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PALYNOMORPHS FROM LUNZ BEDS AND FROM BLACK CLAYEY SHALES IN BASEMENT OF VIENNA BASIN (BOREHOLE LNV — 7)

(2 Tab., 1 Graph, 16 Pl.)

Abstract: The paper contains results of biostratigraphical examination of sedimentary rocks from the basement of the Vienna Basin. The rocks were lithologically referred to as the Lunz beds. Examined were mostly palynomorphs from samples from the bore hole LNV—7. Typical Karnic flora was revealed at a depth of 4348 to 2908 m, and younger microflora ranged to the Rhaetic-Lias.

Резюме: Работа сосредоточена на биостатиграфическую оценку отложений осадков из подошвы венского бассейна, которые были считаны лунзскими горизонтами. С этой целью был применен метод планиморфной оценки образов, главным образом из скважины LNV — 7. Была определена типичная карнская флора в глубине с 4348 до 2908 м и залегающая младшая микрофлора, которая была после тщательного изучения, зачислена в рэт-лейас.

Introduction

I have studied dark-grey schistose beds from several bore holes (LNV—6, LNV—7, Malacky 20, LNV—2, Šaštín 12) in the basement of the Vienna Basin to determine their age on the ground of palynomorphs. I got most reliable data from the bore hole LNV—7. There were two palynomorphs spectra of different age in sedimentary rocks of equal lithology. In other bore holes was only the lower part of the beds, ie. the Lunz beds. Since sedimentary rocks of different ages were only in the bore hole LNV—7, I chose microflora from there for detailed study. As for lithology, the rocks are dark marly shales referred to as the Lunz beds. They are overlaid by dark limestones and underlaid by dark limestones and dolomites. Examination of dark marly shales by maceration revealed well preserved palynomorphs without any signs of corrosion. 14 samples examined were from the bore hole LNV—7 (Tab. I, II) and 20 from the other bore holes mentioned.

I. *Palynological valuation*

Microflora may be divided into two complexes of different ages on the ground of palynomorph spectra: an older complex of the Lunz beds (4348—2908 m) and a younger overlying complex (2501—2301 m) of dark-grey shales lithologically equal to the Lunz beds. Since the samples from the complexes mentioned contained microflora of equal composition and quantity, the samples will be valuated as a complex and not separately.

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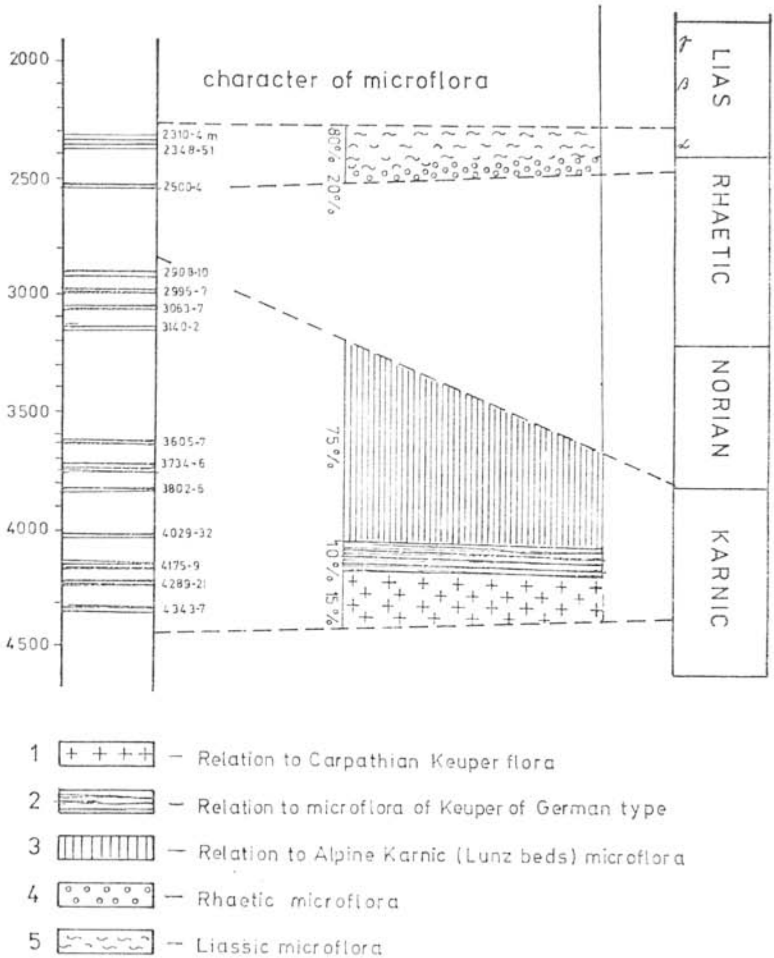
A. *Palynological valuation of the Lunz beds (Graph 1)*

In the complex of sediments studied were 68 species of well preserved plentiful spores and pollen. In the pollen pattern saccate pollen dominated over *Spermophyta* spores. Species of the genus *Ovalipollis,* particularly the species *Ovalipollis lunzensis* KLAUS and *Ovalipollis ovalis* (KRUTZSCH)



KLAUS were quantitatively prevalent. They are typical elements in microflora of the Alpine Karnic Lunz beds. W. Klaus (1960) quoted both species from the Julian substage of the Karnic stage; M. Pautsch (1971) — from the Polish Lower Keuper (locality Trzeciana). *Ovalipollis ovalis* (KRUTZSCH) KLAUS, occurs in 1-2% in our sediments. W. Scheuring (1970) recorded

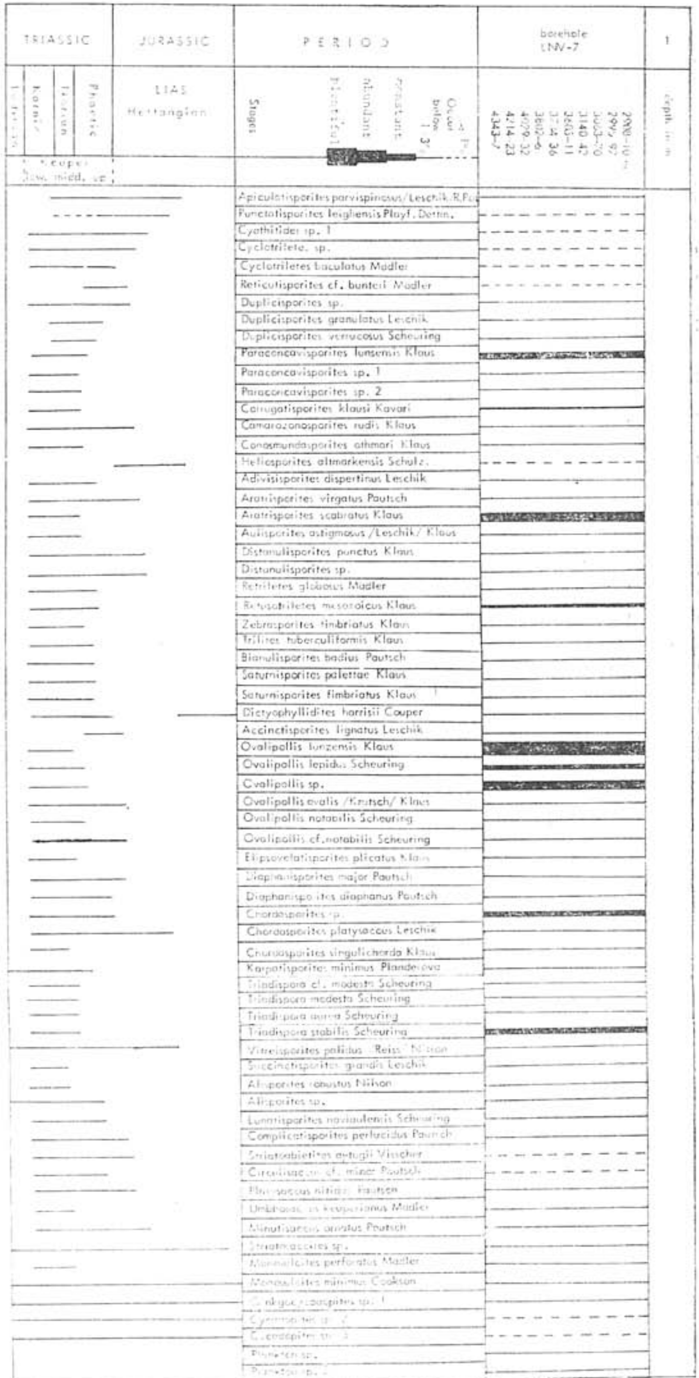
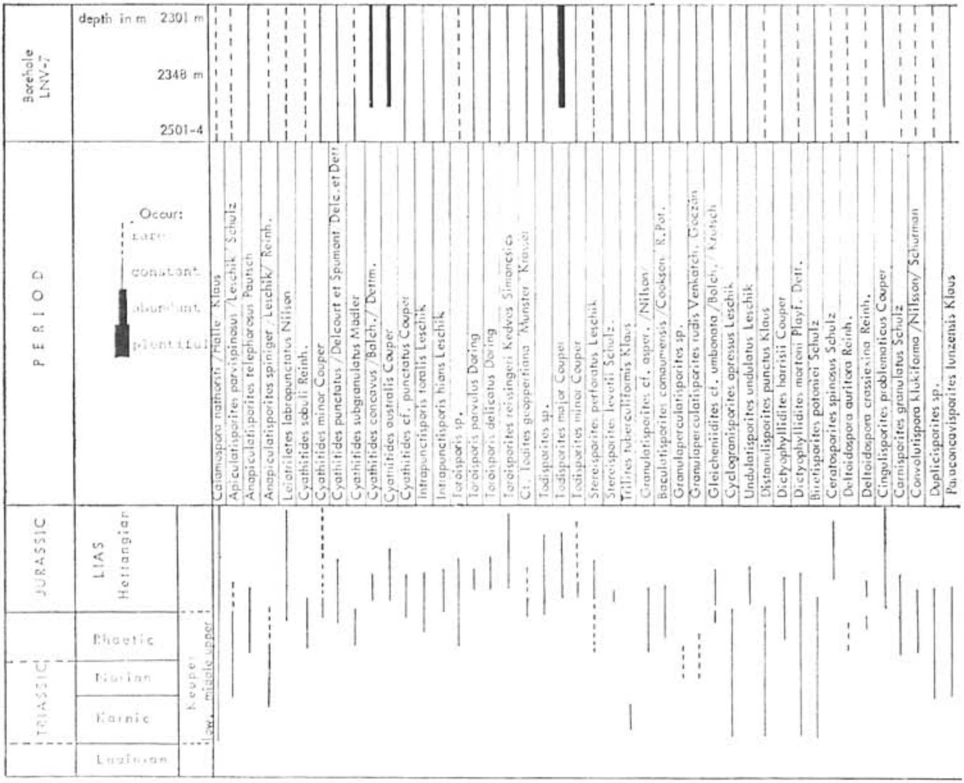

TRIASSIC
JURASSIC
PERIOD
borehole LNV-7
1
Karnic
Norian
Rhaetic
LIAS Hettangian
Keuper
low. midd. up.
Stages
abundant
constant
Occur below 1 %
depth in m
2990-10
3003-70
3140 42
3605-11
3734 36
3802-6
4029 32
4214 23
4343-7
Apiculatisporites parvispinosus/Leschik/R.Po
Punctatisporites leighensis Playf. Dettm.
Cyathitides sp. 1
Cyclotrilete. sp.
Cyclotriletes baculatus Madler
Reticutisporites cf. bunteri Madler
Duplicisporites sp.
Duplicisporites granulatus Leschik
Duplicisporites verrucosus Scheuring
Paraconcavisporites lunsensis Klaus
Paraconcavisporites sp. 1
Paraconcavisporites sp. 2
Corrugatisporites klausi Kovari
Camarozonosporites rudis Klaus
Conosmundasporites othmari Klaus
Heliosporites altmarkensis Schulz.
Adivisisporites dispertinus Leschik
Aratrisporites virgatus Pautsch
Aratrisporites scabratus Klaus
Aulisporites astigmosus /Leschik/ Klaus
Distanulisporites punctus Klaus
Distanulisporites sp.
Retriletes globosus Madler
Retusotriletes mesozoicus Klaus
Zebrasporites fimbriatus Klaus
Triletes tuberculiformis Klaus
Bianulisporites badius Pautsch
Saturnisporites palettae Klaus
Saturnisporites fimbriatus Klaus
Dictyophyllidites harrisii Couper
Accinctisporites lignatus Leschik
Ovalipollis lunzensis Klaus
Ovalipollis lepidus Scheuring
Ovalipollis sp.
Ovalipollis ovalis /Krutsch/ Klaus
Ovalipollis notabilis Scheuring
Ovalipollis cf. notabilis Scheuring
Ellipsovelatisporites plicatus Klaus
Diaphanisporites major Pautsch
Diaphanisporites diaphanus Pautsch
Chordasporites sp.
Chordasporites platysaccus Leschik
Chordasporites singulichorda Klaus
Karpatisporites minimus Planderova
Triadispora cf. modesta Scheuring
Triadispora modesta Scheuring
Triadispora aurea Scheuring
Triadispora stabilis Scheuring
Vitreisporites pallidus /Reiss/ Nilsson
Succinctisporites grandis Leschik
Alisporites robustus Nilsson
Alisporites sp.
Lunatisporites noviaulensis Scheuring
Complicatisporites perlucidus Pautsch
Striatoabietites aytugii Visscher
Minutisaccus crenatus Pautsch
Monosulcites minimus Cookson

