Mineralia slov.
15 *(1938), 5, 385—436*

Biostratigraphical evaluation of weakly metamorphosed sediments of Wechsel Series and their possible correlation with Harmónia Group in Malé Karpaty Mts.

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(XXXIII Plates, 10 figures in the text)
Received April 25, 1983

Новые сведения о возрасте эпизонально метаморфированных сланцев вехселской серии в Австрии и вопросы кореляции с Гарманской серией в Малых Карпатах

Новые месторождения палиноморф в графитовых сланцах вехселской серии (нижняя аустроальпинская единица) свидетельствует на верхний карбон. Образцы из Гразского палеозоя из Ганнерсдорфа (верхняя аустроальпинская единица) тоже содержали хорошо сохранившиеся палиноморфы нижнего и среднего девона. В карбонатно метаосадочных (пенниникум) в близи Бад Схонау были определены юрские палиноморфы.

Introduction *(A Pahr)*

The Wechsel mountain group in the Central Eastern Alps have aroused the attention of geologists for a long time. The reasons for this may have been a particular rock assembly and problems with its tectonic position.

After the fundamental works by H. Mohr (1911—1919) detailed studies by Faupl, Vetters, Huska, Halbmayer, Lemberger (1968—1970) have brought about important new results. Mohr's litho-stratigraphic division of the Wechsel rocks into (top to bottom) Wechsel schists and Wechsel gneiss (with the Permoskythian transgression on top) could be improved by the studies of P. Faupl (1970). His new division (Fig. 1) shows the sequence of the Wechsel gneisses at the bottom, followed by the Underlying = (Liegende) and the Overlying (= Hängende) Wechsel schists, and then, after

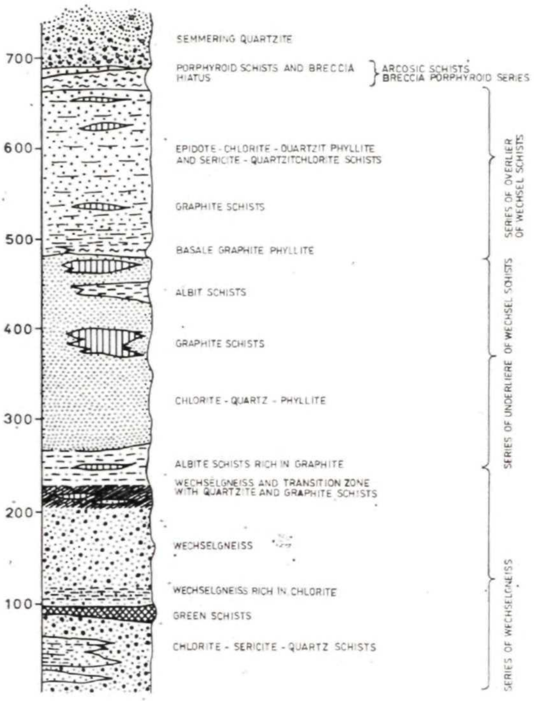


Fig. 1. Lithotrastigraphic profile of the Wechsel series (after Faupl, 1970)

a gap, by the ABP-(= Arkose-Breccia-Porphyroid) series (= Rotliegendes) and the Semmering quartzite (Skythian).

Recent conclusions concerning the tectonic position of the Wechsel unit have shown it as a deeper part of the Lower Austro-Alpine nappe system after a variety of attempts to find its right position in the tectonic scheme of the Eastern Alps. (Fig. 2). This was possible after it had turned out that the Wechsel nappe is not restricted to the Wechsel mountain group proper but is widely spread under the overthrusted Grobgneis nappes of the Central Alpine Zone in Austria, overlapping the Penninic in the East and emerging in several tectonic windows below the Grobgneis nappes in the Northeast and North. (Pahr, 1972, Tollmann, 1976).

The problem of the stratigraphic position of the Wechsel Series

Whereas there were no problems about the lithostratigraphic ranging of the overlying Permoskythian, there have only been assumptions about the stratigraphic position of the underlying Wechsel schists due to the lack of fossils. In 1907 G. A. Koch had announced the discovery of Carboniferous plants north of the village Mariensee (near Aspang), but this turned out to be a mystification as H. Mohr found out and published in 1922 (on the place mentioned by Koch there is only albitic gneiss and a quartz vein cropping out!).

On the other hand H. Mohr stressed the possibility of a (late) Carboniferous age of the graphit-bearing Wechsel schists (1913). His opinion was shard by L. Kober (1912) and K. Bistritschan (1939).

1970 P. Faupl considers the Early Palaeozoic the most probable age of the Wechsel schists after comparing them to similar Early Palaeozoic rocks in the Eastern Alps and the Carpathians. His opinion is based, above all, on the basic tufaceous intercalations in the Wechsel schists.

A. Tollmann (1957) supports the theory of an Early Palaeozoic age, whereas H. Wieseneder (1971) insists on Late Carboniferous, because the underlying and overlying Wechsel schists were not metamorphosed (in the Quartz-Albite-Muscovite-Chlorite subfacies of the greenschist facies) before the Alpidic orogenesis. According to H. W. Flügel (1976) Wieseneder's view fits his idea of a Palaeozoic sedimentation trough of the Northern Alpine Variscan belt.

To H. P. Schönlaub (1977) the dark quartzites indicate Silurian age and so in his geological column we find the Wechsel schists ranged in the Silurian for the most

Fig. 2. Geological situation around the Wechsel group (after Tollmann, 1977)

part, with the top just going up into the early Devonian.

The fact, that the Wechsel unit extends much farther to the East than the "traditional" Wechsel mountain group (Pahr, 1970) widened the scale of Wechsel schists and Wechsel gneisses, but could not as yet provide any proof for a stratigraphic ranging either. The occurrence of (elongated) quartz pebbles in graphitic quartzites around Bernstein could be interpreted as a hint for a (late) Carboniferous age of these rocks.

In this situation, O. Miko of the Dionys Stur Institute in Bratislava, who saw these rocks during an excursion near Bernstein, suggested a cooperation with his institute. Eva Planderová, with ample experience in biostratigraphical ranging (also of metamorphic rocks), could take samples from the "traditional" Wechsel region (especially from "Weinweg" north of the Alpkogel and from several places in the Bernstein region and treat about 50 of them.

Palynological evaluation of epizonally metamorphosed sediments

(E. Planderová)

Since metasediments of the Wechsel series and of the Harmónia group in the Malé Karpaty Mts. have similar lithological characters (A. Pahr, M. Maheľ, O. Miko), both complexes were palynologically studied for the purpose of age correlation.

The study was aimed at information on the age of metasediments of the Wechsel series, more precise age data on dark graphitic schists of the Harmónia group and at their correlation.

Biostratigraphical evaluation of epizonally metamorphosed sediments was based on sporomorphs and acritarchs from chloritic and sericitic phyllites and graphitic schists.

I have got rich palynomorph assemblages from about 50 samples from the whole Wechsel series and the Harmónia group in the Malé Karpaty Mts.

The preservation of palynomorphs shows that changes in temperature and dynamometamorphosis had only partial influence upon exines of sporomorphs. So it was possible to determine the genera, and in many cases also species of palynomorphs. Graphitization damaged exines to 40—70 %. Most sediments were affected by temperatures ranging up to 200°, on the locality Weinweg to 170—180 °C. Samples of sediments affected by higher metamorphosis contained palynomorphs with exines with dark graphite remains and they were regarded sterile with respect to their age.

The degree of preservation of palynomorphs indicated approximately the same degree of metamorphosis of palynomorphs resedimented in the Wechsel series and in the Harmónia group, and a higher degree of metamorphosis in chloritic and sericitic schists from the locality E of Bad Schönau (HM-1, 2). Calcareous schists E of Bad Schönau (are metamorphosed in greenschit facies).

Biostratigraphical research of metasediments was not easy, although the samples were rich in quite well preserved palynomorphs. Autochthonous microflora in all samples except calcareous sandy schists of the Penninicum was mixed with redeposited palynomorphs, and the percentage of autochthonous palynomorphs was low in comparison to older redeposited ones in the Wechsel series. I have only found autochthonous palynomorph assemblages in the Harmónia group.

Determination of palynomorphs was based on the modern systematic-morphological publications by A. Eisenack, 1973, F. H. Cramer, 1964, J. Doubinger, D. C. Raucher, 1962, J. Doubinger, 1968, D. C. McGregor, 1973, D. C. McGregor, 1977, A. Moreau-Benoit, 1980, J. B. Richardson —

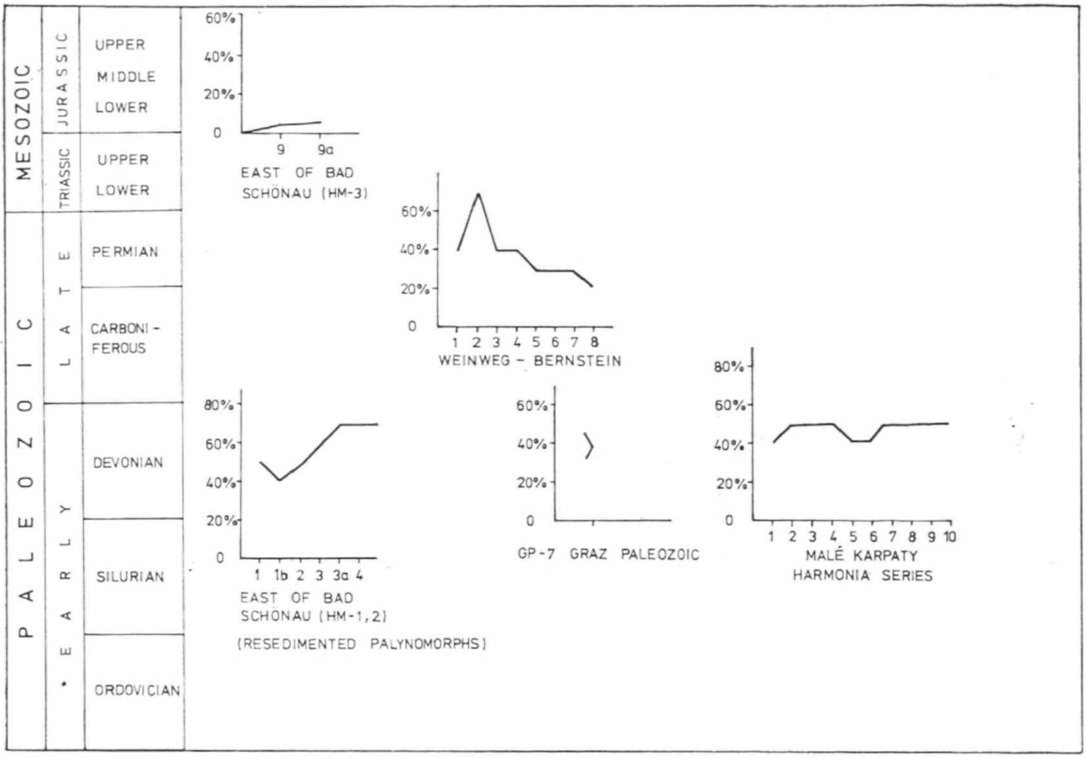


Fig. 3. Degree of grafittization on the exine of palynomorphs

R. Lister, 1969, E. V. Tchibrikova, 1972, 1977.

1. Wechsel area

For the above mentioned reasons the samples from the Wechsel area were repeatedly treated too get assemblages so rich in species as to enable age determination of sediments from the following cross sections:

A. Weinweg (samples 1—8)
B. Bernstein (samples 1—3)
C. E of Bad Schönau (HM-1, 2; samples 1—13)
D. Graz Paleozoic GP-7

In cross sections Weinweg and Bernstein were 80 % of autochthonous Late Paleozoic palynomorphs and 20 % of palynomorphs redeposited from the Early Paleozoic.

In cross section Hennmühle chloritic and sericitic phyllites contained 80 % of Early Paleozoic palynomorphs and scarce Late Paleozoic species. So it was difficult to determine the age of sediments. Detailed evaluation of samples will also comprise resedimented species found in cross sections E of Bad Schönau to indicate the age of sediments from which resedimented species originated, and discussion on their age determination.

Detailed palynological evaluation comprises age dispersion of every species according to various authors, mainly of the European Early and Late Paleozoic.

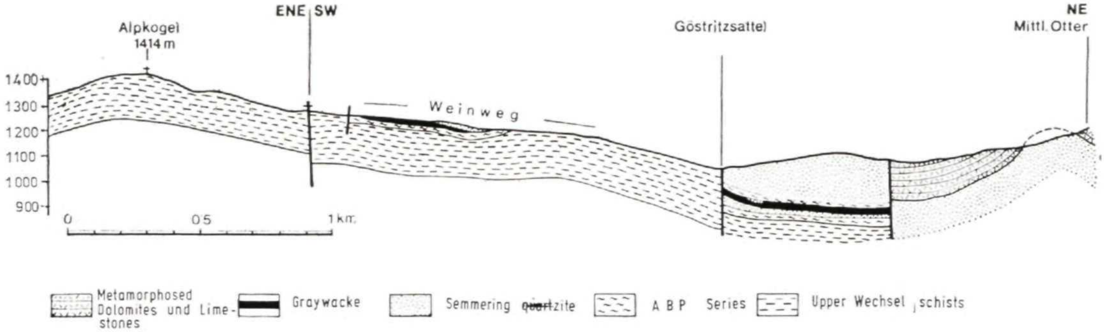


Fig. 4. Geological profile of Weinweg (after Faupl, 1970)

A. Cross section Weinweg

It is in a road cut N of the village Trattenbach. The cross section is in dark-grey sericitic phyllites (fig. 4).

The sampling was done in quite a short pacing and the results are documented by well preserved plentiful palinomorphs. Almost all samples were positive in sporomorphs (1—8), only sample 2 represented more sericitic phyllites. Sporomorph composition is as follows:

Locality 1: Wilsonia pseudopraetecta Inosova, frequent in the Upper Carboniferous (Stephanian C — Autunian base). Frequent were species of *Thymospora thiessenii* (Kos.) Alp., *Lycospora punctata* Kos. — mainly in the Stephanian — Lower Permian; and species of the genus *Verrucatosporites, Florinites antiquus* (Schopf.) Alp., *Torispora securis* Alp., *Colluminisporites ovalis* Peppers., *Dictyotriletes reticulocingulum* (Loose) Schmidt., and various species of the genus *Cordaitina*. The above mentioned spore assemblage is typical of the Stephanian — Lower Permian. Since the percentage of monosaccate pollen was not higher than that of trilete spores, I range the sediments to the Stephanian C.

Samples 3—4 contained poorly preserved sporomorphs representing the following species: *Cordaitina ornata* Samoil., *Scabratisporites scabratus* Teteriuk, *Torispora securis Alp., Raistrickia* sp., *Florinites luberae* Samoil., — species frequent in the Stephanian — Lower Permian. There were also spores of the genus *Potonieisporites, Punctatisporites punctatus* (Kos.) Alp. and unidentifiable species of the genus *Pityosporites*. Sediments from this locality are also ranged to the Stephanian C — Lower Permian.

Locality 5: Sediments of this locality did not contain any monosaccate nor bisaccate pollen; they only contained spores of Spermophyta: *Punctatisporites cingulatus* Alp., *Apiculatisporites irregularis* Alp., *Punctatisporites granifer* Pot., Kr. *Spinosporites* aff., *peppersi* Alp., *Densosporites crassipterus* (Waltz) Schwartzm., *Spinosporites peppersi* Alp., *Punctatosporites* sp., *Aumancisporites* sp. All the species are indicative of the Upper Stephanian.

Locality 6: The sporomorph assemblage is well preserved and diversified in species. The affects of metamorphosis on exines are minimal. The assemblage comprised *Triquitriletes triturgitus* (Looze) Wils. et Ven. occurring in the Stephanian, *Lophotriletes commisuralis* (Kos.) Pot. Kr. occurring in the Stephanian B-C, *Punctatosporites cingulatus* Alp. occurring in the

Stephanian B-C, *Cordaitina* sp. — in the Stephanian — Lower Permian, *Wilsonia pseudopraetecta* Inos. in the Stephanian C, and especially in the Lower Permian; *Thymospora thiessenii* (Kos.) Alp., *Colluminisporites ovalis* Peppers., *Torispora* sp. occurring mostly in the Stephanian C-D, *Dictyotriletes bireticulatus* (Ibr.) Pot. — in the Stephanian B.

The composition of the spore-pollen assemblage and its stratigraphic range are indicative of the Stephanian C — Lower Permian.

Locality 7: the sample contained well preserved sporomorphs: *Lycospora* cf. *granulata* Kos., *Triquitrites perornatus* Radondy-Doub., *Tripartites* sp., *Endosporites globiformis* (Ibr.) S. W. B. *Densosporites* sp., *Lycospora* sp., *Cymatiosphaera* sp., *Acritarcha* indet. These species occur in the Stephanian C-D.

Locality 8 is the last one in the cross section through the schistose formation at the end of the forest road to Weinweg. The sporomorph assemblage consists of *Punctatosporites* sp., *Punctatosporites cingulatus* Alp., *Punctatosporites punctatus* Kos. and *Colluminisporites ovalis* Peppers nian C — Lower Permian. *Limitisporites* sp., *Potonieisporites* sp. are more frequent in the Permian. The species *Illinites unicus* Kos. and *Collumnisporites ovalis* Peppers are frequent in the Stephanian C — Lower Permian. Sediments of this locality contain most Lower Permian microfloral elements indicative of the Lower Permian (fig. 5).

B. Locality Bernstein

The locality is in a road cut near the village Bernstein. It is in graphitic schists (fig. 6). The degree of preservation of organic remains shows that graphitization was not too extensive. The samples contained the following palynomorph species: *Cirratriradites saturni* (Ibr.) S. W. B., frequent in the Upper Carboniferous, mainly in the Stephanian; *Punctatosporites granifer* (Pot. Kr.) Alp., occuring in the Stephanian, *Lycospora pusilla* Alp. — occurring in the Stephanian, *Convolutispora recurva* Innosova — in the Stephanian B-C, *Densosporites triangularis* (Kos.) Alp. occurring in the Stephanian B-C, *Punctatosporites* sp., *Cirratriradites* sp. The sea plankton was represented by *Duvernaysphaera* sp. and *Cymatiosphaera compta* resedimented from the Early Paleozoic. These species are indicative of the Stephanian age of sediments of this locality. They are related microfloristically to samples from Weinweg loc. 5.

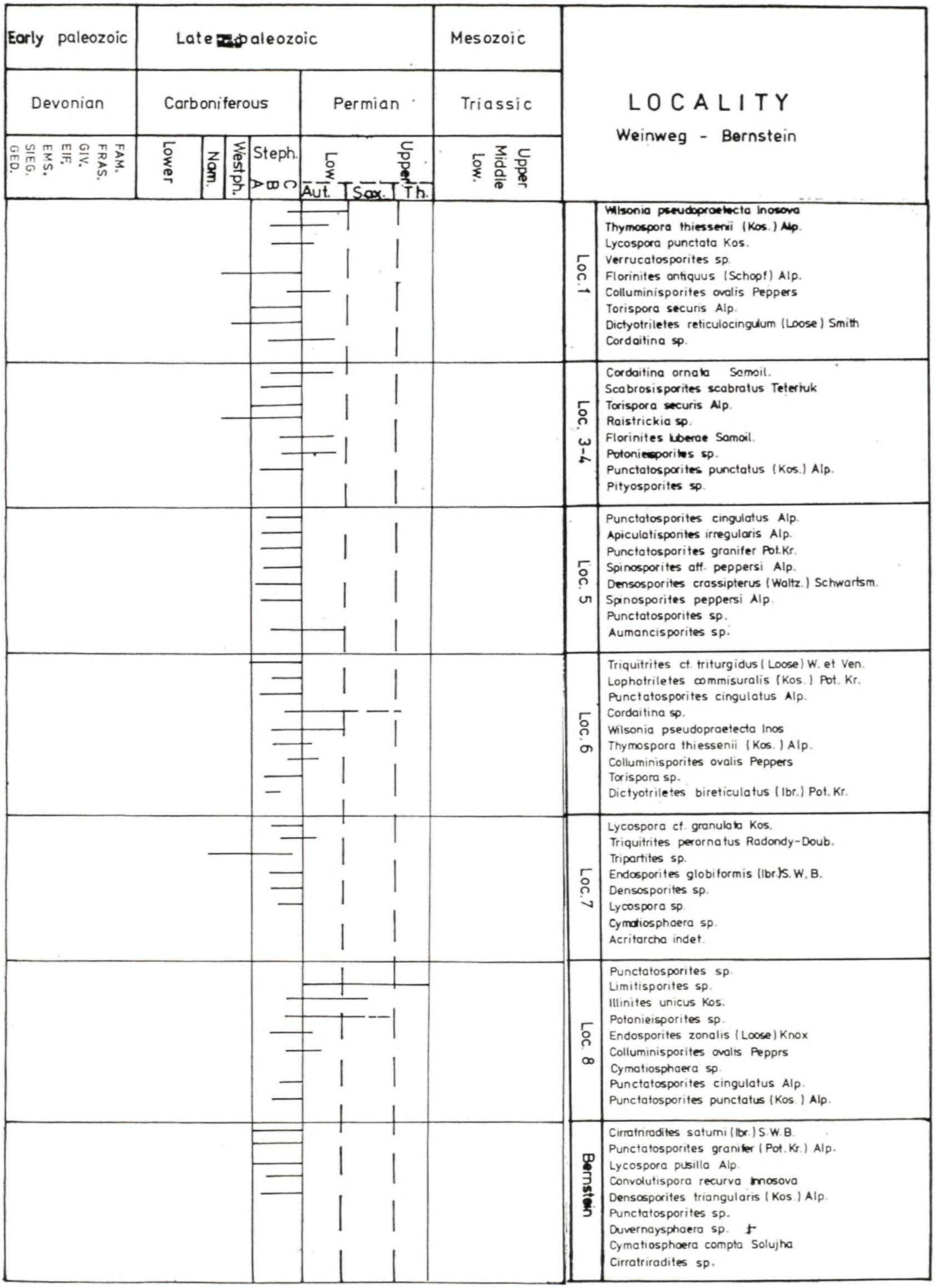
Biostratigraphical evaluation of sediments from cross sections Weinweg and Bernstein proves that they deposited in the Late Paleozoic time. According to microflora the Upper Permian and the uppermost part of the Lower Permian are excluded, and the sediments from the localities 1—7 are Stephanian B — Stephanian C in age. Sediments from the loc. 8 might already be ranged to the base of the Permian.

