MARIA E. PAUTSCH

# SPOROMORPHS OF THE UPPER TRIASSIC FROM A BOREHOLE AT TRZCIANA NEAR MIELEC (S. POLAND)

## Sporomorfy górnego triasu z wiercenia w Trzcianie koło Mielca

SUMMARY

In the Foreland of the Middle Carpathians an assemblage of sporomorphs was encountered in Keuper sediments over a section of about 60 km, extending from the locality of Niwiska in the east to Radzanów in the west (P a u t s c h 1963).

Sporomorphs from the borehole at Trzciana, lying centrally in the investigated area, are the subject of the present publication. Altogether 47 genera and 66 species of sporomorphs were found. On the basis of changes in the composition of assemblages of the profile of the Keuper of Trzciana the presumable oscillation of the sea-coast was determined.

## INTRODUCTION

The present state of investigations already permits the determination of various sporomorph associations existing in the Keuper period testifying to differences in the floristic composition both in the vertical and horizontal area of distribution.

Palynological investigations corroborate the existence of hypothetical V a k h r a m e i e v's plant provinces in so far that there is not a single common species for the spectrum from Trzciana (European province) and for those of the Asiatic province, or of the Siberian area (P o k r o v s k a i a 1966). Moreover, a further floristic differentiation is observed in the European province. Thus, spectra of various composition were found in the following areas:

1. in the Alpine area: a) deep-sea sediments (Carditaschichten, Halobienschiefer, K l a u s 1960), b) inshore sediments (Schilfsandstein, L e s c h i k 1955, Lunzerschichten, B h a r a d w a j et S i n g h 1964), 2. in terrains of the drying up land of West Central Europe (M ä d l e r 1964, a, b), 3. in east Central Europe on the Foreland of the Middle Carpathians

(P a u t s c h 1963 and the present study), 4. in the vicinity of the border of the then existing continent (P a u t s c h 1958), and 5. in the presumably desert areas from Worcestershire (C l a r k e 1965).

In Keuper sediments on the Middle Carpathians Foreland a rich sporomorph assemblage was discovered in boreholes of the State Oil Prospecting Enterprise, Cracow, over a distance of 60 km from the locality Niwiska near Mielec in the east to the locality Radzanów near Busko in the west. The borehole of Trzciana is centrally situated in the above mentioned horizontal profile and has the best elaborated geological documentation. The palynological material obtained from this borehole is the subject of the present paper.

All the slides are stored in the Botanical Institute of the Polish Academy of Sciences in Kraków, Lubicz 46.

## LITHOLOGY

The lithological profile of the investigated section is approximately the following: from the depth of 1116 to 1123 m there occur dark grey to greenish shale and fine-grained greenish and brownish-violet sandstone, from the depth of 1123 to 1132 m brownish red and dark green shale, from the depth of 1132 to 1140 m dark grey, calcareous and black shale with a lamination of shale and intercalations of fine-grained sandstone. No distinct limit appears between the particular series. The beds pass gradually into lithologically different ones, forming interbeddings and intercalations. This points to a certain oscillation of the conditions of sedimentation (F i k, C i s e k, Record Office of the Petroleum Industry). Sporomorphs were found only in three levels, which are lithologically represented by grey shale. The lowest level containing sporomorphs (depth 1132—1140 m) is of Lower Keuper age and derives from a series of dark pelites, whereas the level from the depth of 1119—1123 m is Upper Keuper age from a series of variegated pelites (T o k a r s k i 1962). As concerns the age of the level containing sporomorphs from the depth of 1116—1119 m, opinions differ. T o k a r s k i (1962) assigns the beds from this depth to the Rhaetic, whereas F i k and C i s e k (Record Office of the Petroleum Industry) consider that they still belong to the Keuper. P a c h u c k i (Record Office of the Petroleum Industry) described a well preserved lamellibranch of the species *Anodontophora lettica* Qu. which, according to this author, occurs in sediments of the Upper Muschelkalk and in some Keuper sediments.

## MATERIAL AND METHODS

Sediments from the depth of 1132—1140 m are palynologically the richest.

Sediments from the depth of 1119—1123 m contain poorly preserved

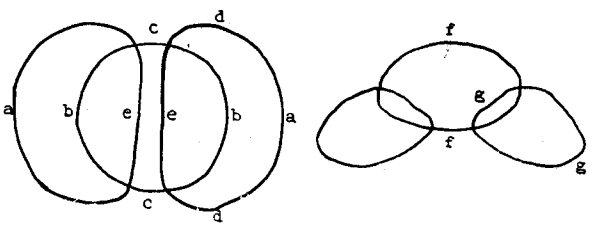
sporomorphs, whereas in those from the depth of 1116—1119 m the sporomorphs are well preserved, but their specific range is relatively smaller. 38 sporomorph species represent forms known from the Lower Keuper of the Harz Mountains Foreland (M ä d l e r 1964), from the Carnian of the Eastern Alps (K l a u s 1960), from the Middle Keuper from Neuwelt near Basel (L e s c h i k 1955), from the Lower Keuper of Thuringia (S c h u l z 1965), and from the Lunzen beds (Lunzer Schichten, B h a r a d w a j et S i n g h 1964). The further 30 sporomorph species represent forms which have not as yet been described.

The maceration of samples was carried out with hydrofluoric, hydrochloric, and nitric acid and of potassium hydroxide. To isolate the sporomorphs from the macerated material a heavy liquid (mixture of cadmium and potassium iodide) was applied. For record purposes 360 slides were prepared, containing single sporomorphs with features characteristic of the given species occurring at Trzciana.

Measurements were made only in the case of sporomorphs which appeared to be little deformed.

A new species was only considered as existing when at least two specimens morphologically similar and well preserved were found. Single specimens were not described as a new species on account of the possibility of the occurrence of anomalies among the sporomorphs. In measuring sporomorphs of an approximately circular outline the largest diameter was always recorded.

