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PARASTOMIOSPHAERA MALMICA (B O R Z A) FROM THE POLISH CARPATHIANS AND THEIR STRATIGRAPHICAL VALUE FOR LOWER TITHONIAN DEPOSITS

(Pl. I—XII and 11 Figs.)

Parastomiosphaera malmica (B o r z a) *z Karpat Polskich i jej znaczenie dla korelacji utworów dolnego tytonu*

(*tabl. I—XII i 11 fig.*)

A b s t r a c t: The species *Parastomiosphaera malmica* (B o r z a) has been found in a number of Upper Jurassic profiles in the western part of the Polish Flysch Carpathians and in the Pieniny Klippen Belt. Their abundant occurrence forms a characteristic microfacies that takes up a constant position between the microfacies with Calpionellidae B o n e t (in the top) and the Lombardia microfacies with *Carpistomiosphaera borzai* (N a g y) and *Stomiosphaera moluccana* W a n n e r. *P. malmica* is a monohemeral species; the *P. malmica* microfacies is of the Lower Tithonian age.

In the present paper one can find a definition of a *P. malmica* zone; there are also profiles with *P. malmica* findings in the Polish Carpathians there, as well as an attempt at correlation with Aptychi zones and remarks concerning the age of some Upper Jurassic lithostratigraphic units of the Carpathians.

INTRODUCTION

For the last few years the author has gathered a relatively rich material concerning the problematic microfossils of *Parastomiosphaera malmica* (B o r z a) 1964, found among the Upper Jurassic deposits of the Polish Carpathians.

The microfossils had been described for the first time by B o r z a in 1964, under the name of *Stomiosphaera malmica* n. sp. of the Upper Jurassic formations in the Czechoslovakian part of the Pieniny Klippen Belt.

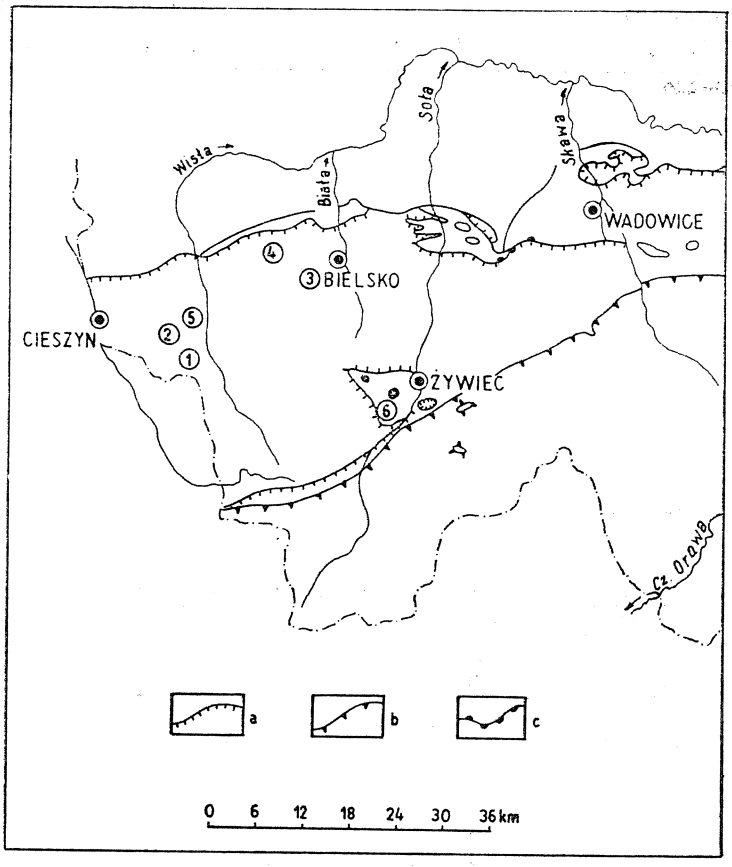


Fig. 1. Tectonic map of the western part of the Polish Carpathians. a — overthrust of the Silesia unit; b — overthrust of the Magura unit; c — Andrychów klippes

Fig. 1. Szkic tektoniczny zachodniej części Karpat polskich. a — linia nasunięcia jednostki śląskiej; b — linia nasunięcia jednostki magurskiej; c — skałki andrychowskie

1 — Cisownica-Tuł; 2 — Cisownica-wieś; 3 — Kamienica; 4 — Jasienica; 5 — Harbutowice; 6 — Radziechowy

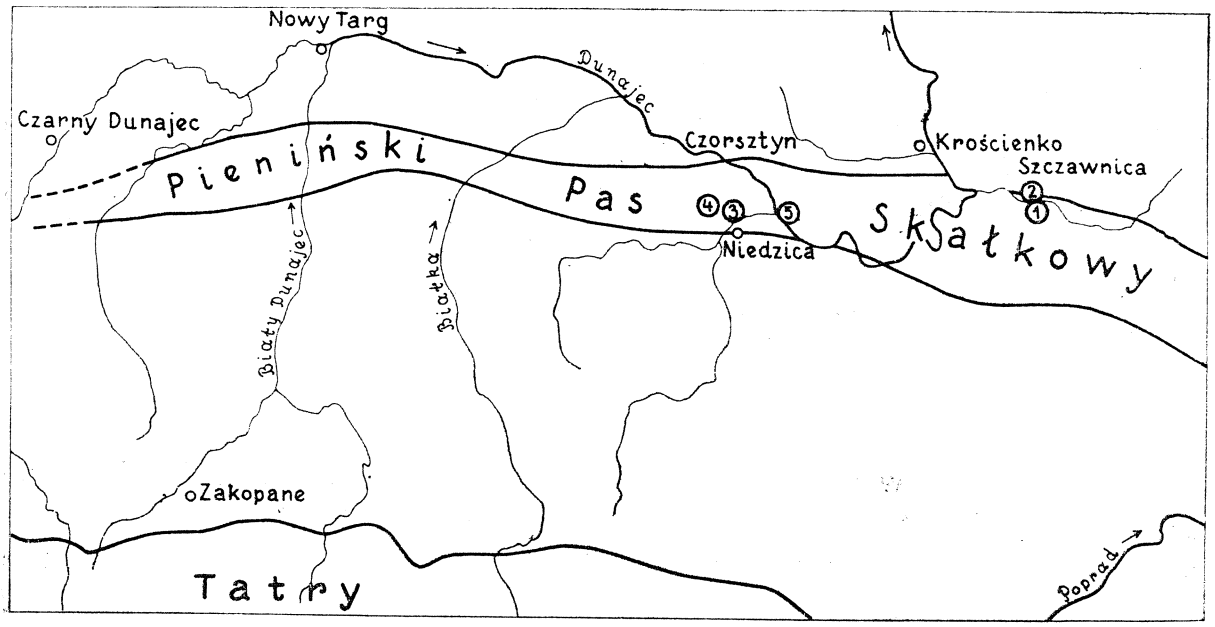


Fig. 2. Localization of findings of *Parastomiosphaera malmica* (B o r z a) in the Polish part of the Pieniny Klippen Belt

Fig. 2. Lokalizacja znalezisk *Parastomiosphaera malmica* (B o r z a) na obszarze polskiej części pienińskiego pasa skałkowego

1 — Zabaniszcze; 2 — Szczawnica Wyżnia; 3 — Niedzica — wieś; 4 — Dolina Kosarzyska — Buwałd; 5 — Kapuśnica

A few years later they were found in the region of the Mecsek Mountains (Hungary), where Nagy (1966) described them as *Cadosina malmica* (Borza); then a note was given on their occurrence in the Polish Carpathians (Nowak, 1968a, 1971b, 1973a). At that time, according to a systematic revision, they were called *Parastomiosphaera malmica* (Borza).

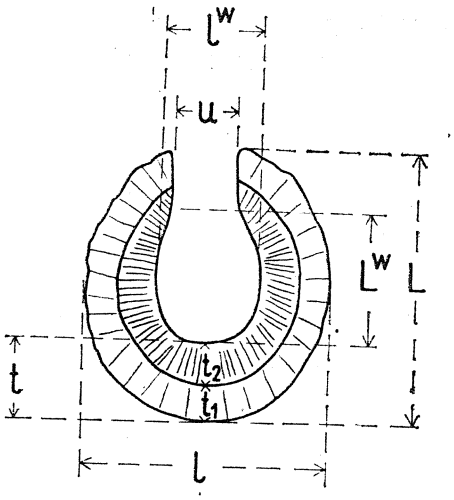


Fig. 3. Schematic outline of *Parastomiosphaera malmica* (Borza) L — length of test; L^w — length of chamber; l — width of test; l^w — width of chamber; u — width of aperture; t — thickness of wall; t_1 — thickness of outer layer; t_2 — thickness of inner layer

Fig. 3. Schematyczny rysunek *Parastomiosphaera malmica* (Borza) L — długość skorupki; L^w — wysokość komory; l — szerokość skorupki; l^w — szerokość komory; u — szerokość ujścia; t — grubość ściany; t_1 — grubość warstwy zewnętrznej; t_2 — grubość warstwy wewnętrznej

Despite diversified and distant areas of occurrence and differences in lithological development of deposits, *P. malmica* always occurs in the same stratigraphic position; above the „Lombardia" microfacies with *Carpistomiosphaera borzai* (Nagy) and *Stomiosphaera moluccana* Wanner, and below a microfacies with Calpionellidae Bonet (cf. Tables I—III).

This characteristic feature, as far as the occurrence of the described microfossils is concerned, allowed a differentiation of an individual Malmica zone (Borza, 1969; Nagy, 1971; Nowak, 1968, 1973a, 1973b).

To stress the importance of the Malmica zone it became necessary, first of all, to establish topontozones of the species in various regions. Then one had to answer some further questions: whether it was a mono-, bi- or a polyhemeral species; whether its development optima in various regions correspond, in fact, to one another in time; and, especially, whether assemblages that occur in them are identical, as far as the ontogenetic development is concerned.

To analyse and answer the above questions, in connection with the material from the Silesian Carpathians and from various successions of

the Polish part of the Pieniny Klippen Belt, a biometric study of the P. malmica species has been worked out on the basis of about 1300 specimens.

To do that, thin sections from 6 Upper Jurassic profiles of the Cieszyn succession from the region of the Cieszyn Silesia (Fig. 1) and 7 profiles of the Hulina, Niedzica and Branisko successions of the Pieniny Mts. were used.

The possibility of relating this species to Aptychi findings in the region of the Silesian Carpathians (Gąsiorowski, 1961, 1962; Gąsiorowski, Nowak — in preparation for press; Gąsiorowski in: Nowak, 1973b) and in the region of the Pieniny Klippen Belt (Gąsiorowski, 1962) was a favourable factor in the process of establishing the age of *P. malmica* topontozones.

The problems discussed in the present paper had been presented in conference of the Carpathian Branch of the Institute of Geology in Cracow on 7th December 1972, and during the symposium devoted to the boundary of Jurassic and Cretaceous in Poland, organized by the Stratigraphic Section of the Polish Geological Society, held in Warsaw on 25th January 1973.

Acknowledgements

The author of the present paper wishes to express his thanks to dr acad. Maria Sido and dr Istvan Nagy, of the Magyar Állami Földtani Intézet in Budapest, and to dr Jozsef Knauer, of the Bauxitautató Vállalat at Balatonalmádi, for fruitful discussion and a thorough study of typical profiles of the Upper Jurassic of Hungary during field excursions in 1972.

I'd also like to thank dr Karel Borza, of the Geologicky Ústav of the Slovakian Academy of Sciences in Bratislava, for his help in completing the bibliography on the subject.

I am indebted to dr S. M. Gąsiorowski for his determination of Aptychi from a number of localities in the region of the Silesian Carpathians and for his generous permission to publish these designations before our collective paper has been completed. I also wish to express my thanks to all those who participated in the discussion after the lecture delivered in Cracow and Warsaw, and to all my friends for exchange of opinions and discussion on stratigraphy of the Upper Jurassic of the Carpathian and other problems involved.

In 1970 I also had the advantage of being able to use in my studies the materials from the Zabaniszcze profile, gathered by doc. dr W. Sikora; all the time I have had the help of the Carpathian Branch of the Geological Institute in Cracow, which I gratefully acknowledge.

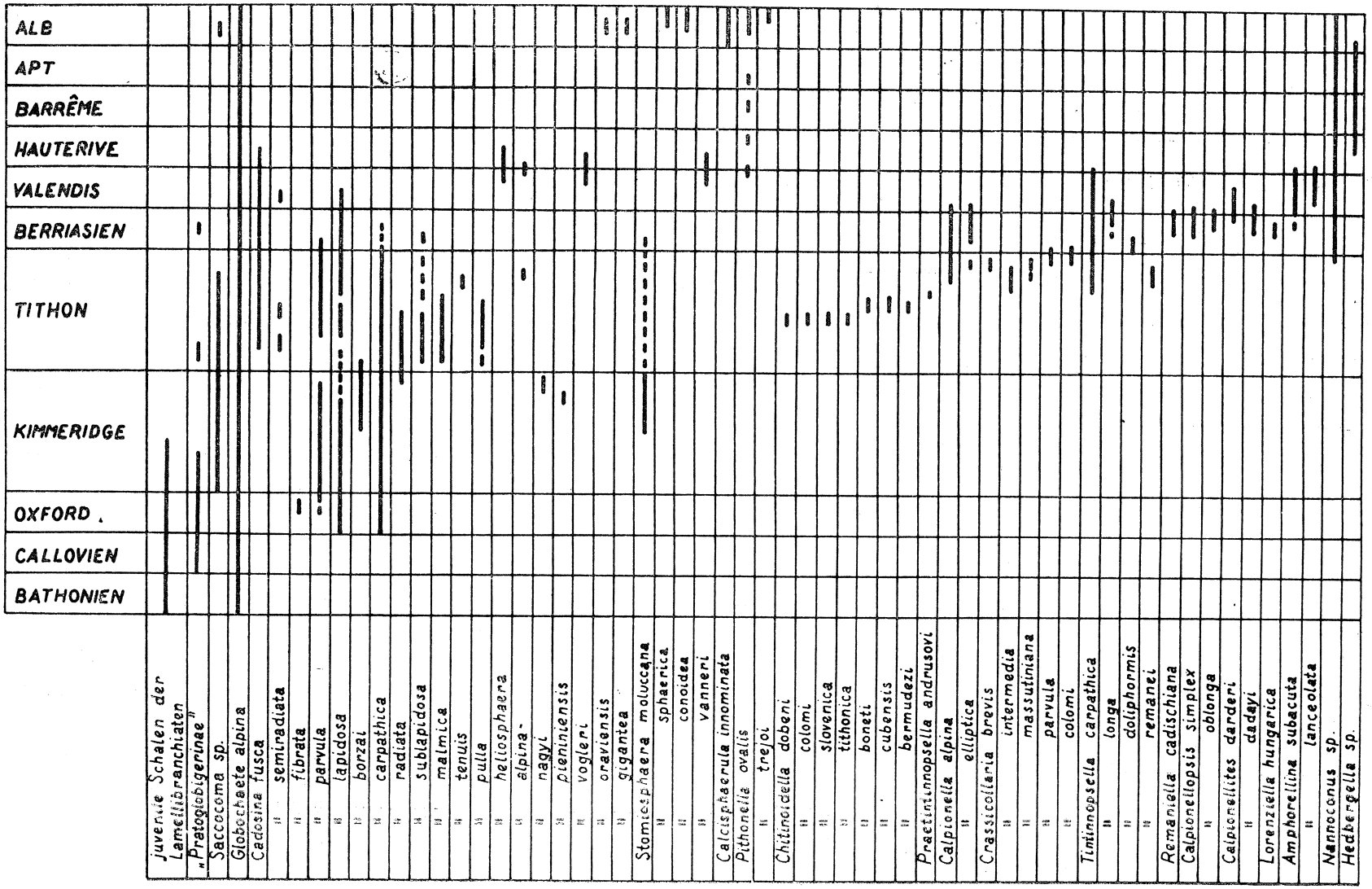
Stratigraphical Correlation of Stomiosphaerids with Aptychi and Ammonite Shells.
/Stratygraficzna korelacja stomiosferidów z aptychami i amonitami/

Ammonite Zones /Zony amonitowe/	Ammonite Stages /Piętra amonitowe/		Aptychi Horizons /Horyzonty aptychowe/ after /wg/ S.M.Gąsiorowski 1962, M.Durand Delga, S.M.Gąsiorowski 1971		Proposed Aptychi Horizons /Proponowane horyzonty aptychowe/		Stomiosphaerids and other Microfossils Zones /Zony stomiosferidowe i inne/ after /wg/ K.Borza 1969, I.Nagy 1971, W.Nowak 1968 and after unpublished new autor's investigations /i nowszych badań autora/
Berriasella boissieri	Berriasian /Berias/		VII	VII-1	VII	VII-1	Calpionellidae Bonet
Virgatosphinctes transitorius	Tithonian /Tyton/	Upper /górny/	VI	VI-2-β	VI	VI-2-β	
				VI-2-α		VI-2-α VI-1-β, VI-1-γ VI-1-α /2/	
Berriasella ciliata Subplanites vimineus Taramelliceras lithographica Hybonoticeras hybonotum		Lower /dolny/		VI-1-β, γ		VI-1-α /1/	Colomisphaera cieszynica Nowak (Chitinoidella Doben)
				VI-1-α			Parastomiosphaera malmica /Borza/
H.beckeri - A.pseudomutabilis	Kimmeridgian /Kimeryd/	Upper /górny/			V		Carpistomiosphaera borzai /Nagy/
Ataxioceras lothari Ataxioceras suberinum Atax. spp.		Lower /dolny/	V				Stomiosphaera moluccana Wanner
Epipeltoceras bimmamatum	Oxfordian /Oxford/	Upper /górny/	IV	IV-2	IV	IV-2	Colomisphaera fibrata /Nagy/
				IV-1		IV-1	
Gregoryceras transversarium			III		III		
Cardioceras cordatum Quenstedtoceras mariae		Lower /dolny/	II	II-3	II	II-3	
				II-2		II-2	
Quenstedtoceras lamberti Peltoceras athleta	Callovian /Kelowej/	Upper /górny/		II-1		II-1	Bositra Roemer

Table — Tabela 2

Stratigraphic distribution of the microfossils in the Czechoslovakian part of the Pieniny Mountains after K. Borza (1969)

Stratygraficzne zasięgi mikroskamieniałości na obszarze czechosłowackiej części pienińskiego pasa skałkowego wg K. Borza (1969)



ACCEPTED SCHEME OF STRATIGRAPHY OF UPPER JURASSIC

In the present paper the author understands the term „Upper Jurassic" as Ammonite stages from Oxfordian to Tithonian inclusive, comprising Ammonite zones sensu W. I. Arkell (1956), from Quenstedtoceras mariae to Virgatosphinctes transitorius (cf. Table 1).

According to Gąsiorowski (1962), and Durand Delga and Gąsiorowski (1971) their equivalents are Aptychi zones, from II — 2 (= Quenstedtoceras mariae) to VI-2-alfa (= Virgatosphinctes transitorius).

In the present paper the following division of Tithonian has been accepted: 1) Lower — corresponding to Ammonite zones from Hybonoticeras hybonotum to Berriasella ciliata and to the Aptychi subzone VI — 1 — alpha — lower part; and 2) Upper — corresponding to the zone Virgatosphinctes transitorius and to the Aptychi subzones VI — 1 — alpha — upper part and VI — 2 — alpha (cf. Table 1).

DEFINITION OF THE PARASTOMIOSPHAERA MALMICA ZONE

The Parastomiosphaera malmica zone was distinguished within Lower Tithonian on the basis of abundant occurrence of this species. Its lower boundary coincides with the lower boundary of range of the species *P. malmica*, confirmed by the Saccocoma (Lombardia) microfacies occurring below, with *Carpistomiosphaera borzai* (Nagy) and *Stomiosphaera moluccana* Wanner. The upper boundary is established on the basis of the occurrence of one — layer Stomiosphaerids of the Colomisphaera cieszynica and Chitinoidella zones — in relation to the microfacies with Calpionellidae Bonet, occurring directly above (cf. Table 1 and Fig. 4).

The species *P. malmica* occasionally occurs beyond the Malmica zone in the uppermost part of Lower Tithonian, in Upper Tithonian and Berriasian (cf. Fig. 4).

The Lower Tithonian age of the Malmica zone is confirmed by findings of Ammonites, Aptychi, Brachiopoda and of microfossils described from the territory of Hungary, Czechoslovakia and Poland (cf. Tables 2 and 3).

a) Findings of Ammonites:

1) Below the Malmica zone there occur Ammonites characteristic of the Beckeri zone; Hungary — the Mecsek Mountains, fide Nagy 1971.

2) Below the Malmica zone there occurs *Ptychophylloceras ptychoicum* (Quenstedt); Czechoslovakia — the Pieniny Mts, the Kysuca succession (= Branisko succession), the Brodno klippe; Scheibner, fide Borza 1969.

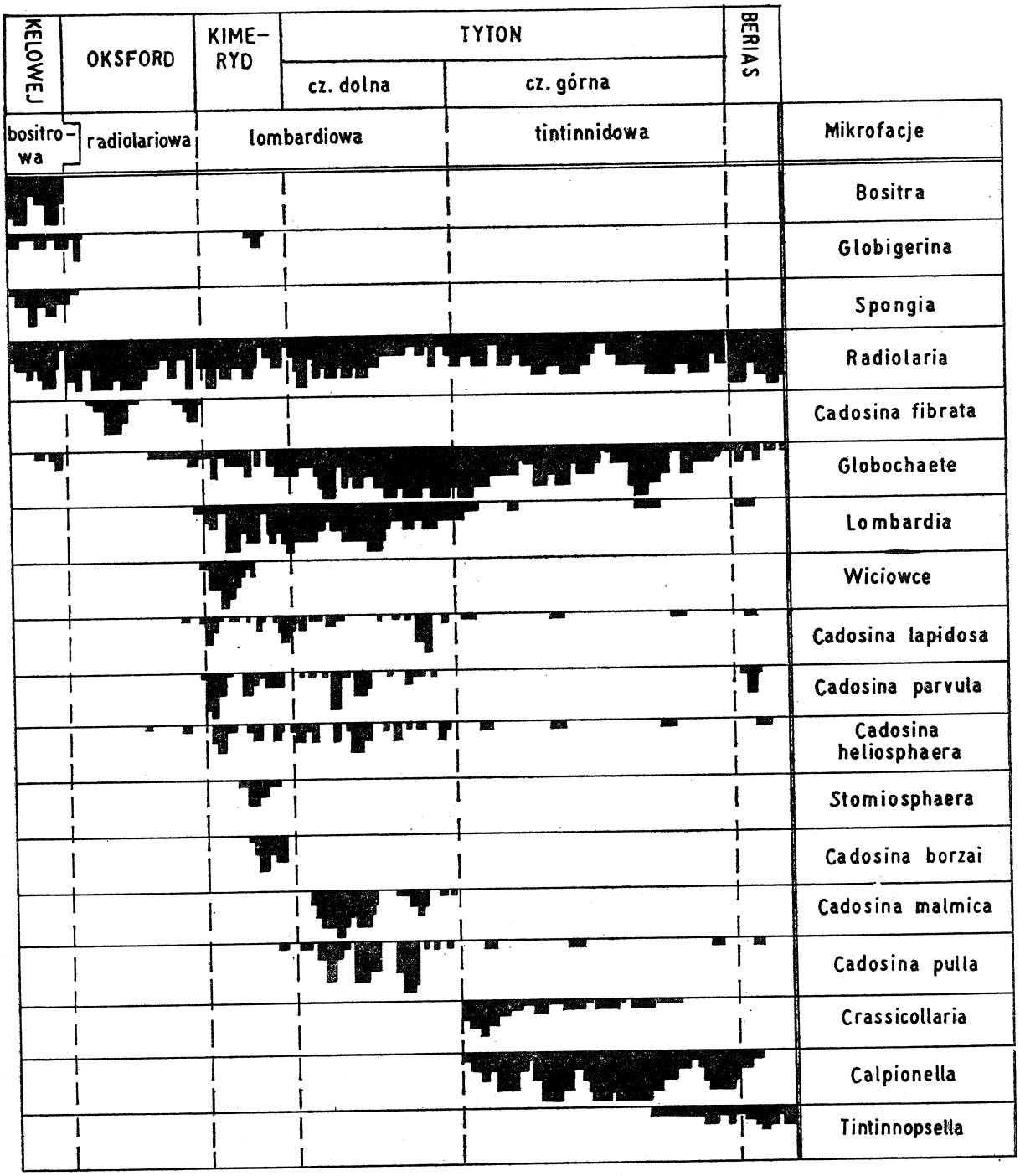
b) Findings of Aptychi:

1) Below the Malmica zone there occur: *Lamellaptychus beyrichi* (Oppel), *Laevaptychus obliquus* (Quenstedt), *Punctaptychus punc-*

Table — Tabela 3

Micropaleonthological division scheme of the Upper Jurassic in the Mecsek Mts (quantitive relations connected only with the section corresponding to a given microfossil) after I. N a g y (1971)

Mikropaleontologiczny schemat podziału górnej jury w Górach Mecsek (Ilościowe stosunki odnoszą się tylko do przedziału odpowiadającego danej mikroskamieniałości), wg I. N a g y (1971)



tatus (V o l t z); corresponding zone IV — 1 — alpha — lower part; Czechoslovakia — the Pieniny Mts, the Kysuca succession, the Brodno klippe; S c h e i b n e r, fide B o r z a, 1969.

2) Below the Malmica zone there occurs an Aptychi assemblage of subzone VI — 1 — alpha — lower part;
Poland — the Silesian Carpathians, the Cieszyn succession, the Cisownica — Tuł profile; Gąsiorowski, Nowak — in preparation for press; Gąsiorowski in: Nowak, 1973b.
3) Within the Malmica zone there occur Aptychi assemblages of subzone VI — 1 — alpha — lower part; the Silesian Carpathians, the Cieszyn succession, the Cisownica — Tuł profile; Gąsiorowski, Nowak — in preparation for press; Gąsiorowski in: Nowak, 1973b.
4) From among deposits containing *P. malmica,* there have been described Aptychi assemblages of subzone VI — 1 — alpha — lower part; Poland — the Pieniny, the Hulina succession, the Szczawnica Wyżnia — slaughter — house profile (Birkenmajer, 1965); the Niedzica succession: Niedzica (klippes above the Niedzica village), the Kosarzyska — Buwald Valley (Birkenmajer, Gąsiorowski, 1960; Gąsiorowski, 1962); the Branisko succession: Kapuśnica (Birkenmajer, Gąsiorowski, 1960; Gąsiorowski, 1962).
5) In the lowest member of Cieszyn limestones, containing limestone blocks from the Malmica zone, there occur Aptychi corresponding to subzone VI — 1 — alpha — lower part; the Silesian Carpathians, the Cieszyn succession: Jasienica, Kamienica (Gąsiorowski, 1961, 1962; Gąsiorowski, Nowak — in preparation for press; Gąsiorowski in: Nowak, 1973b).
6) Above the lowest member of Cieszyn Limestones, already within the limestones with Calpionellidae, there occur Aptychi that are included in subzone VI — 2; the Silesian Carpathians, the Cieszyn succession: Jasienica (Gąsiorowski 1961, 1962; Nowak 1968a).

c) Findings of Brachiopods:
1) Below the Malmica zone there occurs *Pygope triangulus* (Lamarck); Czechoslovakia — the Pieniny, the Kysuca succession, the Brodno klippe; Scheibner, fide Borza 1969.
2) Within the Malmica zone there occurs *Pygope diphya* (Colona); Hungary — the Mecsek Mts; Nagy 1971.
3) Above the Malmica zone there occur *P. diphya* (Col.) and *Rhynchonella spoliata* Suess; Czechoslovakia — the Pieniny, the Kysuca succession, the Brodno klippe; Scheibner, fide Borza 1969.

d) Findings of Microfossils:
Stomiosphaeridae Wanner (emend. Nowak 1968).
1) Below the Malmica zone there occurs a microfacies with *Cadosina* (= *Carpistomiosphaera) borzai* (Nagy) and *Stomiosphaera moluc-*

cana Wanner; Hungary — the Mecsek Mts (Nagy 1966, 1971); Czechoslovakia — the Pieniny Mts: the Kysuca succession, the Brodno klippe; the Czorsztyn succession: Jarabina — Litmanova; the Pruské succession (= the Niedzica succession): the Jerky stream n. Medné; the Manin succession Belušske Slatiny (Borza 1964, 1969); Poland — the Silesian Carpathians, the Cieszyn succession: Cisownica — Tuł (Nowak 1968a, 1973a); the Pieniny, the Niedzica succession: the Niedzica village (klippes above the Niedzica village); the Kosarzyska — Buwałd Valley; the Branisko succession: Kapuśnica (Nowak, 1973a).