From paleoecological viewpoint the sediments deposited most likely in a shallow sea environment or in a desalinated one. Spores of Spermophyta are indicative of a humid swamp zone. The low percentage of cordaite and bisaccate pollen indicates a higher relief distant from the sedimentation area.

C. Cross section E of Bad Schönau (HM-1, 2, WS-8, WS-9, WS-10)

Chloritic-phyllitic schists alternate with brown to brown-grey calcareous schists. The cross section is in the cut of a forest brook near the village Hennmühle (fig. 7). Among 13 samples 7 were positive in quite well preserved palynomorphs.

In contrast to preceding cross sections,



Early paleozoic
Late paleozoic
Mesozoic
Devonian
Carboniferous
Permian
Triassic
LOCALITY
Weinweg - Bernstein
FAM. FRAS. GIV. EIF. EMS. SIEG. GED.
Lower
Nam.
Westph.
Steph. A B C
Low.
Upper
Aut.
Sax.
Th.
Upper Middle Low.
Loc. 1
Wilsonia pseudopraetecta Inosova
Thymospora thiessenii (Kos.) Alp.
Lycospora punctata Kos.
Verrucatosporites sp.
Florinites antiquus (Schopf) Alp.
Colluminisporites ovalis Peppers
Torispora securis Alp.
Dictyotriletes reticulocingulum (Loose) Smith
Cordaitina sp.
Loc. 3-4
Cordaitina ornata Samoil.
Scabrosisporites scabratus Teteriuk
Torispora securis Alp.
Raistrickia sp.
Florinites luberae Samoil.
Potonieisporites sp.
Punctatosporites punctatus (Kos.) Alp.
Pityosporites sp.
Loc. 5
Punctatosporites cingulatus Alp.
Apiculatisporites irregularis Alp.
Punctatosporites granifer Pot.Kr.
Spinosporites aff. peppersi Alp.
Densosporites crassipterus (Waltz.) Schwartsm.
Spinosporites peppersi Alp.
Punctatosporites sp.
Aumancisporites sp.
Loc. 6
Triquitrites cf. triturgidus (Loose) W. et Ven.
Lophotriletes commisuralis (Kos.) Pot. Kr.
Punctatosporites cingulatus Alp.
Cordaitina sp.
Wilsonia pseudopraetecta Inos
Thymospora thiessenii (Kos.) Alp.
Colluminisporites ovalis Peppers
Torispora sp.
Dictyotriletes bireticulatus (Ibr.) Pot. Kr.
Loc. 7
Lycospora cf. granulata Kos.
Triquitrites peronatus Radondy-Doub.
Tripartites sp.
Endosporites globiformis (Ibr.) S. W. B.
Densosporites sp.
Lycospora sp.
Cymatiosphaera sp.
Acritarcha indet.
Loc. 8
Punctatosporites sp.
Limitisporites sp.
Illinites unicus Kos.
Potonieisporites sp.
Endosporites zonalis (Loose) Knox
Colluminisporites ovalis Peppers
Cymatiosphaera sp.
Punctatosporites cingulatus Alp.
Punctatosporites punctatus (Kos.) Alp.
Bernstein
Cirratriradites saturni (Ibr.) S.W.B.
Punctatosporites granifer (Pot. Kr.) Alp.
Lycospora pusilla Alp.
Convolutispora recurva Inosova
Densosporites triangularis (Kos.) Alp.
Punctatosporites sp.
Duvernaysphaera sp.
Cymatiosphaera compta Solujha
Cirratriradites sp.

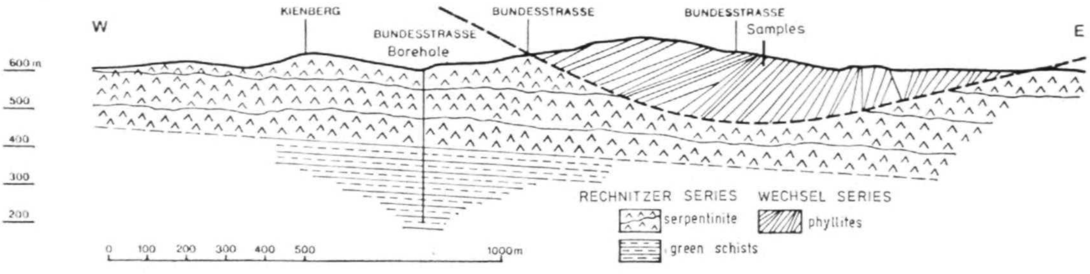


Fig. 6. Geological profile of Bernstein East (after Pahr, 1983)

palynomorphs contain high percentage of Silurian-Devonian species of spores and acritarchs. It may be explained in two ways:

a) the whole assemblage of Early Paleozoic palynomorphs is redeposited in younger sediments — in our case the Wechsel series;

b) they are Early Paleozoic sediments with absolutely dominant Early Paleozoic palynomorphs, and younger sporomorphs are due to contamination.

The first explanation seems better reasoned, since we met with extensive redeposition of Paleozoic palynomorphs into Neogene sediments also in the Carpathians (bore hole Lx-5 Konečný, Lexa, Planderová 1983 in lit.). From geological view (Pahr) the sediments of the Wechsel series from the cross section E of Bad Schönau are regarded as coeval with the sediments from Weinweg and Bernstein.

The samples from the cross section may be divided into a) Paleozoic, b) Jurassic.

a) The Paleozoic samples represent chloritic and sericitic schists in cross sections 1, 2 (samples, 1, 1b, 3, 3a, 4, 13).

b) The Jurassic samples represent sandy schists in cross section 3 (samples, 9, 9a).

a) The sporomorph assemblage from chloritic and sericitic phyllites is:

1. a redeposited Early Paleozoic assemblage comprising *Granulatisporites parvus* (Ibr.) *Pot. occurring* in Lower Devonian, *Duvernnaysphaera kreuseli* Stock. *parvus* (Ibr.) *R. Pot. occurring* in Lower Devonian, *Brochopsophosphaera uralica* Tchibr. — in Silurian, *Cryptostromatia ondogonense* Moreau-Benoit — in Silurian — Devonian (base), *Chitinozoa* sp., *Trachypsophosphaera uspenskae* Tchibr. — Ordovician — Silurian, *Aneurospora goensis* Streel — Lower Devonian, *Grandispora douglastownense* Mc. Gregor — Lower Devonian, *Rhabdosporites langi* (Eisenack) Rich. — Lower — Middle Devonian, *Emphanisporites* sp. — Lower and Middle Devonian, *Pterospermella* cf. *occidua* Deunff. — Silurian — Lower Devonian, *Archeohystrichosphaeridium* cf. *cinctum* Tchibr. — Ordovician — Silurian, *Trachypsophosphaera* sp. — Lower Devonian, *Duvernaysphaera kreuseli* (Stockm. Will.) Raucher — Silurian, *Cymatiosphaera pauciplanum* Cramer — Upper Silurian and Lower Devonian, *Thalisporites chulus* (Cramer) Mc. Gregor — Lower Devonian, *Baltisphaeridium* sp., *Cyclogranisporites retisimilis* Rich. — Lower Devonian, *Tetraletes variabilis* Cramer — Lower Si-

◀ Fig. 5. Abundance of palynomorphs in the samples of profile of Weinweg and Bernstein

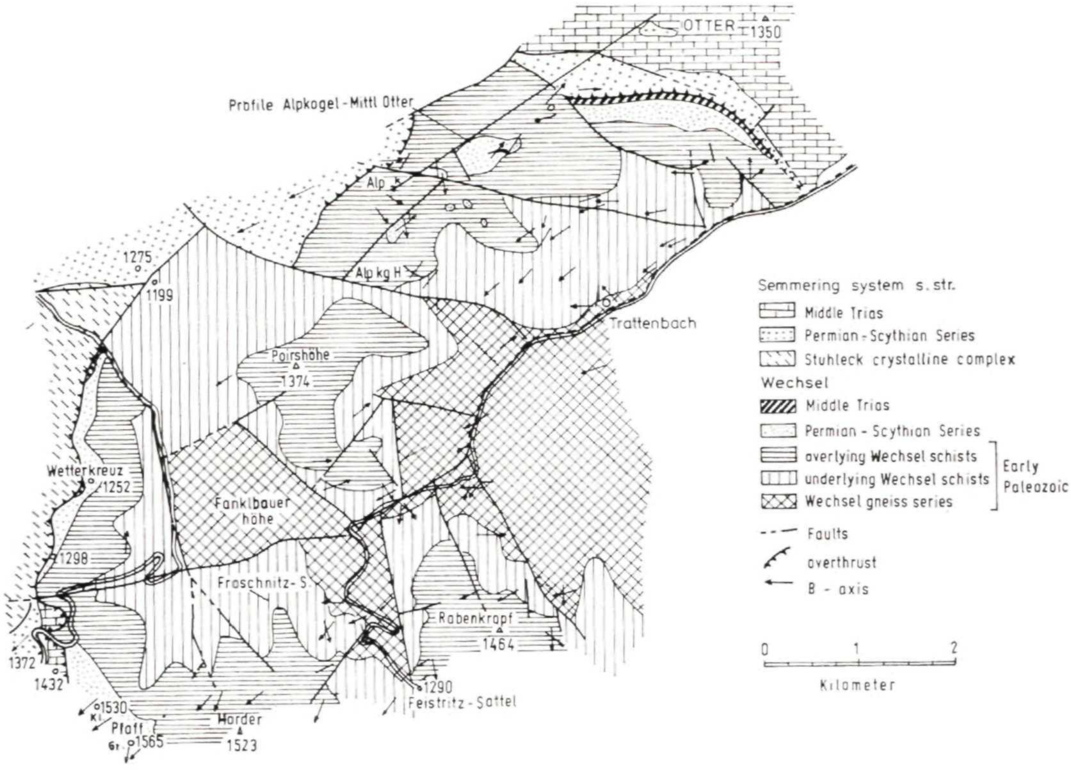


Fig. 7. Geological map of the northeastern Wechsel region (after Faupl, 1970)

lurian — Lower Devonian, Cocquel-Lob. — Lower Devonian, *Pterospermella* cf. *typicans* Salejha — Ordovician, *Hymenozonotriletes* sp. — Upper Devonian, *Staplinium cuboides* Deunff. — Middle — Upper Devonian, *Cymatiosphaera doriochora* Wic. Middle — Upper Devonian, *Azonomonoletes subreticulatus* Tchibr. — Lower — Middle Devonian, *Zonosphaeridium* sp., *Retusotrileteps* sp. — Lower Devonian, *Trachypsophosphaera uspenskae* (Tim.) Tchibr. — Silurian — Middle Devonian, *Leiotriletes microdeltoides* Mc. Gregor — Upper Silurian, *Leiotriletes pullatus* Naum.- Lower Devonian. Among plankton well preserved were species *Synsphaeridium tuberculatum* Eis. from the Silurian, *Synsphaeridium* cf. *sorediforme* (Tim.) Moreau — Benoit — Silurian, *Duvenaysphaera krauseli* Stock. Will.-Silurian, *Cymatiosphaera* sp. A. Richardson Joanides — Silurian, *Cymatiosphaera* cf. *celtica* Deunff. — Upper Silurian and Lower Devonian, *Lophosphaeridium* cf. *dumalis* Playf. — Lower Devonian, *Emphanisporites rotatus* Mc. Gregor — Lower Devonian, *Lophosphaeridium parvum Deunff.* — Upper Silurian — Lower Devonian, *Cymatiosphaera compta* Saerj. — Ordovician — Lower Silurian. The Early Paleozoic species in the range from the Ordovician to the Upper Devonian occur in a rather high percentage. They comprised scarce species from:

2. the Late Paleozoic (autochthonous), like *Thymospora thiessenii* Alp., *Triquitri-*

letes sp., *Verrucatosporites ancoralis* Alp. and bisaccate pollen of the genus *Pityosporites.*

Percentage of species occurring in the Late Paleozoic (Stephanian Lower Permian is very low and one would range the whole formation to the Early Paleozoic. When we, however, consider the wide scale of Early Paleozoic (Silurian — Upper Devonian) palynomorphs and significance of the occurrence of Late Paleozoic (? Permian) species, and on the basis of geological and tectonical interpretation by A. Pahr, we must admit, that also in cross sections E of Bad Schönau (HM-1, 2) the age of sericite — chloritic schists is Late Paleozoic.

Palynomorphs from light calcareous sandy schists in cross section E of Bad Schönau (HM-3, samples 9, 9a) have quite different character.

The palynomorph assemblage consists of *Lycopodiacidites regulatus* Couper from Lias — Dogger, *Reticulatisporites* sp., *Leiophaeridia saerjanti* Pocock from Lower — Middle Jurassic, *Leiosphaeridia staplini* Pocock, *Leiosphaeridia hyalina* Eisenack — Lower — Middle Jurassic, *Leiosphaeridia granulosa* Pocock — Lias — Malm, *Enzonalasporites* sp. Lund — Jurassic, *Paleostomacystis* sp., *Taeniaesporites* sp., *Cymatiosphaera* sp. „A“ Wall. — Lias — Malm, *Dictyotidium* cf. *shaunawanense* Pocock — Lias — Malm, *Gonyaulax* cf. *cladophora* Defl. — Dogger — Malm, *Pareodinia* cf. *ceratophora* Defl. — Lias — Dogger, *Pareodinium* sp., *Nannoceratopsis* cf. *gracilis* (Alberti) Evitt. — Lias — Dogger, *Chytroeisphaeridia pococki* Saerjant from the end of Dogger — Malm, *Pareodinia prolongata* Saerj. — Lias — Dogger, *Rugidinium undulatum* (Pocock) Saerj. — Lias — Dogger. The samples also contained many cystoid planktic forms. I could not determine them according to the available literature.

Loc. Dreihütten is in a road cut. The rocks studied are chloritic schists. Palynomorphs are poorly represented mostly by species which are no reliable basis for more exact age determination. Spores were only represented by *Emphanisporites rotatus* Mc. Gregor, occurring in the Lower Devonian, *Lophosphaeridium parvum* Naum., *Cymatiosphaera compta* Saerj. — Ordovician and Lower Silurian, and *Pterospermopsis* sp. The samples contained isolated Late Paleozoic sporomorph fragments, like *Thymospora* sp., *Vittatina* sp. The problem of age determination of sediments is the same as with samples from the cross section Hennmühle.

2. Graz Paleozoic, sample GP-7

Loc. GP-7 is in a road cut near Hannesdorf. There are darkgrey schists from the Graz Paleozoic — a dolomitic formation. The sediments contained plentiful palynomorphs: *Auroraspora macromanifesta* Rich. occurring in Middle — Upper Devonian, *Retusotriletes* sp. from Middle Devonian, *Retusotriletes divulgatus* Tchibr. — Lower — Middle Devonian, *Stenozonotriletes* sp. „A“ Rauch. — Upper Silurian — Lower Devonian. Other palynomorph species represent planktonic groups, mainly Dinoflagellata and other akritarchs. Significant are *Cymatiosphaera* cf. *mirabilis* Deunff from Upper Silurian — Lower Devonian, *Cymatiosphaera* sp., *Cymatiosphaera wenlockia* Downie — Silurian — Lower Devonian, *Cymatiosphaera* sp. „A“ Rich. — Upper Silurian, *Ammonidium* div. sp. *Riculisphaera fissa* Leoebl. — Lower Devonian.Particularly frequent were species of the genus *Polyedrychium*, mainly *Polyedrychium decorum* Deunff. from Lower — Middle Devonian, *Fimbrioglomerella divisa* Loebl. Drugg — Lower — Middle Devonian, *Synphaeridium spinosum* Moreau-Benoit — Silurian, various species of the genus *Micrhystridium, Lophosphaeridium parvenarum* St. Will. — Ordovician — Upper Silurian, *Micrhystridium parveroquesi* St. et Will. — Upper Silurian — Lower Devonian. The character of palynomorphs is indicative of the Lower — Middle Devonian age of the formation. Spores appear as early as the Middle Devonian.

3. Area of Malé Karpaty Mts. (Harmóna group, fig. 8)

Locality Pezinok. Palynological data on the Harmónia group resulted from the study of many samples from several localities. Most important are the localities of a quarry near the road to Pezinská Baba. Čorná (1968) studied samples from localities in Lamač and presented biostratigraphcal data also on the Harmónia group, without naming the exact locality. On the basis of cuticles she ranged the rocks to Silurian — Devonian.

By detailed examination of samples from the Harmónia group. I revealed a rich palynomorph assemblage mostly composed of acritarchs. It consisted of the following species: *Rhabdosporites langi* (Eis.) Rich. occurring in Lower — Middle Devonian, *Dictyotriletes emsiensis* (Alen) Mc. Gregor — in Lower — Middle Devonian, *Dibolisporites echinaceous* (Eis.) Rich. — Lower — Middle Devonian, *Dibolisporites* sp., *Verrucosisporites pseudospinosus* Streel — Middle Devonian, *Retusotriletes triangulatus* Streel — end of Middle Devonian, *Stenozonotriletes extensus* Naum. — Middle Devonian, *Emphanisporites minutus* Allen — Lower Devonian, *Hymenozonotriletes* sp. Raucher — Lower Devonian, *Azonomonol uritatus* Tchibr. — end of Lower Devonian. Acritarchs were represented by the species *Micrhystridium lapellum* Loebl. Wic. from Upper Silurian — Lower Devonian, *Cymatiosphaera nebulosa* Downie — end of Silurian and

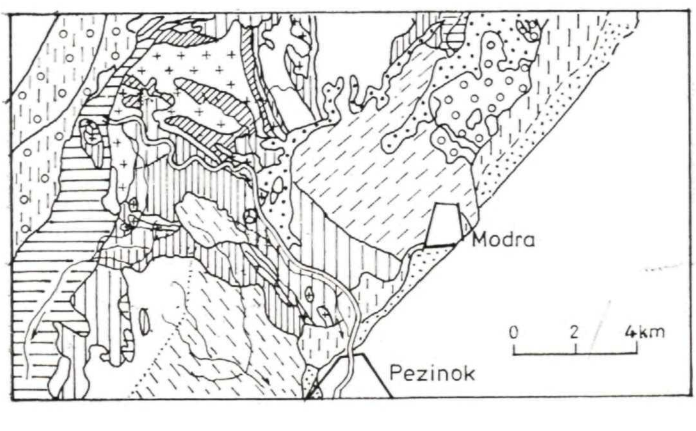


Fig. 8. Map of the localities in Malé Karpaty Mts. (Harmonia series)
1. Biotitic granodiorites (Paleozoic), 2. phyllites, biotitic and sericitic-biotitic phyllites (Paleozoic), 3. Variscan granitoids (Paleozoic), 4. pyrite graphite phyllites (Paleozoic), 5. biotitic mica-schist gneisses (Paleozoic), 6. Harmonia series, 7. quarzites (Triassic), 8. dark-grey schists, marlstones limestones (Jurassic), 9. light-grey calpionelle limestones (Tithonian-Neocenian), 10. Miocene, 11. Localities 1—6

base of Devonian, *Cymatiosphaera leonensis* Cramer — end of Silurian, *Cymatiosphaera* sp. Raucher —end of Silurian — Lower Devonian, *Quadratidium fantasticum* Cramer — Lower — Middle Devonian, *Discina asperella* Tchibr. — Lower Devonian, *Acantodiacrodium* sp. „2" Martin — Upper Devonian, *Duvernaysphaera tennuicingulata* Stapl. — Lower Devonian, *Dictyopsophosphaera polygona* (Stapl.) Tchibr. — Lower Devonian, *Pulvinosphaeridium deunffi* Moreau-Benoit — Lower — Middle Devonian, *Ammonidium loriferum* Deunff — Lower Devonian, *Ammonidium rigidum* (Deunff.) Lister, *Ammonidium sannemani* Deunff. — Lower Devonian, *Ammonidium* cf. *allciteaui* (Deunff.) Moreau-Benoit — end of Silurian — Lower Devonian, *Baltisphaeridium tuberosum* Sanneman — Lower — Middle Devonian, *Tunisphaeridium* cf. *tenloculoferum* (Martin) Eis. — Lower — Middle Devonian, *Pterospermella pernambucensis* (Britto) Eis. — Lower — Middle Devonian, *Onandogella deunffi* Cramer — Upper Silurian — Lower Devonian, *Riculosphaera fissa* Loebl. et Drugg — Upper Silurian — Lower Devonian, *Moyera uticansis* Thusu — Upper Silurian — Lower Devonian, *Evittia granulatispinosa* (Down.) Lister — Upper Silurian — Lower Devonian, *Multiplicisphaeridium raspa* (Cramer) Eis. — Silurian — Lower Devonian, *Multiplicisphaeridium ramusculosum* (Deunff.) Eis. — Lower — Middle Devonian, *Multiplicisphaeridium* cf. *rabiosum* Cramer — Upper Silurian — Lower Devonian, Lagenochitina — Silurian — base of Devonian. On the basis of the plentiful palynomorphs and their age dispersion we can range the metamorphosed sediments of the Harmónia group to the Lower Devonian. Acritarchs are indicative of the Upper Silurian but the spores found only started appearing as late as the Lower Devonian (fig. 9).