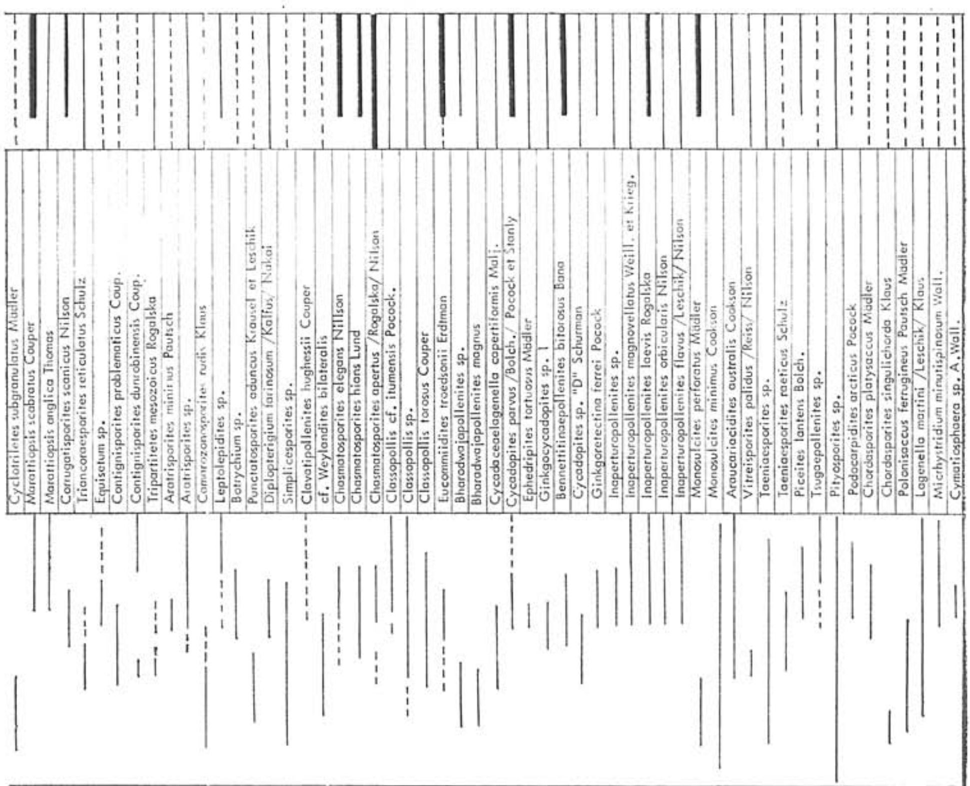
Plate I

Table 2



it mostly in the Rhaetic and the Lias, and *Ovalipollis notabilis* SCHEURING and *Ovalipollis lepidus* SCHEURING — in the gypsum Keuper.

Some species of the genus *Triadispora,* e.g. *Triadispora stabilis* SCHEURING from the gypsum Keuper, with its stratigraphical range of the Karnic to the Lower Norian, are as plentiful as O. lunzensis. Because of their broad stratigraphical range the data on the age of species from the gypsum Keuper are not reliably informative about the actual time of occurrence of the species also found in our samples. Less frequent are species *Lunatisporites noviaulensis* SCHEURING, *Triadispora modesta* SCHEURING, B. W. SCHEURING. (1970) recorded them in the gypsum Keuper, too. Another component of pollen and spores correlable with occurrences in the German Lower Keuper, namely *Aratrisporites virgatus* PAUTSCH quoted by M. Pautsch (1971) from both the Lower and the Upper Keuper. Its stratigraphical range is Lower Karnic — Upper Rhaetic. W. Klaus (1960) recorded *Aratrisporites scabratus* KLAUS in the Karnic of the Lunz beds, whereas M. Pautsch (1971) found it in the German Trias also in the Upper Keuper. Some species were only found in the Karnic. For instance, *Reticulatisporites cf. bunteri* MÄDLER



recorded by K. Mädler (1964) in the Lower Keuper, is Karnic. The period is also characterized by spores of the species *Paraconcavisporites* e.g. *Paraconcavisporites lunzensis* KLAUS found by W. Klaus (1960) in the Julian substage of the Alpine Karnic. M. Pautsch recorded *Paraconcavisporites* sp. in the Lower Keuper. In our country it was found in the Lunz beds near Hradište nad Vrátnom (M. Kochanová—A. Kullmanová—P. Snopková, 1976) and in the Lunz beds near Liptovskü Hrádok (E. Planderová, 1972). Since it was not found in other sediments, it may be included among species biostratigraphically significant for the Karnic. Such are dominantly *Corrugatisporites klausi* KAVARI (3—5 % in our samples), *Conosmundasporites othmari* KLAUS (1—3 %). W. Klaus recorded it in the Karnic Halobia beds.

The species *Retitriletes globosus* MÄDLER is typical of the Lower Keuper (K. Mädler, 1964), *Retusotriletes mesozoicus* KLAUS — of the Karnic Lunz beds. It is scarce in the Zlambach beds (Rhaetic) (W. Klaus 1960). In our country it was only found in the Lunz beds. *Zebrasporites fimbriatus* KLAUS is present to 1—3 % in our samples. W. Klaus (1960) found it in the Karnic

Halobia beds with narrow stratigraphical range like that of *Saturnisporites palettae* K l a u s from Halobia beds, *Saturinisporites fimbriatus* KLAUS from cardida beds; *Elipsovelatisporites plicatus* KLAUS from the Karnic Halobia beds. All the species (Table 1) are Karnic. They are most frequent in the Halobia and the Lunz beds. For this reason I compared the species from the samples taken from the depth 4348—2908 m with the species of European Trias, and refer the sediments under study to the Karnic (Julian) as for their age.

B. *Palynological valuation of dark-grey shales from depth of 2501—2301 m (Table 2)*

Dark-grey shales of an overlying complex of sediments from three drill cores 21 (2301—2303 m), 22 (2348—2351 m), 24 (2501—2504 m) were studied in microfloristic respect. The samples offered plentiful well preserved palynomorphs suitable for microfloristic and biostratigraphic valuation. I have ranged the palynomorphs examined to 100 species. In contrast to the subjacent complex of the Lunz beds with dominantly saccate pollen, the overjacent coplex exhibited prevalence of *Sporophyta* spores over saccate pollen. Samples from the depth 2301—2351 m contain abundant species of the genera *Maratiopsis, Chasmatosporites, Eucommiidites, Bharadwajapollenites, Bennettitinaepollenites, Inaperturapollenites, Araucariacidites, Classopollis, Todisporites.* All the genera are typical of the Lias, and/or Rhaetic-Lias.

The species *Maratiopsis scabratus* COUPER is quoted by J. L u n d (1977) from the Uppermost Rhaetic-Lias α 1—3, by M. R o g a l s k a (1976) — as more frequent from Pliensbachian — Toarcian. *Maratiopsis anglica* THOMAS was recorded in the Lias. In respect of biostratigraphy the genus *Chasmatosporites* is significant. We found its species *Chasmatosporites elegans* NILSON, *Chasmatosporites hians* LUND and *Chasmatosporites apertus* (ROGALSKA) NILSON in our samples. M. R o g a l s k a (1976) recorded the species in the Lias and Dogger. J. L u n d (1977) found *Chasmatosporites hians* LUND in the Lower Rhaetic. Evidently, the species so abundant in our samples (5—10 %) range stratigraphically from the Rhaetic to the Lias. They are, however, not quoted from sediments older than Rhaetic.

The sample from the depth 2501—4 m exhibits common features with the overjacent sediments except the occurrence of two biostratigraphically significant genera. Among *Sporophyta* were species *Calamospora nathorsti* (HALLE) KLAUS without stratigraphical significance *Apiculatisporites parvispinosus* (LESCHIK) SCHULZ present throughout the Upper Trias. J. L u n d (1977) recorded abundant *Anapiculatisporites telephorosus* PAUTSCH in the Lower Rhaetic to the Lias. The species *Leiotriletes labropunctatus* NILSON occured as late as the Lias. The genus *Cyathitides is* represented by many species. Most frequent are *Cyathitides concavus* (BOLCH) DETTM. and *Cyathitides australis* COUPER. Most species of *Cyathitides* found in our samples appear first in the Lias, with the exception of *Cyathitides subgranulatus* MÄDLER found as early as Lower Rhaetic (K. M ä d l e r, 1964). *Torisporis parvulus* DÖRING and *Torisporis delicatus* DÖRING appear as late as Lower Lias, as well as *Todisporites major* COUPER and *Todisporites minor* COUPER.

J. Bóna (1969) recorded all the species in Hungarian Lias. *Stereisportites levettii* SCHULZ shows a very limited range in the upper part of the Lower Lias, whereas *Stereisporites perforatus* SCHULZ is also in the lower part of the Lower Lias (E. Schulz, 1970). The species *Granuloperculatisporites rudis* VENK. et GÓCZAN is typical of the Rhaetic. It is scarce in the Lower Lias. It is present in 1—3 % in our samples. The species *Dictyophyllidites harrisii* COUPER and *Dictyophyllidites mortoni* PLAYF. DETTM. are most frequent in the Upper Trias; according to G. Playford and M. Dettman (1965) — in the Hettangian. J. Lund (1977) recorded *Deltoidospora auritora* REINH. and *Deltoidospora crassiexina* REINH. in the Lower Rhaetic — as α_3.

Pollen of species of the genus *Classopollis* appear since the Rhaetic time. They are significant for distinguishing the lower part of the Upper Trias of its upper part. A comparison with Rhaetic localities in the Klippen Belt shows that pollen of this genus are more frequent in Rhaetic localities than in the microfloristic association described from the bore hole LNV-7. And also the genus *Classopollis torosus* is generally referred to as more frequent in the Rhaetic than in the Lias.

Plentiful are also species from the group of monocolpate and monosulcate pollen, mainly *Cycadopites parvus* (BOLCH.), POCOCK, *Gingkocycadopites* sp., *Bennettitinaepollenites bitorosus* BÓNA, *Gingkoretectina* sp., „D" SCHURMAN, *Gingkoretectina ferrei* POCOCK. All the species ranged from the Lias to younger sediments. M. Rogalská (1976) quoted the species of the genus *Inaperturopollenites* from the Lower Lias. *Eucommiidites troedsoni* ERDTMAN is scarcer since the Rhaetic, and more frequent since the Lias (J. Lund, 1977). It is present by 5—10 % in our samples. Among *Gymnospermae* more abundant are only *Monosulcites perforatus* MÄDLER, *Cycadopites parvus* (BOLCH.) POCOCK *Inaperturapollenites laevis* ROGALSKA. They are all Jurassic species with possible scarce occurrence in the Upper Rhaetic. Bisaccate pollen of *Gymnospermae* are present in low percent. Only *Vitreisporites palidus* (REISS.) NILSON, *Taeniaesporites raeticus* SCHULZ, Piceites latens BOLCH., *Tsugaepollenites* sp., *Podocarpidites arcticus* POCOCK, *Chordasporites platysaccus* Mädler, *Chordasporites singularichorda* KLAUS, *Polonisaccus ferruginaeus* (PAUTSCH) MÄDLER ossurred to 1 %. Most *Gymnospermae* appear as late as the Rhaetic and Lias. W. Klaus (1960) recorded the species *Chordasporites singulichorda* KLAUS only in the Karnic.

