu *S*, bi podatek o širšem grebenu *E* ustrezal, ker je greben *E* dejansko širši. V obeh sifonalnih grebenih sta vidna tudi kanala, ki ju smatra ASTRE za pomembna za pretakanje vode. Ligamentna guba je kratka in subtrikotna. Struktura lupine je izrazito prizmatična. Psevdostebrički na notranji strani lupine niso razviti na sifonalnem delu.

Podobnosti in razlike: Od podobnega rodu *Medeela* se rod *Fossulites* loči predvsem po značilni zgradbi sifonalne cone in izraziti prizmatični zgradbi lupine.

Holotip: Tab. 27, sl. 3, prečni presek spodnje ali desne lupine. Holotip je kot zbrusek shranjen v paleontološki zbirki Katedre za geologijo in paleontologijo Univerze E. Kardelja v Ljubljani. Inv. št. 5461.

Diagnoza: V prečnem preseku spodnje lupine je najbolj vidno rebro na kardinalni strani lupine, katerega dolžina dosega skoraj premer lupine, širina pa vsaj eno tretjino lupine. Struktura tega rebra je iz orientiranih kvadratnih prizem ali iz lamelarno-celularne strukture z antiklinalno povitimi lamelami. Teme antiklinale je obrnjeno navznoter lupine, oziroma se antiklinala odpira navzven. Sifonalna grebena sta izrazita in približno enako velika. Sifonalni greben *S* je le nekoliko ožji od grebena *E*. Slednji je zlasti v bazalnem delu širši. Kot med obema sifonalnima grebenoma znaša okoli 45°. Medsifonalna cona je ozka in konkavna. Njena širina ustreza približno širini sifonalnega grebena *S*. Izrazit je nožni greben *V*, v katerem ima lupina podobno strukturo iz orientiranih kvadratnih prizem kot v obeh sifonalnih grebenih in v močnem rebru na kardinalni strani lupine, to je antiklinalno povito lamelarno-celularno strukturo s temenom antiklinale obrnjenim navzven.

Kardinalni aparat ni ohranjen, ligamentna guba ni razvita. V prečnem preseku lupine je prednji del lupine z nožnim grebenom izbočen.

Opis: Prečni presek spodnje lupine ima premer v smeri kardinalna cona — sifonalna cona z velikim rebrom vred 1,6 cm in prečno na to smer 1,1 cm. Brez velikega rebra ima lupina v prečnem preseku subovalno obliko. Lupina je razmeroma tanka, saj doseže komaj 1,1 mm. Po vsem obsegu je zgrajena iz orientiranih kvadratnih prizem, kar je značilno za rod *Bournonia*. Primerek spada v družbo malih burnonij, ki so značilne za lagunarno okolje bivanja in je v zbrusku svetlo sive barve v nasprotju s temno barvo matične kamnine, to je apnenca.

Leva ali zgornja lupina ni ohranjena.

Podobnosti in razlike: Prav zaradi svojega močnega rebra na kardinalni strani lupine ni nova vrsta podobna nobeni znani vrsti. V sifonalnem delu je nekoliko podobna vrsti *B. retolata* (Astre) kot je podana na Tabli 3, slika 1 v razpravi PEJOVIĆEVE iz leta 1978.

Locus typicus: Profil Dolenja vas, ter. točka 45; Tržaško-komenska planota.

Stratum typicum: Spodnji del liburnijske formacije (»vremske plasti«), ki jih štejemo v maastrichtij. Poleg te vrste so bile najdene še vrste *Bournonia* aff. *retrolata* (Astre), *Bournonia* sp. secundo Pejović. Vse te vrste so značilne za lagunarno okolje vsaj na Tržaško-komenski planoti.

Bournonia aff. quadripinnae Pejović 1988
Slika 10 v tekstu

aff. 1988 *Bournonia quadripinnae* n. sp.; PEJOVIĆ D., 42—43, Pl. 1, fig. 1.

Fosilni material: Prečni presek spodnje lupine v kosu apnenca iz sinsedimentne breče spodnjega dela liburnijske formacije v profilu Dolenja vas; ter. točka 45.

Opis: Prečni presek spodnje lupine ima subovalno obliko z dvema neenakima sifonalnima grebenoma in dvema neenakima rebroma na kardinalni strani lupine. Premera lupine znašata 1,5 cm v smeri kardinalna cona — sifonalna cona (ne upoštevajoč reber), pravokotno na to smer pa 1 cm.

Sifonalno cono gradita dva močna grebena, to je sifonalni greben *S*, ki je močnejši (daljši in zaobljen na vrhu) in sifonalni greben *E*, ki je polovico krajši od prvega in na vrhu nekoliko bolj oster. Medsifonalni prostor je precej širok, gladek in konkavno vdolbljen. Širina tega prostora je še enkrat večja od posameznih sifonalnih grebenov.

Zunanja plast lupine je iz kvadratnih prizem ter močno stanjšana med rebri in sifonalnimi grebeni. Obe močni rebri na kardinalni strani lupine sta ozki in na koncu koničasti. Njiju dolžina je precej različna. Rebro na zadnji strani lupine je še enkrat daljše od rebra na sprednji strani. Razdalja med tema rebroma je približno enaka kot med sifonalnima grebenoma in tudi oblika prostora med njima je zelo podobna medsifonalni coni na nasprotni strani lupine.

Podobnosti in razlike: Razpored reber je enak kot pri holotipu v razpravi PEJEVIĆEVE iz leta 1988. Rebra so pri našem primerku nekoliko krajša, kar pa je lahko vzrok tudi v tem, da so le delno ohranjena. Kot med sifonalnima grebenoma znaša pri primerku PEJEVIĆEVE 25°, pri našem primerku pa okoli 30°, vendar je ta kot zaradi zavitih grebenov težko oceniti.

Stratigrafski horizont in razširjenost: Primerek PEJOVIĆEVE je bil najden pri kraju Selca na otoku Braču v spodnjecampanijskih plasteh. Naš primerek je bil najden v plasteh maastrichtija v profilu Dolenja vas na Tržaško-komenski planoti.

Bournonia aff. retrolata (Astre) 1929
Tab. 27, sl. 4

aff. 1929 *Biradiolites retrolatus* n. sp. ASTRE G., 230, Pl. 20, fig. 6, 7.
aff. 1972 *Bournonia retrolata* (Astre); COMPOBASSO V., 366, fig. 1/4.
aff. 1978 *B. retrolata* (Astre); PEJOVIĆ D., Tab. 3, sl. 1.

Fosilni material: Prečni presek spodnje lupine iz kosa apnenca iz sinsedimentne breče v profilu Dolenja vas; ter. točka 45.

Opis: Premer prečnega preseka spodnje lupine znaša 1,1 cm v smeri kardinalna cona — sifonalna cona in 1,2 cm pravokotno na to smer. Lupina je zgrajena iz usmerjenih kvadratnih prizem. Greben *E* je kratek, odrezan, vendar enako širok v bazi kot greben *S*.

Podobnosti in razlike: Po zunanjem habitusu je ta primerek precej podoben primerku na Tabeli 3, sl. 1 v PEJOVIĆEVI razpravi iz leta 1978, pa tudi primerku na sliki 1/4 v CAMPOBASSO-vi razpravi iz leta 1972. Večjih podobnosti z ostalimi znanimi vrstami iz literature nismo našli. V našem primeru gre lahko tudi za novo podvrsto vrste *B. retrolata*. Obstojajo namreč male razlike pri obliki medsifonalne cone, ki je pri našem primerku videti bolj ravna in širša kot pri znanih primerkih vrste *B. retrolata* (Astre).

Stratigrafski položaj in razširjenost: Ta primerek smo našli v črno-rjavem apnencu, ki sestavlja apnenčevo brečo v spodnjem delu liburnijske formacije in spada v maastrichtij. Poleg vrste *B.* aff. *parva* Pejović in *Bournonia* sp. sec. Pejović 1878, ki jo je ta avtorica našla pri Novem Pazaru.

Nahajališče: Profil ob cesti Dolenja vas—Vrabče; ter. točka št. 45 na Tržaško-komenski planoti.

Bournonia triangulata n. sp.
Tab. 28, sl. 1

Izvor imena: »*triangulata*« po trikotni obliki v prečnem preseku spodnje lupine.

Material: Več prečnih presekov spodnje ali desne lupine v kosih apnenca iz sinsedimentne breče v profilu Dolenja vas; ter. točka 45.

Holotip: Tabla 28, sl. 1, prečni presek spodnje lupine — zbrusek, ki je shranjen v paleontološki zbirki Katedre za geologijo in paleontologijo Univerze E. Kardelja v Ljubljani; inv. št. 5462.

Stratigrafski položaj in razširjenost: ASTRE prišteva to vrsto z območja Moulin de l'Agly v coniacij. V našem primeru gre očitno za više ležeči stratigrafski horizont, verjetno za maastrichtij. Primerek je bil najden skupno z vrstami in rodovi: *Radiolitella, Kuehnia* aff. *serbica* in *Pseudopolyconites* pri Dolenji vasi.

Nahajališče: Profil Dolenja vas pri Senožečah; ter. točka 51; Tržaško-komenska planota.

Genus *Kuehnia* Milovanović 1956
Kuehnia aff. *serbica* Milovanović 1956

aff. 1956 *Kuehnia serbica* n. sp.; MILOVANOVIĆ B., 131—144, Tab. 1, sl. 1.
aff. 1968 *Kuehnia serbica* Milovanović; PEJOVIĆ D., 171, Tab. 4, sl. 1, 2

Fosilni material: Prečni presek spodnje lupine v sivem apnencu.

Opis: Prečni presek spodnje lupine ima premer 2 cm in je subovalne oblike. Na zadnjem delu lupine so dokaj dobro izraženi »osculi«, prednji del lupine je slabše ohranjen. Dobro je ohranjena ligamentna guba, ki je na koncu ostro odrezana. Struktura zunanje plasti lupine je pretežno lamelasta, vendar, kot smo rekli, lupina ni v celoti ohranjena in se zato lahko predpostavlja, da je delno tudi prizmatična. Psevdostebrički na notranji strani lupine niso razviti.

Podobnosti in razlike: Primerek je zelo podoben individuu na Tab. 4, sl. 1 in 2 v razpravi PEJOVIĆEVE iz leta 1968.

Statigrafski položaj in razširjenost: Vrsta *Kuehnia serbica* je bila najdena v Srbiji in Črni gori, sedaj pa tudi na Tržaško-komenski planoti pri Dolenji vasi. Na srbskih in črnogorskih nahajališčih je značilna za zgornji del campanija, oziroma spodnji del maastrichtija. Pri nas je bila najdena v maastrichtijskih skladih.

Nahajališče: Profil Dolenja vas; terenska točka 51; Tržaško-komenska planota.

Genus *Pseudopolyconites* Milovanović 1935
Slika 13 v tekstu

1935 *Pseudopolyconites parvus* n. gen., n. sp.; MILOVANOVIĆ B., 1—79.

Fosilni material: Prečni presek odlomka spodje lupine iz sivega apnenca pri Dolenji vasi.

Opis: Ker gre le za odlomek lupine in še to v prečnem preseku, ni mogoče določiti vrste. K sreči imamo opravka ravno s tistim delom lupine, ki ima ligamentno gubo, ki je eden od značilnih elementov za določitev roda *Pseudopolyconites*. Ligamentna guba na našem preseku je razcepljena v obliki dvojne opanke. Velikost preseka znaša okoli 3 cm.

Podobnosti in razlike s podobnimi primerki: Naš odlomek lupine, oziroma ligamentna guba je nekoliko podoben kot pri vrsti *P. laskarevi* Milovanović-Sladić iz zahodne Srbije. Taka ligamentna guba je vidna na Tabli 2, slika 1 v razpravi SLADIĆ-TRIFUNOVIĆEVE iz leta 1971.

Stratigrafski položaj in razširjenost: Primerek je bil najden v plasteh, ki vsebujejo še druge radiolite, značilne za zgornji senonij, oziroma za maastrichtij, kot npr. *Radiolitella* sp., *Kuehnia* aff. *serbica* in druge. Rod *Pseudopolyconites* je razširjen v Srbiji, na otoku Braču, najden je bil na Nanosu in v Italiji (Apulija), povsod v najmlajših senonijskih skladih.

Nahajališče: Profil Dolenja vas; terenska točka 51; Tržaško-komenska planota.

Subgenus *Radiolitella* Douvillé 1904
Sliki 14 in 15 v tekstu

1904 *Radiolitella forojuliensis* Pirona; DOUVILLÉ H. 535—537, Pl. 14, fig. 1, 2, 3.

Fosilni material: Dva prečna preseka spodnje lupine, od teh eden le na območju kardinalne cone lupine.

Opis: Obe lupini imata poligonalno prizmatsko zgradbo. DOUVILLÉ imenuje te prizme kanale. Ligamentna guba je kratka in trikotne oblike.

Podobnosti in razlike: Eden od primerkov (slika 9) se močno približuje DOUVILLÉ-jevi vrsti *R. forojuliensis* tako po obliki, kot po velikosti ligamentne gube.

Stratigrafski položaj in razširjenost: Primerke tega rodu smo dobili na Nanosu in na Medejskem hribu (Colle di Medea). Po DOUVILLÉ-ju je ta rod značilen za maastrichtij. Sedaj je bil najden tudi na Tržaško-komenski planoti v skladih, ki smo jih tudi prišteli v maastrichtij.

Nahajališče: Profil Dolenja vas; terenski točki 47 in 51; Tržaško-komenska planota.

SKLEPI

V spodnjem delu profila Dolenja vas smo pod terciarnimi skladi ugotovili kredne sklade z rudistno favno. Ti skladi so v spodnjem delu iz sivih mikritnih in sparitnih apnencev, više, to je tik pod terciarnimi plastmi pa iz temno sivih, rjavih in črnih mikritnih apnencev in sinsedimentne apnenčeve breče. Ti slednji apnenci in apnenčeva breča pripadajo spodnjemu delu liburnijske formacije ali »vremskim plastem«. Vse opisane kredne sklade v profilu Dolenja vas, tudi spodnji del liburnijske formacije, uvrščamo stratigrafsko v zgornji maastrichtij. Liburnijska formacija pripada torej delno v kredo (maastrichtij), delno v terciar (paleocen). Medtem ko so sivi mikritni in sparitni apnenci pod liburnijskimi plastmi nastajali na odprtem morskem šelfu, so nastajali liburnijski skladi delno v lagunah, delno že v sladkovodnem okolju, kar pričajo v nekaterih plasteh ostanki sladkovodnih polžev. Male oblike rodov *Bournonia* in *Gyropleura*, ki so uspevale v spodnjem delu liburnijske formacije, so se ob koncu krede morale prilagoditi tem izjemnim razmeram. V srednjem delu liburnijske formacije, to je v kozinskih plasteh, ni več sledu o rudistih. Kozinske sklade štejemo v terciar (danij?).

Giroplever žal nismo mogli nikjer v profilu Dolenja vas izpreparirati iz matične kamnine, da bi jih natančneje obdelali, njih preseki pa so premalo značilni za determinacijo. Tako ostaja vprašanje giroplever s paleontološkega stališča še vedno odprto.

Pri burnonijah ni pri nobenem primerku ohranjen kardinalni aparat (zobje, mioforia itd.). Ti elementi so morali biti šibko razviti. Pri rodu Bournonia tudi ni razvita ligamentna guba. Vse to kaže, da je bilo okolje, v katerem so školjke živele, mirno, voda je imela nizek energetski indeks. Rudisti niso rabili za zapiranje lupin močnega aparata.

Burnonije so imele relativno dolgo in ozko valjasto obliko s premerom 1 do 2 cm, zato pa so rabile za oporo dokaj močna rebra, oziroma grebene. Sploh pa je še odprto vprašanje o višini teh školjk, saj se ni ohranila nobena cela lupina in jih poznamo le iz presekov v matični kamnini (apnencu). Vsekakor niso mogle biti višje od nekaj centimetrov. Posamezni individui so bili verjetno zakopani v apnenčevo blato, ki je tedaj obilno nastajalo kot kemična usedlina. Močna rebra so burnonijam služila lahko tudi za zasidranje v blatu.

Značilno za lupine vseh tedaj živečih organizmov je, da so precej tenke. V zbruskih je videti, da so lupine rudistov precej poškodovane (navrtane) od zajedalcev. Morda so bile to morske gobe, morda tudi drugi zajedalci. To vprašanje bi bilo zanimivo posebej obdelati.

Dalje lahko ugotovimo, da ni bilo tedaj strnjenih naselij rudistnih školjk — trat, ampak so posamezni primerki živeli solitarno. Niso gradili bioherm.

Iz vsega bi lahko povzeli, da je rudistna kredna favna, ki je bila značilna še v spodnjem in srednjem senoniju po velikih, številnih in bizarnih oblikah, ugašala na kraški karbonatni platformi Tržaško-komenske planote v drobnih, dokaj primitivnih vrstah, ki so uspevale v mirnem lagunarnem okolju.

KORALNA FAVNA IZ PALEOCENA V PROFILU DOLENJA VAS

Dragica TURNŠEK

Sl. 16; Tab. 29—35

POVZETEK

Uvod. V profilu Dolenja vas so bile korale najdene v 18 vzorcih. Določenih je 11 vrst, ki pripadajo 9 rodovom:

Stylocoenia montium (Oppenheim 1912) . . . . . Tab. 29, sl. 1—3
Dendrophyllia candelabrum Hennig 1899 . . . . . Tab. 29, sl. 4—6
Dendrophyllia dendrophylloides M. Edw. et H. . . . . Tab. 30, sl. 1—2
Haimesastraea peruviana Vaughan 1922 . . . . . Tab. 30, sl. 3
Plocophyllia karstica n. sp. . . . . Tab. 31—32
Siderastraea sp. . . . . Tab. 33, sl. 1
Actinacis cognata Oppenheim 1901 . . . . . Tab. 33, sl. 2—4
Rhizangia sp. . . . . Tab. 33, sl. 5
Goniopora elegans (Leymerie 1846) . . . . . Tab. 34, sl. 1—3
Goniopora sp. . . . . Tab. 34, sl. 4
Litharaeopsis subeptithecata (Oppenheim 1912) . . . . . Tab. 35, sl. 1—4

Stratigrafska primerjava. Koralne vrste iz Dolenje vasi smo lahko primerjali z nahajališči v Skandinaviji in Grenlandiji (FLORIS 1972), v Ukrajini in Srednjem Povolžju (KUZMICHEVA 1975) in na Medvednici pri Zagrebu (POLŠAK 1985). S skandinavskimi nahajališči je skupna vrsta *Dendrophyllia candelabrum*, ki je zelo pogostna, in je tam stratigrafsko natančno omejena na danij. Z nahajališči evropskega dela Sovjetske zveze so skupne štiri vrste: *Dendrophyllia dendrophylloides, Stylocoenia montium, Goniopora elegans* in *Actinacis cognata*. Prva je v Povolžju uvrščena v celoten paleocen, ostale tri v montij-thanetij. Z Medvednico sta skupni dve vrsti, *Dendrophyllia dendrophylloides* in *Actinacis cognata*. To nahajališče je uvrščeno v paleocen. S temi primerjavami je potrjena paleocenska starost koral v Dolenji vasi.

Nekatere od koralnih vrst iz Dolenje vasi se omenjajo tudi v eocenu, tako 4 vrste v Rosićih pri Majevici v severni Bosni (OPPENHEIM) 1912), po ena pa v Furlaniji OPPENHEIM 1901) in v Karpatih (ELIAŠOVA 1974). Pripomniti moram, da po novejših raziskavah nahajališče v Rosićih verjetno sega še v paleocen, ker so na širšem prostoru Majevice odkrita nova paleocenska nahajališča grabenskih sedimentov (glej BABIĆ et al. 1976).

Položaj posameznih koralnih vrst v Dolenji vasi. V profilu v Dolenji vasi se je pokazalo, da so nekatere koralne vrste časovno omejene na ozke horizonte in bodo morda služile za stratigrafsko osnovo na širšem prostoru (sl. 16). *Dendrophyilla*

candelbarum, D. dendrophylloides ter *Rhizangia* sp. se pojavljajo skozi ves paleocen in nimajo natančnejšega stratigrafskega položaja. *Stylocoenia montium* je vezana na horizont Dv 22, *Plocophyllia karstica* na Dv 23 b, *Actinacis cognata* na Dv 23, *Goniopora elegans* na Dv 18, 20, 22 in *Litharaeopsis* na Dv 24, kar je vse v območju zgornjega danija (montija). Vrsta *Goniopora* sp. se z mnogimi primerki pojavlja na horizontu Dv 29, to je v zgornjem thanetiju.

Paleoekološke ugotovitve. V Dolenji vasi lahko korale po obliki kolonij razdelimo v dva večja tipa. Prvi so dendroidno ramozne oblike, drugi pa masivne skorjasto-gomoljaste oblike. Te druge so grebenotvorne, vendar so kolonije majhne in so tvorile le »patch« grebene. Zanimivo je, da se dendroidne korale pojavljajo od začetka danija skozi ves paleocen, masivne pa so uspevale le v zgornjem daniju (montiju) in potem ponovno v zgornjem thanetiju. (Sl. 16.)

SKLEP. Korale v Dolenji vasi se ločijo v dva ekološka tipa: dendroidne, ki se pojavljajo skozi ves paleocen, in masivne grebenotvorne, ki smo jih dobili le v zgornjem daniju (montiju) in zgornjem thanetiju. Paleocensko starost potrjuje primerjava z enakimi vrstami v Skandinaviji, Ukrajini in Povolžju ter na Medvednici.

Natančen stratigrafski položaj koral v Dolenji vasi, kjer so nekatere vrste omejene na zelo ozke horizonte, bo lahko služil kot startigrafska osnova za širše področje osrednje Jugoslavije, kjer so paleocenske korale že najdene, pa še niso paleontološko obdelane.

SKLEPNE UGOTOVITVE

Na NW delu dinarske karbonatne platforme je v profilu Dolenja vas razgaljenih 135 m karbonatnih sedimentov. Ti dokumentirajo mejo kreda — terciar (K — T) s pestro fosilno združbo. Plitvovodni karbonatni facies je raznovrsten, odložen v navidezno neprekinjenem zaporedju sedimentov v času od zgornjega maastrichtija do thanetija.

Glede na tradicionalno razčlenitev liburnijske formacije v vremske, kozinske in miliolidne plasti smo interpretirali njih starost takole: vremenske plasti pripadajo maastrichtiju, kozinske plasti najstarejšemu terciarju (najverjetneje daniju) in miliolidne plasti thanetiju.

Nadrobne študije rudistov, koral, foraminifer in dasikladacejskih alg, njihov odnos do tipa mikrofaciesa in njihova stratigrafska lega v sorazmerno popolnem profilu lahko služi kot podlaga za nadaljnja stratigrafska preučevanja na širšem območju celotne dinarske karbonatne platforme. Na njej so namreč znana le posamezna izolirana nahajališča ali pa dokaj nepopolni profili iz obdobja zgornje krede v najstarejši terciar.

V profilu Dolenja vas je pod mejo K — T razvita makro- in mikro- združba v organogenem apnencu. Ta je značilna za zgornji maastrichtij. Preraščanje skeletnih delov in sledovi aktivnosti endolitov kažejo na majhno hitrost sedimentacije. Plasti sinsedimentne breče z »hermatipičnimi« rudisti nakazujejo povečan energijski indeks vode glede na bližino litoralne cone. Plasti z več mikrita so bile namreč odložene v zaščitenem, lagunskem okolju.

Nad mejo K — T so odloženi temni mikritni apnenci konkordantno na kredne apnence. Ti mikritni apnenci vsebujejo številne plastiklaste, stromatolite in izsušitvene pore. Fosili so redki in majhnih dimenzij. V nekaterih plasteh nastopajo oblike mikrokodiuma kot posamični kristali ali kot skupki kristalov razpršeni v mikritnem apnencu. Ta sediment se je odlagal v medplimskem in nadplimskem okolju. Kasneje odloženi apnenec je glede na velike foraminifere uvrščen v thanetij. Kaže na postopno transgresijo od lagunskega v plitvomorsko okolje z zanj tipičnimi karbonati.

Fosilno združbo zgornjekrednih vremskih plasti karakterizirajo *Rhapydionina liburnica* in rudisti iz roda *Bournonia*, *B. parva* in *B. problematica* n. sp. skupaj z lumakelami gyroplever.