As for paleoecology, it is sure that the sediments deposited in marine environment, in a zone rich in plankton. Species diversity of spores of Spermophyta from the emerged continent are indicative of the nearness of the depositional environment to dry land. On dry land there was a humid environment favourable for the development of primary lycopod and pteridophytous vegetation. The climate was evidently suitable for terrestrial flora.

On the age of epizonally metamorphosed sediments

The existing opinions about the age of sericitic, chloritic and graphitic schists of the Wechsel series were contradictory, not reasoned by paleontological data. Metamorphosed sediments were regarded as fossilless, „barren". We have collected rich palynomorphic material by palynological method and on the basis of the material we can determine the age of the sediments under study. The age determination of metasediments was complicated by the character of rocks, by destruction of palynomorph exines by metamorphosis, and particularly by a high percentage of resedimented palynomorphs in some cross sections. Repeated sampling and treatment of probes, determinations on the basis of plentiful palynological literature showed that cross sections Weinweg and Bernstein are most suitable for the age determinations of sediments (fig. 10).

a) Samples from the profiles contained well preserved Stephanian — Lower Permian sporomorph assemblage and a low percentage of redeposited palynomorphs from the Silurian — Lower Devonian (mainly plankton).

The Upper Permian age is denied by the sporomorph assemblage without typical Upper Permian species, especially monosaccate and bisaccate pollen.

b) Samples of the Graz Paleozoic contained plentiful typical Lower — Middle Devonian microfloral assemblage, and Upper Silurian — Lower Devonian sea plankton from the Acritarcha group; indicative unambiguously of the Lower — Middle Devonian.

c) Sediments of calcareous sandy schists from the cross section E of Bad Schönau (HM-3) are Jurassic. According to A. Pahr it is the Penninicum wedged in the Wechsel series.

d) Weakly metamorphosed sediments of the Harmónie group in the Malé Karpaty Mts. are ranged to the Lower Devonian on the basis of the palynomorph assemblage.

Possible correlation between sediments of Wechsel series and of Harmónia group in Malé Karpaty Mts.

The results of our study show that in spite of the possibility of lithological correlation, the existing data are not sufficient for biostratigraphical correlation between metasediments of the Wechsel series and of the Harmónia group.

Redeposited Silurian — Devonian palynomorphs from cross sections E of Bad Schönau (HM-1, 2, WS-8, WS-9) may be correlated with palynomorphs of the Harmónia group; i. e. the original Silurian — Devonian sediments may be correlated to phyllites of the Harmónia group.

The question remains open for further lithological, petrographical and palynological investigations.

Biostratigraphical study of sediments in these areas may result in new data on age and enlighten the relationship between the Alpine and Carpathian systems. At the present state of our knowledge it would be better to correlate the Harmónia group with the Gemeric Paleozoic (perhaps the Gelnica group).

Paleoecological evaluation

With respect to paleoecology we take into concideration the depositional environment, i. e. a) the water environment, and b) the terrestrial environment with plants producing pollen and spores transported to the places of sedimentation by wind and water. Significant are the distance of the respective localities from dry land and climate (temperature, humidity).

Palynological research of metasediments also revealed paleoecological conditions.

a) Paleoecological conditions in the time of deposition of the Graz Paleozoic. The palynomorph assemblage comprised mostly spores of Sphermophyta growing on dry land, indicative of warm humid climate with swamps and vegetation of Pteridophyta and Arthrophyta, less sea plankton of the Acritarcha group indicative of the sea environment. More frequent terrestrial Pteridophyta and Arthrophyta are indicative of the nearness of dry land.

b) Silurian — Lower Devonian period in Malé Karpaty Mts. There was a marine depositional environment with dominant sea plankton of Dinoflagellata and Acritarcha, and less terrestrial plants. The deposition proceeded farther from dry land. Destruction of spore exine and of Acritarcha shows that the degree of metamorphosis must have been higher in the Malé Karpaty Mts. than in the Graz Paleozoic.

c) Upper Carboniferous Stephanian C to lowest Permian), Cross sections of the Wechsel series contained palynomorph assemblages with dominant spores and

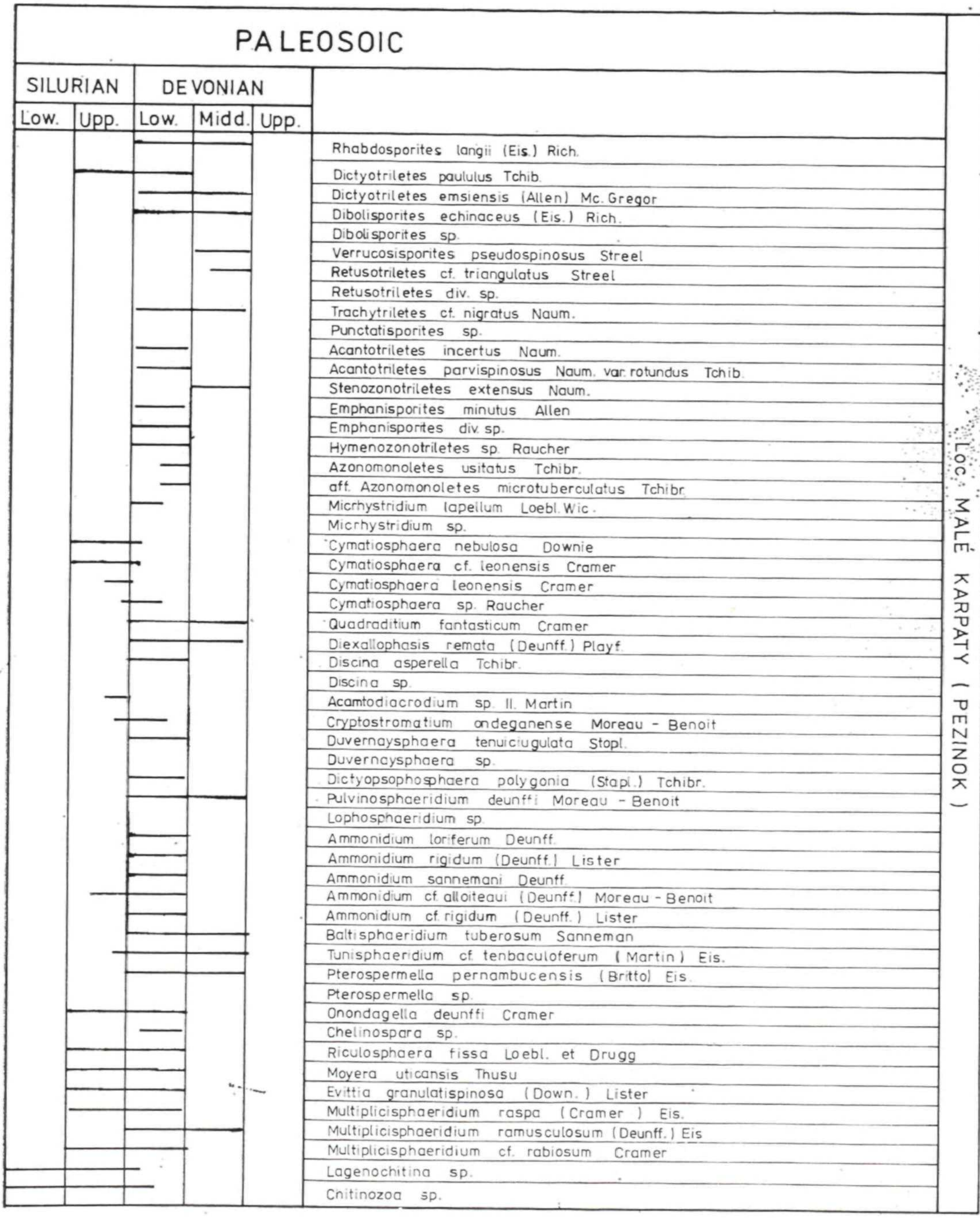


Fig. 9. Abundance of palynomorphs in the samples of Malé Karpaty-Harmonia series

pollen of terrestrial plants, mostly Pteridophyta growing on humid swampy substrata in favourable climatic conditions. It is likely, that the localities of the Wechsel series — although deposited in a marine environment were not far from dry land with plentiful Pteridophyta and Arthrophyta. The lack of coniferous saccate pollen indicates flat dry land relief.

Redeposition of Early Paleozoic palynomorphs into sediments of the Wechsel series may indicate restless depositional environment.

d) There was a marine depositional environment in the cross section E of Bad Schönau (HM-3 loc. 9, 9a) in the Jurassic period. The sea was far from the coast. This presumption is based on 90 % sea plankton in the palynomorph assemblage. The plankton is so plentiful that many cyst species have not even been mentioned in literature so far. Scarce pollen and spores only indicate that either dry land was far from the locality or the climate was extremely dry and vegetation poorly diversified in species. On the other hand we may presume a warm sea environment because the plankton is well developed and shows all characters typical of an environment favourable for the development of organisms.

Palynological conclusions

Palynological research of lithologically similar, epizonally metamorphosed sediments results in the following conclusions:

a) The Late Paleozoic (Stephanian C the lowest Permian) age of sericitic, chloritic and graphitic schists of the Wechsel series was determined reliably for the first time.

b) The age of phyllites of the Graz Paleozoic is Lower — Middle Devonian.

c) The age of the Harmónie group is Lower Devonian.

d) Calcareous-sandy schists of the Penninicum wedged in the Jurassic Wechsel series.

e) It is not yet possible to correlate metasediments of the Wechsel series with the Harmónie group.

f) Palynomorph exines were graphitized to 40—70 %. Most destroyed were palynomorphs from localities in the Malé Karpaty and HM-1, 2 (E of Bad Schönau).

g) There are about 80 % of resedimented Early Paleozoic palynomorphs in the cross section E of Bad Schönau and about 20 % on other localities of the Wechsel series. This indicates the presence of Silurian — Devonian rocks in the Late Paleozoic of the Wechsel series. The redeposited material is also indicative of restless sedimentation with intense material transport into the depositional environment.

Biostratigraphical research of weakly metamorphosed sediments by palynological methods may result in reliable information on the age of sediments so far referred to as fossilless. The study is enabled by exine resistance to all kinds of metamorphosis except that of high degree. This is proved by our results, and by data collected in the Carpathians in the past decade. The relation of metamorphism to preservation of fossil organisms in sediments is now studied all over the world with respect to chemical structure of sporopollenine and to biostratigraphical and geological facts.

The submitted results are the first to be further complemented and precised by persistent palynological research of complete cross sections in the Malé Karpaty Mts. and some units of the Alpine system.

Geological conclusions *(A. Pahr)*

A geological evaluation of the palynological results shows that we have Late

Carboniferous — lower Permian schists in the topmost branch of the Wechsel schists in the „traditional" Wechsel mountain group (Nr. i1, Weinweg), and we also have palynomorphs of the same age outside of it (Nr. 2, east of Bernstein).

Interesting results were obtained from locality Nr. 4 (east of Bad Schönau). In this profile (thickness about 70 metres) we have early Palaeozoic, late Palaeozoic and Jurassic palynomorphs. The Jurassic remnants occur in an imbricated thrust wedge of calcareous phyllites from the neighbouring Penninic realm (Möltern window) of the Rechnitz series.

The occurence of early and late Palaeozoic in this profile can be explained in two ways:

1) There are schists of early Palaeozoic age in (deeper) parts of the Wechsel schists and the sequence is tectonically piled up in the profile.

2) We have late Palaeozoic (upper Carboniferous — lower Permian) age in the whole, sequence, with a lot of early Palaeozoic palynomorphs resedimentated in the younger formation.

Both possibilities may occur in different places. At present no decision in this problem is available, further detailed investigation will have to decide it.

The findings of Upper Silurian — Middle Devonian palynomorphs in graphitic schists of the Graz Palaeozoic in Hannersdorf (Nr. 5) provide additional information to the age determination by macrofossils which have been found here in dolomites since 1877 (Middle Devonian).

As to the correlation of the Wechsel group with the Harmonia group in the Little Carpathians detailed geological and petrological correlation is necessary and under planning. According to M. Maheľ (1982) the Harmonia Group consists of more units of different ages. Only the Early Paleozoic parts are here correlated to a part of the Wechsel Series. So the problem of further palynomorph correlation study of weakly metamorphosed sediments in the two significant tectonic units still remains open.

The authors are quite aware that all the work done by them up to now, is just a first step in the research of a region, which was, for the most part, devoid of fossils, but nevertheless seems important for structural problems in this part of the Eastern Alps and Little Carpathians.

Review by M. Maheľ

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Nové poznatky o veku epizonálne metamorfovaných bridlíc z wechselskej série v Rakúsku a otázka korelácie s harmónskou skupinou v Malých Karpatoch

EVA PLANDEROVÁ — ALFRED PAHR

V práci sa zaoberáme vekovým zaradením slabometamorfovaných sedimentov wechselskej série a koreláciou so sedimentmi harmónskej skupiny Malých Karpát.

Doterajšie názory na vekové zaradenie sericitických, chloritických a grafitických fylitov z wechselskej série boli protichodné a nezakladali sa na paleontologických dôkazoch. Metamorfované sedimenty sa pokladali za bezfosílne, tzv. hluché. Palinologickou metódou sme získali dosť bohatý palinologický materiál a na základe jeho hodnotenia môžeme skúmané sedimenty vekovo identifikovať. Úlohu komplikoval jednak charakter hornín, pôsobenie metamorfózy na exinu palinomorf (stali sa ťažšie určiteľnými), ale hlavne vysoké percento resedimentovaných palinomorf v niektorých vzorkách. Po spracovaní vzoriek viacerými spôsobmi, opakovaných odberoch a určovaní na základe bohatej palinologickej literatúry sme zistili, že oporou na posúdenie veku sedimentov môže byť profil Weinweg a Bernstein.

a) Vo vzorkách z týchto profilov sme zistili dobre zachované spoločenstvo sporomorf stefanského až spodnopermského veku a iba nízke percento redeponovaných palinomorf zo silúru až spodného devónu (hlavne planktónu).

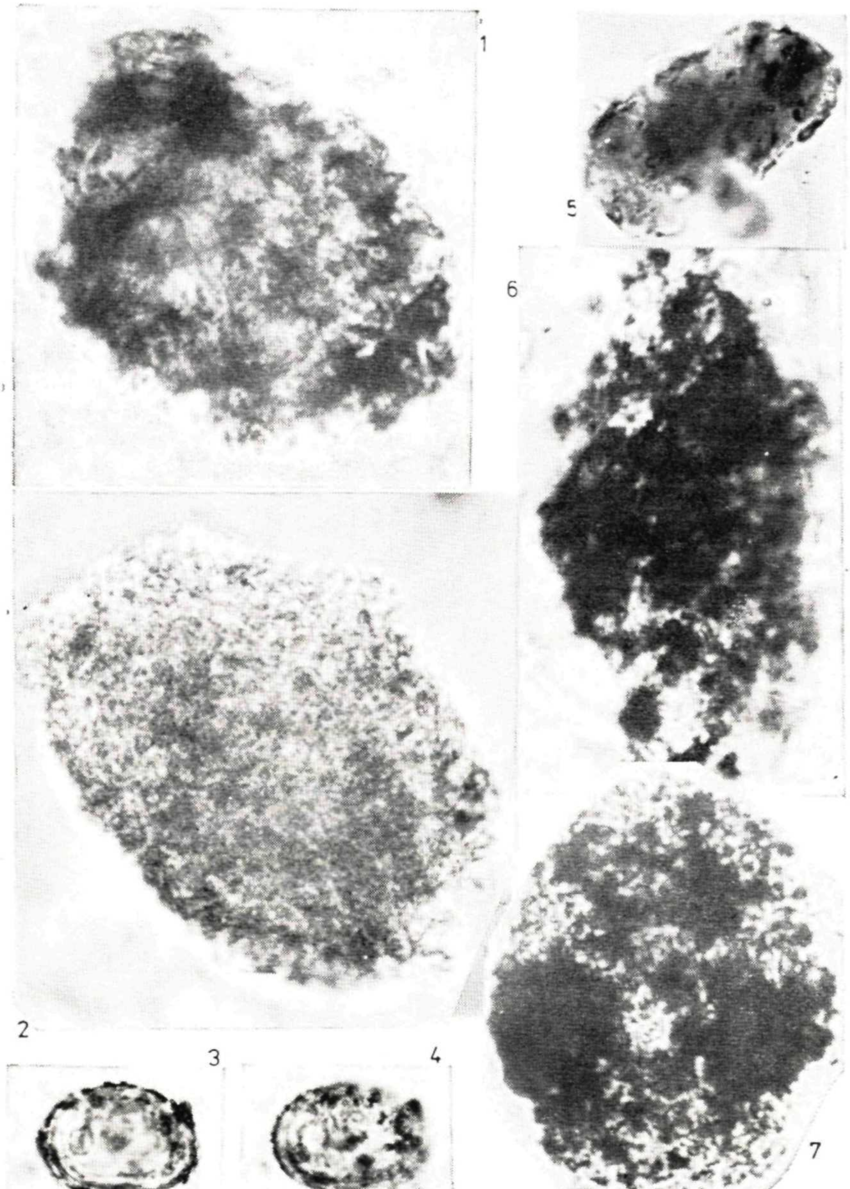
Vysoké percento redeponovaných palinomorf silúrskeho-spodnodevónskeho veku do mladopaleozoických sedimentov vzorky z profilu V od Bad Schönau (HM-1, 2) skresľovali vekové zaradenie. Z geologicko-tektonického a litologického aspektu pokladáme (A. Pahr) všetky tri lokality za vekovo identické. Zaradenie sedimentov do vrchného karbónu až spodného permu pokladáme za výsledok geologicko-tektonickej interpretácie a zohľadnenie autochtónnych stefansko-spodno-permských sporomorf. Vek ostatných spracovaných vzoriek, hlavne z profilu Weinweg, považujeme jednoznačne palinomorfami za dobre doložený stefan C až bázu spodného permu. Proti zaradeniu do vrchného permu svedčí sporomorfová asociácia bez typických vrchnopermských druhov, najmä monosakátnych a bisakátnych peľov.

b) Vzorky zo štajerskohradeckého paleozoika boli bohaté na typickú spodno až strednodevónsku mikrofloristickú asociáciu a vrchnosilúrsky až spodnodevónsky morský planktón zo skupiny akritarcha. Preto možno vek spodný až stredný devón pokladať za doložený.

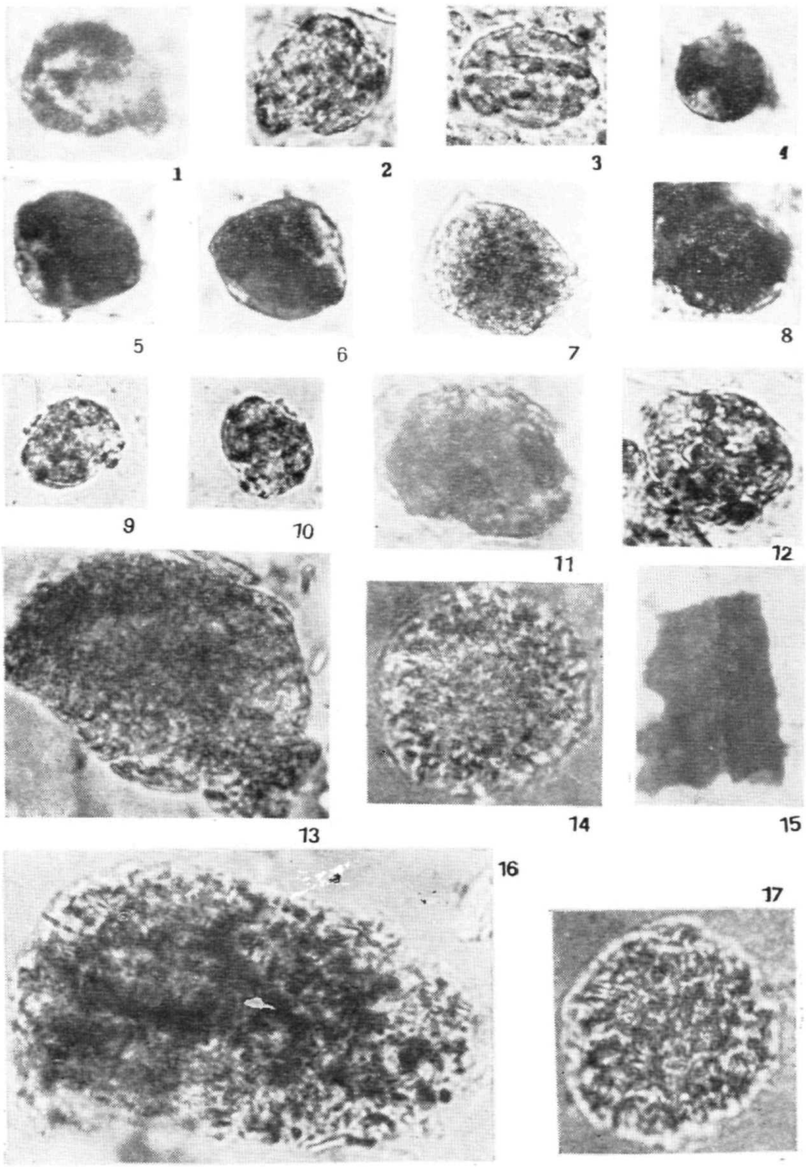
c) Sedimenty vápnitých piesčitých bridlíc z profilu V od Bad Schönau (HM-3) možno jednoznačne hodnotiť ako jurské. Podľa A. Pahra ide o vklinené penninikum do wechselu.

d) Slabometamorfované sedimenty z harmónskej skupiny Malých Karpát podľa charakteru asociácie palinomorf jednoznačne poukazujú na spodnodevónsky vek.