Tintinnida

1) Above the Malmica zone, occasionally containing in the covering a microfacies with one — layer Stomiosphaerids of the Cieszynica zone and specimens of *Chitinoidella* Doben (cf. Borza, 1969; Nowak, 1968a, 1973a), there occur Calpionellidae; Hungary — the Mecsek Mts (Nagy, 1966, 1971); Czechoslovakia — the Pieniny Mts: the Czorsztyn, Pruske, Podbiele, Kysuca and Manin successions (Borza, 1969); Poland — the Silesian Carpathians, the Cieszyn succession: Cisownica — Tuł (Nowak, 1968a); the Pieniny Mts: the Hulina, Niedzica and Branisko successions (Nowak, 1971b, 1973a) [1].
2) Above the lowest member of Cieszyn limestones (with limestones blocks of the Malmica zone), there occur Calpionellidae; the Silesian Carpathians, the Cieszyn succession: Kamienica, Jasienica (Nowak, 1968a, 1968b, 1973a, 1973b).

DESCRIPTION OF PROFILES WITH FINDINGS OF *PARASTOMIOSPHAERA MALMICA* (BORZA) FROM THE TERRITORY OF THE POLISH CARPATHIANS

THE SILESIAN CARPATHIANS

From the region the Silesian Carpathians samples for examination were taken from the following profiles of Lower and Upper Tithonian and of Berriasian of the Cieszyn succession:

a) Cisownica — Tuł near Goleszów (cf. Fig. 1)
b) Cisownica village
c) Kamienica near Bielsko Biała
d) Jasienica near Bielsko Biała
e) Harbutowice near Skoczów
f) Radziechowy near Żywiec.

[1] Calpionellidae Bonet occurring in the region of the Polish part of the Pieniny Klippen Belt were also mentioned by Birkenmajer in a number of papers. The point of time at which they had occurred above the Saccocoma (Lombardia) microfacies or a microfacies with Saccocoma (Lombardia) and Globochaete alpina was regarded as a boundary between Kimmeridgian and Lower Tithonian (Birkenmajer, 1958, 1963, 1965, 1973), and not as one between Lower and Upper Tithonian.

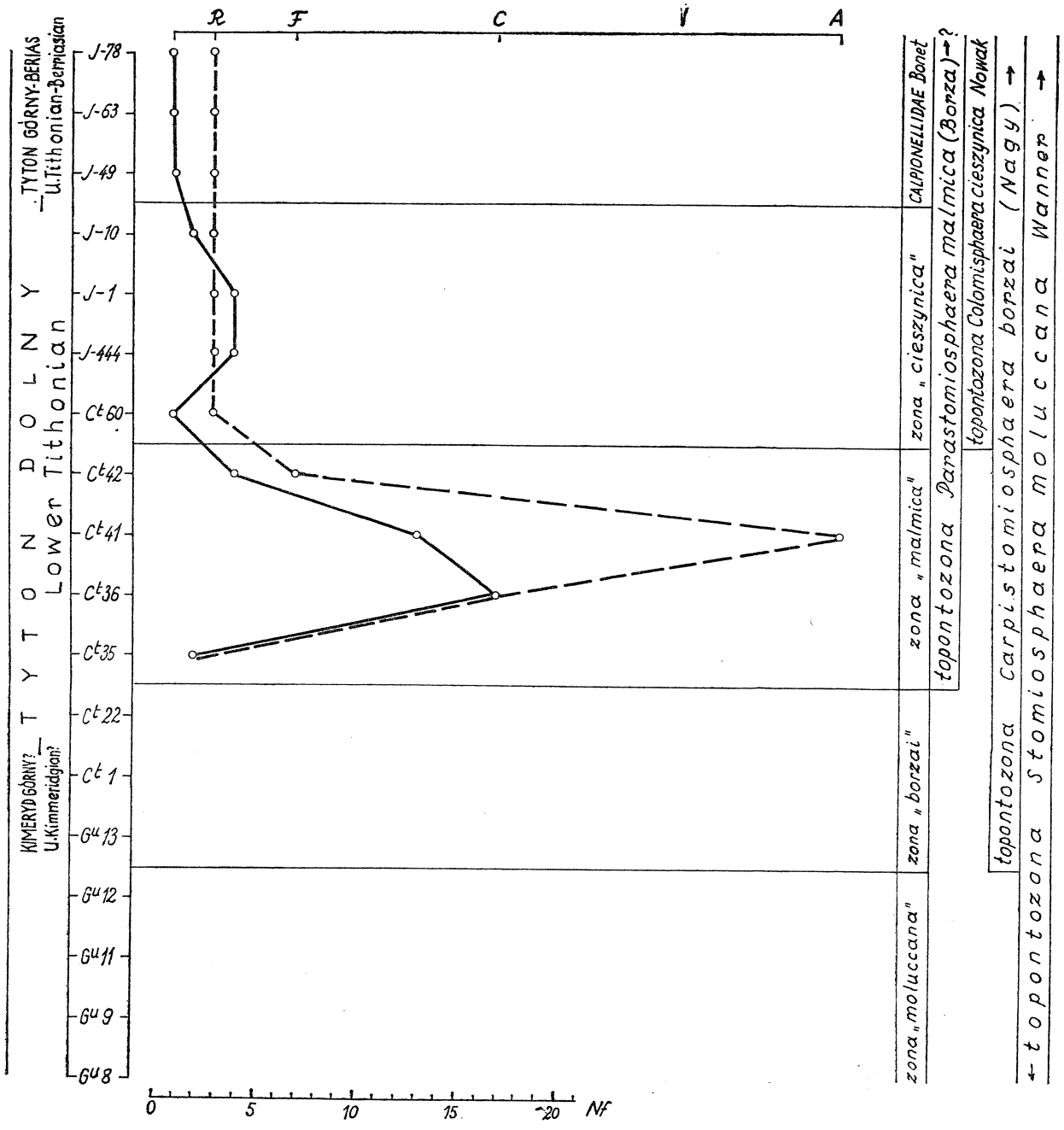


Fig. 4. A scheme of localization and frequency of occurrence of *Parastomiosphaera malmica* (Borza) in the collective profile: Gumna — Cisownica Tuł — Jasienica. Dashed line — frequency of occurrence of *P. malmica* specimens (cf. unnumbered scale: R, F, C, A); continuous line — number of represented forms (cf. number scale: Nf)

Fig. 4. Wykres rozmieszczenia i częstotliwości występowania *Parastomiosphaera malmica* (Borza) w zbiorczym profilu: Gumna — Cisownica Tuł — Jasienica. Linia przerywana — częstotliwość występowania okazów *P. malmica*; (por. skala nieliczbowa: R, F, C, A); linia ciągła — ilość reprezentowanych form (por. skala liczbowa: Nf)

a) Cisownica — Tuł profile

The Radoń stream, flowing from under the Tuł Mountain and crossing Cisownica, in its upper course shows a profile of deposits of the Cieszyn succession: from the Lower Cieszyn Shales, through the Cieszyn Lime-

stones to the Upper Cieszyn Shales, belonging to the digitation nappe of Tuł (Burtanówna, Konior, Książkiewicz, 1937; Książkiewicz, 1964, 1968; Nowak, 1968a, Fig. 3).

Samples for examination were taken from beds within the Lower Cieszyn Shales, in which the author had previously found specimens of *P. malmica* (Borza), i.e. from the beds indicated with the symbols: CT 60, CT 42, CT 41, CT 36, and CT 35 (cf. Fig. 5).

So-called younger fauna of Aptychi comes from this profile from the beds CT 36 and CT 39 (cf. Gąsiorowski in: Nowak, 1973 b, pp. 404—405); it is represented by:

Lamellaptychus group A *beyrichi* (Opp.) f. typ. Trauth,
Lamellaptychus group A cf. *beyrichi* (Opp.) em. Trauth
Lamellaptychus group A „sp." indet.:

a) a form without lateral depression
b) a form with normal general inflexion, with axis crossing the marginal point;
c) a form with sculpture resembling the sculpture of *Lamellaptychus mortilleti* (Pictet et Loriol);

Lamellaptychus group A, or
Punctaptychus group A — a form with normal general inflexion, with axis crossing the lateral edge;
Laevaptychus (Obliquuslaevaptychus) „sp." indet.;
Laevaptychus (indet. fragments).

According to Gąsiorowski (op. cit.), the occurrence of Laevaptychi in this assemblage is a premise for regarding it as older than Middle Tithonian; in general, it points out to the Lower Tithonian (higher part of subzone VI-1). In the lower part of the profile, starting from the beds CT 34 to CT 1 there have been found assemblages of Stomiosphaerids without the *P. malmica* species. The following species are represented there: *Colomisphaera pulla* (Borza), *Carpistomiosphaera borzai* (Nagy), *Stomiosphaera moluccana* Wanner, *S. colomi* Durand Delga, *S. moreti* Durand Delga, *Colomisphaera ornata* Nowak, and also *Cadosina fusca* Wanner, problematic globigerines (? „Protoglobigerinae") and segments of planktonic Crinoids — *Saccocoma* Agassiz — in detrital material.

The composition of the microfossils mentioned above, among others the presence of the species *C. borzai* (since *P. malmica* is absent there), seems to point to the fact this section of the profile already belongs to an older zone of Stomiosphaerids, described as the „Borzai zone".

Rich fauna comes from the lowest part of this section from the bed Ct 1 — which has a character of an Aptychus breccia (Gąsiorowski in: Nowak, 1973 b, p. 404). The fauna occurring there is composed of:

Lamellaptychus group C?

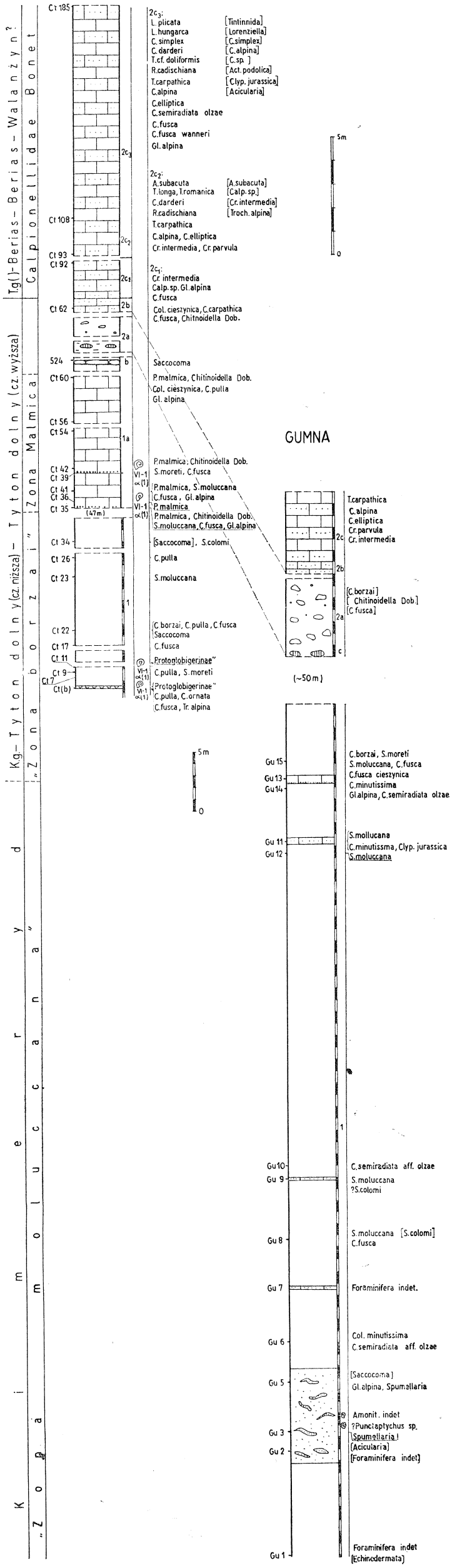


Fig. 5. Lithostratigraphic profiles of the Upper Jurassic of the Cieszyn succesion (group) in Cisownica Tuł and Gumna near Cieszyn. 1 — Lower Cieszyn Shales; 1a — limestones of the Góra Tuł Member; 2 — Cieszyn Limestones; 2a — shales with exotics of the Kamienica Member; 2b — limestones of the Jasienica — Łazy Member; 2c — limestones of the Jasieniowa Member

Fig. 5. Profile litologiczno-stratygraficzne górnej jury sukcesji (grupy) cieszyńskiej w Cisownicy Tuł i Gumna koło Cieszyna. 1 — łupki cieszyńskie dolne; 1a — ogniwo wapieni z Góry Tuł; 2 — wapienie cieszyńskie; 2a — ogniwo łupków z blokami egzotykowymi z Kamienicy; 2b — ogniwo wapieni z Jasienicy — Łaz; 2c — ogniwo wapieni z Jasieniowej

Lamellaptychus group A cf. *beyrichi* (O p p.)
Lamellaptychus group A „sp." indet.:

a) a form with normal general inflexion — with axis crossing the external edge;
b) a form with axis crossing the marginal point;
c) a form with axis crossing the lateral edge;
d) a form with parallel ribs;
e) a form with general retroverse inflexion.

Lamellaptychus group B?
Punctaptychus sp. indet.
Laevaptychus sp. indet.

This fauna also corresponds to subzone VI-1. A small number of Punctaptychi in this assemblage, as well as its lower position in the profile may, according to G ą s i o r o w s k i (op. cit.), point out to its affiliation to the lower part of subzone VI-1-alpha, i.e., to the Upper Kimmeridgian rather than Lower Tithonian.

Above the profile, starting from CT 62 to CT 80, already within the limestones without Calpionellidae (cf. Fig. 5—2b), there occurs an assemblage composed of: *Colomisphaera cieszynica* N o w., *C. minutissima* (C o l.), *C. pulla* (B o r z a), *Stomiosphaera moreti* D u r a n d D e l g a, *Cadosina fusca* W a n. and *C. semiradiata* W a n., *Chitinoidella* D o b e n, *Globochaete,* calcareous benthonic foraminifers and fragments of *Saccocoma* — found in the detrital material. This section of the profile corresponds to the „Cieszynica zone."

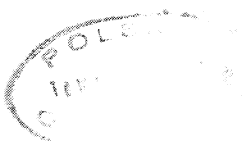
First specimens of Calpionellidae occur in the profile, starting from the bed CT 82 (so called limestones with Calpionellidae; Fig. 5—2c).

b) t h e C i s o w n i c a v i l l a g e p r o f i l e.

Samples for examination come from limestone blocks occurring in the lowest member of Cieszyn limestones, which are a component of the Goleszów digitation (B u r t a n ó w n a, K o n i o r, K s i ą ż k i e w i c z, 1937; K s i ą ż k i e w i c z, 1964, 1968, 1972).

The blocks, mentioned above, occur among weathering waste in the terrace bluff, above the shale exposure with 3 horizons of calcareo-siderite concretions (N o w a k, 1973 b, p. 404), visible it the right slope of the big meander of the Radoń stream, not far from the local sawmill. Above them, higher stratigraphically, there is an exposure of the Cieszyn limestones (cf. the Geological Map of the Silesian Carpathians, B u r t a n ó w n a et al., op. cit.; K s i ą ż k i e w i c z, 1964, 1968). Limestones from the sample CA 12 represent a microfacies characteristic of the Malmica zone, with a great number of specimans of the *P. malmica* species (cf. Plate II, Fig. 1—2).

Apart from limestones of the type mentioned above, there also occur limestones with Stomiosphaerids there, that are characteristic of the „Cieszynica zone".



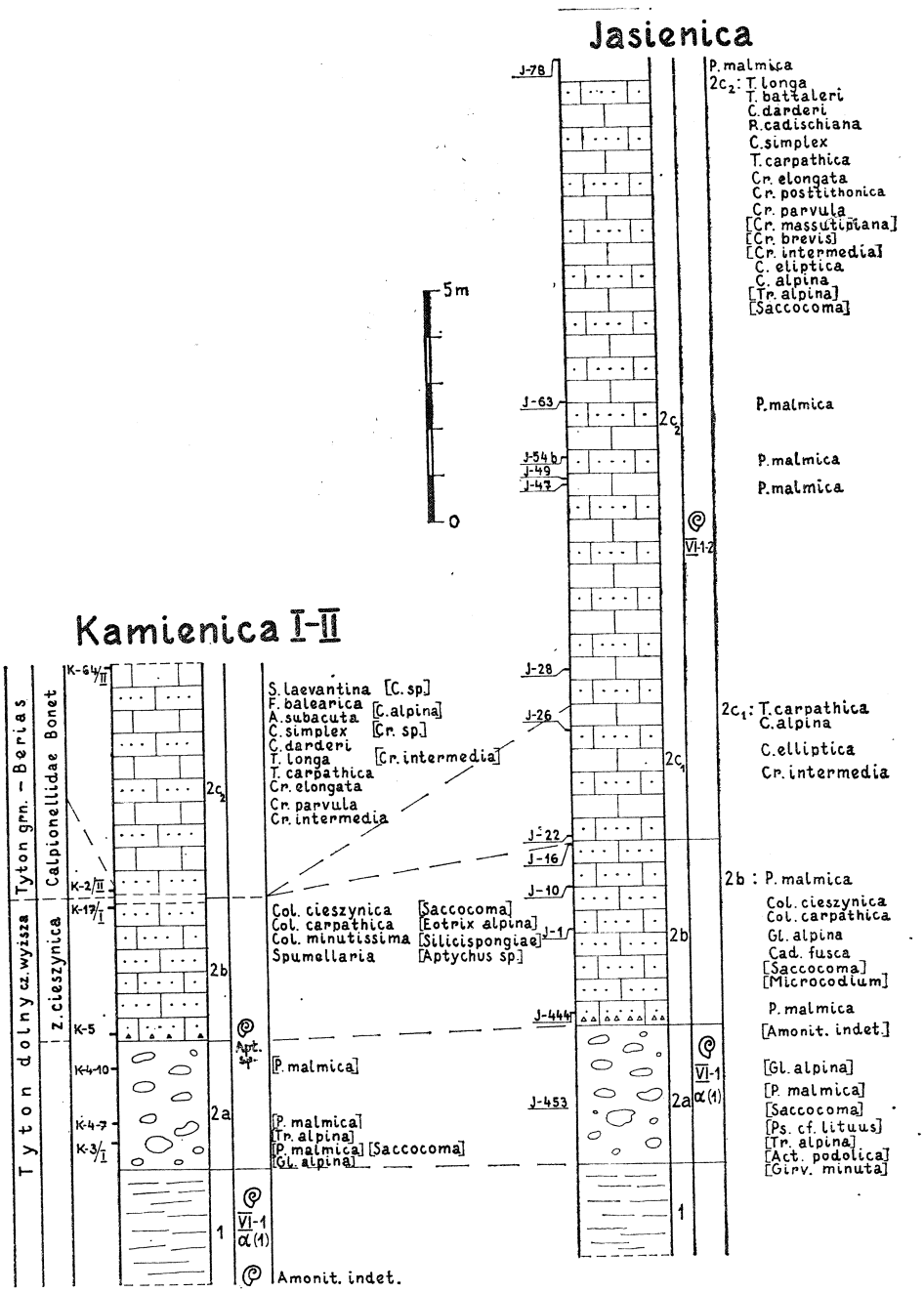


Fig. 6. Lithostratigraphic profiles of the Upper Jurassic of Cieszyn succession (group) in Kamienica I—II and Jasienica near Bielsko-Biała. 1 — Lower Cieszyn Shales; 2 — Cieszyn Limestones; 2a — Shales with exotics of the Kamienica Member (locus typicus); 2b — Limestones of the Jasienica — Łazy Member; 2c — Limestones of the Jasieniowa Member

Fig. 6. Profile litologiczno-stratygraficzne górnej jury sukcesji (grupy) cieszyńskiej w Kamienicy I—II i Jasienicy koło Bielska-Białej. 1 — łupki cieszyńskie dolne; 2 — wapienie cieszyńskie; 2a — ogniwo łupków z blokami egzotykowymi z Kamienicy (locus typicus); 2b — ogniwo wapieni z Jasienicy — Łaz; 2c — ogniwo wapieni z Jasieniowej

A group of quarries on the northern slope of Jasieniowa Góra at Goleszów, described in the works of K s i ą ż k i e w i c z (1963, 1964, 1968), of G e r o c h (1967), and of P e s z a t (1967), show directly younger members of the Cieszyn limestones. In that group the profile of the quarry

„pod przekopem" („under a cross-cut") uncovers limestones without Calpionellidae in the lower part and limestones with Calpionellidae Bonet in the upper one (Geroch, Nowak, Peszat — unpublished materials); the profile of „Przekop" („cross-cut") uncovers limestones with Calpionellidae, distinguished there by Książkiewicz (1973), Morycowa and Nowak im: Geroch (1967); the profile of the „wall" uncovers detritic limestones of the upper part of the Cieszyn limestones (cf. descriptions: Książkiewicz, 1963, 1964, 1968; Geroch, 1967; Peszat, 1967).

c) Kamienica I and II profiles

The stream flowing across Kamienica shows a profile of the upper part of the shales member with exotic blocks (cf. Fig. 6) north of the road bridge. This profile has been already presented schematically (Nowak, 1968 a, Fig. 3). Also the relation between deposits occurring there and younger members of the Cieszyn limestones has been presented by this author.

Samples for biometric study come from limestone blocks, indicated with the symbols: K-4-9, K-4-7 and K-3 in figure 6.

In the zone of occurrence of exotic blocks there has been found *Lamellaptychus* „sp." indet. (described by dr Gąsiorowski in: Nowak, 1973 b), indicating the so-called younger assemblages of subzone VI-1-alpha.

Above the member with exotic blocks, starting from the bed K-I-5 to K-I-17, there occur deposits that belong to the limestones without Calpionellidae member. In beds of the intrasparite type the following species have been found: *Colomisphaera cieszynica* Now., *C. carpathica* (Borza), and Spumellariae, spiculas of Silicispongiae, fragments of *Saccocoma* Agas., and fragments of undefined Aptychi (cf. Fig. 6, bed K-I-5). The Stomiosphaerids assemblage corresponds to the Cieszynica zone.

The younger member of Cieszyn limestones is visible in a quarry, indicated as Kamienica II. In the beds: from K-II-2 to K-II-62 Tintinnidae are of Berriasian character. That allows to number the deposits of the Kamienica II profile among the higher part of Cieszyn limestones. A gap in exposures between the Kamienica I, and Kamienica II profiles includes the highest part of the limestones member without Calpionellidae and the lower part of the limestones with Calpionellidae of the Upper Tithonian age.

d) Jasienica profile

A quarry, now closed down, used to uncover a profile of the uppermost part of Lower Cieszyn shales and the lower part of Cieszyn limestones in the sixties (Nowak, 1964, 1968 a — Fig. 3; 1968 b, 1968 c — Fig. 1). Samples for examination come from a limestone block from the

shales member with exotic blocks, indicated with the symbol J 453, and from beds of detritic and biomicrite limestones: the limestones without Calpionellidae (J 444, J 1, J 10) and the limestones with Calpionellidae (J 54, J 63, J 78). Their position in the profile of Cieszyn limestones at Jasienica is presented in Fig. 6.

Gąsiorowski (1961) described an Aptychi assemblage from the shales member with exotic blocks from that locality. It is composed of:

Lamellaptychus group A: cf. *beyrichi* (Opp.) em. Trauth — 1 specimen

Lamellaptychus group A: „sp." indet. — 4 specimens

Laevaptychus (Obliquslaevaptychus) sp. indet. — 1 specimen

Laevaptychus (Obliquslaevaptychus) — an undefined fragment.

Originally, Gąsiorowski (1961, 1962) had numbered that assemblage among the undifferentiated subzone VI-1; later he estimated its position as corresponding to the position of so-called younger assemblages of subzone VI-1-alpha (cf. Gąsiorowski in: Nowak, 1973 b).

In the upper part of the profile of Cieszyn limestones in that quarry, starting from a sedimentary breccia bed J 03 to J 16 (cf. Fig. 6), there occur the limestones without Calpionellidae. They comprise assemblages of Stomiosphaerids, characteristic of the „Cieszynica zone" (locus typicus cf. Nowak, 1968 a). Their covering is built of limestones with Calpionellidae of the Upper Tithonian and Berriasian age (Nowak, 1968 a, 1968 b, 1968 c, 1971 a, 1971 c).

The Aptychi assemblage, mentioned by Gąsiorowski (1961, 1962), comes from the upper part of the profile of Cieszyn limestones, exposed in the neighbouring quarries at Łazy. This assemblage is composed of:

Lamellaptychus group A:

rectocostatus (Pet.) em. Trauth cf. f. typ. Trauth — 1 specimen

„sp. 1 ex gr. a Trauth" — 2 specimens

„sp." indet., without lateral depression — 1 specimen.

Unfortunately, its position in profiles of the quarries mentioned above has not been determined more precisely. According to Gąsiorowski (1961), this assemblage corresponds to the uppermost part of Dursztyn limestones in the Czorsztyn succession in the Pieniny Klippen Belt and it represents Upper Tithonian (= Transitorius zone). In the present paper, however, it has been numbered among subzone VI-2 (cf. Gąsiorowski, 1962), whose stratigraphic range, according to Durand Delga and Gąsiorowski (1971) is described as the Transitorius zone and the lower part of the Boissieri zone.

e) Harbutowice profile

In the drilling H-9, done at Harbutowice, south of Skoczów, by the Carpathian Branch of the Institute of the Geology, Upper Cieszyn Shales

and Cieszyn Limestones were found under sediments of the Silesian Paleocene — Eocene series (cf. Liszkowa, Nowak, 1970).