Spodnji del kozinskih plasti vsebuje majhne fosilne organizme s tenko steno kot npr. *Clypeina* sp., *Protelphidium* sp., ki jim slede miliolide, ataxophragmiide (*Pseudochrysalidina* sp.), *Bolkarina* sp. in česti horizonti z »*Microcodium*«. V ozko omejenih nivojih tega dela plasti se pojavljajo tudi dasikladacejske alge *Parkerella* sp., in dendroidne ter razmozne korale *Haimesastraea peruviana*, *Dendrophyllia dendrophylloides* in *D. candelabrum*.

Zgornji del kozinskih plasti prinaša kot dopolnilo k dendroidnim oblikam koral še masivne vrste *Stylocoenia montium*, *Actinacis cognata*, *Goniopora elegans*, *Plocophyllia karstica* n. sp. in *Litharaeopsis subepithecata*. Dasikladacejske alge predstavljajo *Orioporella villattae*, *Cymopolia paronai* in *C. mayaense*. *Idalina* sp. in *Periloculina* sp. sta prvi veliki foraminiferi s porcelansko hišico, ki se pojavita po meji K — T.

V tako imenovanih miliolidnih apnencih se prvič pojavijo talusi rdečih alg. Številne male rotalide nastopajo skupaj z vrstami *Miscellanea* sp. 2 (LEPPIG 1988), *Coskinon rajkae* in *Cribrobulimina carniolica*, vodilnimi za thanetijsko stopnjo. Še vedno se pojavljajo masivne in dendroidne korale.

Konkordantnost sedimentov v plasteh, ki premoščajo mejo K — T v profilu Dolenja vas, njihova enoličnost, plitvo okolje sedimentacije in njihova stalno se ponavljajoča tropska favna, meče novo luč na dogodke ob meji K — T. Odsotnost močnejših erozijskih znakov na meji K — T in stalno plitvovodno okolje kažeta na trajno globino le nekaj metrov, ki jo ponazarja stalno razmerje med površino karbonatne platforme in morsko gladino. Prav tako je verjetno, da je bila v tem času vseskozi topla klima. Kajti na preostalem centralnem delu karbonatne platforme, ki je bila v tem času delno tudi okopnela, so nastajali boksiti in premog. Dinarska karbonatna platforma je imela tedaj geografski položaj ob robu tropskega pasu na približno 30° severne širine, kar bi ustrezalo današnji legi Rdečega morja. Kakršnakoli klimatska odstopanja ali/in padec morske gladine, ki so v neposredni zvezi s splošno znanim izumiranjem zajetnega števila favne na širšem odseku, bi morala pustiti nek signal v sklenjeni skladovnici kamnin, pa čeprav bi bil sedimentacijski proces prekinjen le za nekaj časa med posameznimi plastmi, razgaljenimi v tem profilu. V profilu pri Dolenji vasi pa ni bil najden noben tak signal, niti kakšna druga sled o posebno izrazitem dogodku na meji kreda — terciar.

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PLATES – TABLE

EXPLANATION TO PLATES 1–26

All the photographs are taken from thin-sections, either directly enlarged to photo paper or with the film. The photographs were made by Vlado VIVOD, Carmen NAROBE, Marko ZAPLATIL and Igor LAPAJNE. Material is kept on Paleontological Institut Ivan RAKOVEC, ZRC SAZU.

RAZLAGE K TABLAM 1–26

Vse fotografije so izdelane iz zbruskov, ali direktno na foto papir ali preko filma. Izdelovali so jih Vlado VIVOD, Carmen NAROBE, Marko ZAPLATIL in Vlado LAPAJNE. Material je shranjen na Paleontološkem inštitutu Ivana RAKOVCA, ZRC SAZU.

PLATE 1

Fig. 1 Foraminiferal wackestone with rudists (*Bournonia parva* Pejović). Intensive endolithic boring of shells is evident.
Upper Maastrichtian, Dv 46/5073.

Fig. 2 *Gyropeura* fragments in bioturbated biomicritic wackestone of restricted shelf facies.
Upper Maastrichtian, Dv 47/5078

TABLA 1

Sl. 1 Foraminiferni mikritni apnenec z lupinami rudistov (wackestone) (*Bournonia parva* Pejović). Opazna je intenzivna endolitizacija rudistnih skeletov.
Zgornji maastrichtij, Dv 46/5073.

Sl. 2 Odlomki giroplevr v biomikritnem apnencu (wackestone) z znaki bioturbacije. Facies zaprtega plitvega šelfa.
Zgornji maastrichtij, Dv 47/5078.

All enlarged 10 × in incident light.
Vse povečano 10 × v odbojni svetlobi.

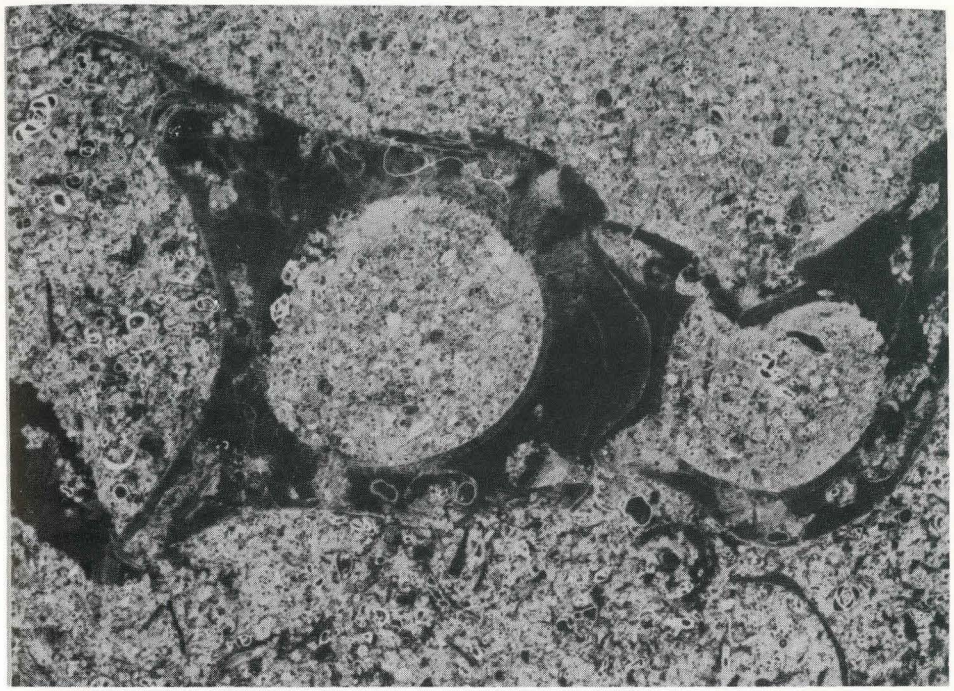

PLATE 2

Fig. 1 Miliolidal limestone with *Dicyclina schlumbergeri* Munier-Chalmas (A), and *Gyropleura* fragments (B). Endolithic boring of shell. Restricted shelf facies.
Upper Maastrichtian, Dv 5/6577.

Fig. 2 *Rhapydionina liburnica* in biomicritic miliolidal packstone. Internal sediment in the gastropod mold.
Upper Maastrichtian, Dv 5/6582.

TABLA 2

Sl. 1 Miliolidni apnenec s foraminifero *Dicyclina schlumbergeri* Munier-Chalmas (A), in fragmenti giroplevr (B), ki jih je zajela endolitizacija. Facies zaprtega šelfa.
Zgornji maastrichtij, Dv 5/6577.

Sl. 2 *Rhapydionina liburnica* v miliolidno biomikritnem apnencu (packstone). Interni mikrit v pori mikrogastropoda.
Zgornji maastrichtij, Dv 5/6582.

All enlarged 10 × in incident light.
Vse povečano 10 × v odbojni svetlobi.

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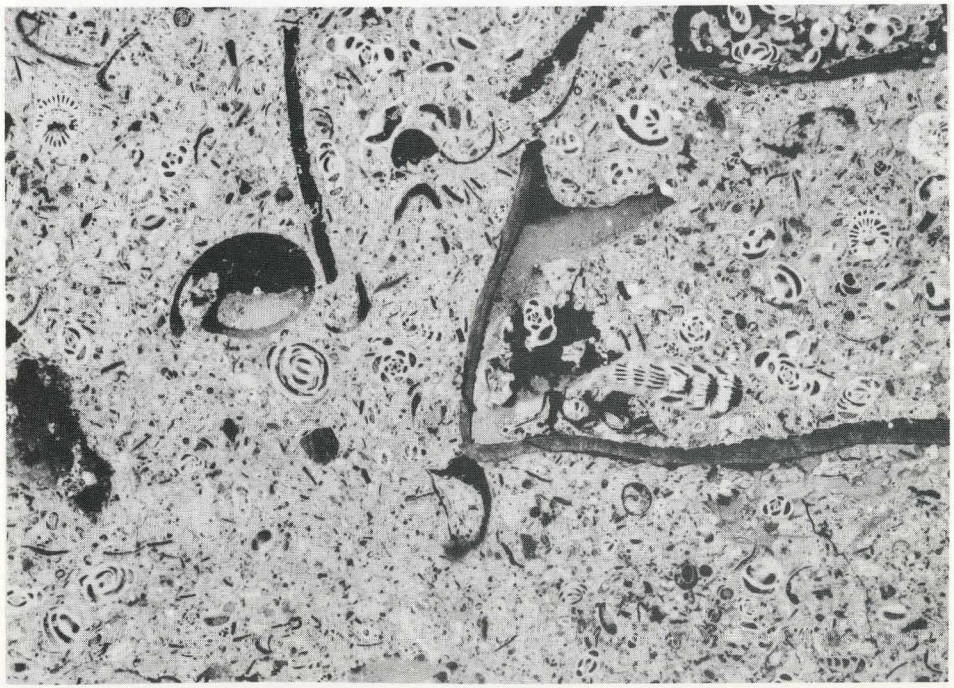

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PLATE 3

Fig. 1 Calcite pseudomorphose after gypsum crystals (arrows) in micritic limestone with *Microcodium*. Supratidal facies.
Lower Danian, Dv 44/8-6556.

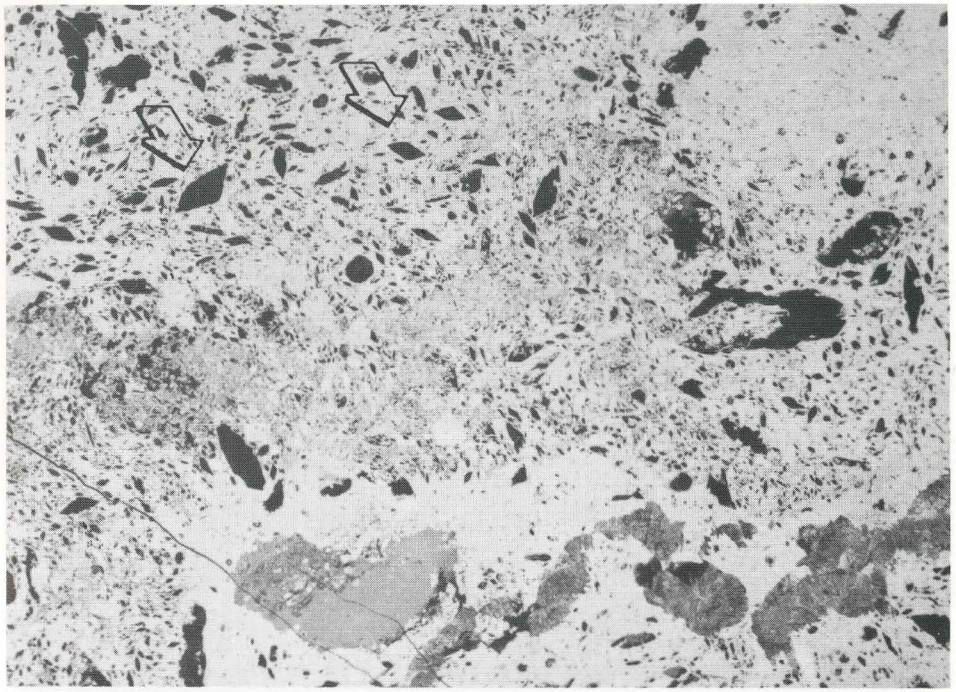
Fig. 2 Biomicritic plasticlast enerusted by nonskeletal algae in foraminiferal limestone. Shallow subtidal facies.
Upper Maastrichtian, Dv 45/1-5068.

TABLA 3

Sl. 1 Nadomeščanje kristalov sadre s kalcitom (puščice) v mikritnem apnencu z mikrokodiji. Nadplimski facies.
Spodnji danij, Dv 44/8-6556.

Sl. 2 Biomikritni plastiklasti obdani z neskeletnimi algami v foraminifernem apnencu. Nizek podplimski facies.
Zgornji maastrichtij, Dv 45/1-5068.

All enlarged 10 × in incident light.
Vse povečano 10 × v odbojni svetlobi.



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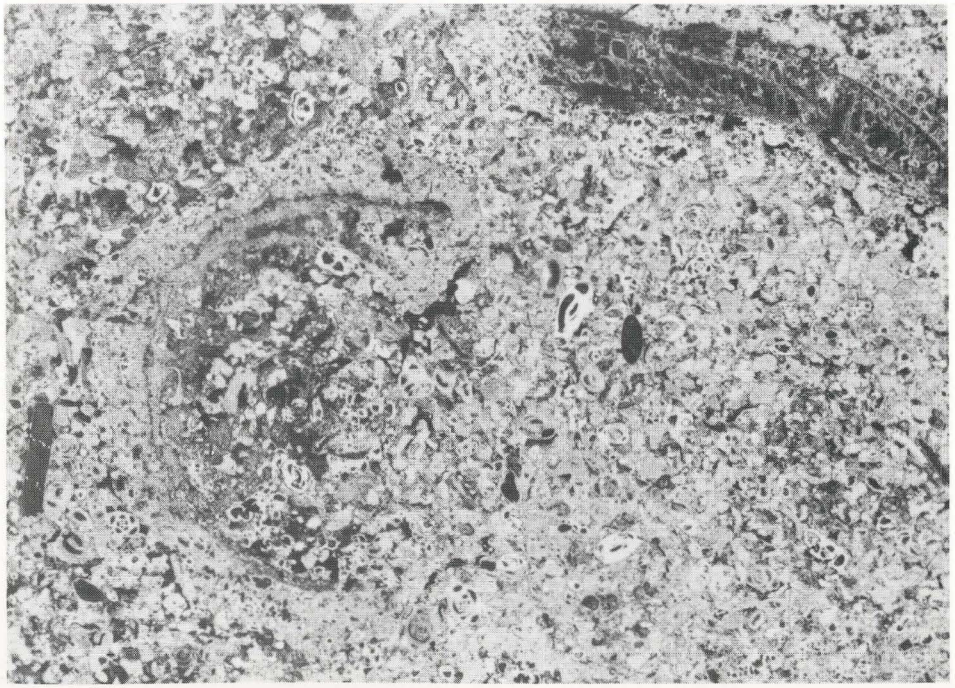

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PLATE 4

Fig. 1 Bioturbated micritic clasts and *Microcodium* fragments.
Intertidal facies.
Lower Danian, Dv 44/6-6559.

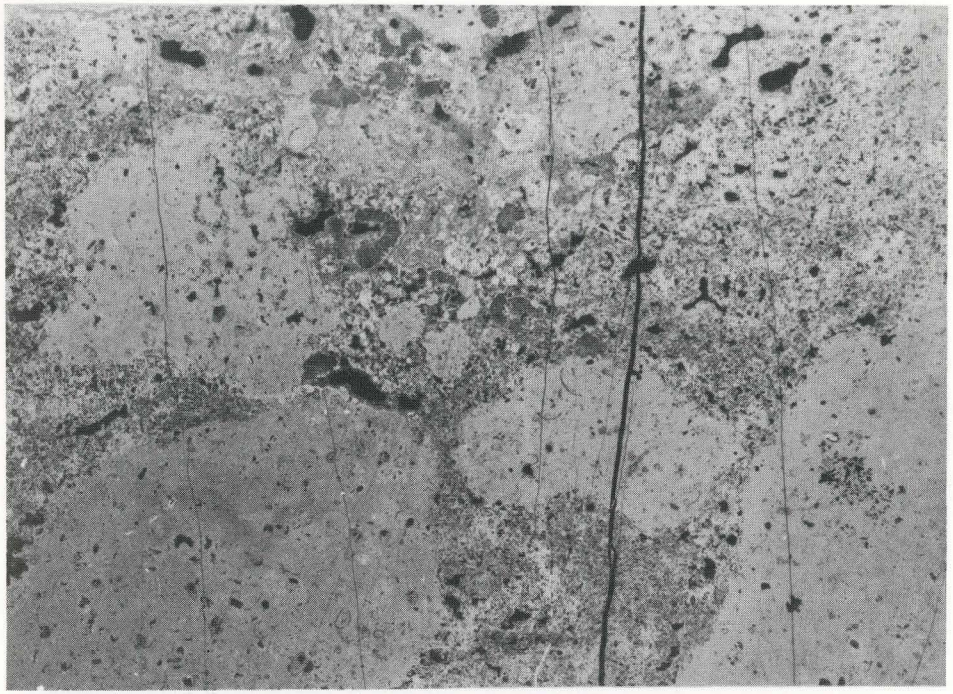
Fig. 2 Biomicritic wackestone with algae and ostracoda. Shrinkage pores (arrows) indicate littoral facies.
Lower Danian, Dv 44/4-6564.

TABLA 4

Sl. 1 Mikritni klasti in fragmenti mikrokodija v mikritnem apnencu z znaki bioturbacije.
Medplimski facies.
Spodnji danij, Dv 44/8-6559.

Sl. 2 Biomikritni apnenec z algami in ostrakodi (wackestone).
Izsušitvene pore (puščice) so značilne za obrežni facies.
Spodnji danij, Dv 44/4-6564.

All enlarged 10 × in incident light.
Vse povečano 10 × v odbojni svetlobi.



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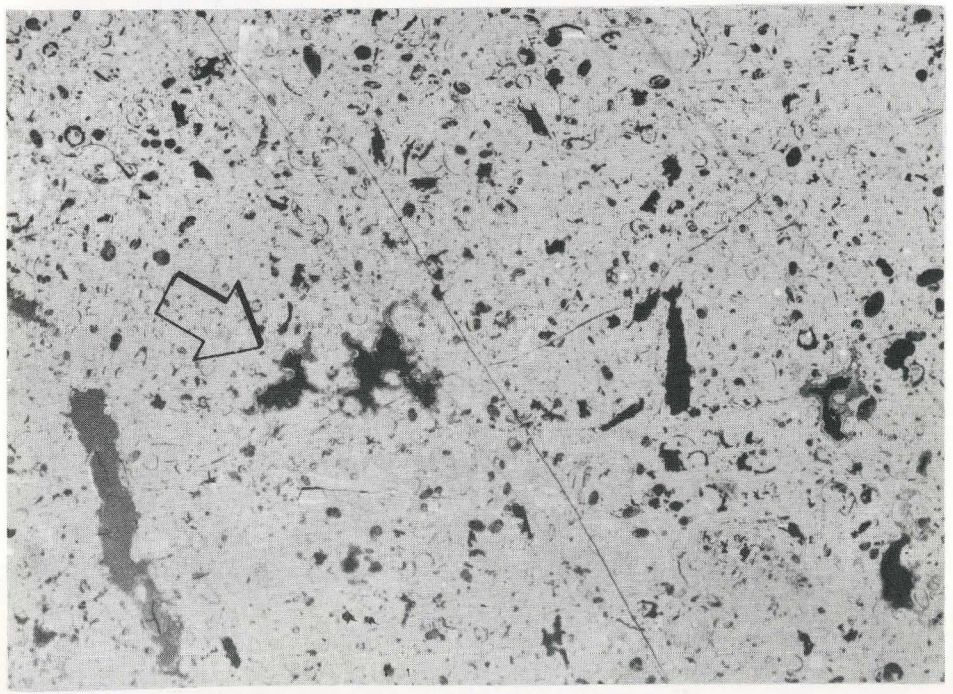

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PLATE 5

Fig. 1 *Microcodium* structure in biomicritic limestone and stromatolitic overgrowth. Intertidal facies.
Lower Danian, Dv 44/4-6564.

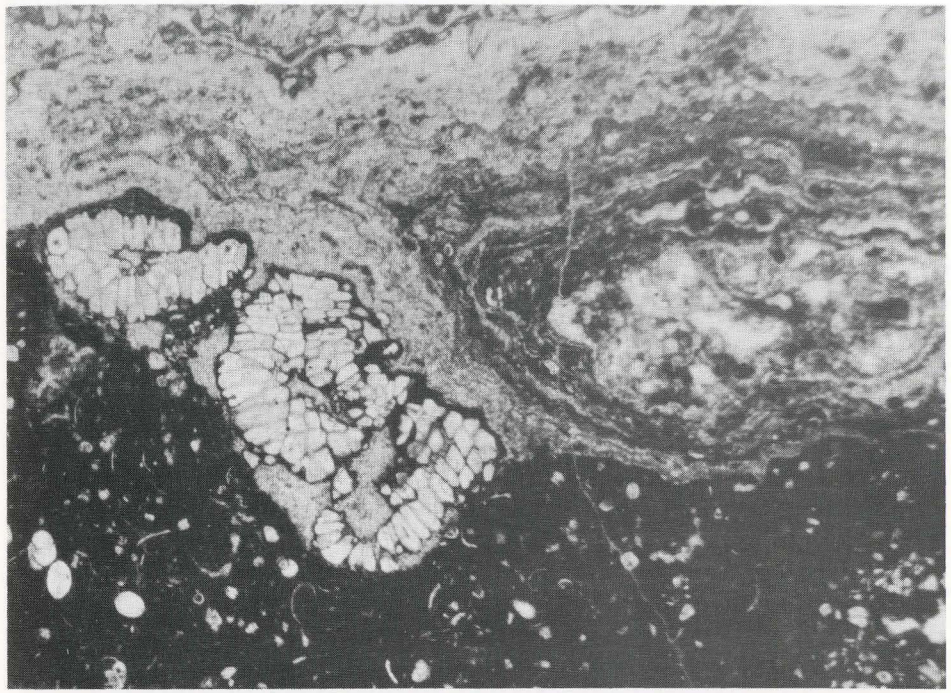
Fig. 2 Bioturbation vug in carbonate mud, filled by *Microcodium* fragments and pelagic foraminifers.
Lower Danian, Dv 44/2-6570.

TABLA 5

Sl. 1 Mikrokodiji v biomikritnem apnencu, ki ga prerašča stromatolit. Medplimski facies.
Spodnji danij, Dv 44/4-6564.

Sl. 2 Votlina, nastala pri bioturbaciji karbonatnega blata, ki je zapolnjena z drobci mikrokodijev in s pelagičnimi foraminiferami.
Spodnji danij, Dv 44/2-6570.

All enlarged 30 × in transparent light.
Vse povečano 30 × v presevni svetlobi.



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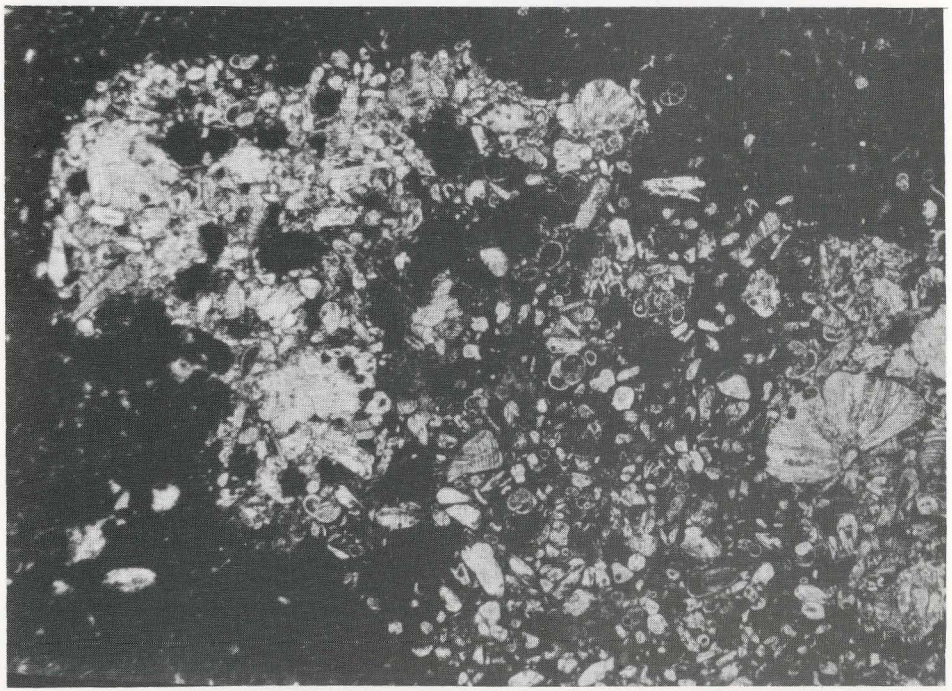

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PLATE 6

Fig. 1 Micritic limestone, intensively bioturbated. Intertidal lagoonal facies.
Lower Danian, Dv -44/6592.