The samples examined contained plentiful marine plankton, like *Lagenella martini* (LESCHIK) KLAUS with broad stratigraphical range, *Micrhystridium minutispinosus* WALL. in the Upper Rhaetic and Lias.

Microflora 2501—2301 m may be characterized as follows. The comparison of the range of species showed the Liassic, most likely Hettangian α 1—3 age of dark shales from the depth 2301—2338 m. In sediments from the depth 2501 m the typical Liassic sporomorph association is missing (Tab. 2), still there are species of the genera *Classopolis*, *Granulaperculatisporites rudis* VENK. GOCZÁN, *Dictyophillidites*, *Eucommiidites troedsonii* ERDTMAN; excluding the Karnic age of the sediments under study. They may be referred to end of the Rhaetic or to the Rhaetic/Lias boundary.

The distribution of the species in the material studied facilitated distinguishing two different microfloristic associations of spores and pollen in the bore hole LNV-7. They are:

1. An association of typical Karnic flora from the lower part of the bore hole (4347—2908 m). It is mixed flora of the Alpine Lunz beds recorded by W. Klaus 1960, and of the Carpathian Keuper according to M. Pautsch (1971), and partly also microflora of the German Keuper according to K. Mädler (1964). It is not surprising because coeval floras in the Trias show still many common features. The Karnic flora in our material is more variable in species than microflora in the lower part of the Carpathian Keuper and of the Lunz beds. For more accurate age determination of the beds studied our flora could be best (correlated with that, of the Halobia beds) of the Lunz beds. The spore-pollen diagram shows prevalence of *Gymnospermathae* over *Sporophyta*. In the Lunz beds near Liptovský Hrádok (E. Planderová, 1972) the *Sporophyta* spores prevail over *Gymnospermae* pollen both in quatity. The same associations as in the Lunz beds near Liptovský Hrádok were found by P. Snopková (in M. Kochanová—A. Kullmanová—P. Snopková, 1976) in the Lunz beds near Hradište pod Vrátnom. A comparison of data on the Lunz beds in the bore hole LNV-7 shows differences in palynomorph associations between the former and the Lunz beds in Hradište and in Liptovskü Hrádok. The Lunz beds from the bore hole LNV-3 studied by P. Snopková (in A. Kullmanová — M. Kochanová — P. Snopková — O. Samuel, 1969) have the same microfloristic composition as in the bore hole LNV-7. It is very likely that differences between spore--pollen associations in the Lunz beds are due to different geomoprohological conditions. In fact, the quantitative and qualitative predominances of *Spermophyta* are indicative of swampy conditions with hydrophilous lowland vegetation mostly represented by *Pteridophyta* and other *Spermophyta*. Prevalence of *Gymnospermae* is indicative of elevated relief on dry land or of mountains with gymnospermous woody plants whose pollen got in sea or lagoon in increased amounts. On the ground of age diapason of some species of Alpine Lunz beds they may be ranged to the Julian substage of the Karnic. The valuation of palynomorphs and the comparison with their occurrences in the Alpine and German Trias and in the Carpathian Keuper shows that domiant is microflora related to the Alpine Karnic (up to 75 %), less frequent are species related to the flora of the Carpathian Keuper (15 %) and least frequent are species related to the German Keuper.

2. Rhaetic — Liassic (2501—4 m) and Liassic (Hettangian 2301—2348 m) microflora. Palynomorph spectrum of these sediments has a different character and is younger that Karnic (Table 2).

Microflora in sediments from the depth 2501—2504 m shows still Rhaetic--Liassic character, with plentiful *Spermophyta* spores of the genus *Anapiculatosporites spiniger* (LESCHIK) REINH., *Anapisulatisporites telephorosus* PAUTSCH *Cyathitides subranulatus* MÄDLER *Cyclogranisporites apressus* LESCHIK, *Distanulisporites punctus* KLAUS, *Paraconcavisporites lunzensis* KLAUS, *Triancoraesporites reticulatus* SCHULZ, *Intrapunctisporites toralis* LESCHIK, *Intrapunctisporites hians* LESCHIK. They do not pass into the Lias anymore. Since the samples contain many species ceasing to occur in the Rhaetic, and characteristic Liassic species are either less frequent or absent, I range the sediment to the Rhaetic or to the Rhaetic/Lias boundary. Rhaetic microflora known in Slovakia from the Tomanová group in the Vysoké Tatry mountains

(J. Michalík — E. Planderová — M. Sýkora, 1976) comprises much higher percentage of species of the genus Classopolis than the samples from the bore hole LNV-7. It is perhaps Late Rhaetic or the intermediatry Rhaetic--Liassic period.

Liassic microflora (2301—2348 m, Table 2) contains plentiful palynomorphs mostly in the Lias (the Hettangian). They are representatives of the genera *Cyathitides, Todites, Maratiopsis, Chasmatosporites,* a.o. (Table 2). Palynomorphs characteristic of the Karnic and/or Lower Keuper — if present in the Liassic sediments under study — must be residimented. Their occurrences are negligible if compared with autochthonous microflora.

Geologists may reject ranging the black shales to the Lias, because they are lithologically equal with the Lunz beds and rest immediately above them.

II. *Paleocological characteristic of depositional environment.*

The examination of palynomorph spectrum resulted in distinguishing different paleoecological conditions for sedimentation cycles.

1. In the Karnic of the Lunz beds the *Gymnospermae* pollen are more frequent than *Spermophyta* spores in the pollen spectrum. The Karnic relief must have been related with the depositional environment. There are, however, less species of Spermophyta, so there should have been less plain between the elevated relief and the sea. Climate might had been less humid, warm, perhaps subtropical.

2. Paleoecological conditions were different in the Rhaetic-Liassic time. *Spermophyta* spores markedly prevailed in species over *Gymnospermae* pollen. The spore-pollen spectrum is indicative of plentiful hydrophilous *Pteridophyta* vegetation characteristic solely of plain areas with humid and swampy soils. Well preserved spores and pollen attest to the nearness of dry land and probably also to lagoonal depositional environment. Abundant marine plankton indicate marine environment. Elevated relief with *Gymnospermae* woody plants could have been farther from the depositional environment.

Gymnospermae pollen in the spectrum were those of the genera *Pinus, Ginkgo, Cycas* a.o.

Correlation of our pollen diagram with European palynomorph diagrams shows relationship with other Rhaetic-Liassic flora. Our microflora is very resemblant to Hungarian Liassic flora (B. Bóna, 1962), to Central German Rhaetic — Liassic flora (E. Schulz, 1967) and still more to Polish Liassic flora (M. Rogalska, 1976). There also are species related to Rhaetic — Liassic flora in southwestern Denmark (J. Lund, 1977). Comparison of the pollen diagram with the Liassic flora in our regions studied showed striking resemblance between the diagram and the Liassic flora of the Kysuca group in the Klippen Belt (J. Haško — E. Planderová, 1977). A somewhat poorer spectrum of samples from Zázrivá compared with that of samples from the bore hole LNV-7 shows the spore-pollen association and the same marine plankton, only the palynomorph association from the basement of the Vienna Basin is richer and better preserved.

Conclusions

Palynological examination of samples from the bore hole INV-7 showed that:

1. Karnic microflora of the Lunz beds (4347 m —2908 m) is best correlabie with microflora of the Alpine Halobia and Lunz beds (approx. Julian), and well correlable with microflora of the Lunz beds from the bore holes LNV-3, Malacky 20, LNV-6, LNV-2.

2. Rhaetic-Liassic (8501—2301 m) microflora is well correlable with Liassic microflora from the Zázrivá beds of the Klippen Belt.

3. Regarding paleoecology, it is presumed that Karnic clima was more arid, subtropic, as evidenced by the fact that most palynomorphs in the pollen spectrum consist of *Gymnospermae* pollen from elevated relief. Rhaetic-Liassic climate must have been favourable for hydrophilous *Pteridophyta* vegetation. The depositional environment was most likely marine — lagoonal.

Translated by E. Jasingerová

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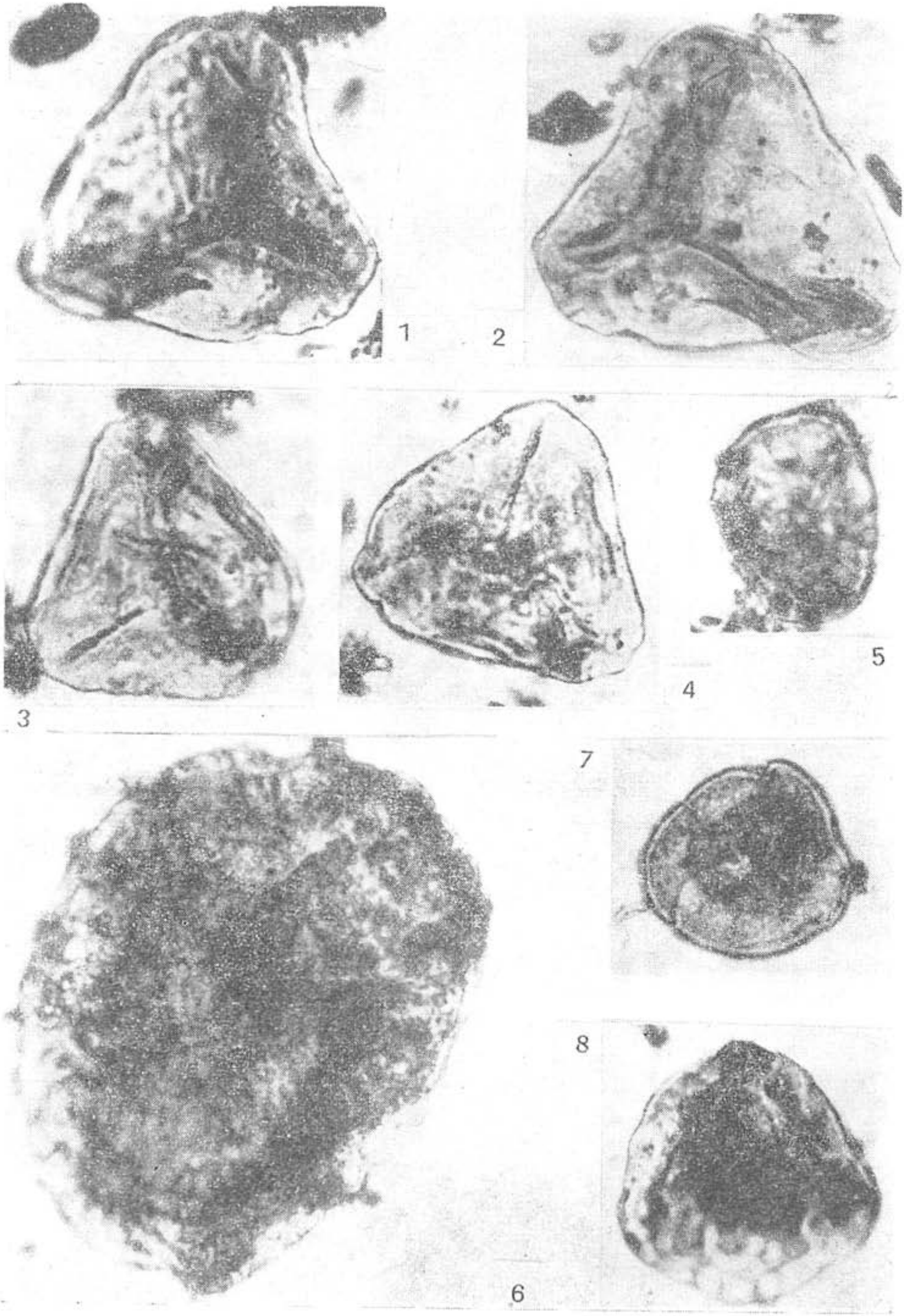
Plate 1



