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Palynological correlation of the Bunter and Muschelkalk in selected profiles from Western Poland

ABSTRACT: The results are here reported of palynological studies on the Middle Bunter, the Röt and the Muschelkalk, from 4 borehole profiles in Western Poland: Połczyn *IG-1*, Gorzów Wlkp. *IG-1*, Środa *IG-2* and Otyń *IG-1*. Seven characteristic, stratigraphically important microflora assemblages have been differentiated which were used as a basis for the palynological correlation of deposits. The presence of index species made it possible to compare the microflora here described with that of the same age from sediments of the epicontinental facies and the Alpine Triassic of Europe. This served as a basis for palynological documentation of the Lower and Middle Triassic of Western Poland mostly without fauna.

INTRODUCTION

The palynological studies of the Bunter and Muschelkalk have been carried out in Western Poland in 4 borehole profiles showing great thickness of sediments and a typical lithological development.

Profile Połczyn *IG-1* is the northernmost one in Pomerania. Boreholes Gorzów Wlkp. *IG-1*, Środa *IG-2* and Otyń *IG-1* are successively situated farther south within the Fore-sudetic area, the last named borehole being but fragmentarily investigated in what palynology is concerned (Fig. 1).

In the profiles under consideration the Röt sediments are those supplying most adequate faunal documentation. A characteristic fauna bearing the index species *Costatoria costata* (Zenk.) has been observed in boreholes Gorzów Wlkp. *IG-1* (Gajewska 1964, Senkowiczowa 1965), and Środa *IG-2* (I. Gajewska — in press).

The microflora being described in the present paper is abundant and supplies data for a relatively complete documentation of the Bunter and Muschelkalk sediments in the area here under consideration.

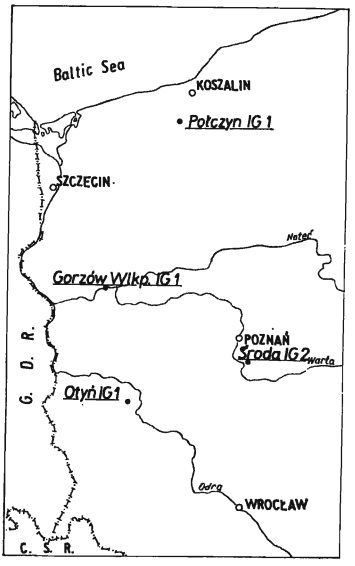

Fig. 1. Localization of investigated borehole profiles

This microflora is characterized by great numerical and specific abundance of plants represented by spores, pollen grains and microplankton from the Acritarcha Evitt group. Observation of particularly important changes in the specific composition provided a basis for the differentiation of characteristic palynologic-stratigraphic assemblages suggesting the microfloristic correlation of sediments in the various profiles here considered (Fig. 2).

The presence of index species has proved very useful for correlation with the Lower and Middle Triassic microflora known from outside of the Polish territory both in the epicontinental and the Alpine Triassic facies of Europe.

The results of the palynological analysis of the deposits under consideration are shown in diagrammatic tables illustrating the occurrence of microflora in profiles: Gorzów Wlkp. *IG-1* (Fig. 3), Połczyn *IG-1* (Fig. 4) and Środa *IG-2* (Fig. 5). The per cent values given in the size divisions are estimative because of the often strongly damaged exine prohibiting the identification of miospores. Hence, the age of the samples and the stratigraphic conclusions are based chiefly on the qualitative composition of the well preserved microflora.

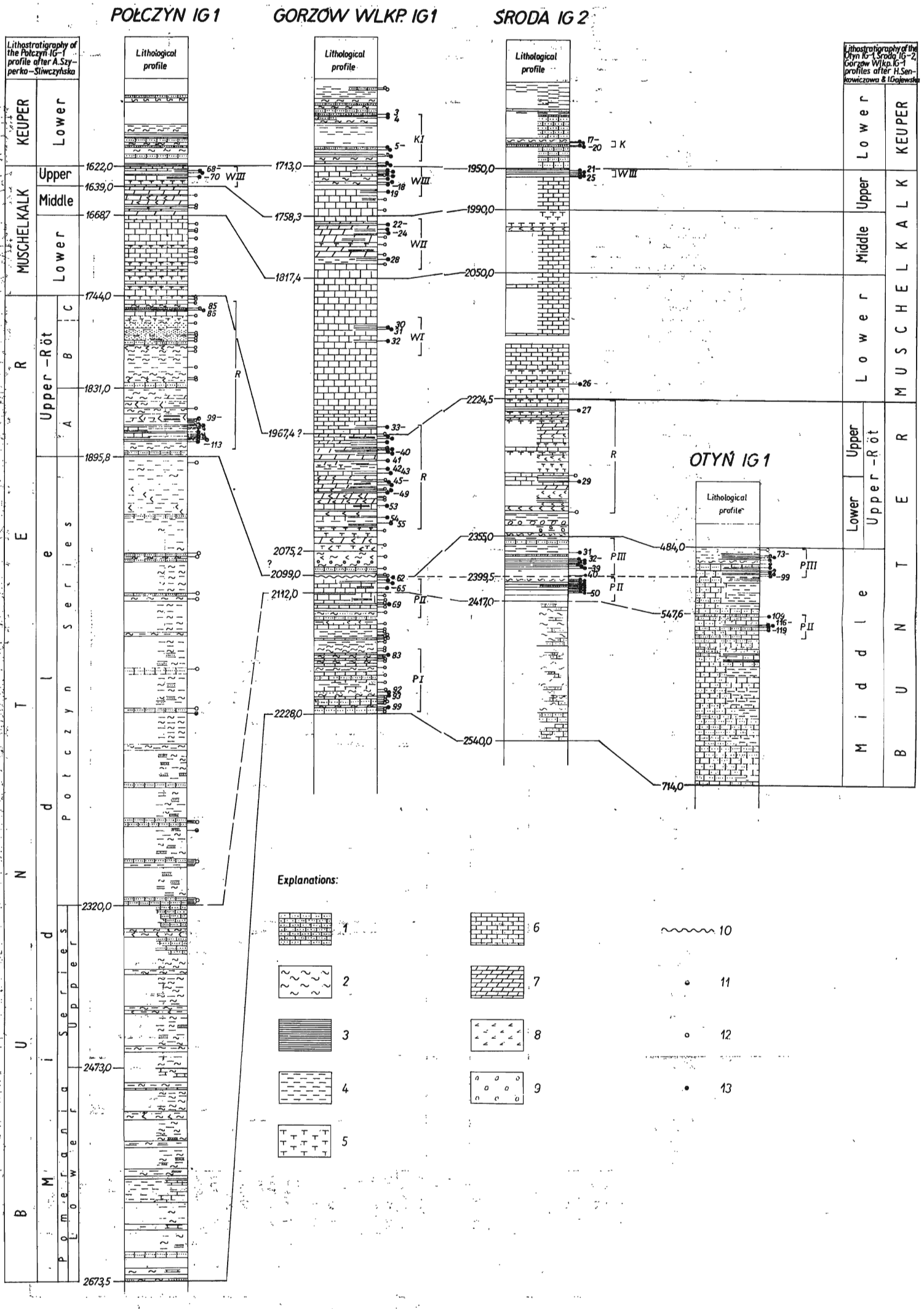

Fig. 2. Lithological and palynological correlation of the Middle Bunter, Röt and Muschelkalk sediments in the profiles of: Połczyn *IG-1*, Gorzów Wlkp. *IG-1*, Środa *IG-2*, Otyń *IG-1*

1 — sandstones, *2* — siltstones, *3* — grey and dark-grey mundstones, *4* — variegated mundstones, *5* — marls, *6* — limestones *7* — dolomites, *8* — gypsum and anhydrites, *9* — conglomerates, *10* — outwashed surface, *11* — samples taken from aggregates — palynologically barren, *12* — samples palynologically barren, *13* samples containing microflora