Measurements of bisaccate sporomorphs were made according to the following schema:




a — a length of sporomorphs
b — b length of body
c — c breadth of body
e — a length of bladder
d — d breadth of bladder
e — e distance between the distal bladder roots
f — f height of body
g — g height of bladder

Measurements carried out according to this schema proved to be the most appropriate for bisaccate sporomorphs of the Mesozoic on account of the secondary flattening of the specimens during sedimentation mostly in polar view. Specimens in equatorial view occur very seldom, so that measurements taken in this position are of no practical significance.

## LIST OF SPOROMORPH SPECIES OCCURRING IN THE KEUPER OF TRZCIANA COMMON FOR THE WHOLE PROFILE

### TURMA TRILETES REINSCH 1881, EMEND. R. POTONIÉ ET KREMP 1954
### SUBTURMA AZONOTRILETES LUBER 1935

#### INFRATURMA LAEVIGATI BENNIE ET KIDSTON 1886, EMEND. R. POTONIÉ 1956

Genus *Calamospora* Schopf et Bentall 1944
*Calamospora tener* Leschik, emend. de Jersey
Genus *Punctatisporites* Ibrahim, emend. R. Potonié et Kremp 1954
*Punctatisporites crassexinis* Mädler
*Punctatisporites magnus* Pautsch
*Punctatisporites subcarpaticus* Pautsch
Genus *Todisporites* Couper 1958
*Todisporites minor* Couper
Genus *Crispetectatisporites* Pautsch
*Crispetectatisporites punctatus* Pautsch
Genus *Retusotriletes* Naumowa 1953
*Retusotriletes mesozoicus* Klaus
Genus *Carnisporites* Mädler 1964
*Carnisporites hercynicus* Mädler
*Carnisporites* cf. *ornatus Mädler*
*Carnisporites* cf. *telephorus* Pautsch, emend. Mädler
Genus *Paraconcavisporites* Klaus 1960
*Paraconcavisporites* sp.

#### INFRATURMA APICULATI BENNIE ET KIDSTON 1886, EMEND. R. POTONIÉ 1956

Genus *Converrucosisporites* R. Pot. et Kremp 1954
*Converrucosisporites conferteornatus* Pautsch
*Converrucosisporites diverseornatus* Pautsch
Genus *Cyclogranisporites* R. Pot. et Kremp. 1954
*Cyclogranisporites rugosetectatus* Pautsch
Genus *Baculatisporites* Thomson et Pflug 1953
*Baculatisporites comaumensis* Cookson, emend. R. Potonié 1956
Genus *Conbaculatisporites* Klaus 1960
*Conbaculatisporites mesozoicus* Klaus
Genus *Keuperisporites* Schulz 1965
*Keuperisporites baculatus* Schulz

#### INFRATURMA MURORNATI R. POTONIÉ ET KREMP 1954

Genus *Distalanulisporites* Klaus 1960
*Distalanulisporites punctus* Klaus
Genus *Microreticulatisporites* Knox, emend. R. Potonié et Kremp 1954
*Microreticulatisporites opacus* Leschik, emend. Klaus
Genus *Lycopodiacidites* Couper, emend. R. Potonié 1956
*Lycopodiacidites kuepperii* Klaus
Genus *Camarozonosporites* R. Potonié, emend. Klaus 1960
*Camarozonosporites rudis* Leschik, emend. Klaus
Genus *Spiralisporites* Pautsch

*Spiralisporites insignis* Pautsch
Genus *Bianulisporites* Pautsch
*Bianulisporites badius* Pautsch

## TURMA ZONALES BENNIE ET KIDSTON 1886, EMEND. R. POTONIÉ ET KREMP 1954

### SUBTURMA ZONOTRILETES WALTZ 1935

#### INFRATURMA ZONATI R. POTONIÉ ET KREMP 1954

Genus *Styxisporites* Cookson et Dettmann 1958
*Styxisporites granulatus* Pautsch

## TURMA MONOLETES IBRAHIM 1933

### SUBTURMA AZONOMONOLETES LUBER 1935

Genus *Leschikiisporis* R. Potonié 1958
*Leschikiisporis aduncus* Leschik, emend. R. Potonié
Genus *Echinitosporites* Schulz et Krutzsch 1961
*Echinitosporites iliacoides* Schulz et Krutzsch

## TURMA ALETES IBRAHIM 1933

### SUBTURMA AZONALETES LUBER, EMEND. R. POTONIÉ ET KREMP 1954

Genus *Laricoidites* R. Potonié, Thomson et Thiergart 1950
*Laricoidites subcarpaticus* Pautsch

## TURMA SACCITES ERDTMAN 1947

### SUBTURMA MONOSACCITES CHITALEY 1951, EMEND. R. POTONIÉ ET KREMP 1954

#### INFRATURMA TRILETESACCITI LESCHIK 1955

Genus Ellipsosaccus Pautsch
*Elipsosaccus subcarpaticus* Pautsch

#### INFRATURMA MONOLETESACCITI PAUTSCH

Genus *Aratrisporites* Leschik 1955, emend. Klaus 1960, emend. Pautsch
*Aratrisporites saturni* Thiergart, emend. Mädler, emend. Pautsch
*Aratrisporites virgatus* Leschik, emend. Pautsch
*Aratrisporites rotundus* Mädler, emend. Pautsch
*Aratrisporites pilosus* Leschik, emend. Pautsch
*Aratrisporites scabratus* Klaus, emend. Pautsch
*Aratrisporites* cf. *fischeri* Klaus, emend. Pautsch

#### INFRATURMA ALETESACCITI LESCHIK 1953

Genus *Circulisaccus* Pautsch
*Circulisaccus major* Pautsch
*Circulisaccus minor* Pautsch
Genus *Institisporites* Pautsch
*Institisporites crispus* Pautsch