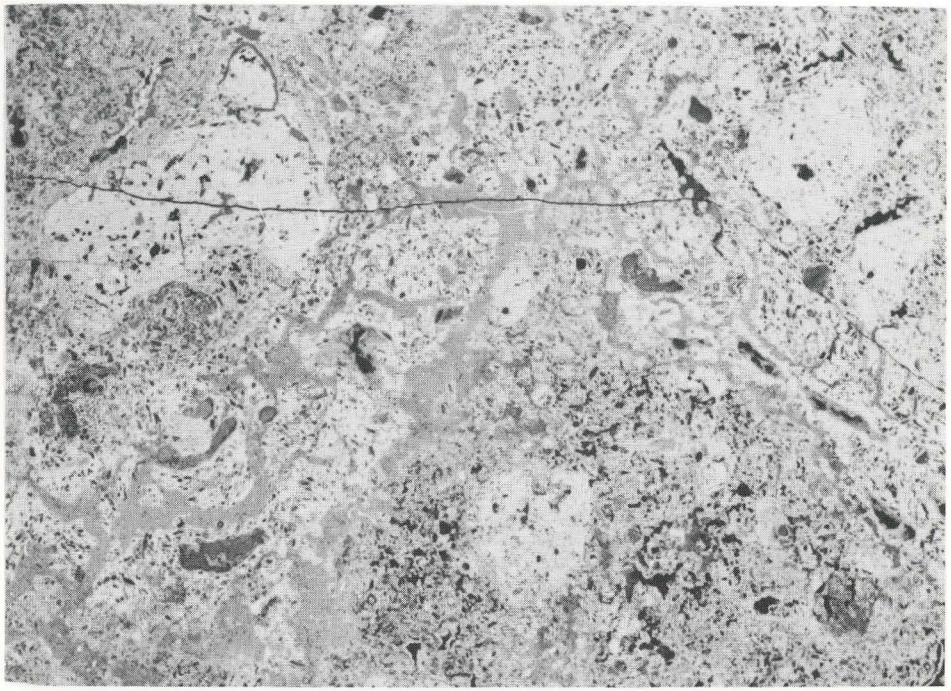
Fig. 2 Gastropod shell in biomicritic limestone. Numerous calcite prisms of *Microcodium* are evidnet.
Lower Danian, Dv 44/3 a-6568.

TABLA 6

Sl. 1 Mikritni apnenec z intenzivno bioturbacijsko teksturo. Medplimsko okolje.
Spodnji danij, Dv -4/6592.

Sl. 2 Lupina polža v biomikritnem apnencu s številnimi prizmami razsutega mikrokodija.
Spodnji danij, Dv 44/3 a-6568.

All enlarged 10 × in incident light.
Vse povečano 10 × v odbojni svetlobi.



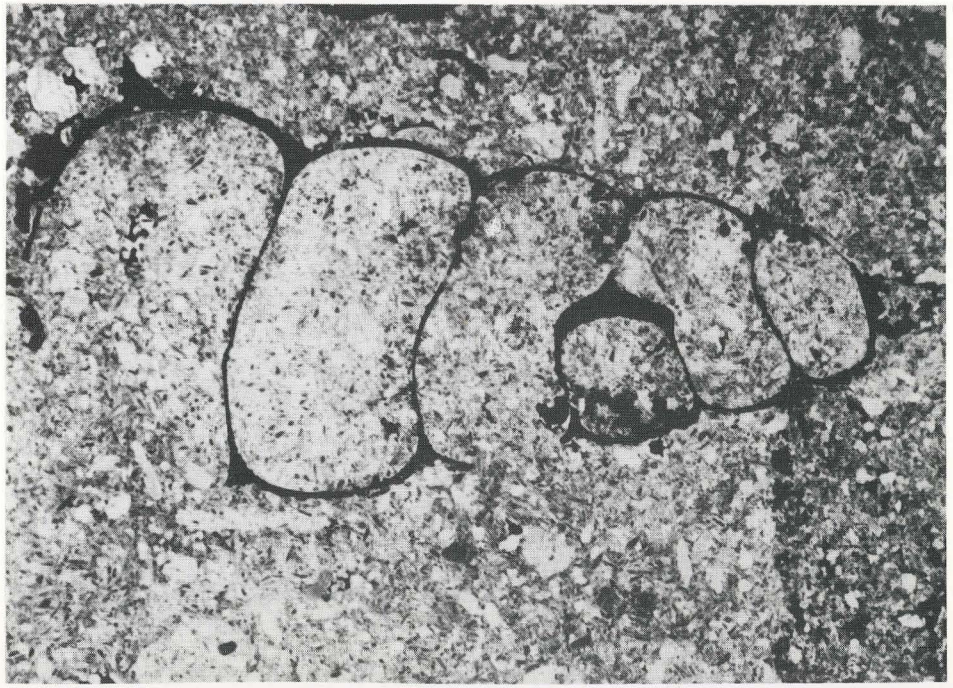


PLATE 7

Fig. 1 Corals in dark foraminiferal wackestone. Lagoonal facies.
Lower Danian, Dv -2/6601.

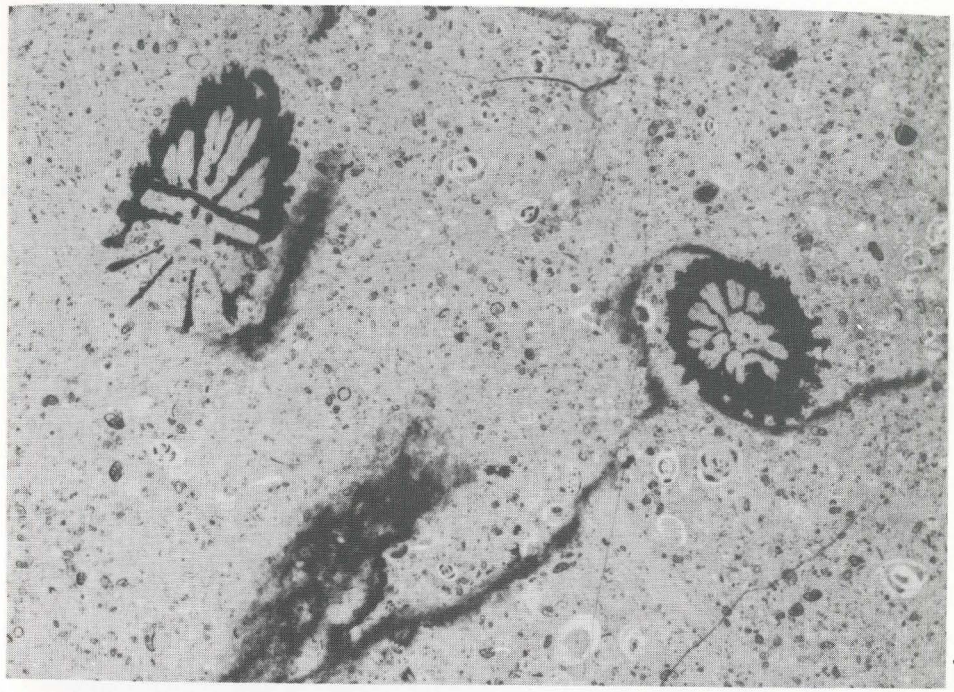
Fig. 2 Poorly washed biointramicritic limestone, Miliolides and »*Pseudochrysalidina*« (A).
Bioerosion of coral skeletons.
Lower Danian, Dv -4-5/6587.

TABLA 7

Sl. 1 Korale v temnem foraminifernem apnencu (wackestone).
Lagunski facies.
Spodnji danij, Dv -2/6601.

Sl. 2 Slabo izpran biointramikritni apnenec. Miliolide in »*Pseudochrysalidina*« (A). Bioerozija koralnih skeletov.
Spodnji danij, Dv -4-5/6587.

All enlarged 10 × in incident light.
Vse povečano 10 × v odbojni svetlobi.



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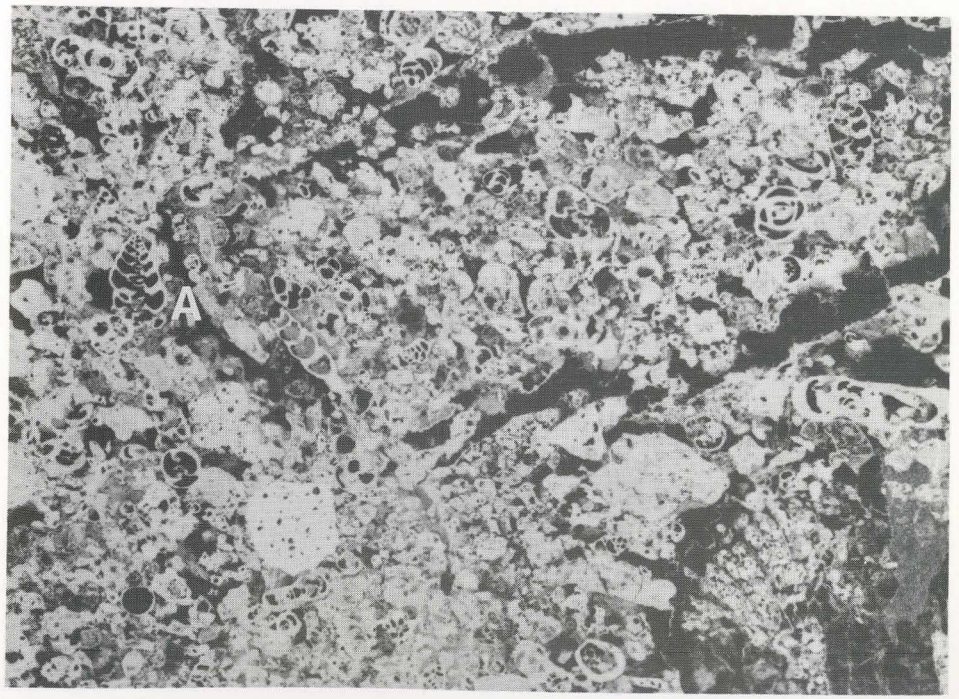

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PLATE 8

Fig. 1 *Microcodium* structure and its calcite prisms in micritic limestone. Supratidal facies. Lower Danian, Dv -4/6594.

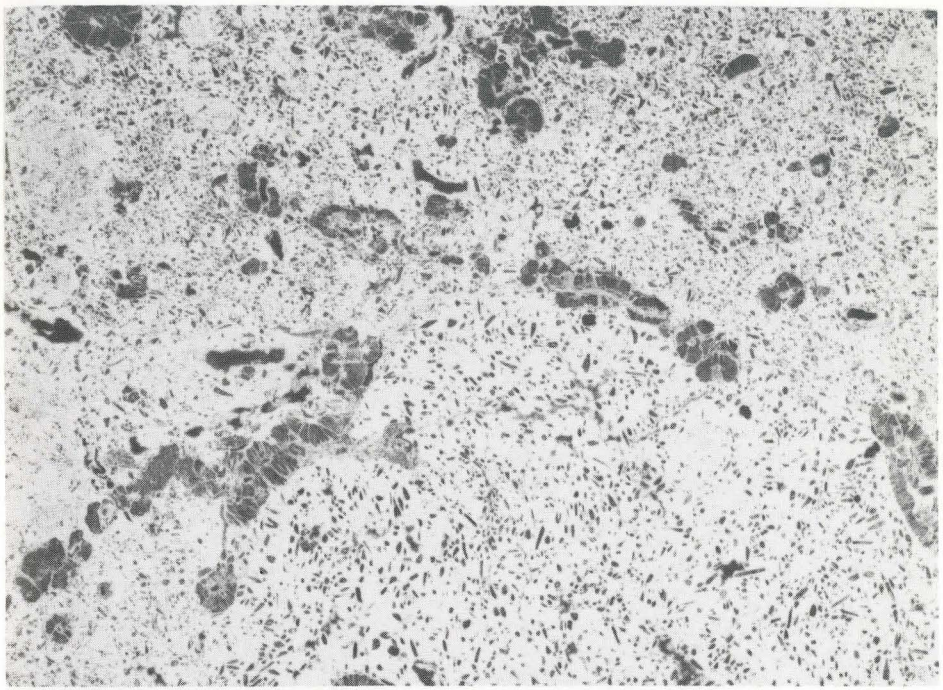
Fig. 2 Micritic limestone with borings. Vugs are filled with *Microcodium* fragments. Intertidal facies.
Lower Danian, Dv -3/6597.

TABLA 8

Sl. 1 Mikrokodij in njegove razsute kalcitne prizme v mikritni osnovi. Nadplimski facies.
Spodnji danij, Dv -4/6594.

Sl. 2 Mikritni apnenec z bioturbacijsko teksturo. Pore so zapolnjene s fragmenti mikrokodijev. Medplimski facies.
Spodnji danij, Dv -3/6597.

All enlarged 10 × in incident light.
Vse povečano 10 × v odbojni svetlobi.



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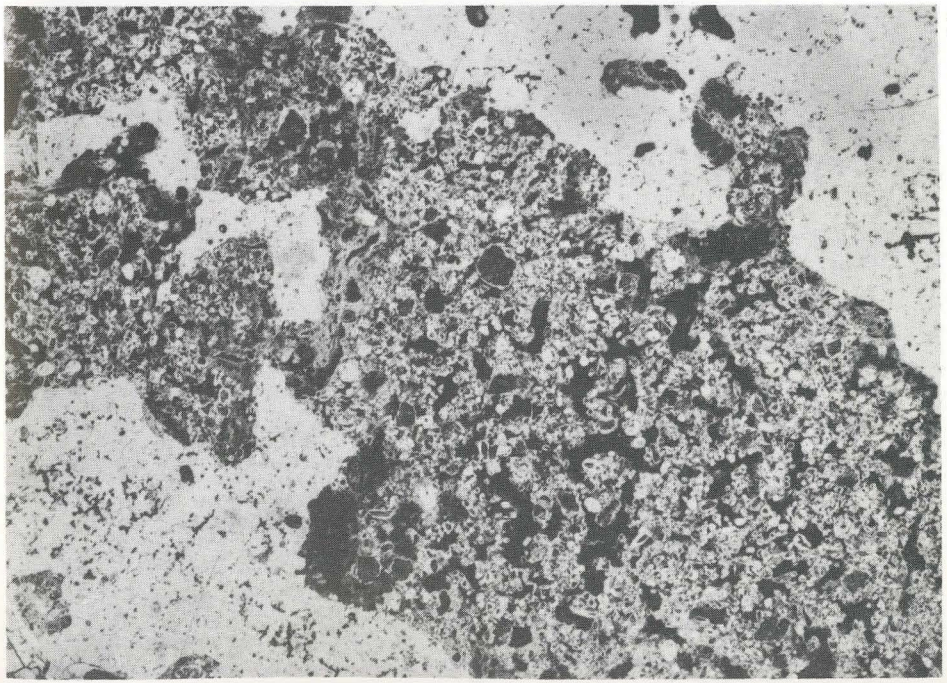

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PLATE 9

Fig. 1–3 *Microcodium* facies.
1. Colony of *Microcodium*. Dv 35/5021.
2. Isolated *Microcodium* structure in micritic fenestral limestone. Dv 35/5021.
3. Calcite prisms of *Microcodium*. Dv 35/5021.
Lower Danian. Intertidal lagoonal facies.

TABLA 9

Sl. 1–3 Facies strukture *Microcodium*.
1. Kolonija mikrokodijev. Dv 35/5021.
2. Izolirana struktura mikrokodija v mikritnem apnencu z izsušitvenimi porami. Dv 35/5021
3. Kalcitne prizme razpadlega mikrokodija. Dv 35/5021. Medplimski lagunski facies. Spodnji danij.

All enlarged 30 × in transparent light.
Vse povečano 30 × v presevni svetlobi.


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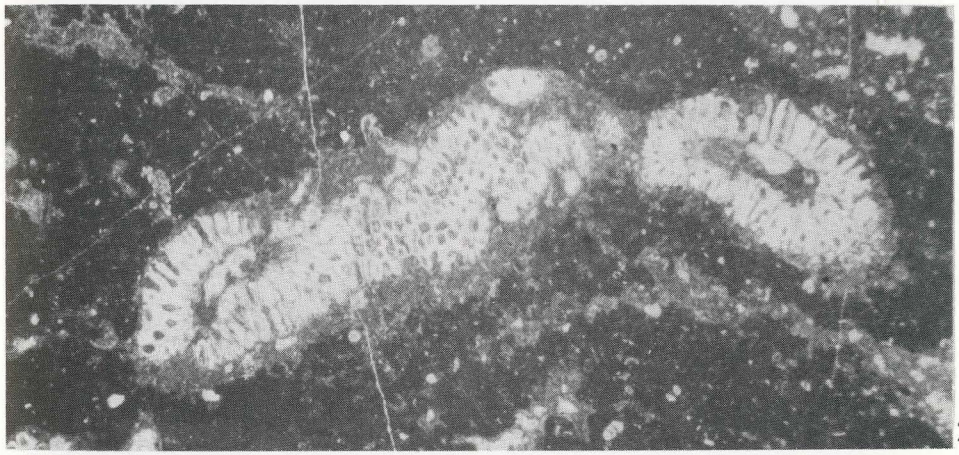
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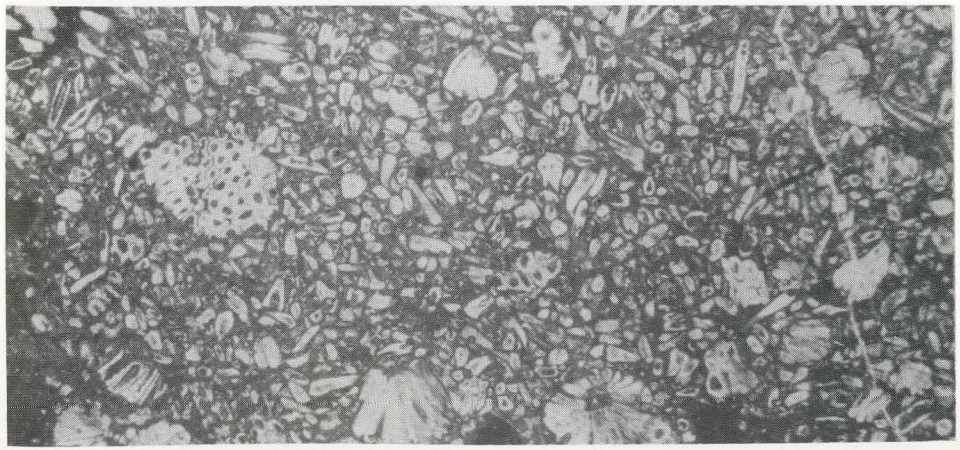
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PLATE 10

Fig. 1 Algal – foraminiferal mudstone with *Microcodium, Clypeina* sp. (A), *Protelphidium* sp. (B). Lagoonal facies.
Lower Danian, Dv -1/6605.

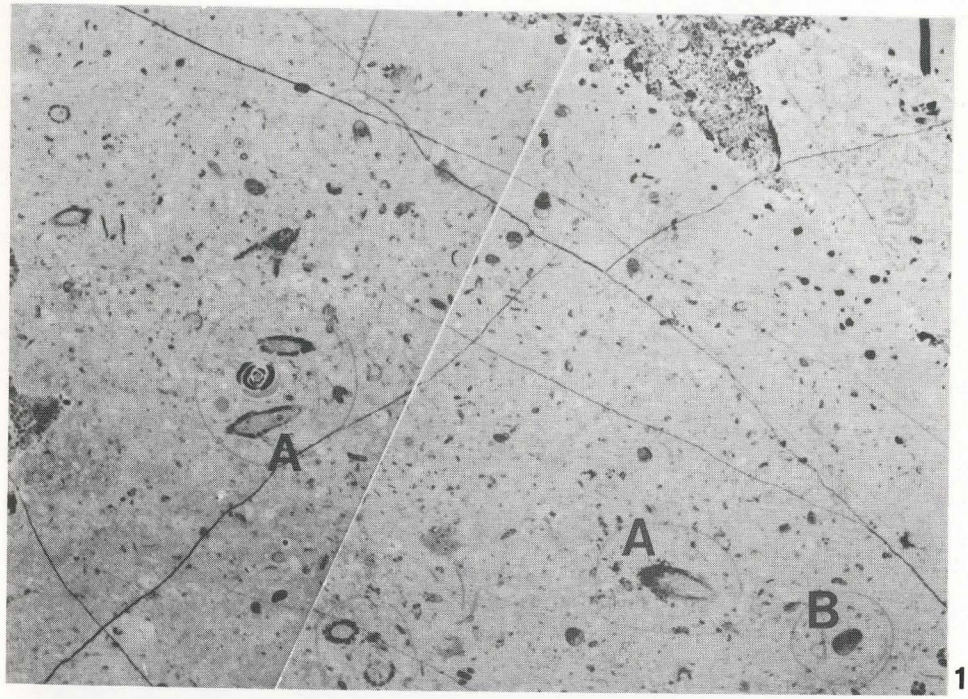
Fig. 2 Fenestral (arrows) bioturbated algal limestone. Microproblematicum sp. (A). Intertidal facies.
Lower Danian, Dv 43/5064.

TABLA 10

Sl. 1 Algalno foraminiferni apnenec, (mudstone) z *Microcodium, Clypeina* sp. (A), *Protelphidium* sp. (B). Lagunski facies.
Spodnji danij, Dv – 1/6605

Sl. 2 Mikritni apnenec z algami (Microproblematicum sp.) (A) in z izsušitvenimi porami (puščice). Bioturbacijska tekstura.
Spodnji danij, Dv 43/5064.

All enlarged 10 × in incident light.
Vse povečano 10 × v odbojni svetlobi.



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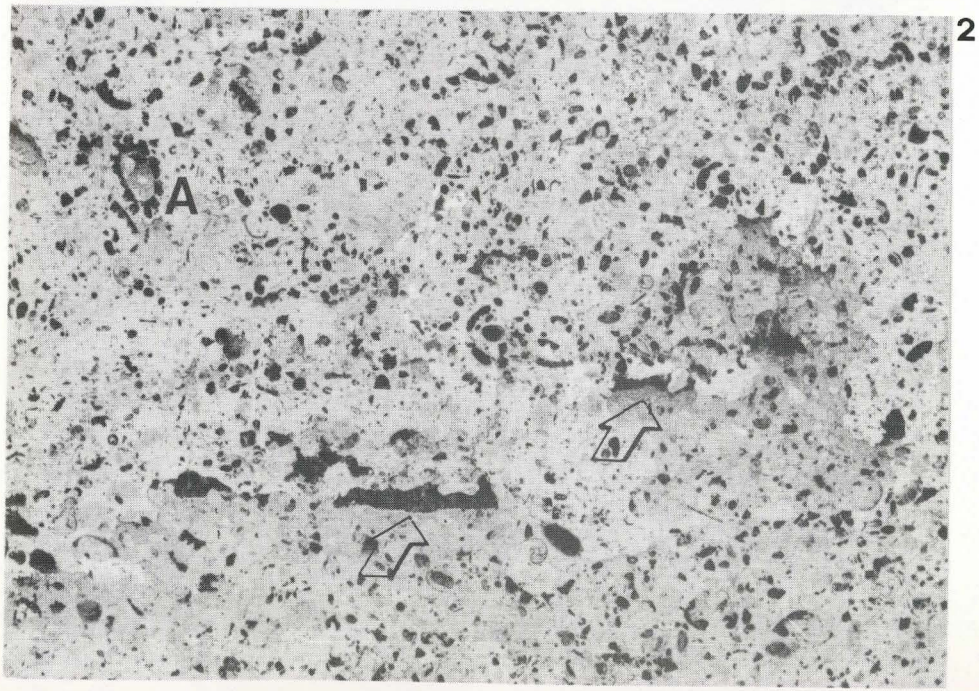

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PLATE 11

Fig. 1 Micritic foraminiferal limestone (*Valvulineria* sp.) (A) in contact with poorly washed miliolidal wackestone.
Lagoonal facies.
Lower Danian, Dv 40/5055.