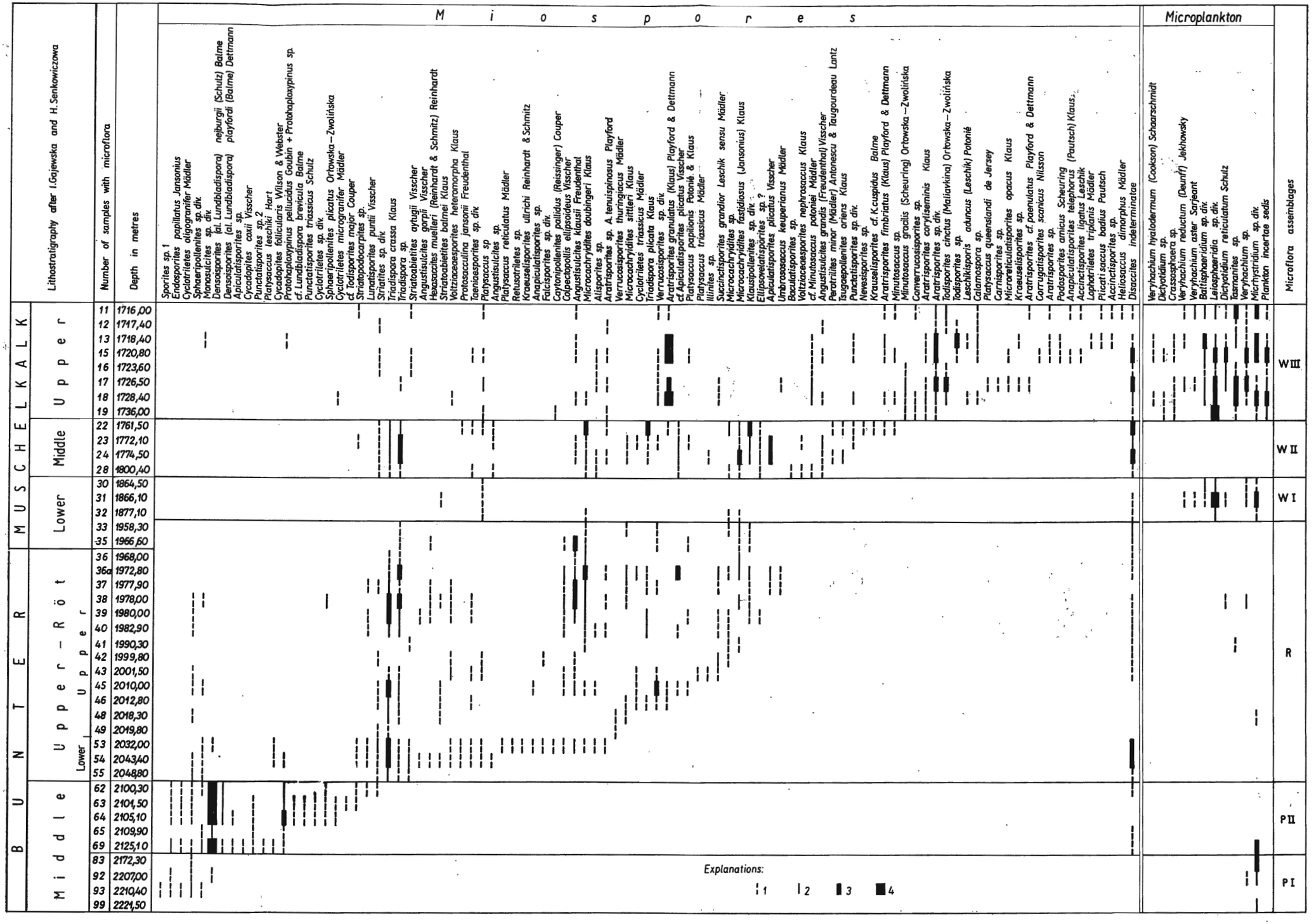

Fig. 3. Occurrence of miospores and microplankton in Bunter and Muschelkalk sediments from the Gorzów Wlkp. *IG-1* profile

1 — number of specimens with 1 to 3 per cent content, *2* — 4 to 10 per cent content, *3* — 11 to 30 per cent content, *4* — above 30 per cent content

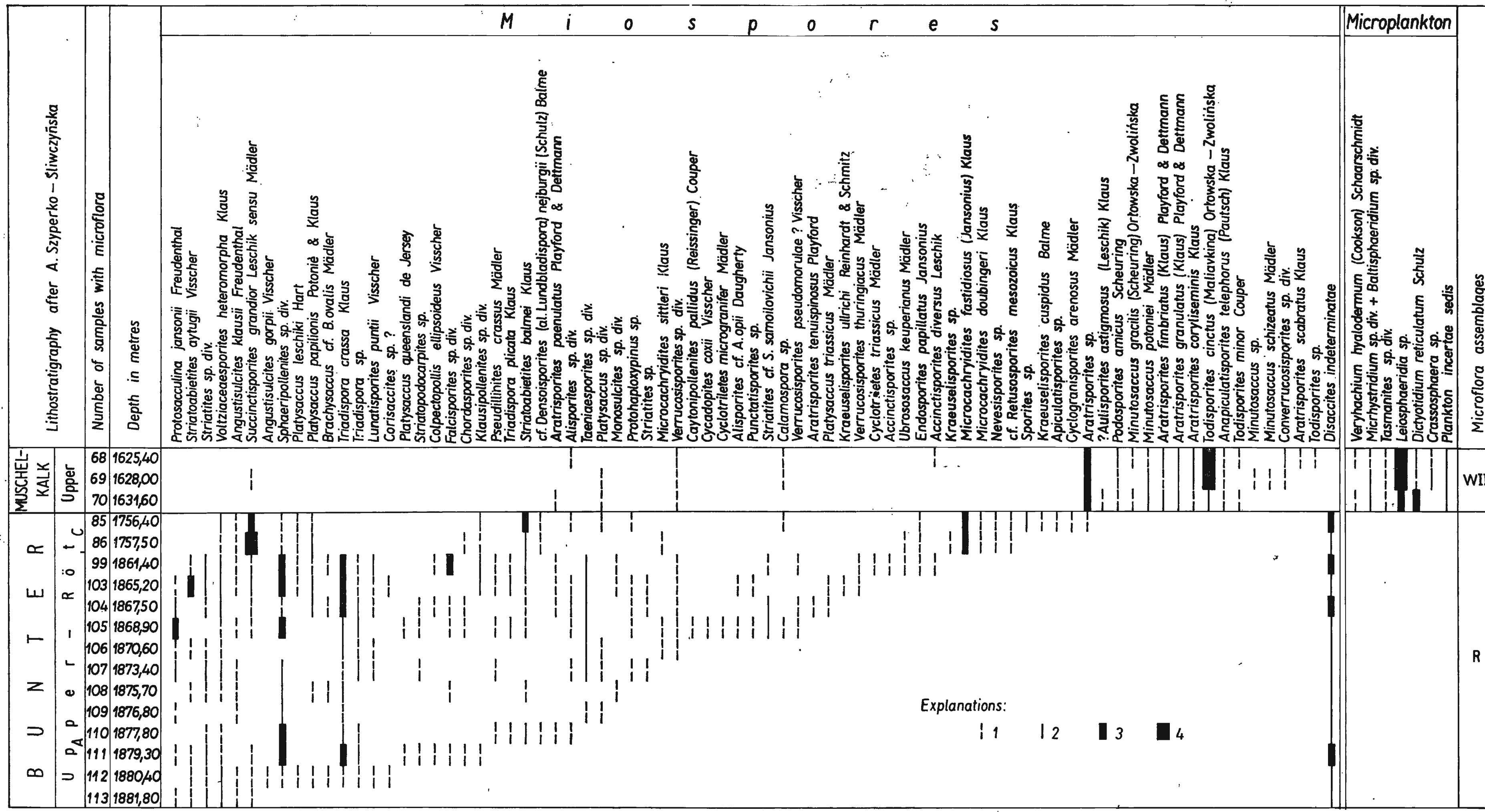

Fig. 4. Occurrence of miospores and microplankton in Bunter and Muschelkalk sediments from Połczyn *IG-1* profile

Legend as in Fig. 3

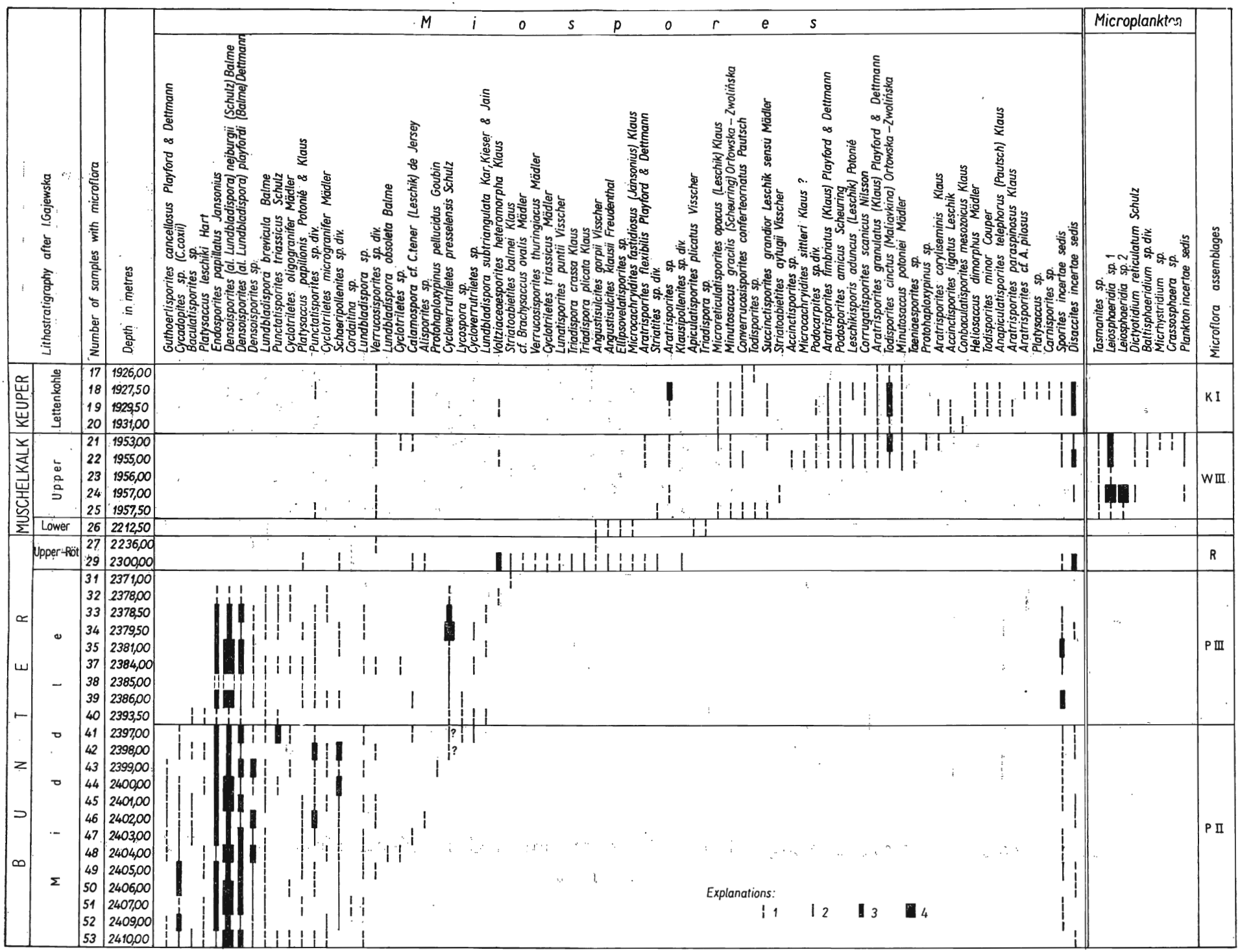

Fig. 5. Occurrence of miospores and microplankton in Bunter, Muschelkalk and Lower Keuper sediments in the Środa *IG-2* profile

Legend as in Fig. 3

Descriptions of species of stratigraphic importance, also of the newly created species *Sphaeripollenites plicatus* Orł.-Zwol., as well as of the new combination of the species *Minutosaccus* (al. *Protodiploxypinus*) *gracilis* (Scheuring) Orł.-Zwol. will be given in a paper by Orłowska-Zwolińska (1979).