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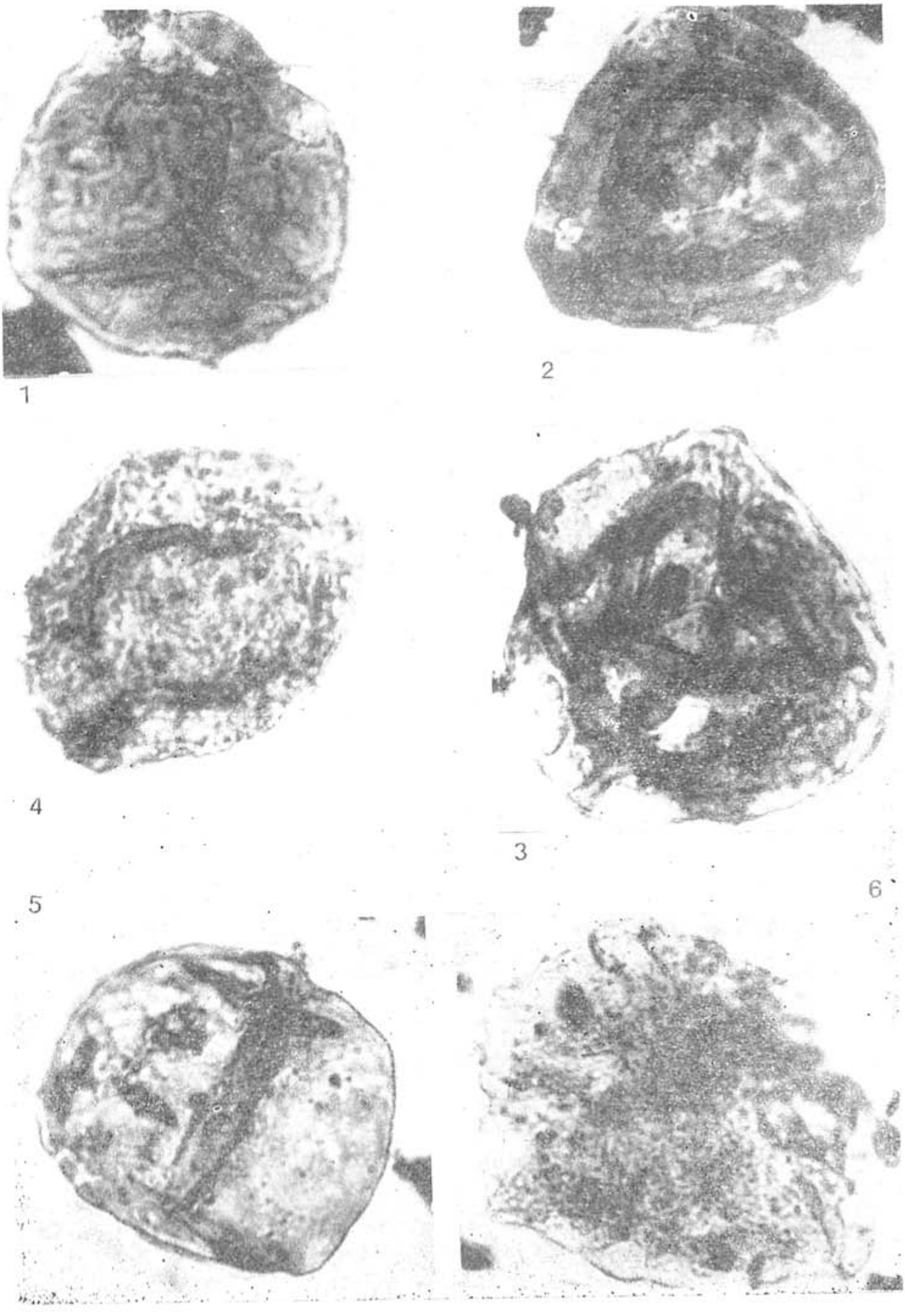

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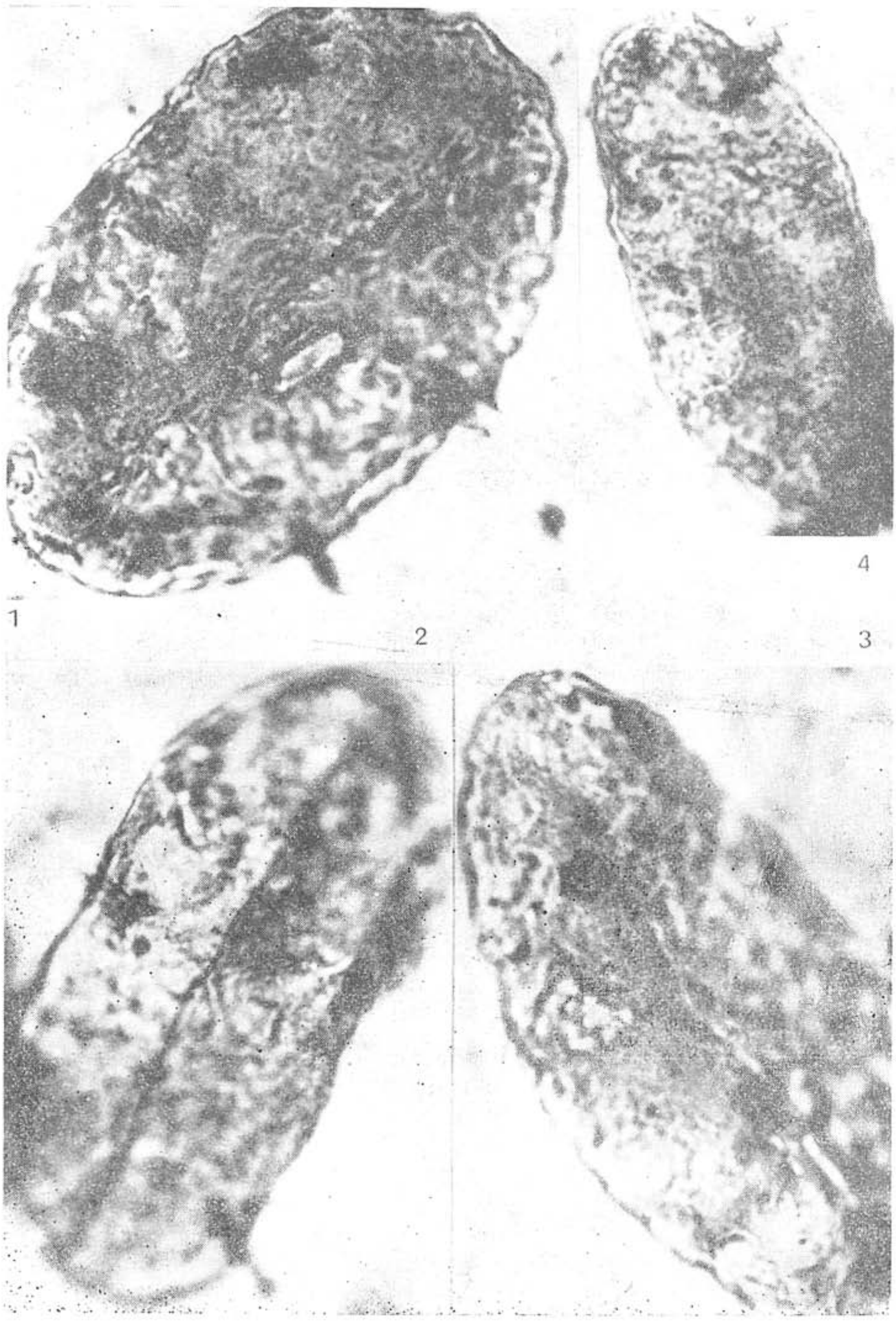

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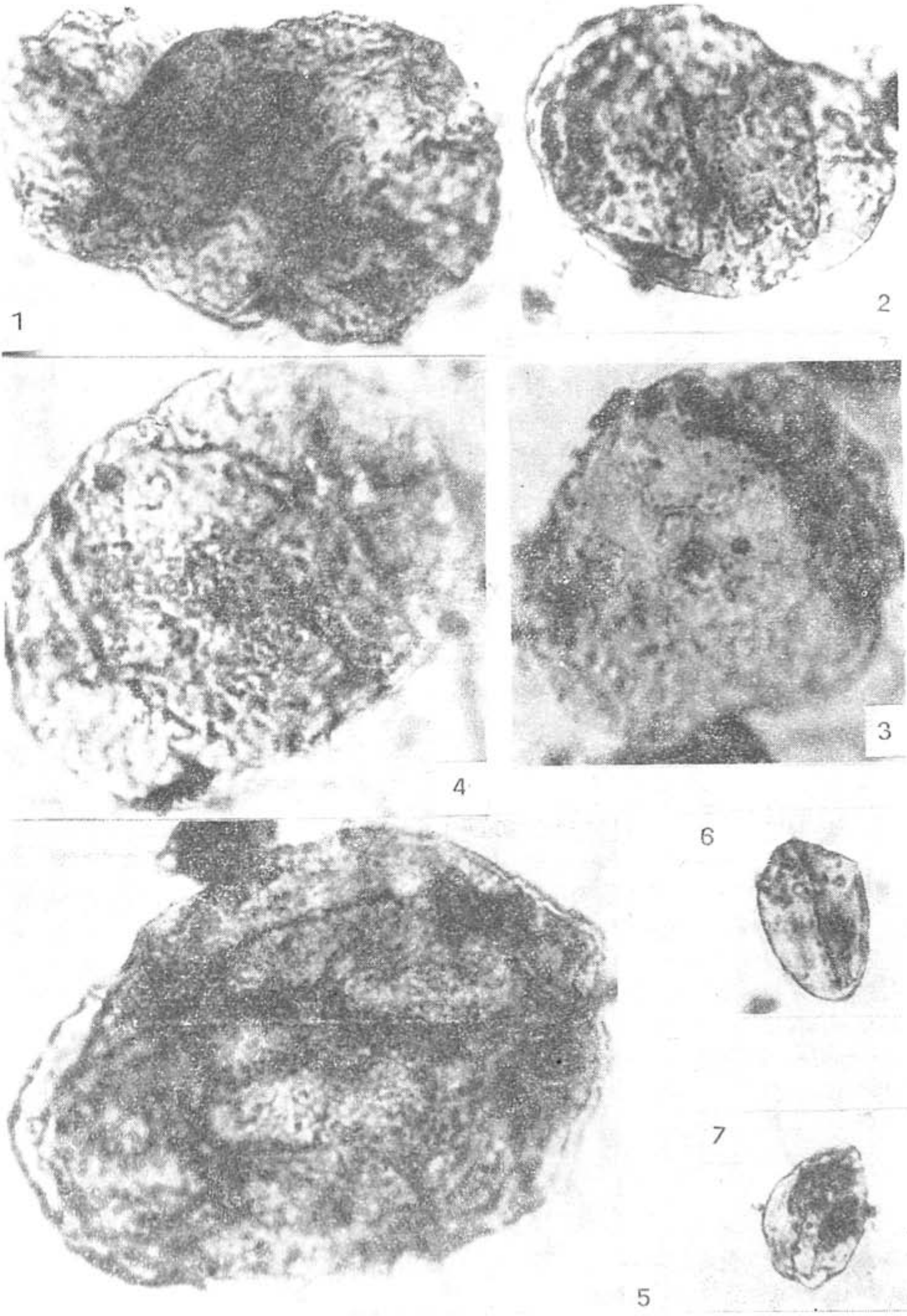