In the thin section prepared from an intrasparite bed from the interval 22—23 metres deep, the following have been found:

Parastomiosphaera malmica (Borza) — R

Globochaete alpina Lombard — R

Benthonic foraminifers (indet.) — R

At the same time the following foraminifers have been found in shales (determination by Liszkowa): *Glomospira* div. sp. (abundant), *Paleogaudryina? varsoviensis* (Bielecka, Pożaryski), *Trocholina* ex gr. *solecensis* Bielecka et Pożaryski, *T.* cf. *alpina* (Leupold), *Trochammina quinqueloba* Geroch. This assemblage can be compared with microfauna II — sensu Geroch (1967), occurring in Cieszyn limestones. On the other hand, the composition of microfossils found in the thin section allows us to number the drilled deposits among the limestones without Calpionellidae, since Calpionellidae are absent there.

f) Profiles at Radziechowy

Radziechowy I

A quarry near the graveyard at Radziechowy uncovers deposits about 5 metres thick, of the Upper Cieszyn Limestones (the quarry No 79 in Peszat's paper, 1967).

Nowak (1970) regarded them as belonging to the limestones without Calpionellidae in their lower part and to the limestones with Calpionellidae in the upper one; thus, he numbered them among Upper Tithonian.

A specimen belonging to the *P. malmica* species has been found in the sample R-I-32, beside ? *Crassicollaria intermedia* (Durand Delga) — R and Tintinnida indet. — R, coming from a bed 2,5 metres away from the bottom of the quarry.

Radziechowy VIII

In a limestone quarry, situated not far from the chapel, there is visible a profile, about 30 metres thick, of Upper Cieszyn Limestones (the quarry No 80 in Peszat, 1967), Nowak (1970) described them as belonging to the limestones without Calpionellidae in the lower part, and in the upper one — as belonging to the limestones with Calpionellidae member of Upper Tithonian. The specimen of *P. malmica* comes from one of the lowest beds, at that time exposed in that quarry, indicated with the symbol R-VIII-1 by the author. Apart from that, ? Tintinnida indet., and *Globochaete alpina* Lomb. have been found there. In a higher sample (R-VIII-74) the following have also been found: *Colomisphaera carpathica* (Borza), *C. minutissima* (Colom), *Cadosina fusca wanneri* Now. First determinable Calpionellidae: *Calpionella alpina* Lorenz, *C.* sp., and the undetermined ones — in intraclasts — have been des-

cribed only from the upper part of the profile in the sample R-VIII-241.

Radziechowy X

In a small quarry situated by the road from Przybędza to Góra Matyska there is, an exposure of Upper Cieszyn Limestones (the quarry No 78 in Peszat, 1967). Nowak (1970) numbered them among limestones without Calpionellidae and among limestones with Calpionellidae of the Upper Tithonian — Berriasian age. The specimen of *P. malmica* was found there in one of the lowest beds (R-X-4), in the microfossil assemblage:

Colomisphaera minutissima (Col.), *Cadosina fusca* Wan., *Globochaete alpina* Lomb., and in intraclasts: *Saccocoma* Agas., calcareous algae indet. On the other hand, a samle from the uppermost part of the profile (R-X-44) contained an assemblage composed of:

Crassicollaria intermedia (Durand Delga)
Crassicollaria massutiniana (Colom)
Crassicollaria brevis Remane
Crassicollaria parvula Remane
Crassicollaria sp. indet.
Calpionella alpina Lorenz
Tintinnopsella carpathica (Murgeanu et Filipescu)
? *Calpionellites darderi* (Colom).

THE PIENINY MOUNTAINS

Samples for examination from the region of the Pieniny Klippen Belt come from the following localities (cf. Fig. 2):

a) the Szczawnica Wyżnia — slaughter house — the Grajcarek stream profile;
b) the Szczawnica Wyżnia — Zabaniszcze profile;
c) the profile of the „West Klippe", above the Niedzica village;
d) the profile of the „East Klippe", above the Niedzica village;
e) the profile of a waterfall in the Kosarzyska — Buwałd Valley;
f) the profile of a quarry in the Kosarzyska — Buwałd Valley;
g) the Kapuśnica profile.

a) Szczawnica Wyżnia — slaughter house, the Grajcarek stream

The Grajcarek stream uncovers in the left bank — below the slaughter house at Szczawnica Wyżnia — an Upper Jurassic profile of the Hulina succession (= the Magura succession sensu Birkenmajer, 1965, 1973), from Manganese Radiolarites, through Green and Red Radiolarites, Aptychi Marls and Shales, to Cherty Limestone inclusive (cf. Fig. 7).

Birkenmajer reported in his paper (1965, p. 345) upon the occurrence of Aptychi fauna in Aptychi Shales from that locality (after un-

published materials of dr Gąsiorowski); the fauna found there corresponds to the lower part of subzone VI-1-α that has been interpreted as Upper Kimmeridgian.

Nowak (1971 b, p. 217) described a microfossil assemblage coming from Aptychi Shales of the locality mentioned above; it is composed of:

Parastomiosphaera malmica (Borza) — A

Saccocoma Agas. — A

Globochaete alpina Lombard — A

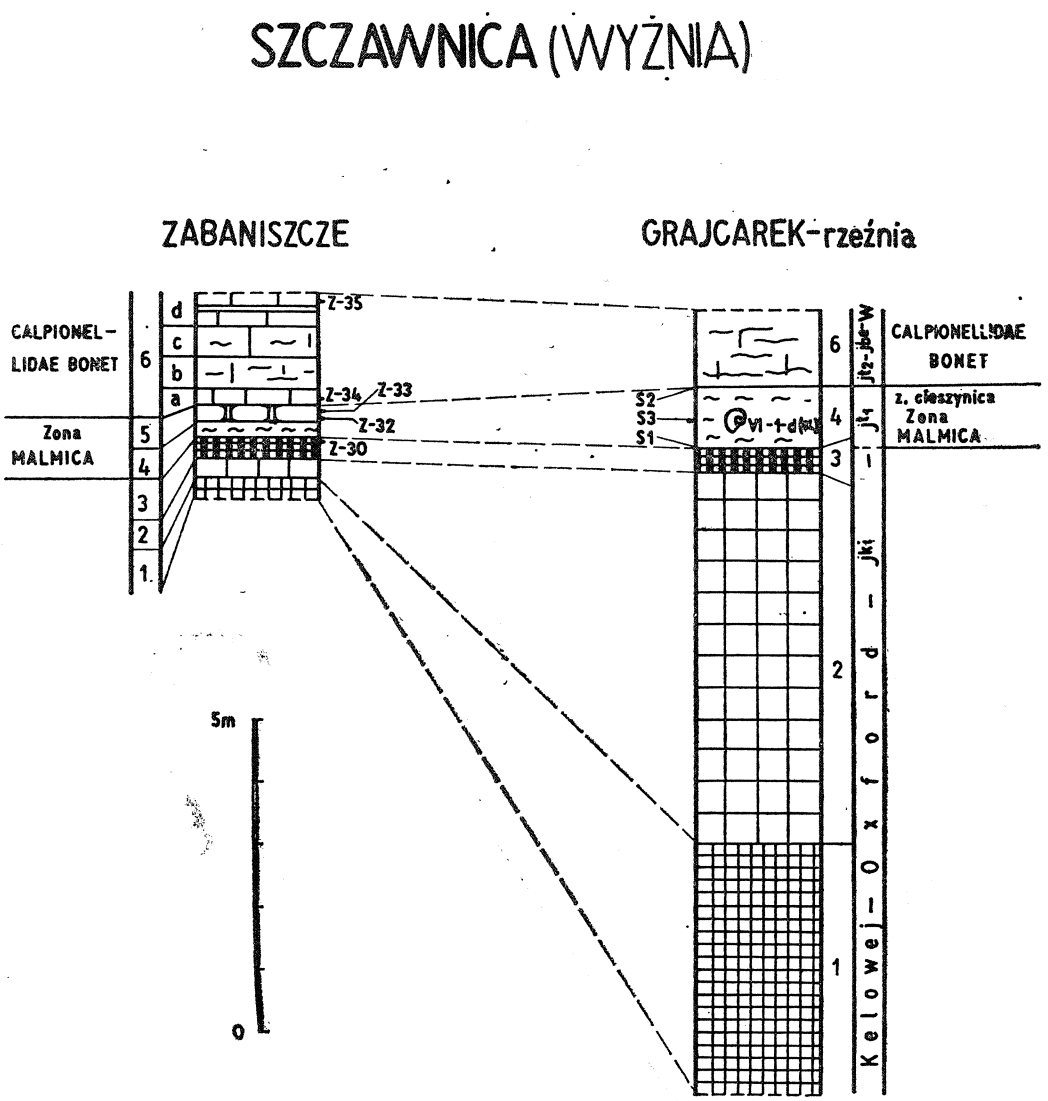


Fig. 7. Lithostratigraphic profiles of the Middle and Upper Jurassic of Hulina succession in Szczawnica Wyżnia. 1 — Manganese Radiolarites; 2 — Green Radiolarites; 3 — Red Radiolarites; 4 — Aptychi Marls and Shales; 5 — Pseudonodular Limestone; 6 — Cherty Limestone; J^{ki} — Kimmeridgian; J^{t1} — Lower Tithonian; J^{t2}—J^{be}—W — Upper Tithonian Berriasian-Valanginian

Remarks: Lithostratigraphical profile and localization of thin slides in the Zabaniszcze profile after W. Sikora 1971.

Fig. 7. Profile litologiczno-stratygraficzne środkowej i górnej jury sukcesji hulińskiej w Szczawnicy Wyżniej. 1 — radiolaryty manganowe; 2 — radiolaryty zielone; 3 — radiolaryty czerwone; 4 — margle i łupki aptychowe; 5 — wapień pseudobulasty; 6 — wapień rogowcowy; J^{ki} — kimeryd; J^{t1} — tyton dolny; J^{t2}—J^{be}—W — tyton górny-berias-walanżyn

Uwaga: litostratygrafia i lokalizacja próbek na szlify w profilu Zabaniszcze wg W. Sikory 1971.

On the basis of the above description he numbered Aptychi Shales among Lower Tithonian. This opinion was supported by a biometric study of *P. malmica* and the data obtained from it (Nowak, 1973 a). Moreover, it has been found out that in the upper part of Aptychi Shales (sample S 2) there occurs a microfacies with one-layer Stomiosphaerids, characteristic of a zone higher than the Malmica one. Considering its position in the profile and partly the microfossil composition, the former can be compared to the Cieszynica zone in the Silesian Carpathians. Such a type of microfacies can be still found in the lowest part of Cherty Limestones in this profile (samples S 4 and S 5).

b) Szczawnica Wyżnia — Zabaniszcze

Upper Jurassic deposits of the Hulina succession in the profile of the Zabaniszcze stream comprise, according to Sikora, (1971): a) Manganese Radiolarites; b) Green Radiolarites; c) green siliceous limestones in beds 1—5 centimetres thick, intercallated with red clayey shales (these deposits, according to Sikora — op cit., p. 212 — correspond to Red Radiolarites in age); d) Pseudonodular Limestone with an Aptychi Shales member at the bottom; e) Cherty Limestone.

Samples for examination come from: Pseudonodular Limestone (cf. Sikora, op. cit., p. 112, item d) — and they have been indicated with the symbols: Zab. 32 and Zab. 33 (cf. Nowak 1971 b, Fig. 33), and from siliceous limestone intercallation among red shales (cf. Sikora, op. cit., p. 212, item b) — indicated with the symbol Zab. 30 [2].

Nowak (1971 b, p. 218) found microfossils in samples indicated with the symbols: Zab. 32 and Zab. 33, which belong to:

Parastomiosphaera malmica (Borza) — A

Saccocoma Agas. — A

Globochaete alpina Lombard — A;

and in the sample Zab. 32 also to:

Carpistomiosphaera borzai (Nagy) — R.

The sample Zab. 30 represents a different microfacies in which Spumellaria prevail, while Stomiosphaerids are represented only by isolated of *P. malmica* and by specimens of ? *Carpistomiosphaera* sp. indet.

On the basis of the presence of the *P. malmica* species those assemblages had been numbered among Lower Tithonian (Nowak op. cit.), and later, as a result of a biometric study, their affiliation to the Lower Tithonian Malmica zone was confirmed (Nowak 1973 a).

In the covering of Pseudonodular Limestone in the described profile there occurs Cherty Limestone, represented by a microfacies with *Nannoconus.* In the upper part it contains isolated specimens of *Tintinnopsella carpathica* (Murgeanu et Filipescu) and *Amphorellina sub-*

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[2] In the litho-stratigraphic profile (cf. Nowak 1971 b, p. 216; Fig. 33), a sample of that limestone was indicated with the symbol Zab. 31/S.

acuta Colom., pointing possibly to ? Valanginian — Hauterivian (Nowak 1971 b). On the other hand, no Tintinnidae assemblages characteristic of the Upper Tithonian and Berriasian deposits have been found there, so far, maybe because of unsatisfactory sampling or tectonic gaps.

c) The Niedzica village, the „west" klippe

The profile of this klippe was described by Birkenmajer (1958, part III, p. 58, Fig. 80). Deposits, of which the klippe under description is built, belong to the Niedzica succession; they are, starting from the oldest ones (cf. Fig. 8): 1) „Opalinium" Marls and Shales with spherosiderites („Murchisonae" Shales), 2) White Crinoidal Limestone, 3) Red Crinoidal Limestone, 4) Lower Nodular Limestone, 5) Lower Red Radiolarites, 6) Green Radiolarites, 7) Upper Red Radiolarites, 8) passage beds, 9) Upper Nodular Limestone: a) Upper Nodular Limestone without Calpionellidae, b) Upper Nodular Limestone with Calpionellidae.

Samples coming from Upper Nodular Limestone (the section that belongs to the Malmica zone), indicated with the symbols Ni80/5 and Ni80/6, were the subject of examination.

Birkenmajer (1958) regarded the lower part of Nodular Limestone without Calpionellidae as belonging to Kimmeridgian, while Upper Nodular Limestone with Calpionellidae — as belonging to Lower Tithonian.

Gąsiorowski (1962) found Aptychi assemblages corresponding to subzone IV-2 (Uppermost Oxfordian) in passage beds from Upper Red Radiolarites to Upper Nodular Limestone; in Upper Nodular Limestone — faunas from zone V (= Lower Kimmeridgian) and subzone VI-1-alpha-lower part (= Upper Kimmeridgian — lower part of Lower Tithonian). The Aptychi fauna of subzone VI-1-alpha-lower part, coming from Upper Nodular Limestone without Calpionellidae, has been interpreted as Upper Kimmeridgian.

Nowak (1973 a) has found: *Colomisphaera fibrata* (Nagy) — in the lowest part of Upper Nodular Limestone; *Saccocoma* microfacies with *Carpistomiosphaera borzai* (Nagy) — in the middle part (about 3 metres from the bottom of Upper Nodular Limestone); numerous specimens of *P. malmica* — in the upper part, also in the *Saccocoma* microfacies and in the microfacies with *Saccocoma* and *Globochaete alpina.*

New data obtained from the studies done recently also point to the fact that the first metres of Upper Nodular Limestone above the Malmica zone cannot be numbered among so-called Upper Nodular Limestone with Calpionellidae (sensu Birkenmajer op. cit.) yet, since they are represented by a microfacies of the same type as the one below in the profile with numerous *Saccocoma, Globochaete* and one — layer Stomiosphaerids. They seem to correspond to assemblages of the „Cieszynica zone", while Calpionellidae are entirely absent there. The latter

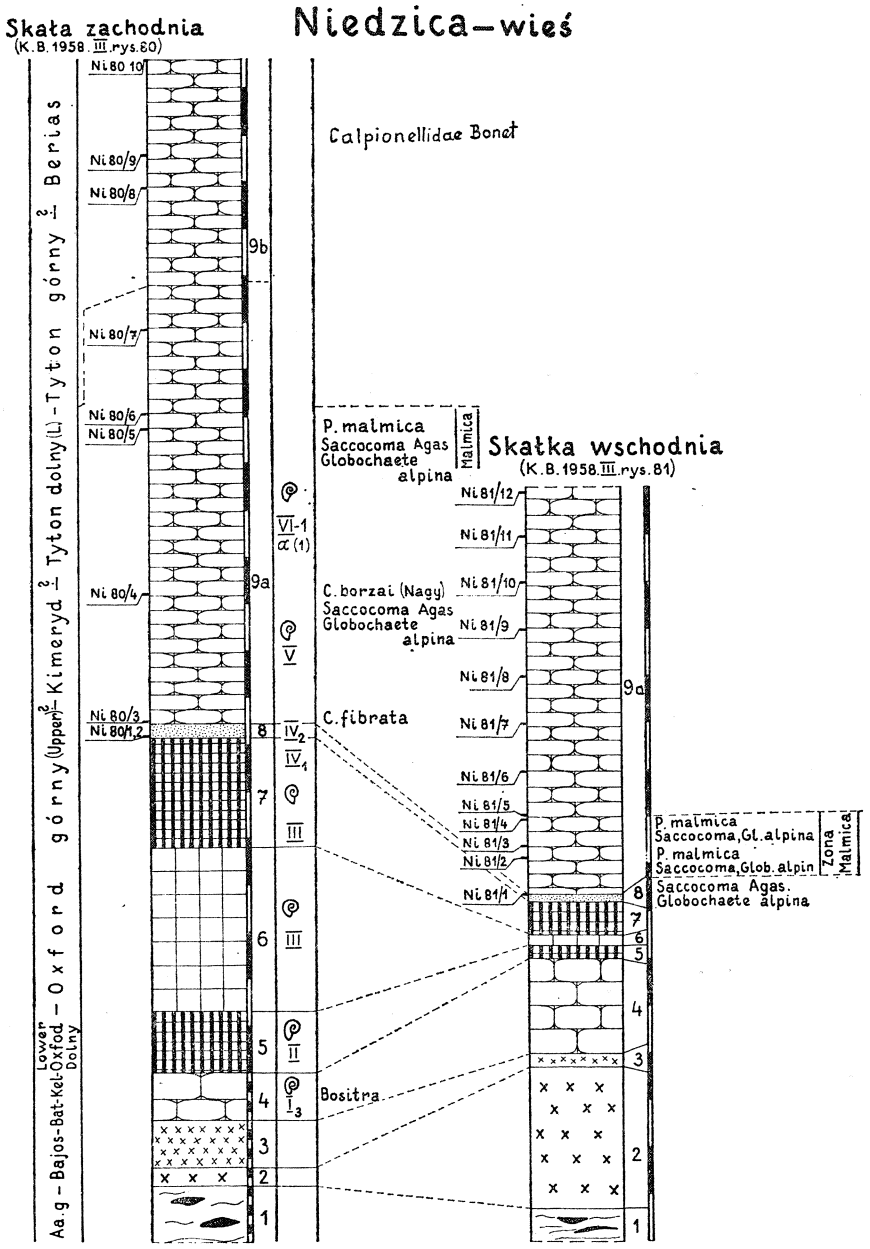

Fig. 8. Lithostratigraphic profiles of the Middle and Upper Jurassic Niedzica succession in the klippes above Niedzica — wieś (Pieniny Klippen Belt). 1 — shales with sphaerosiderites; 2 — White Crinoidal Limestone; 3 — Red Crinoidal Limestone; 4 — Lower Nodular Limestone; 5 — Lower Red Radiolarites; 6 — Green Radiolarites; 7 — Upper Red Radiolarites; 8 — passage beds; 9 — Upper Nodular Limestone; a — Upper Nodular Limestone without Tintinnids; b — Upper Nodular Limestone with Tintinnids

Fig. 8. Profile litologiczno-stratygraficzne środkowej i górnej jury sukcesji niedzickiej w skałkach powyżej Niedzicy — wsi. 1 — łupki sferosyderytowe; 2 — wapień krynoidowy biały; 3 — wapień krynoidowy czerwony; 4 — wapień bulasty dolny; 5 — radiolaryty czerwone dolne; 6 — radiolaryty zielone; 7 — radiolaryty czerwone górne; 8 — warstwy przejściowe; 9 — wapień bulasty górny; a — wapień bulasty górny bez tintinnidów; b — wapień bulasty górny z tintinnidami

occur only above them, and in the part exposed at present they go as far as Berriasian, inclusively (= zone B — upper part sensu R e m a n e, 1964, 1968).

d) The Niedzica village, the „east" klippe

The profile of the klippe was described by Birkenmajer (1958, part III, pp. 61—62, Fig. 81). Jurassic deposits that occur here belong to the Niedzica succession. The lithostratigraphic profile shown in Fig. 8 in the present paper comprises only deposits of the lowest tectonic scale (older than the „beds with globigerinids and radiolarians"). The following can be found in the scale (overturned series): 1) Shales with spherorosiderites, 2) White Crinoidal Limestone, 3) Red Crinoidal Limestone, 4) Lower Nodular Limestone, 5) Lower Red Radiolarites, 6) Green Radiolarites, 7) Upper Red Radiolarites, 8) a tectonic breccia at the boundary of Upper Red Radiolarites and Upper Nodular Limestone ? = passage beds ?, 9) Upper Nodular Limestone, a — Upper Nodular Limestone without Calpionellidae.

Samples for examination were collected from Upper Nodular Limestone, containing specimens of *P. malmica*; in the profile they were indicated with the symbols: Ni 81/2 and Ni 81/4 (cf. Fig. 8).

Nowak (1973 a) found abundant specimens of *P. malmica* in them; that allowed him to number those assemblages among the Lower Tithonian Malmica zone.

The sample Ni 81/1, that comes from Upper Nodular Limestone of the immediate vicinity of the „passage beds" represents a microfacies with *Saccocoma* and *Globochaete alpina* without *P. malmica*.

However, the fact that other Stomiosphaerids are absent there does not allow an evaluation whether the microfacies still represents Lower Tithonian, or already Kimmeridgian. A low position of the Malmica zone in this profile points to the fact that the tectonic gap between Upper Red Radiolarites and Upper Nodular Limestone is at least 5—6 metres, in comparison with the profile of the „west" klippe from the Niedzica village.

The eastern part of the klippe described above uncovers younger parts of Upper Nodular Limestone without Calpionellidae. They represent microfacies with *Saccocoma* and *Globochaete alpina*, and one-layer Stomiosphaerids of the type mentioned above. These limestones also occur in overturned position here. They are in tectonic contact either with Radiolarites or directly with Lower Nodular Limestone.

e) The profile of the „waterfall" in the Kosarzyska — Buwałd Valley

The profile of the Upper Jurassic Niedzica succession in the Kosarzyska — Buwałd Valley (the „waterfall") was described and illustrated by Birkenmajer (1958, part III, pp. 48—51, Figs. 78—79). Starting from the oldest deposits, he distinguished the following members within Upper Jurassic: a) Upper Red Radiolarites, b) passage beds between Radiolarites and Upper Nodular Limestone, c) Upper Nodular Limestone without Calpionellidae and with Calpionellidae, d) Cherty Limestone (Biancone).

In this profile the Upper Nodular Limestone without Calpionellidae

and with Calpionellidae was described as belonging to Kimmeridgian — Valanginian, while the Cherty Limestone — as belonging to Valanginian — Hauterivian (Birkenmajer, op. cit.).

Gąsiorowski (1962) described the Aptychi fauna of this profile, coming from all deposits described above: in the Upper Radiolarites he distinguished an Aptychi assemblage, corresponding to zone III and subzone IV-1 (Upper Oxfordian); in the passage beds from Upper Red Radiolarites to Upper Nodular Limestone he distinguished subzones IV-1 and IV-2 (Upper Oxfordian); in the Upper Nodular Limestone — zone V (= Lower Kimmeridgian) and subzone VI-1-alpha-lower part (= Upper Kimmeridgian); in the Biancone Limestones — zone VIII (Valanginian — Barremian).

In this profile, chosen as a model for establishing the position of the Malmica zone because of favourable Aptychi records, no *P. malmica* specimens have been found, unfortunately despite the very dense sampling (cf. Fig. 9). However, since the Malmica zone was discovered in a near-by quarry (see: item f, the quarry profile in the Kosarzyska — Buwałd Valley, p. 113), it is possible that the absence of the described zone in the „waterfall" profile may be caused by a gap, probably between the localities at which the samples Kos. 23 and Kos. 24 were collected. At that place two different microfacies occur, one very close to the other. One microfacies (mainly *Saccocoma* Agas.), that occurs lower in the profile, is characteristic of the lower part of Upper Nodular Limestone. The other (*Chitinoidella* Doben, one-layer Stomiosphaerids and *C. cieszynica* Now.) is characteristic of zones underlying deposits with Calpionellidae, which constitute its covering in the described profile (Fig. 9).

In this profile there is only a limited possibility of a direct correlation of Stomiosphaerid zones with Aptychi ones. Also the lack of full data concerning the localization of Aptychi faunas make the task still more difficult, apart from their general affiliation to appropriate lithostratigraphic units distinguished in the profile.