When working out the present paper the lithostratigraphic scheme of the Middle Bunter and of the Röt accepted by the writer was that determined for Western Pomerania by Szyperko-Śliwczyńska (1966, 1973). The lithostratigraphic division of the Röt deposits in boreholes Gorzów Wlkp. *IG-1*, Środa *IG-2* and Otyń *IG-1* are given after Senkowiczowa (1965; in press), for the Muschelkalk deposits in borehole Gorzów Wlkp. *IG-1* after Senkowiczowa (in press) and in borehole Środa *IG-2* after Gajewska (in press).

Very sincere thanks are here due to Dr. A. Szyperko-Śliwczyńska, Dr. I. Gajewska, Dr. H. Senkowiczowa and Dr. T. Marcinkiewicz for their most valuable advice, discussions and critical remarks concerning the stratigraphy of the Lower Triassic, also for making accessible the yet unpublished descriptions of some profiles. Mrs. D. Oleksiak must be thanked for the photography of miospores and the Acritarcha.

CHARACTERISTICS OF THE MICROFLORA

The data obtained by the palynological investigations of the profiles Gorzów Wlkp. *IG-1*, Połczyn *IG-1*, Środa *IG-2* and Otyń *IG-1* may be summarized giving a description of the well characterising Triassic microflora from the Middle Bunter to the Lower Keuper. The miospores found there indicate a luxuriant land vegetation, while the occasionally abundant planktonic organisms suggest marine sedimentary environments. The microflora here described is rich both numerically and specifically. The presence may be observed of even Paleozoic genera, especially striate pollen grains of importance in the Lower Triassic, of short-range species within the Triassic, also the appearance of species passing into younger deposits.

The differentiation of the specific composition, also of the quantitative participation of the particular elements in this rich fossil group, due to evolutionary changes and to climatic oscillations, constitute their valuable significance in the study of Triassic stratigraphy.

The characteristic assemblages of microflora distinguished in the profiles here considered are marked in the diagrammatic tables by symbols lettered *PI, PII, PIII, R, WI, WII, WIII* to facilitate their comparisons and correlations (Fig. 2).

MIDDLE BUNTER

The oldest Middle Bunter sediments here analyzed are those encountered in profiles Gorzów Wlkp. *IG-1*, Środa *IG-2* and Otyń *IG-1*.

The microflora they yield is characterized by the regular, occasionally abundant, occurrence of Densoisporites and Lundbladispora. Three assemblages of Middle Bunter microflora have been differentiated and are marked by the symbols *PI*, *PII* and *PIII*.

The first assemblage — *PI* — has been observed in sediments of the lowermost part of the Middle Bunter in borehole Gorzów Wlkp. *IG-1* at a depth from 2172.3 to 2221.5 metres. It is poorly represented by miospores comprising but few species:

Densoisporites (al. ***Lundbladispora***) ***nejburgii*** **(Schulz) Balme**
Endosporites papillatus **Jansonius**
Cyclotriletes oligogranifer **Mädler**
Sphaeripollenites **sp. div.**
Monosulcites **sp. div.**

Another characteristic feature of this assemblage is a fairly abundant presence of microplankton representing the genera *Micrhystridium* and *Veryhachium* (Fig. 3).

The assemblage marked *PII*, for which the name *"Densoisporites nejburgii"* is here suggested has been differentiated from the above assemblage *PI* in the Gorzów Wlkp. *IG-1* profile at a depth from 2100.3 to 2125.1 m, also in the Środa *IG-2* profile (between 2397.0 and 2410.0 m) and in the Otyń *IG-1* profile at a depth between 547.6 and 573.0 metres. The last named assemblage is best devoloped in the Środa *IG-2* profile (Fig. 5) where it is characterized by the predominance of the species ***Densoisporites*** (al. ***Lundbladispora***) ***nejburgii*** (Schulz) Balme (Pl. 2, Figs 4—5).

There is an abundance of the species:

Densoisporites playfordi **(Balme) Dettmann — Pl. 2, Fig. 7**
Densoisporites **sp.**
Endosporites papillatus **Jansonius — Pl. 1, Fig. 6, 7**
Lundbladispora brevicula **Balme — Pl. 2, Fig. 6.**

The species:

Punctatisporites triassicus **Schulz — Pl. 2, Fig. 3**
Cyclotriletes oligogranifer **Mädler**
C. microgranifer **Mädler**
Platysaccus papilionis **Potonié & Klaus — Pl. 1, Fig. 4.**
P. leschiki **Hart — Pl. 1, Fig. 1**
Protohaploxypinus pellucidus **Goubin — Pl. 1, Fig. 5**
Sphaeripollenites **sp. div.**
Taeniaesporites noviaulensis **Leschik**
Cycadopites coxii **Visscher — Pl. 1, Fig. 2,**

and others (Figs 2 and 5) occur regularly though in smaller abundance.

The assemblage *PIII* — for which the name *"Cyclotriletes presselensis"* is being suggested — is connected with the uppermost part of the Middle Bunter (Otyń profile between a depth of 487.6 to 511.5 m; Środa profile between 2371.0 and 2393.5 m).

The above assemblage is a continuation of assemblage *PII*. It contains, side by side with specimens of the genera *Densoisporites*, *Lundbladispora* and the species *Endosporites papillatus* and others known from the *PII* assemblage with a predominance of the species *Cycloverrutriletes presselensis* Schulz (Fig. 5, Pl. 2, Figs 1, 2). The latter species occurs regularly, occasionally in abundance, it has a short vertical range and a wide geographical expansion.

Assemblage *PIII* has not been observed in profile Gorzów Wlkp. *IG-1*, this may be referred to the considerable reduction within the above profile of the Middle Bunter sediments (Fig. 2).

THE RÖT

Röt deposits have been investigated in profiles Gorzów Wlkp. *IG-1*, Połczyn *IG-1* and Środa *IG-2*. The name suggested by the writer for a characteristic assemblage of microflora differentiated in the Röt sediments under the symbol "*R*" is "*Voltziaceaesporites heteromorpha*". It is best developed in profile Połczyn *IG-1* (between 1756.4 and 1881.8 m) and in profile Gorzów Wlkp. *IG-1* (between 1958.3 and 2048.8 m) where it overlies the Middle Bunter assemblage of microflora (Figs 3 and 4). Its development is poorest in profile Środa (at a depth between 2236.0 and 2300 m) (Fig. 5).

The composition of the Röt assemblage is characterized by strong specific differentiation as compared with that in the Middle Bunter. This reliably indicates a clearly defined microfloristic boundary between these two lithostratigraphic units.

Spores quantitatively predominant in the spectre of the Middle Bunter occur but singly and sporadically in the Röt. Pollen grains are here the dominant element. Disaccate pollen grains with the characteristic trilete mark, assigned to the genus *Triadispora*, are numerous. The genus *Triadispora* makes its first appearance in the Röt deposits where it is encountered both, regularly and commonly. In the samples here examined it is represented by:

Triadispora crassa — Pl. 6, Fig. 1, 2
T. plicata Klaus — Pl. 6, Fig. 8

and a major group of grains only generically identified because of the damaged exine.

Among the *Disaccitriletes* grains a characteristic Triassic genus, the *Angustisulcites*, is found, represented chiefly by the species:

Angustisulcites klausii Freudenthal — Pl. 4, Fig. 3
A. gorpii Visscher.

Striate pollen grains belonging to the genera *Striatites* (Pant) Jansonius — including a characteristic species *S. samoilovichii* Jansonius (Pl. 5, Fig. 2), also *Taeniaesporites* (Leschik) Klaus, *Striatopodocarpites* (Zoricheva & Sedova) Hart. and *Striatoabietites* (Sedova) Hart. The latter genus is represented regularly by two Triassic species:

Striatoabietites aytugii Visscher
S. balmei Klaus — Pl. 4, Fig. 1, 2.

From among the disaccate pollen grains those most noteworthy are the regularly occurring grains of *Voltziaceaesporites heteromorpha* Klaus (Pl. 5, Fig. 1). Other pollen grains here encountered are:

Brachysaccus ovalis Mädler
Hexasaccites muelleri (Reinhardt & Schmitz) Reinhardt — Pl. 3, Figs 3, 4
Microcachryidites doubingeri Klaus — Pl. 6, Figs 4, 6
M. fastidiosus (Jansonius) Klaus — Pl. 6, Fig. 3
M. sittleri Klaus — Pl. 6, Fig. 7
Platysaccus triassicus Mädler — Pl. 6, Fig. 5
Succinctisporites grandior Leschik sensu Mädler — Pl. 5, Fig. 5

Spores, whose per cent content in the Röt spectre is notably lower than that of the pollen grains, are represented by species with great stratigraphic importance, i.a. by:

Aratrisporites tenuispinosus Playford — Pl. 3, Fig. 2
Cyclotriletes triassicus Mädler — Pl. 3, Figs 5, 6
Kraeuselisporites ullrichi Reinhardt & Schmitz — Pl. 4, Fig. 5
Verrucosisporites pseudomorulae Visscher
V. thuringiacus Mädler — Pl. 3, Fig. 1

It should be noted that in the assemblage under consideration the spores of *Densoisporites nejburgii* (Schulz) Balme occur sporadically as single specimens. This observation coincides with Schulz's view (1966) that the above species, predominant in the Middle Bunter, is a form disappearing in the Röt.