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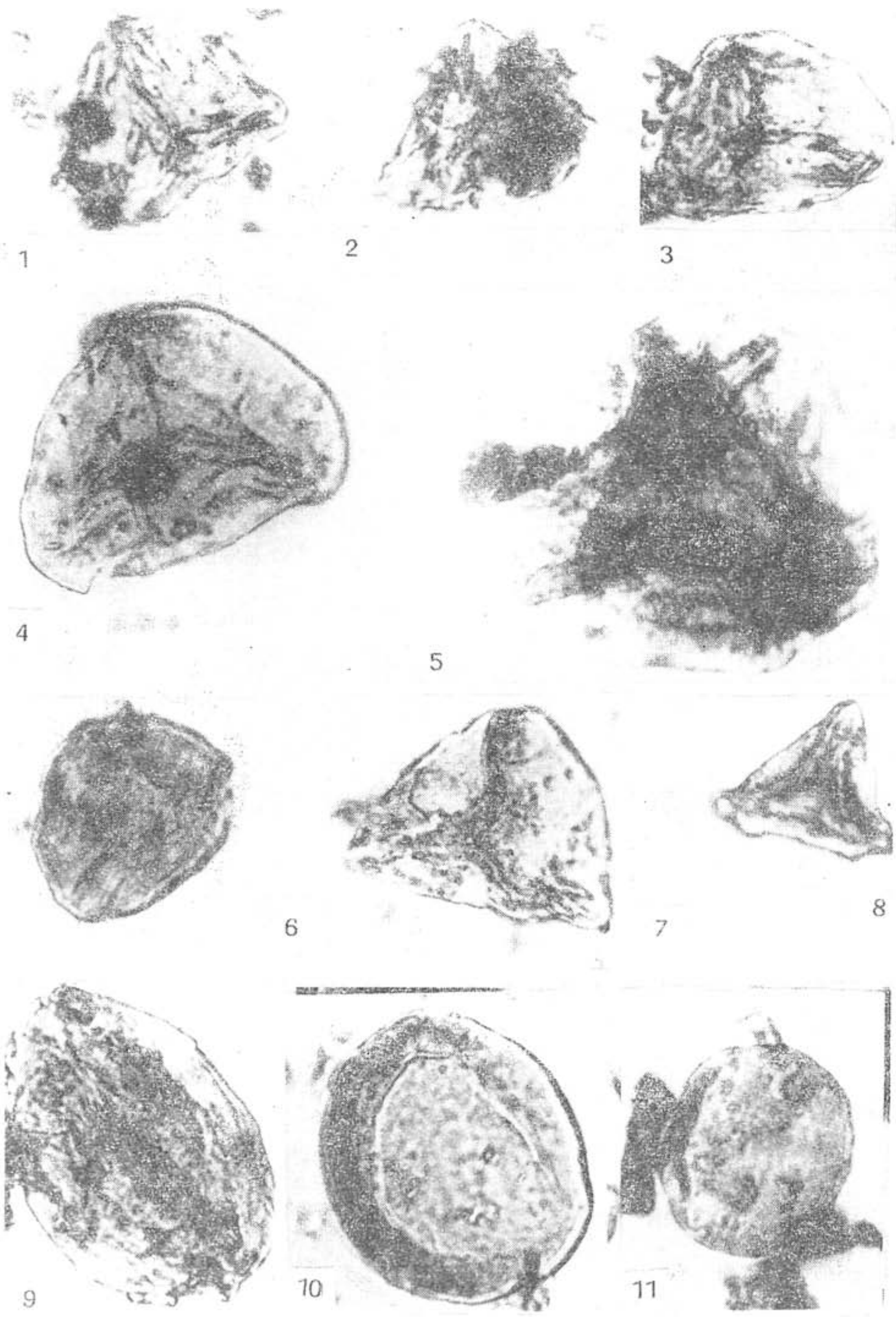

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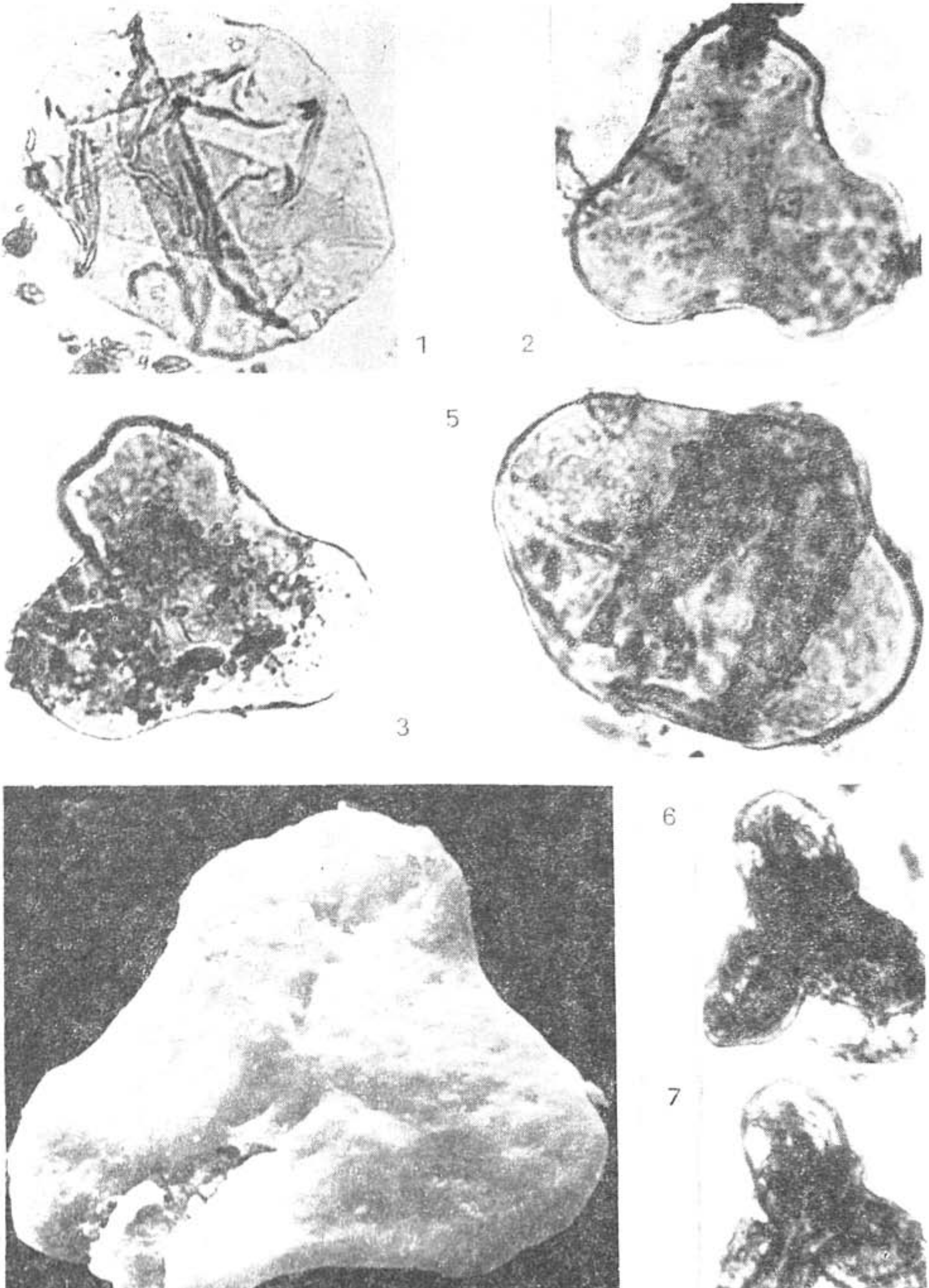

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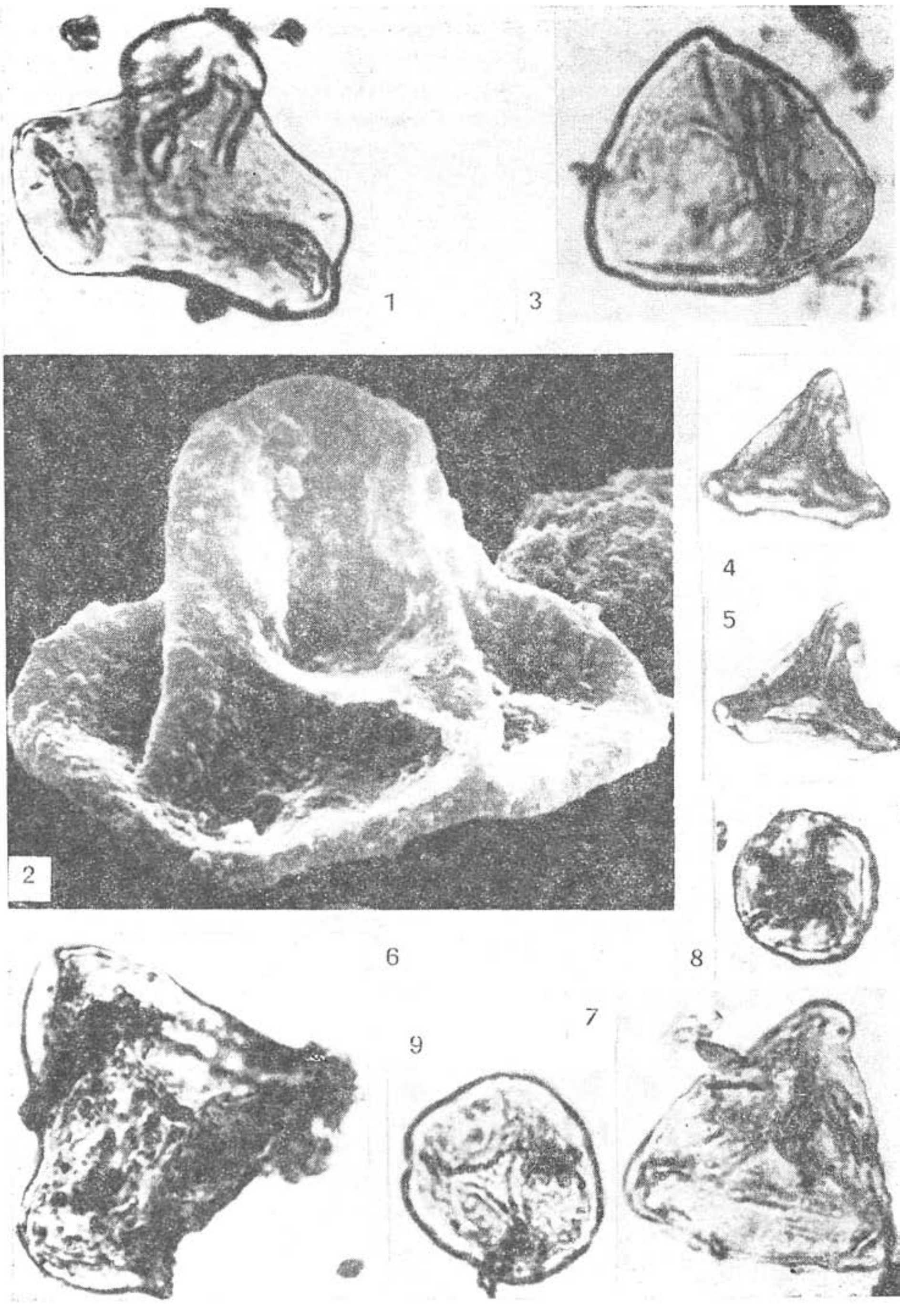