It seems inquestionable that the fauna of zone V corresponds to the lower part of profile ot the Upper Nodular Limestone without Calpionellidae (probably it does not rich more than 5 metres from the bottom of Upper Nodular Limestone). On the other hand, establishing the position of the fauna of subzone VI-1-alpha-lower part happens to be rather difficult. As it has been already stated above, it can be seen from the microfacial analysis that there may exist a gap between the samples Kos. 23 and Kos. 24 (among others, the absence of the Lower Tithonian Malmica zone, already mentioned). It might be expected then that the Aptychi fauna of subzone VI-1-alpha-lower part should occur above the gap mentioned above, since it is different from the fauna of zone V. On the other hand, however, this fauna — corresponding to the lower part of subzone VI-1-alpha (so-called „Faunas 1" — sensu Gąsiorow-

ski, 1962, p. 59) — is characteristic, among others, of Upper Nodular Limestone without Calpionellidae. It is not unlikely then that this fauna should come from the section of the profile below the spot where the sample Kos. 27 was collected. At that place in the profile, i.e. about 1,3 metres from the supposed gap and about 6,5 metres from the bottom of Upper Nodular Limestone, there occur first specimens belonging to Calpionellidae. At present, however microfacies occurring there (Kos. 24—

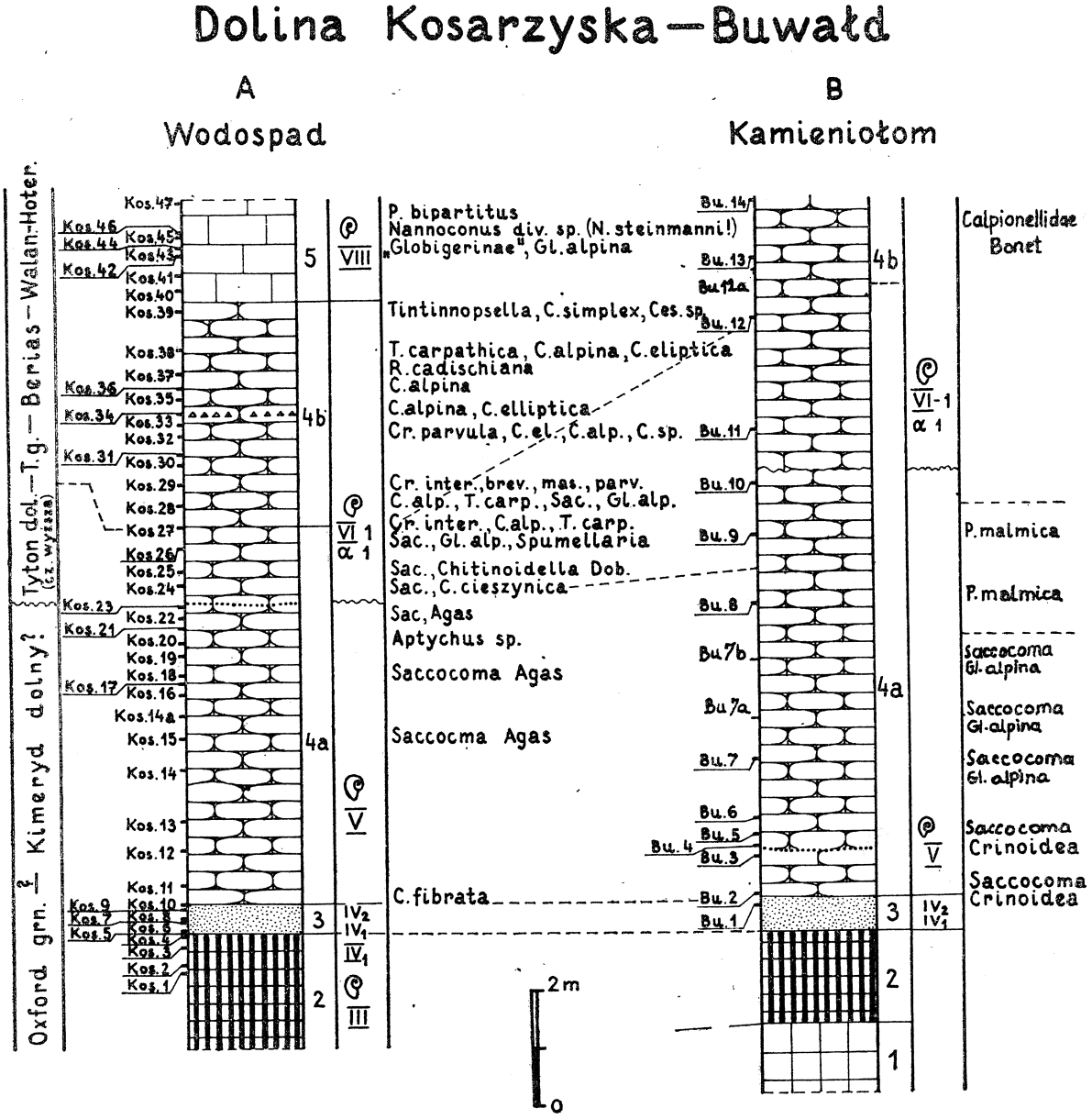

Fig. 9. Lithostratigraphic profiles of the Upper Jurassic of Niedzica succession in the Dolina Kosarzyska — Buwałd (Pieniny Klippen Belt). 1 — green Radiolarites; 2 — Upper Red Radiolarites; 3 — passage beds; 4 — Upper Nodular Limestone; a — Upper Nodular Limestone without Tintinnids; b — Upper Nodular Limestone with Tintinnids; 5 — cherty limestone

Fig. 9. Profile litologiczno-stratygraficzne górnej jury sukcesji niedzickiej w Dolinie Kosarzyskiej — Buwałd. 1 — radiolaryty zielone; 2 — radiolaryty czerwone górne; 3 — warstwy przejściowe; 4 — wapień bulasty górny; a — wapień bulasty górny bez tintinnidów; b — wapień bulasty górny z tintinnidami; 5 — wapień rogowcowy

Kos. 26) are older than the zone with Calpionellidae, but at the same time they are not older than the Lower Tithonian Malmica zone (probably Lower Tithonian-upper part).

f) The quarry profile in the Kosarzyska — Buwałd Valley

This Klippe was described by Birkenmajer (1958, part III, p. 52, Fig. 79). It is built of Jurassic deposits that belong to the Niedzica succession. The following are found in it:

1) Green Radiolarites, 2) Upper Red Radiolarites, 3) passage beds between Upper Red Radiolarites and Upper Nodular Limestone, 4) Upper Nodular Limestone: a) — Upper Nodular Limestone without Calpionellidae and b) — Upper Nodular Limestone with Calpionellidae (cf. Fig. 9).

Gąsiorowski (1962) described Aptychi assemblages from this profile that come Green Radiolarites — zone III (= Upper Oxfordian--lower part); from Upper Red Radiolarites, passage beds and from Upper Nodular Limestone (without Calpionellidae) — Aptychi faunas from zone III to subzone VI-1-alpha-lower part, similarly as in the „waterfall" profile.

The subject of examination were samples collected from Upper Nodular Limestone, from the contact area with passage beds to its latest exposures, adjacent to the quarry dump (cf. Fig. 9). Samples containing specimens of *P. malmica* are indicated with the symbols Bu 8 and Bu 9 in the profile.

In a sample indicated with the symbol Bu 9 numerous specimens of the *P. malmica* species have been found; it gave grounds for describing the assemblage of this sample as belonging to the Malmica zone, while Upper Nodular Limestone without Calpionellidae from this locality — as belonging to Lower Tithonian (Nowak, 1973 a). The presents of the Malmica zone in the described profile were then confirmed in the following sample (Bu 8). That allows the Malmica zone to comprise deposits of Upper Nodular Limestone without Calpionellidae that are at least 1,5 metres thick.

Upper Nodular Limestone without Calpionellidae that occurs in this profile below the Malmica zone represents microfacies with *Saccocoma* and microfacies with *Saccocoma* and *Globochaete alpina,* while the one above the Malmica zone (about 4,5 metres thick) — is characteristic of microfacies with *Saccocoma* and *Globochaete alpina* containing one-layer Stomiosphaerids, mentioned above.

Upper Nodular Limestone with Calpionellidae is found there only in the last section of the profile, exposed at present (sample Bu 14). The assemblage that is present there, composed of *Calpionella alpina* Lor., *C.* sp., *Tintinnopsella carpathica* (Murgeanu et Filipescu), *Remaniella cadischiana* (Colom), is of Berriasian age (= ? subzone D-1, sensu Remane in: Le Hegarat, Remane, 1968).

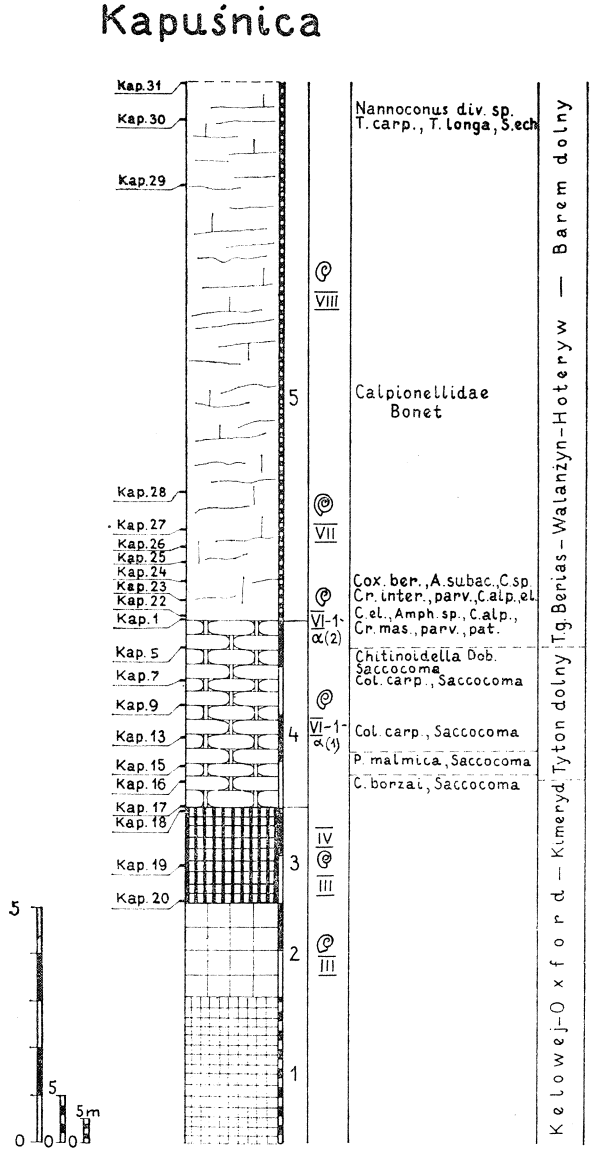

Fig. 10. Lithostratigraphic profile of the Branisko succession in Kapuśnica (Pieniny Klippen Belt). 1 — Manganese Radiolarites; 2 — Green Radiolarites; 3 — Red Radiolarites; 4 — Pseudo-nodular Limestone; 5 — Cherty Limestone

Fig. 10. Profil litostratygraficzny sukcesji braniskiej w Kapuśnicy. 1 — radiolaryty manganowe; 2 — radiolaryty zielone; 3 — radiolaryty czerwone; 4 — wapień pseudobulasty; 5 — wapień rogowcowy

g) The Kapuśnica profile

In the Kapuśnica profile the subject of examination were samples of Pseudonodular Limestone and of the Biancone type limestone — to Nodular Limestone inclusively; the limestones were uncovered on the left bank of the Dunajec river, oposite the Niedzica castle. This profile was described in detail by Birkenmajer (1958, part III, p. 32, Fig. 75) and, since then, it has been mentioned several times in the author's later papers. The section of the profile described in the present paper (cf. Fig. 10) was numbered among the Branisko succession by Birkenmajer (op. cit.).

According to him (Birkenmajer, 1965, 1973), Pseudonodular

Limestone of this succession belongs to Kimmeridgian, while Cherty Limestone — to Lower Tithonian-Lower Barremian.

Gąsiorowski (1962) described an Aptychi assemblage corresponding to zones III and IV (= Upper Oxfordian) from Red Radiolarites of the examined profile; from Pseudonodular Limestone — subzone VI-1-alpha-lower part (= Upper Kimmeridgian); from passage beds between Pseudonodular Limestone and Biancone Limestone — subzone VI-1-alpha-upper part (= lower part of Lower Tithonian); and from Biancone Limestone — zone VII (= Berriasian) and zone VIII (Valanginian — Lower Barremian) [3].

Nowak (1973 a) found abundant examples of the *P. malmica* species in Pseudonodular Limestone (a sample indicated with the symbol Kap. 15, cf. Fig. 10) — situated about 1 metre down from the top of Red Radiolarites, and a microfacies with *Saccocoma* and *Globochaete alpina* with the species *Carpistomiosphaera borzai* (Nagy) occurring in great numbers — about 0,3 metre below. On that basis the above mentioned part of profile of Pseudonodular Limestone can be numbered among the Malmica and the „Borzai" zones. Also in so-called „passage beds" — 0,6 metre away from the bottom of Cherty Limestone (the sample Kap. 5, cf. Fig. 10), there has been found an assemblage composed of: *Chitinoidella* Doben, *Saccocoma* Agas., *Globochaete alpina* Lomb., *Colomisphaera carpathica* (Borza, Spumellaria and Silicispongiae, while in the bottom be of Cherty Limestone (the sample Kap. 1, cf. Fig. 10) — an assemblage with Calpionellidae of Berriasian age (= ? subzone B-upper part, sensu Remane 1964, Remane in: Le Hegarat, Remane, 1968). The latter assemblage is composed of *Crassicollaria intermedia* (Durand Delga), *Cr. massutiniana* (Colom), *Cr. parvula* Remane, *Crassicollaria* — pathological forms, *Calpionella elliptica* Cadisch, *C. alpina* Lorenz, ? *Amphorellina subacuta* Colom and Spumellaria and *Globochaete alpina* Lomb. The sample for biometric study comes from the Malmica zone and is indicated with the symbol Kap. 15.

AN ATTEMPT AT CORRELATION OF THE PARASTOMIOSPHAERA MALMICA ZONE AND AMMONITES AND APTYCHI

On the basis of presented data it can be observed that the position of the Malmica zone in the region of the Polish Carpathians corresponds to its assumed position in the Czechoslovakian part of the Pieniny Klippen Belt (cf. Borza 1969), and in the Mecsek Mountains (Nagy 1971).

The Malmica zone always occurs above the *Saccocoma* (*Lombardia*)

[3] According to a more recent interpretation by Durand Delga and Gąsiorowski (1971), the undivided zone VII comprises, apart from Berriasian, also Valanginian, while the undivided zone VIII comprises Hauterivian and Barremian.

microfacies or above the microfacies with *Saccocoma* (*Lombardia*) and *Globochaete alpina* containing *Carpistomiosphaera borzai* (Nagy) and *Stomiosphaera moluccana* Wanner. In the region of the Silesian Carpathians where the microfossils mentioned above do not form homogeneous microfacies but are only an accessory element in intrasparite layers that occur among the shale deposit (calcareous flysch), the Malmica zone is situated higher in the profile than deposits containing specimens of *C. borzai* (Nagy), *S. moluccana* Wanner, *Saccocoma* Agas., *Globochaete alpina* Lomb. Above the Malmica zone there always occur microfacies with Calpionellidae Bonet (Czechoslovakia — the Pieniny Mts., Hungary — the Mecsek Mts., Poland — the Pieniny), or deposits of calcareous flysch. Within the latter, biomicrite or intrasparite intercalations contain representatives of Calpionellidae Bonet, occasionally even in very numerous (Poland — the Silesian Carpathians).

The boundary of the Malmica zone with Calpionellidae is also confirmed by a number of zones of smaller importance. The following zones were distinguished for the first time in their borderland in the Pieniny region in Czechoslovakia by Borza (1969): a) a zone with *Cadosina* (*Colomisphaera*) *pulla,* b) a zone with *Chitinoidella dobeni,* c) a zone with *C. boneti,* and d) a zone with *Praetintinnopsella andrusovi.*

In connection with Ammonites (Hungary — the Mecsek Mountains, Czechoslovakia — the Pieniny), the position of the Malmica zone can be relatively well described as far as its age is concerned, i.e. above the Beckeri zone and below the Transitorius one. Such a position is not denied by other macrofossils, mentioned above (cf. p. 95), found in the Czechoslovakia part of the Pieniny Klippen Belt. On the other hand, the occurrence of the Ammonites: *Ptychophyloceras ptychoicum, Pygope triangulus* and *Rhynchonella spoliata,* together with specimens cf. *C. borzai* at the base of the Malmica zone in the Brodno Klippe, points to the fact that the lower boundary of the Malmica and of the „Borzai" zones runs above the bottom of Lower Tithonian. Those data also point out that the boundary of the Kimmeridgian and Tithonian stages is situated within the „Borzai zone", in its upper part (cf. Table 1). A certain age discrepancy is visible, however, at the attempt at correlation of Stomiosphaerids and the Malmica zone with Aptychi levels, as presented by Gąsiorowski (1962), and Durand Delga, Gąsiorowski (1971). In the case that is now being considered this disagreement is basically connected with age interpretation of the Aptychi subzone VI-1-alpha. Among others, Aptychi faunas coming from deposits in which the species *Parastomiosphaera malmica* (Borza) was found recently, have been described as belonging to this subzone.

According to Gąsiorowski (1962), subzone VI-1-alpha represents Upper Kimmeridgian and Lower Tithonian, i.e. it corresponds to Ammonite zones: from the Beckeri zone to the Ciliata one.

The Kimmeridgian part of this subzone is dated by the fauna (1) coming from Upper Nodular Limestone of the Niedzica succession and from Nodular or Pseudonodular Limestone of the Branisko succession. This fauna (1) takes up a lower position than the fauna (2) found in passage beds — between Nodular or Pseudonodular Limestone and Biancone Limestone of the Branisko succession. Fauna (2) is almost identical with fauna (1) (cf. Gąsiorowski, op. cit. p. 59). However, in rocks containing fauna (2) there occur Calpionellidae, which are absent in rocks with fauna (1). On the basis of the above data, as well as in connection with the occurrence of Tithonian Ammonites together with Calpionellidae and Aptychi fauna (3) in Red Rogoźnik Lumachelle, Aptychi faunas (2), (3), and also (4) have been numbered among Lower Tithonian, among appropriate Aptychi subzones:

fauna (4) — subzone VI-1-gamma
fauna (3) — „ VI-1-beta
fauna (2) — „ VI-1-alpha-upper part.

On the other hand, fauna (1) has been described as belonging to Upper Kimmeridgian (corresponding to the Beckeri zone), i.e. to the lower part of subzone VI-1-alpha (cf. Table 1); it was done on the basis of its occurrence in rocks without Calpionellidae, and because of its lower position in relation to fauna (2). On the same basis the Aptychi assemblage was numbered among Upper Kimmeridgian by Birkenmajer (1965). This assemblage had been described by Dr. Gąsiorowski from Aptychi shales of the Szczawnica Wyżnia — slaughter house profile, and later interpreted by Birkenmajer (op. cit.) as the lower part of subzone VI-1-alpha.

It could be gathered from the above data that the Malmica zone in the Polish part of the Pieniny Klippen Belt is of the Upper Kimmeridgian age and not of the Lower Tithonian one, as it was pointed out by the data concerning other regions.

It is still an open question whether, in fact, the Malmica zone occurred earlier — already in Upper Kimmeridgian in the region of the Polish Pieniny Mts., or whether the correlation of Aptychi with Ammonites was not so precise as to give grounds for solving the problem of age of deposits containing the species *P. malmica* (Borza).

It should be stressed that the correlation based on microfossils — microfacies does not show such a disagreement, at least an evidenced one, in relation to other areas. The sequence of corresponding microfacies is always the same (cf. Tables 2 and 3). That seems to point to the fact that they are important not only as the same biostratigraphic zones but probably also as chronostratigraphic ones. The biometric study of the species *P. malmica* (Borza) from the region of the Pieniny Mts and the Flysch West Carpathians also confirms this opinion (cf. Fig. 11).

It seems then that there is ground for accepting the attempts at age

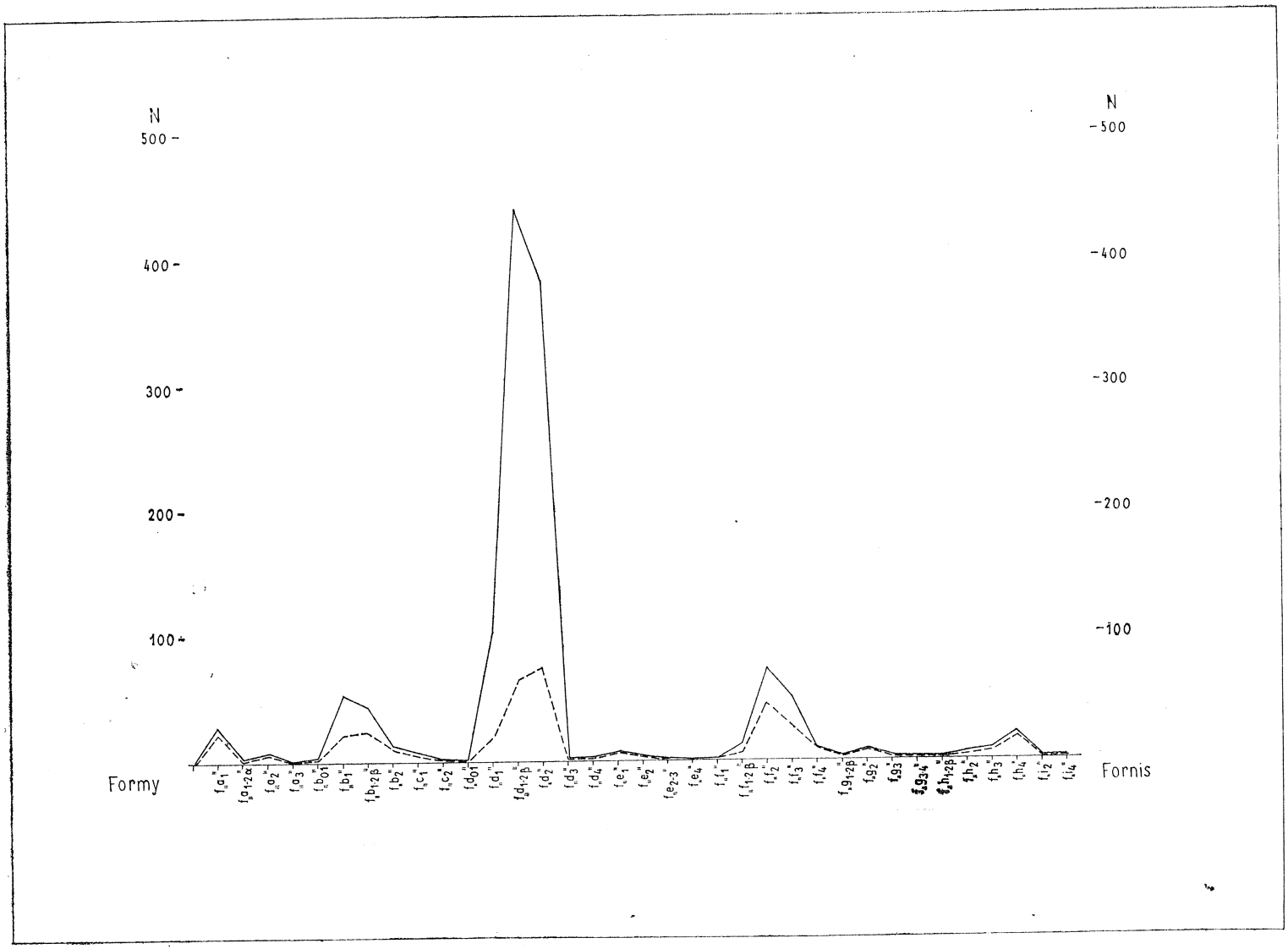

Fig. 11. Frequency distribution of the diverse forms of *Parastomiosphaera malmica* (B o r z a) in the Lower Tithonian deposits (zone Malmica) in the Polish Carpathians

Remarks: dashed-line — Silesia Carpathians; continuous-line — Pieniny; — N number of specimens

Fig. 11. Porównawczy wykres zawartości form *Parastomiosphaera malmica* (B o r z a) w utworach tytonu dolnego (zona Malmica) w Karpatach Śląskich i polskiej części pienińskiego pasa skałkowego

Uwaga: linia przerywana — Karpaty Śląskie; linia ciągła — Pieniny; N — ilość egzemplarzy

correlation of Stomiosphaerids with Ammonites, worked out from the Mecsek Mts and the Czechoslovakian part of the Pieniny Mts, as useful in relation to the territory of Poland. Otherwise, the earlier-than-in-other-areas occurrence of the described microfacies, inclusive of the Malmica zone, should be considered as a special case; so far there has not been enough paleontological material to evidence it.

There are, however recent data that allow a modification of the accepted zonal scheme of Aptychi and of further conclusions concerning the attemptes at correlation with Ammonite zones. In relation to the works by Remane (1963, 1964) and by others, especially by Le Hégarat, Remane (1968), and by Alleman, Catalano, Fares, Remane (1971), it is accepted now that the first appearance of Tintinnidae (= Calpionellidae Bonet) establishes the boundary between Lower and Upper Tithonian, and not between Kimmeridgian and Tithonian — as it has been generally assumed, so far.

According to this arrangement, the boundary between Lower and Upper Tithonian in the Aptychi scheme, worked out by Gąsiorowski (1962), and Durand Delga, Gąsiorowski (1971), runs within the Aptychi subzone VI-1-alpha i.e. between fauna (1) and (2), and not between VI-1-gamma and VI-2-alpha (cf. Table 1) — as it was accepted before. In concequence, since fauna (1) is almost identical with fauna (2), the two faunas cannot be used to establish this boundary. Furthermore, within the lower part of the Aptychi subzone VI-1-alpha, there should run an important boundary between the Kimmeridgian and Tithonian stages. However, as it can be seen from investigations carried on so far, this boundary is not reflected in assemblages of the Aptychi faunas in that part of subzone VI-1-alpha. A distinct boundary is visible only between the faunas mentioned above and the ones belonging to zone V.

It is an open question then whether the boundary between the Kimmeridgian stage and the Tithonian one can be found within zone VI — within the Aptychi fauna of the lower part of subzone VI-1-alpha, or between the fauna of zone VI and that of zone V ?

It should be observed that the Kimmeridgian age of zone V can be justified by the correlation of Aptychi faunas with Ammonite zones in the region of Swabian Albian, where the fauna corresponds to the „gamma" Malm and to the „delta" Malm. On the other hand, there is no such justification for the Kimmeridgian age (Upper Kimmeridgian) of the lowest part of zone VI (lower part of subzone VI-1-alpha). As it has been already mentioned, its age was established on the basis of a higher position of the faunas of this subzone in relation to the faunas of zone V in the Pieniny region, as well as on the basis of their lower position than the position of occurrence of Calpionellidae and also of the Tithonian Ammonites from Rogoźnik (cf. Gąsiorowski, 1962).

It is an open question then whether the lower part of subzone

VI-1-alpha without Calpionellidae corresponds exclusively to the Ammonite zones of Hybonotum-Ciliata, or whether the Upper Kimmeridgian Beckeri zone is also represented beside them — in the lowest part of the described Aptychi subzone. A further question is still to be answered: whether Upper Kimmeridgian is represented in the Aptychi fauna of the Swabian Albian of the „delta" Malm, numbered among zone V. As it is well known, the „delta" Malm (= Aulacostephanus pseudomutabilis zone) was numbered among the upper part of Lower Kimmeridgian (sensu anglico) by Arkell (1956); this zone (the Pseudomutabilis zone) is nowadays generally accepted as the uppermost zone of Upper Kimmeridgian. It should be also observed that Neumayr (1873) — the author of the „Beckeri zone", included the Pseudomutabilis zone in it, while distinguishing the former one. The Beckeri zone, thus understood, sensu Neumayr (op. cit.), separated the Tenuilobatus zone from Lower Tithonian one: the Lithographica zone and the Hybonotum one. Also other German geologists (fide Arkell, op. cit.) approved of the age equivalent of the Pseudomutabilis and Beckeri zones; recently also Ziegler (1958) accepted that opinion. As it can be seem from the above reasoning, it seems very probable that within the Aptychi zone V there may be present an equivalent of the Beckeri zone.

It seems right that the Ammonite zones mentioned above are not numbered among different Aptychi stages, until it has been definitely decided whether the Beckeri zone and the Pseudomutabilis one are exactly of the same age, or perhaps the Beckeri zone takes up a somewhat higher position within Upper Kimmeridgian in relation to the Pseudomutabilis zone. The author of the present paper has considered the possibility of age correlation of the Ammonite zones mentioned above — as corresponding to Upper Kimmeridgian (= „delta" Malm — sensu Quenstedt), which has expressed in literature. He thus thinks it is groundless to number the lower part of subzone VI-1-alpha among the Beckeri zone, or to assume a boundary between zone V and zone VI, separating Lower Kimmeridgian from Upper one. He is of the opinion that the Beckeri zone can be included in the Aptychi zone V; according to him the boundary between Kimmeridgian and Tithonian runs between this zone and zone VI.