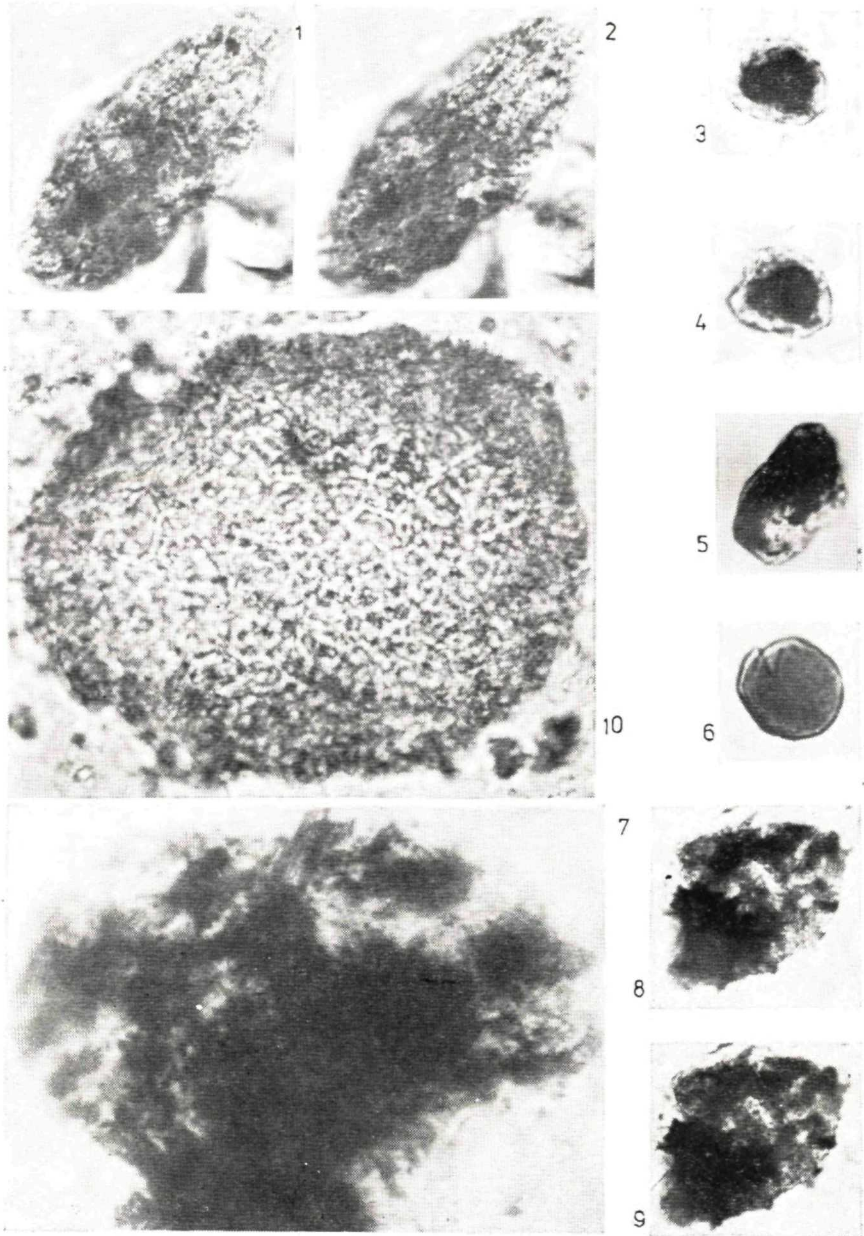
Podľa názoru M. Maheľa (1982) harmónska skupina, ako aj wechselská séria nie sú jednotného veku. Ďalším štúdiom bude možno získať nové poznatky o ich veku, ako aj ďalšie korelačné možnosti.



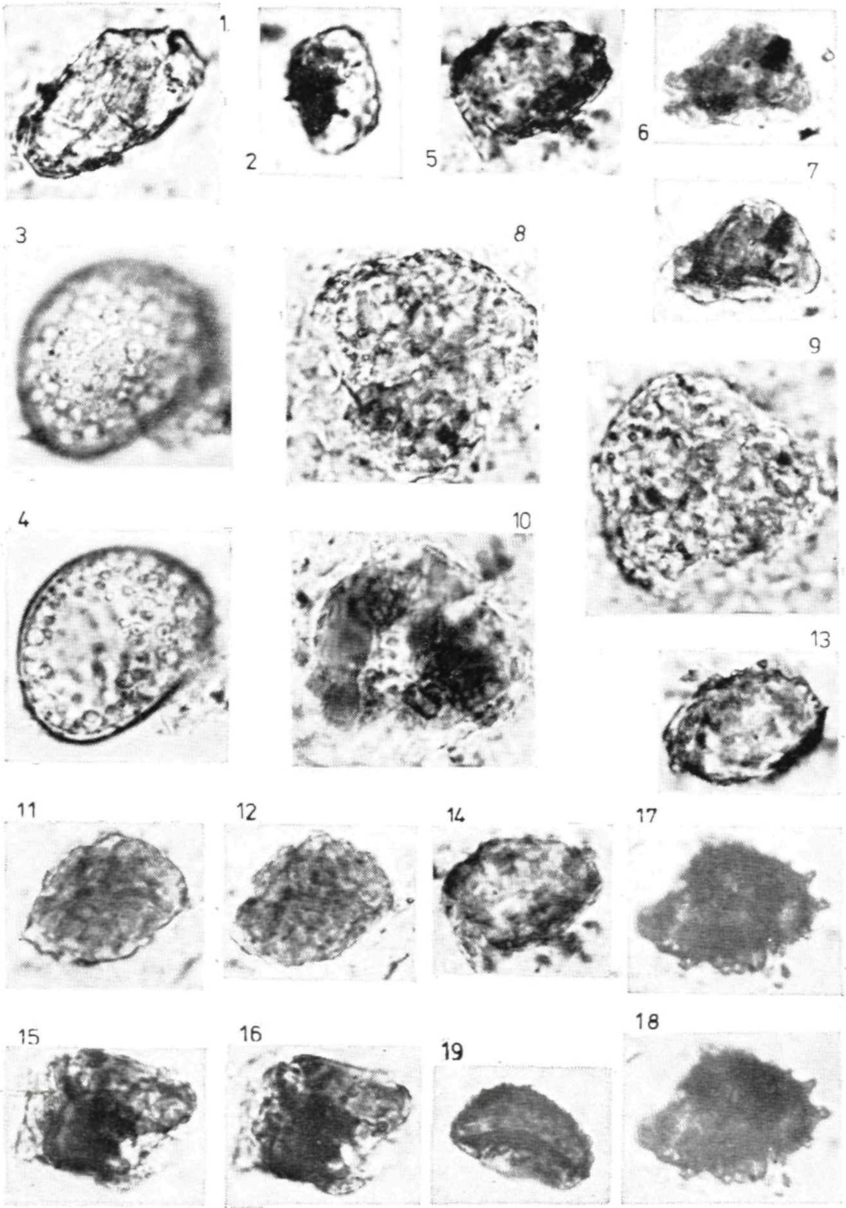
Pl. I. Weinweg loc. 3—4
fig. 1 — *Cordaitina ornata* Samoil., (loc. 3), 2 — *Wilsonia (?) pseudopraetecta* Innos., (loc. 1), 3—4 — *Thymospora thiessenii* (Kos.) Alp., 5 — *Thalisporites scoticus* Butt. Will., 6 — *Florinites* cf. *antiquus*, 7 — *Florinites luberae* Samoil.



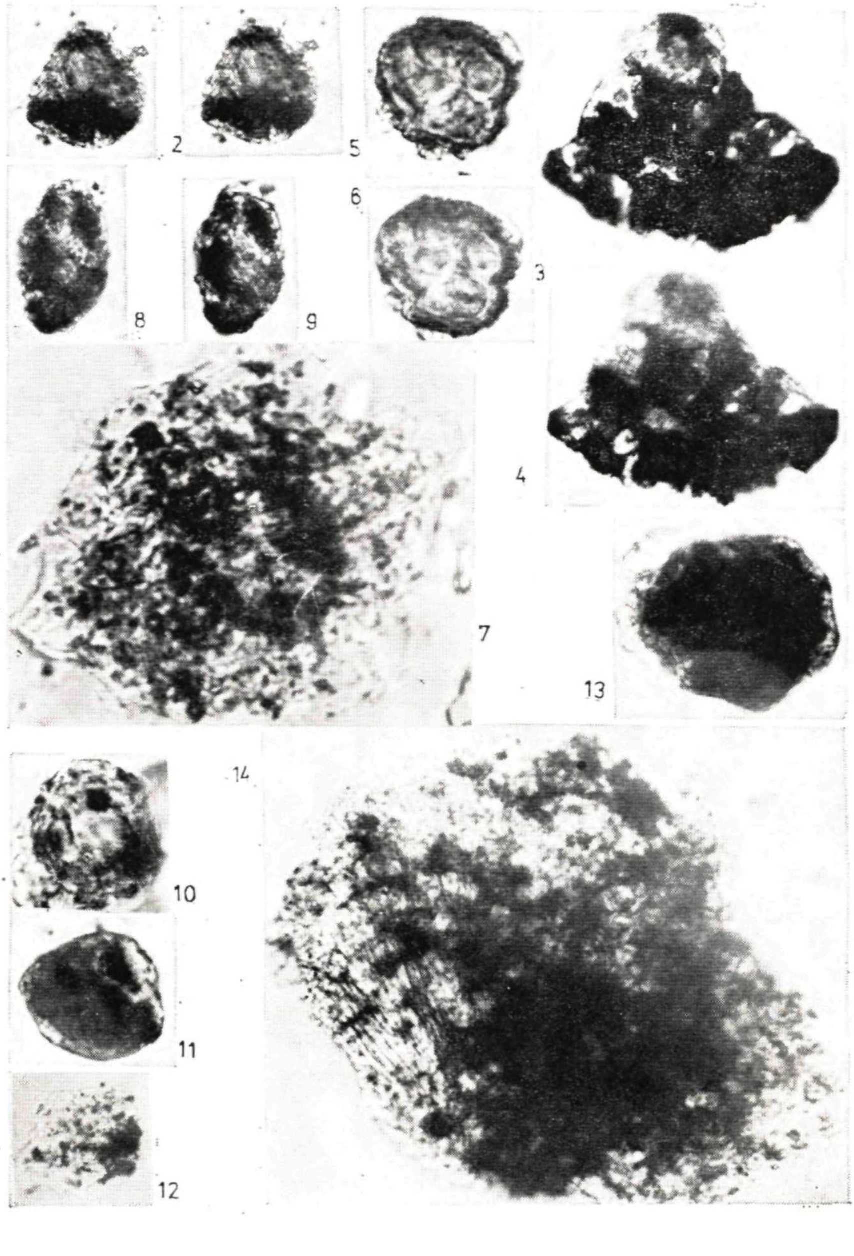
Pl. II. Weinweg
fig. 1 — *Calamospora* sp. (loc. 8), 2 — *Punctatosporites* sp. (loc. 8), 3 — *Punctatosporites cingulatus* Alp. (loc. 5), 4 — *Sporites* sp., 5—6 — *Punctatisporites punctatus* (Kos.) Alp. (loc. 1—3), — *Lycospora punctata* Kos. (loc. 1—3), 8 — *Limitisporites* sp. (loc. 8), 9—10 — *Verrucatosporites* sp. (loc. 1—3), 11 — *Illinites unicus* Kos. (loc. 8), 12 — *Apiculatisporites irregularis* Alp. (loc. 8), 13 — Kerogén, 14 — *Florinites antiquus* (Schopf). Alp. (loc. 1), 15, 17 — *Dictyotriletes reticulocingulum* (Loose) Smith et Butt. (loc. 3), 16 — cf, *Potonieisporites* (loc. 8)



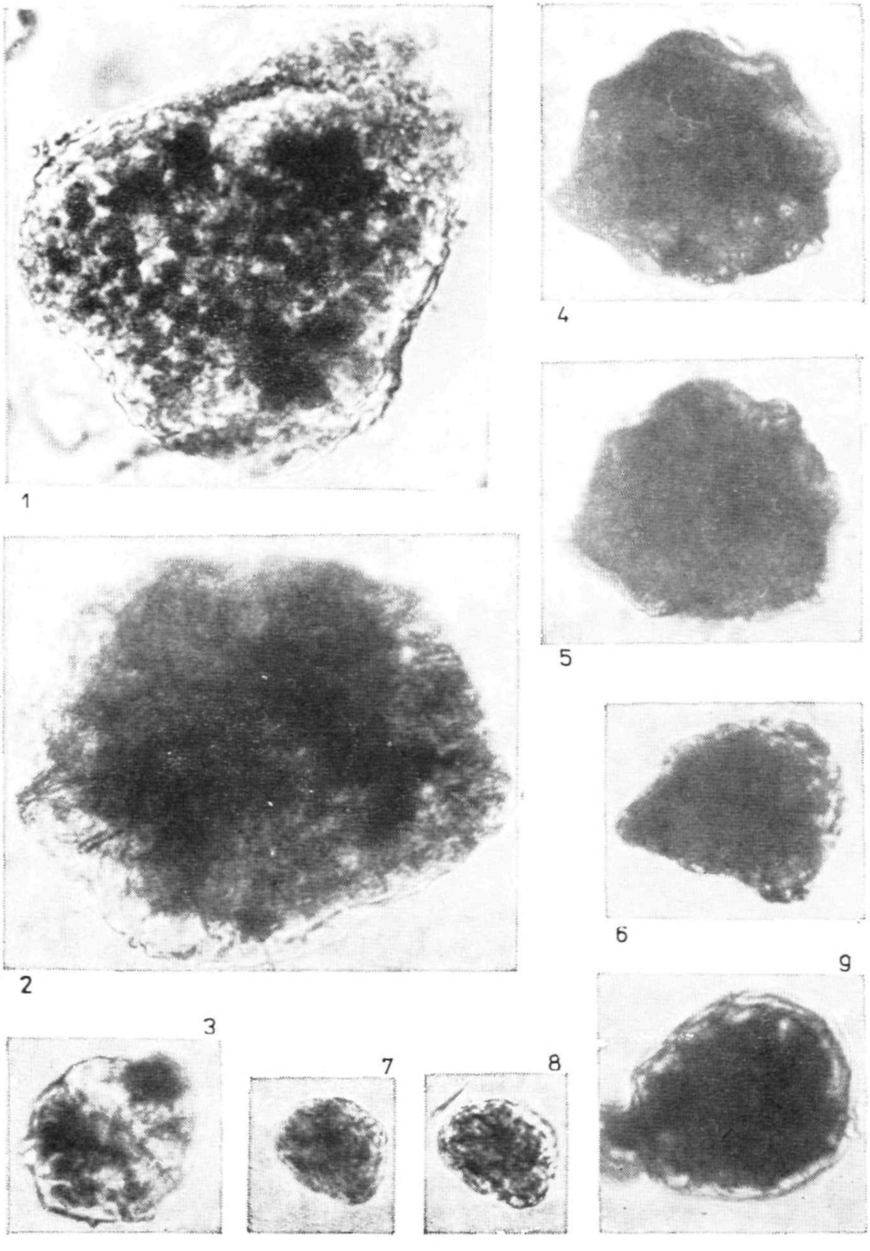
Pl. III. Weinweg
fig. 1—2 — *Colluminisporites ovalis* Peppers (loc. 1), 3—4 — *Scabratisporites scabratus* Teteriuc (loc. 1), 5 — *Torispora securis* Alp. (loc. 1), 6 — *Sponge spore* (loc. 3), 7 — *Torispora* sp. (loc. 3), 8—9 — *Raistrickia* sp. (loc. 3), 10 — *Cordaitina* sp.



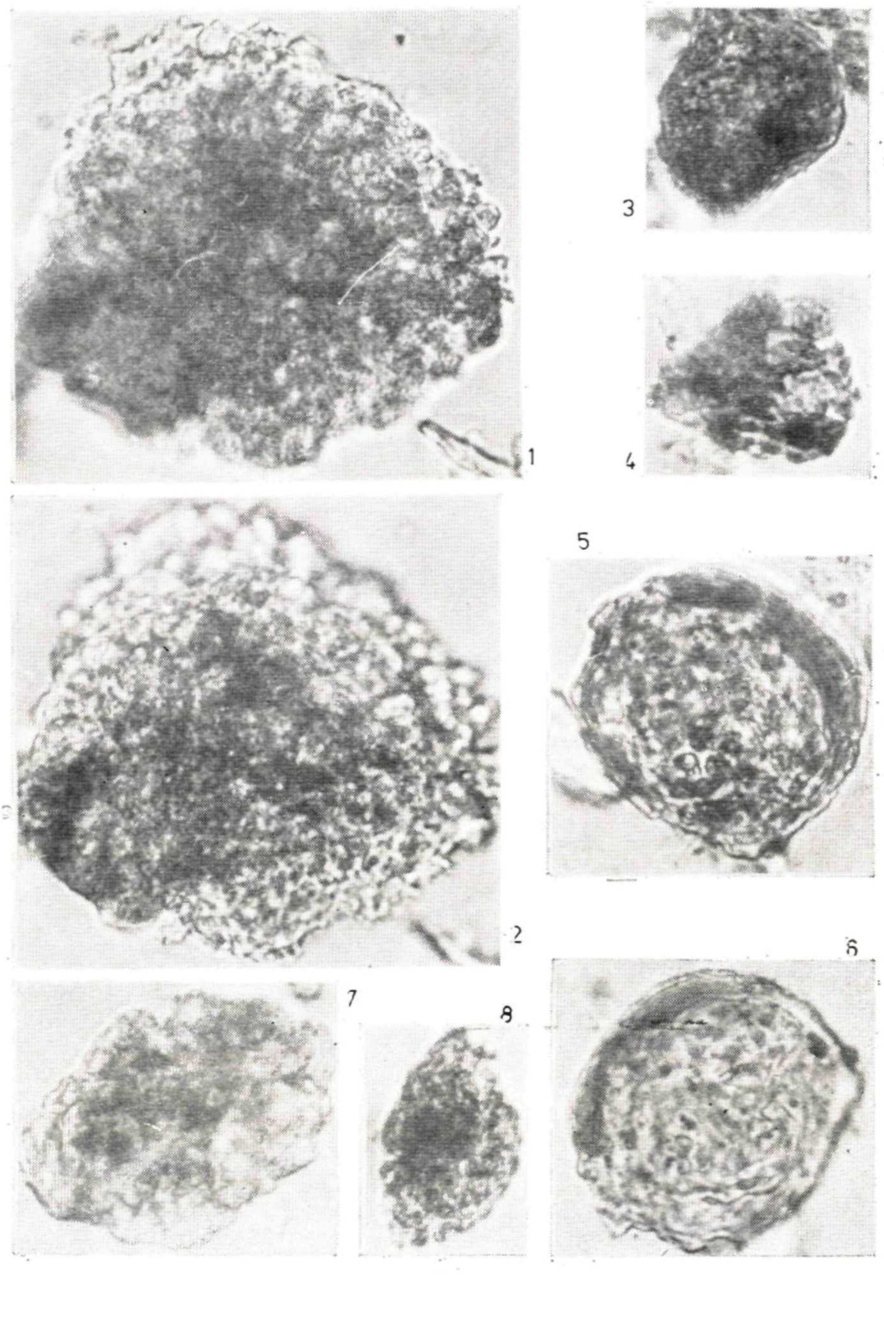
Pl. IV. Weinweg loc. 5—6
fig. 1 — *Aumancisporites* sp., 2 — *Punctatisporites granifer* (Pot. Kr.) Alp., 3—4 — *Spinosporites* aff. *peppersi* (Peppers) Alp., 5 — *Verucosisporites* sp., 6—7 — *Triquitrites* cf. *triturgidus* (Loose) Wols. et Wen., 8—9 — *Dictyotriletes* cf. *bireticulatus* Alp., 10 — *Densosporites crassipterus* (Waltz) Schwarts., 11—12 — *Lophotriletes commisuralis* (Kos.) Pot. Kr., 13—14 — *Spinosporites peppersi* Alp., 15—16 — *Pterospermopsis* sp., 17—18 — *Apiculoretispora* sp., 19 — *Punctatosporites cingulatus* Alp.