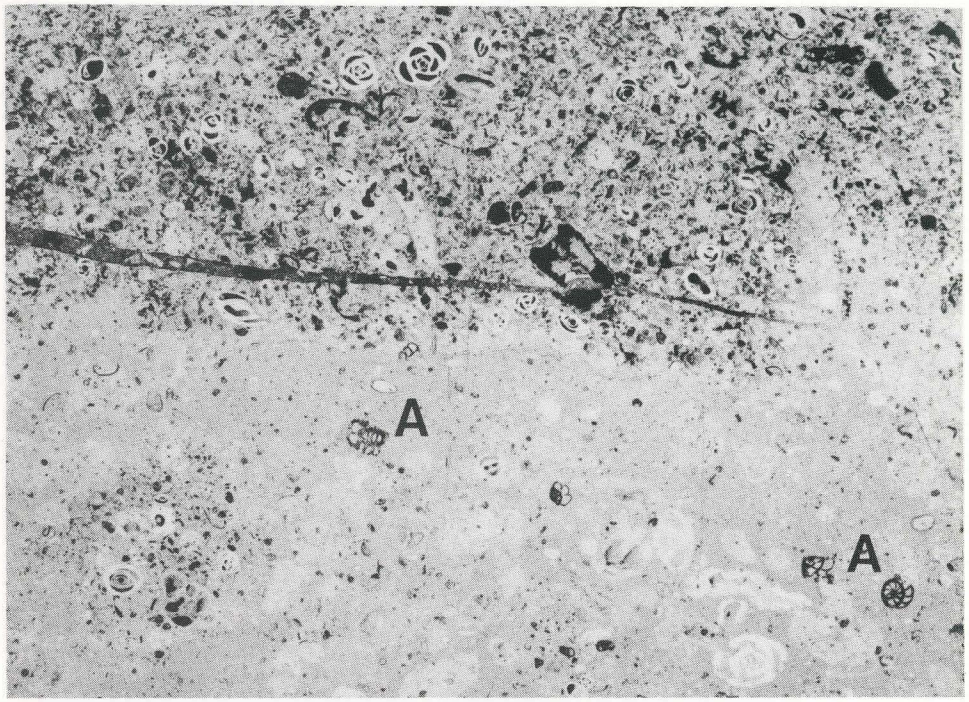
Fig. 2 Bioeroded foraminiferal limestone. Rare gastropods.
Lower Danian, Dv 41/5058.

TABLA 11

Sl. 1 Kontakt foraminifernega mikritnega apnenca (*Valvulineria* sp.) (A) in izpranega miliolidnega apnenca (wackestone).
Lagunski facies.
Spodnji danij, Dv 40/5055.

Sl. 2 Foraminiferni apnenec z znaki bioerozije. Redki polži.
Spodnji danij, Dv 41/5058.

All enlarged 10 × in incident light.
Vse povečano 10 × v odbojni svetlobi.



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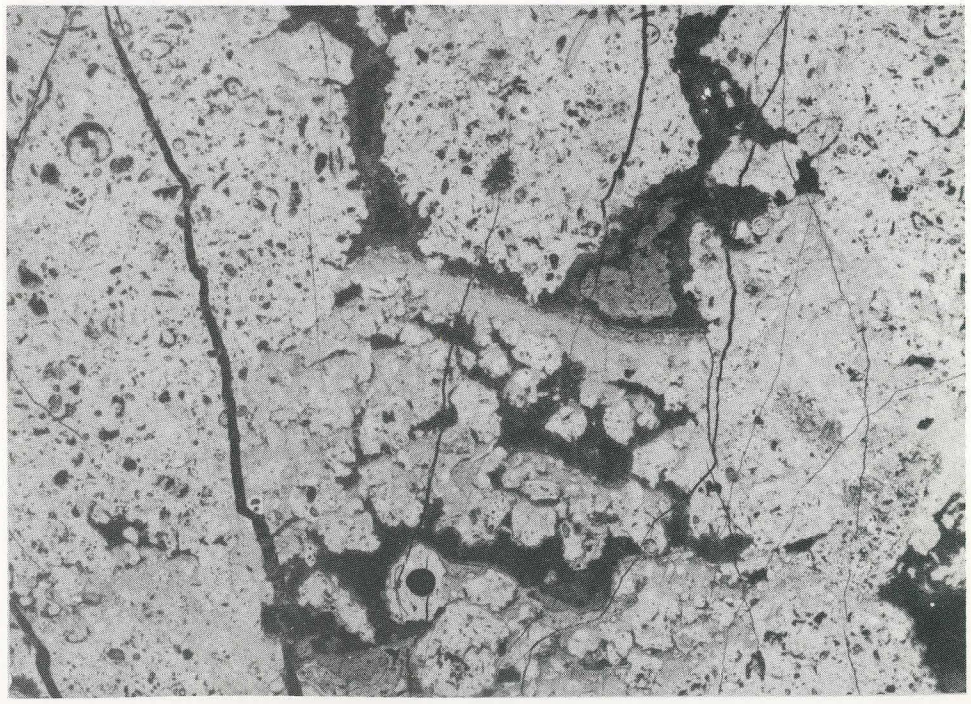

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PLATE 12

Fig. 1 *Microcodium* structure in fenestral micritic limestone.
Intertidal facies.
Lower Danian, Dv 35/5025.

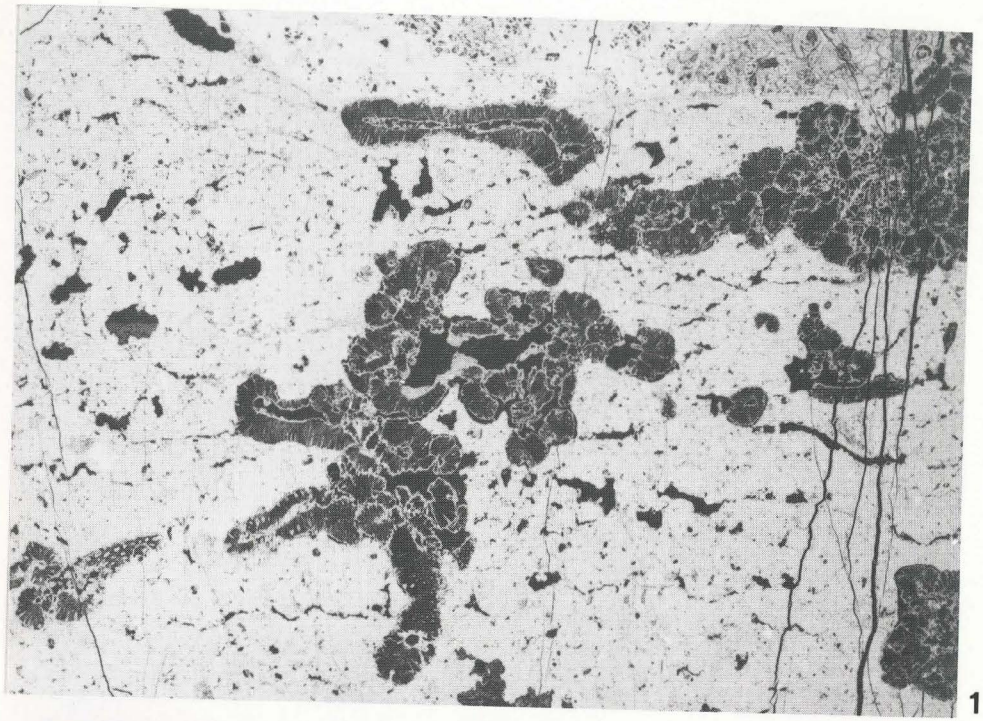
Fig. 2 Poorly washed algal-foraminiferal packstone with intraclasts and recrystalised corals, *Cymopolia* sp. *Dendrophyllia* sp.
Lower Danian, Dv 37/5036.

TABLA 12

Sl. 1 *Microcodium* v mikritnem apnencu z izsušitvenimi porami.
Medplimski facies.
Spodnji danij, Dv 35/5025.

Sl. 2 Delno izpran algno-foraminiferni apnenec (packstone) z intraklasti in rekristaliziranimi koralami, *Cymopolia* sp. *Dendrophyllia* sp.
Spodnji danij, Dv 37/5036.

All enlarged 10 × in incident light.
Vse povečano 10 × v odbojni svetlobi.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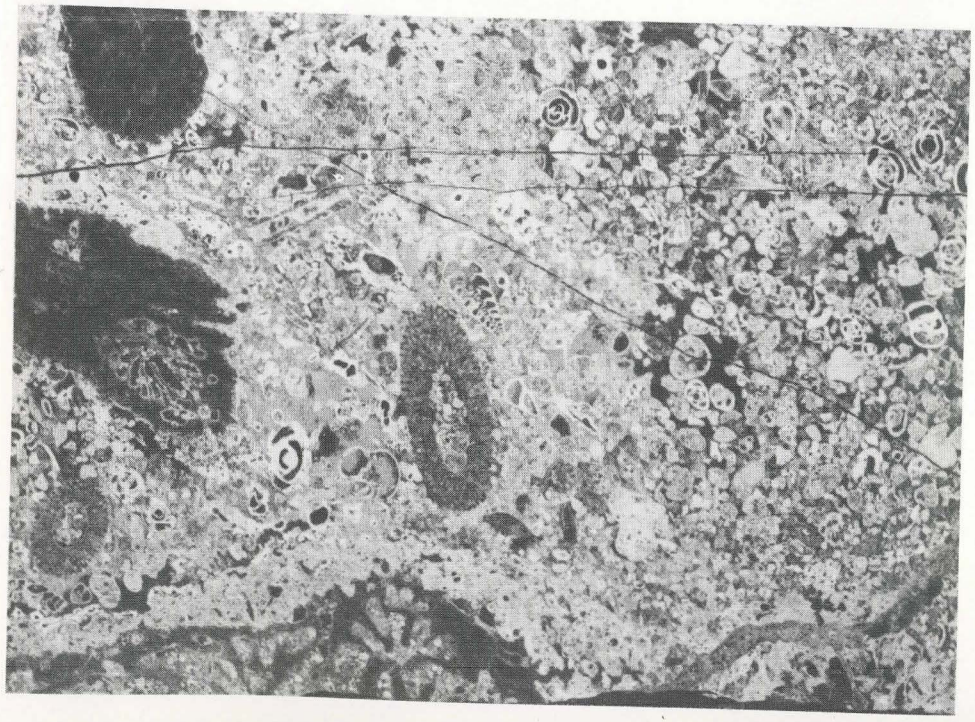
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PLATE 13

Fig. 1 Bioturbated foraminiferal packstone, *Valvulina* (A). Lagoonal facies.
Lower Danian, Dv 4/4645.

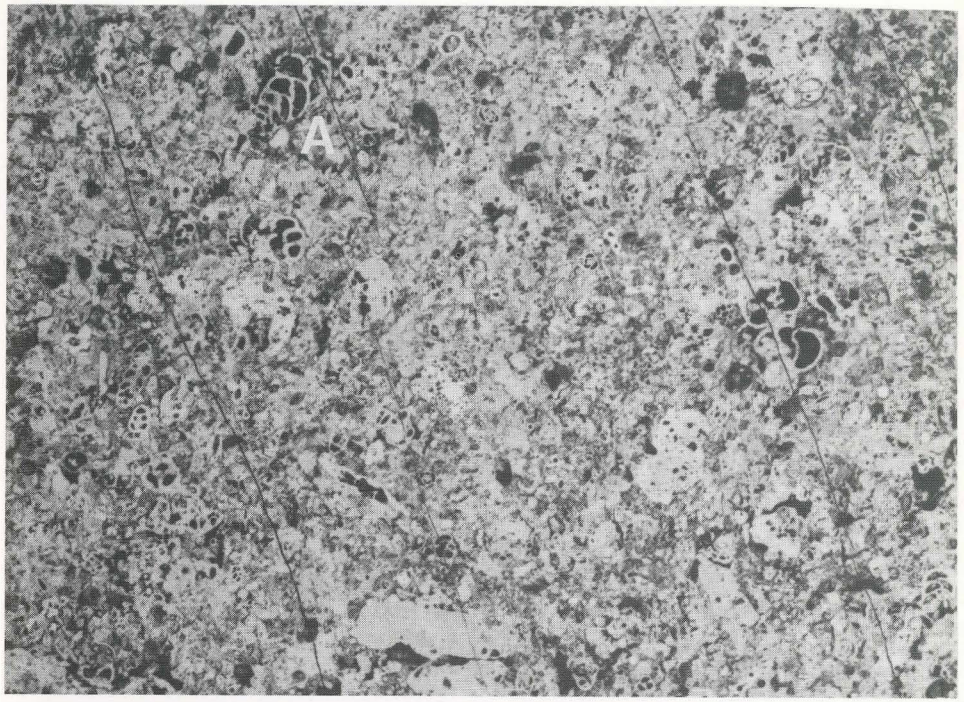
Fig. 2 Washed biointramicritic packstone.
Lower Danian, Dv 2/4639.

TABLA 13

Sl. 1 Foraminiferni apnenec (packstone) z bioturbacijsko teksturo, *Valvulina* (A).
Lagunski facies.
Spodnji danij, Dv 4/4645.

Sl. 2 Izpran biointramikritni apnenec (packstone).
Spodnji danij, Dv 2/4639.

All enlarged 10 × in incident light.
Vse povečano 10 × v odbojni svetlobi.



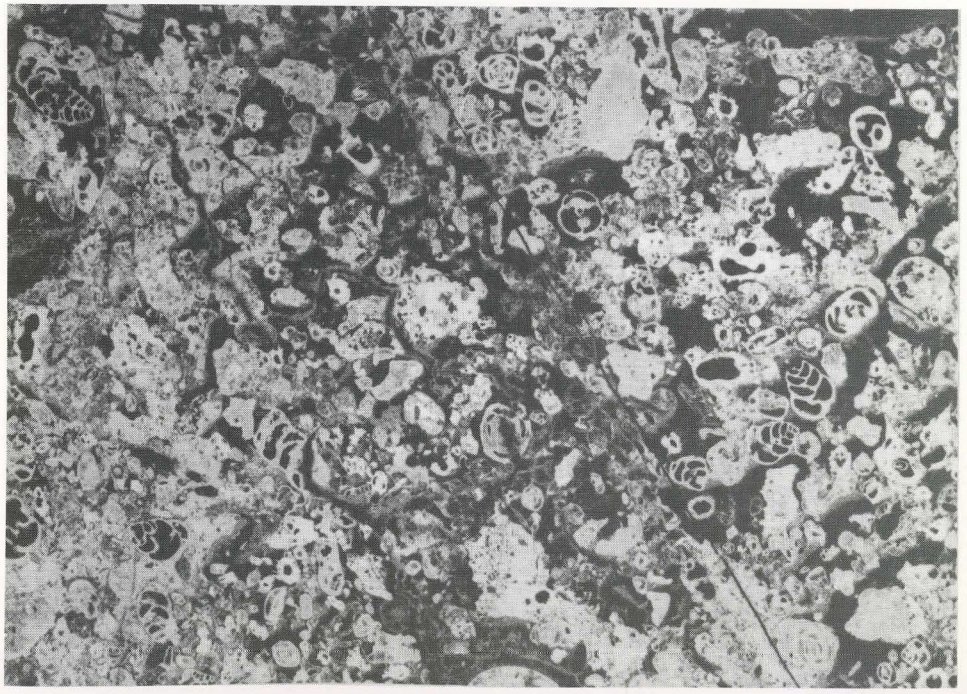


PLATE 14

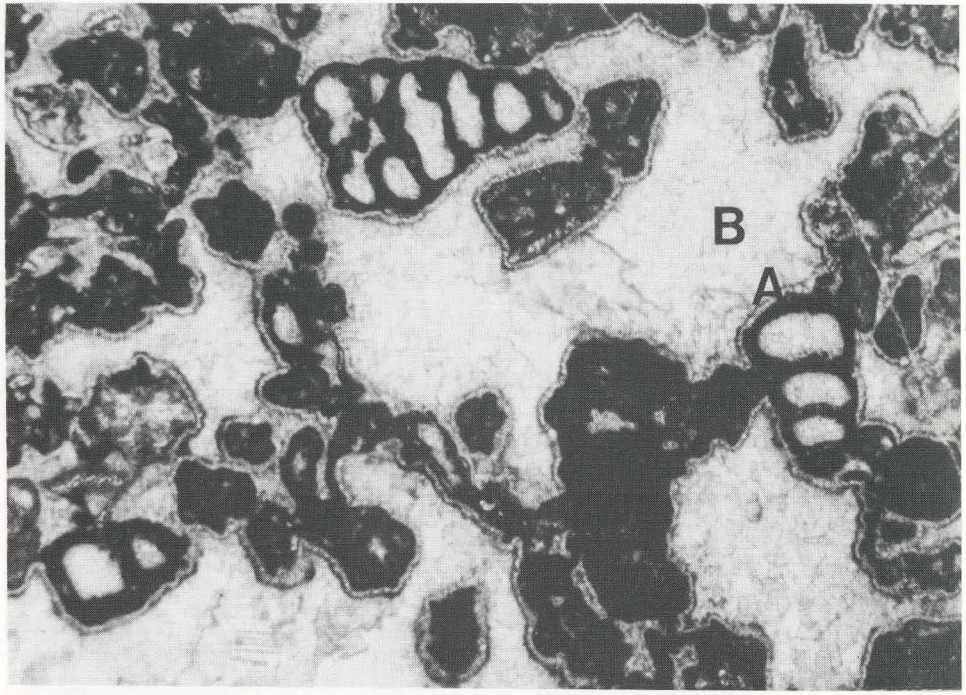
Fig. 1 Detail from fig. 2. Fenestral biointrasparitic limestone. Two generations of calcite cement – rim cement (A) and blocky sparite (B).
Enlarged 30 × in transparent light.

Fig. 2 Foraminiferal-algal intrasparitic grainstone with shrinkage pores (fenestral limestone) *»Scandonea«, Clypeina.* Intertidal facies.
Lower Danian, Dv 3/4641.
Enlarged 10 × incident light.

TABLA 14

Sl. 1 Detajl slike 2. Bioinstrasparitni apnenec z izsušitvenimi porami. Opazni sta dve generaciji kalcitnega cementa – obrobni cement (A) in sparitni cement (B).
Povečano 30 × v presevni svetlobi.

Sl. 2 Foraminiferno-algni intrasparitni apnenec z izsušitvenimi porami (fenestral grainstone) *»Scandonea«, Clypeina.* Medplimski facies.
Spodnji danij, Dv 3/4641.
Povečano 10 × v odbojni svetlobi.



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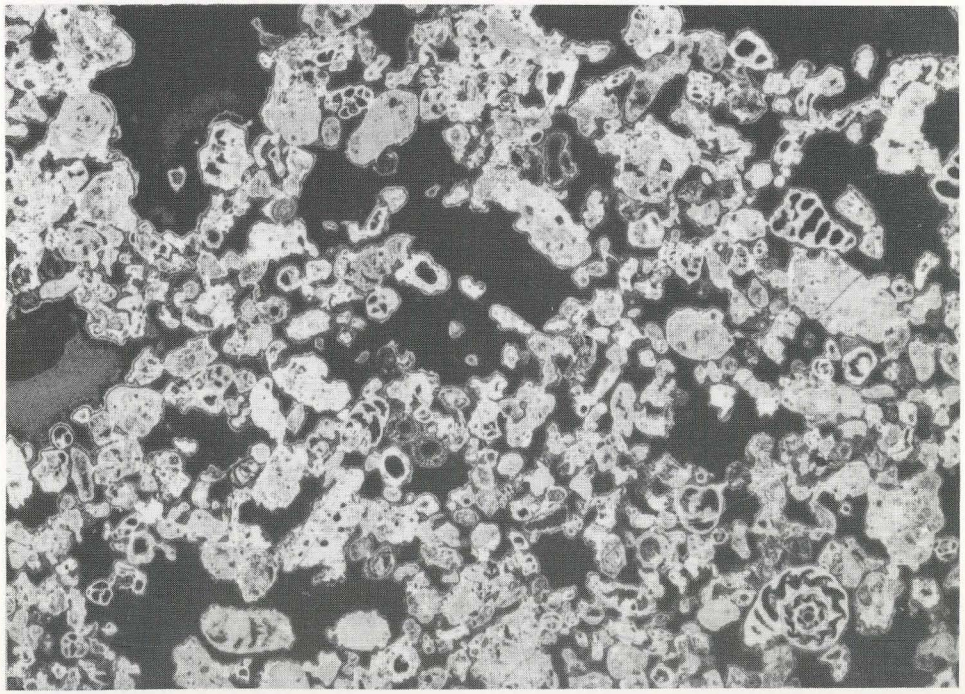

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PLATE 15

Fig. 1 Algal limestone (*Cymopolia* sp.) with shrinkage pores and some plasticlasts. Intertidal facies.
Lower Danian, Dv 35/5012.

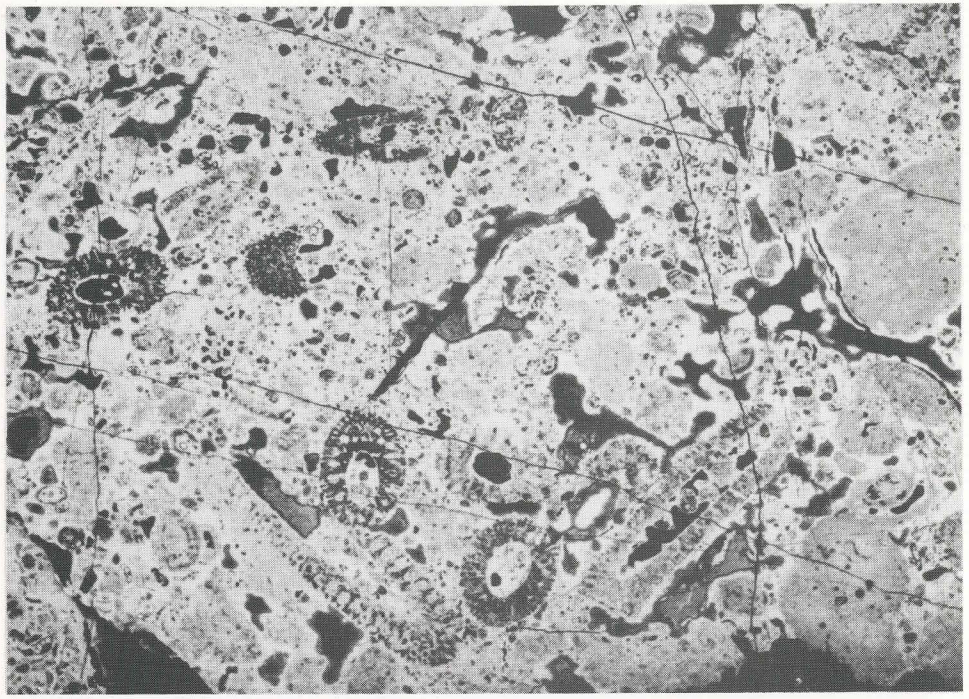
Fig. 2 Fenestral limestone with coral colony and oyster skeleton. *Rhizangia* sp. Intertidal lagoonal facies.
Lower Danian, Dv 9/4654.

TABLA 15

Sl. 1 Algni apnenec z izsušitvenimi porami in plastiklasti.
Alga pripada rodu *Cymopolia* sp. Medplimski facies.
Spodnji danij, Dv 33/5012.

Sl. 2 Kolonija koral in školjčna lupina v apnencu z izsušitvenimi porami. *Rhizangia* sp.
Medplimski lagunski facies.
Spodnji danij, Dv 9/4654.

All enlarged 10 × in incident light.
Vse povečano 10 × v odbojni svetlobi.


1


2

PLATE 16

Fig. 1 Bioturbated algal – foraminiferal packstone. *Cymopolia* (A), *Valvulineria* (B). Lagoonal facies.
Lower Danian, Dv 13/4664.