The microfloristic assemblage investigated in the boreholes of Western Poland is characteristic of all the Röt sediments. A closer classification of the Röt on the basis of microflora calls for further investigations. So far it is only possible to attempt the identification of microflora in the upper part of the Röt. This suggestion is based on the numerical increase of grains of the genus *Microcachryidites*, particularly of the species *M. fastidiosus* (Jansonius) Klaus, as well as of grains belonging to *M. doubingeri* Klaus and *M. sittleri* Klaus. The pollen grains so prominent in the uppermost Röt have not been found in its lowermost part, some sporadical specimens of *M. sittleri* excepted. Moreover, pollen grains *Succinctisporites grandior* Leschik sensu Mädler are more numerous and regularly dispersed in the upper part of the Röt, while those of *Triadispora* are of greater importance in the lower part because of their more regular abundance. Hence, it seems reasonable to suppose that the differentiation of microflora reflects changes in the sedimentary conditions. The pollen grains of *Triadispora* are more numerous in that part of the profile where gypsum and anhydrites occur in larger amounts. On the other hand, in the upper part of the Röt, where sedimentation takes on a carbonaceous-muddy character, the number of *Triadispora* grains decreases while those of *Microcachryidites* grow distinctly more numerous. This may, therefore, be a reliable basis to recognize the microfloristic differences of the upper part of the Röt. In borehole Połczyn *IG-1* this is referred to zone C (Szyperko-Śliwczyńska 1966), in borehole Gorzów Wlkp. *IG-1* to the Wilczkowice beds (Senkowiczowa 1965).

The Röt assemblage in the Gorzów Wlkp. *IG-1* profile also occurs in sediments assigned to the lowermost part of the Muschelkalk. Palynological studies, carried out so far, do not provide doubtless evidence for their assignment to the Röt or to the Muschelkalk. There is a notable lack in the literature (Fischer 1972, Smith & Warrington 1971) of palynological criteria concerning the separation of the sediments here considered.

THE MUSCHELKALK

The most complete picture of microflora in the Muschelkalk deposits has been provided by the Gorzów Wlkp. *IG-1* profile. An assemblage named *WI* has been differentiated in the Lower Muschelkalk sediments overlying the microfloristic assemblage of the Röt. It has yielded single specimens of the pollen grains of *Platysaccus* sp., *Striatoabietites balmei* Klaus, *Microcachryidites* sp. div. et al. The correct assignment of the *WI* assemblage is indicated by the abundance of microplankton specimens from the Acritarcha group. *Leiosphaeridia* are predominant, also the genera *Micrhystridium, Baltisphaeridium* and *Veryhachium.*

The presence of microplankton characterized by long stratigraphic ranges is controlled by the facies since this indicates the marine sedimentary environment. The last named assemblage is not an accurate age indicator of the deposits. It has namely been differentiated in the profile as the successive assemblage in the microfloristic sequence. It differs from the underlying Röt assemblage as well as from the well defined overlying *WII* assemblage. The *WI* assemblage lacks numerous species characteristic of the Röt, its most significant feature being the abundance of microplankton (Fig. 3) indicating increased marine transgression.

The next assemblage *WII* of the rich microflora, which the writer suggests to call "*Tsugaepollenites oriens*" has been differentiated in the Middle Muschelkalk sediments of Gorzów Wlkp., at a depth from 1767.0 to 1800.4 m. It is characterized by the presence of genus *Triadispora*, while the numerically predominant species here is *T. plicata* (Pl. 7, Fig. 2) in opposition to the Röt assemblage, species *T. crassa* (Pl. 7, Fig. 1) being second to it. There is also an abundance of the following species:

Apiculatisporites plicatus Visscher — Pl. 7, Fig. 8
Klausipollenites sp.,
Microcachryidites doubingeri Klaus
M. fastidiosus (Jansonius) Klaus — Pl. 7, Fig. 3

and a regular occurrence of

Aratrisporites tenuispinosus Playford
Alisporites sp.
Angustisulcites klausii Freudenthal
A. grandis (Freudenthal) Visscher
Striatites sp.
Voltziaceaesporites nephrosaccus Klaus.

On the other hand, no specimens of *Voltziaceaesporites heteromorpha* Klaus have been encountered. Sporadically they are found in sediments younger than the Röt.

Of particular importance is the presence in the sediments here considered of the species:

Perotrilites minor (Mädler) Antonescu & Taugourdeau-Lantz — Pl. 7, Figs 5, 6
Tsugaepollenites oriens Klaus — Pl. 7, Figs 4, 7, 9.

The former is recognized as an index species of the Muschelkalk (Taugourdeau-Lantz 1974), while the latter has so far been reported only from the Middle Muschelkalk (Klaus 1964, Warrington 1974).

Sediments of the lower part of the Upper Muschelkalk, overlying the palynologically documented Middle Muschelkalk, have not yielded any sporomorphs from the profiles under consideration.

The differentiated microflora assemblage *WIII*, whose characteristic feature is the high per cent content of planktonic species, is already in contact with the top part of the Upper Muschelkalk.

The miospores are represented by a great abundance of genus *Aratrisporites*, chiefly those of the species *A. granulatus* (Klaus) Playford & Dettmann. *A. coryliseminis* Klaus, *A. tenuispinosus* Playford, *A. fimbriatus* (Klaus) Playford & Dettmann are also common. The genus *Todisporites* with the predominant species *T. cinctus* (Maliavkina) Orłowska-Zwolińska is also abundant in the *WIII* assemblage.

In the above assemblage the first appearance is made in a Triassic profile of the following species:

Accinctisporites ligatus Leschik
Anapiculatisporites telephorus (Pautsch) Klaus
Corrugatisporites scanicus Nilsson
Leschikisporis aduncus (Leschik) Potonié
Microreticulatisporites opacus Klaus
Minutosaccus (al. *Protodiploxypinus*) *gracilis* (Scheuring) Orłowska-Zwolińska
Podosporites amicus Scheuring et al.

The miospores found in the spectre here considered also persist in the overlying Lower Keuper deposits.

Microplankton, occasionally more numerous than the miospores is represented in notable abundance in the *WIII* assemblage by: *Leiosphaeridia* sp. div., *Tasmanites* sp. div., *Crassosphaera* sp., *Veryhachium* sp. div., *Micrchystridium* sp. div. and *Baltisphaeridium* sp. div. (Pl. 8, Figs 1—9).

In the overlying Lower Keuper deposits there is a decrease in the amount of plankton accompanied by changes in its specific composition marked by the absence of genera *Leiosphaeridia, Crassosphaera* and *Tasmanites.*

The palynological boundary, expressed in the picture of microflora in a change of the per cent content of microplankton, reflects the facial changes that occurred in Poland between the marine facies of the Muschelkalk and the limnic one of the Lower Keuper.

CONCLUSIONS AND CORRELATION WITH THE CONTEMPORANEOUS MICROFLORES OUTSIDE OF POLAND

The Bunter and Muschelkalk microflora worked out from the profiles here considered contains characteristic species which reliably suggest the differentiation of separate, stratigraphically important assemblages. This has made it possible to document and correlate the Lower and Middle Triassic sediments from profiles of Western Poland, also to compare those of the same age from the epicontinental and Alpine facies of the European Triassic.

The microflora of the Middle Bunter from profiles in Western Poland can be very clearly correlated with analogous floras in the German Democratic Republic (Schulz 1964, 1966) and the Moesian Platform of Rumania (Venkatachala, Beju & Kar 1968). The Polish microflora also displays features in common with that of the lower part of the Baskunczakska series in the vicinity of the Central Pre-Caspian, also the Olenek of the southern Mangyshlak (USSR — Bogacheva & Vinogradova 1973). It will be interesting to note that in the work by Movshevich & Kozur (1975) the major part of the Baskunczakska series has been recognized as corresponding to the Röt with only its lowermost part corresponding to the upper part of the Middle Bunter. The writer supposes that the existing palynological evidence allows the correlation of the lower part of the Baskunczakska series in the vicinity of the Central Pre-Caspian with the uppermost part of the Middle Bunter both in Poland and in the German Democratic Republic.

The *PI, PII, PIII* assemblages differentiated in the Middle Bunter microflora from profiles of the Fore-sudetic monocline (Gorzów Wlkp. *IG-1*, Środa *IG-2* and Otyń *IG-1*) occur in sediments comparable on lithostratigraphic evidence (Szyperko-Śliwczyńska 1973, and unpublished material) with the Pomeranian and Połczyn series distinguished in western Pomerania (Połczyn *IG-1* profile, Fig. 2).

Sediments from the above profiles containing the *PI* assemblage may be regarded as age-correspondents of the lower Pomeranian series, those with the assemblage *PII* as corresponding in age to the upper Pomeranian series and the lower part of the Połczyn series, while sediments with the assemblage *PIII* as age correspondents of the upper part of the Połczyn series.

Outside the Polish territory these three: *PI, PII* and *PIII* assemblages are comparable with corresponding assemblages differentiated in the profiles of Brandenburg in the German Democratic Republic. The basis for correlation consists of comparative materials rendered accessible by Schulz and those from profiles worked out by the writer as a result of the co-operation between Poland and G.D.R.

The *PI* assemblage may, with some probability, be connected with the microflora of the Volpriehausen series.

The *PII* assemblage has features in common with the microflora of the Detfurth series and with that of the lower part of the Hardegsen series, while the *PIII* assemblage may be readily correlated with the microfloristic assemblage of the upper part of the Hardegsen series thanks to the appearance of the characteristic miospore *Cycloverrutriletes presselensis* Schulz (Schulz 1964, 1966).

The Röt assemblage differentiated in the Połczyn *IG-1* and the Gorzów Wlkp. *IG-1* profiles distinctly resembles the Röt microflora in many European countries. Most of its features in common are with the Röt microflora in the German Democratic Republic (Schulz 1965, 1966, Mädler 1964, Reinhardt & Schmitz 1965); Holland (Freudenthal 1964, Visscher 1967); and eastern France (Adloff & Doubinger 1969). In Great Britain the age-correspondents of the assemblage here described are represented by the microfloras of the lower part of the "Keuper" Sandstone Group in the Central Middlands of England, locally of the Green Beds and the lower part of the "Keuper" Marl, correlated with the Upper Bunter according to the epicontinental classification and with the upper Scythian in the Alpine classification (Smith & Warrington 1971, Warrington 1973).

In the Alps a similar assemblage occurs in the shales of the upper Werfenian (Klaus 1964).

The lowermost microfloristic Muschelkalk assemblage *WI* does not yield any palynological age suggestions for these deposits. The abun-

dance of micro-planktonic forms indicates stronger marine transgression at that time.