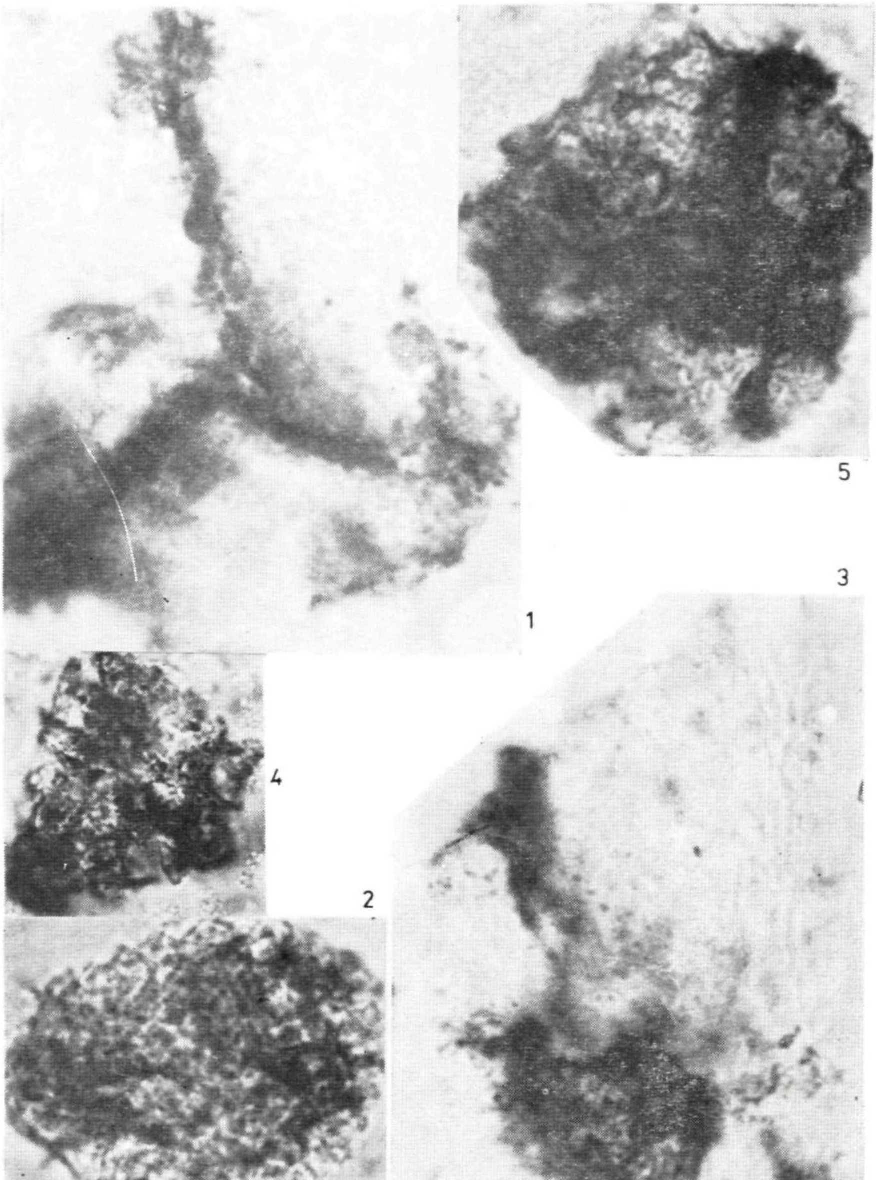
Pl. V. Weinweg loc. 7
fig. 1—2 — *Lysospora* cf. *granulata* Kos., 3—4 — *Triquitrites perornatus* Radondy Doub., 5—6 — *Tripartites* sp., 7 — *Endosporites globiformis* (Ibr.) S. W. B., 8—9 — *Aumancisporites* sp., 10 — *Densosporites* sp., 11 — *Lycospora* sp., 12 — *Cymatiosphaera pentaster* Staplin (redepos.), 13 — *Cymatiasphaera* sp., 14 — *Acritarcha indet.*



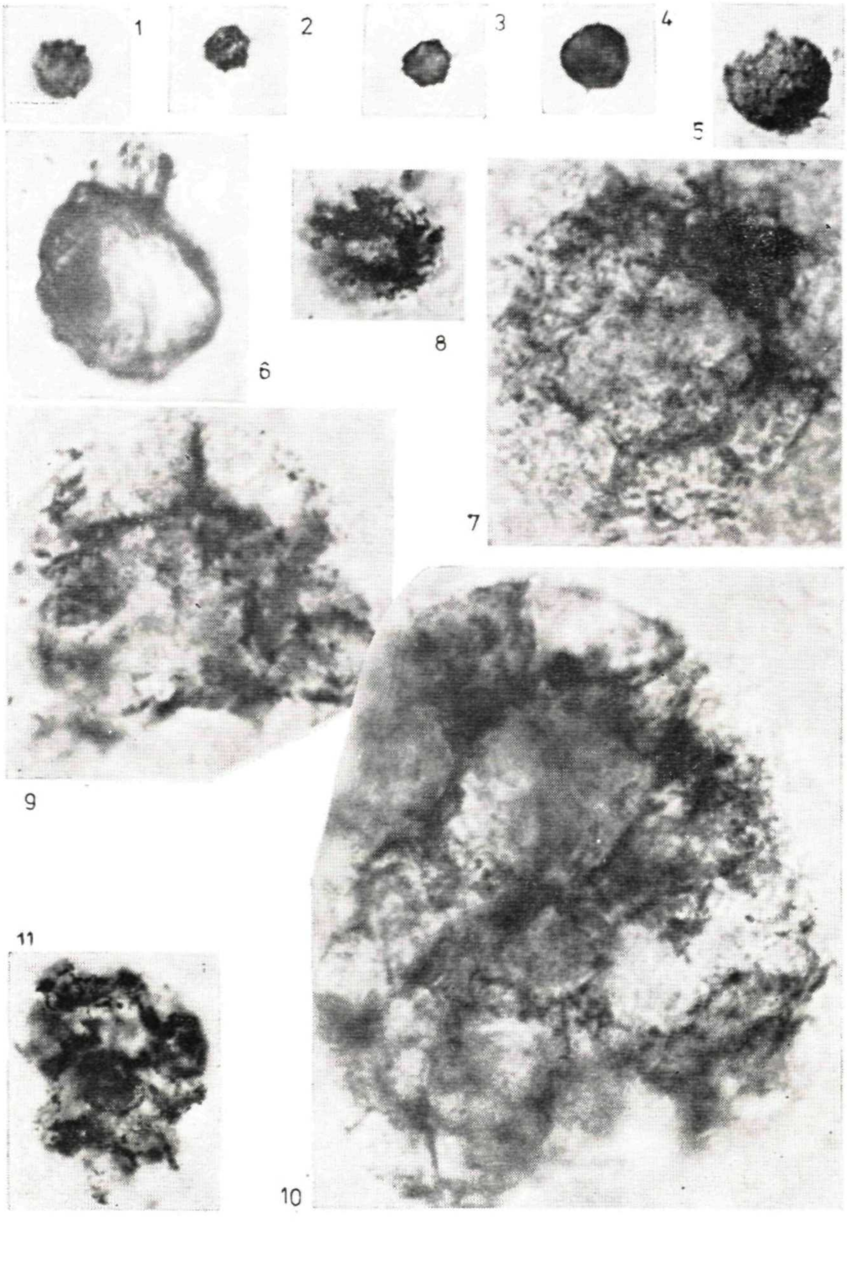
Pl. VI. Bernstein
fig. 1 — *Densosporites triangularis* (Kos.) Alp., 2 — *Cirratriradites saturni* (Ibr.) S. W. B., 3 — ? *Ahrensisporites*, 4—5 — *Duvernaysphaera lockpartensis* Thusu (redepos.), 6 — *Cymatiosphaera compta* Salujha (redepos.), 7—8 — *Lycospora* sp., 9 — *Cymatiosphaera compta* Salujha (redepos.)



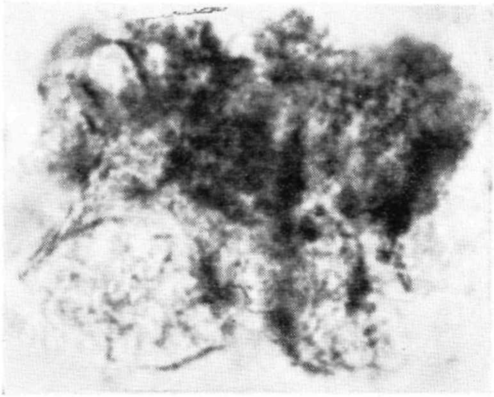
Pl. VII Bernstein
fig. 1—2 — *Cirritriradites saturni* (Ibr.) S. W. B., 3 — *Punctatosporites granifes* (Pot. Kr.) Alp., 4 — *Lycospora pusilla* Alp., 5—6 — *Convolutispora recurva* Innosova, 7 — *Azonomonoletes* sp., 8 — *Archaoperisaccus* sp.



Pl. VIII. GP-7
fig. 1 — *Retusotriletes* sp., 2 — *Cyclogranisporites* sp., 3 — *Auroraspora macromanifestus* Rich., 4 — *Stenozonotriletes* sp., 5 — *Retusotriletes divulgatus* Tchibr.



Pl. IX. GP-7
fig. 1—3 — *Micrhystridium parveroquesi* St. Will., 4 — *Micrhystridium* sp., 5 — *Lophospaeridium parvenarum* St. Will., 6 — *Ammonidium* sp., 7 — *Cymatiosphaera* cf. *wenlockia* Downie, 8 — *Cymatiosphaera* sp., 9 — *Cymatiosphaera mirabilis* Deunff., 10 — *Cymatiosphaera* cf. *mirabilis* Deunff., 11 — *Pterospermella* sp.



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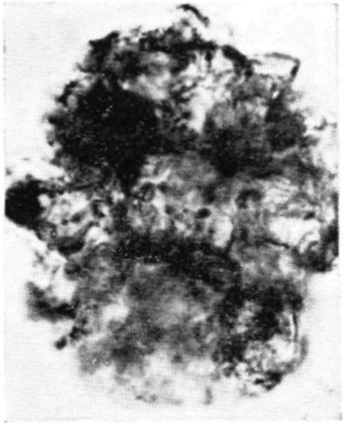

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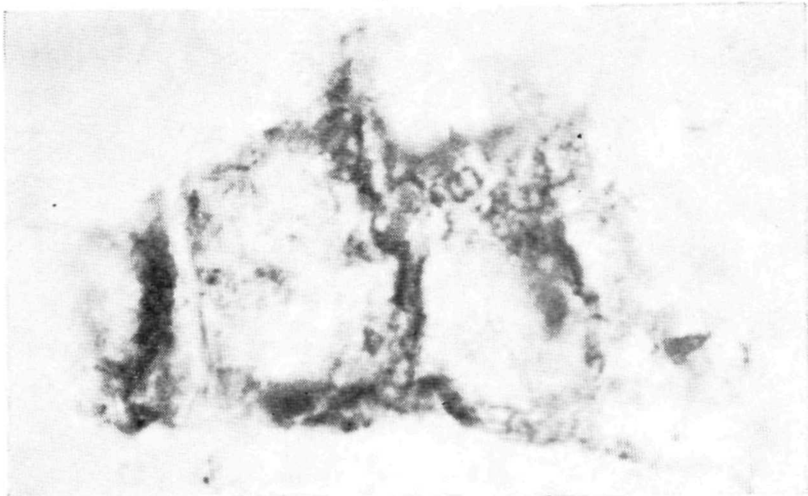

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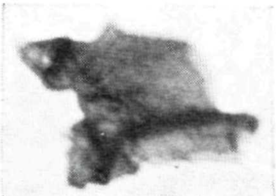

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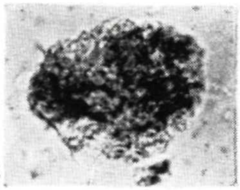

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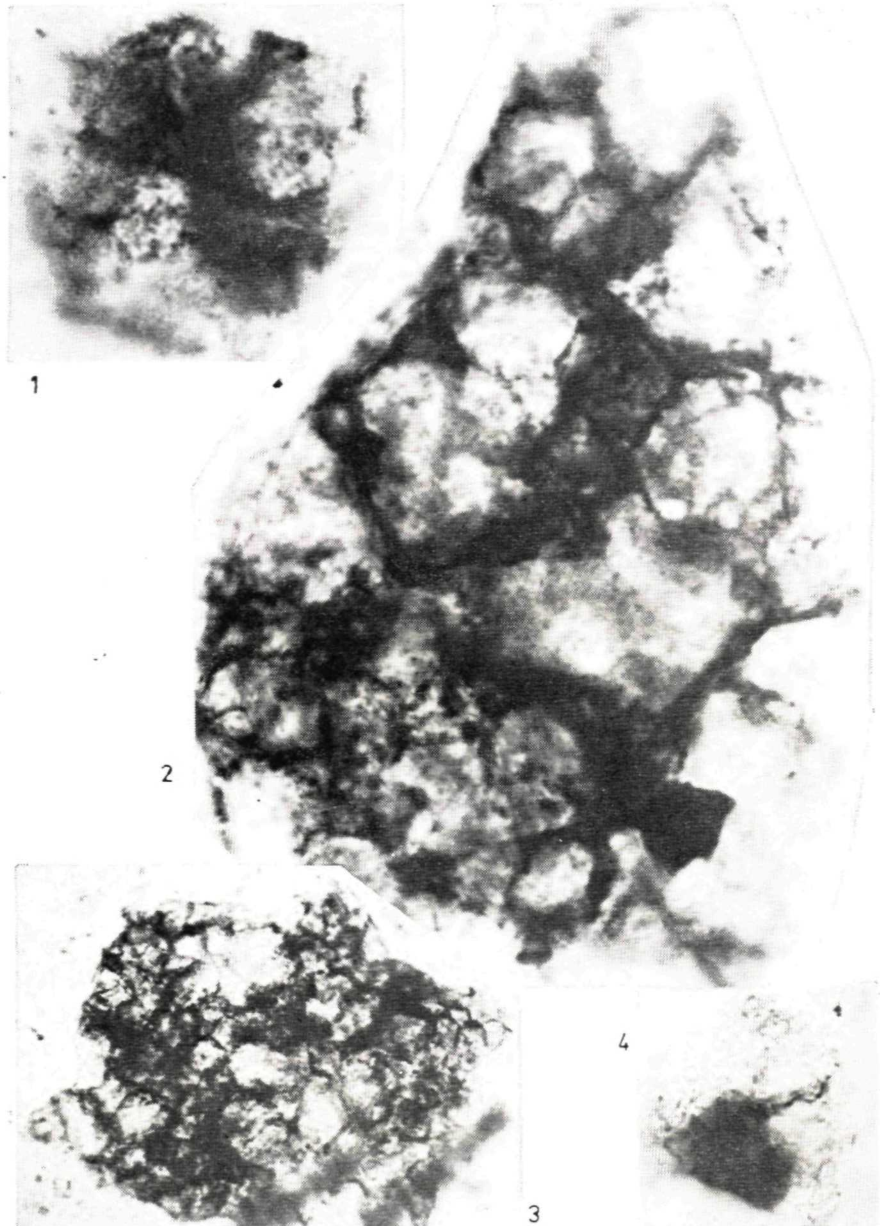
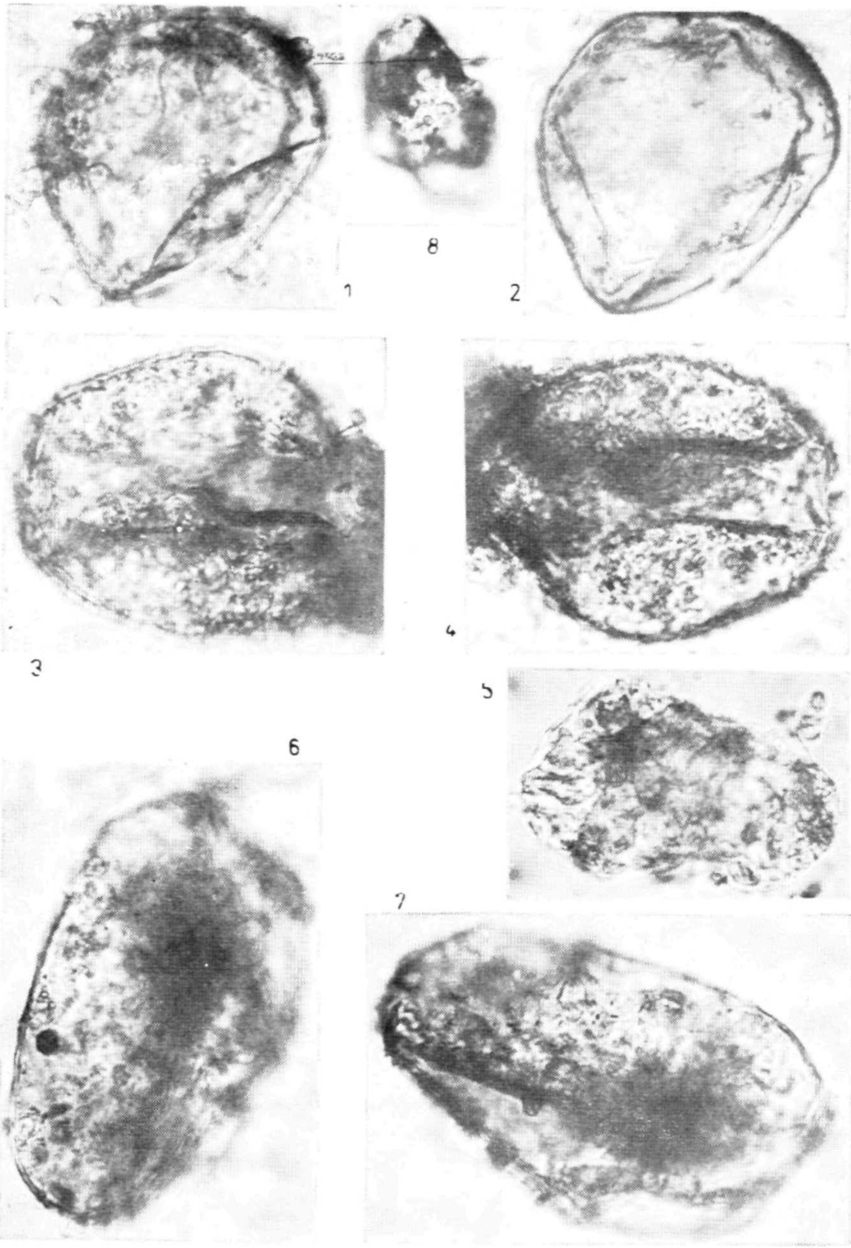
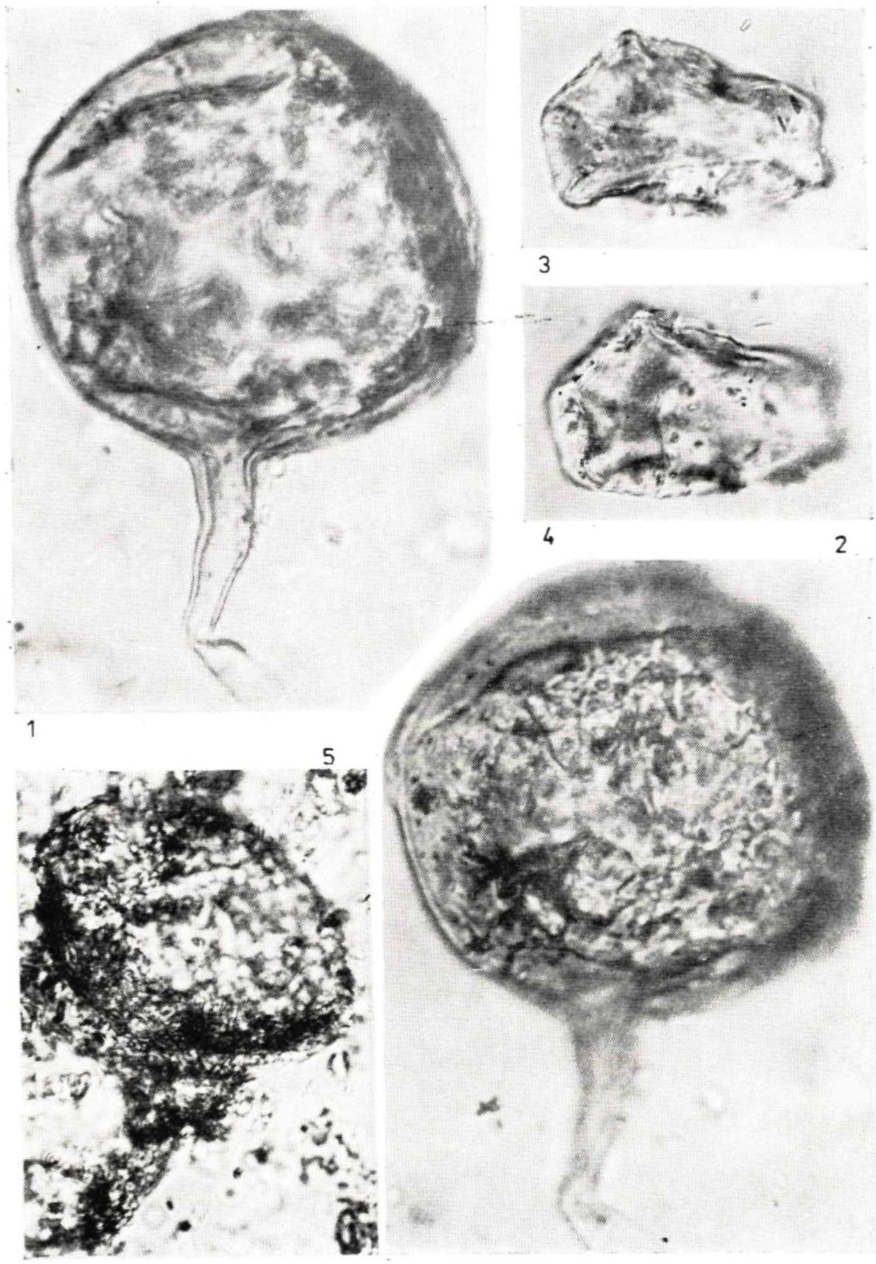
Pl. X. GP-7
fig. 1 — *Pterospermopsis* sp., 2 — *Fimbrioglomerella* sp., 3 — *Fimbrioglomerella divisa* Loebl. Drug., 4 — *Synsphaeridium spinosum* Moreau-Benoit, 5 — *Quadraditum* cf. *fantasticum* Cramer, 6 — *Cymatiosphaera* sp.