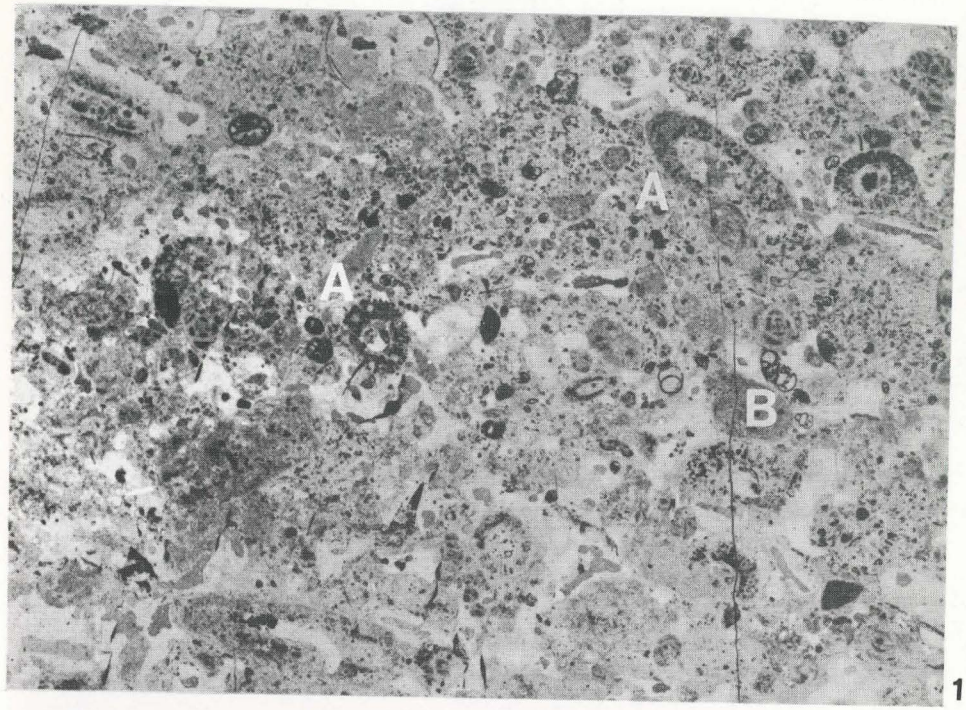
Fig. 2 Fenestral (arrows) biomicritic limestone. Intertidal facies.
Lower Danian, Dv 12/4660.

TABLA 16

Sl. 1 Algno-foraminiferni apnenec (packstone) z bioturbacijsko teksturo. *Cymopolia* (A), *Valvulineria* (B). Lagunski facies.
Spodnji danij, Dv 13/4662.

Sl. 2 Biomikritni apnenec z izsušitvenimi porami (puščice). Medplimski facies.
Spodnji danij, Dv 12/4660.

All enlarged 10 × in incident light.
Vse povečano 10 × v odbojni svetlobi.



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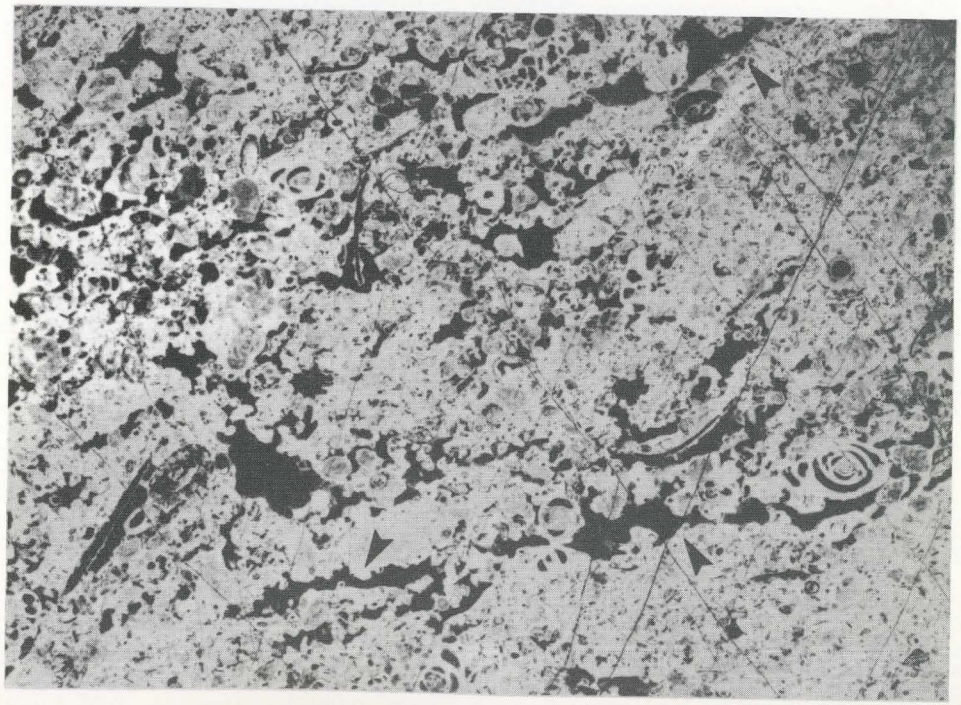


2

PLATE 17

Fig. 1 Corals and gastropods in poorly washed miliolidal limestone. *Dendrophyllia*. Open shelf facies.
Upper Danian, Dv 16/4668.

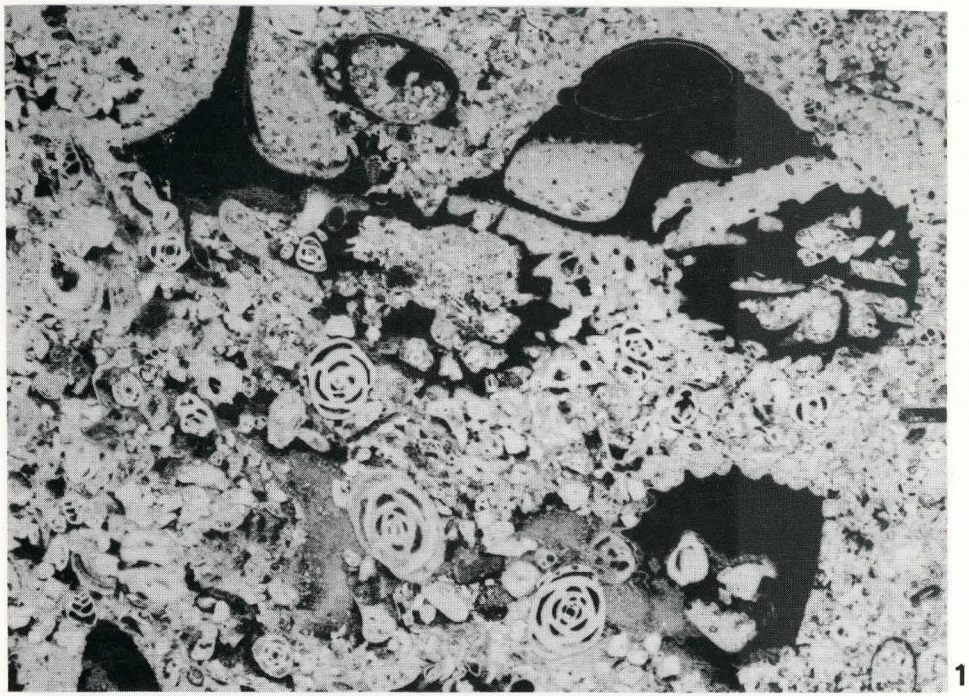
Fig. 2 Biointramicritic limestone. Bioerosion of intraclasts is evident (arrow).
Lower Danian, Dv 15/4666.

TABLA 17

Sl. 1 Koraliti in skeleti polžev v slabo izpranem miliolidnem apnencu. *Dendrophyllia*.
Facies odprtega šelfa.
Zgornji danij, Dv 16/4668.

Sl. 2 Biointramikritni apnenec. Opazna je bioerozija intraklastov (puščica).
Spodnji danij, Dv 15/4666.

All enlarged 10 × in incident light.
Vse povečano 10 × v odbojni svetlobi.



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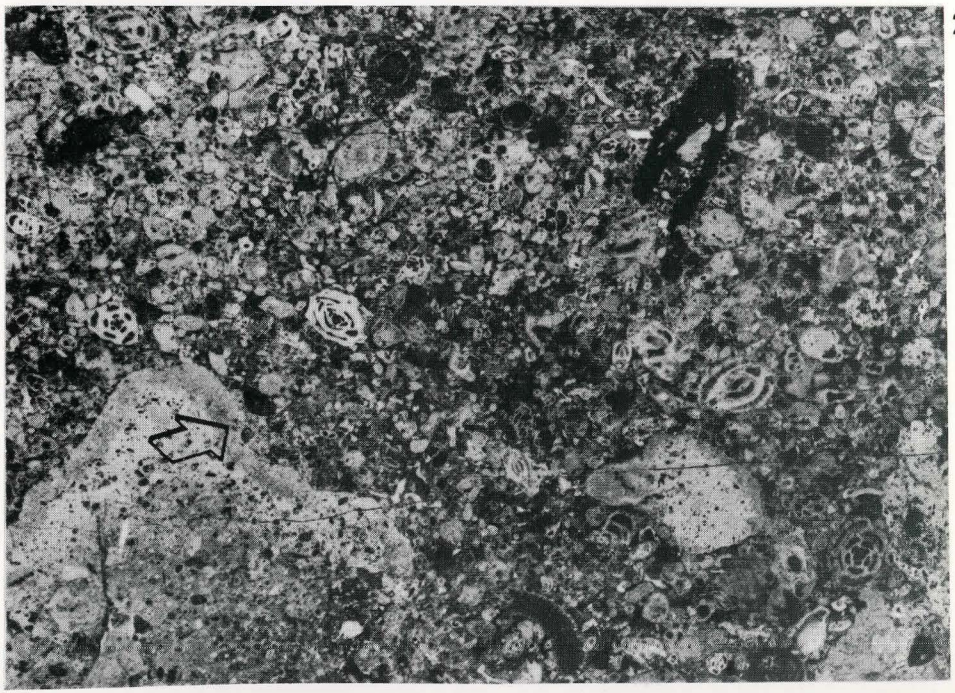


2

PLATE 18

Fig. 1 Algae, corals and larger benthic foraminifera *(Idalina)* in intrasparitic grainstone. Open shelf facies.
Upper Danian, Dv 31/4993.

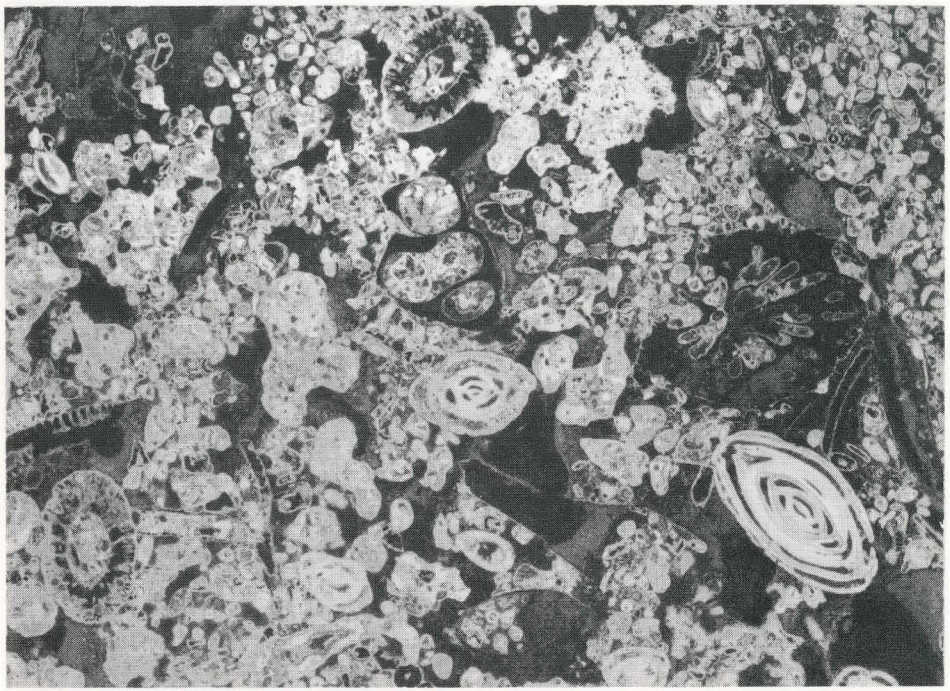
Fig. 2 Biointrasparitic algal packstone-grainstone. Shelter porosity below oyster shell.
Upper Danian, Dv 31/4994.

TABLA 18

Sl. 1 Intrasparitni apnenec (grainstone) z algami, koralami in velikimi bentičnimi foraminiferami (*Idalina* sp.). Facies odprtega šelfa.
Zgornji danij, Dv 31/4993.

Sl. 2 Biointrasparitni algalni apnenec (packstone-grainstone). Dežnikasta poroznost pod školjčno lupino.
Zgornji danij, Dv 31/4994.

All enlarged 10 × in incident light.
Vse povečano 10 × v odbojni svetlobi.



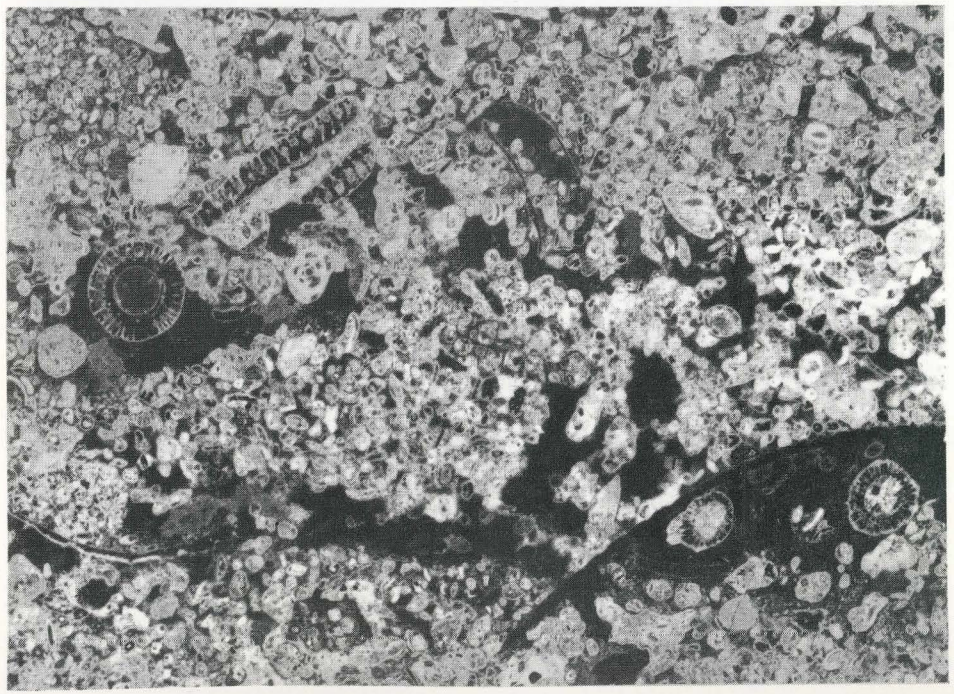


PLATE 19

Fig. 1 Corals in foraminiferal micritic limestone (boundstone), *(Dendrophyllia candelabrum)*. Coral-algal patch reef facies.
Upper Danian, Dv 21/4680.

Fig. 2 Bioerosion of corals in washed biointramicritic packstone, *(Goniopora elegans* (A), *Dendrophyllia candelabrum)* (B).
Upper Danian, Dv 18/4673.

TABLA 19

Sl. 1 Korale v foraminifernem mikritnem apnencu. *(Dendrophyllia candelabrum)*. Koralno-algni grebenski facies.
Zgornji danij, Dv 21/4680.

Sl. 2 Bioerozija koralnih skeletov v izpranem biointramikritnem apnencu, *(Goniopora elegans* (A) *Dendrophyllia candelabrum)* (B).
Zgornji danij, Dv 18/4673.

All enlarged 10 × in incident light.
Vse povečano 10 × v odbojni svetlobi.

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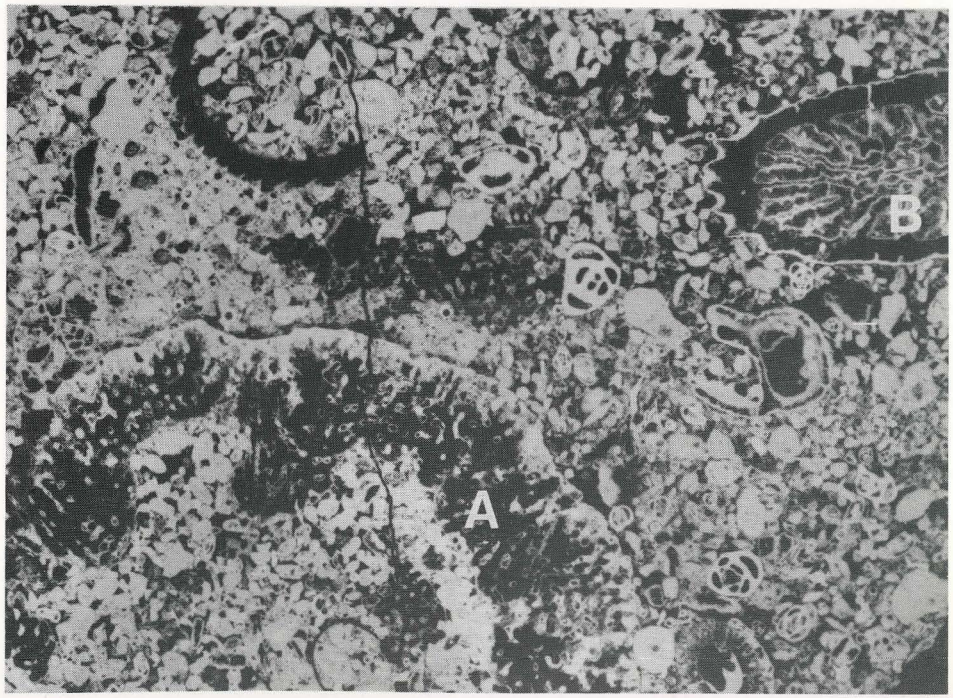


2

PLATE 20

Fig. 1 *Archaelithothamnium* algae in symbiosis with corals, *(Actinacis cognata)*. Coral-algal patch reef facies.
Upper Danian, Dv 23/4684.

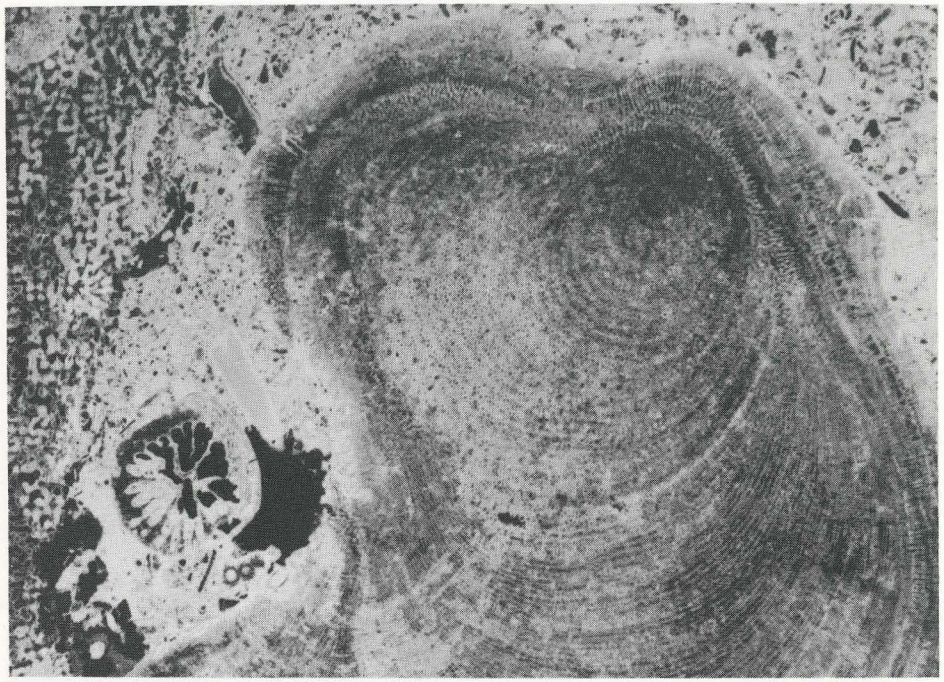
Fig. 2 Bioturbated coralinacean algal limestone in contact with coral-biolithite *(Dendrophyllia candelabrum)*.
Upper Danian, Dv 21/4681.

TABLA 20

Sl. 1 Litotamnijska alga v simbiozi s koralami *(Actinacis cognata)*. Grebenski facies.
Zgornji danij, Dv 23/4684.

Sl. 2 Kontakt algnega apnenca z bioturbacijsko teksturo in koralnega biolitita *(Dendrophyllia candelabrum)*.
Zgornji danij, Dv 21/4681.

All enlarged 10 × in incident light.
Vse povečano 10 × v odbojni svetlobi.



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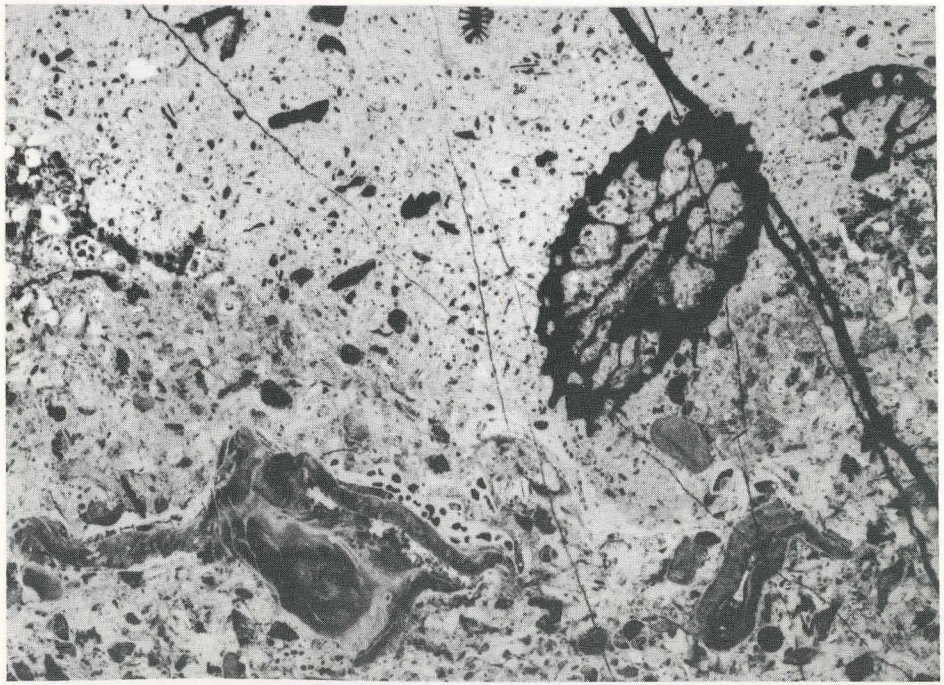


2

PLATE 21

Fig. 1 Well sorted foraminiferal-algal grainstone (biocalcarenite), *Rotalia* sp. div., *Discocyclina seunesi* (arrow). Open shelf facies.
Thanetian, Dv 26/4690.

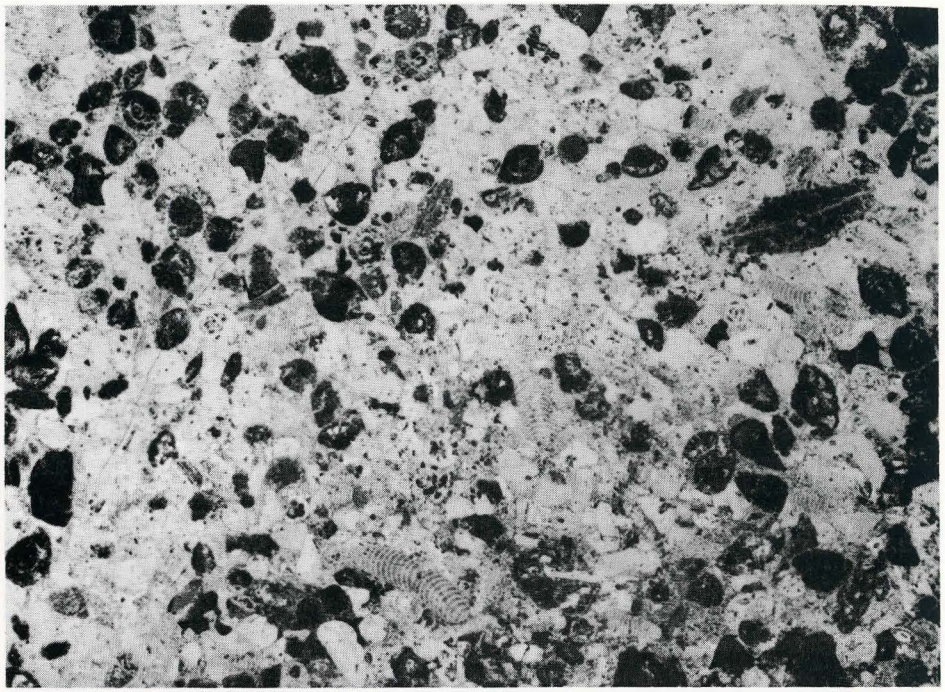
Fig. 2 Bioerosion of coralline skeletons and infilling of voids by intraclasts. *(Actinacis cognata).*
Upper Danian, Dv 23/4685.