## SUBTURMA DISACCITES COOKSON 1947

### INFRATURMA STRIATITI PANT 1954

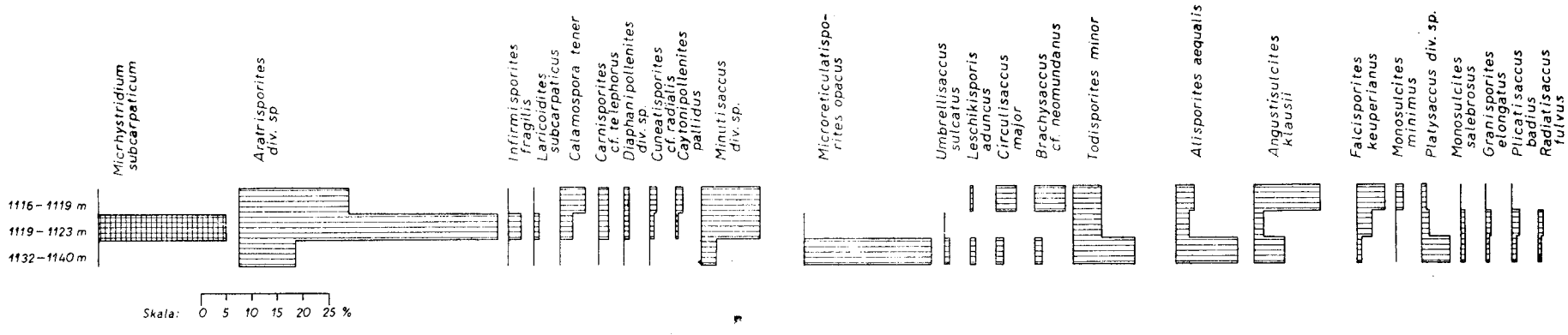
Genus *Taeniaesporites* Leschik 1955
*Taeniaesporites kräuseli* Leschik
Genus *Ovalipollis* Krutzsch, emend. Klaus 1960
*Ovalipollis lunzensis* Klaus
Genus Striatites Pant 1955
*Striatites limpidus* Balme et Hennelly, emend. Jansonius
*Striatites elongatus* Pautsch
Genus *Faunipollenites* Bharadwaj 1962
*Faunipollenites subcarpaticus* Pautsch
Genus *Infirmisporites* Pautsch
*Infirmisporites fragilis* Pautsch
Genus *Umbrellisaccus* Pautsch
*Umbrellisaccus sulcatus* Pautsch

### INFRATURMA DISACCITRILETI LESCHIK 1955

Genus *Illinites* Kosanke 1950, emend. Klaus 1964
*Illinites chitonoides* Klaus
Genus *Angustisulcites* Freudenthal 1964, emend. Visscher 1966
*Angustisulcites klausii* Freudenthal

### INFRATURMA DISACCIATRILETI LESCHIK 1955

Genus *Caytonipollenites* Couper 1958
*Caytonipollenites pallidus* Reissinger, emend. Couper
Genus *Alisporites* Daugherty 1941, emend. Mädler 1964
*Alisporites aequalis* Mädler
Genus *Complicatisaccus perlucidus* Pautsch
Genus *Diaphanisporites* Pautsch
*Diaphanisporites diaphanus* Pautsch
*Diaphanisporites major* Pautsch
Genus *Cuneatisporites* Leschik 1955
*Cuneatisporites* cf. *radialis* Leschik
Genus *Falcisporites* Leschik 1956, emend. Klaus 1960
*Falcisporites keuperianus* Pautsch
Genus *Brachysaccus* Mädler 1964
*Brachysaccus* cf. *neomundanus* Leschik, emend. Mädler
Genus *Minutisaccus* Mädler 1964
*Minutisaccus subcarpaticus* Pautsch
*Minutisaccus ornatus* Pautsch
Genus *Granisaccus* Mädler 1964
*Granisaccus elongatus* Pautsch
Genus *Plicatisaccus* Pautsch
*Plicatisaccus badius* Pautsch
Genus *Radiatisaccus* Pautsch
*Radiatisaccus fulvus* Pautsch
Genus *Platysaccus* Naumowa, emend. R. Potonié et Klaus 1954
*Platysaccus* cf. *papilionis* R. Potonié et Klaus
*Platysaccus niger* Mädler
*Platysaccus nitidus* Pautsch
*Platysaccus subcarpaticus* Pautsch




The diagram of sporomorphs from Trzciana
*Diagram sporomorf z kajpru Trzciany*

TURMA PLICATES NAUMOWA 1939, EMEND. R. POTONIÉ 1960

SUBTURMA MONOCOLPATES IVERSEN ET TROELS-SMITH 1950

Genus *Monosulcites* Cookson 1947, emend. Couper 1958
*Monosulcites minimus* Cookson
*Monosulcites perforatus* Mädler
*Monosulcites salebrosus* Pautsch

## DESCRIPTION OF SPOROMORPHS

TURMA TRILETES REINSCH 1881, EMEND. R. POTONIÉ ET KREMP 1954

SUBTURMA AZONOTRILETES LUBER 1935

INFRATURMA LAEVIGATI BENNIE ET KIDSTON 1886, EMEND. R. POTONIÉ 1956

### Genus *Calamospora* Schopf, Wilson et Bentall 1944

### *Calamospora tener* Leschik, emend. de Jersey

Pl. I, fig. 1

Synonims: *Laevigatisporites tener* Leschik 1955
*Punctatasporites flavus* Leschik 1955
*Calamospora mesozoica* Couper 1958
*Calamospora nathorsti* Klaus 1960

Dimensions: diameter of spores: 35—58 μ mean 46 μ
length of trilete mark rays: 5—14 μ „ 9 μ

Number of specimens: 40, 23 of which suitable for measurement.

Distribution: Lower and Middle Jurassic of Great Britain, Middle Keuper from Neuwelt near Basel, Carnian of the Eastern Alps, Lower Keuper of the Harz Mts Foreland, Lower and Upper Keuper of Trzciana, Ipswich Coal Measures, Queensland.

Description: Spores initially probably circular, secondarily folded. Thin, light-coloured wall, hyaline smooth. Some specimens have a slightly punctate structure. The trilete mark is often visible. Its rays are straight, thin, usually not reaching 1/2 of the spore radius.

### Genus *Punctatisporites* Ibrahim, emend. R. Potonié et Kremp 1954

### *Punctatisporites crassexinis* Mädler

Pl. I, fig. 3

Dimensions: diameter of spores: 42—49 μ mean 44 μ
length of trilete mark rays: 14—19 μ „ 16 μ
thickness of wall: 3 μ

Number of specimens: 3, all suitable for measurement.