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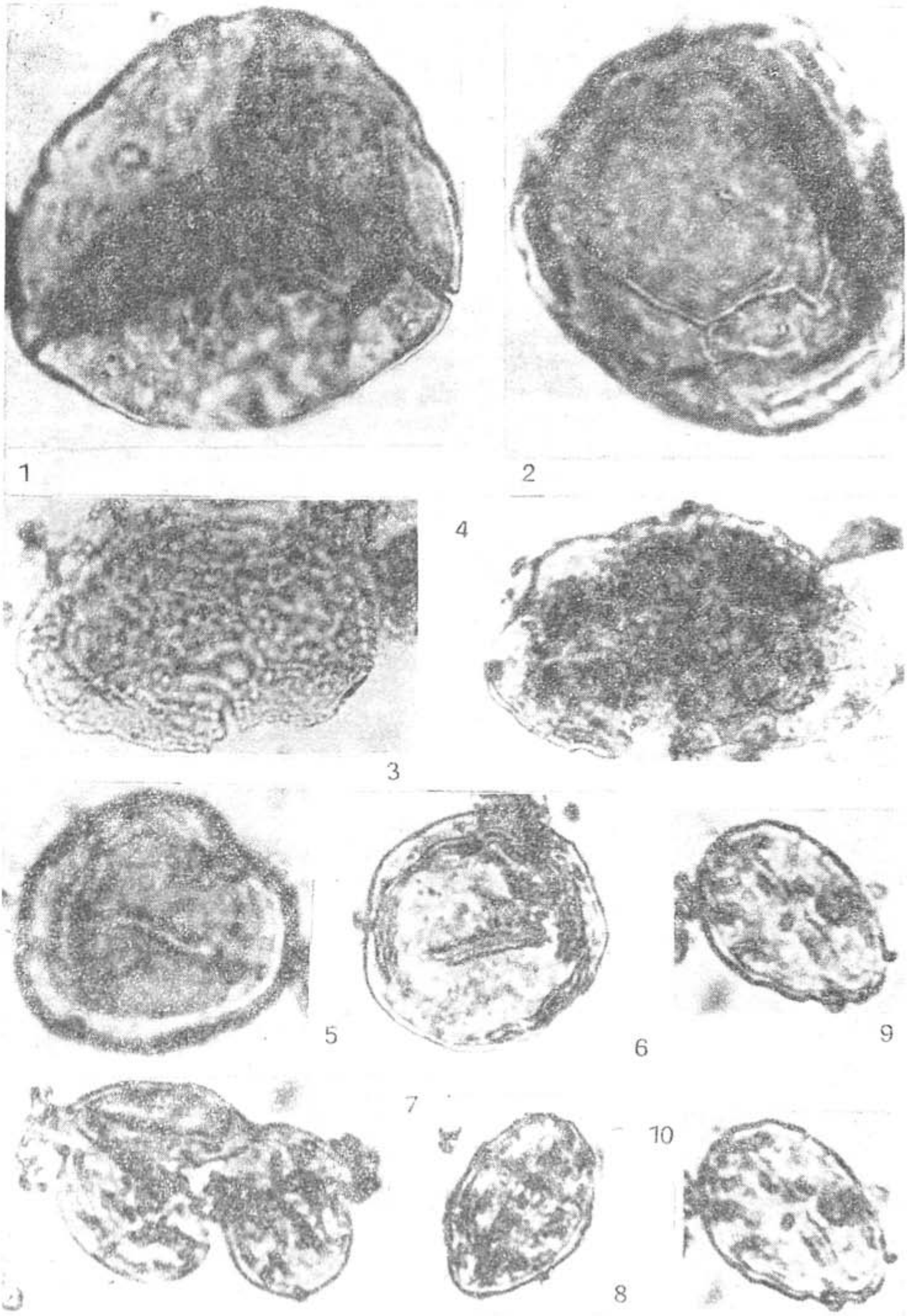

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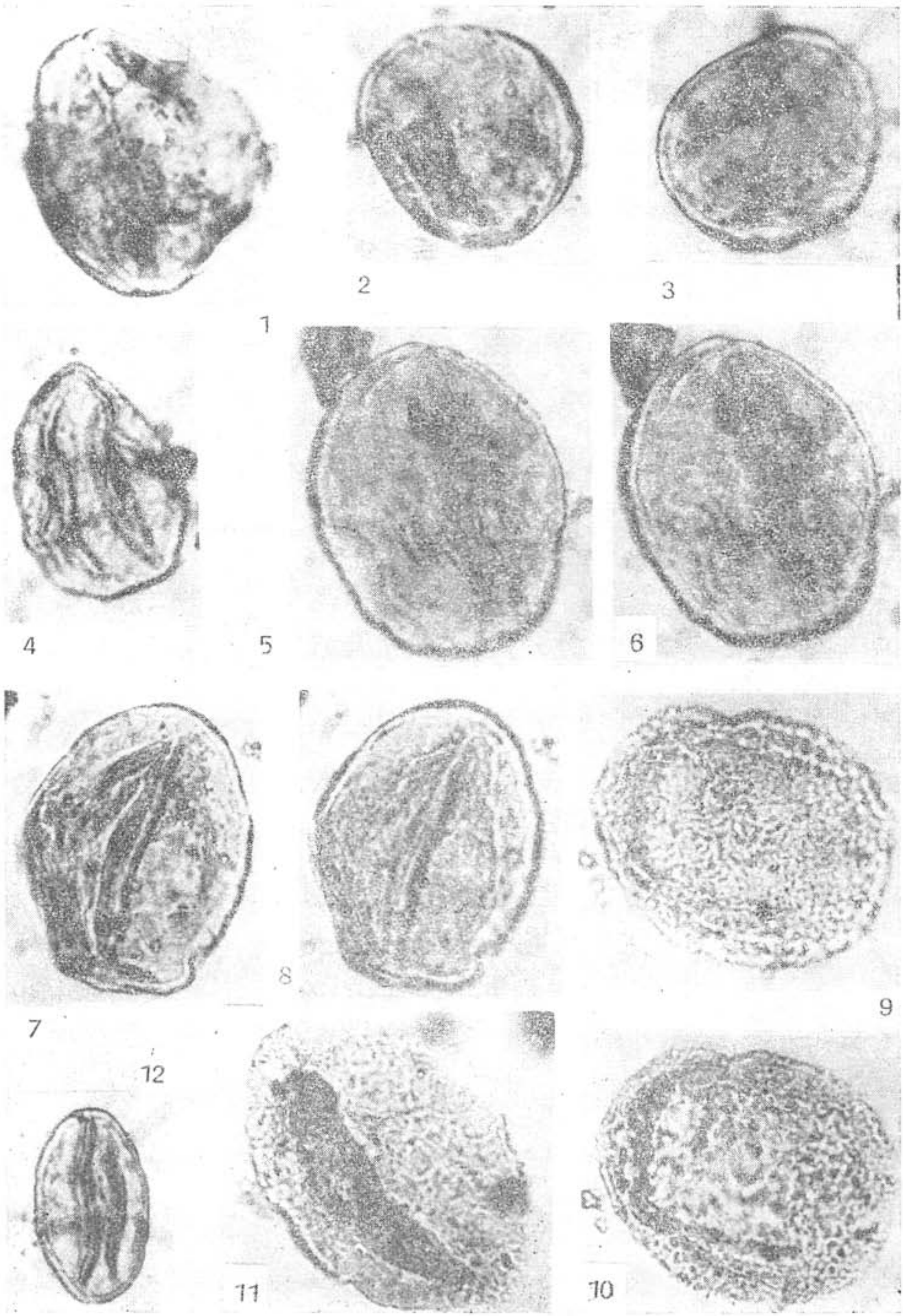

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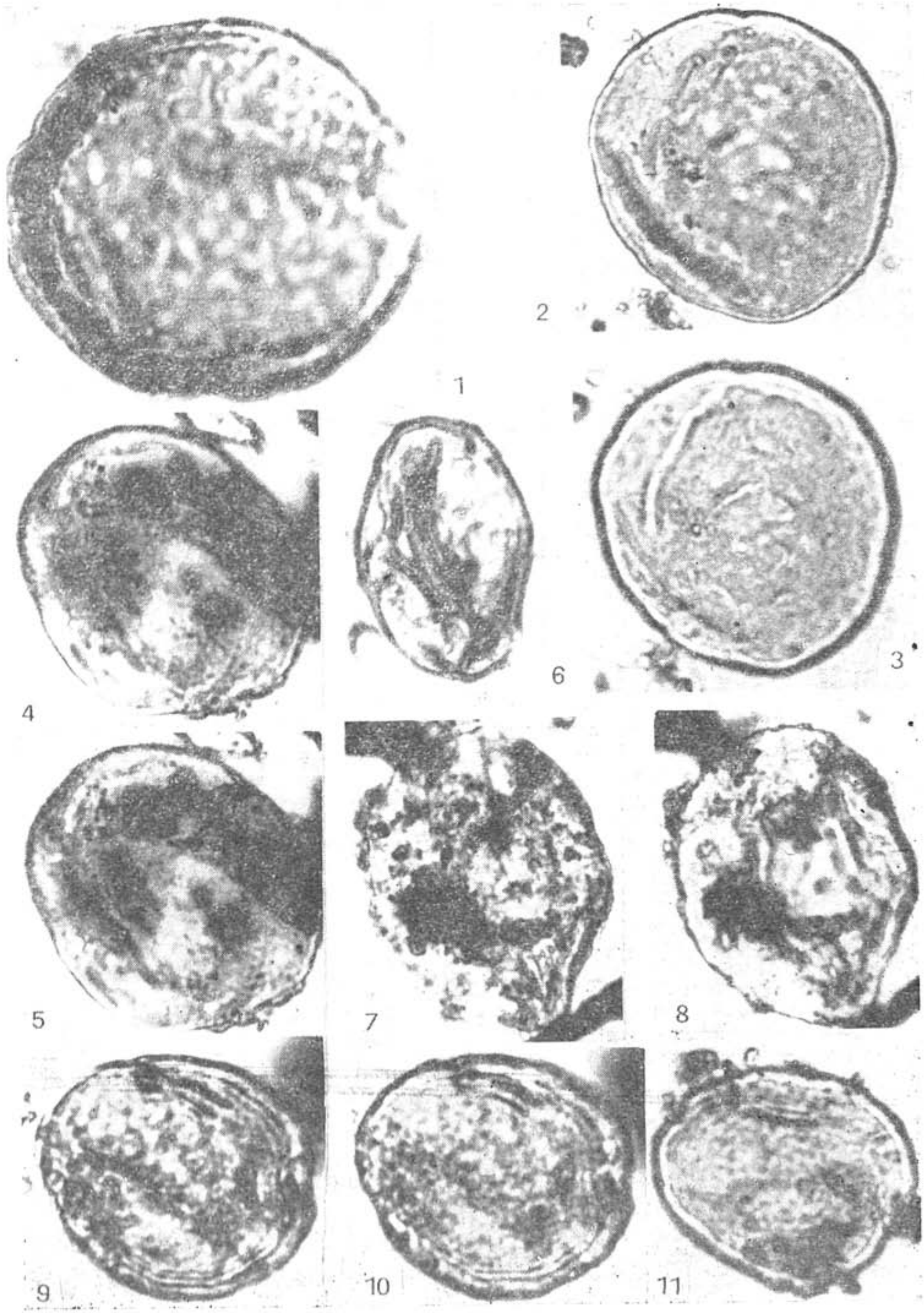

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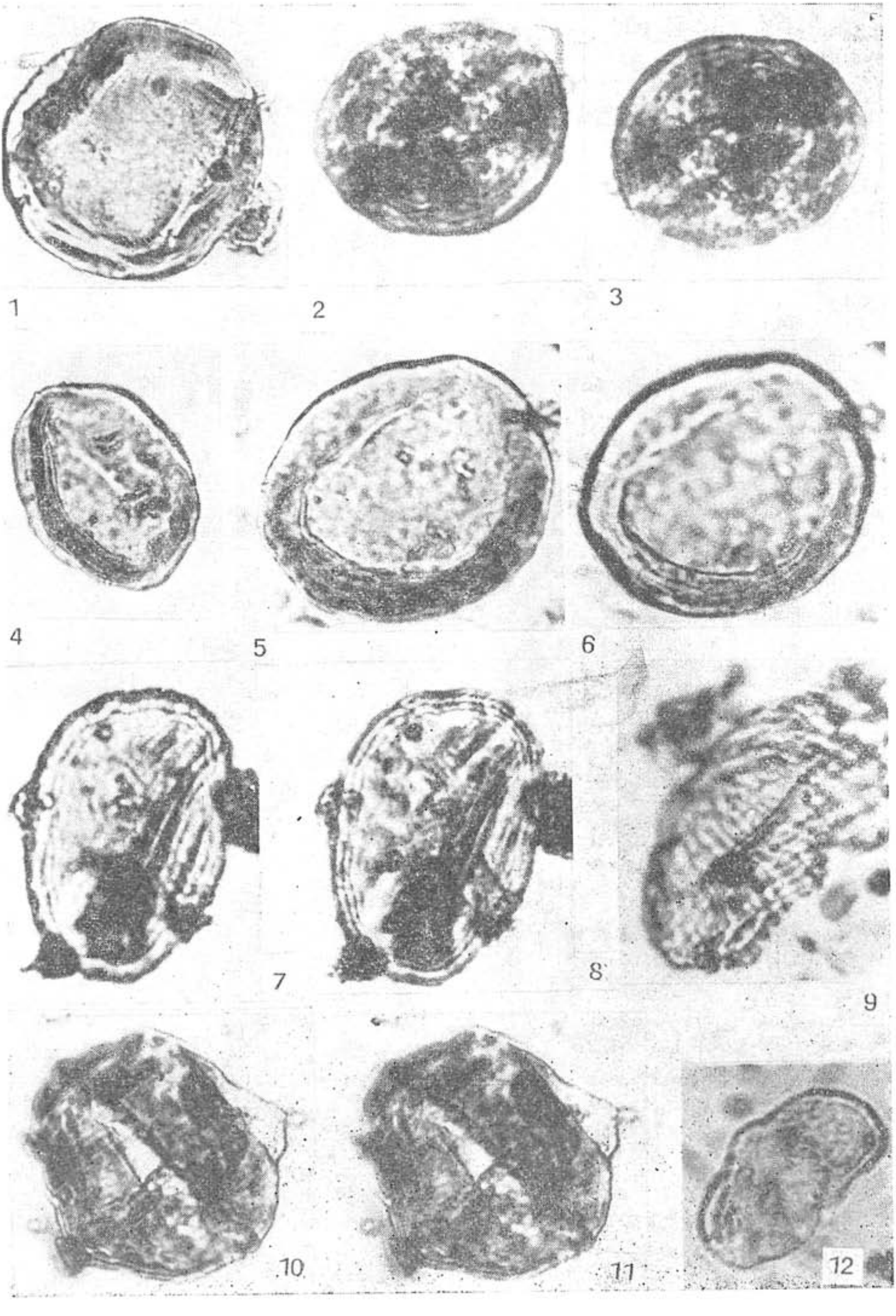