In conclusion, it should be pointed out the Aptychi subzone VI-1-alpha cannot be helpful in establishing boundaries within Tithonian in a more detailed way. It happens so because of its vast age range — from the Hybonotum zone to the Transitorius one. At the same time, the assemblages of Aptychi faunas that belong to this subzone cannot be the basis for answering the question whether deposits with the fauna of this subzone, containing the *P. malmica* species, are of the Upper Kimmeridgian or of Lower Tithonian age. At the present stage of studies these faunas can be used for biostratigraphic purposes in connection with correspond-

ing microfacies only (cf. Table 1). It is caused by the fact that at least 3 different Stomiosphaerid zones (the „Borzai zone" — pro parte, the Malmica zone and the Cieszynica zone = the „Pulla" zone — sensu Borza + Chitinoidella zones — sensu Borza 1969) corespond to subzone VI-1-alpha in its lower part only.

* * *

The new data that have been obtained recently allow a correction of the age range of the Aptychi subzone VI-1 and thus of the age of some formations in the region of the Silesian Carpathians and the Polish part of the Pieniny Kippen Belt. They have some bearing on problems of paleogeography and diastrophism in the Carpathian geosyncline during Kimmeridgian and Tithonian.

I) Suggested changes in the age range of Aptychi subzones:
   a) The Upper Kimmeridgian — Lower Tithonian age accepted for subzone VI-1 (Gąsiorowski, 1962; Durand Delga, Gąsiorowski, 1971) should be changed into Lower and Upper Tithonian (lower part).
   b) The Upper Kimmeridgian — Lower Tithonian age (lower part), accepted for subzone VI-1-alpha (op. op. cit.), should be changed into Lower and Upper Tithonian (lower part).
   c) The Upper Kimmeridgian age, accepted for the lower part of subzone VI-1-alpha should be changed into Lower Tithonian.
   d) The Lowér Tithonian age (lower part), accepted for the upper part of subzone VI-1-alpha (op. op. cit.), should be changed into Upper Tithonian.
   e) The Lower Tithonian age (lower part), accepted for the subzones VI-1-beta and VI-1-gamma should be changed into Upper Tithonian.

II) Remarks on Aptychi assemblages of the Cieszyn succession:
   a) The Aptychi assemblage from Łazy—Jasienica, numbered among the undifferentiated subzone VI-1 (Gąsiorowski, 1961, 1962), should be numbered among fauna equivalents of the lower part of subzone VI-1-alpha (= Lower Tithonian).
   b) The assemblage of Aptychi breccia from the Cisownica—Tuł profile, numbered among subzone VI-1 (= Upper Kimmeridgian — Lower Tithonian) and accepted as Upper Kimmeridgian rather than Lower Tithonian (Gąsiorowski in: Nowak, 1973 a), should be regarded as corresponding to the Lower part of subzone VI-1-alpha (= Lower Tithonian).
   c) Aptychi assemblages from Kamienica, Grodziec, Pogórze near Skoczów, together with the „younger" assemblage from Cisownica—Tuł, numbered among subzone VI-1 and accepted as Lower Tithonian (Gąsiorowski in: Nowak, 1973 b), should be

numbered among the lower part of subzone VI-1-alpha (Lower Tithonian).

III) Remarks concerning the age of deposits belonging to the Cieszyn succession:

a) In the Lower Cieszyn Shales there occur Aptychi assemblages corresponding to the lower part of subzone VI-1-alpha (rec.). Their occurrence in the Cisownica—Tuł profile in the upper part of the described lithostratigraphic unit — within the Malmica zone, points out to its Lower Tithonian age. On the other hand, their presence in the lower part of the Cisownica—Tuł profile and in the Gumna profile — within the „Borzai zone", gives grounds for numbering the above mentioned sections of profile of the Lower Cieszyn Shales occurring below the Malmica zone, among Lower Tithonian — Upper Kimmeridgian.

b) In the Cieszyn limestones, in the member with exotic material in limestone blocks there occurs an Aptychi fauna corresponding to the lower part of subzone VI-1-alpha (rec.) (cf. Łazy—Jasienica), as well as microfacies corresponding to the Malmica zone (Kamienica, Jasienica) and also to the „Borzai" and Chitinoidella (Gumna) zones. Most probably, the following Ammonites also come from this member: *Hybonoticeras hybonotum* and *Taramelliceras succedens*, found by Oppel (1865) at Radziechowy, and also the fauna of the Štramberk type, with *Pseudovirgatites scruposus* among others, described by Blaszke (1911). So far, no limestone blocks or intercalations with Calpionellidae have been found within this member. Thus the latter member is of the pre-Upper Tithonian age (upper part of Lower Tithonian).

c) In the limestone member without Calpionellidae there occurs a Stomiosphaerid assemblage, characteristic of the „Cieszynica zone" (Jasienica, Kamienica, Cisownica—Tuł, the Cisownica Village); On the other hand, representatives of Calpionellidae Bonet are absent there. This member is of the pre-Upper Tithonian age (upper part of Lower Tithonian), and it resembles the age of the exotic member.

d) Younger members of the Cieszyn limestones, eg. limestone members with Calpionellidae, shale members at Góra Zamkowa and detritic limestones distinguished as „Upper Cieszyn Limestones", containing Aptychi of subzone VI-2 (Jasienica—Łazy) (cf. Gąsiorowski, 1961, 1962) and Calpionellidae, are of the Upper Tithonian and Berriasian age, and probably also of the Valanginian age.

IV) Remarks concerning the age of lithostratigraphic units of the Pieniny Klippen Belt:

a) The Kimmeridgian age, accepted for the Upper Nodular Lime-

stone without Calpionellidae in the Niedzica succesion (Birkenmajer, 1958, 1965, 1973), should be changed into Kimmeridgian — Lower Tithonian.

b) The Kimmeridgian age, accepted for Aptychi Marls and Shales in the Magura succession (= Hulina succession — sensu Sikora) (op. op. cit.), should be changed into Lower Tithonian.

c) The Kimmeridgian age, accepted for the Pseudonodular Limestone of the Branisko succession (op. op. cit.), should be changed into ? Upper Kimmeridgian — Lower Tithonian.

d) The Lower Tithonian age, accepted for the lower boundary of Cherty Limestone with Calpionellidae in the Magura (= Hulina — sensu Sikora), Branisko and Pieniny successions (op. op. cit.) should be changed into Upper Tithonian.

e) The Lower Tithonian age, accepted for the lower boundary of the Dursztyn limestones with Calpionellidae Bonet in the Czorsztyn succession (op. op. cit.) should be changed into Upper Tithonian.

f) The Lower Tithonian age, accepted for the lower boundary of Red Calpionella Limestones in the Czertezik and Niedzica successions should be changed into Upper Tithonian.

g) The Lower Tithonian age, accepted for the Lower boundary of Upper Nodular Limestone with Calpionellidae in the Niedzica succession (op. op. cit.) should be changed into Upper Tithonian.

V) Remarks on Stomiosphaerid zones:

a) The ?Middle — ?Upper Tithonian age accepted by the author for the Colomisphaera cieszynica zone (Nowak 1968), should be changed into Lower Tithonian — the upper part, according to the present division of the Tithonian.

b) The Lower and probably Upper Tithonian age, accepted by the author for the Parastomiosphaera malmica zone (op. cit.) should be changed, according to the present division, into Lower Tithonian.

c) Because of a vast age range of the index species *Colomisphaera pulla* (Borza), the Pulla zone distinguished by the author (op. cit.) is now substituted by the „Borzai zone" (sensu Borza 1969, and Nagy 1971), of the age range: Upper Kimmeridgian — Lower Tithonian (lower part).

CONCLUSIONS

The *Parastomiosphaera malmica* (Borza) species occurs in Tithonian and Berriasian deposits in the region of the Polish Carpathians. All the same, its abundant occurrence has been observed in Lower Tithonian

only. It then forms a characteristic microfacies (= the Parastomiosphaera malmica zone) with *Saccocoma* Agas., *Globochaete alpina* Lomb., Spumellaria an other planktonic microfossils in different successions and in deposits very different from one another, as far as their lithological structure is concerned. This microfacies is to be found in a vast area of the Silesian Carpathians and the Pieniny Klippen Belt and it always takes up the same, constant position in relation to the „Lombardia" microfacies with *Carpistomiosphaera borzai* (= the „Borzai" zone), and to the microfacies with Calpionellidae Bonet. Its biofacial character, as well as the fact that it was found in the territory of Czechoslovakia and Hungary, seem to point out that it might be very widely spread in the area of the Mediterranean province during Lower Tithonian. The fact that up till now it has not been found in other regions than the ones mentioned above, may be connected with unfavourable conditions of its preservation and recognition, among others in connection with a possible general silicification of deposits of that period.

With reference to the results of studies carried on in the Polish Carpathians and the data obtained from the region of the Mecsek Mountains and the Czechoslovakian part of the Pieniny Klippen Belt, the abundant occurrence of the species *Parastomiosphaera malmica* (Borza), connected with its development optimum, can be regarded as an indication of the Lower Tithonian age.

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REFERENCES
WYKAZ LITERATURY

Allemann F., Catalano R., Fares F., Remane J. (1971), Standard Calpionellid Zonation (Upper Tithonian — Valanginian) of the Western Mediterranean Province. *Proc. II Planctonic Conference Roma 1970.* Roma.

Arkell W. J. (1956), Jurassic geology of the world. Edinburgh—London.

Birkenmajer K. (1958), Przewodnik geologiczny po pienińskim pasie skałkowym. cz. III. Wycieczki w rejonie Falsztyn—Czorsztyn—Niedzica—Sromowce. Wyd. Geol. Warszawa.

Birkenmajer K. (1963), Stratygrafia i paleogeografia serii czorsztyńskiej pienińskiego pasa skałkowego (Stratigraphy and paleogeography of the Czorsztyn Series — Pieniny Klippen Belt, Carpathians — in Poland). *Studia geol. pol.* 9, Warszawa.

Birkenmajer K. (1965), Zarys budowy geologicznej pienińskiego pasa skałkowego (Outlines of the Geology of the Pieniny Klippen Belt). *Rocz. Pol. Tow. Geol.* 35, 3, pp. 327—356, Kraków.

Birkenmajer K. (1973), Jura. Pieniński pas skałkowy. Budowa geologiczna Polski, t. I, cz. 2. Mezozoik. Wyd. Geol. Warszawa.

Blaszke F. (1911), Zur Tithonfauna von Stramberg in Mähren. *Ann. d. Naturhist. Hofmus.*, Bd. XXV, Wien.

Borza K. (1964), Die Gattung Stomiosphaera Wanner 1940 in den Westkarpaten. *Geol. Sborn.* 15, 2, p. 189—195, Bratislava.

Borza K. (1969), Die Mikrofazies und Mikrofossilien des Oberjuras und der Unterkreide der Klippenzone der Westkarpaten. *Slov. Ak. Ved.* Bratislava.

Burtanówna J., Konior K., Książkiewicz M. (1937), Mapa geologiczna Karpat Śląskich. Pol. Ak. Um. Wyd. Śląskie, Kraków.

Durand Delga M., Gąsiorowski S. M. (1971), Les niveaux a Aptychus dans les pays autour de la Méditerranée occidentale et dans les Carpathes. *C. R. Acad. Sc. Paris,* t. 270, p. 767—770, Paris.

Gąsiorowski S. M. (1961), Nowe dane o wieku warstw cieszyńskich serii śląskiej. *Spraw. Posiedz. Komis. PAN,* Kraków.

Gąsiorowski S. M. (1962), Aptychi from the Dogger, Malm and Neocomian in the Western Carpathians. *Studia geol. pol.* 10, Warszawa.

Gąsiorowski S. M., Nowak W. (w przygotowaniu do druku) On the Age of Lower Cieszyn Shales (Silesian series, Outer Carpathians).

Geroch S. (1966), Małe otwornice dolnej kredy serii śląskiej w Polskich Karpatach (Lower Cretaceous Small Foraminifera of the Silesian Series, Polish Carpathians). *Rocz. Pol. Tow. Geol.* 36, 4, p. 413—480, Kraków.

Geroch S. (1967), Some assemblages of microfauna from the silesian series of the Western Polish Carpathians. *Biul. IG* 211, p. 369—381, Warszawa.

Le Hégarat G., Remane J. (1968), Tithonique superieur et Berriasien de l'Ardèche et de l'Hérault. Corrélation des Ammonites et des Calpionelles. *Geobios* 1, p. 7, Lyon.

Książkiewicz M. (1951), Regionalna Geologia Polski, t. 1, z. 1. Karpaty. Wyd. Pol. Tow. Geol., Kraków.

Książkiewicz M. (1963), Karpates externes, guide des excursions. *Assoc. Géol. Karpato-Balkanique, VI-ème Congres.* Excursion A-I. Varsovie—Cracovie.

Książkiewicz M. (1964), On the Tectonics of the Cieszyn Zone. A. Reinterpretation. *Bull. Acad. Pol. Sci., sér. géol. géogr.* V, 12. nr 4, Varsovie.

Książkiewicz M. (1968), Geology of the Polish Flysch Carpathians. Guide to Excursion No C44 Poland. *Intern. Geol. Congress XXIII Ses. Prague 1968.* Wyd. Geol. Warszawa.

Liszkowa J., Nowak W. (1970), Wyniki wierceń kartujących z lat 1965—1966 w okolicach Skoczkowa. *Kwart. geol.* 14, nr 4, Warszawa.

Nagy I. (1966), A Stomiosphaera és Cadosina nemzetség rétegtani szerepe a mecseki felsöjúrában. (Sur le ròle stratigraphique des genres Stomiosphaera et Cadosina dans le Jurassique supérieure de la Montagne Mecsek). *Földtani Közlöny,* 96, 1, p. 86—104. Budapest.

Нагы И. (1971), Расчленение верхнеюрских отложений гор Мечек по ископаемым организмам.
Ann. Inst. Geol. Publ. Hung., vol. LIV, fasc. 2, p. 319—332, Budapest.

Neumayr M. (1873), Die Fauna der Schichten mit Aspidoceras acanthicum. *Abh. Geol. Reichsanst.*, Bd. V, Wien.

Nowak W. (1964), Egzotyki z dolnych łupków cieszyńskich z Jasienicy. *Kwart. geol.* 8, nr 4, Warszawa.

Nowak W. (1965), Stomiosfery warstw cieszyńskich oraz uwagi o możliwości wyzyskania ich dla celów korelacji stratygraficznej. *Kwart. geol.* 9, nr 2, p. 443—444, Warszawa.

Nowak W. (1968a), Stomiosphaeridy warstw cieszyńskich (kimeryd — hoteryw) polskiego Śląska Cieszyńskiego i ich znaczenie stratygraficzne (Stomiosphaerids

of the Cieszyn Beds (Kimmeridgian — Hauterivian) in the Polish Cieszyn Silesia and Their Stratigraphical Value). *Rocz. Pol. Tow. Geol.* 38, 2—3, p. 275—327, Kraków.

Nowak W. (1968b), Porównanie rozwoju górnego tytonu i beriasu z Jasienicy i Cieszyna (Góra Zamkowa). *Kwart. geol.* 12, nr 4, Warszawa.

Nowak W. (1968c), Deux nouvelles espèces de *Crassicollaria* Remane 1962 (Tintinnida) du Berriasian des Carpathes Polonaises de Flysch (Dwa nowe gatunki *Crassicollaria* Remane 1962 (Tintinnida) z beriasu Polskich Karpat fliszowych). *Rocz. Pol. Tow. Geol.* 38, 2—3, p. 329—334, Kraków.

Nowak W. (1970), Zagadnienie litologicznej i stratygraficznej korelacji wapieni cieszyńskich na obszarze Kotliny Żywieckiej. *Kwart. geol.* 14, nr 4, Warszawa.

Nowak W. (1971a), Distribution and Variability of Calpionella Lorenz 1902 (Tintinnida) in the Cieszyn Limestones, Polish Western Carpathians (Rozmieszczenie i zmienność *Calpionella* Lorenz 1902 (Tintinnida) w wapieniach cieszyńskich Polskiego Śląska Cieszyńskiego). *Rocz. Pol. Tow. Geol.* 41, 4, p. 571—602, Kraków.

Nowak W. (1971b), Wyniki badań mikrofacjalnych profilu Szczawnica—Zabaniszcze. Przewodnik XLIII Zjazdu Polskiego Towarzystwa Geologicznego, Kraków 12—14 września 1971. Warszawa.

Nowak W. (1971c), Zmiany patologiczne u *Crassicollaria* Remane 1962 (Tintinnida). Pathologic Changes in *Crassicollaria* Remane 1962 (Tintinnida). *Rocz. Pol. Tow. Geol.* 41, 2, p. 303—311, Kraków.

Nowak W. (1973a), Znaczenie Parastomiosphaera malmica (Borza) dla korelacji utworów dolnego tytonu w Karpatach. *Kwart. geol.* 17, nr 3, Warszawa.

Nowak W. (1973b), Jura. Karpaty zewnętrzne. Budowa geologiczna Polski t. I, cz. 2. Wyd. geologiczne, Warszawa.

Oppel A. (1865), Über die Tithonische Etage. *Z. Dtsch. Geol. Ges.* 17, Berlin.

Peszat C. (1967), Rozwój litologiczny i warunki sedymentacji wapieni cieszyńskich. (The lithological development and conditions of sedimentation of the Cieszyn limestones). *PAN, Prace geol.* 44, Warszawa.

Remane J. (1963), Les Calpionelles dans les couches de passage Jurassique — Crétacé de la fosse vocontiene. *Trav. Lab. Géol. Grenoble*, t. 39, p. 25—82, Grenoble.

Remane J. (1964), Untersuchungen zur Systematik und Stratigraphie der Calpionellen in den Jura — Kreide — Grenzschichten des Vocontischen Troges. *Palaeontographica (A)*, vol. 123, p. 1—57. Stuttgart.

Sikora W. (1971), Wycieczka D-2. Trasa: Zakopane—Szczawnica—Jaworki—Czorsztyn—Kapuśnica—Złatne—Dursztyn. Przewodnik XLIII Zjazdu Polskiego Towarzystwa Geologicznego, Kraków 12—14 wrzesień 1971. *Wyd. geol.* Warszawa.

Ziegler B. (1958), Das nordwesteuropäische Äquivalent des Suebiums. *N. Jhrb Geol. u. Paläont., Monatshefte* no 10, p. 433—436, Stuttgart.

STRESZCZENIE

W ostatnim dziesięcioleciu opisano z obszaru ČSRS (Pieniny), Węgier (Góry Mecsek) i Karpat Polskich (Śląsk Cieszyński, Pieniny) problematyczne mikroskamieniałości pod nazwą *Parastomiosphaera malmica* (Borza), mające istotne znaczenie dla celów mikrobiostratygraficznej korelacji jury górnej (K. Borza, 1964, 1969; I. Nagy, 1966, 1971; W. Nowak, 1965, 1968, 1973 a, 1973 b).

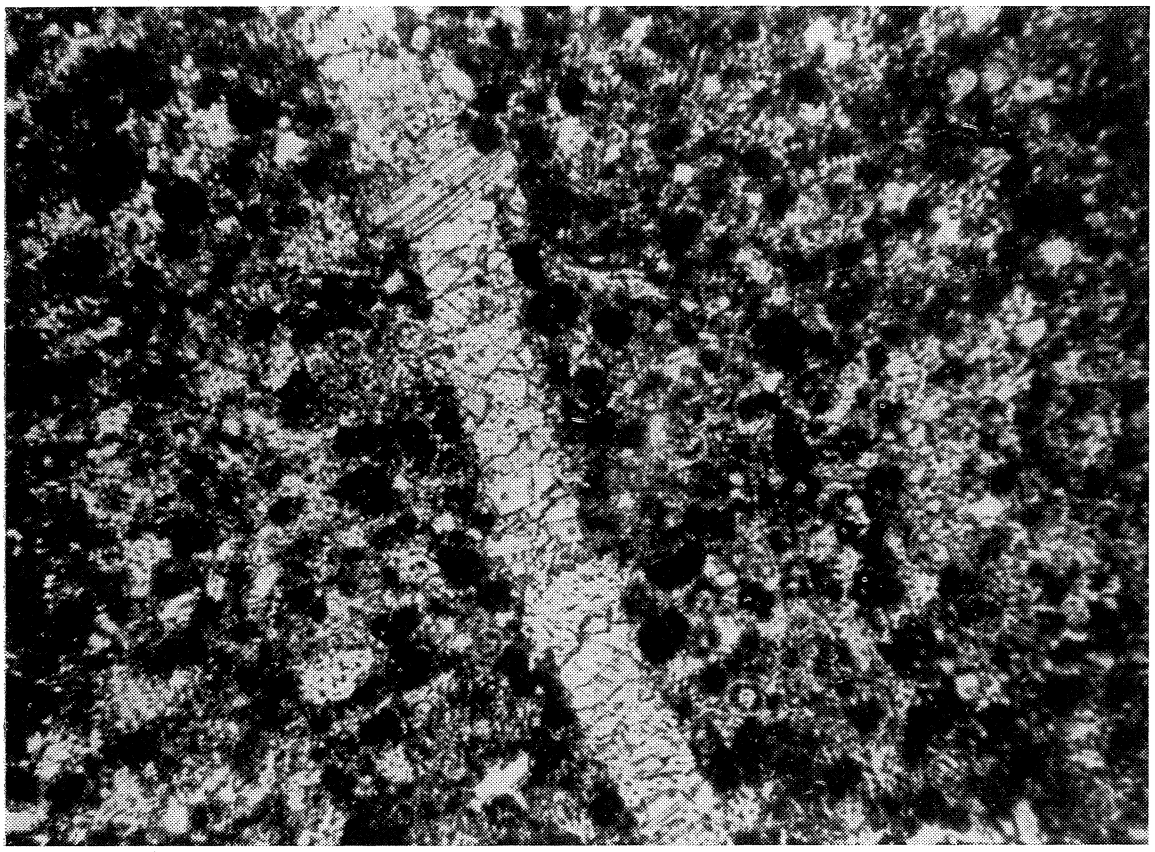
W wyniku badań na różnych obszarach ustalono, że występują one zwykle masowo, tworząc charakterystyczną mikrofację (por. tabl. 1—3), z udziałem członów planktonicznego krynoida *Saccocoma* Agas., zoospor *Globochaete alpina* Lombard, promienic i in., zaznaczającą się na pograniczu dwu ważnych mikrofacji o szerokim rozprzestrzenieniu: mikrofacji „lombardiowej" (w spągu) i mikrofacji kalpionellowej (*Calpionellidae* Bonet).

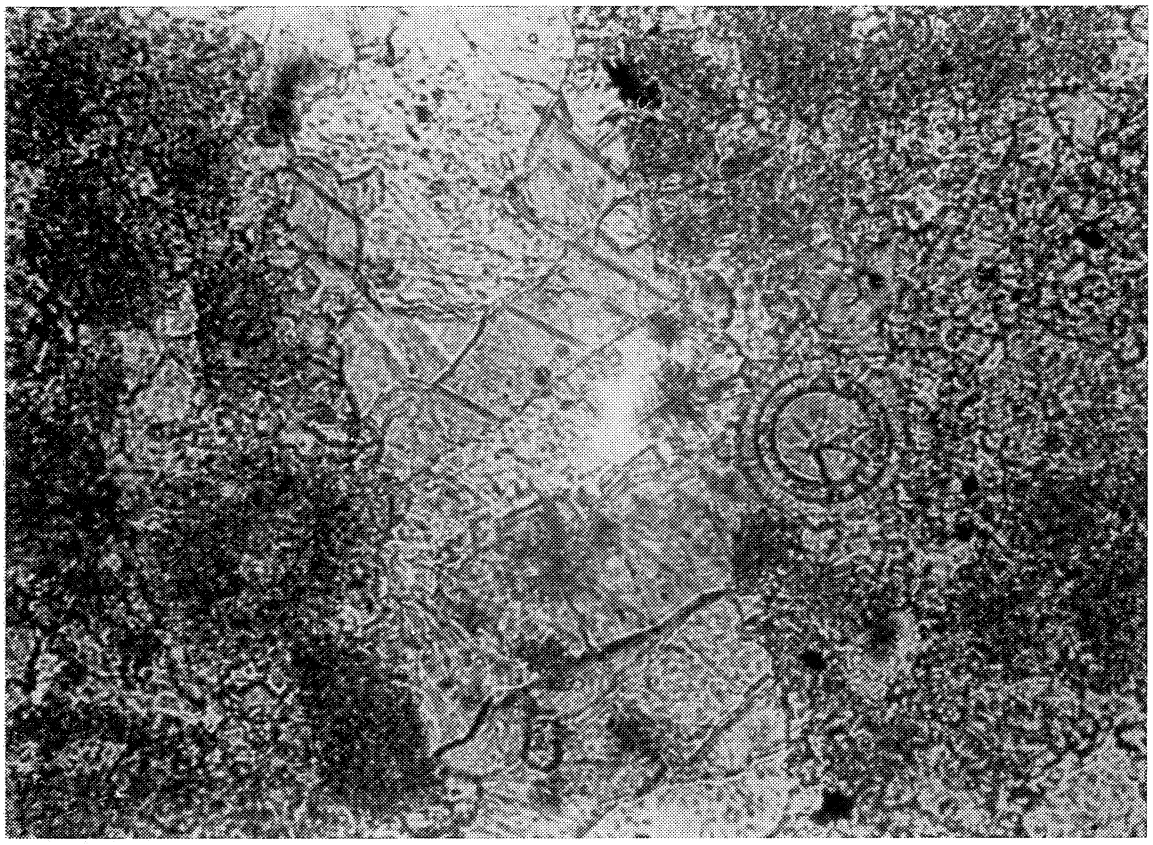
Niniejsza praca jest poświęcona ściślejszemu zdefiniowaniu zony Parastomiosphaera malmica, jej zasięgu wiekowego oraz znaczeniu dla korelacji utworów dolnego tytonu, w nawiązaniu do wyników uzyskanych ze studium biometrycznego wykonanego przez autora na podstawie materiału z Karpat Polskich.