Distribution: Lower Keuper of the Harz Mts Foreland, Lower Keuper of Trzciana.

Description: Round spores with a relatively thick wall, light-brown. Exine infragranulate. The rays of trilete mark distinct, straight, not thickened, pointed, of not quite equal length.

### *Punctatisporites magnus* Pautsch

Pl. I, fig. 5

| | | | |
|---|---|---|---|
| Dimensions: | diameter of spores: | 89—111 μ | mean 100 μ |
| | length of trilete mark rays: | 16—40 μ | „ 28 μ |
| | thickness of wall: | 3— 5 μ | „ 4 μ |

Number of specimens: 4, 3 of which suitable for measurement.

Distribution: Lower and Upper Keuper of Trzciana.

Description: Very large round spores of a dark-brown colour. The wall is multilayered. Three layers are clearly visible: the internal one a little lighter-coloured in the section than the two others, of a thickness corresponding approximately to 1/4 of that of the whole wall, the middle layer, the thickest, amounting to about 1/2 of the thickness of the whole wall, and the third, external layer, corresponding to 1/4 of the wall thickness. Exine dark-brown, smooth, or slightly punctate. Small wrinkles on the surface occur in places, being perhaps of secondary origin. The rays of trilete mark longer than half the spore radius, straight, not thickened, ending obtusely or branching. The branches of rays short, with no traces of the beginning of curvaturae.

All the specimens found are fissured.

### *Punctatisporites subcarpaticus* Pautsch

Pl. I, fig. 2

| | | | |
|---|---|---|---|
| Dimensions: | diameter of spores: | 42—60 μ | mean 50 μ |
| | length of trilete mark rays: | 13—21 μ | „ 18 μ |
| | thickness of wall: | 3— 4 μ | „ 3 μ |

Number of specimens: 10, 7 of which suitable for measurement.

Distribution: Lower and Upper Keuper of Trzciana.

Description: Thick-walled spore of medium size, roundish. The wall is composed of three layers. The thickness of the internal layer amounts to 1/4—1/3 of that of the whole wall, the middle layer corresponds to 1/2 and the external one to about 1/4 of the whole thickness of the wall. In optical section the internal layer is slightly lighter in colour than the middle and external one. The internal boundary of the whole wall is distinctly visible in its optical section. The wall is brown, smooth

in outline, slightly punctate. There also occur small wrinkles on the surface, which are probably of secondary origin.

The rays of the trilete mark not thickened, straight, of not quite equal length, often forked at the ends or blunt. The branches of rays have distinct terminations, showing no tendency to form curvaturae. The length of rays is about 2/3 of the spore radius. Secondary folds in the wall occur rarely.

## Genus *Todisporites* Couper 1958

### *Todisporites minor* Couper

Pl. I, fig. 4

| | | |
|---|---|---|
| Dimensions: | diameter of spores: | 32—50 μ mean 39 μ |
| | lenght of trilete mark rays: | 6—16 μ „ 12 μ |
| | thickness of wall: | 1—1,8 μ |

Number of specimens: 372, 342 of which suitable for measurement.

Distribution: Middle Jurassic of Great Britain, Lunz Coal Measures, Middle Keuper from Neuwelt near Basel (after Bharadway et Singh, 1964), Lower und Upper Keuper of Trzciana.

Description: Outline of spore circular in polar view. In other positions shows slight curves, the shape of the spore reminiscent of a polygon. Wall fairly thick (1—1·8 μ), distinctly two-layered. External layer thicker than the internal one and brighter. Infragranulate structure, not always well visible. Spore smooth in outline. Exine greyish-yellow. Rays of trilete mark straight, distinct, narrow, usually of uneven length. Couper suggests that this species derives from *Todites princeps* Presl, emend. Gothan.

## Genus *Crispetectatisporites* Pautsch

### *Crispetectatisporites punctatuts* Pautsch

Pl. II, fig. 1

| | | |
|---|---|---|
| Dimensions: | diameter of spores: | 88—98 μ mean 93 μ |
| | length of trilete mark rays: | 28—49 μ „ 35 μ |
| | height of lists: | 5— 6 μ |
| | thickness of wall: | 1·5 μ |

Number of specimens: 2, both suitable for measurements.

Distribution: Lower Keuper of Trzciana.

Description: Light in colour, rounded triangular spore with rays of trilete mark developed into vertically erect lists up to 6 μ high. Margin of the list crisp. The length of rays is up to 2/3—3/4 of the spore radius. Wall 1·5 μ thick, one-layered, smooth, distinctly punctate near the apex.

## Genus *Retusotriletes* Naumowa 1953

### *Retusotriletes* cf. *mesozoicus* Klaus

Pl. I, fig. 7

| | | |
|---|---|---|
| Dimensions: | diameter of spores: | 32—34 μ mean 33 μ |
| | length of trilete mark rays: | 8—17 μ „ 11 μ |
| | thickness of wall: | 1 μ |

Number of specimens: 3, all suitable for measurement.

Distribution: Upper Keuper of Trzciana.

Description: Spores circular in outline with punctate wall 1 μ thick of a greyish-yellow colour. Trilete mark distinctly visible, without thickened rays. The contact areas distinctly thinner, smooth, limited by curvaturae perfectae.

*Retusotriletes mesozoicus* spores found by Klaus in the Carnian of the Eastern Alps are larger (35—55 μ) than the specimens from Trzciana. Klaus found them chiefly in Carnian continental sediments (1960).

Mädler describes similar spores from the Muschelkalk of Germany as possessing curvaturae and thickenings at the branches of lists. He considers these thickenings to be characteristic of this species and, referring to the Alpine material, calls these spores *Carnisporites* (*Retusotriletes*) *mesozoicus* Klaus, emend. Mädler. In the material from Trzciana no thickenings were observed near the branches of lists, and therefore the name *Retusotriletes* was retained.