TABLA 21

Sl. 1 Dobro sortiran foraminiferno-algni biokalkarenit z *Discocyclina seunesi* (puščica), *Rotalia* sp. div.
Thanetij, Dv 26/4690.

Sl. 2 Bioerozija koralnih skeletov *Actinacis cognata* in zapolnitev medprostorov z intraklasti.
Zgornji danij, Dv 23/4685.

All enlarged 10 × in incident light.
Vse povečano 10 × v odbojni svetlobi.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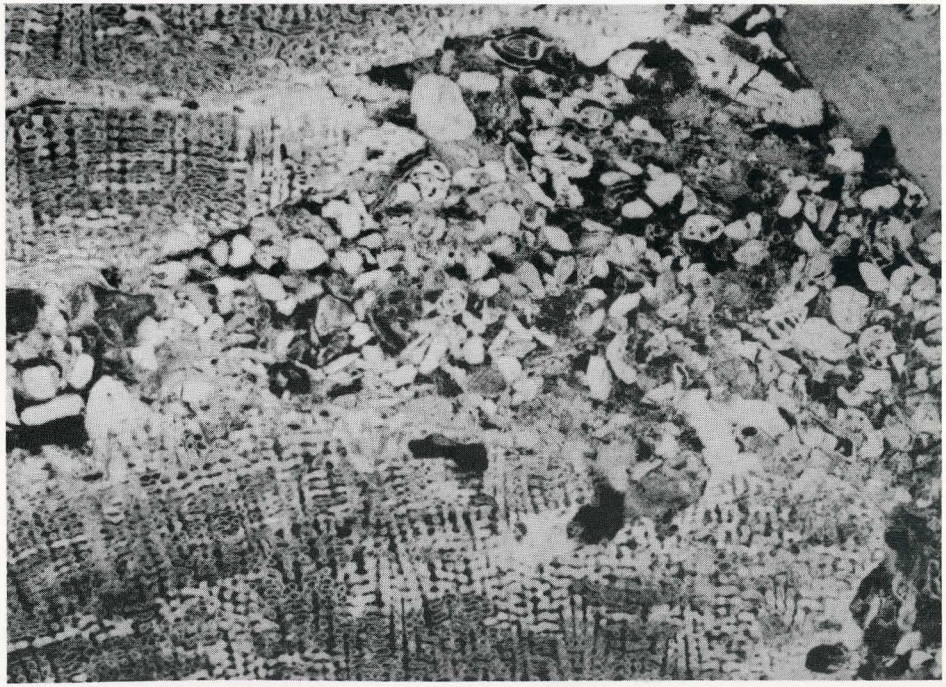

2

PLATE 22

Fig. 1 Foraminiferal micritic packstone, *Idalina sinjarica*, (A). *Cribrobulimina carniolica* (B), n. genus (C), *Miscellanea* sp. 2 (D).
Thanetian, Dv 30/4698.

Fig. 2 Fragments of coralinacean red algae in micritic matrix.
Open shelf facies.
Thanetian, Dv 29 d.

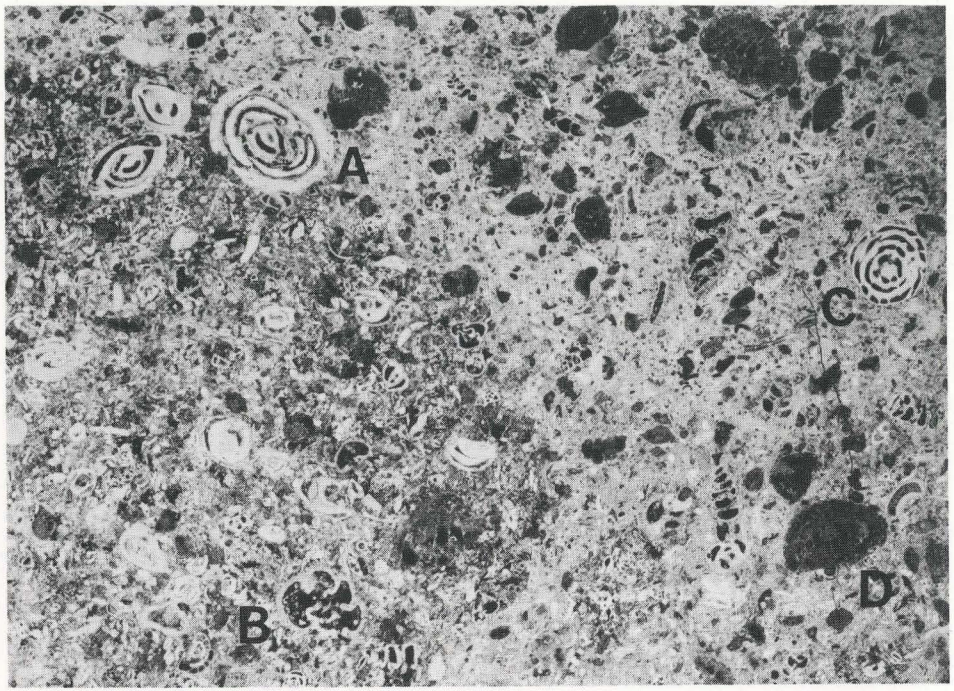
TABLA 22

Sl. 1 Foraminiferni mikritni apnenec (packstone) *Idalina sinjarica* (A), *Cribrobulimina carniolica* (B), n. genus (C), *Miscellanea* sp. 2 (D).
Thanetij, Dv 30/4698.

Sl. 2 Odlomki litotamnijskih alg v mikritni osnovi. Facies odprtega šelfa.
Thanetij, Dv 29 d.

All enlarged 10 × in incident light.
Vse povečano 10 × v odbojni svetlobi.

Miscellanea sp. 2 = *M. juliettae villattea* Leppig 1988



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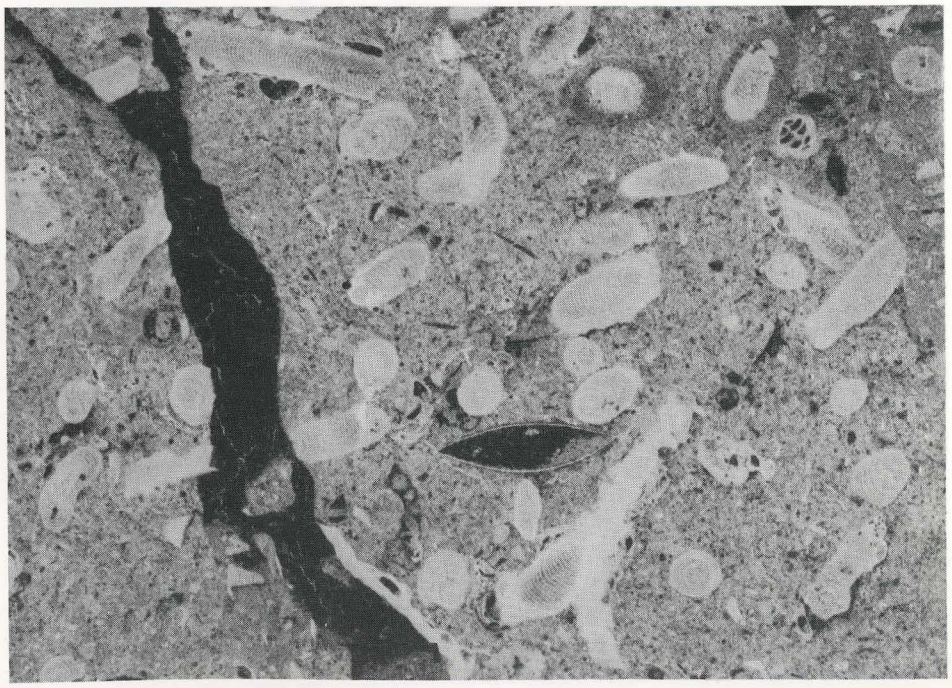


2

PLATE 23

Fig. 1 Foraminiferal micritic wackestone with *Coskinon rajkae* (E) and *Miscellanea* sp. 2 (fB) (D). Open shelf facies.
Thanetian, Dv 30/4701.

Fig. 2 Foraminiferal micritic limestone with numerous *Miscellanea* sp. 2 (fA and fB) (D).
Thanetian, Dv 30/4701.

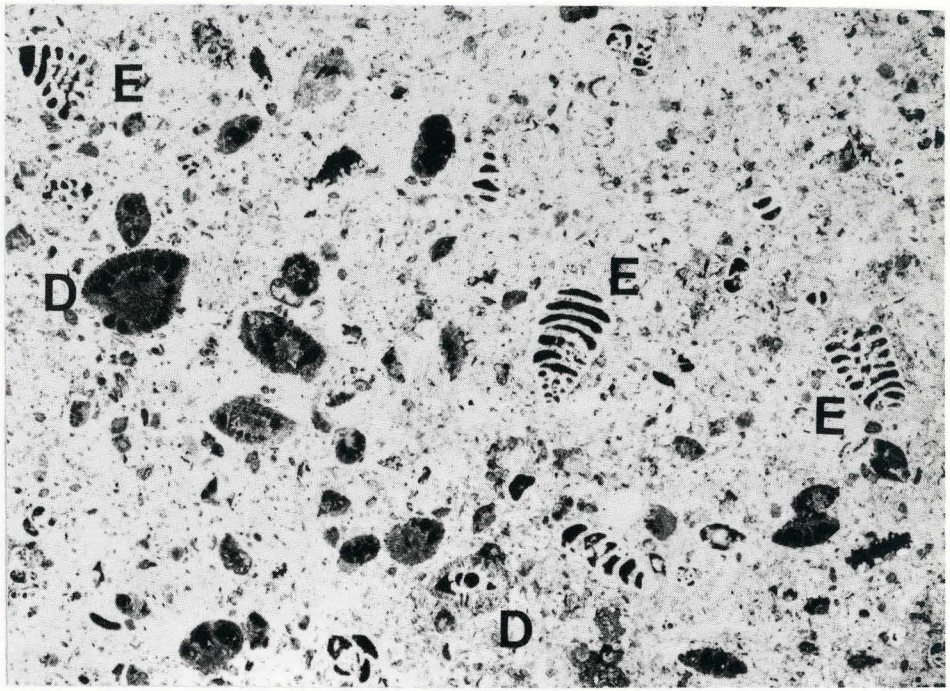
TABLA 23

Sl. 1 Mikritni foraminiferni apnenec z vrsto *Coskinon rajkae* (E) ter *Miscellanea* sp. 2. (fB) (D). Facies odprtega šelfa.
Thanetij, Dv 30/4701.

Sl. 2 Foraminiferni mikritni apnenec s številnimi foraminiferami Miscellanea sp. 2 (oblika A in oblika B) (D).
Thanetij, Dv 30/4701.

All enlarged 10 × in incident light.
Vse povečano 10 × v odbojni svetlobi.

Miscellanea sp. 2 = *M. juliettae villattea* Leppig 1988



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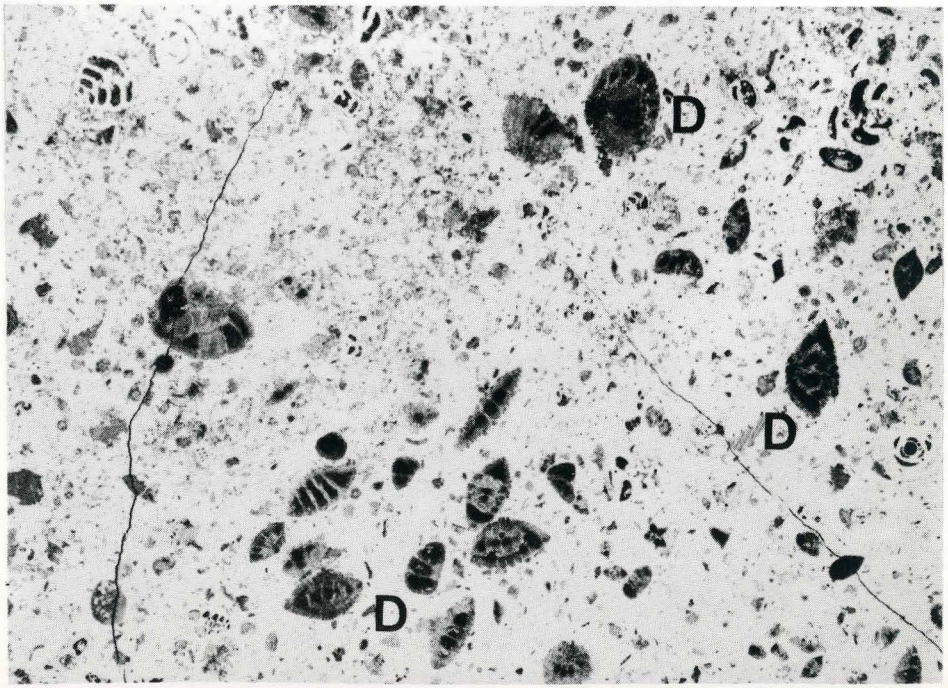


2

PLATE 24

Section of Dolenja vas. Age: Upper Maastrichtian.

Fig. 1 *Bigenerina* sp., Dv 46/5074, 30 ×.
Fig. 2–4 *Dargenioella* sp., 30 ×.
2. Dv –5/6578.
3. DV 45/2-5069.
4. DV 47/5079 b.
Fig. 5 *Ophthalmidium* sp., 46/5077, 80 ×.
Fig. 6 *Triloculina* sp. below, *Moncharmontia* apenninica. (De Castro) abow, Dv 46/5074, 80 ×.
Fig. 7 *M. apenninica* (De Castro), Dv 47/5079 b, 80 ×.
Fig. 8–10 *Rhapydionina liburnica* (Stache), 30 ×.
8. longitudinal section, Dv -5/6574.
9. oblique section, Dv -5/6577.
10. oblique section, Dv -5/6577.
Fig. 11 *Rhapydionina* sp., Dv -5/6582, 30 ×.
Fig. 12 *Dicyclina schlumbergeri* Munier-Chalmas, Dv -5/6577, 30 ×.
All in transparent light.

TABLA 24

Profil Dolenja vas. Starost: Zgornji maastrichtij.

Sl. 1 *Bigenerina* sp., Dv 46/5074, 30 ×.
Sl. 2–4 *Dargenioella* sp. 30 ×.
2. Dv -5/6578.
3. DV 45/2-5069.
4. Dv 47/5079 b.
Sl. 5 *Ophthalmidium* sp., Dv 46/5077 80 ×.
Sl. 6 *Triloculina* sp., spodaj, *Moncharmontia apenninica* (De Castro) zgoraj, Dv 46/5074, 80 ×.
Sl. 7 *M. apenninica* (De Castro), Dv 47/5079 b, 80 ×.
Sl. 8–10 *Rhapydionina liburnica* (Stache), 30 ×.
8. vzdolžni prerez, Dv -5/6574.
9. poševni prerez, Dv -5/6577.
10. poševni prerez, Dv -5/6577.
Sl. 11 *Rhapydionina* sp., Dv -5/6582 30 ×.
Sl. 12 *Dicyclina schlumbergeri* Munier-Chalmas,Dv -5/6577 30 ×.
Vse v presevni svetlobi.

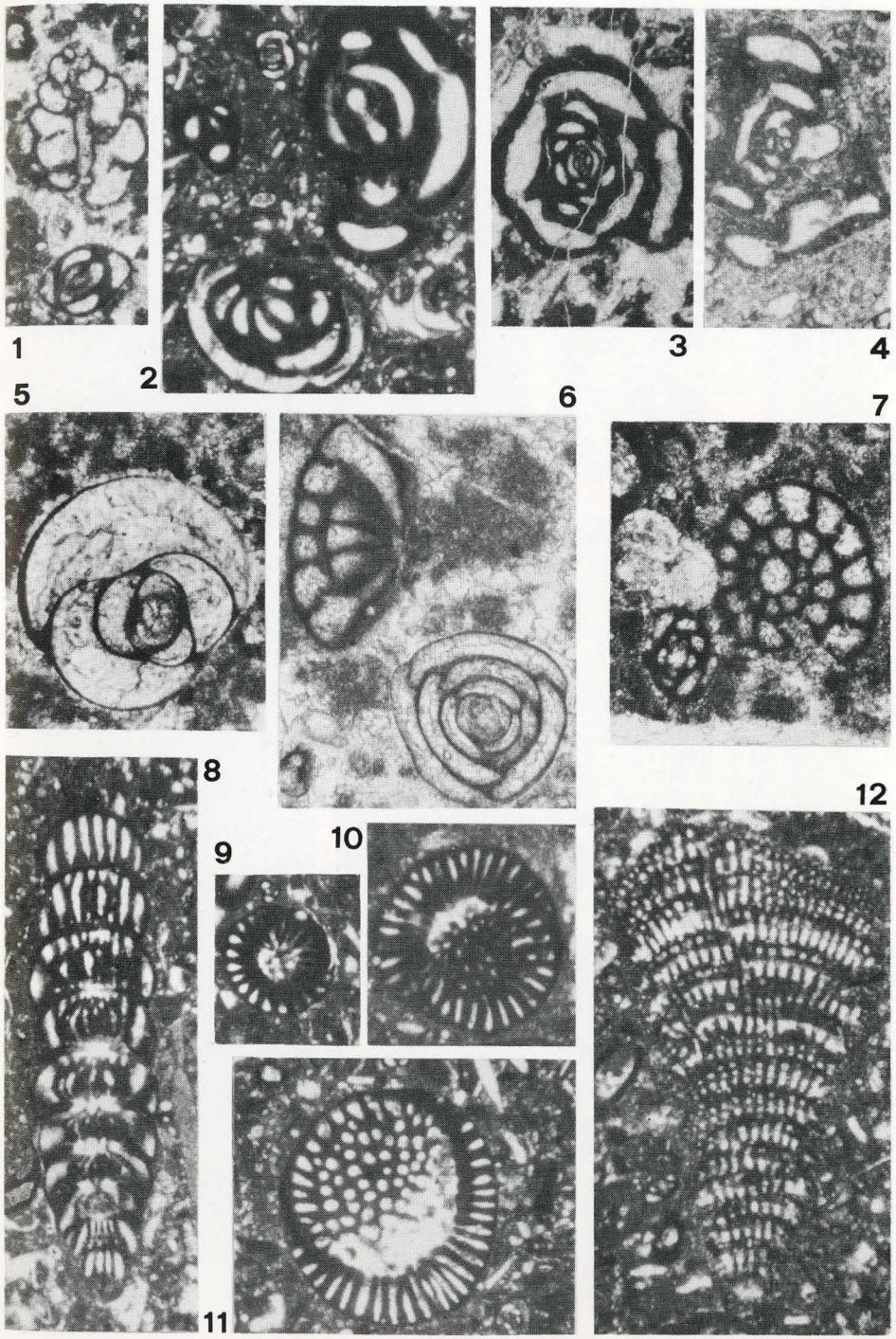


PLATE 25

Section Dolenja vas. Age: Danian – Lower and Upper (Montian).

Fig. 1–2 *Bolkarina* sp., 30 ×.
1. Dv 5/6964.
2. Dv -5/4647.

Fig. 3 *Periloculina* cf. *slovenica* Drobne, Dv 37/5036, 30 ×.

Fig. 4–5 New genus, miliolid-alveolinid type, 30 ×.
4. Dv 37/5038.
5. Dv 37/5038.

Fig. 6 »*Pseudochrysalidina*« sp., Dv 4-5/6587 30 ×.

Fig. 7 »*Scandonea*« sp., Dv 3/4641 30 ×.

Fig. 8–11 *Protelphidium* sp., 80 ×.
8. Dv 44/5067.
9. Dv 44/4-7574.
10. Dv 44/8-6622.
11. Dv-4-5/6597.

Fig. 12 Rotaliids foraminifers, Dv 44/2-6570, 80 ×.
All in transparent light.

TABLA 25

Profil Dolenja vas. Starost: Danij – spodnji in zgornji (montij).

Sl. 1–2 *Bolkarina* sp., 30 ×.
1. Dv 5/6948.
2. Dv 5/4647.

Sl. 3 *Periloculina* cf. *slovenica* Drobne, Dv 37/5036, 30 ×.

Sl. 4–5 Nov rod miliolidno-alveolinidnega tipa, 30 ×.
4. Dv 37/5038.
5. Dv 37/5038.

Sl. 6 »*Pseudochrysalidina*« sp., Dv 4-5/6587, 30 ×.

Sl. 7 »*Scandonea*« sp., Dv 3/4641, 30 ×.

Sl. 8–11 *Protelphidium* sp., 80 ×.
8. Dv 44/5067.
9. Dv 44/4-7574.
10. Dv 44/8-6622.
11. DV 4–5/6597.

Sl. 12 Rotaliidne foraminifere, Dv 44/2-6570, 80 ×.
Vse v presevni svetlobi.

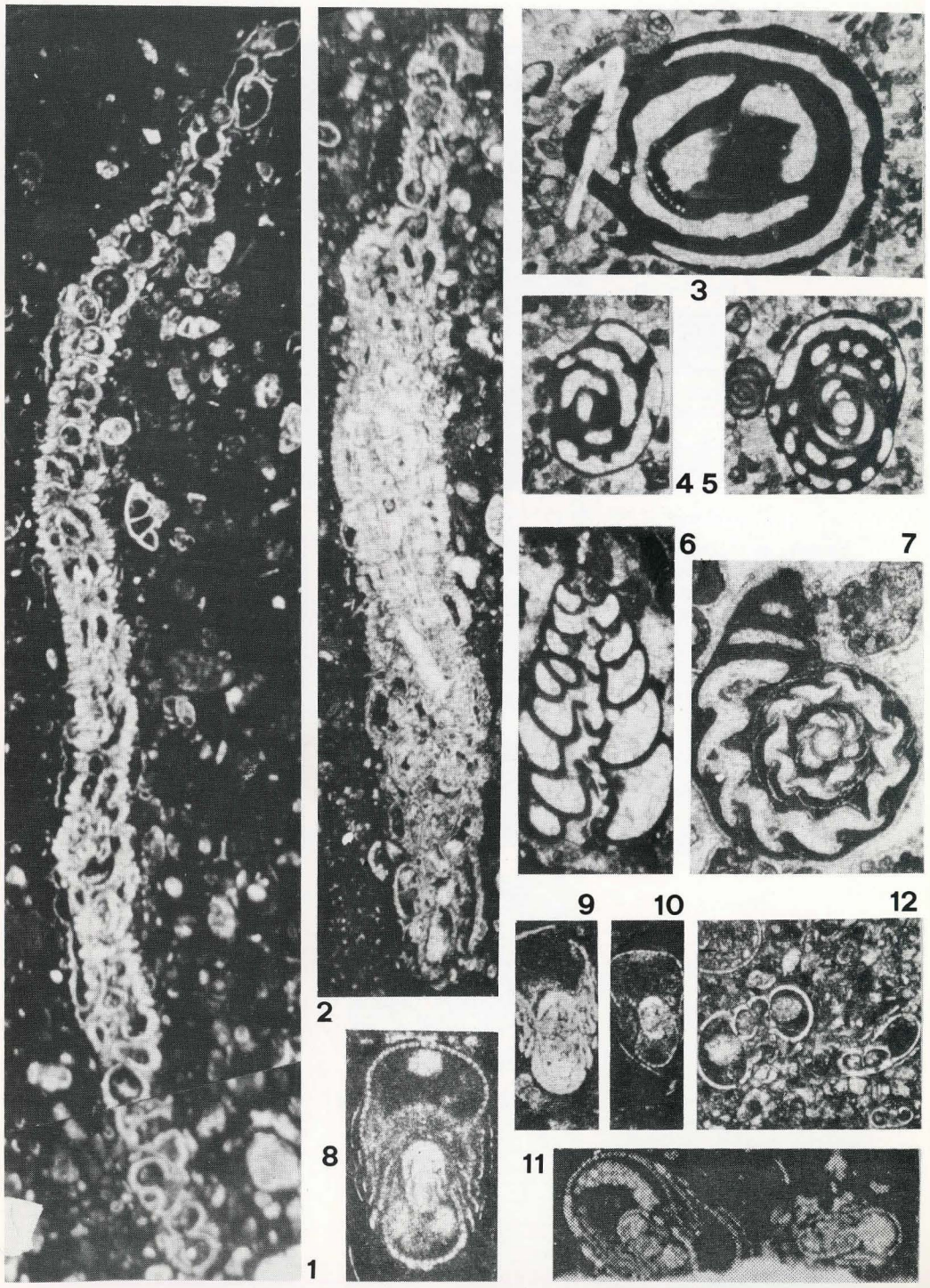


PLATE 26

Section of Dolenja vas. Age: Thanetian.