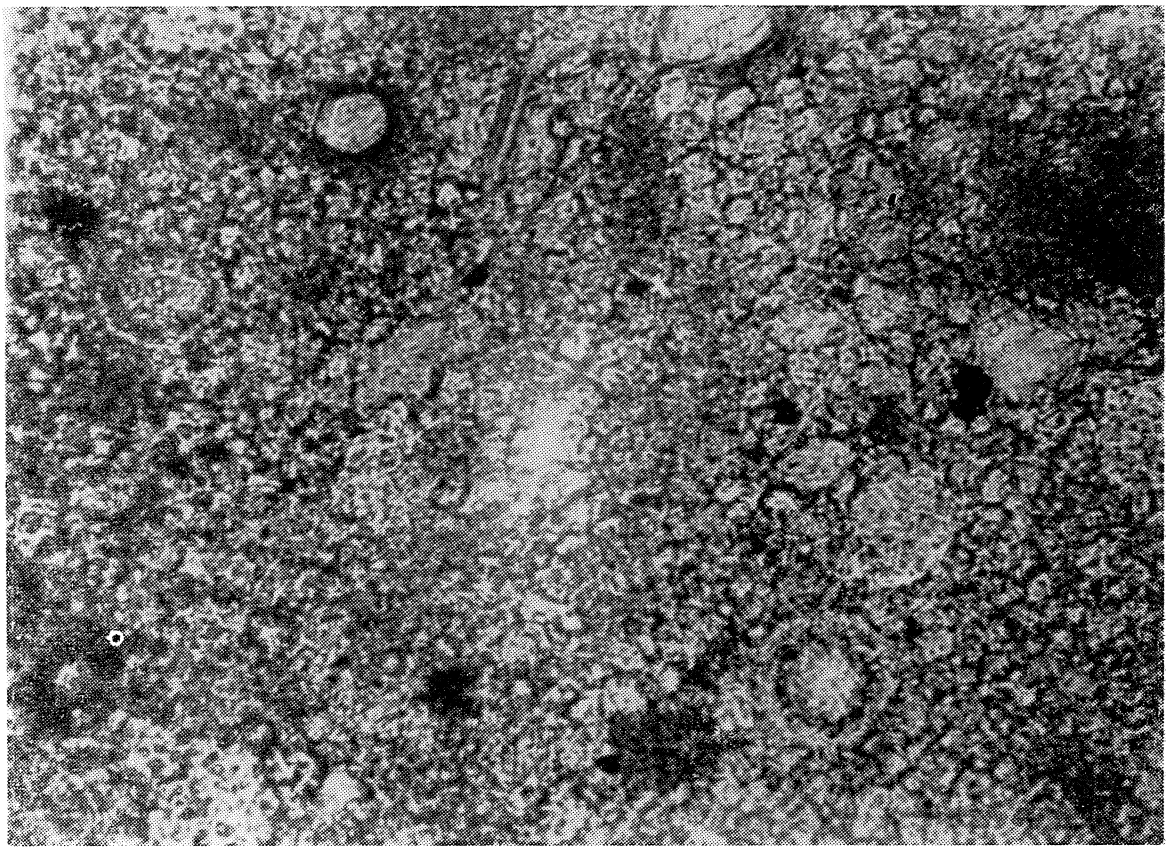
W Karpatach Polskich mikrofację z *P. malmica* (Borza) stwierdzono w bardzo różnych pod względem wykształcenia litologicznego utworach. Na obszarze Pienin (por. fig. 2 i 7—10) w sukcesji hulińskiej jest ona obecna bądź w wapieniach pseudobulastych (Szczawnica Wyżnia—Zabaniszcze), bądź w łupkach aptychowych (Szczawnica Wyżnia — rzeźnia, p. Grajcarek); w sukcesji niedzickiej — w wapieniach bulastych bez kalpionell (skałki: „wschodnia" i „zachodnia" powyżej Niedzicy — wsi; „wodospad" w Dolinie Kosarzyskiej — Buwałd; kamieniołom w Dolinie Kosarzyskiej — Buwałd); w sukcesji braniskiej — w wapieniach pseudobulastych z rogowcami (Kapuśnica). W Karpatach Śląskich (fig. 1 i 5—6), gdzie utwory jury górnej wykształcone są w facji fliszu wapiennego, występuje ona bądź w stropie dolnych łupków cieszyńskich — zaznaczając się wzbogaceniem ławic mikrytowych i intrasparitowych w okazy *P. malmica* (Borza) (profil: Cisownica Tuł), bądź jest reprezentowana w blokach wapieni — mikrytach, występujących na wtórnym złożu w ogniwie łupków z blokami egzotykowymi, rozwiniętym w spągu wapieni cieszyńskich (Cisownica-wieś, Kamienica, Jasienica).

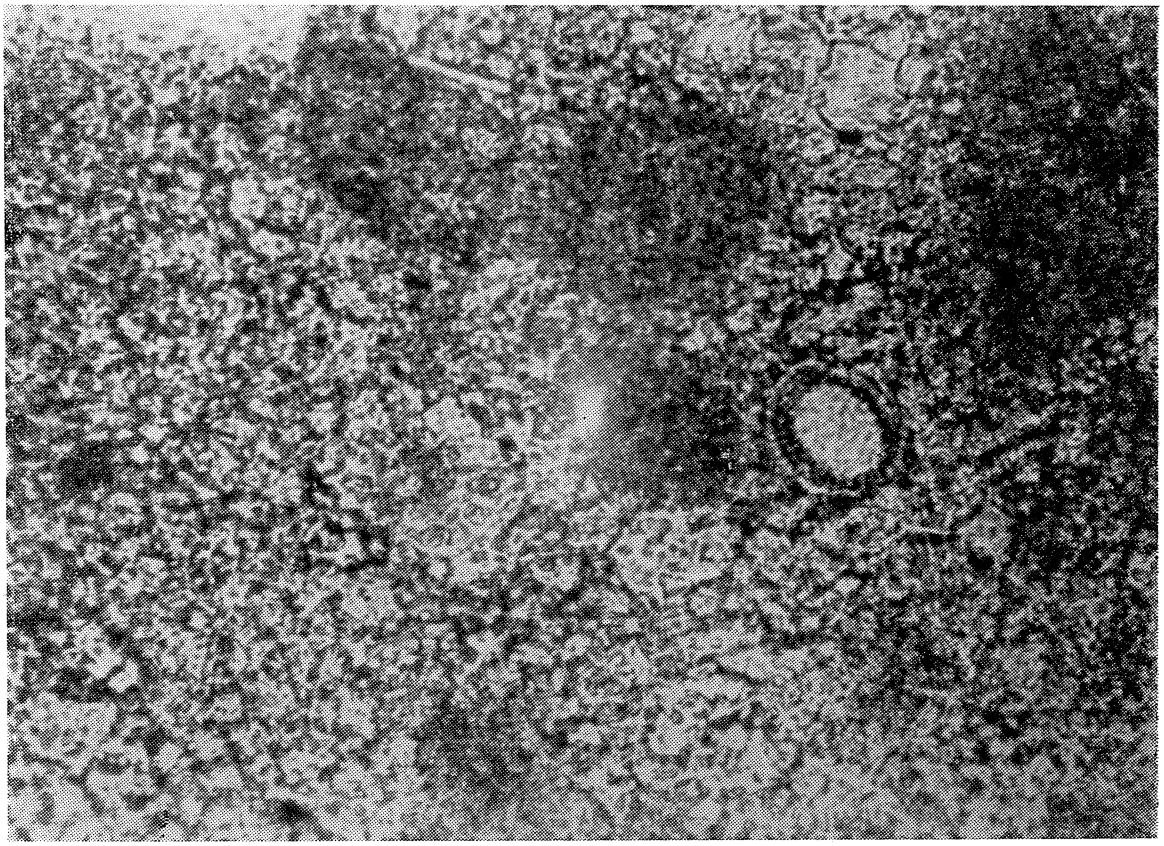
W wyniku zbadania rozmieszczenia gatunku *P. malmica* (Borza) i jego częstotliwości występowania w powyższych sukcesjach można było ustalić jego rozprzestrzenienie (zasięg) wiekowe oraz optima rozwojowe (por. fig. 4). W sukcesji cieszyńskiej stwierdzono go w szeregu ogniw, poczynając od wapieni stomiosferidowych w stropie dolnych łupków cieszyńskich przez ogniwo łupków z egzotykami, wapienie „pod-kalpionellowe", do wapieni z tintinnidami (*Calpionellidae* Bonet) beriasu włącznie. Pozwala to na orientacyjne zakreślenie zasięgu wiekowego tego gatunku na obszarze polskiego Śląska Cieszyńskiego — na tyton dolny — berias.

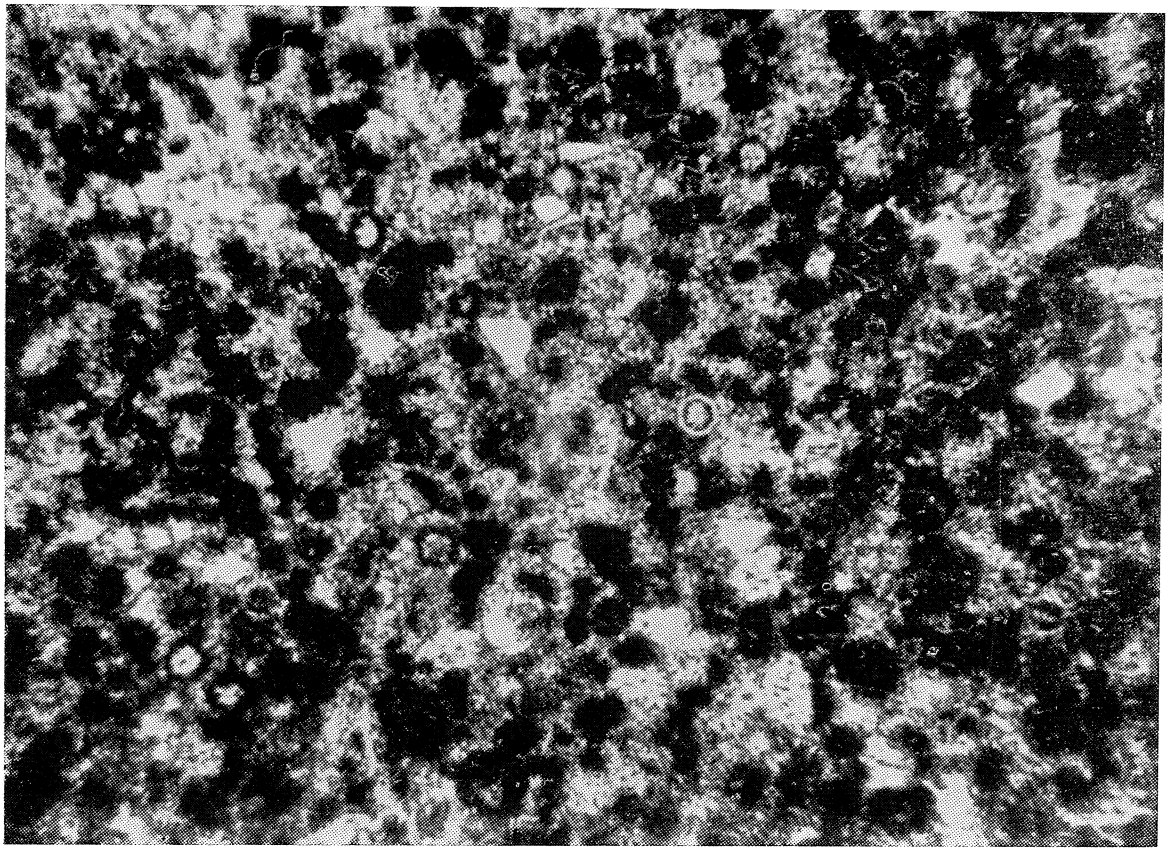
Częstotliwość jego występowania w wyżej wymienionych ogniwach jednakże jest zmienna (por. fig. 4). Waha się ona od obfitego nagromadzenia w stropie dolnych łupków cieszyńskich (ogniwo wapieni stomiosferidowych) do pojedynczych egzemplarzy w obrębie pozostałych ogniw. Stosunki te odnoszą się zarówno do ilościowego udziału form, przez które jest reprezentowany gatunek *P. malmica* (Borza), jak i jego liczebności