## Genus *Carnisporites* Mädler 1964

### *Carnisporites* cf. *hercynicus* Mädler

Pl. I, fig. 6

| | | |
|---|---|---|
| Dimensions: | diameter of spores: | 24—31 μ mean 28 μ |
| | length of trilete mark rays: | 6—16 μ „ 9 μ |
| | thickness of wall: | 1— 2 μ |

Number of specimens: 6, all suitable for measurement.

Distribution: Lower Keuper of the Harz Mts Foreland, Upper Keuper of Trzciana.

Description: Spores triangular rounded in outline with infragranulate or smooth, greyish-brown wall. Straight, distinct lists, without thickenings, not reaching the equator, more or less distinctly branched at the ends. In some specimens at a certain adjustment of the microscope curvaturae perfectae are visible. At the proximal pole the ends of lists are sometimes kneed.

Similar spores, but slightly larger on the average (30—35 μ), were described by Mädler from the Lower Keuper of the Harz Mts Foreland by the name of *Carnisporites hercynicus*.

## *Carnisporites* cf. *ornatus* Mädler

Pl. II, fig. 4—5

| | | |
|---|---|---|
| Dimensions: | diameter of spore: | 32 μ |
| | length of trilete mark rays: | 12—13 μ |
| | height of grana: | 2— 3 μ |
| | thickness of wall: | 1·5 μ |

Number of specimens: one, suitable for measurement.

Distribution: Upper Keuper of Trzciana.

Description: Spore rounded oval in outline, greyish-brown. Trilete mark with thin, straight rays, without visible branches at the ends, almost reaching the equator. The contact areas covered with small granula (below 1 μ) lying about 1 μ apart. The side of the spore beginning from the equator ornamented with grana 2—3 μ in size. The height and breadth of grana more or less the same. The distance between the grana of the distal part amounts to 2—6 μ. A similar spore was described by Mädler from the Lower Keuper of the Harz Mts Foreland by the name of *Carnisporites ornatus*. This author also found only one specimen differing of a much larger size (50 μ), entirely smooth contact areas, and distinctly branched ends of lists. He considered that the kind of ornamentation on the distal side indicated derivation from *Selaginellaceae*. The specimen found in Trzciana sediments closely resembles *Lycopodium densum* (Erdtman 1957, p. 76, fig. 139) spores.

## *Carnisporites* cf. *telephorus* Pautsch, emend. Mädler

Pl. II, fig. 3

| | | |
|---|---|---|
| Dimensions: | diameter of spores: | 21—31 μ mean 28 μ |
| | length of trilete mark rays: | 7—13 μ „ 9 μ |
| | thickness of wall: | 1— 2 μ |

Number of specimens: 22, 13 of which suitable for measurement.

Distribution: Lower and Upper Keuper of Trzciana.

Description: Spores roughly circular in outline, light yellow. The length of trilete mark rays amounts to 3/4 of the spore radius. Thin, straight, not always clearly visible rays, usually with no branching of the ends. The contact areas smooth with a border anchor-like bend near the rays. The surface of the spore outside the contact areas covered with loosely disposed spinae 1—2 μ in length.

*Carnisporites telephorus* Pautsch, emend. Mädler is of slightly larger size (30—40 μ), with contact areas not always smooth, and more frequently occurring branching of rays. However, the essential character of the structure is the same.

## Genus *Paraconcavisporites* Klaus 1960

### *Paraconcavisporites* sp.

Pl. II, fig. 2

| | | |
|---|---|---|
| Dimensions: | diameter of spores: | 35—45 μ mean 41 μ |
| | length of trilete mark rays: | 13—19 μ „ 16 μ |

Number of specimens: 3, all suitable for measurement.

Distribution: Carnian of the Eastern Alps, Lower Keuper of Trzciana.

Description: Spores triangular in outline, greyish-yellow, with concave or straight sides and smooth wall. The rays of trilete mark slightly undulate, contacting unsymmetrically at the apex, almost reaching the equator. In one specimen kyrtomes between the terminations of rays were noted.

Similar spores were found by Klaus in the Carnian of the Alps, but in insufficient number to determine the variability and morphological features of the species. Neither is the state of preservation of the specimens from Trzciana good enough to establish for certain their morphology; however, examined species is presumably the same as that mentioned by Klaus.

*Paraconcavisporites lunzensis* Klaus possesses punctate contact areas.

INFRATURMA APICULATI BENNIE ET KIDSTON 1886, EMEND. R. POTONIÉ 1956

## Genus *Converrucosisporites* R. Potonié et Kremp 1954

### *Converrucosisporites conferteornatus* Pautsch

Pl. II, fig. 7

| | | |
|---|---|---|
| Dimensions: | diameter of spores: | 76—120 μ mean 101 μ |
| | length of trilete mark rays: | 24— 49 μ „ 33 μ |
| | diameter of warts: | 2— 6 μ „ 4 μ |
| | height of warts: | 0— 4 μ „ 1·25 μ |
| | thickness of wall: | 3— 4 μ „ 3·40 μ |

Description: Large triangular spores with slightly concave sides and wall covered with multilateral warts lying close to each other on the distal side. The variability in the diameter of the base of warts on one specimen ranges from 1 to 3 μ. The mean height of warts amounts to 1·25 μ. The warts are distributed uniformly on the distal side. On the proximal side they become gradually smaller towards the apex. No increase in their size was observed at the corners of spores, nor thickening of the wall. The trilete mark rays reach 2/3 of the spore radius. The margins of leasurae are smooth and not thickened. The thickness of the wall ranges from 3 to 4 μ. The spore is of a red-brown colour.

### *Converrucosisporites diverseornatus* Pautsch

Pl. III, fig. 1

| | | | | |
|---|---|---|---|---|
| Dimensions: | diameter of spores: | 86—99 μ | mean | 92 μ |
| | length of trilete mark rays: | 24—37 μ | „ | 33 μ |
| | diameter of warts: | 2— 6 μ | „ | 4 μ |
| | height of warts: | 0·5— 6 μ | „ | 2·80 μ |
| | thickness of wall: | 1— 2 μ | „ | 1·75 μ |

Number of specimens: 4, all suitable for measurement.