Fig. 1–2 *Miscellanea* sp. 2 (Leppig 1988), f B, 30 ×.
1. Dv 28/4693.
2. Dv 30/4699.

Fig. 3–4 *Miscellanea* sp. 2 (Leppig 1988), f A, 30 ×.
3. Dv 30/4698.
4. Dv 30/4701.

Fig. 5 *Haddonia* sp., Dv 30/4701, 30 ×.

Fig. 6 *Schlosserina* sp., Dv 30/4701, 80 ×.

Fig. 7–8 *Coskinon rajkae* Hottinger et Drobne, 30 ×.
7. Dv 30/4699.
8. Dv 30/4701.

Fig. 9 *Kathina selveri Smout,* Dv 26/4690, 50 ×.

Fig. 10–11 *Cribrobulimina carniolica* Hottinger et Drobne, 30 ×.
10. Dv 30/4698.
11. Dv 30/4698.

Fig. 12 New genus, miliolid-alveolinid type, Dv 30/4698 30 ×.
All in transparent light.

TABLA 26

Profil Dolenja vas. Starost: thanetij.

Sl. 1–2 *Miscellanea* sp. 2 (Leppig 1988), oblika B, 30 ×.
1. Dv 28/4693.
2. Dv 30/4699.

Sl. 3–4 *Miscellanea* sp. 2 (Leppig 1988), oblika A 30 ×.
3. Dv 30/4698.
4. Dv 30/4701.

Sl. 5 *Haddonia* sp., Dv 30/4701, 30 ×.

Sl. 6 *Schlosserina* sp., Dv 30/4701, 80 ×.

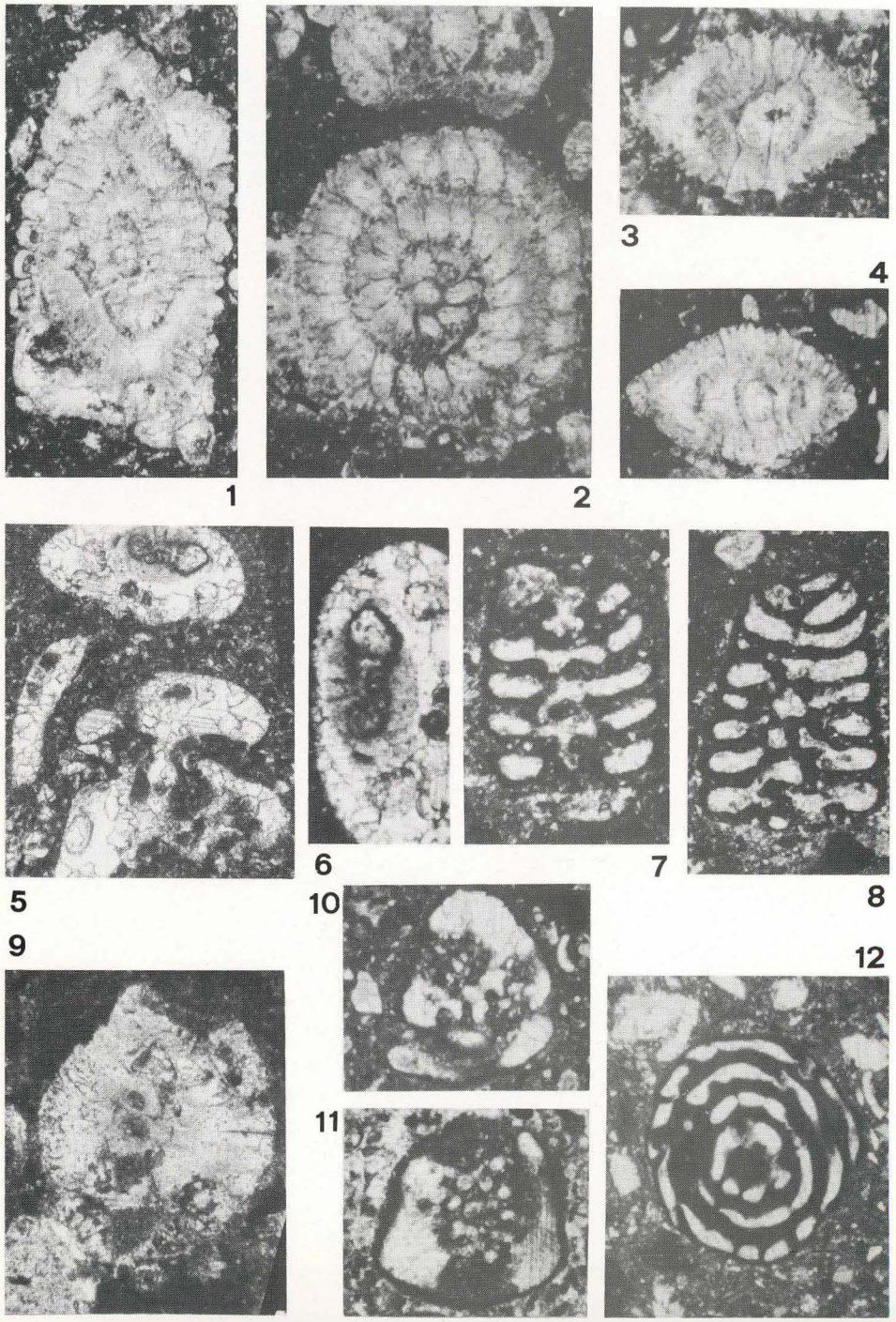
Sl. 7–8 *Coskinon rajkae* Hottinger et Drobne, 30 ×.
7. Dv 30/4699.
8. Dv 30/4701.

Sl. 9 *Kathina selveri* Smout, Dv 26/4690, 50 ×.

Sl. 10–11 *Cribrobulimina carniolica* Hottinger et Drobne, 30 ×.
10. Dv 30/4698.
11. Dv 30/4698.

Sl. 12 Nov rod, miliolidno-alveolinidni tip, Dv 30/4698, 30 ×.
Vse v presevni svetlobi.

Miscellanea sp. 2 = *M. juliettae villattea* Leppig 1988



EXPLANATION TO PLATES 27–28

All the photographs of thin sections; thin sections enlarged 5 ×
Photographs was made by Marjan GRM.

RAZLAGE K TABLAMA 27–28

Vse so fotografije zbruskov; zbruski so povečani 5 ×
Vse fotografije zbruskov je izdelal Marjan GRM.

PLATE 27

Fig. 1 *Bournonia parva* Pejović 1988
Transversal section through the lower valve; thin section;
Dolenja vas, Upper Maastrichtian; 5 ×.

Fig. 2 *Bournonia* aff. *parva* Pejović 1988.
Transversal section through the lower valve; thin section;
Dolenja vas, Upper Maastrichtian; 5 ×.

Fig. 3 *Bournonia problematica* n. sp.
Transversal section through the lower valve; thin section;
Inv. No. 5461;
Dolenja vas, Upper Maastrichtian; 5 ×.

Fig. 4 *Bournonia* aff. *retrolata* (Astre) 1929.
Transversal section through the lower valve; thin section;
Dolenja vas, Upper Maastrichtian; 5 ×.

TABLA 27

Sl. 1 *Bournonia parva* Pejović 1988.
Prečni presek spodnje lupine; zbrusek;
Dolenja vas, zgornji maastrichtij; 5 ×.

Sl. 2 *Bournonia* aff. *parva* Pejović 1988.
Prečni presek spodnje lupine; zbrusek;
Dolenja vas, zgornji maastrichtij; 5 ×.

Sl. 3 *Bournonia problematica* n. sp.
Prečni presek spodnje lupine; zbrusek; inv. št. 5461;
Dolenja vas, zgornji maastrichtij; 5 ×.

Sl. 4 *Bournonia* aff. *retrolata* (Astre) 1929.
Prečni presek spodnje lupine; zbrusek;
Dolenja vas, zgornji maastrichtij; 5 ×.

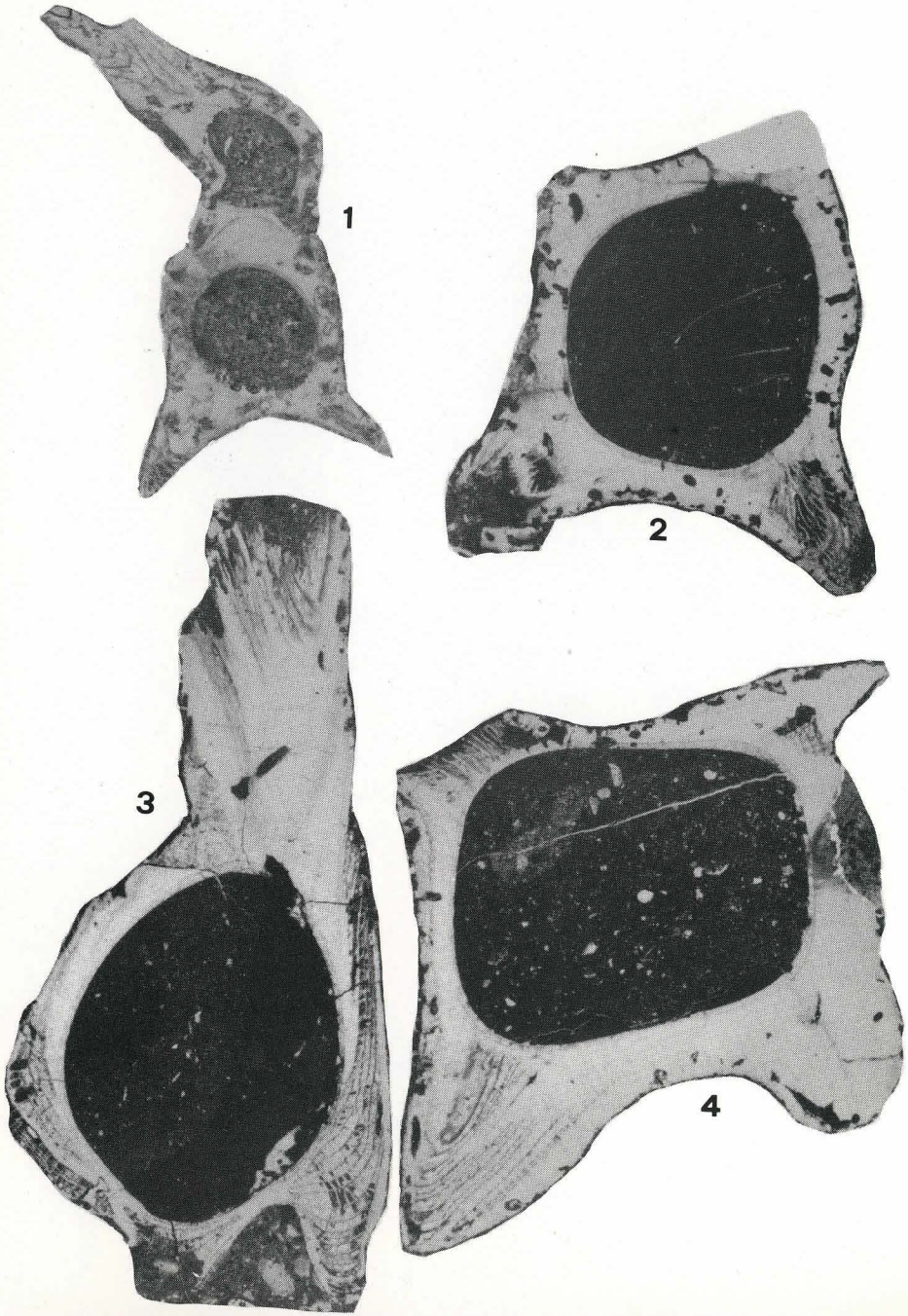


PLATE 28

Fig. 1 *Bournonia triangulata* n. sp.
Transversal section through the lower valve; thin section;
Invent. No. 5462;
Dolenja vas, Upper Maastrichtian; 5 ×.

Fig. 2 *Bournonia* cf. *wiontzeki* Pejović 1968.
Transversal section through the lower valve; thin section;
Dolenja vas, Upper Maastrichtian; 5 ×.

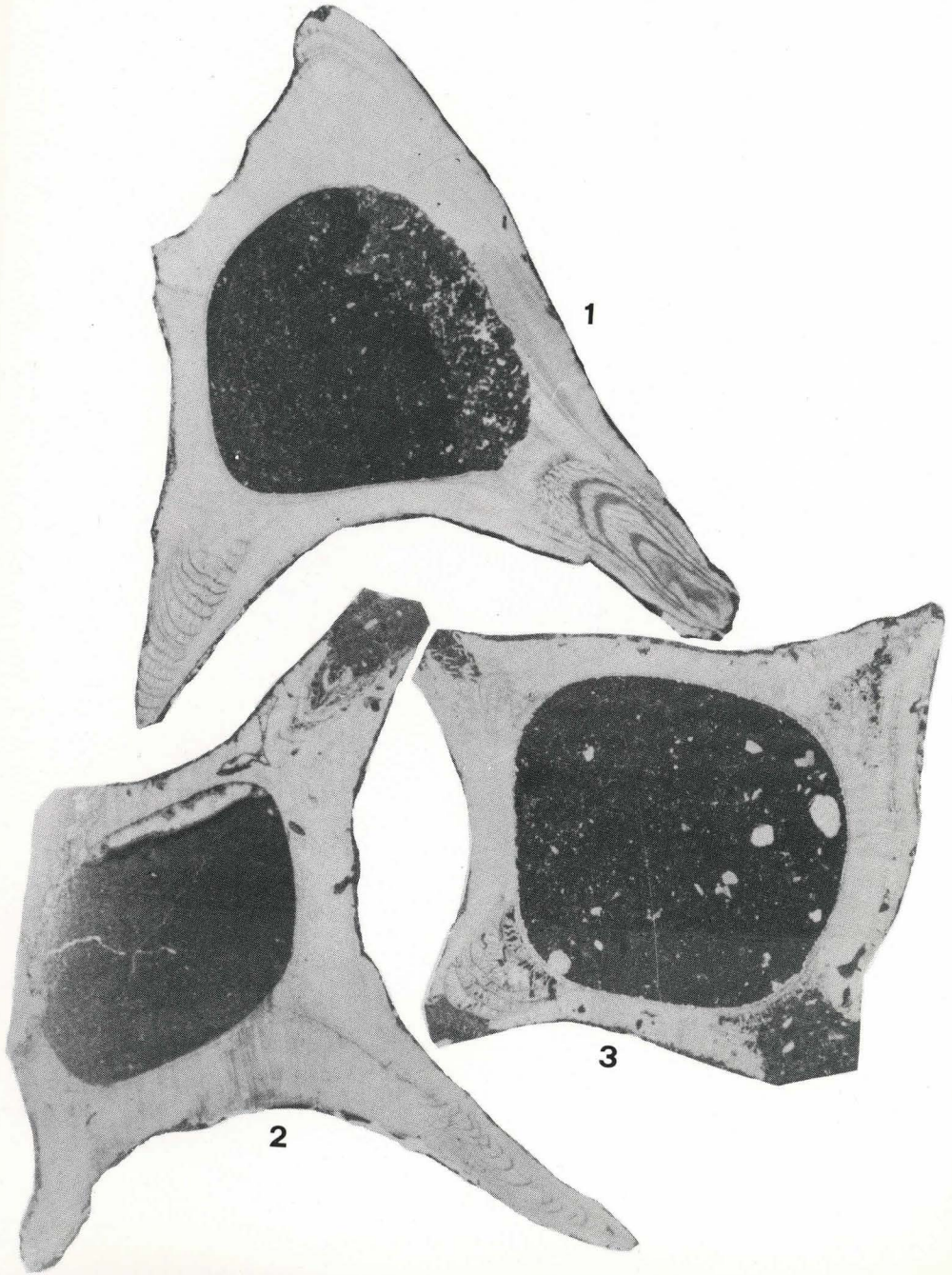
Fig. 3 *Bournonia* sp. sensu Pejović 1978.
Transversal section through the lower valve; thin section;
Dolenja vas, Upper Maastrichtian; 5 ×.

TABLA 28

Sl. 1 *Bournonia triangulata* n. sp.
Prečni presek spodnje lupine; zbrusek;
Inv. št. 5462;
Dolenja vas, zgornji maastrichtij; 5 ×.

Sl. 2 *Bournonia* cf. *wiontzeki* Pejović 1968.
Prečni presek spodnje lupine: zbrusek;
Dolenja vas, zgornji maastrichtij; 5 ×.

Sl. 3 *Bournonia* sp. sensu Pejović 1978.
Prečni presek spodnje lupine; zbrusek;
Dolenja vas, zgornji maastrichtij; 5 ×.



EXPLANATION TO PLATES 29–35

All figures are negatives, thin sections are enlarged directly onto the paper, except those marked as positives.
Photographs were taken by Carmen NAROBE.

RAZLAGE K TABLAM 29–35

Vse slike so negativi, zbruski so povečani direktno na papir, razen pri tistih, ki so označene kot pozitivi.
Slike je izdelala Carmen NAROBE.

PLATE 29

Fig. 1–3 *Stylocoenia montium* (Oppenheim 1912).
1. Transverse section of the colony with subcerioid corallites. Thin section Dv 22/4683, 8 ×.
2. Detail from fig. 1. with transverse corallites, 20 ×.
3. Longitudinal structure of the colony.
Thin section Dv 22/4683, 20 ×.

Fig. 4–6 *Dendrophyllia candelabrum* Hennig 1899.
4. Transverse and longitudinal section of dendroid corallites. Thin section Dv 37/2-5032, 8 ×.
5. Transverse and longitudinal section of corallites of another colony. Preservation of costae and wall varies. Thin section Dv 21/4679, 8 ×.
6. Detail from fig. 4, positive, 30 ×.

TABLA 29

Sl. 1–3 *Stylocoenia montium* (Oppenheim 1912).
1. Prečni presek kolonije s subcerioidnimi koraliti.
Zbrusek Dv 22/4683, 8 ×.
2. Detajl s sl. 1, s prečnimi koraliti, 20 ×.
3. Podolžni presek kolonije. Zbrusek Dv 22/4683, 20 ×.

Sl. 4–6 *Dendrophyllia candelabrum* Hennig 1899.
4. Prečni in podolžni presek dendroidnih koralitov.
Zbrusek Dv 37/2-5032, 8 ×.
5. Prečni in podolžni presek koralitov druge kolonije.
Različna ohranjenost kost in stene. Zbrusek Dv 21/4679, 8 ×.
6. Detajl s sl. 4, pozitiv, 30 ×.

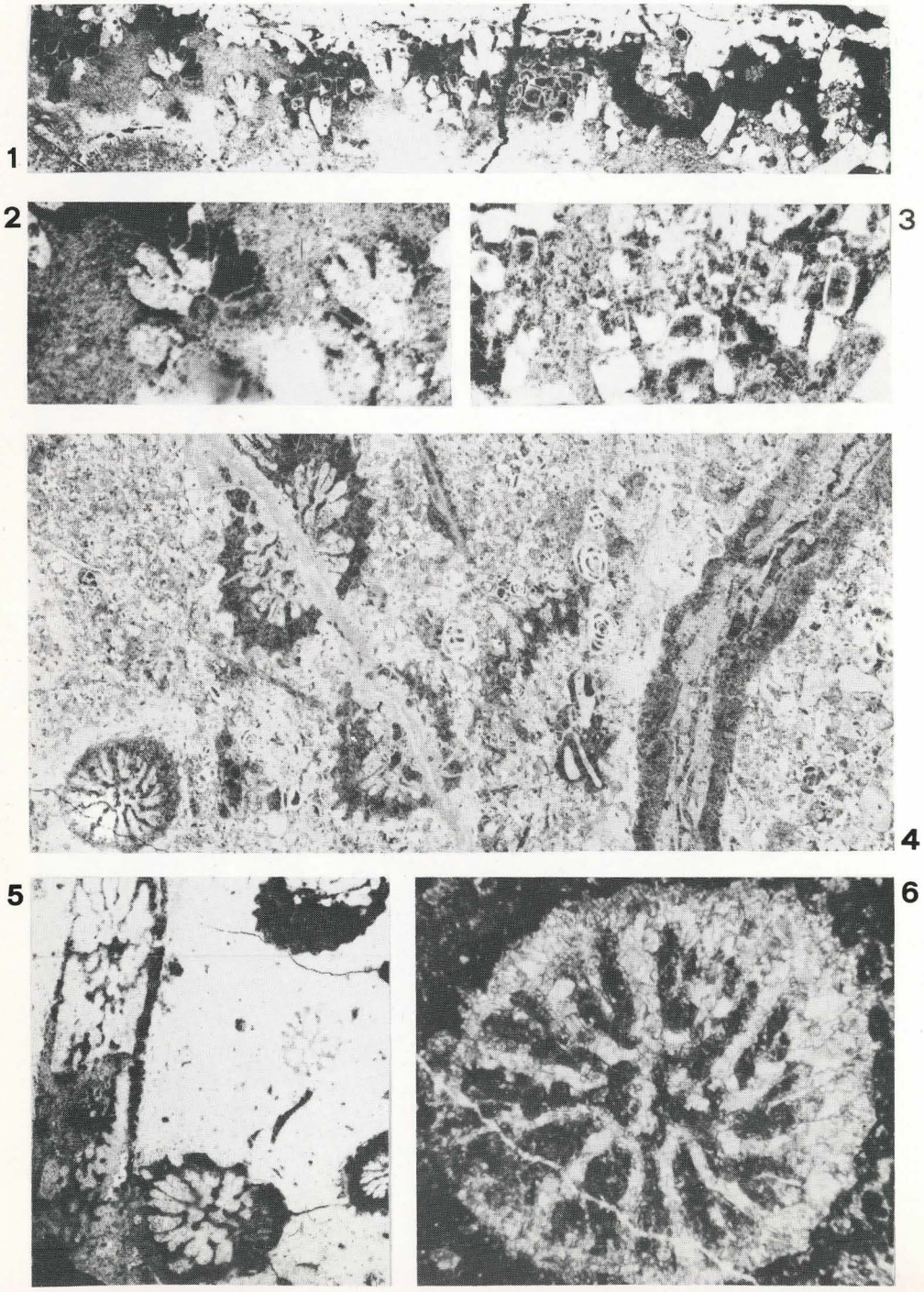


PLATE 30

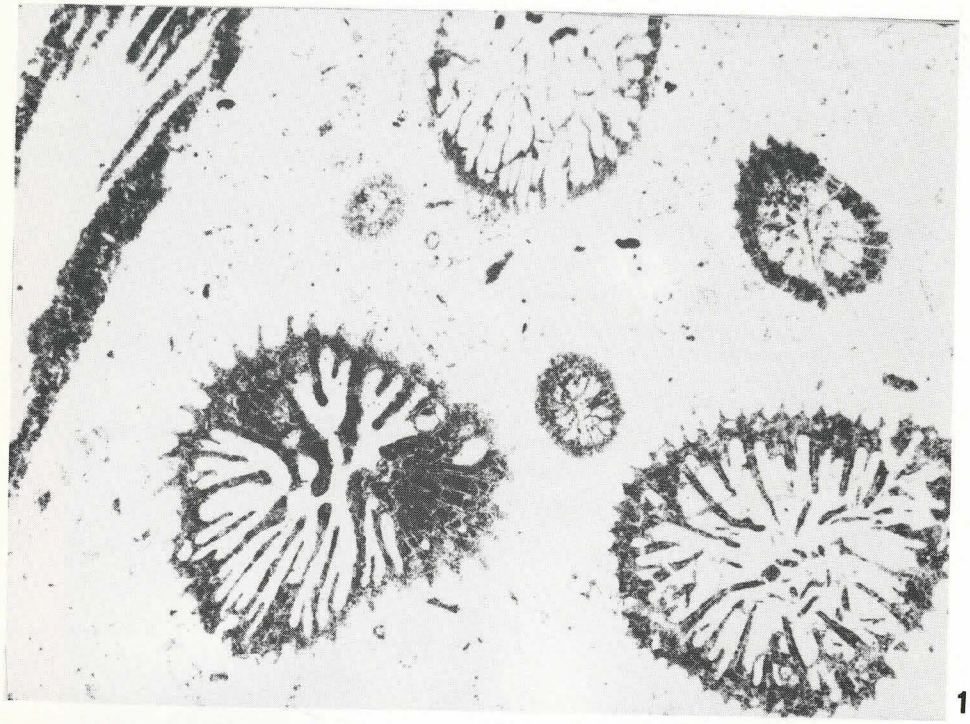
Fig. 1–2 *Dendrophyllia dendrophylloides* M. Edwards et Haime 1850.
1. Transverse and longitudinal section of dendroid corallites. Note costae, synapticulotheca, columella paritetal or absent. Thin section Dv 7/978 b, 8 ×.
2. Detail from fig. 1. Microstructure of septa, positive, 30 ×.