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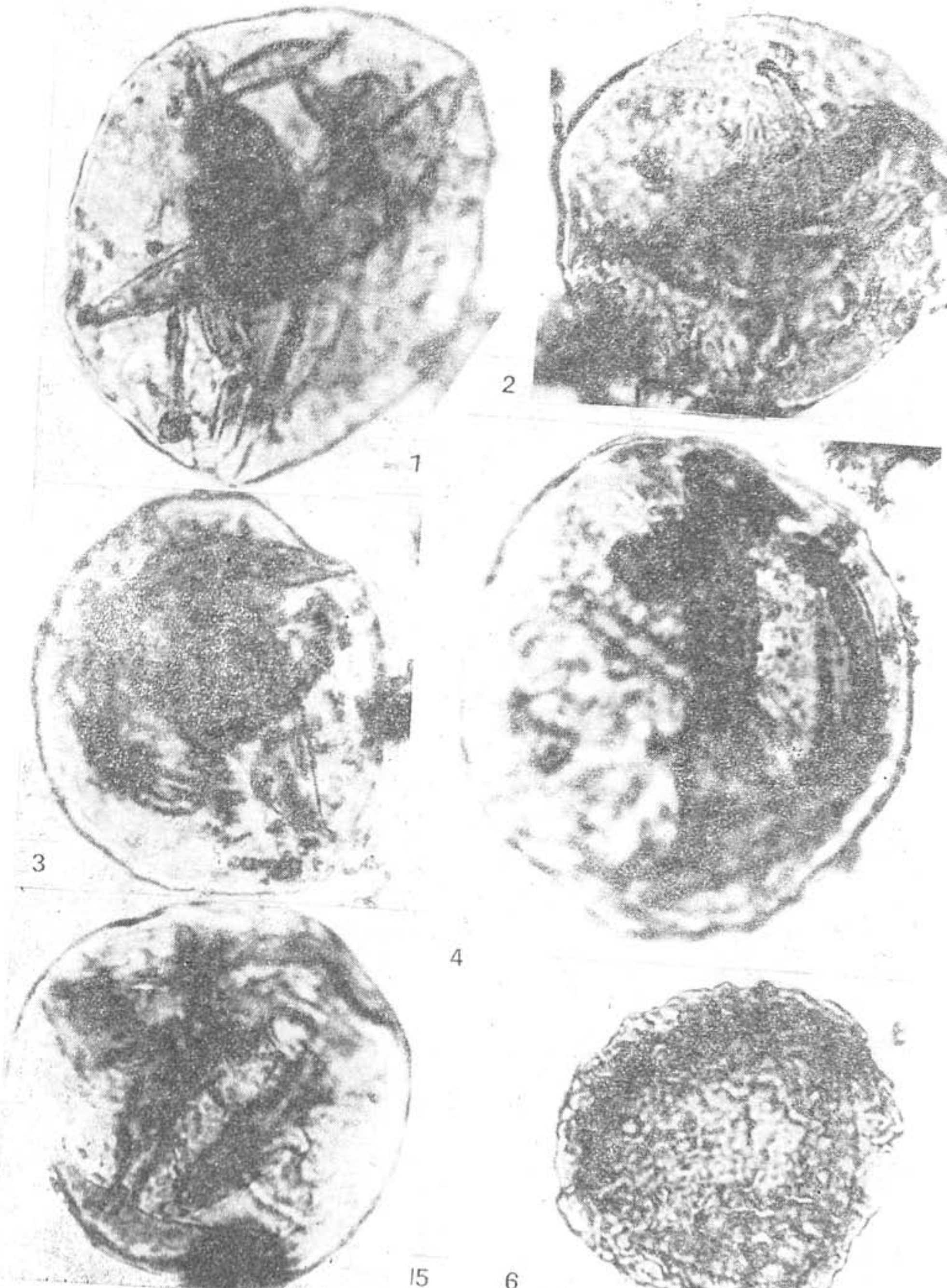

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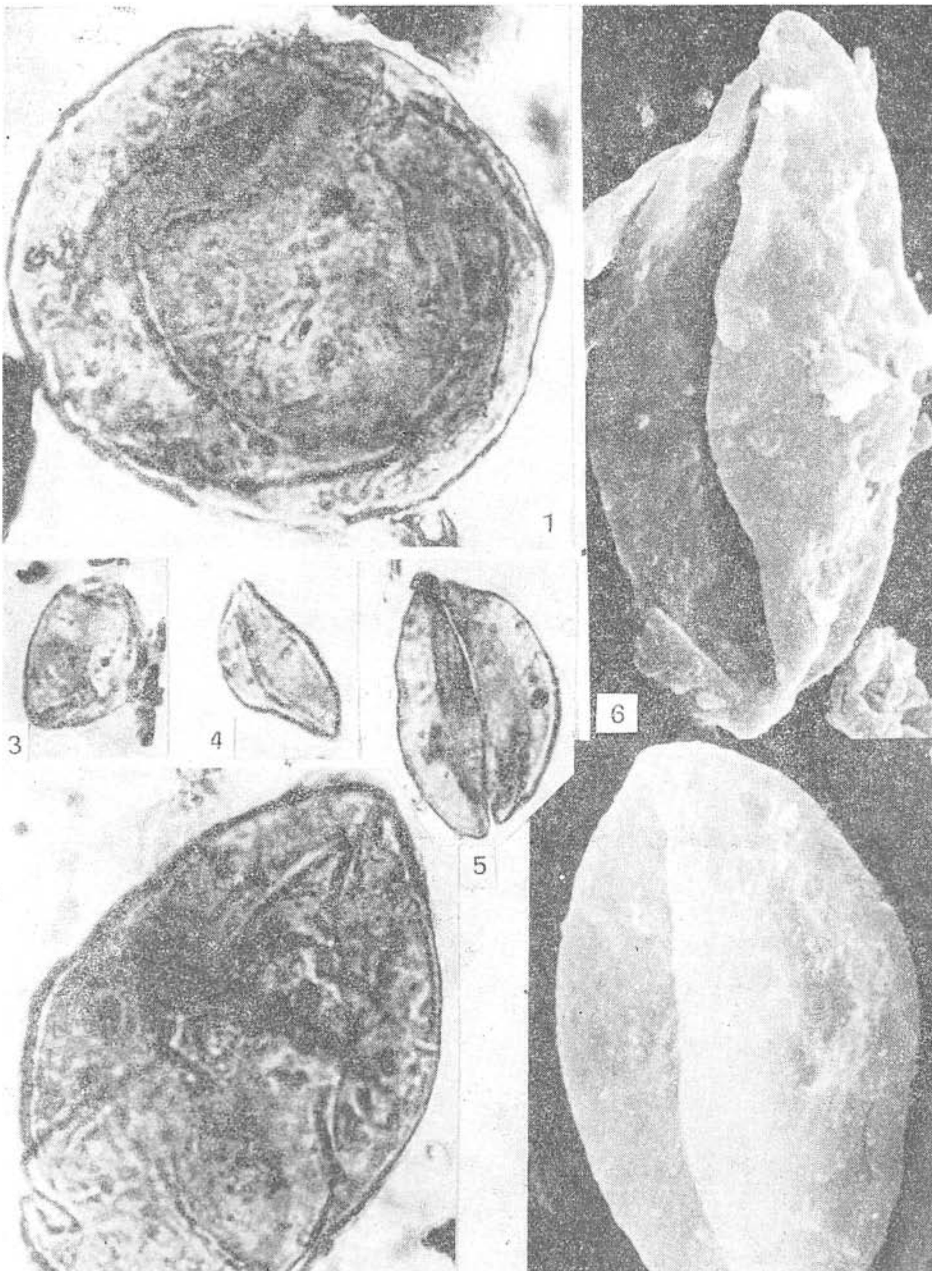

Plate 14

1

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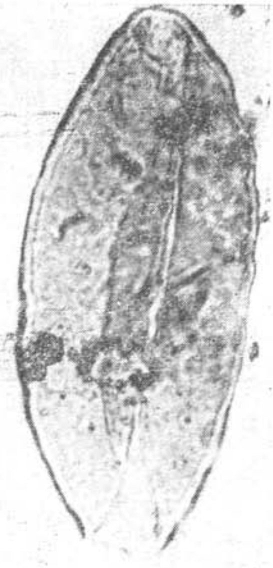

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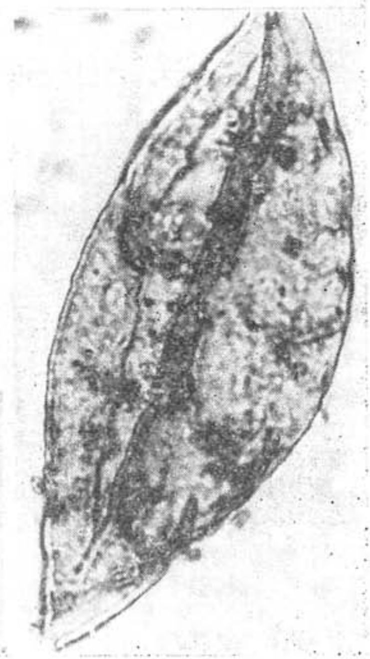

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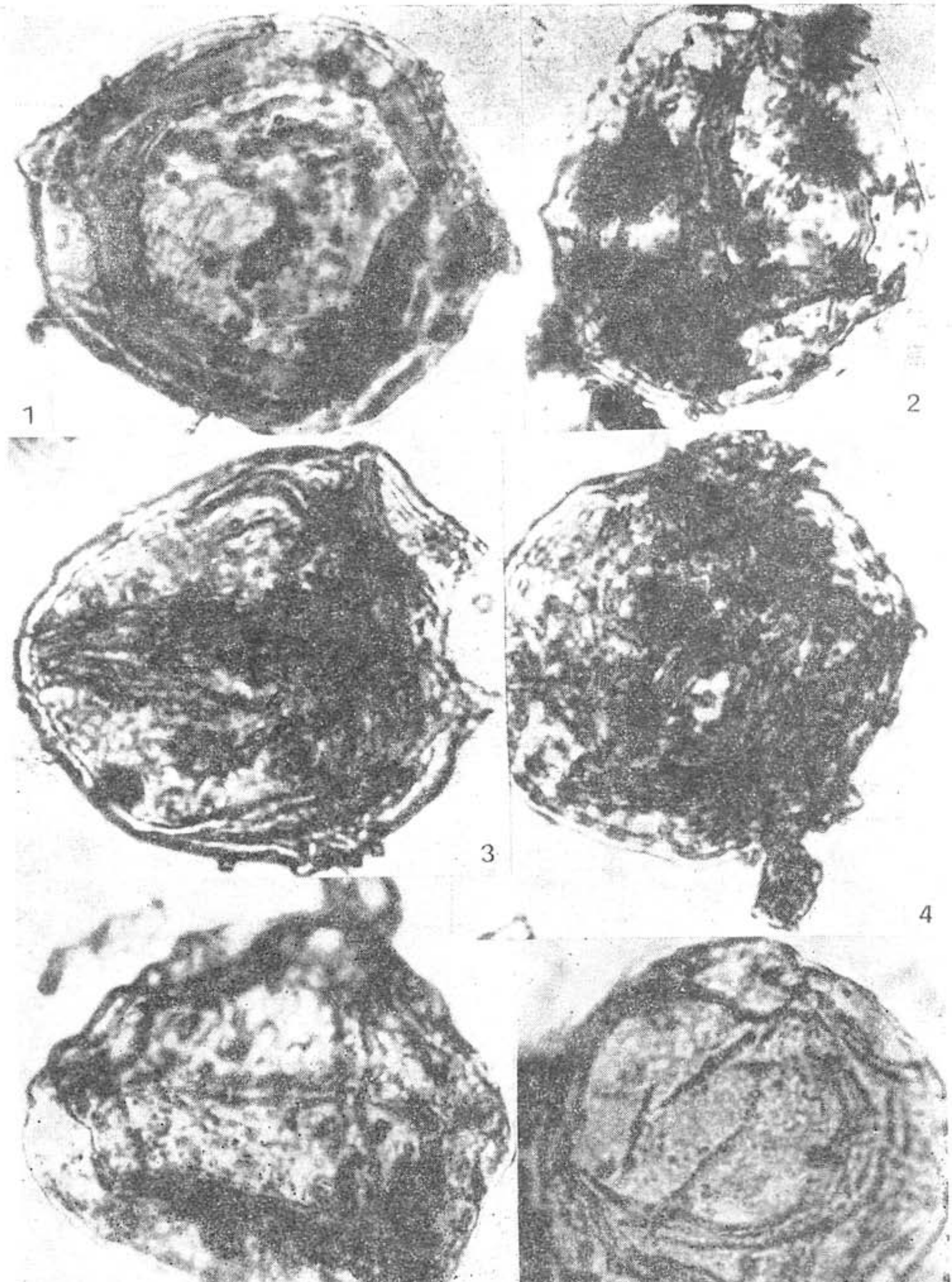
Plate 15