Distribution: Lower and Upper Keuper of Trzciana.

Description: Large triangular spores with slightly concave or straight sides; wall covered with warts varying in size, distributed irregularly on the surface of the spore. The diameter of the base of warts on one specimen varies within the range of ±4 μ. The base of warts is circular or multilateral in outline, their height being up to 6 μ (mean 2·8 μ). The largest warts are implanted at the corners and those of medium size on the distal side. No warts occur near the trilete mark the wall there being hardly punctate. The warts are disposed loosely in relation to each other. The spacing between them usually equals their diameter, not being smaller than the radius of the warts. The wall is 1—2 μ thick, not thickened at the corners, of greyish-yellow colour. The rays of the trilete mark are straight, unthickened, reaching or exceeding 2/3 of the spore radius.

## Genus *Cyclogranisporites* R. Potonié et Kremp 1954

### *Cyclogranisporites rugosetectatus* Pautsch

Pl. III, fig. 4

| | | | | |
|---|---|---|---|---|
| Dimensions: | diameter of spores: | 49—60 μ | mean | 55 μ |
| | length of trilete mark rays: | 8—24 μ | „ | 13 μ |
| | thickness of wall: | 1— 3 μ | „ | 2 μ |

Number of specimens: 12, all suitable for measurement.

Distribution: Lower and Upper Keuper of Trzciana.

Description: Round greyish-yellow or light-brown spores with fairly thick exine composed of two layers. The internal layer is much thinner than the external. Its thickness amounts to 1/4—1/3 of the thickness of the whole wall. The external layer is thicker and sculptured. The sculpture is composed of small, round granula up to 1 μ in size, the distance between them amounting to 1·5 μ. The trilete mark is very characteristic. Its rays usually reach 1/2 of the spore radius. They are accompanied by transverse wrinkles or elevations up to 4 μ long and 1 μ broad. The contact areas are almost entirely smooth, bordered by distinct curvaturae perfectae, arcuately bent between the lists.

## Genus *Baculatisporites* Thomson et Pflug 1953

### *Baculatisporites comaumensis* Cookson, emend. R. Potonié

Pl. II, fig. 6

| | | |
|---|---|---|
| Dimensions: | diameter of spores: | 49—57 μ mean 52 μ |
| | length of trilete mark rays: | 11—19 μ „ 14 μ |

Number of specimens: 6, 4 of which suitable for measurement.

Distribution: from the Upper Triassic to the Cretaceous; at Trzciana it occurs in the Upper Keuper.

Description: Round spores, relatively thin-walled with short bacula on the whole surface. Greyish-yellow or light brown. Rays of trilete mark thin but distinct visible, almost reaching the equator.

## Genus *Conbaculatisporites* Klaus 1960

### *Conbaculatisporites mesozoicus* Klaus

Pl. III, fig. 6

| | | |
|---|---|---|
| Dimensions: | diameter of spores: | 39—62 μ mean 53 μ |
| | length of trilete mark rays: | 9—21 μ „ 15 μ |

Number of specimens: 3, all suitable for measurement.

Distribution: Carnian of the Eastern Alps, Lower Keuper of the Harz Mts Foreland, Upper Keuper of Trzciana.

Description: Spores distinctly triangular, with concave or straight sides. Fairly thin wall, of light colour with delicate bacula. Ratio of length to thickness of bacula approximate by 2 : 1. Bacula loosely distributed. Spores of this species found in Keuper sediments at Trzciana are slightly larger than the forms described by Klaus (39—48 μ) from Carnian sediments of the Eastern Alps.

## Genus *Keuperisporites* Schulz 1965

### *Keuperisporites baculatus* Schulz

Pl. IV, fig. 1

| | | |
|---|---|---|
| Dimensions: | diameter of spore: | 114 μ |
| | length of trilete mark rays: | 39—47 μ |
| | length of bacula: | 15—16 μ |
| | thickness of wall: | 3— 4 μ |

Number of specimens: one, suitable for measurement.

Distribution: Keuper of Thuringia, Lower Keuper of Trzciana.

Description: Spore roughly circular in outline. Brown in colour. Rays of trilete mark distinct, thickened, almost reaching the border of

the spore. Sculpture on the distal side composed of warts with irregular bases. Beginning from the equator the spore, apart from warts, has sparsely implanted long bacula. Smooth contact areas reaching about half the length of trilete mark rays.

INFRATURMA MURORNATI R. POTONIÉ ET KREMP 1954

## Genus *Distalanulisporites* Klaus 1960

### *Distalanulisporites* cf. *punctus* Klaus

Pl. III, fig. 2

| | | |
|---|---|---|
| Dimensions: | diameter of spores: | 32 μ |
| | length of trilete mark rays: | 8—13 μ mean 10 μ |
| | diameter of anulus: | 14—17 μ „ 15 μ |
| | thickness of anulus: | 1— 2 μ |

Number of specimens: 2, both suitable for measurement.

Distribution: Upper Keuper of Trzciana.

Description: Spores round or subtriangular, of a light colour, fairly thin-walled. One specimen is smooth, the other granulate. On the distal side the two specimens have a centrally placed anulus of thickened exine. The ratio of the breadth of the anulus to its inside diameter in the granulate specimen is 1 : 15, and in the smooth one 1 : 5. The markedly thin trilete mark amounts to 3/4 of the spore radius. The rays of the mark branch forming curvaturae perfectae. Both specimens differ from the forms described by Klaus in their much narrower distal anulus. In Alpine forms the ratio of the breadth of the anulus to its inside diameter is 1 : 1 or 1 : 2.

## Genus *Microreticulatisporites* Knox. emend. R. Potonié et Kremp 1954

### *Microreticulatisporites* cf. *opacus* Leschik, emend. Klaus

Pl. III, fig. 5

| | | |
|---|---|---|
| Dimensions: | diameter of spores: | 55—86 μ mean 65 μ |
| | length of trilete mark rays: | 15—29 μ „ 23 μ |
| | thickness of wall: | ca. 3 μ |

Number of specimens: 430, 126 of which suitable for measurement.