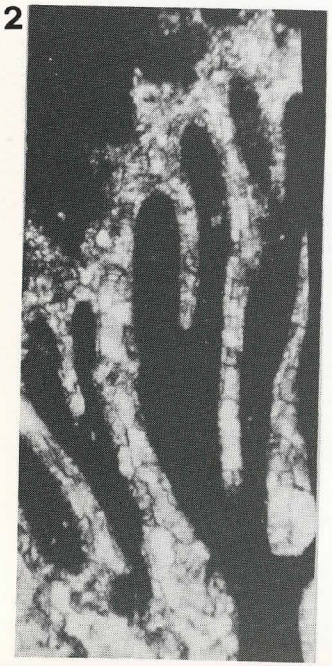
Fig. 3 *Haimesastraea peruviana* Vaughan 1922.
Transverse and longitudinal section of ramose colony with subplocoid corallites. Thin section Dv 9/979 b, 8 ×.

TABLA 30

Sl. 1–2 *Dendrophyllia dendrophylloides* M. Edwards et Haime 1850.
1. Prečni in podolžni presek dendroidnih koralitov.
Vidne so koste, sinaptikuloteka in kolumela, ki je parietalna, ali manjka. Zbrusek Dv 7/978 b, 8 ×.
2. Detajl s sl. 1, mikrostruktura sept, pozitiv, 30 ×.

Sl. 3 *Haimesastraea peruviana* Vaughan 1922.
Prečni in podolžni presek ramozne kolonije s subplokoidnimi koraliti. Zbrusek Dv 9/979 b, 8 ×.





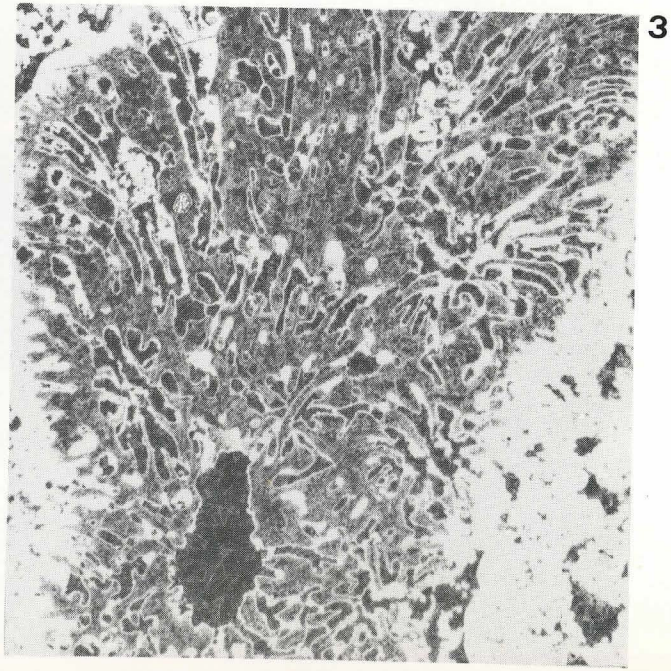


PLATE 31

Fig. 1–3 *Plocophyllia karstica* n. sp.
1. Transversal section of some monocentric and irregular corallites in phaceloid colony.
Thin section Dv 23 b/1, 4 ×.
2. Transversal section of irregular polycentric corallites. Thin section Dv 23 b/2, 4 ×.
3. Longitudinal section of one corallite. Note long tabulate and vesicular dissepiments.
Thin section Dv 23 b/3, 4 ×.

TABLA 31

Sl. 1–3 *Plocophyllia karstica* n. sp.
1. Prečni presek monocentričnih in nepravilnih koralitov v faceloidni koloniji.
Zbrusek Dv 23 b/1, 4 ×.
2. Prečni presek nepravilnih policentričnih koralitov.
Zbrusek Dv 23 b/2, 4 ×.
3. Podolžni presek enega koralita. Vidijo se dolgi tabulatni in vezikularni disepimenti.
Zbrusek Dv 23 b/3, 4 ×.

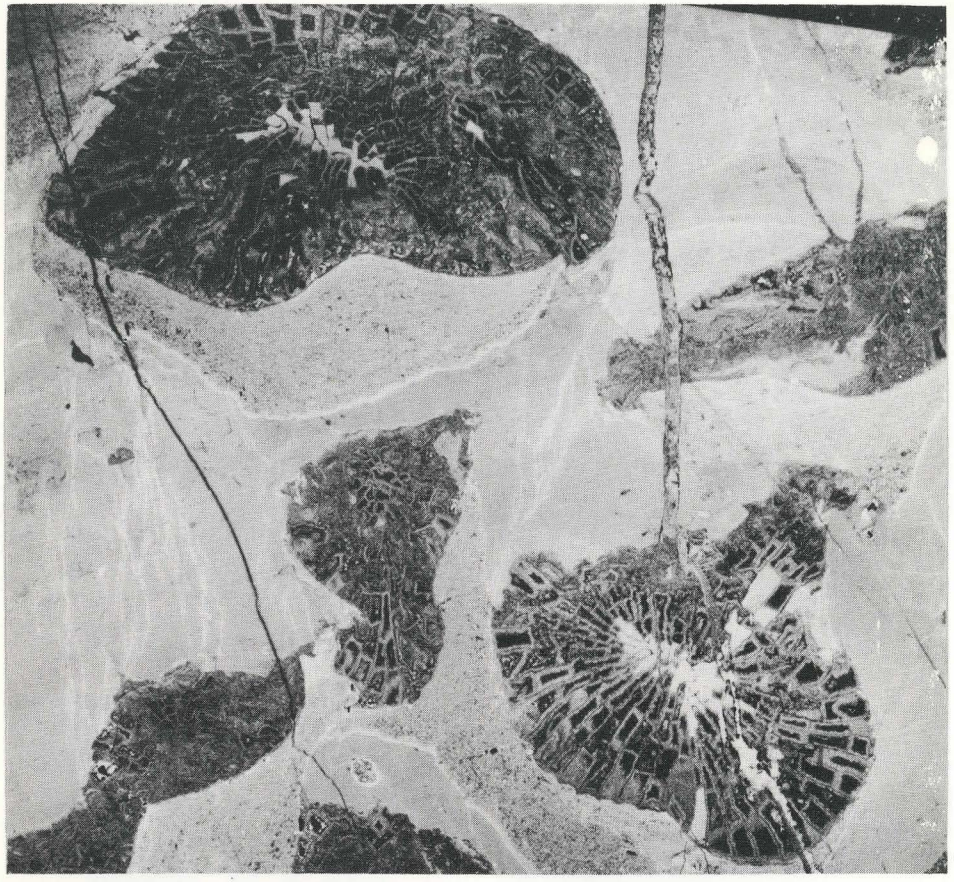

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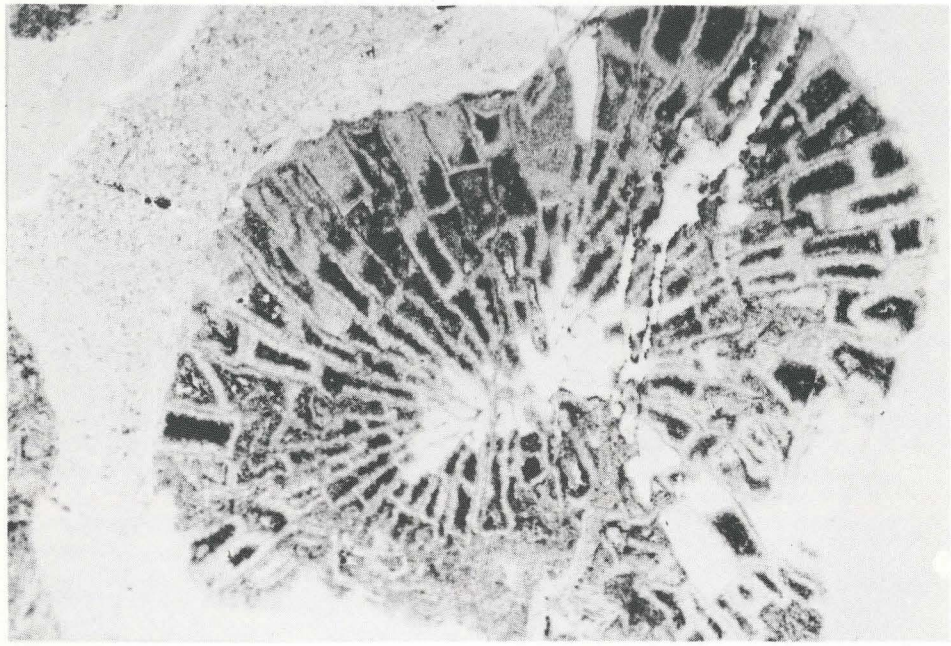
PLATE 32

Fig. 1–3 *Plocophyllia karstica* n. sp.
1. Transverse section of one monocentric corallite.
Thin section Dv 23 b/1, 8 ×.
2. Longitudinal section of one corallite. Note abundant endotheca with long dissepiments.
Thin section Dv 23 b/4, 4 ×.
3. Microstructure of septa with dark median line.
Thin section Dv 23 b/2, positive, 30 ×.

TABLA 32

Sl. 1–3 *Plocophyllia karstica* n. sp.
1. Prečni presek enega monocentričnega koralita.
Zbrusek Dv 23 b/1, 8 ×.
2. Podolžni presek enega koralita. Bogata endoteka iz dolgih disepimentov. Zbrusek Dv 23 b/4, 4 ×.
3. Mikrostruktura sept s temno osrednjo linijo.
Zbrusek Dv 23 b/2, pozitiv 30 ×.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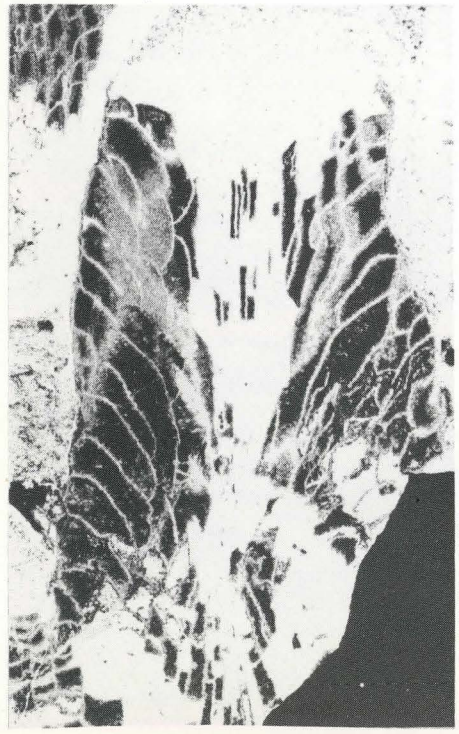
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PLATE 33

Fig. 1 *Siderastraea* sp.
Transverse section of colony with poorly preserved subthamnasterid corallites and incomplete synapticulotheca.
Thin section Dv 32/1-4998, 8 ×.

Fig. 2–4 *Actinacis cognata* Oppenheim 1901.
2. Transverse section of colony with roundish corallites and wide peritheca. Thin section Dv 23/4684, 8 ×.
3. Longitudinal section of colony. Note pennular ornamentation of septa. Thin section Dv 23/4685, 8 ×.
4. Detail from fig. 2. Transverse section of one corallite, microstructure not definable. Positive, 30 ×.

Fig. 5 *Rhizangia* sp.
Transverse section of two corallites, note lateral connection and synapticular wall. Thin section Dv 9/979 a, 8 ×.

TABLA 33

Sl. 1. *Siderastraea* sp.
Prečni presek kolonije s slabo ohranjenimi subtamnasteridnimi koraliti in nepopolno sinaptikuloteko.
Zbrusek Dv 32/1-4998, 8 ×.

Sl. 2–4 *Actinacis cognata* Oppenheim 1901.
2. Prečni presek kolonije z okroglastimi koraliti v široki periteki. Zbrusek Dv 23/4684, 8 ×.
3. Podolžni presek kolonije. Okrasitve sept so penule.
Zbrusek Dv 23/4685, 8 ×.
4. Detajl s sl. 2. Prečni presek enega koralita, mikrostruktura je nedoločljiva. Pozitiv, 30 ×.

Sl. 5 *Rhizangia* sp.
Prečni presek dveh koralitov. Vidi se lateralna povezava in sinaptikularna stena. Zbrusek Dv 9/979 a, 8 ×.


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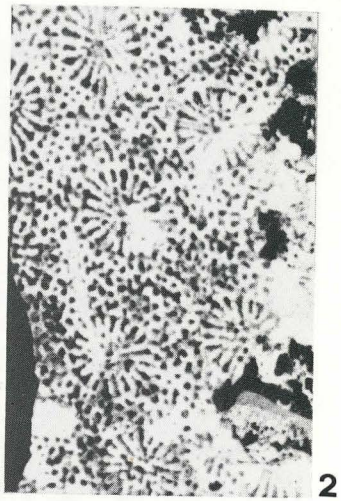
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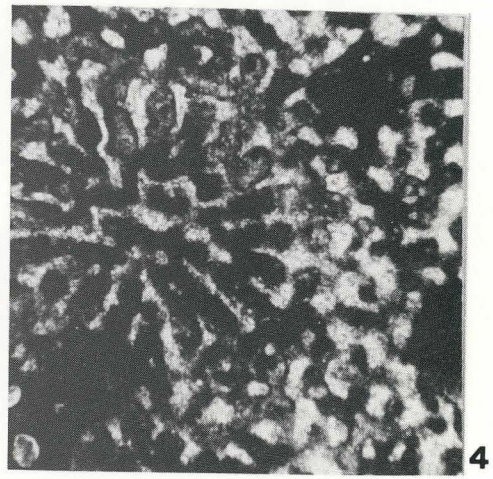
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PLATE 34

Fig. 1–3 *Goniopora elegans* (Leymerie 1846).
1. Transverse section of colony with subcerioid corallites. Thin section Dv 20/4677, 8 ×.
2. Longitudinal section of colony. Thin section Dv 22/4682, 8 ×.
3. Detail from Fig. 1, 20 ×.

Fig. 4 *Goniopora* sp.
Thin section Dv 29/4696, 8 ×.

TABLA 34

Sl. 1–3 *Goniopora elegans* (Leymerie 1846).
1. Prečni presek kolonije s subcerioidnimi koraliti. Zbrusek Dv 20/4677, 8 ×.
2. Podolžni presek kolonije. Zbrusek Dv 22/4682, 8 ×.
3. Detajl s sl. 1, 20 ×.

Sl. 4. *Goniopora* sp.
Zbrusek Dv 29/4696, 8 ×.

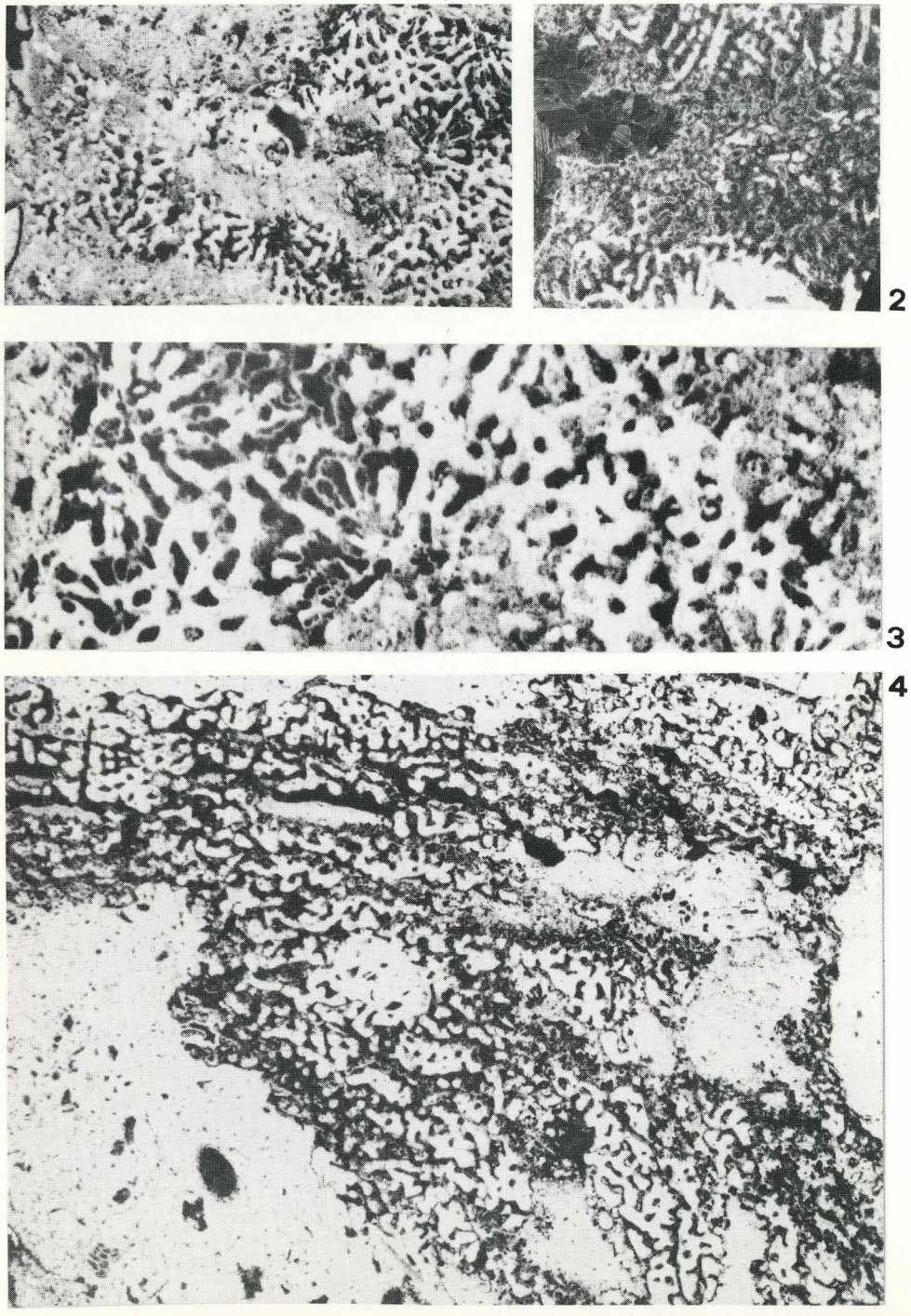
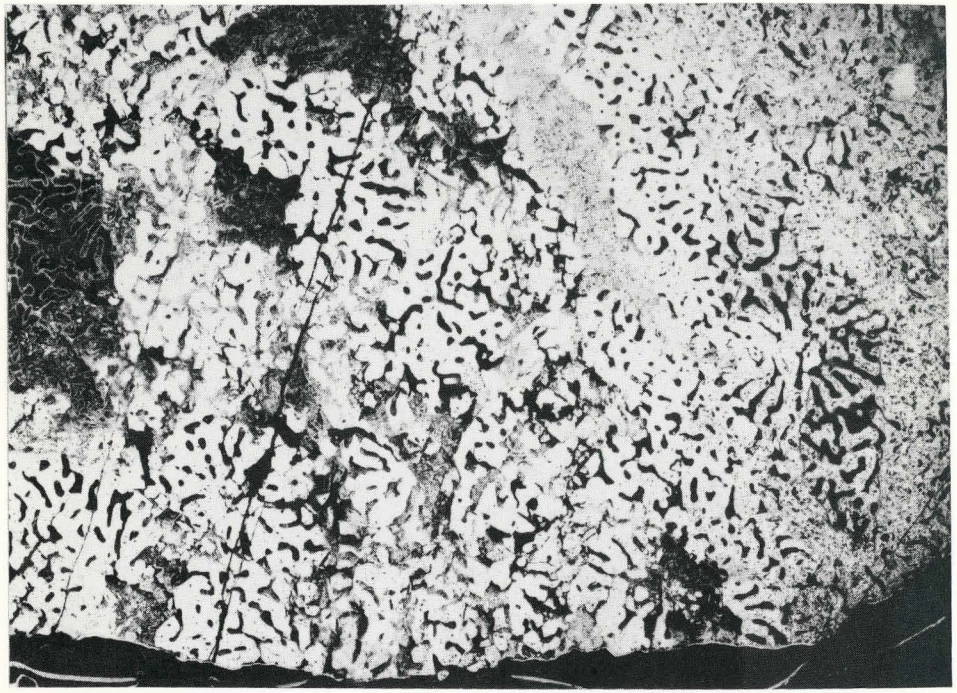


PLATE 35

Fig. 1–4 *Litharaeopsis subepithecata* (Oppenheim 1912).
1. Transverse section of colony with subcerioid corallites and sparse skeleton. Thin section Dv 24/982 c, 4 ×.
2. Detail from Fig. 1, 8 ×.
3. Longitudinal section of colony, with porous skeleton. Thin section Dv 24/982 d, 8 ×.
4. Transverse section of one corallite, showing recrystalized septal structure. Thin section Dv 24/982 a, positive, 20 ×.

TABLA 35

Sl. 1–4 *Litharaeopsis subepithecata* (Oppenheim 1912).
1. Prečni presek kolonije s subcerioidnimi koraliti in redkim skeletom. Zbrusek Dv 24/982 c, 4 ×.
2. Detajl s sl. 1, 8 ×.
3. Podolžni presek kolonije s poroznim skeletom. Zbrusek Dv 24/982 d, 8 ×.
4. Prečni presek koralita s prekristalizirano septalno mikrostrukturo. Zbrusek Dv 24//982 a, pozitiv. 20 ×.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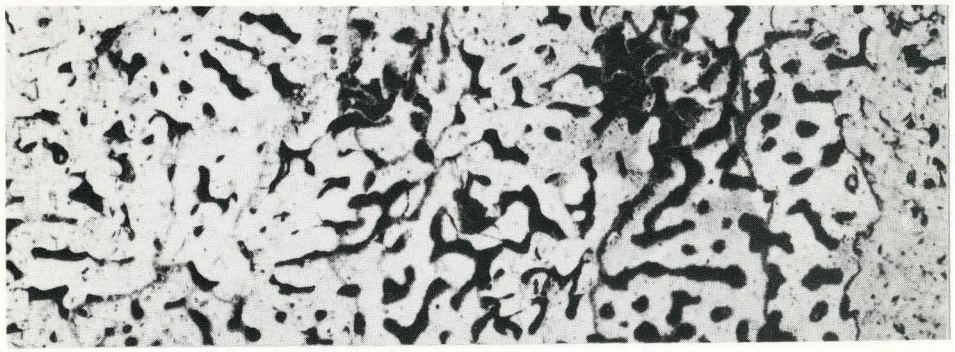
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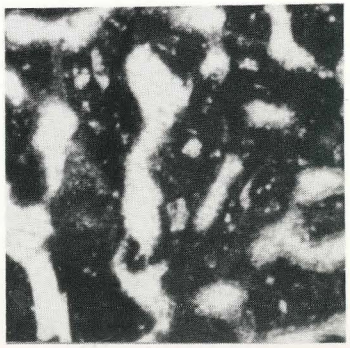
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