The *WII* assemblage characterized by the presence of the species *Tsugaepollenites oriens* Klaus, *Perotrilites minor* (Mädler) Antonescu & Taugourdeau-Lantz has a number of features resembling those in the Muschelkalk microflora of SE France (Taugourdeau-Lantz 1974).

The determination of the occurrence ranges of the above species makes easier a more accurate age assignment of the *WII* assemblage as characteristic of the Middle Muschelkalk. The species *Perotrilites minor* is known from the Lower Muschelkalk of Germany (Mädler 1964), from the Lower and Middle Muschelkalk of France (Taugourdeau-Lantz 1974) and has also been encountered in the Anisian of the Eastern Carpathians in Rumanian territory (Antonescu 1970, Antonescu & Tougourdeau-Lantz 1973).

The presence of this species, called *Aequitriradites minor* Mädler (syn. *Perotrilites minor*) in the Nordsø borehole in Denmark is also reported by Bertelsen (1975). That author refers to the Anisian the assemblage yielding the species named above.

The co-occurrence of *P. minor* with *Tsugaepollenites oriens* Klaus has been observed by Warrington (1974) in the biostratigraphic unit *D* differentiated in the upper part of deposits refferred to as the Lower "Keuper" Marl in the west of Lancashire in Great Britain. The correlation made by the above author shows their presence in sediments which are an age equivalent of the Anisian (Warrington 1970, 1973).

The stratigraphic position of the species *Tsugaepollenites oriens* Klaus is by Klaus (1964) associated with sediments of the Middle Muschelkalk.

The *WIII* assemblage observed in the top part of the Upper Muschelkalk is characterized by a different microflora. The appearance is here first made in a Triassic profile of numerous species passing into the overlying Keuper deposits where they occur in high per cent abundance. The presence, even the predominance of microplanktonic specimens from genera *Leiosphaeridia, Tasmanites, Crassosphaera, Veryhachium, Micrhystridium* and *Baltisphaeridium* provides a basis for comparing the *WIII* assemblage with the Upper Muschelkalk microflora in the German Democratic Republic (Schulz 1976).

According to the currently accepted correlation, the microflora of the higher part of the Upper Muschelkalk represents the Ladinian.

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T. ORŁOWSKA-ZWOLIŃSKA

KORELACJA PALINOLOGICZNA PSTREGO PIASKOWCA I WAPIENIA MUSZLOWEGO W WYBRANYCH PROFILACH ZACHODNIEJ POLSKI

(Streszczenie)

Przedstawiono wyniki badań polinologicznych pstrego piaskowca i wapienia muszlowego z profilów wiertniczych: Połczyn *IG-1*, Gorzów Wlkp. *IG-1*, Środa *IG-2* i Otyń *IG-1* usytuowanych w zachodniej Polsce (fig. 1).

Znaleziona bogata mikroflora obejmuje spory, ziarna pyłku i mikroplankton z grupy Acritarcha Evitt. Zmiany w składzie gatunkowym umożliwiły wyróżnienie

charakterystycznych zespołów palinologiczno-stratygraficznych, które na tabelach graficznych określono symbolami: *PI, PII, PIII, R, WI, WII, WIII.* Na podstawie wymienionych zespołów przeprowadzono korelację badanych osadów w profilach zachodniej Polski (fig. 2), a następnie korelację z równowiekową mikroflorą facji epikontynentalnej i alpejskiej Europy.

Mikroflora środkowego pstrego piaskowca w profilach zachodniej Polski charakteryzuje się regularnym, a niekiedy dominującym, występowaniem okazów *Densoisporites nejburgii* (Schulz) Balme oraz zawiera także ważne stratygraficzne gatunki: *Densoisporites playfordi* (Balme) Dettmann, *Lundbladispora brevicula* Balme, *Endosporites papillatus* Jansonius, *Punctatisporites trassicus* Schulz, *Cyclotriletes oligogranifer* Mädler, *C. microgranifer* Mädler, *Cycloverrutriletes presselensis* Schulz, *Platysaccus papilionis* Potonié et Klaus, *P. leschiki* Hart, *Cycadopites coxii* Visscher, *Sphaeripollenites* sp. div. i inne.

W zakresie mikroflory środkowego pstrego piaskowca w profilach Gorzów Wlkp. *IG-1*, Środa *IG-2* i Otyń *IG-1* wyróżniono 3 zespoły: *PI, PII* i *PIII.*

Zespół *PI* występuje w profilu Gorzów Wlkp. *IG-1* w osadach, które na podstawach litostratygraficznych mogą być określone jako odpowiednik wiekowy serii pomorskiej dolnej, wyróżnionej na obszarze Pomorza Zachodniego (Szyperko-Śliwczyńska 1973). Zespół ten ubogo reprezentowany przez miospory, charakteryzuje się obecnością gatunku *Densoisporites nejburgii* (Schulz) Balme oraz dość znacznym udziałem mikroplanktonu (fig. 3).

Zespół *PII*, dla którego proponuje się nazwę „*Densoisporites nejburgii*" wyróżniono w profilach Gorzów *IG-1*, Środa *IG-2* i Otyń *IG-1*, w osadach stanowiących odpowiednik wiekowy serii pomorskiej górnej i dolnej części serii połczyńskiej.

Cechą wyróżniającą omawiany zespół jest dość zróżnicowany skład gatunkowy, w którym gatunek *Densoisporites nejburgii* osiąga maksimum procentowego występowania (fig. 3 i 5).

Zespół *PIII*, o proponowanej nazwie „*Cycloverrutriletes presselensis*", stwierdzono w profilach Środa *IG-2* i Otyń *IG-1* (fig. 2). Zespół ten związany jest z wyższą częścią serii połczyńskiej. Pod względem florystycznym stanowi kontynuację zespołu *PII*, a o jego odrębności decyduje pojawienie się i niekiedy liczne występowanie gatunku *Cycloverrutriletes presselensis* Schulz (fig. 5).

Zespół *R*, określony mianem „*Voltziaceaesporites heteromorpha*" wyróżniono w profilach Połczyn *IG-1*, Gorzów *IG-1* i Środa *IG-2*. Odznacza się on regularnym występowaniem gatunku *Voltziaceaesporites heteromorpha* oraz licznym udziałem gatunków, wśród których najważniejsze są: *Triadispora crassa* Klaus, *T. plicata* Klaus, *Angustisulcites klausii* Freudenthal, *Striatites samoilovichii* Jansonius, *Striatoabietites balmei* Klaus, *Succinctisporites grandior* Leschik sensu Mädler, *Microcachryidites fastidiosus* (Jansonius) Klaus, *M. doubingeri* Klaus, *M. sittleri* Klaus, *Verrucosisporites thuringiacus* Mädler, *Verrucosisporites pseudomorulae* Visscher, *Kraeuselisporites ullrichi* Reinhardt et Schmitz, *Cyclotriletes triassicus* Mädler, *Aratrisporites tenuispinosus* Playford, *Hexasaccites muelleri* (Reinhardt) i inne.

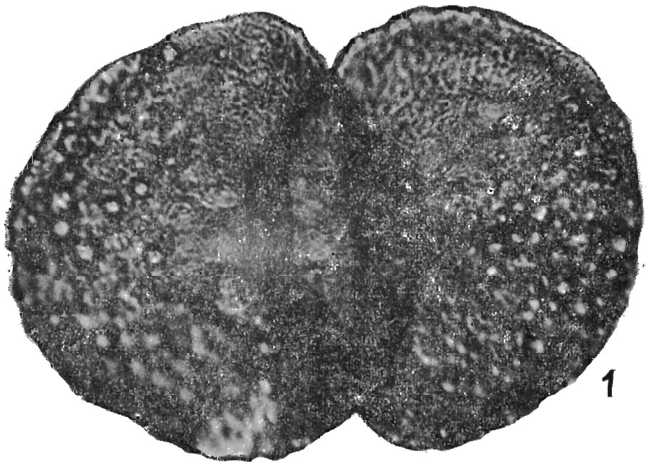
Najniższy zespół mikroflory wapienia muszlowego *WI* nie daje podstawy dla palinologicznego datowania tych osadów. Obfite występowanie mikroplanktonu jest świadectwem wzmożonej transgresji w tym czasie.

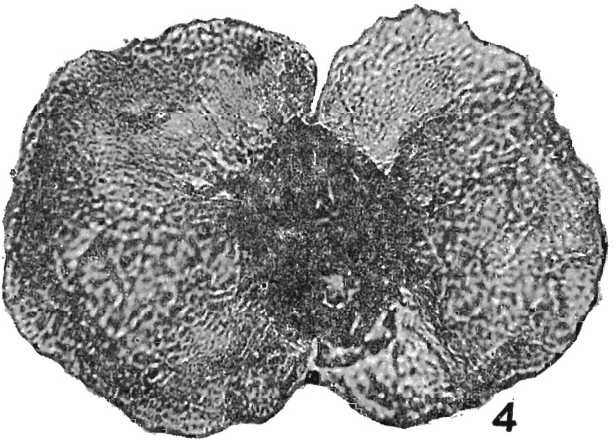
Zespół mikroflory wapienia muszlowego — *WII*, dla którego proponuje się nazwę „*Tsugaepollenites oriens*", wyróżniono w profilu Gorzów Wlkp. *IG-1*. Licznie występują w nim gatunki: *Triadispora plicata* Klaus, *T. crassa, Microcachryidites doubingeri* Klaus, *M. fastidiosus* (Jansonius) Klaus, *Apiculatisporites plicatus* Visscher, *Angustisulcites klausii* Freudenthal, *Angustisulcites grandis* (Freudenthal) Vischer, *Aratrisporites tenuispinosus* Playford i inne (fig. 3).