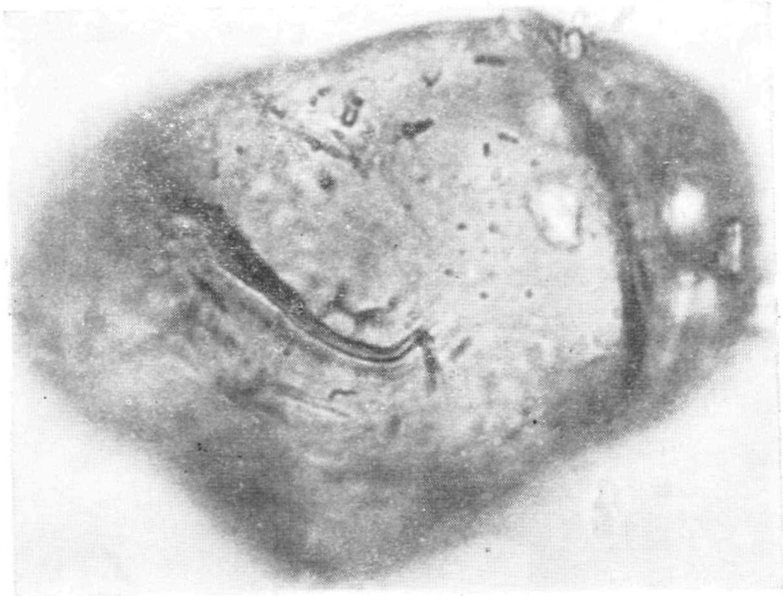
Pl. XI. GP-7
fig. 1 — *Polyedrychium* sp. 1, 2 — *Polyedrychium* sp. 2, 3 — ? *Polyedrychium*, 4 — *fragment of Pterosermopsis*



Pl. XII. HM-3 n. 9 (East of Bad Schönau)
fig. 1—2 — *Protoleiosphaeridium diaphanum* Stapl., 3—4 — *Acritarcha indet.*, 5 — *Pterospermopsis* sp., 6—7 — *Acritarcha* (Protoleiosphaeridium?), 8 — *Acritarcha indet.*



Pl. XIII. HM-3 n. 9a
fig. 1—2 — *Pareodinia prolongata* Saerj., 3—4 — *Acritarcha indet.*, 5 — *Pareodinia* sp.



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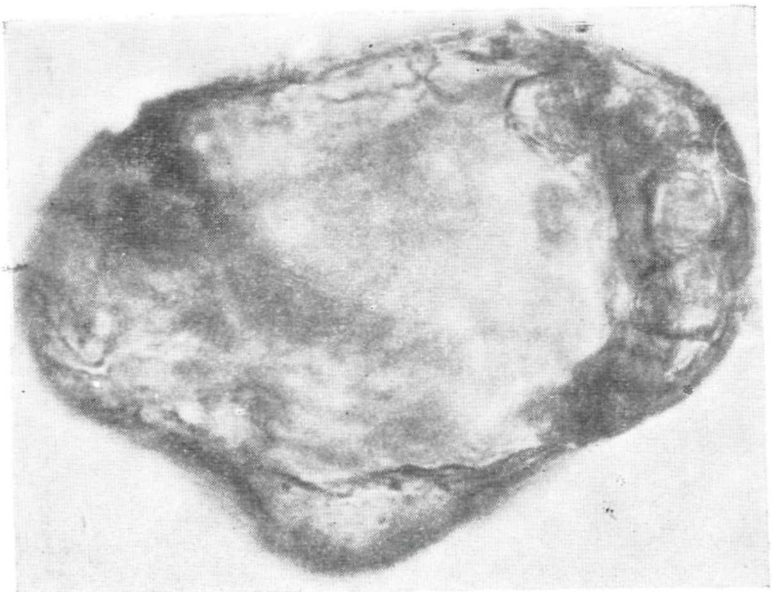

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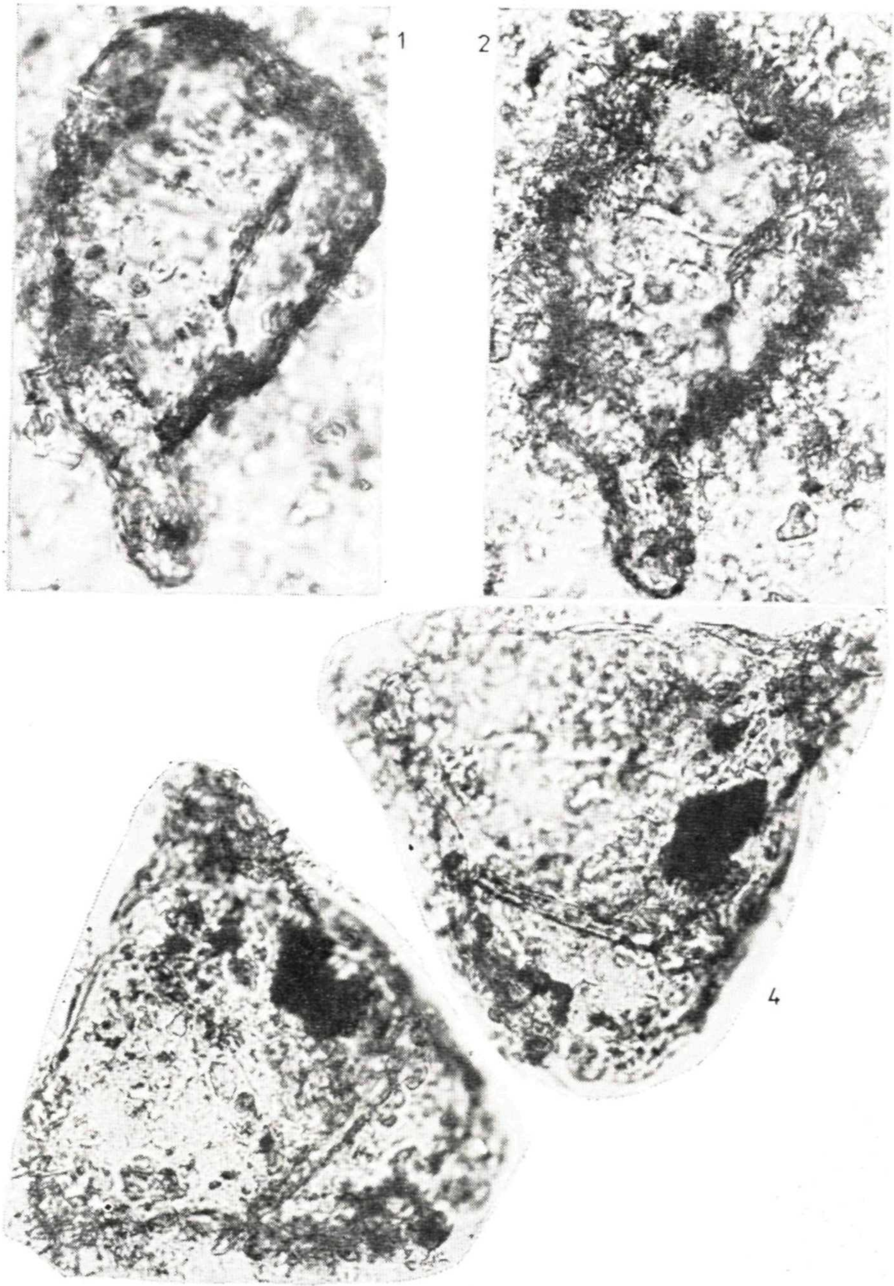
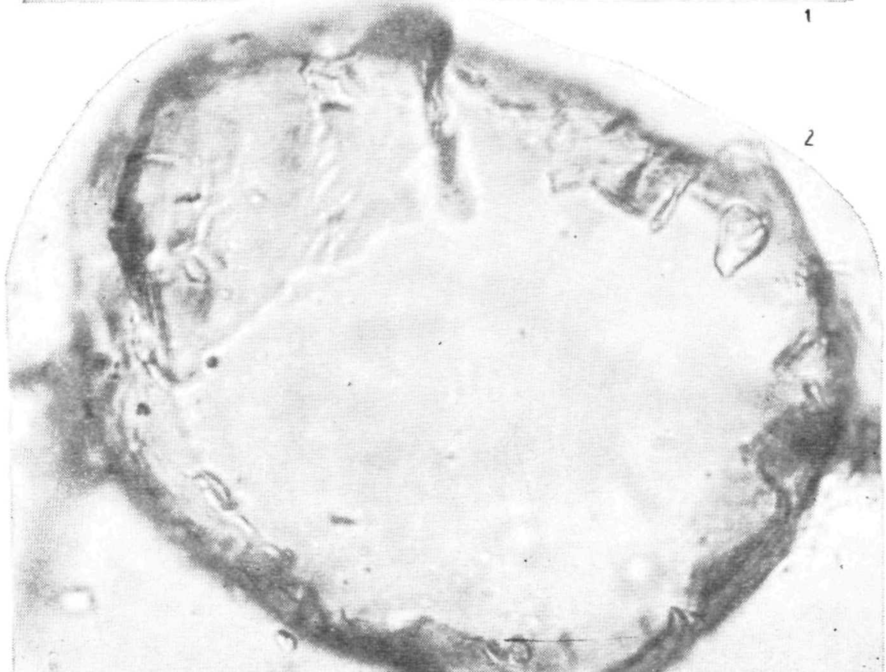
Pl. XIV. HM-3 n. 9a
fig. 2—2 — *Cysta?*



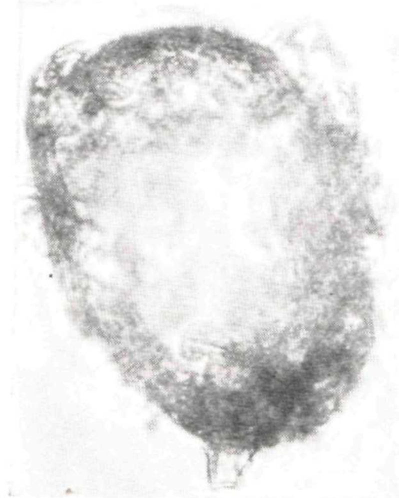
Pl. XV. HM-3 n. 9a
fig. 1—2 — *Gonyaulax* cf. *areolata* Saerj., 3—4 — *Cystyts*

1



Pl. XVI. HM-3 n. 9a
fig. 2—2 — *Gonyaulax* sp.

1



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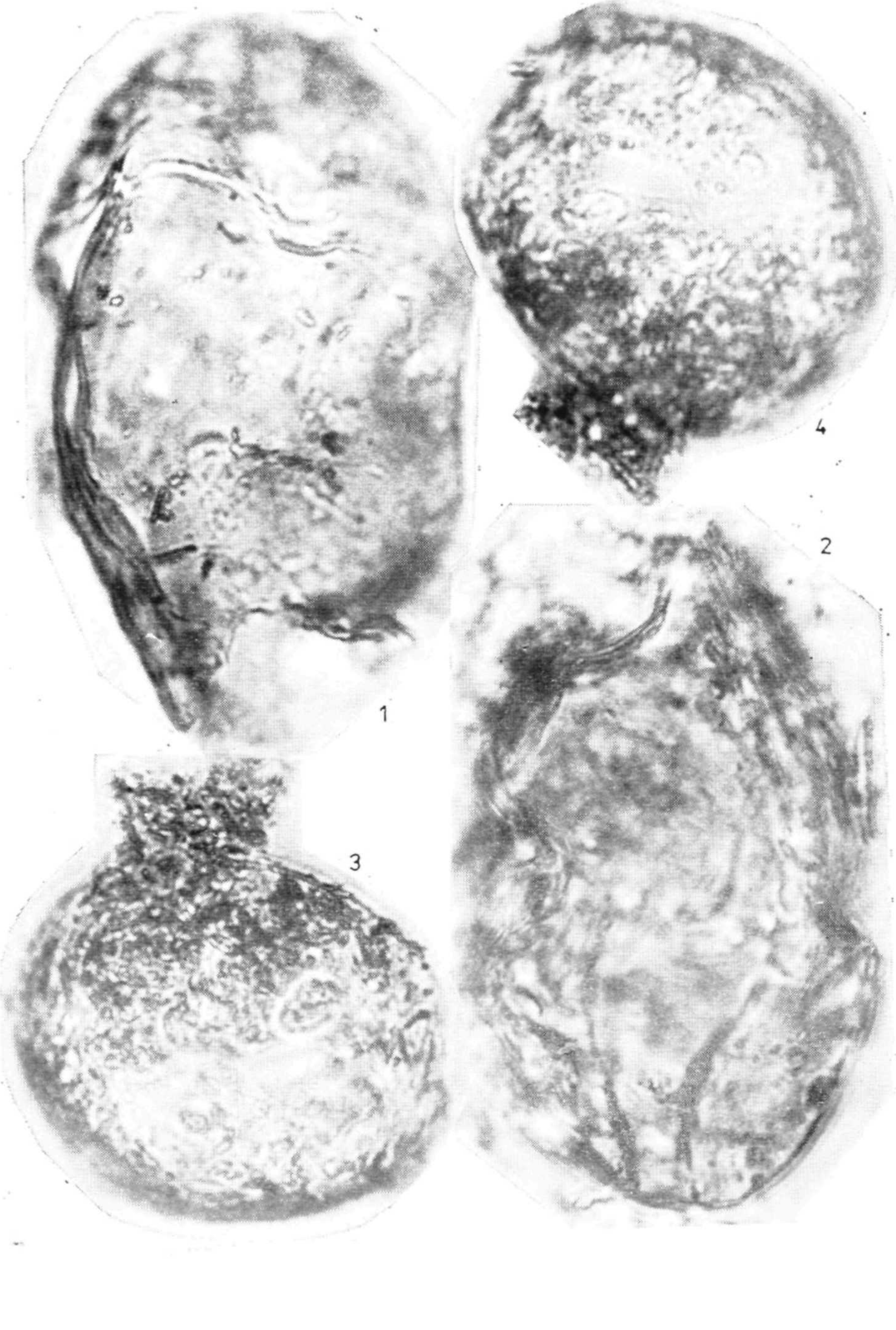
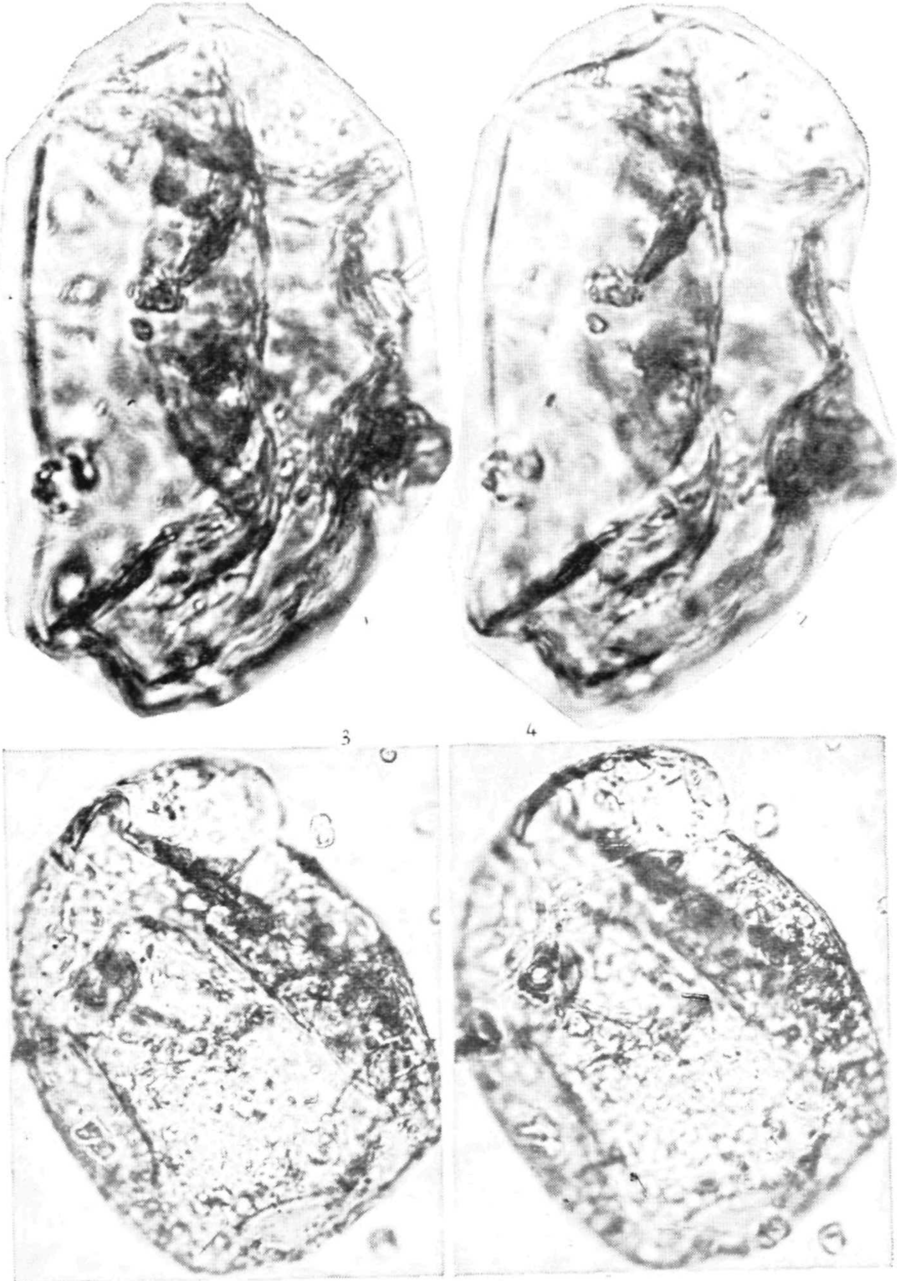
Pl. XVII. HM-3 n. 9
fig. 1—2 — *Gonyaulax* sp., 3 — *Thalasisphora* sp.



Pl. XVIII. HM-3 n. 9
fig. 1—2 — *Gonyaulax cladophora* Deunff., 3—4 — *Gonyaulax cladophora* Deunff.

Pl. XIX. HM-3 n. 9a
fig. 1—2 — *Gonyaulax* sp., 3—4 — *Gonyaulax* sp.



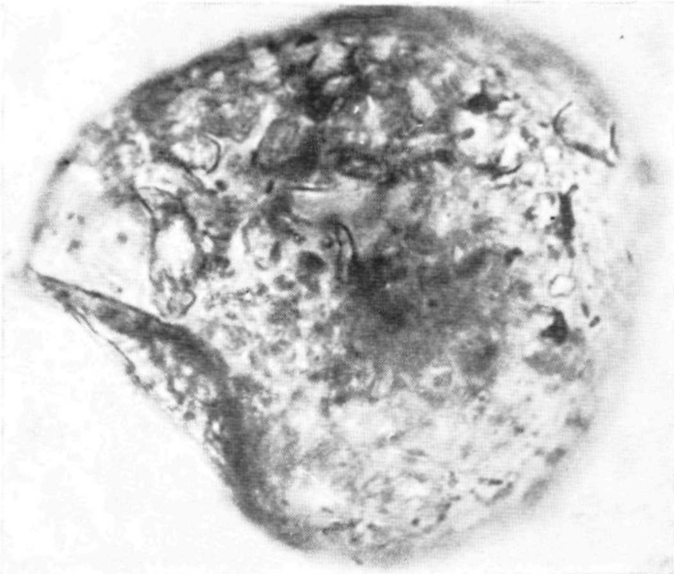
Pl. XX. HM-3 n. 9a
fig. 2—2 — *Gonyaulacysta* sp., 3—4 — *Cysta* sp.