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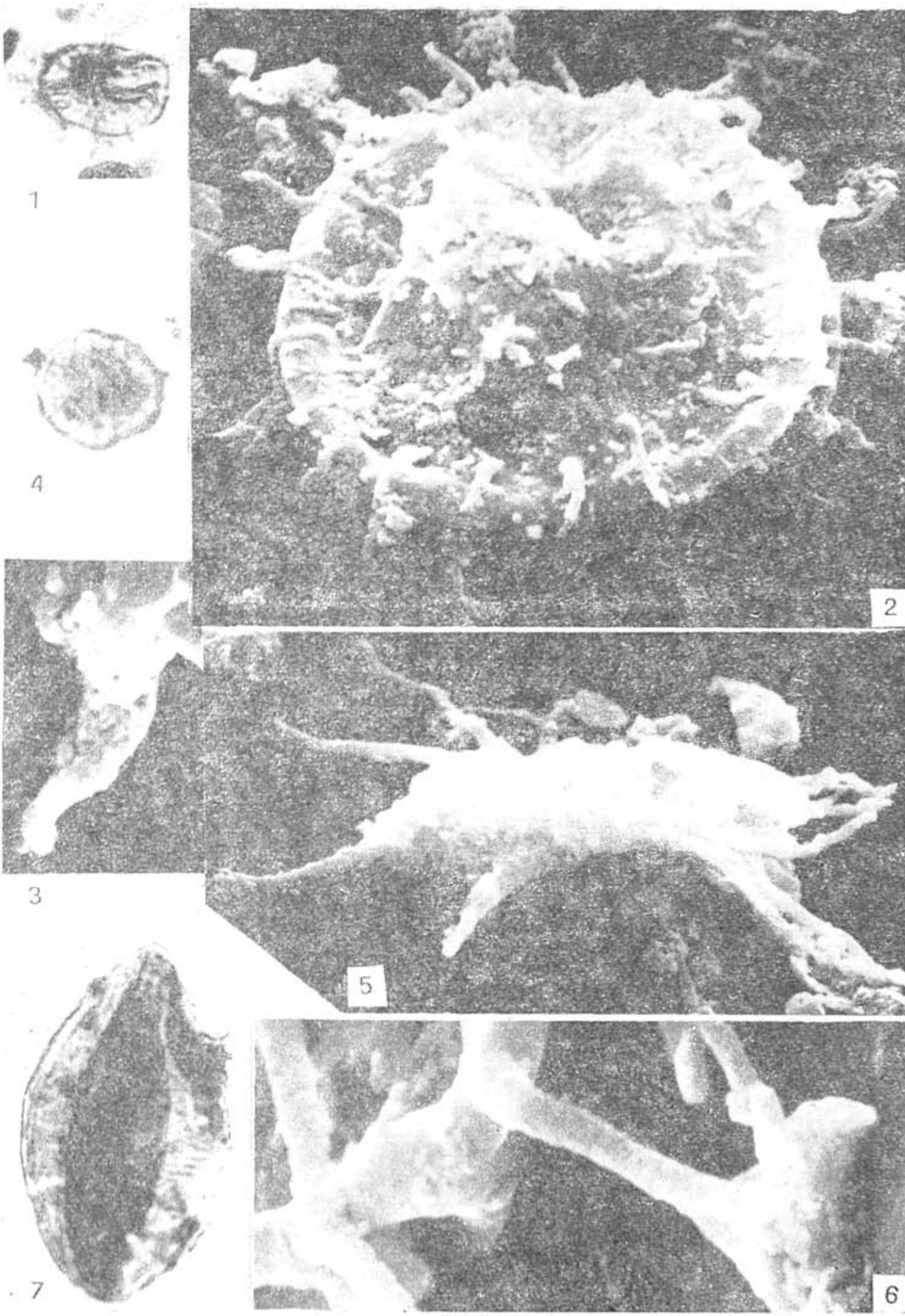

Explanations to Plates

Plate 1. Karnic—Lunz beds.

1—2 — *Paraconcavisporites lunzensis* KLAUS, 3—4 — *Paraconcavisporites* sp., 5 — *Distanulisporites* cf. *punctus* KLAUS, 6 — *Aratrisporites scabratus* KLAUS, 7 — *Distanulisporites punctus* KLAUS, 8 — *Bianulisporites badius* PAUTSCH.

Plate 2. Karnic—Lunz beds.

1 — *Camarozonotriletes rudis* KLAUS, 2—3 — *Corrugatisporites klausi* KAVARI, 4 — *Conosmundasporites othmari* KLAUS, 5 — *Aulisporites astigmosus* (LESCHIK) KLAUS, 6 — *Zebrasporites fimbriatus* KLAUS.

Plate 3. Karnic—Lunz beds.

1 — *Ovalipollis ovalis* (KRUTZSCH) KLAUS, 2—3 — *Ovalipollis lunzensis* KLAUS, 4 — *Ovalipollis* sp.

Plate 4. Karnic—Lunz beds.

1 — *Chordasporites singulichorda* KLAUS, 2 — *Triadispora modesta* SCHEURING, 3 — *Triadispora stabilis* SCHEURING, 4 — *Diaphanisporites diaphanus* PAUTSCH, 5 — *Striatoabietites aytugyi* VISSCHER, 6—7 — *Monoculsites minimus* COOKSON.

Plate 5. Rhaetic.

1 — *Udulatisporites undulatus* LESCHIK, 2 — *Gleicheniidites* sp., 3 — *Leiotriletes* sp., 4 — *Gyathitides sobuli* REINH, 5 — *Thomsonisporites* sp., 6 — *Cyclogranisporites cpressus* LESCHIK, 7 — *Intrapunctatisporites hians* LESCHIK, 8 — *Gleicheniidites umbonatus* (BOLCH.) KRUTZSCH, 9 — *Eucommiidites troedsonii* ERDTMAN, 10 — *Classopollis torosus* COUPER, 11 — *Chasmatosporites apertus* (ROGALSKA) NILSON.

Plate 6. Rhaetic—Lias.

1 — *Calamospora nathorstii* (HALLE) KLAUS, 2—3 — *Cyathitides australis* COUPER, 4 — *Cyathitides* SEM No. 3790 magn. 2000 x, 5 — *Cyathitides* sp. 1, 6—7 — *Cyathitides concavus* (BOLCH.) DETTM.

Plate 7. Rhaetic—Lias.

1 —*Deltoidospora crassiexina* REINH., 2 — *Deltoidospora* SEM No. 3790 magn. 2300 x, 3 — *Dictyophyllidites harrisi* COUPER, 4—5 — *Gleicheniidites umbonata* (BOLCH.) KRUTZSCH, 6 — *Triancoraesporites reticulatus* SCHULZ, 7 — *Intrapunctisporites hians* LESCHIK, 8 — *Stereisporites* sp., 9 — *Stereisporites* sp.

Plate 8. Rhaetic—Lias.

1 — *Todisporites major* COUPER, 2 — *Todisporites goepertiana* (MÜNSTER) KRASSER, 3—4 — *Aratrisporites minimus* PAUTSCH, 5—6 — *Aratrisporites cf. minimus* PAUTSCH, 7—8 — *Maratiopsis scabratus* COUPER, 9—10 — *Maratiopsis anglica* THOMAS.

Plate 9. Rhaetic—Lias.

1—3 — *Eucommiidites troedsoni* ERDTMAN, 4 — *Eucommiidites* sp., 5—8 — *Eucommiidites troedsoni* ERDTMAN, 9—11 — *Clavatipollenites hughesi* COUPER, 12 — *Labiipollenites* sp.

Plate. 10. Rhaetic—Lias.

1 — *Chasmatosporites apertus* (ROGALSKA) NILSON, 2—3 — *Chasmatosporites hians* LUND, 4—5 — *Chasmatosporites hians* LUND, 6 — *Chasmatosporites elegans* NILSON,

7—8 — *Chasmatosporites apertus* (ROGALSKA) NILSON, 9—11 — *Sphaeripollenites subgranulatus* COUPER.

Plate 11. Rhaetic—Lias.

1, 4, 5—8 — *Classopollis torosus* COUPER, 2—3 — *Classopollis cf. itumensis* POCOCK, 9 — *Ephedripides tortuosus* MÄDLER, 10—11 *Weylandites bilateralis*, 12 — *Vitreisporites palidus* (REIS.) NILSON.

Plate 12. Rhaetic—Lias.

1 — *Inapertulapollenites laevis* ROGALSKA, 2 — *Inapertulapollenites orbicularis* NILSON, 3 — *Inapertulapollenites* sp., 4 — *Inapertulapollenites magnovelatus* WEYL. et KRIEG, 5 — *Polonisaccus ferrugineus* (PAUTSCH) MÄDLER 6 — *Tsugaepollenites* sp.

Plate 13. Rhaetic—Lias.

1 — *Araucariacidites australis* COOKSON, 2 — *Bharadwajapollenites* sp., 3—4 — *Cycadopites* sp., 5 — *Monosulcites minimus* COUPER, 6 — *Cycadopites* sp. 1 SEM No. 3633 magn. 300 x, 7 — *Cycadopites* sp. 2 SEM No. 2562 magn. 3000 x.

Plate 14. Rhaetic—Lias.

1 — *Bennetitinaepollenites bitorosus* (BÓNA) BÓNA, 2 — *Cycadopites* sp. 1, 3 — *Cycadopites* sp. A, 4 — *Ginkgoretectina ferrei* POCOCK, 5 — *Cycadopites* sp., 6 — *Bharadwajapollenites magnus* (MARST.) JAIN, 7—8 — *Monosulcites minimus* COUPER.

Plate. 15. Rhaetic—Lias.

1 — *Plancton* sp. 1, 2 — *Plancton* sp. 2, 3 — *Plancton* sp. 3, 4 — *Cymatiosphaera* sp. A, 5 — *Plancton* sp. 4, 6 — *Plancton* sp. 5.

Plate. 16. Rhaetic—Lias.

1 — *Micrhystridium minutispinosum* WALL., 2 —*Micrhystridium* SEM. No. 3633, magn. 6000 x, 3 — *Micrhystridium* SEM. No. 3634, det. magn. 12000 x, 4 — *Plancton* sp., 5 — *Hystrichosphaeridae* sp. 1 SEM. No. 3645, magn. 5500 x, 6 — *Hystrichosphaeridae* sp 2 SEM. No. 3646, det. magn. 9000 x, 7 — *Lagenella martini (LESCHIK) KLAUS.*