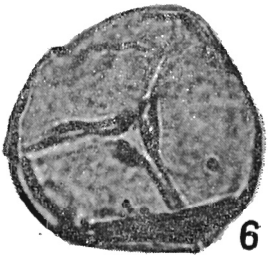
Cechę wyróżniającą stanowi obecność gatunków *Perotrilites minor* (Mädler) Antonescu et Taugourdeau-Lantz oraz *Tsugaepollenites oriens* Klaus, które dają podstawę do skorelowania zawierających je osadów z osadami środkowego wapienia muszlowego w facji epikontynentalnej i osadami anizyku w facji alpejskiej triasu Europy.

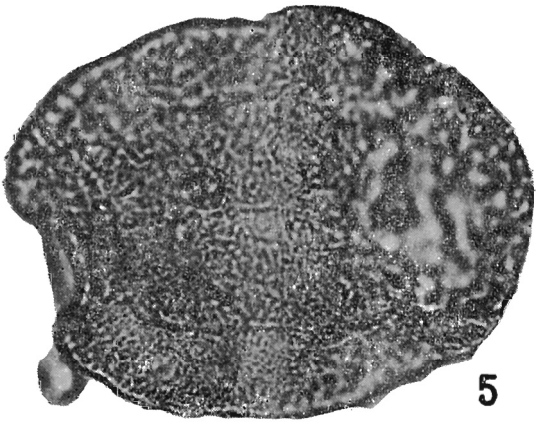
Zespół *WIII* stwierdzono w stropowej części górnego wapienia muszlowego w profilach Gorzów Wlkp. *IG-1*, Połczyn *IG-1* i Środa *IG-2*. Pojawiają się tu po raz pierwszy w profilu triasowym liczne gatunki, które w dużych ilościach procentowych występują w wyżej leżących osadach kajpru dolnego.

Obecność, a niekiedy przewaga, w zespole *WIII* okazów mikroplanktonu nad miosporami stanowi cechę wyróżniającą opisywany zespół od mikroflory kajpru dolnego (fig. 5).

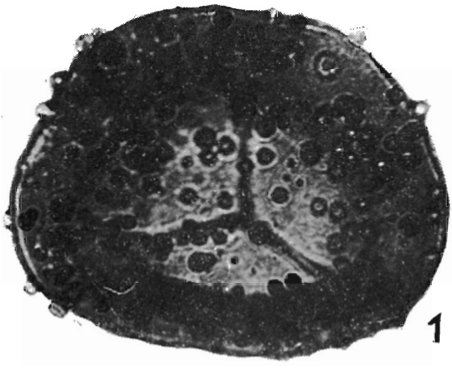


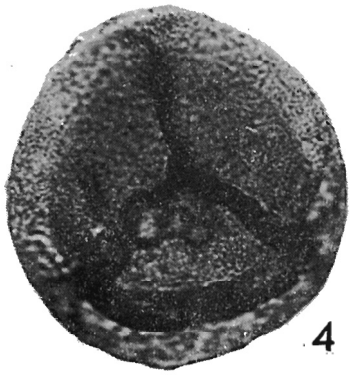


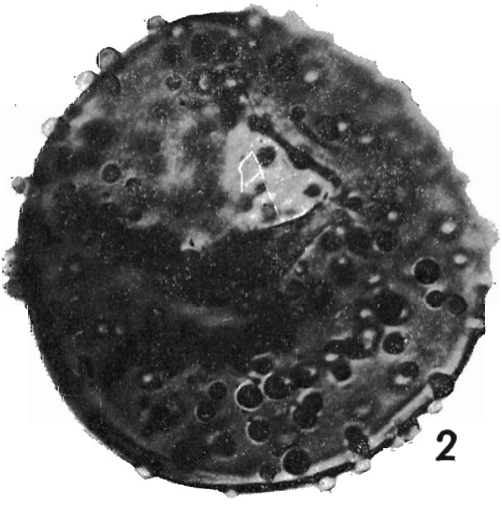


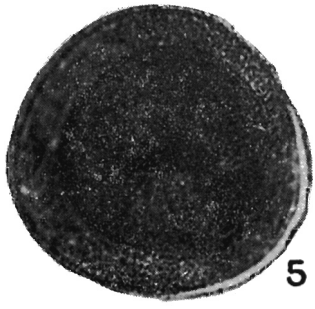


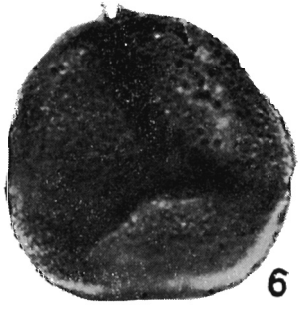
1 — *Platysaccus leschiki* Hart; borehole Środa *IG-2*, depth 2393.0 m; × 500.
2 — *Cycadopites coxii* Visscher; Środa, 2397.0 m; × 1000.
3 — *Cycadopites* cf. *C. follicularis* Wilsson et Webster; Otyń *IG-1*, 559.0 m; × 1000.
4 — *Platysaccus* cf. *P. papilionis* Potonié et Klaus; Otyń, 560.0 m; × 500.
5 — *Protohaploxypinus pellucidus* Goubin; Otyń, 559.0 m; × 1000.
6—7 — *Endosporites papillatus* Jansonius; Środa *IG-2*, 2381.0 m, × 1000; *6* — isolated central

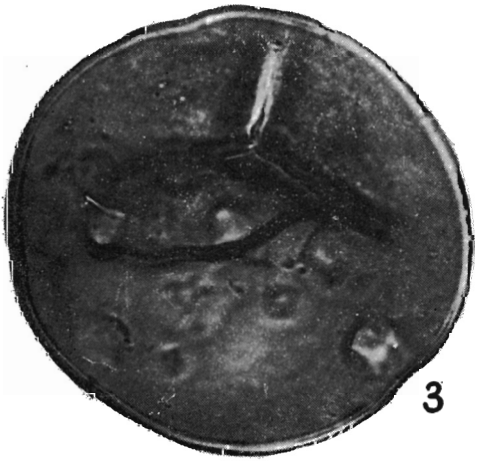


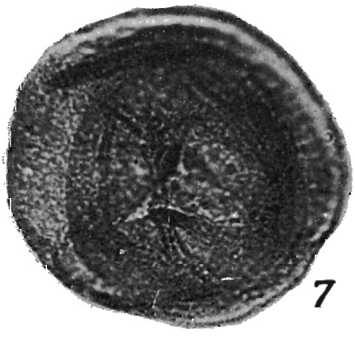




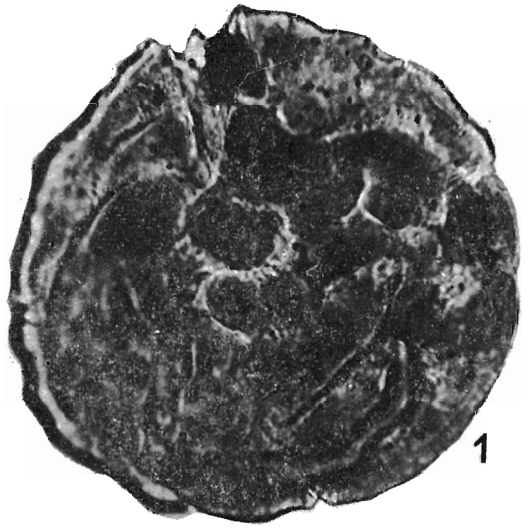


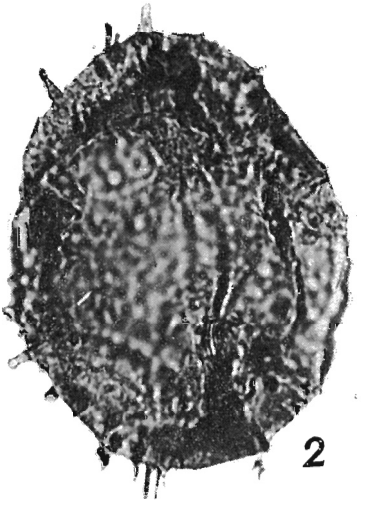


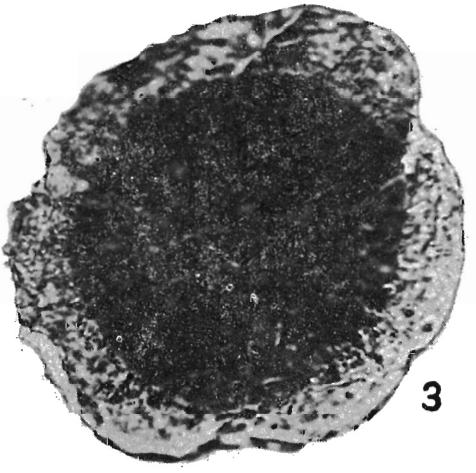


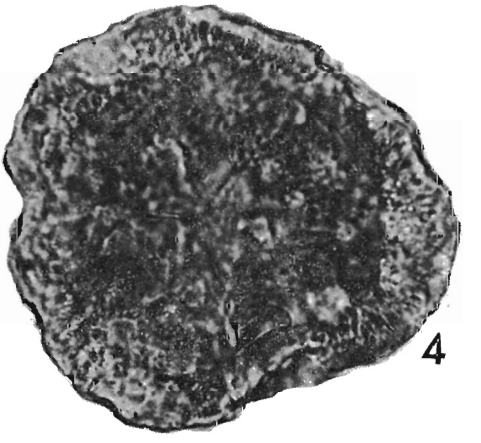


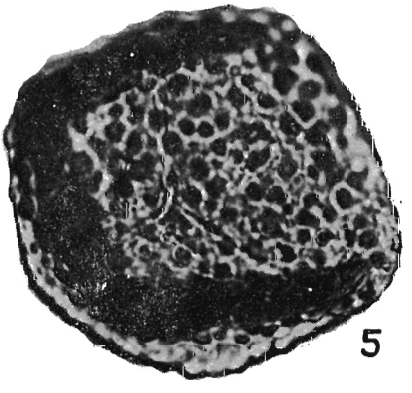
1—2 — *Cycloverrutritetes presselensis* Schulz; *1* — Środa *IG-2*, 2378.5 m; *2* — Otyń, 498.5 m.
3 — *Punctatisporites triassicus* Schulz; Otyń, 491.9 m.
4—5 — *Densoisporites nejburgii* (Schulz) Balme; Środa *IG-2*; *4* — 2393.5 m; *5* — 2401.0 m.
6 — *Lundbladispora brevicula* Balme; Otyń, 504.3 m. (The outline of exine deformed in print).
7 — *Densoisporites playfordi* (Balme) Dettmann; Środa, 2384.0 m.