1

2

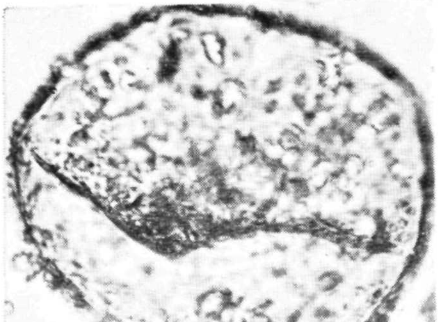
3

Pl. XXI. HM-3 n. 9a
fig. 1 — *Cysta A*, 2—3 — *Gonyaulacysta* sp.

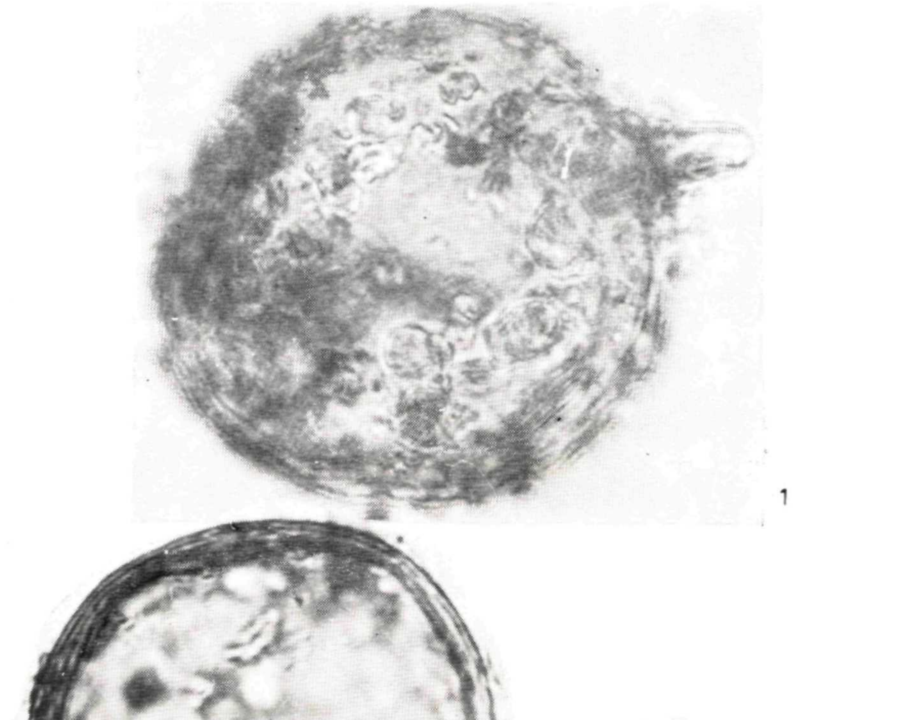


1

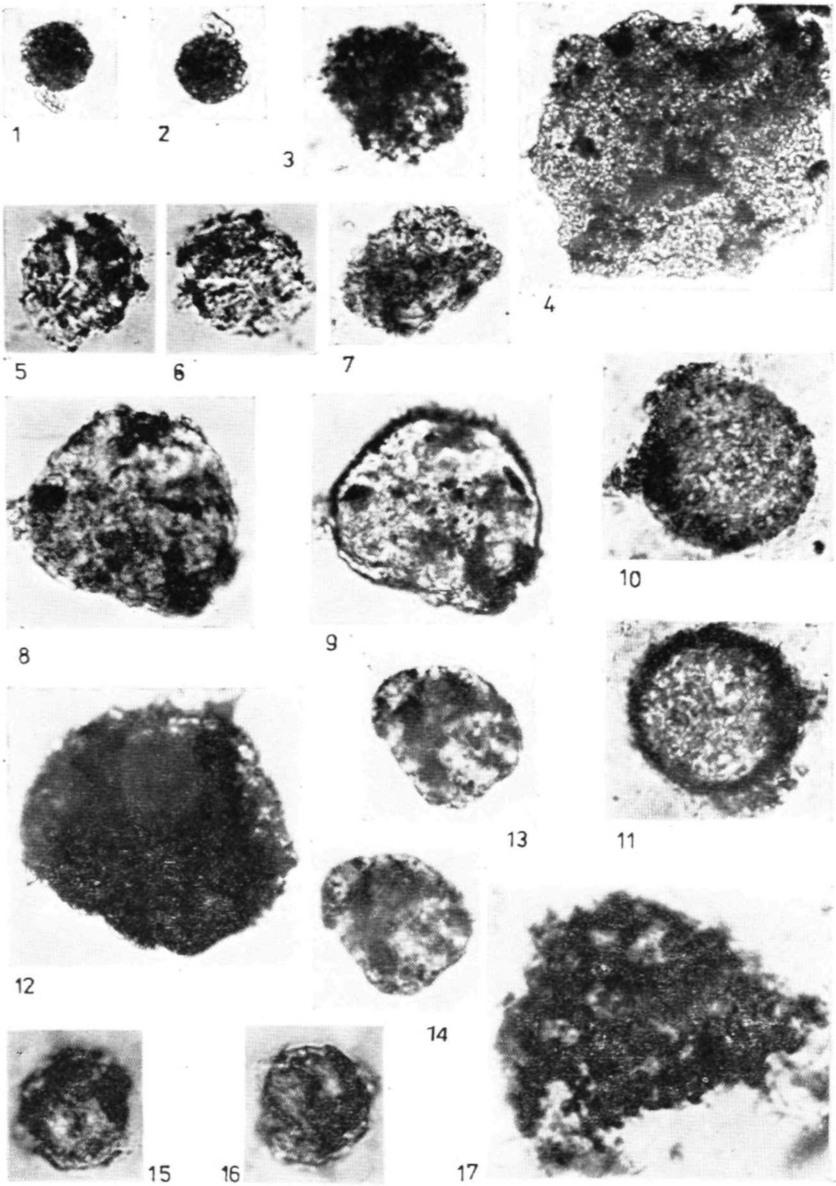
2 3



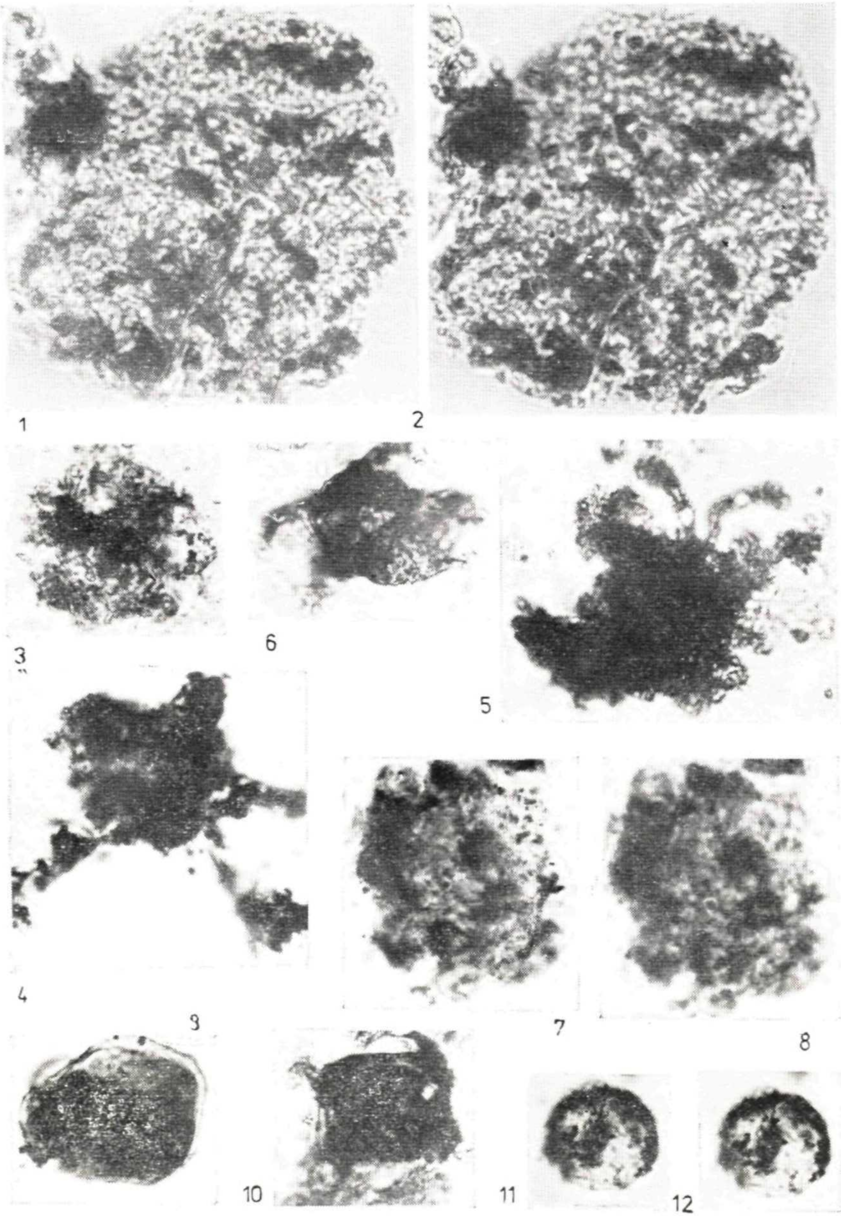
Pl. XXII. HM-3 n. 9a
fig. 1 — *Cysta*, 2—3 — *Gonyaulacysta* sp.



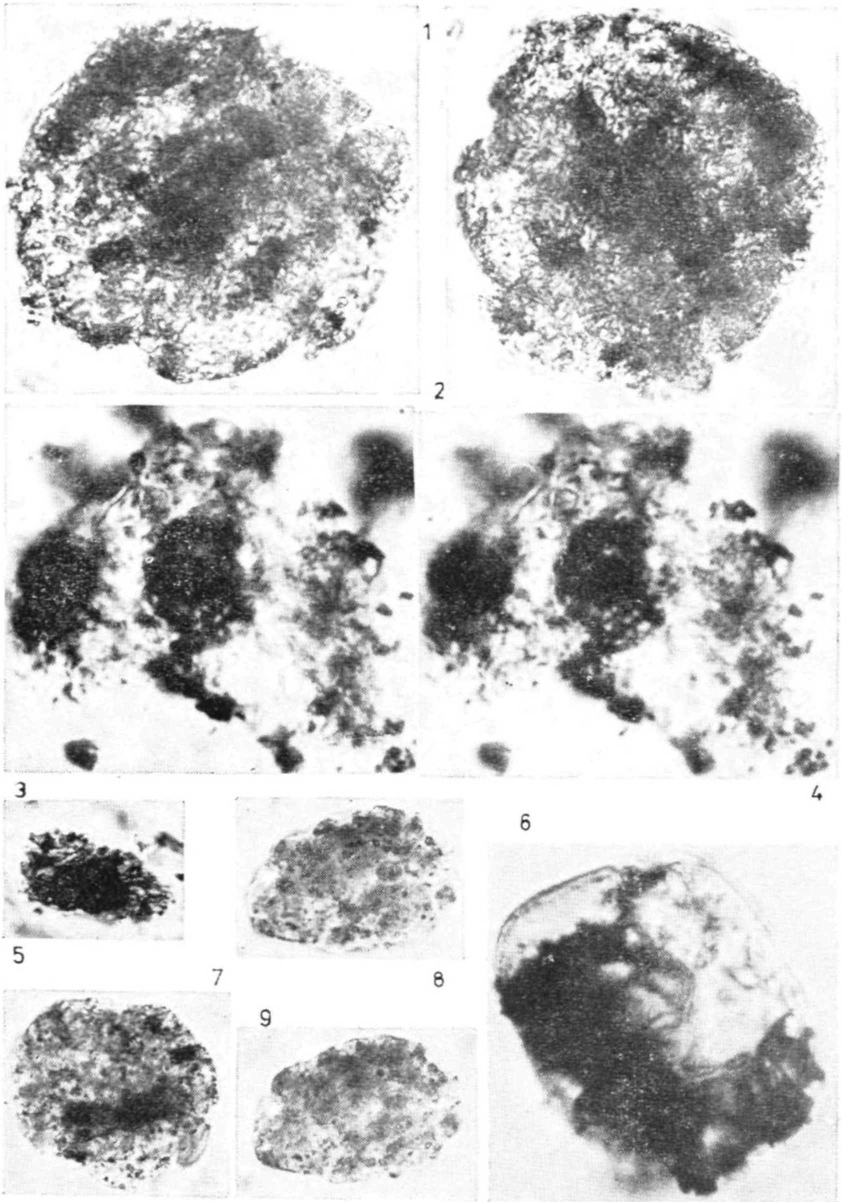
Pl. XXIII. HM-3 n. 9a
fig. 1—3 — *Gonyaulacysta* sp.



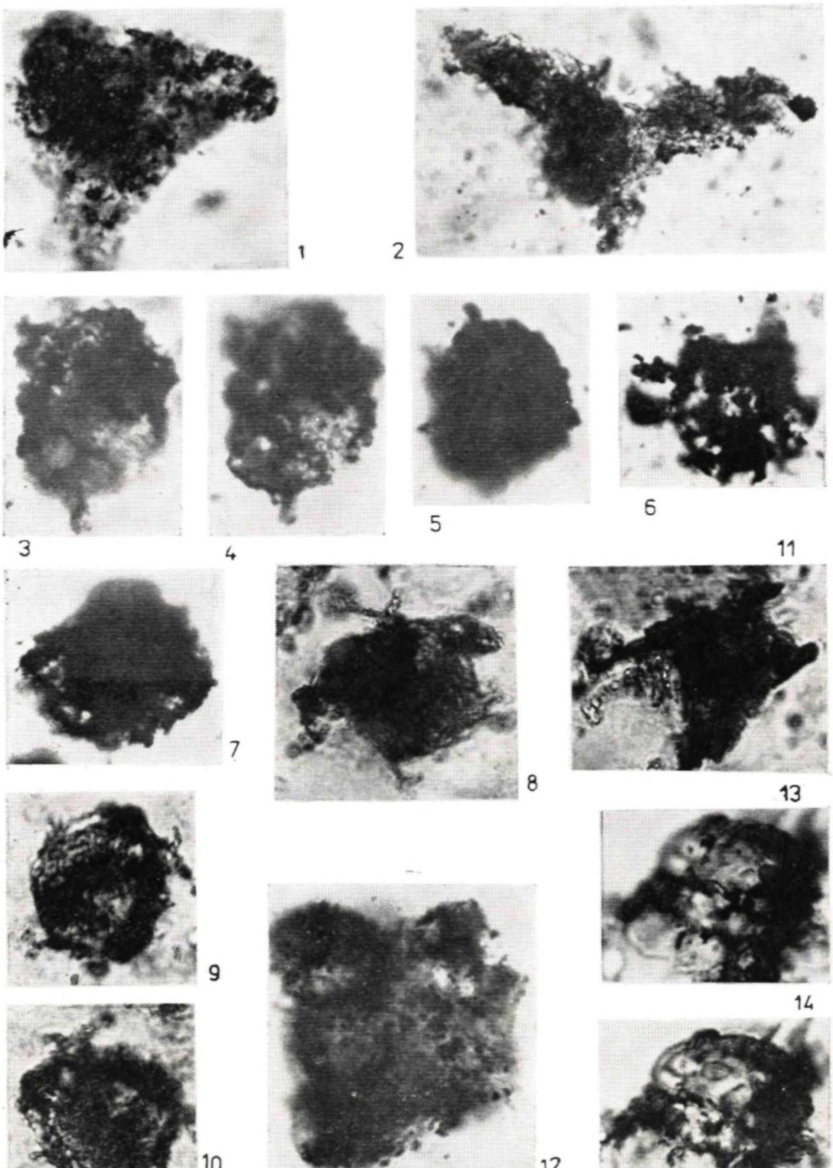
Pl. XXIV. Pezinok (Malé Karpaty)
fig. 1—2 — *Dictyotriletes paululus* Tchibr., 3 — *Verrucosisporites pseudospinosus* Streel., 4 — *Trachytriletes* cf. *nigratus* Naum., 5—6 — *Verrucosisporites pseudospinosus* Streel., 7 — *Punctatisporites incertus* Naum., 8—9 — *Acantotriletes incertus* Naum., 10—11 — *Stenozonotriletes extensus* Naum., 12 — *Emphanisporites* sp., 13—14 — *Emphanisporites minutus* Allen, 15—16 — *Acantotriletes parvispinosus* Naum var., *rotundus* Tchibr., 17 — *Dictyotriletes emsiensis* (Allen) Mc. Gregor



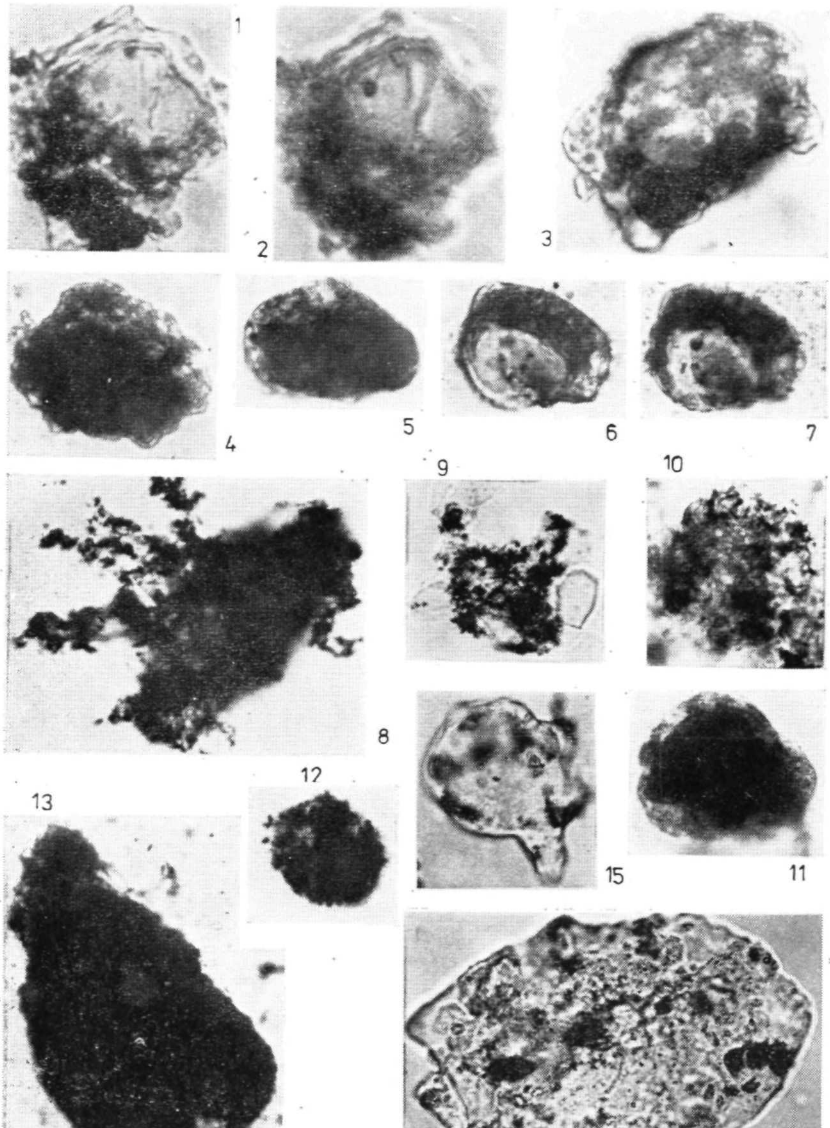
Pl. XXV. Pezinok (Malé Karpaty)
fig. 1—2 — *Dibolisporites echinaceus* (Eis.) Rich., 3 — *Multiplicisphaeridium raspa* (Eis.) Rich., 4 — *Multiplicisphaeridium ramunculosum* (Deunff.) Eis., 5 — *Multiplicisphaeridium* cf. *rabiosum* (Cramer) Cramer, 6 — *Evittia granulatispinosa* (Down.) List., 7—8 — *Moyeria uticansis* Thusu, 9 — *Chelinospora* sp., 10 — *Acantodiacrodium* sp. „2" Martin, 11—12 — *Lophosphaeridium* sp.