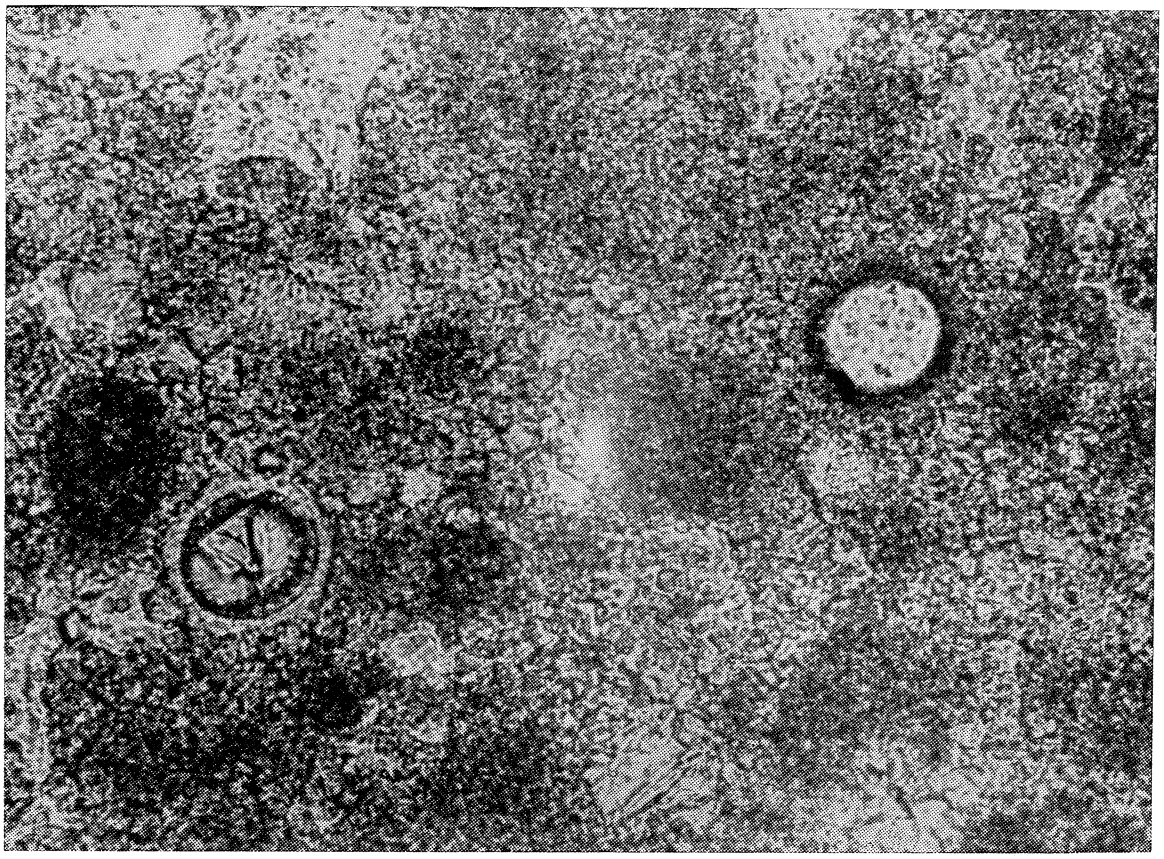


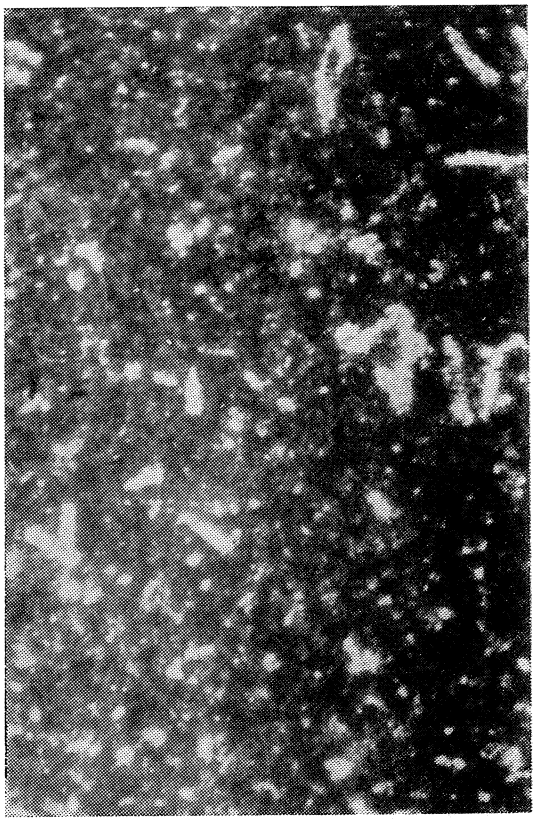


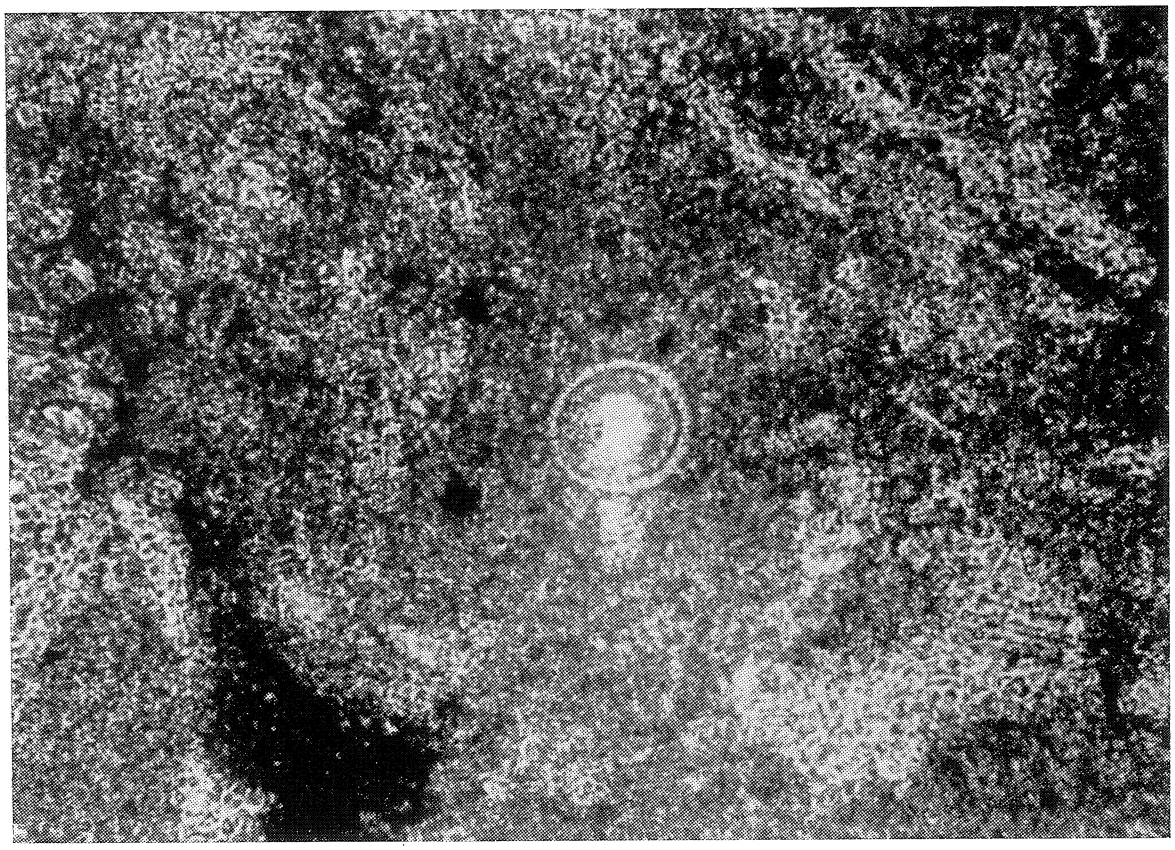


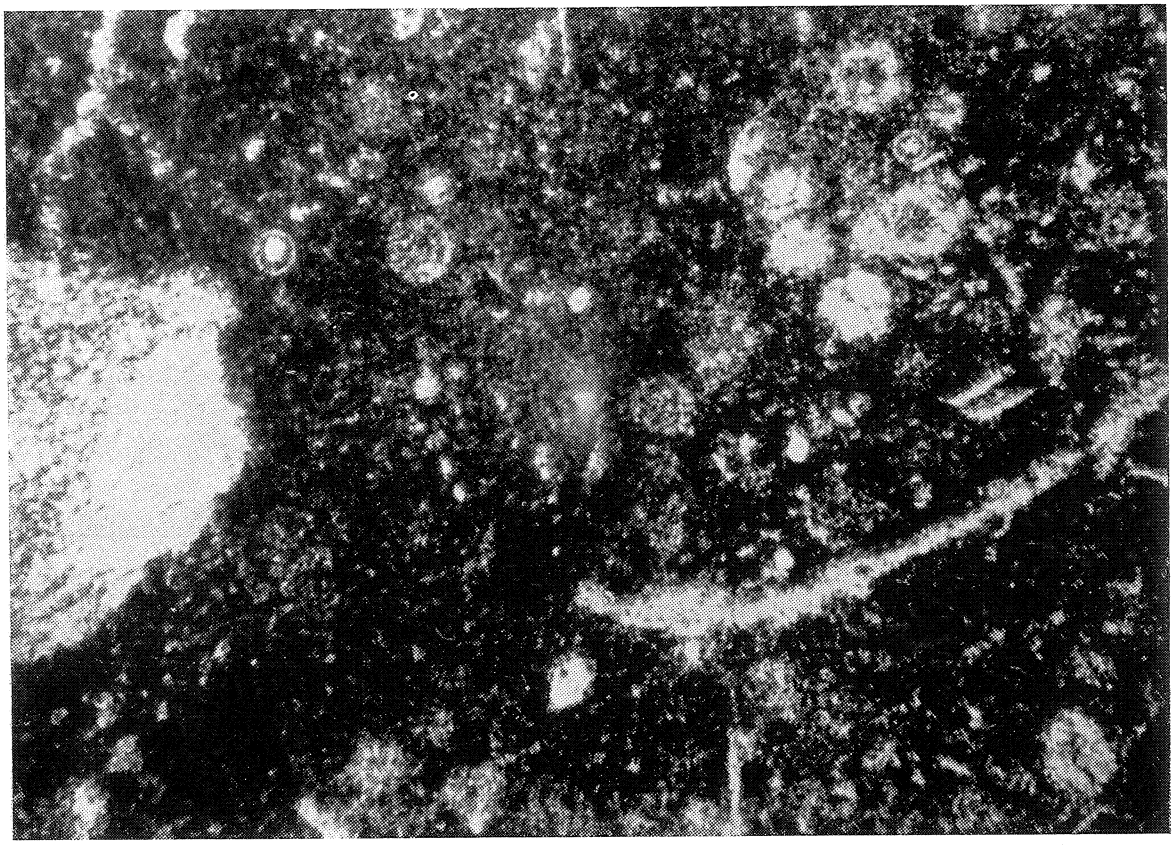


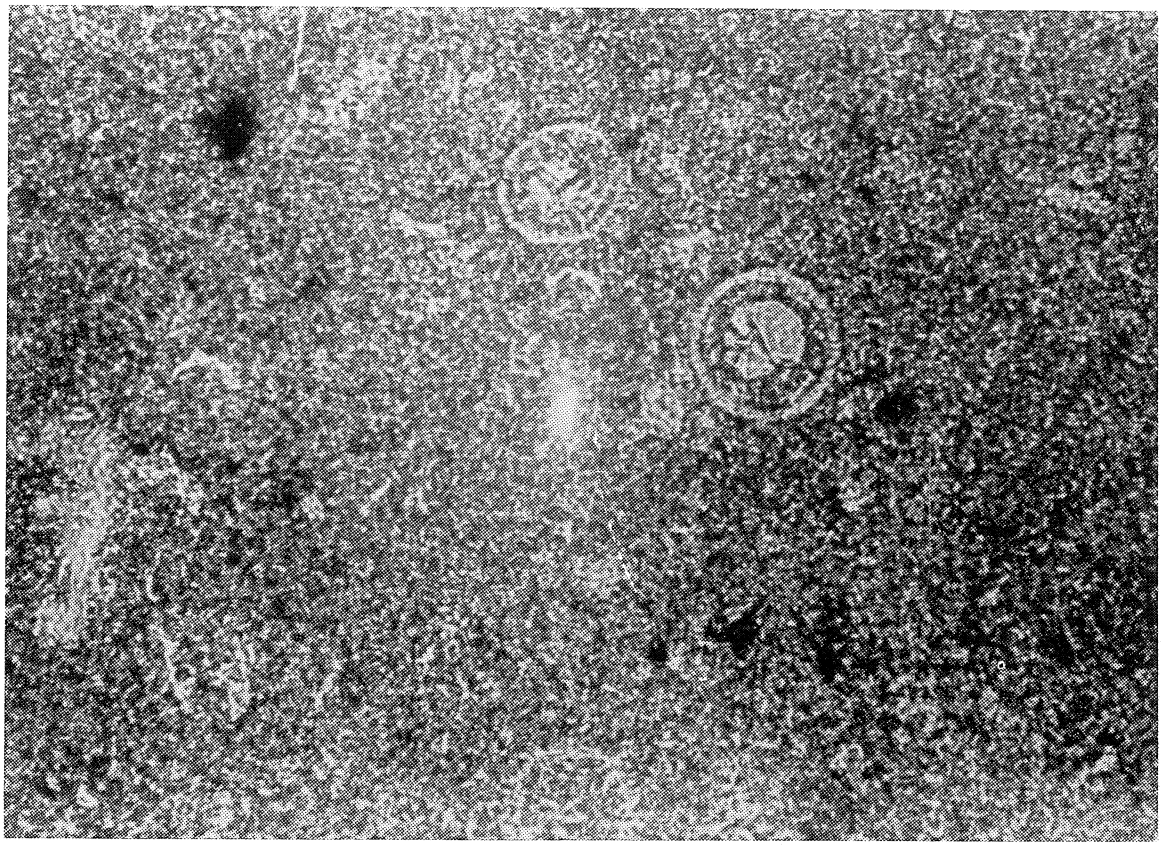


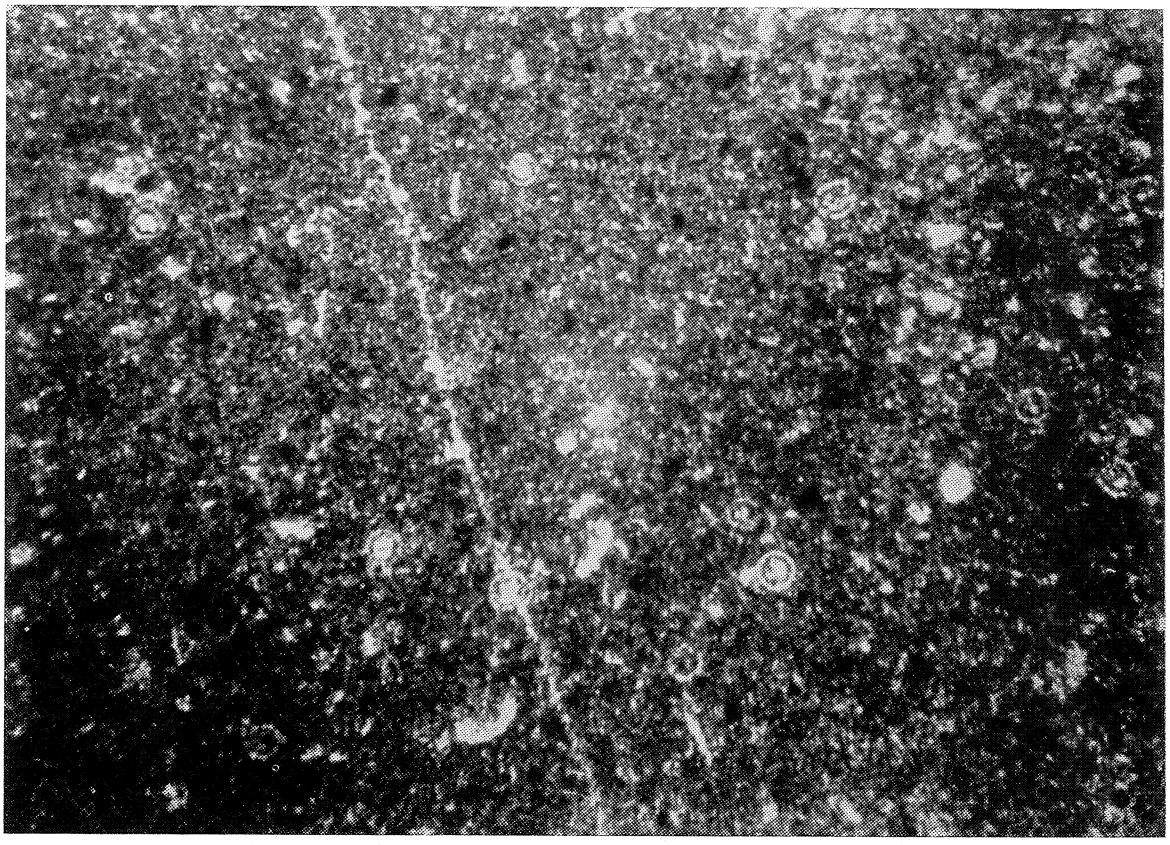


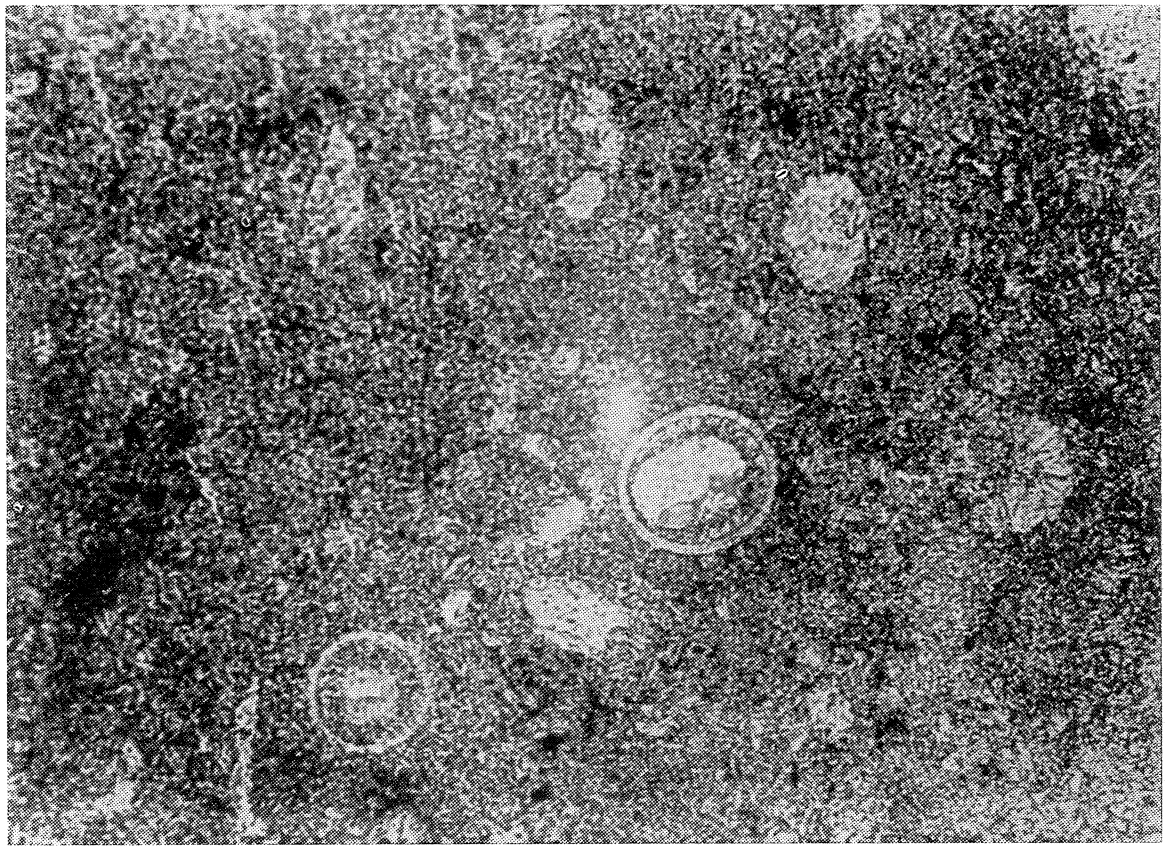


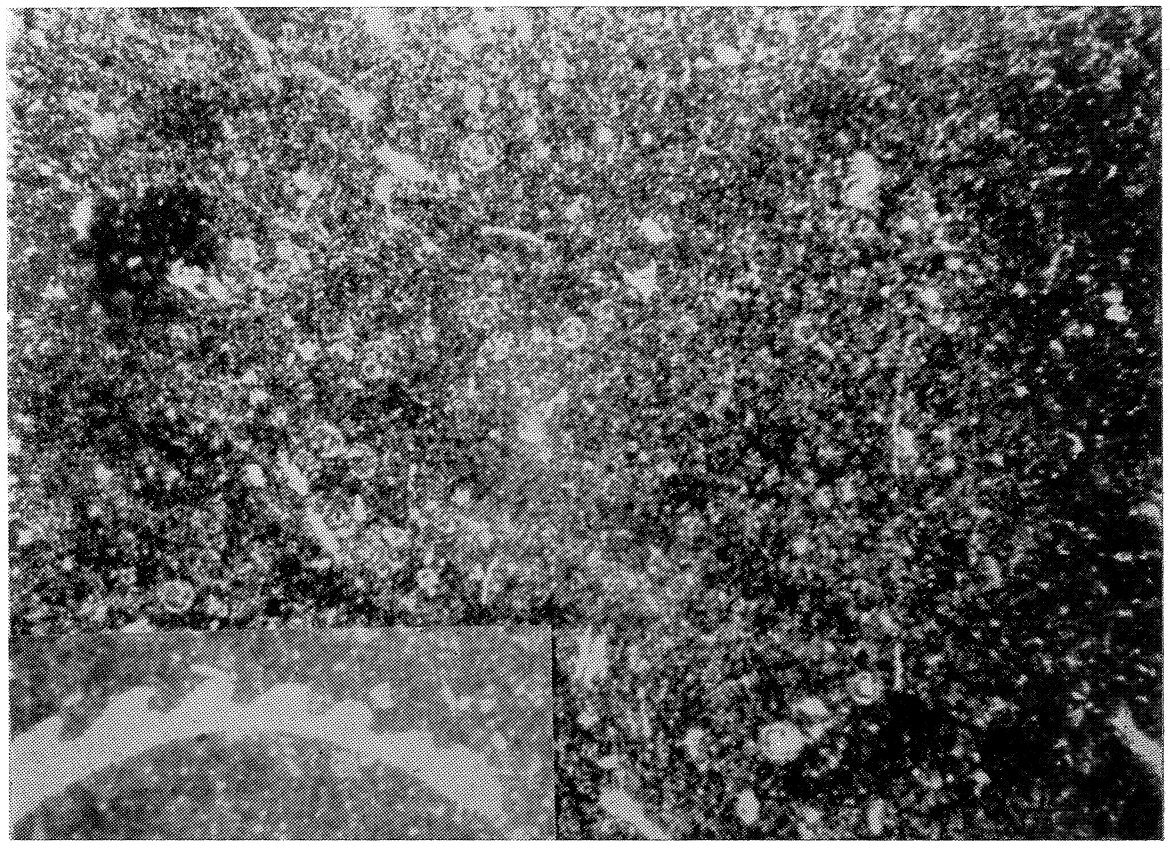


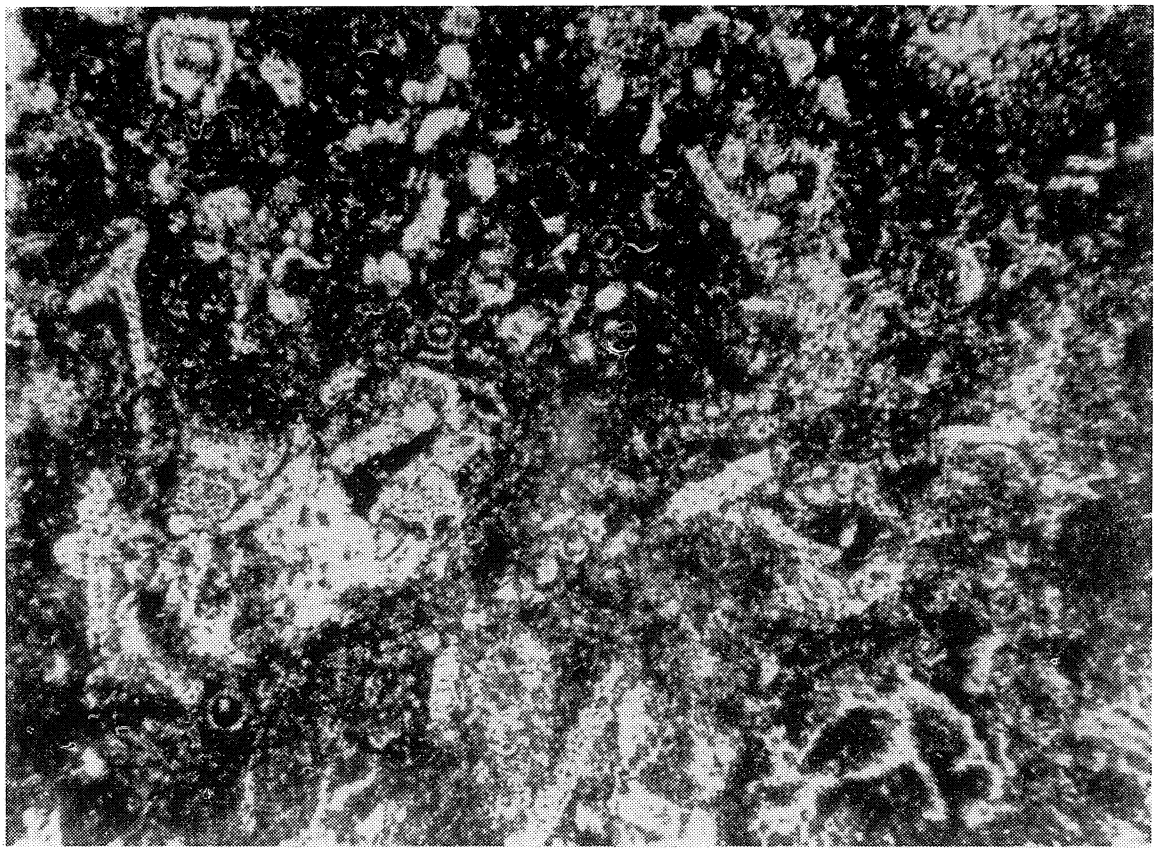


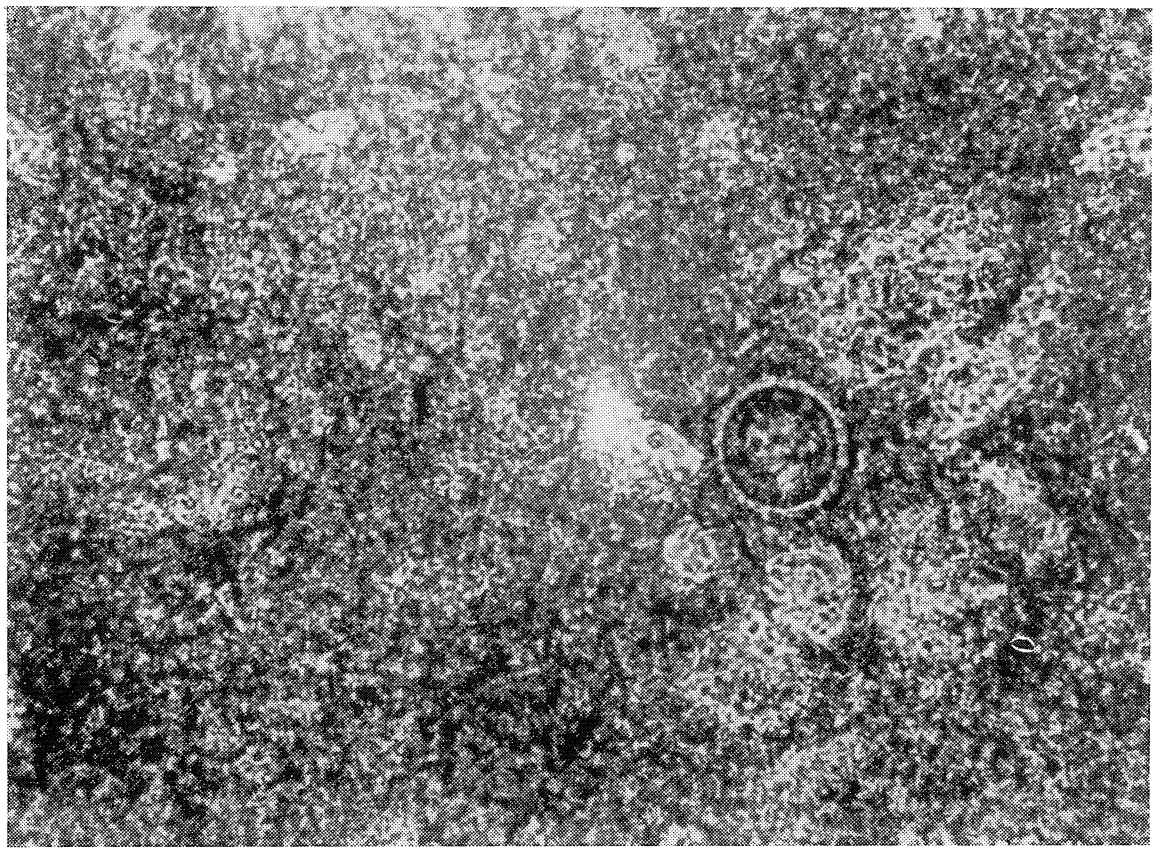


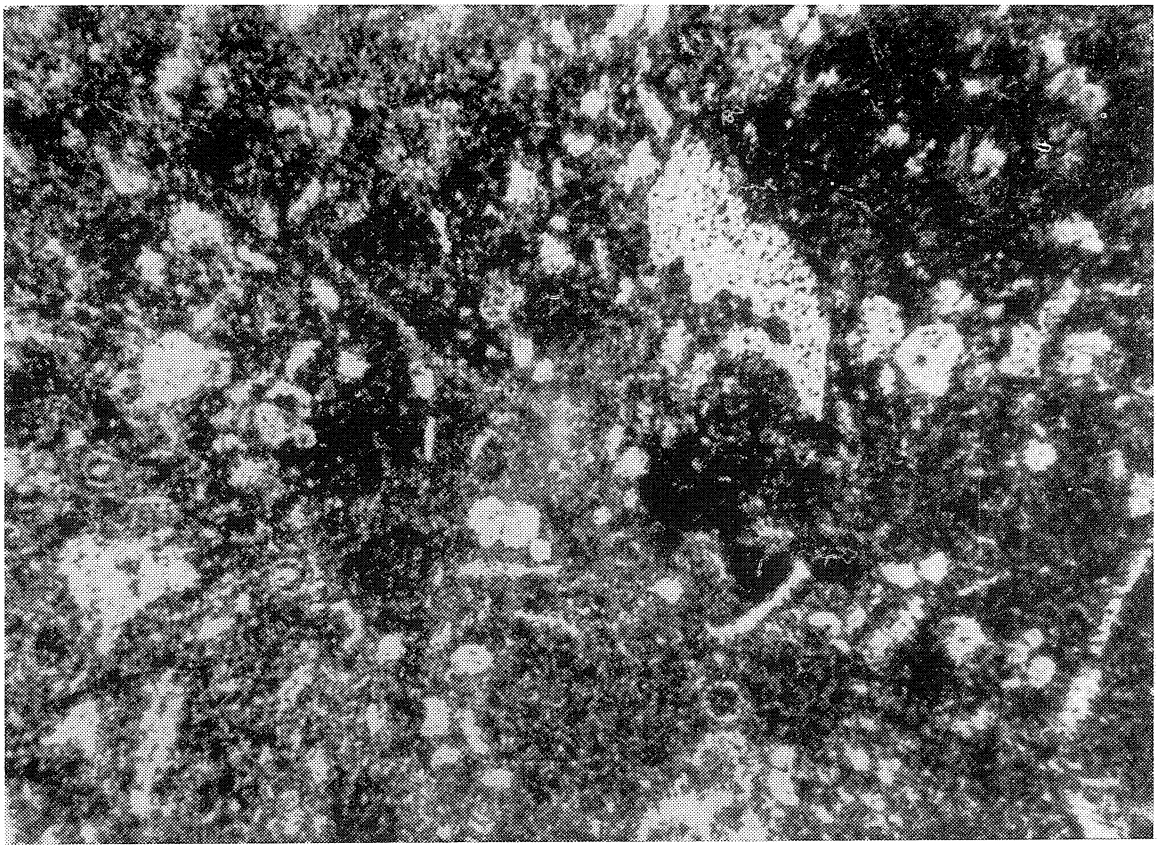


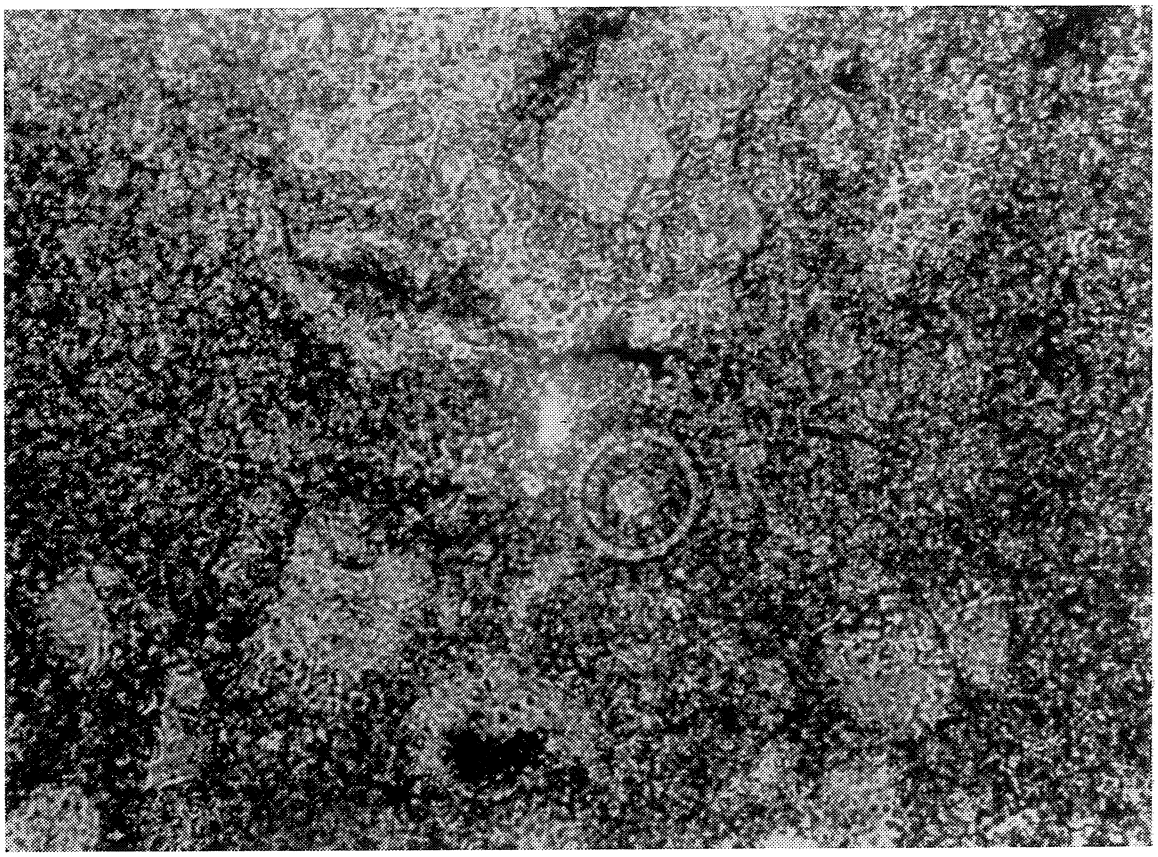


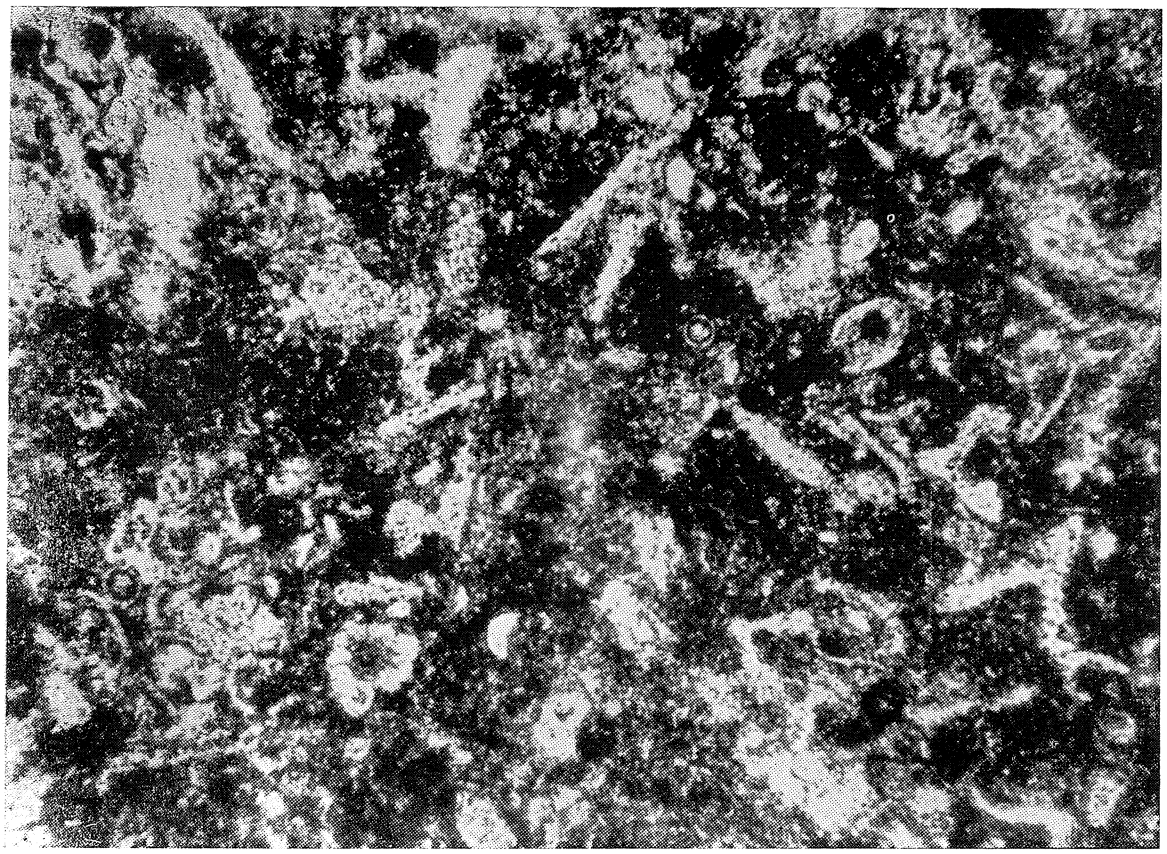


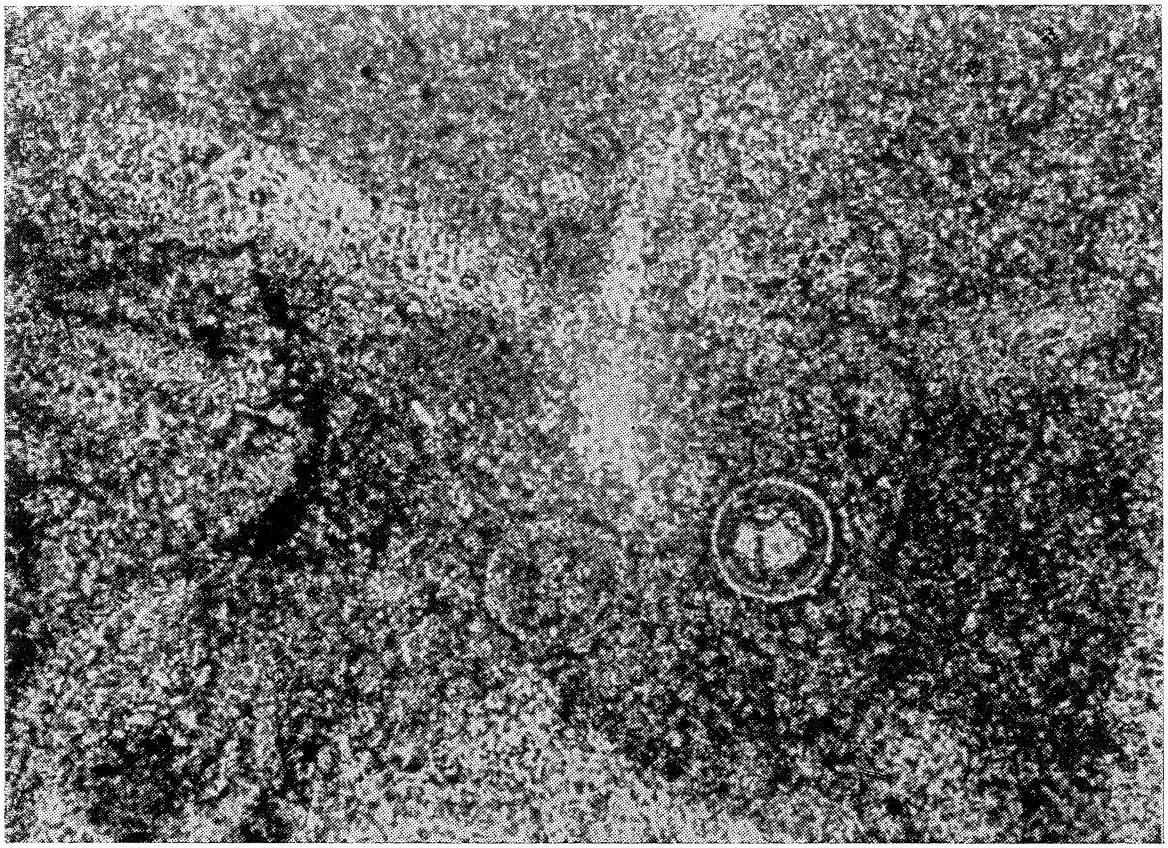


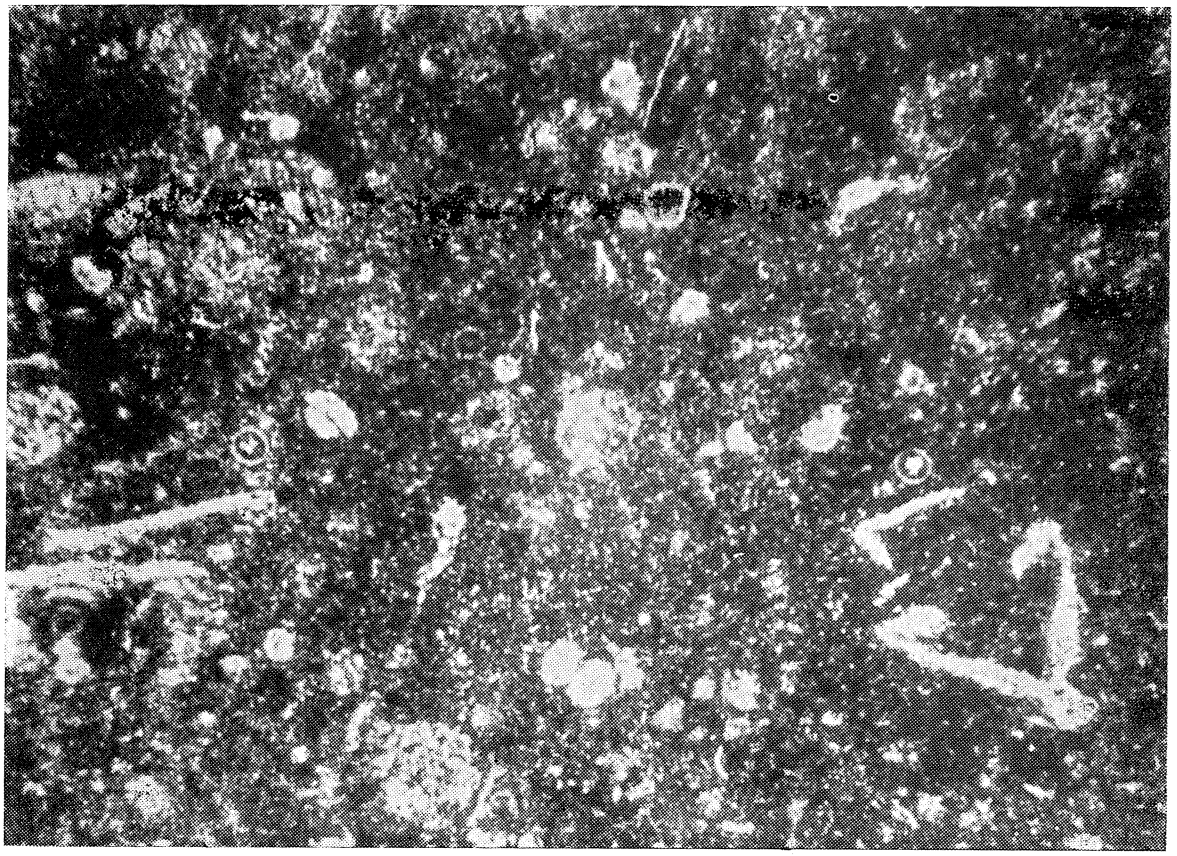


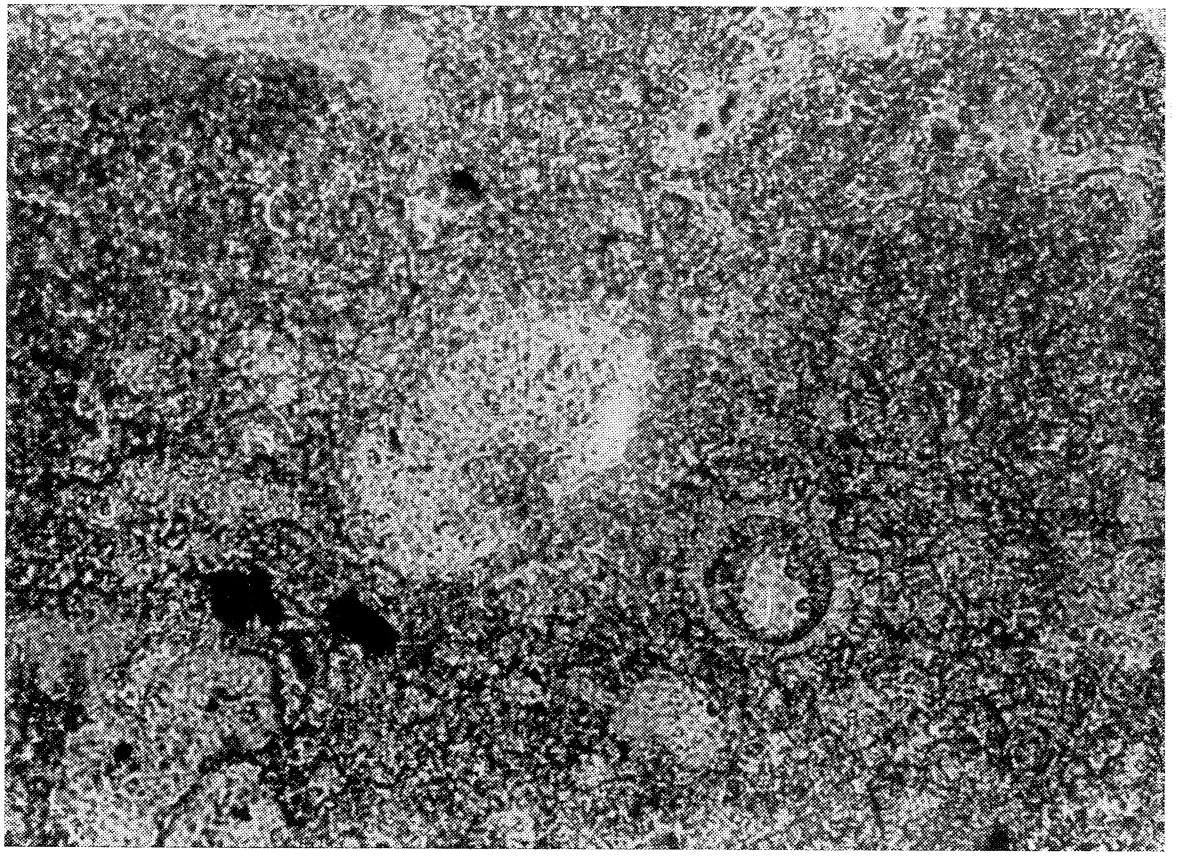


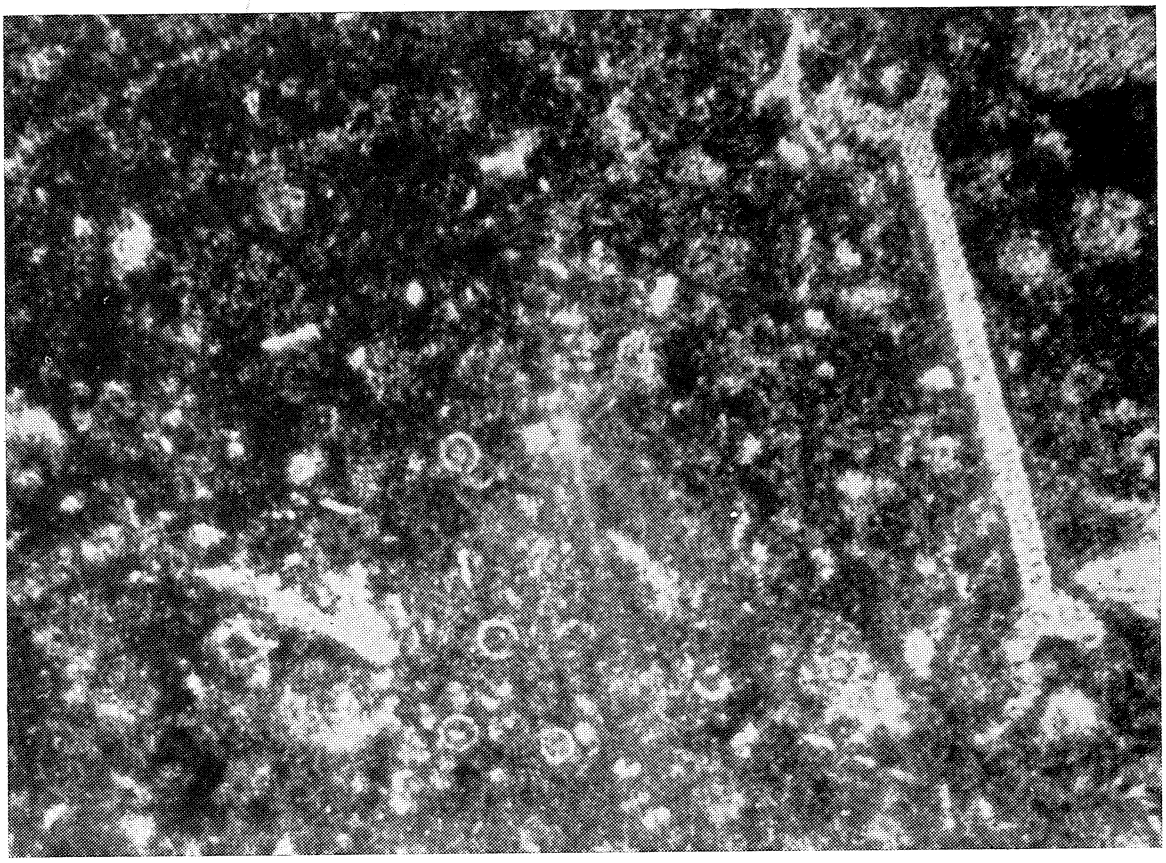


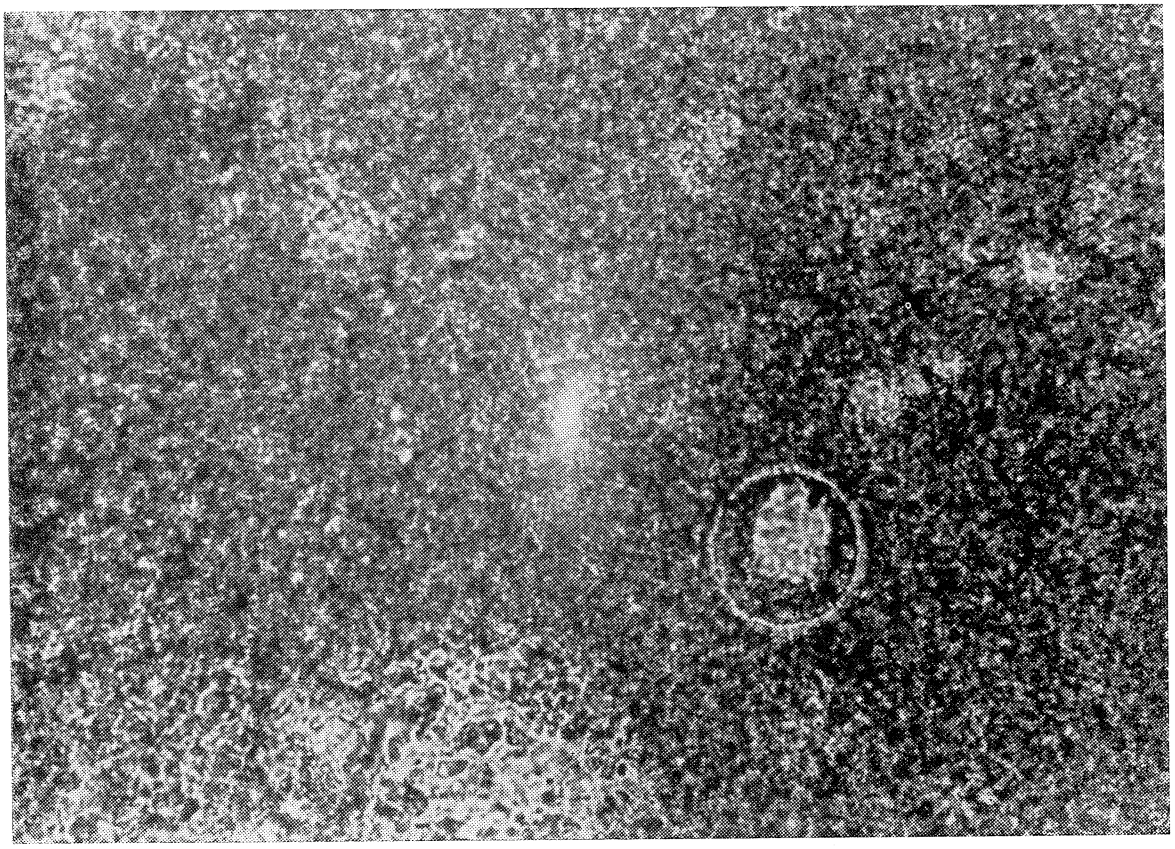












w ogóle. Podobną obfitość jak w stropie dolnych łupków cieszyńskich stwierdza się jedynie w blokach wapieni w ogniwie z egzotykami. W tych jednakże profilach, gdzie powyższe bloki występują (Cisownica-wieś, Kamienica, Jasienica) ogniwo wapieni stomiosferidowych — prawdopodobnie w wyniku erozji ?podmorskiej — jest nieobecne.

Na przykładzie zbiorczego profilu sukcesji cieszyńskiej, skonstruowanego na podstawie cząstkowych profilów Gumna, Cisownica—Tuł, Jasienica, można było ustalić, że omawiany gatunek posiada na obszarze polskiego Śląska Cieszyńskiego tylko jedno optimum rozwojowe (por. fig. 4) i może być ono tutaj stosunkowo dokładnie wyznaczone. Zaznacza się ono powyżej „zony borzai", a poniżej „zony cieszynica" i *Calpionellidae* Bonet oraz wiąże się, jak już wspomniano, z ogniwem wapieni stomiosferidowych w stropie łupków cieszyńskich dolnych.

W nawiązaniu do wyników badań wykonanych na obszarze pienińskim, oraz w oparciu o wyniki studium biometrycznego (por. fig. 11) można było ustalić, że temu optimum rozwojowemu odpowiada w różnych sukcesjach pienińskiego pasa skałkowego moment rozwoju mikrofacji z *P. malmica*. Wobec zgodności następstwa szeregu wyróżnionych mikrofacji na terenie Karpat Polskich moment ten można również uznać za zgodny w czasie z pojawieniem się omawianej mikrofacji na obszarze czechosłowackiej części pienińskiego pasa skałkowego (K. Borza, 1969) oraz na obszarze Gór Mecsek (I. Nagy), (por. tab. 2—3).

Przedstawiony sposób występowania gatunku *Parastomiosphaera malmica* (Borza), m. in.: obfitość jego występowania — w krótkim okresie czasu — w stałej pozycji — na rozległym obszarze — niezależnie od wykształcenia litologicznego utworów, ma wszelkie cechy wartościowej zony biostratygraficznej. W nawiązaniu do nazwy gatunku indeksowego oraz wcześniejszych supozycji (K. Borza, 1969; I. Nagy, 1971; W. Nowak, 1965, 1968) przyjęto dla niej nazwę „zony Parastomiosphaera malmica".

W pracy (str. 91) podano jej definicję oraz w nawiązaniu do znalezisk makro- i mikroskamieniałości — w tym również zrektyfikowanych wiekowo kalpionell (F. Allemann, R. Catalano, F. Fares, J. Remane, 1971), określono jej wiek jako dolnotytoński.

Ponadto, w nawiązaniu do próby korelacji z zonami aptychowymi (str. 116), rozważono w pracy możliwość skorygowania granic zasięgu wiekowego VI poziomu aptychowego (sensu S. M. Gąsiorowski, 1962; M. Durand Delga, S. M. Gąsiorowski, 1971), sugerując ograniczenie go wyłącznie do piętra tytońskiego (por. tab. 1). Zaproponowano w związku z powyższym (str. 122) wiekowe zrektyfikowanie niektórych jednostek litostratygraficznych górnej jury Karpat.

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EXPLANATIONS OF PLATES
OBJAŚNIENIA TABLIC

Plate — Tablica I

Fig. 1. Intrasparite with *Parastomiosphaera malmica* (B o r z a); Lower Cieszyn Shales, the Malmica zone (= Lower Tithonian); the Cieszyn succession: Cisownica — Tuł (CT 41). × 90

Fig. 1. Intrasparyt z *Parastomiosphaera malmica* (B o r z a); dolne łupki cieszyńskie, poziom Malmica (= tyton dolny); sukcesja cieszyńska: Cisownica — Tuł (CT 41). × 90

Fig. 2. As above. On the right hand — a transverse section of the specimen *P. malmica* (B o r z a) × 320

Fig. 2. Jak wyżej. W polu widzenia po prawej poprzeczne cięcie okazu *P. malmica* (B o r z a) × 320

Plate — Tablica II

Fig. 1—2. Intrasparite with *Parastomiosphaera malmica* (B o r z a); a block of limestones of the Malmica zone; Cieszyn Limestones: shales with exotic blocks member (upper part of the Lower Tithonian); Cieszyn succession: Cisownica — wieś (Ca 12). × 320

Fig. 1—2. Intrasparyt z *Parastomiopshaera malmica* (B o r z a); blok wapienia z poziomu Malmica; wapienie cieszyńskie: ogniwo łupków z blokami egzotykowymi (górna część tytonu dolnego); Sukcesja cieszyńska: Cisownica — wieś (CA 12). × 320

Plate — Tablica III

Fig. 1. Intrasparite with *Parastomiosphaera malmica* (B o r z a); a block of limestones of the Malmica zone; Cieszyn Limestones: Shales with exotic blocks member (Upper part of the Lower Tithonian); the Cieszyn succession: Kamienica (K-4-7) × 90

Fig. 1. Intrasparyt z *Parastomiosphaera malmica* (B o r z a); blok wapienia z poziomu Malmica; wapienie cieszyńskie: ogniwo łupków z blokami egzotykowymi (górna część tytonu dolnego); sukcesja cieszyńska: Kamienica (K-4-7). × 90

Fig. 2. As above. On the left hand — a transverse section of the specimen *P. malmica* (B o r z a); on the right — a transwerse section of *Cadosina* ex gr. *semiradiata* W a n n e r

Fig. 2. Jak wyżej. W polu widzenia: po lewej poprzeczne cięcie okazu *P. malmica* (B o r z a), po prawej poprzeczne cięcie *Cadosina* ex gr. *semiradiata* W a n n e r × 320

Plate — Tablica IV

Fig. 1. Saccocoma (Lombardia) microfacies with *Parastomiosphaera malmica* (B o r z a); Nodular Limestones; Hungary — the Mecsek Mts, the Magyaregregy profile (a quarry with diabas intrusions). WRL/18/72. × 60

Fig. 1. Mikrofacja sakkokomowa (lombardiowa) z *Parastomiosphaera malmica* (B o r z a); wapienie bulaste; Węgry — Góry Mecsek, profil Magyaregregy (kamieniołom z intruzjami diabazów). WRL/18/72. × 60

Fig. 2. Microfacies with *Parastomiosphaera malmica* (B o r z a); the Malmica zone;

the Hulina succession, Pseudonodular Limestones; Zabaniszcze (Zab./29/S/70). × 60

Fig. 2. Mikrofacja z *Parastomiosphaera malmica* (B o r z a); poziom Malmica; sukcesja hulińska, wapienie pseudobulaste; Zabaniszcze (Zab./29/S/70). × 60

Fig. 3. Radiolarian microfacies with *Parastomiosphaera malmica* (B o r z a); Hulina succession, siliceous limestone intercalations in variegated shales (? = Red Radiolarites after W. S i k o r a 1971); Zabaniszcze (Zab./30/5/70). × 60