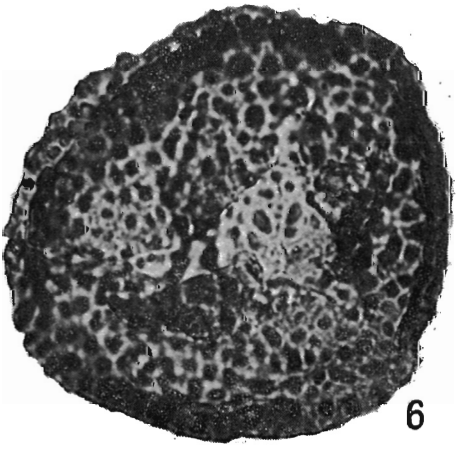






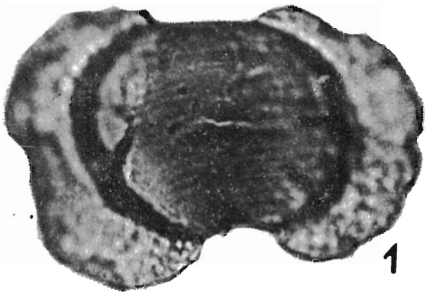


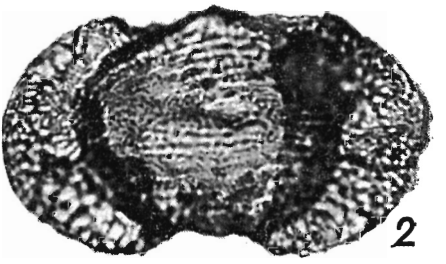


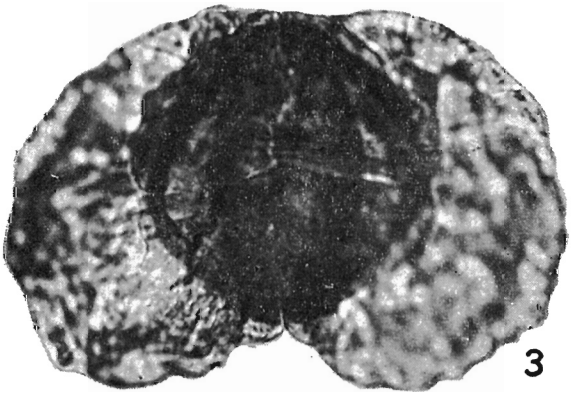


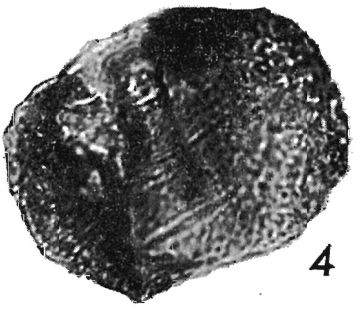
1 — *Verrucosisporites thuringiacus* Mädler; Gorzów Wlkp. *IG-1*, 2028.3 m.
2 — *Aratrisporites tenuispinosus* Playford; Połczyn *IG-1*, 1867.5 m.
3—4 — *Hexasaccites muelleri* (Reinhardt & Schmitz) Reinhardt; Gorzów Wlkp. *IG-1*; *3* — 1966.6 m; *4* — 1980.0 m.
5—6 — *Cyclotriletes triassicus* Mädler; *5* — Połczyn *IG-1*, 1861.4 m; *6* — Gorzów Wlkp. *IG-1*, 1972.8 m.

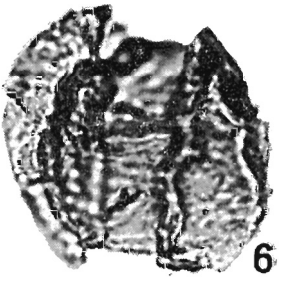
All figures × 1000

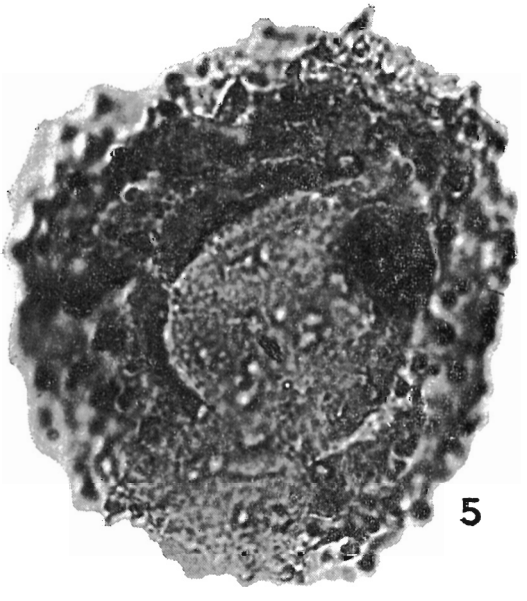


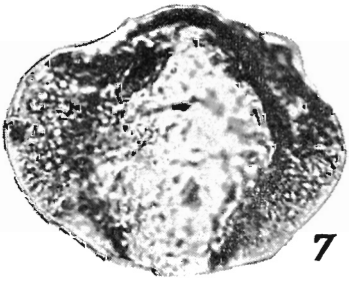






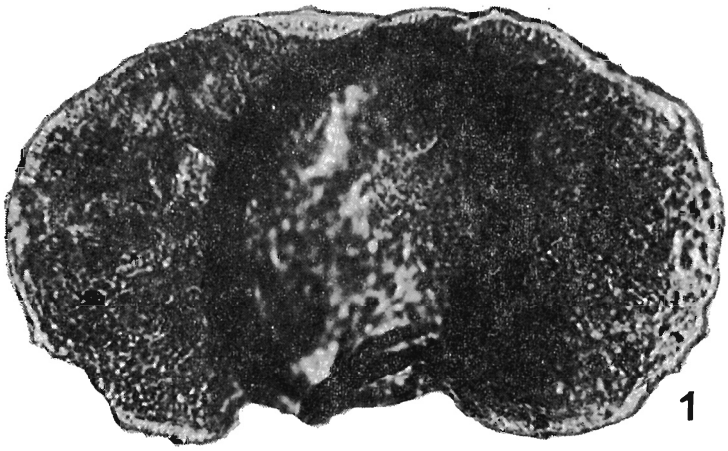


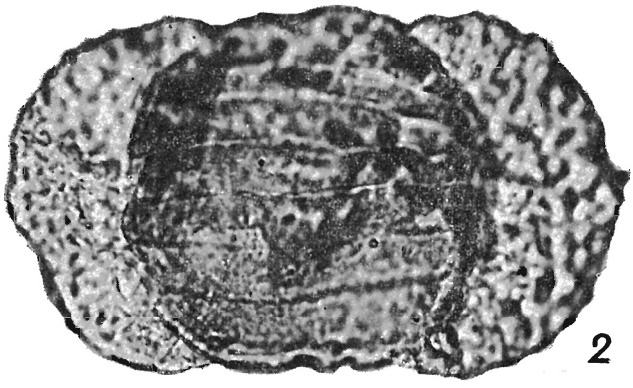


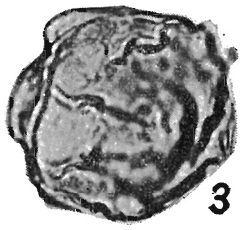


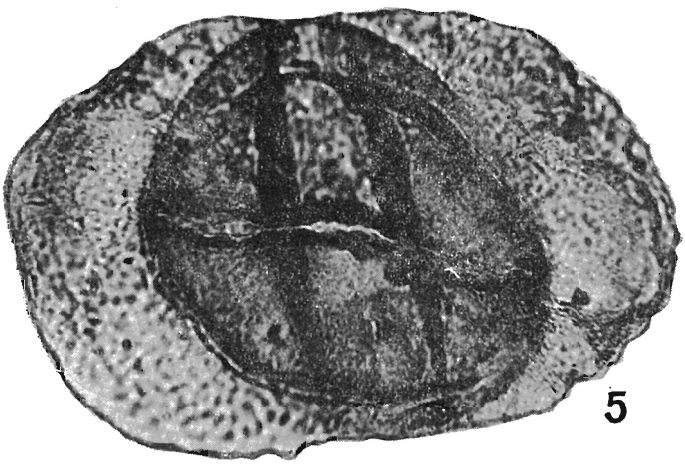
1—2 — *Striatoabietites balmei* Klaus; Połczyn *IG-1*, 1757.5 m.
3 — *Angustisulcites klausii* Freudenthal; Połczyn *IG-1*, 1757.5 m.
4 — *Protohaploxypinus* sp.; Połczyn, 1756.0 m.
5 — *Kraeuselisporites ullrichi* Reinhardt & Schmitz; Gorzów Wlkp. *IG-1*, 2032.0 m.
6 — *Protosacculina jansonii* Freudenthal; Połczyn *IG-1*, 1868.9 m.
7 — *Klausipollenites* sp.; Połczyn *IG-1*, 1756.0 m.