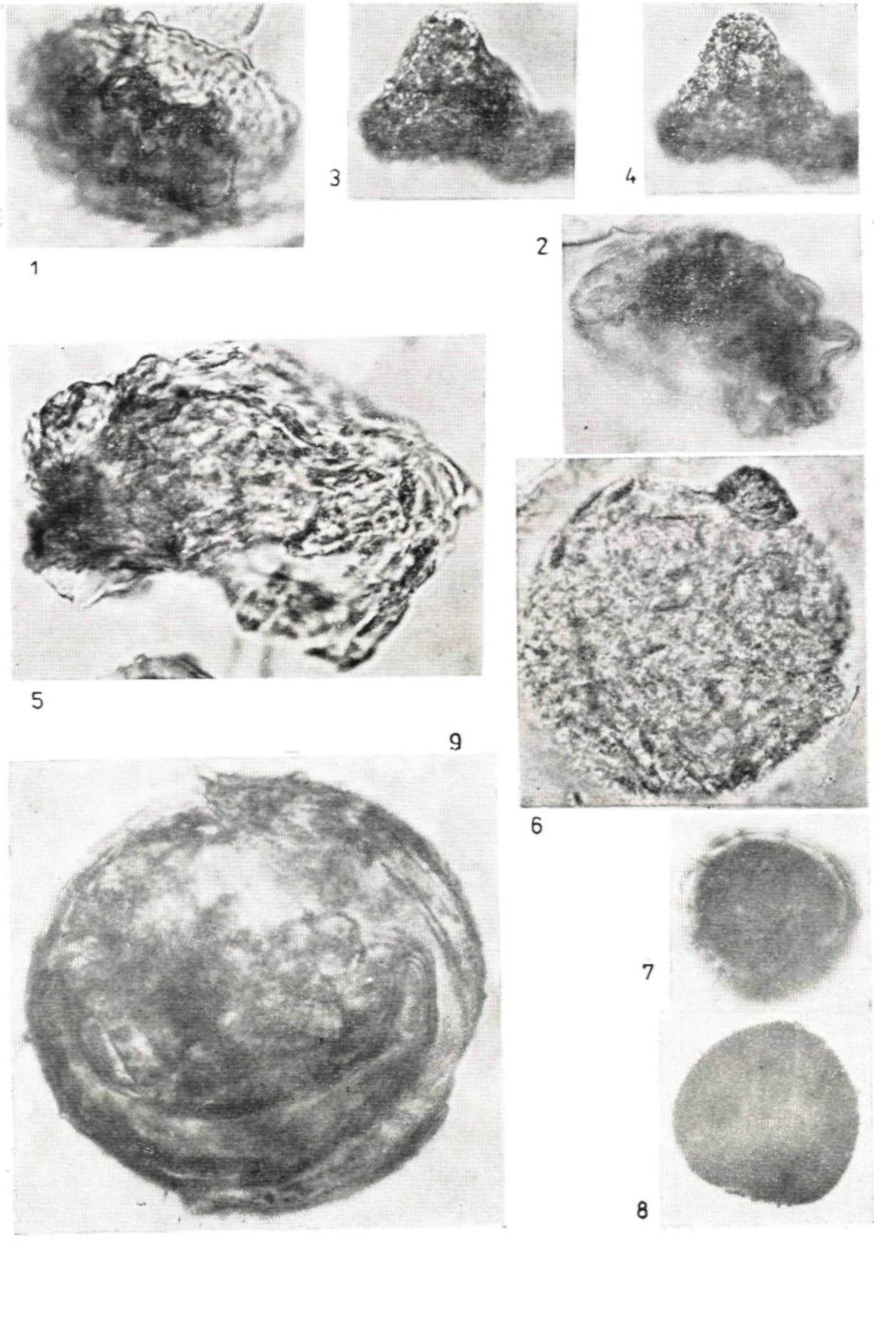
Pl. XXVI. Pezinok (Malé Karpaty)
fig. 1—2 — *Pterospermella* sp., 3—4 — *Pterospermella pernambucensis* (Britto) Eis., 5 — *Pterospermella* sp., 6 — *Riculasphaera fissa* Loebl. Drugg., 7 — *Baltisphaeridium tuberosum* (Sanneman) Eis., 8—9 — *Baltisphaeridium* cf. *tuberosum* (Sanneman) Eis.



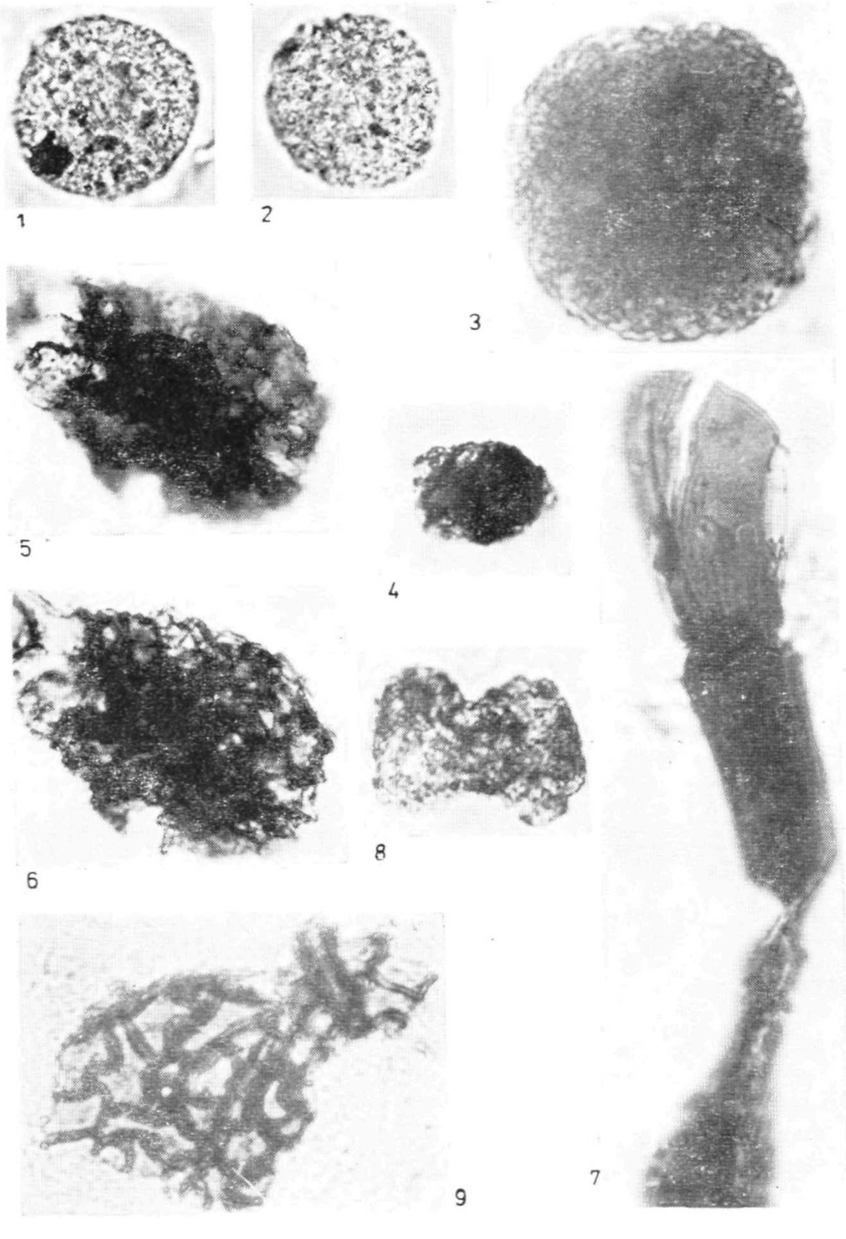
Pl. XXVII Pezinok (Malé Karpaty)
fig. 1 — *Onandogella* sp., 2 — *Onandogella deunffi* Cramer, 3—4 — *Ammonidium* cf. *loriferum* Moreau-Benoit, 5 — *Ammonidium* cf. *rigidum* Deunff. Lister, 6 — *Ammonidium sannemani* Deunff., 7 — *Ammonidium* cf. *alloiteaui* (Deunff.) Moreau-Benoit, 8—10 — *Ammonidium rigidum* (Deunff.) Moreau-Benoit, 11 — *Ammonidium loriferum* Deunff., 12 — *Pulvinosphaeridium deunffi* Moreau-Benoit, 13—14 — *Dictyopsophosphaera polygonia* (Stapl.) Tchibr.



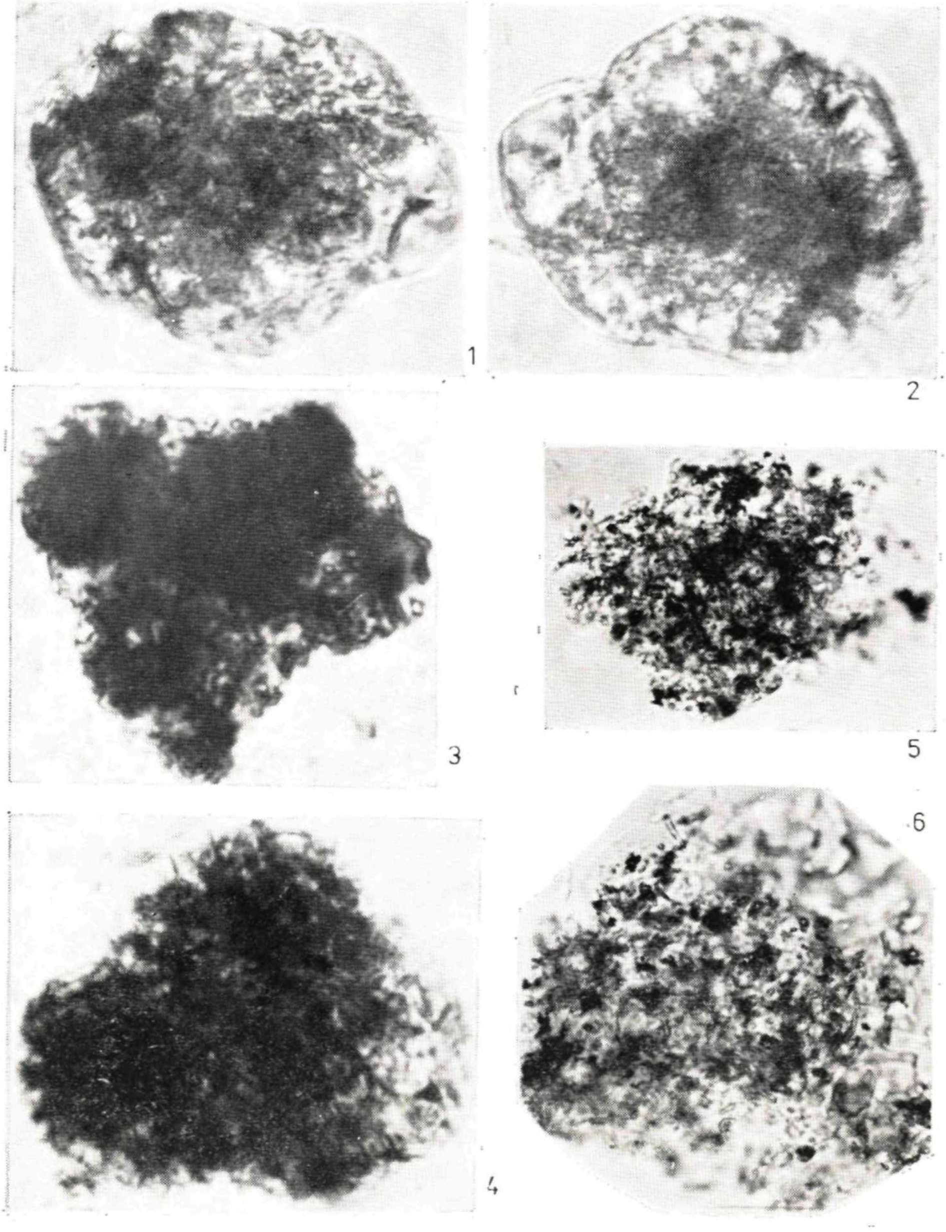
Pl. XXVIII. Pezinok (Malé Karpaty)
fig. 1—2 — *Duvernaysphaera tennuicingulata* Staplin, 3 — *Cryptostromatium andegavense* Moreau-Benoit, 4—5 — *Discina* sp., 6—7 — *Discina asperalla* Tchibr., 8 — *Diexallopsis remata* (Deunff.) Playf., 9 — *Quadratidium fantasticum* Cramer, 10—11 — *Cymatiosphaera nebulosa* Downie, 12 — *Mycrhystridium lapellum* Loebl. Wic., 13 — *Lagenochitina* sp., 14 — *Acritarcha indet.*, 15 — *Acritarcha indet.*



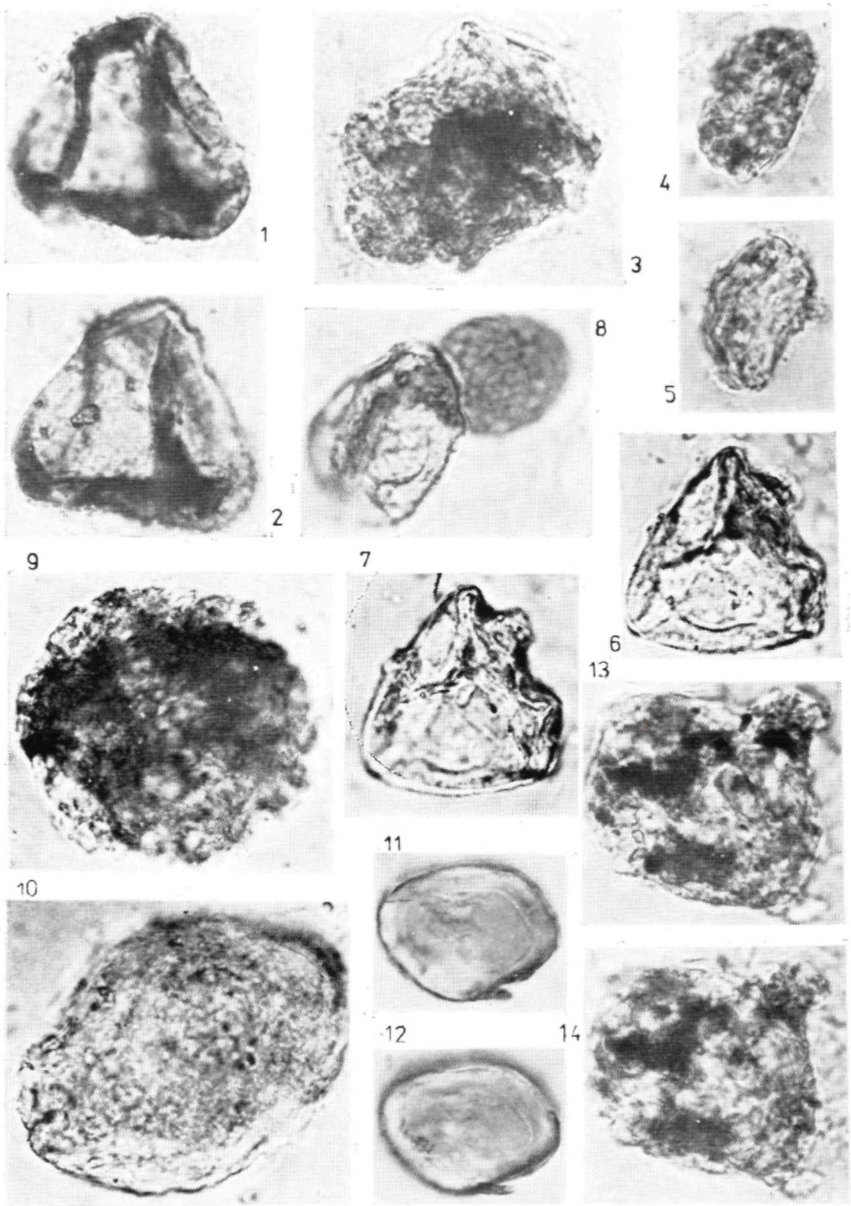
Pl. XXIX. East of Bad Schönau (HM s. 1)
fig. 1—2 — *Verrucosisporites ancoralis* Alp., 3—4 — *Diatomozonotriletes franclini* Mc. Gregor, 5 — *Vittatina* sp., 6 — *Acantotriletes* sp., 7—8 — *Duvernaysphaera* sp., *Lophosphaeridium* sp., 9 — *Zonosphaeridium* sp. (HM-9)



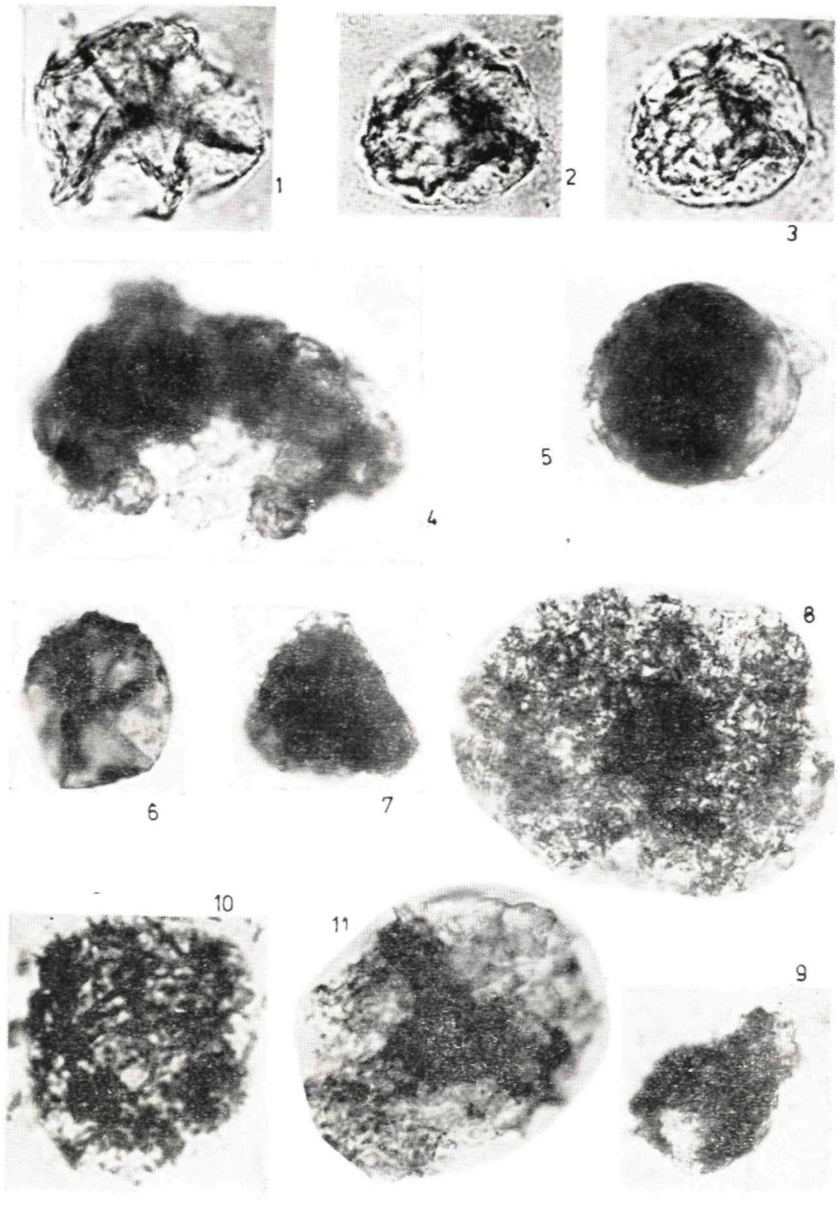
Pl. XXX. East of Bad Schönau (HM-1 s. 1 L)
fig. 1—2 — *Granulatisporites parvus* (Ibr.) Pot. Kr., 3 — *Brochopsophosphaera uralica* Tchibr. (redepos.), 4 — *Duvernaysphaera kreuzeli* Stock. Will. (redepos.), 5—6 — *Cymatiosphaera* sp. (redepos.), 7 — *Acritarcha* sp., 8 — *Cryptostromatium andegavense* Moreau-Benoit (redepos.), 9 — *Tracheides*



Pl. XXXI. East of Bad Schönau (HM-1 s. 3)
fig. 1—2 — *Cyclogranisporites retisimilis Rieg.* (redepos.), 3—4 — *Tetraletes variabilis* Cramer (redepos.), 5 — *Cymatiosphaera* sp. 1 (redepos.), 6 — *Cymatiosphaera* sp. 2 (redepos.)



Pl. XXXII. East of Bad Schönau (HM-1, 2)
fig. 1—2 — *Leiotriletes marginalis* Mc. Gregor (redepos.), 3 — *Hymenozonotriletes* sp. (redepos.), 4—5 — *Thymospora thiensenii* dep. (autochtonna), 6—7 — *Cymatiosphaera* sp. (redepos.), 8 — *Reticulatisporites* (autochtonnous), 9 — *Retusotriletes* sp. (redepos), 10 — *Acritarcha indet.* (redepos.), 11—12 — *Zonosphaeridium* sp., 13—14 — *Raistrickia* cf. *clavata* Hacquebard (redepos.)



Pl. XXXIII. East of Bad Schönau (HM-1, 2) Redeposited palynomorphs.
fig. 1 — *Staplinium cuboides* Deunf., 2—3 — *Cymatiosphaera doioriochoria* Wic., 4 — *Synsphaeridium tuberculatum* Eis., 5 — *Cymatiosphaera* sp. „A“ Rich., 6 — *Aneurospora goensis* Streel, 7 —*Duvernaysphaera kreuseli* Stock. Will., 8 — *Pterospermella* cf. *occidua* Deunff., 9 — *Chitinozoa* sp. magn. 250×, 10 — *Moiria uticansis* Thusu, 11 — *Cymatiosphaera pauciplanum* Cramer