Fig. 3. Mikrofacja radiolariowa z *Parastomiosphaera malmica* (B o r z a); sukcesja hulińska, wkładka skrzemieniałego wapienia w łupkach pstrych (? = radiolaryty czerwone sensu W. S i k o r a 1971); Zabaniszcze (Zab./30/5/70). × 60

Fig. 4. Microfacies with *Parastomiosphaera malmica* (B o r z a); the Malmica zone, the Hulina succession, Pseudonodular Limestones; Szczawnica Wyżnia — Zabaniszcze (Zab./32/5/70). × 60

Fig. 4. Mikrofacja z *Parastomiosphaera malmica* (B o r z a); poziom Malmica; sukcesja hulińska, wapienie pseudobulaste; Szczawnica — Zabaniszcze (Zab./32/5/70). × 60

Plate — Tablica V

Fig. 1. *Parastomiosphaera malmica* (B o r z a). Saccocoma (Lombardia) microfacies with *P. malmica*; Nodular Limestones; Hungary — the Mecsek Mts; the Magyaregregy profile (a quarry with diabas intrusions) WRL/18/72. × 320

Fig. 1. *Parastomiosphaera malmica* (B o r z a). Mikrofacja sakkokomowa (lombardiowa z *P. malmica*; wapienie bulaste; Węgry — Góry Mecsek, profil Magyaregregy (kamieniołom z intruzjami diabazów). WRL/18/72. × 320

Fig. 2. Saccocoma (Lombardia) microfacies with *Parastomiosphera malmica* (B o r z a); the Malmica zone; the Branisko succession, Pseudonodular Limestones; Kapuśnica (Kap./15). × 90

Fig. 2. Saccocoma (Lombardia) microfacies with *Parastomiosphaera malmica* (B o r z a); poziom Malmica; sukcesja braniska, wapienie pseudobulaste; Kapuśnica (Kap./15). × 90

Plate — Tablica VI

Fig. 1. *Parastomiosphaera malmica* (B o r z a). Microfacies with *P. malmica,* the Malmica zone; the Hulina succession, Marls and Shales with Aptychi (subzone VI-1-alfa-lower part); Szczawnica Wyżnia, the Grajcarek stream — slaughterhouse (Szcz/1/70). × 320

Fig. 1. *Parastomiosphaera malmica* (B o r z a). Mikrofacja z *P. malmica,* poziom Malmica; sukcesja hulińska, margle i łupki aptychowe (podpoz. VI-1-alfa — część dolna); Szczawnica Wyżnia, potok Grajcarek — rzeźnia (Szcz/1/70). × 320

Fig. 2. Microfacies with *Parastomiosphaera malmica* (B o r z a), the Malmica zone, the Hulina succession, Marls and Shales with Aptychi (subzone VI-1-alfa — lower part); Szczawnica Wyżnia, the Grajcarek stream — slaughterhouse (Szcz/1/70). × 90

Fig. 2. Mikrofacja z *Parastomiosphaera malmica* (B o r z a), poziom Malmica; suksecja hulińska, margle i łupki aptychowe (podpoz. VI-1-alfa — część dolna); Szczawnica Wyżnia, potok Grajcarek — rzeźnia (Szcz/1/70). × 90

Plate — Tablica VII

Fig. 1. *Parastomiosphaera malmica* (B o r z a). Microfacies with *P. malmica,* the Malmica zone; the Hulina succession, Marls and Shales with Aptychi (subzone VI-1-alfa — lower part); Szczawnica Wyżnia, the Grajcarek stream — slaughterhouse (Szcz/3/70). × 320

Fig. 1. *Parastomiosphaera malmica* (B o r z a). Mikrofacja z *P. malmica*, poziom Malmica; sukcesja hulińska, margle i łupki aptychowe (podpoz. VI-1-alfa — część dolna); Szczawnica Wyżnia, potok Grajcarek — rzeźnia (Szcz/3/70). × 320

Fig. 2. Microfacies with *Parastomiosphaera malmica* (B o r z a) and Lamellaptychus, the Malmica zone; the Hulina succession, Marls and Shales with Aptychi (subzone VI-1-alfa — lower part); Szczawnica Wyżnia, the Grajcarek stream — slaughterhouse (Szcz/3/70). × 90

Fig. 2. Mikrofacja z *Parastomiosphaera malmica* (B o r z a) i Lamellaptychus, poziom Malmica; sukcesja hulińska, margle i łupki aptychowe (podpoz. VI-1-alfa — część dolna); Szczawnica Wyżnia, potok Grajcarek — rzeźnia (Szcz/3/70). × 90

Plate — Tablica VIII

Fig. 1. Saccocoma (Lombardia) — Radiolarian microfacies with *Parastomiosphaera malmica* (B o r z a), the Malmica zone; the Niedzica succession, Upper Nodular Limestones without Calpionella; the „west" klippe above the Niedzica village (Ni/80/5/70). × 90

Fig. 1. Mikrofacja sakkokomowo (lombardiowo) — radiolariowa z *Parastomiosphaera malmica* (B o r z a), poziom Malmica; sukcesja niedzicka, wapień bulasty górny bez kalpionell; skałka „zachodnia" powyżej Niedzicy — wsi (Ni/80/5/70). × 90

Fig. 2. *Parastomiosphaera malmica* (B o r z a) (Explanation see above). × 320

Fig. 2. *Parastomiosphaera malmica* (B o r z a) (Objaśnienia patrz wyżej). × 320

Plate — Tablica IX

Fig. 1. Saccocoma (Lombardia) — Radiolarian microfacies with *Parastomiosphaera malmica* (B o r z a), the Malmica zone; the Niedzica succession, Upper Nodular Limestones without Calpionella; the „east" klippe above the Niedzica village (Ni 81/2/70). × 90

Fig. 1. Mikrofacja sakkokomowo (lombardiowo) — radiolariowa z *Parastomiosphaera malmica* (B o r z a), poziom Malmica, sukcesja niedzicka, wapień bulasty górny bez kalpionell; skałka „wschodnia" powyżej Niedzicy wsi (Ni 81/2/70). × 90

Fig. 2. *Parastomiosphaera malmica* (B o r z a). (Explanation see above). × 320

Fig. 2. *Parastomiosphaera malmica* (B o r z a). (Objaśnienie patrz wyżej). × 320

Plate — Tablica X

Fig. 1. Saccocoma (Lombardia) — Globochaete microfacies with *Parastomiosphaera malmica* (B o r z a); the Niedzica succession, Upper Nodular Limestones without Calpionella; the „east" klippe above the Niedzica village (Ni 81/4/70). × 90

Fig. 1. Mikrofacja sakkokomowo (lombardiowo) globochetowa z *Parastomiosphaera malmica* (B o r z a); sukcesja niedzicka, wapień bulasty górny bez kalpionell; skałka „wschodnia" powyżej Niedzicy wsi (Ni 81/4/70). × 90

Fig. 2. *Parastomiosphaera malmica* (B o r z a) (Explanation see above). × 320

Fig. 2. *Parastomiosphaera malmica* (B o r z a) (Objaśnienie patrz wyżej). × 320

Plate — Tablica XI

Fig. 1. Saccocoma (Lombardia) — Radiolarian microfacies with *Parastomiosphaera malmica* (B o r z a), the Malmica zone, the Niedzica succession, Upper No-

dular Limestones without Calpionella, the Kosarzyska Valley — Buwałd; the quarry (Bu 9/70). × 90

Fig. 1. Mikrofacja sakkokomowo (lombardiowo) — radiolariowa z *Parastomiosphaera malmica* (B o r z a), poziom Malmica; sukcesja niedzicka, wapień bulasty górny bez kalpionell; Dolina Kosarzyska — Buwałd; kamieniołom (Bu 9/70). × 90

Fig. 2. *Parastomiosphaera malmica* (B o r z a). (Explanation see above). × 320

Fig. 2. *Parastomiosphaera malmica* (B o r z a). (Objaśnienie patrz wyżej). × 320

Plate — Tablica XII

Fig. 1. Saccocoma (Lombardia) — Radiolarian microfacies with *Parastomiosphaera malmica* (B o r z a), the Malmica zone; the Branisko succession, Pseudonodular Limestones; Kapuśnica (Kap. 15/70). × 90

Fig. 1. Mikrofacja sakkokomowo (lombardiowo) — radiolariowa z *Parastomiosphaera malmica* (B o r z a), poziom Malmica; sukcesja braniska, wapień pseudobulasty; Kapuśnica (Kap. 15/70). × 90

Fig. 2. *Parastomiosphaera malmica* (B o r z a). (Explanation see above). × 320

Fig. 2. *Parastomiosphaera malmica* (B o r z a). (Objaśnienie patrz wyżej). × 320