Distribution: Middle Keuper from Neuwelt near Basel, Carnian of the Eastern Alps, Lower Keuper of Trzciana, and sporadically in the lower part of the Upper Keuper of this borehole.

Description: Spores round or subtriangular with a fairly thick wall. Colour light- or dark-brown. Sculpture very variable, composed of

single warts multilateral in outline and of clotted elevation formed by the joining of several warts. Laesurae straight or slightly undulate, distinct, amounting to 3/4 of the spore radius, often with accompanying thickened stripes. In some specimens with a finer sculpture the contact areas seem smoother than the remaining part of the spore. The sculpture is mostly uniform on the whole spore.

Specimens of *Microreticulati* sp. *opacus* Leschik, emend. Klaus from the Middle Keuper of Basel differ in their much smaller size ranging, according to Leschik, from 44 to 48 μ. Specimens of *Microreticulatisporites opacus* Leschik, emend. Klaus found by Klaus in the Carnian of the Eastern Alps correspond in size (55—67 μ) to those from Trzciana, but differ in a more triangular shape and sculpture similar to reticulum.

*Converrucosisporites lunzensis* Bharadwaj et Singh spores from the Lunzen beds (54—58 μ) probably correspond to *Microreticulatisporites opacus* Leschik, emend. Klaus spores (55—67 μ) found by Klaus in the Eastern Alps. They also are more triangular than the specimens from Trzciana.

## Genus *Lycopodiacidites* Couper, emend. R. Potonié 1956

### *Lycopodiacidites kuepperii* Klaus

Pl. IV, fig. 5

Dimensions: diameter of spore: 58 μ
length of trilete mark rays: 21—27 μ
thickness of wall: 3 μ

Number of specimens: 1, suitable for measurement.

Distribution: Carnian of the Eastern Alps, Lower Keuper of Trzciana.

Description: Spore subtriangular, dark brown. Proximal side smooth, the distal one with sculpture in the form of thick rugae bent in and out. The rugae reach the margins of the spore, which therefore has an undulate outline. The rays of the trilete mark are thickened, their length being almost equal to that of the spore radius. The size of the specimen from Trzciana lies within the limits reported by Klaus for this species from the Carnian of the Alps (52—70 μ).

## Genus *Camarozonosporites* R. Potonié, emend. Klaus 1960

### *Camarozonosporites rudis* Leschik, emend. Klaus

Pl. III, fig. 3

Dimensions: diameter of spores: 35—45 μ mean 40 μ
length of trilete mark rays: 11—14 μ „ 13 μ

Number of specimens: 6, all suitable for measurement.

Distribution: Middle Keuper from Neuwelt near Basel, Carnian and Norian of the Eastern Alps, Lower and Upper Keuper of Trzciana.

Description: Light-coloured spores circular or slightly triangular in outline, with large, dark rugae on the distal side. The rugae usually lie parallelly to the margin of the spore, the longest occurring near the equator. The proximal side smooth with a thin wall and distinct trilete mark. The rays of the mark amount to more than 3/4 of the spore radius.

## Genus *Spiralisporites* Pautsch

### *Spiralisporites insignis* Pautsch

Pl. V, fig. 1

| | | | |
|---|---|---|---|
| Dimensions: | diameter of spores: | 124—155 μ | mean 140 μ |
| | length of trilete mark rays: | 34— 57 μ | „ 41 μ |
| | breadth of thickened stripes: | 8— 11 μ | „ 9 μ |

Number of specimens: 2, both suitable for measurement.

Distribution: Lower Keuper of Trzciana.

Description: Large, round brown spore with trilete mark; thickened exine stripe lying spirally on the distal side. The beginning of the stripe lies in the region of the distal pole and has a rounded end. There also occur closed circles, i.e. anuli. The proximal side almost smooth. Laesurae running not entirely straight and not exceeding 3/4 of the spore radius.

## Genus *Bianulisporites* Pautsch

### *Bianulisporites badius* Pautsch

Pl. IV, fig. 6

| | | | |
|---|---|---|---|
| Dimensions: | diameter of spores: | 37—53 μ | mean 43 μ |
| | length of trilete mark rays: | 11—24 μ | „ 16 μ |
| | breadth of distal anulus: | 3— 6 μ | „ 4 μ |
| | breadth of equatorial anulus: | 3— 4 μ | „ 3 μ |

Number of specimens: 5, all suitable for measurement.

Distribution: Lower and Upper Keuper of Trzciana.

Description: Dark brown triangular spores of medium size with thickened anulus in the equatorial part and stripe of thickened exine of triangular shape on the distal side. The thickened equatorial and distal stripes lie next to each other, being separated only by a very narrow groove. The thickened parts are of a dark brown colour. The inside diameter of the distal anulus, i.e. the circumpolar part, is composed of a much thinner wall, being therefore lighter-coloured than the anuli. The proximal side of the spore punctate, rays of trilete mark thin, slightly undulate, reaching the equatorial anulus. The sides of the spore straight, the corners slightly rounded.

TURMA ZONALES BENNIE ET KIDSTON 1886, EMEND. R. POTONIÉ 1956

SUBTURMA ZONOTRILETES WALTZ 1935

INFRATURMA ZONATI R. POTONIÉ ET KREMP 1954

## Genus *Styxisporites* Cookson et Dettmann 1958

### *Styxisporites granulatus* Pautsch

Pl. V, fig. 2

Dimensions: diameter of spores: 60—99 μ mean 75 μ
breadth of zona: 5—10 μ

Number of specimens: 3, all suitable for measurement.

Distribution: Upper Keuper of Trzciana.

Description: Three specimens were found, one of which lies polarly, the two others equatorially. In polar view the shape of the spore is subtriangular and in equatorial view flat-conical. The lists slightly convex and wavy reach the margins of the spore. Around the equator a zona 5—10 μ wide occurs with a slightly wavy margin. The sculpture on the whole spore is granulate or infragranulate. Exine light brown. On the distal side, beginning from the equator, the spore is covered with spinae about 3 × 1·5 μ in size.