All figures × 1000





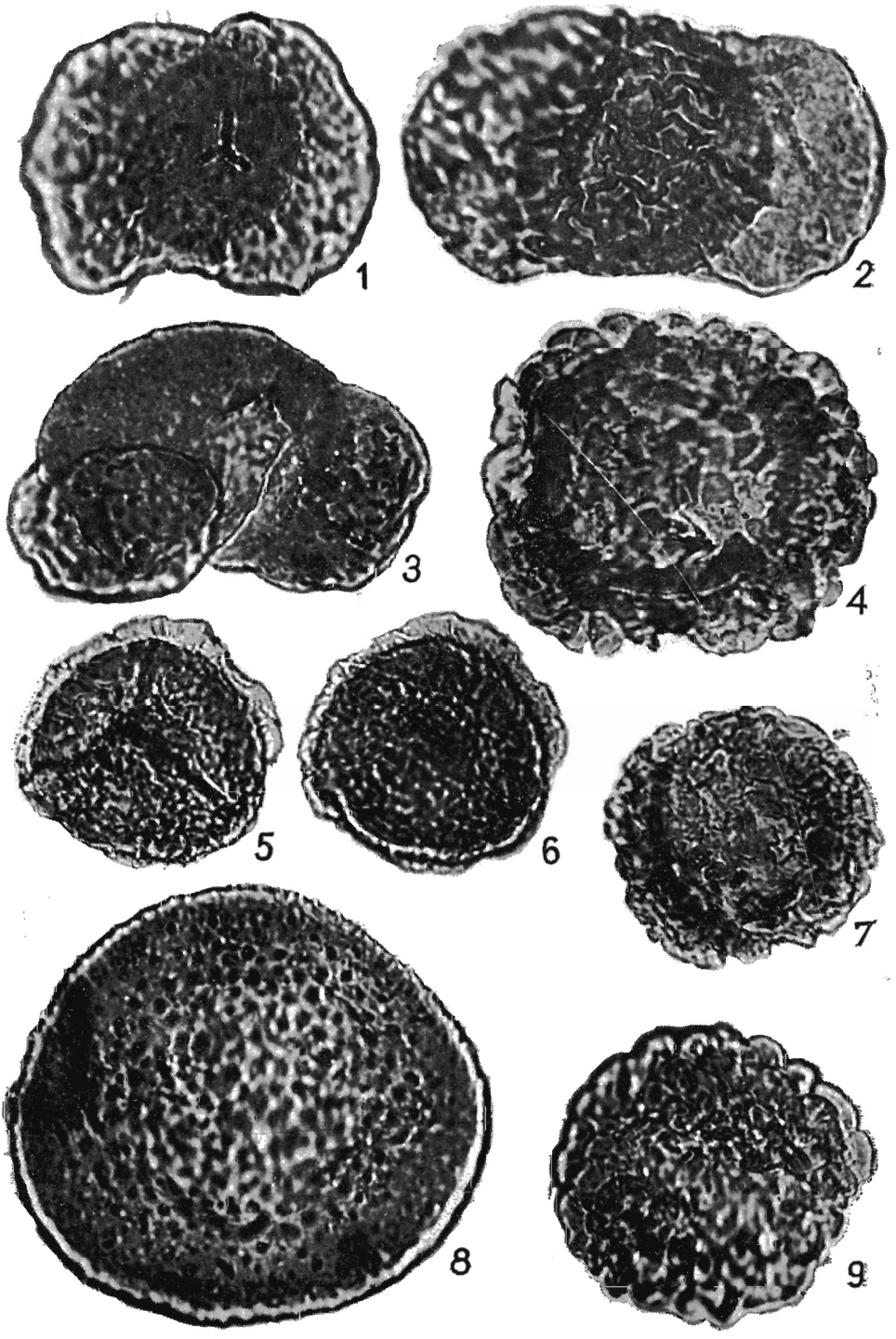




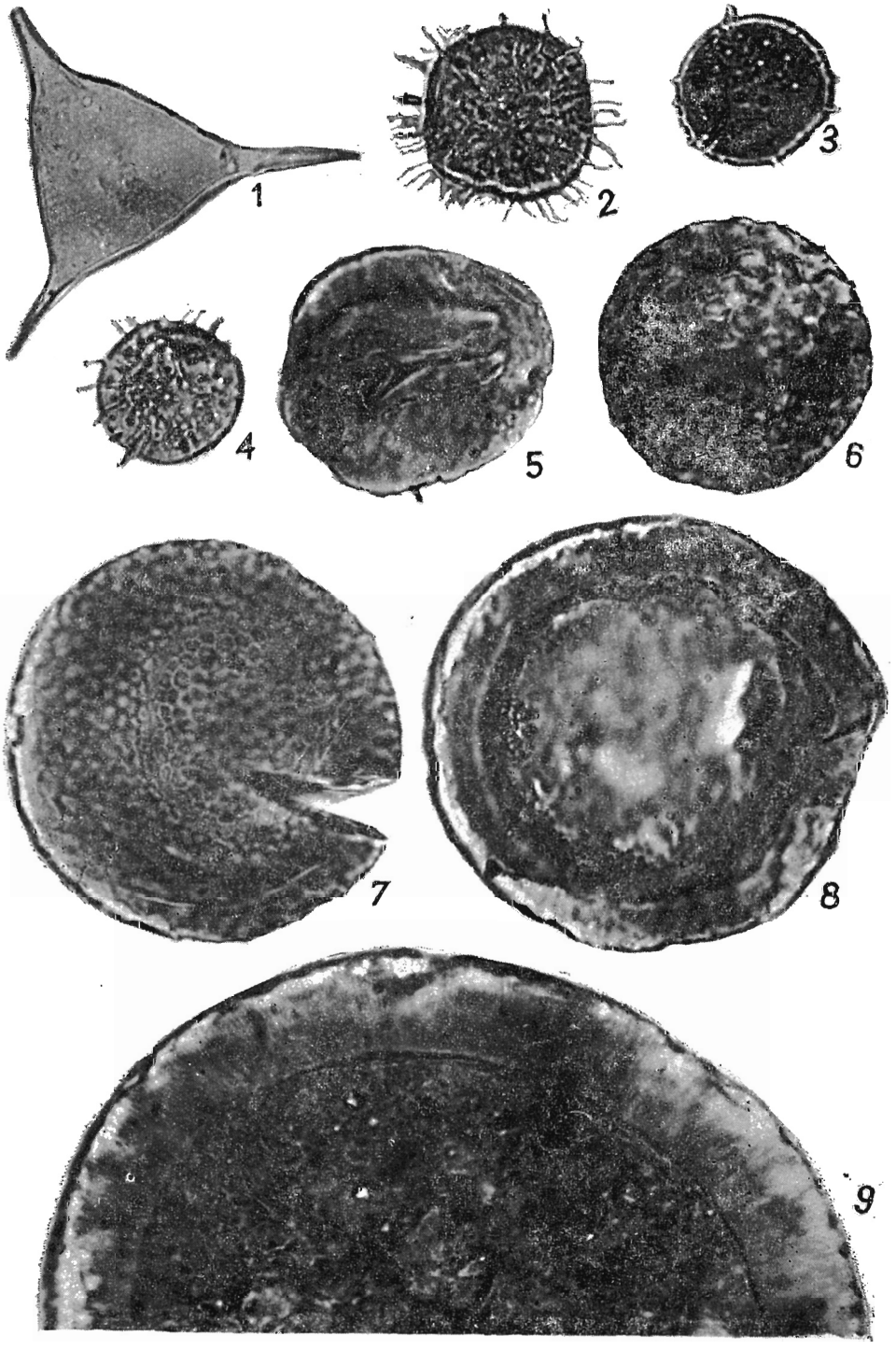
1 — *Voltziaceaesporites heteromorpha* Klaus; Połczyn *IG-1*, 1756.0 m.
2 — *Striatites samoilovichii* Jansonius; Połczyn *IG-1*, 1861.4 m.
3—4 — *Sphaeripollenites plicatus* Orł.-Zwol.; Połczyn *IG-1*; 3 — 1961.4 m; 4 — 1868.9 m.
5 — *Succinctisporites grandior* Leschik sensu Mädler; Połczyn *IG-1*, 1757.5 m, × 750.
6 — *Cycadopites* sp.; Gorzów Wlkp. *IG-1*, 2043.4 m.

All figures × 1000 except for Fig. 5

1—2 — *Triadispora crassa* Klaus; Połczyn *IG-1; 1* — 1865.2 m; *2* — 1861.4 m.
3 — *Microcachryidites fastidiosus* (Jansonius) Klaus; Połczyn *IG-1,* 1757.5 m.
4 — *Microcachryidites doubingeri* Klaus; Gorzów Wlkp. *IG-1,* 1972.8 m.
5 — *Platysaccus triassicus* Mädler; Połczyn *IG-1,* 1756.0 m.
6 — *Microcachryidites doubingeri* Klaus; Gorzów Wlkp. *IG-1,* 1767.5 m.
7 — *Microcachryidites sittleri* Klaus; Gorzów Wlkp. *IG-1,* 1972.8 m.
8 — *Triadispora plicata* Klaus; Gorzów Wlkp., 1980.0 m.



1 — *Triadispora crassa* Klaus; Gorzów Wlkp. *IG-1*, 1767.5 m.
2 — *Triadispora plicata* Klaus; Gorzów Wlkp. *IG-1*, 1767.5 m.
3 — *Microcachryidites fastidiosus* (Jansonius) Klaus; Gorzów Wlkp. *IG-1*, 1776.5 m.
4, 7, 9 — *Tsugaepollenites oriens* Klaus; Gorzów Wlkp. *IG-1*; *4* — 1774.5 m; *7*, *9* — 1767.5 m.
5—6 — *Perotrilites minor* (Mädler) Antonescu & Taugourdeau-Lantz; Gorzów Wlkp. *IG-1*, 1767.5 m; *5* — proximal surface; *6* — distal surface.
8 — *Apiculatasporites plicatus* Visscher; Gorzów Wlkp. *IG-1*, 1774.5 m.



1 — *Veryhachium reductum* (Deunff.) Jekhowsky; Gorzów Wlkp. *IG-1*, 1718.4 m.
2 — *Baltisphaeridium debilispinum* Wall & Downie; Gorzów Wlkp. *IG-1*, 1718.4 m. (The outline of the specimen deformed in print).
3—4 — *Micrhystridium* sp. div.; 3 — Połczyn *IG-1*, 1625.4 m; 4 — Gorzów Wlkp. *IG-1*, 1718.4 m.
5 — *Leioshaeridia* sp.; Połczyn *IG-1*; 1625.4 m.
6 — *Dictyotidium reticulatum* Schulz; Połczyn *IG-1*, 1628.0 m.
7 — *Crassosphaera* cf. C. *hexagonalis* Wall; Połczyn *IG-1*, 1622.5 m.