TURMA MONOLETES IBRAHIM 1933

SUBTURMA AZONOMONOLETES LUBER

## Genus *Leschikiisporis* R. Potonié 1958

### *Leschikiisporis aduncus* Leschik, emend. R. Potonié

Pl. IV, fig. 2—3

Synonyms: *Punctatosporites aduncus* Leschik (43 × 38 μ)
„ *rimosus* Leschik (32 × 27 μ)
„ *stellarius* Leschik (26 μ)
*Punctatasporites percussus* Leschik (33 × 23 μ)

Dimensions: length of sporomorphs: 26—34 μ mean 31 μ
breadth of sporomorphs: 22—32 μ „ 27 μ
length of laesura: 11—32 μ „ 17 μ
diameter of pores: 7— 8 μ
thickness of wall: 1— 2 μ

Number of specimens: 24, all suitable for measurement.

Distribution: Middle Keuper from Neuwelt near Basel, Lower Keuper of the Harz Mts Foreland, Lower and Upper Keuper of Trzciana.

Description: Spores oval or round with monolete laesura, which in some specimens is bent at an angle or has ends bent centripetally. There often occurs an additional fissure perpendicular to the laesura. In some specimens there are one or several small, round pores (1 μ) and in others large, single pores mostly about 8 μ in size. Exine 1—2 μ thick, infragranulate. Grana sometimes slightly protruding above the wall. Colour of spores greyish-yellow to light-brown.

Spores with a single list and single small pore were described by Leschik from the Middle Keuper from Neuwelt near Basel and named *Punctatosporites rimosus*. From the same finding Leschik also described spores with a single list and an additional fissure perpendicular to it, giving them the name of *Punctatosporites aduncus*. Infragranulate, oval spores with three small pores, also from the Keuper from Neuwelt near Basel were described by Leschik as *Punctatasporites percussus*. From the same locality he also described granulate, round spores with a single round pore 8 μ in diameter, calling them *Punctatosporites stellarius*. Spores of the *Punctatosporites aduncus* Leschik type were also found by Mädler in sediments of the Lower Keuper of the Harz Mts Foreland. This author accepted the name emended by Potonié, i.e. *Leschikiisporis aduncus*. Mädler compares the latter form to spores *Asterotheca meriani* Brongniart, emend. Stur, on the basis of the work of Bharadwaj and Singh (1956). From the Middle Keuper from the locality of Lunz these authors described isospores removed from sporangia *Asterotheca meriani*, noting among them a considerable morphological variability. The essential type of the structure is oval form with monolete laesura. However, there also occur forms with a smaller or larger additional fissure disposed perpendicularly to the laesura. Mädler drew the conclusion that the perpendicular fissure is of secondary origin, since he observed that it sometimes passes to the other side of the laesura. In his opinion, *Punctatosporites rimosus* Leschik with a monolete laesura bent at the ends and a single small pore, belongs to *Leschikiisporis aduncus*. He considers it to be an immature form. Mädler also suggests that *Punctatosporites stellarius* and *Punctatasporites percussus* belong to *Leschikiisporis*. Mädler's assumption is right. In the material from Trzciana a specimen was found (Pl. IV, fig. 3), which on account of its round shape and round, radially striated membrane of the pore 8 μ in diameter, can be assigned to *Punctatosporites stellarius* and at the same time possesses a monolete laesura with a defined additional perpendicular fissure, permitting its classification with the species *Punctatosporites aduncus*. There also found several specimens with a monolete laesura and small pores one to five in number, combining therefore features of *Punctatosporites rimosus* with those of *Punctatasporites percussus*. As concerns the size of *Leschikiisporis aduncus*, the specimens from Trzciana are

slightly smaller than those described by Leschik from the Middle Keuper from Neuwelt near Basel, as well as from the specimens from the Lower Keuper of the Harz Mts Foreland, measured by Mädler.

## Genus *Echinitosporites* Schulz et Krutzsch 1961

### *Echinitosporites iliacoides* Schulz et Krutzsch

Pl. IV, fig. 4

| | | | |
|---|---|---|---|
| Dimensions: | diameter of body: | 35—40 μ | mean 37 μ |
| | height of columnae: | 5—10 μ | „ 7 μ |
| | breadth of columnae: | 2— 6 μ | „ 4 μ |

Number of specimens: 5, all suitable for measurement.

Distribution: Keuper of the Lower Lusatia, Lower and Upper Keuper of Trzciana.

Description: Spore circular in polar view, reniform in equatorial view, with large columnae. These columnae are much larger on the distal side, amounting to 10 μ in height and 6 μ in breadth. The proximal part in the specimens from Trzciana is grooved, making it impossible to measure the columnae of this part, or determine other details of their structure.

*Echinitosporites iliacoides* spores were described by Schulz and Krutzsch from the Keuper of the Calau boring. These authors observed that the proximal side of this species is punctate and has a monolete laesura disposed centrifugally.

The sculpture of the distal side is very characteristic, permitting the determination even of crumpled specimens.

## TURMA ALETES IBRAHIM 1933

### SUBTURMA AZONALETES LUBER, EMEND. R. POTONIÉ ET KREMP 1954

## Genus *Laricoidites* R. Potonié, Thomson et Thiergart 1950

### *Laricoidites subcarpaticus* Pautsch

Pl. VII, fig. 3

| | | | |
|---|---|---|---|
| Dimensions: | length of sporomorphs: | 66—147 μ | mean 107 μ |
| | breadth of sporomorphs: | 53—127 μ | „ 96 μ |
| | thickness of wall: | 1·5— 2 μ | |

Number of specimens: 19, 17 of which suitable for measurement.

Distribution: Lower and Upper Keuper of Trzciana.

Description: Large, roughly circular sporomorphs with usually numerous secondary folds. Exine indistinctly infragranulate, light-brown or less frequently yellow. Its thickness ranges from 1·5 to 2 μ. On some specimens there appears a very slightly pronounced monolete laesura.

TURMA SACCITES ERDTMAN 1947

SUBTURMA MONOSACCITES CHITALEY 1951, EMEND. R. POTONIÉ ET KREMP 1954.

INFRATURMA TRILETESACCITI LESCHIK 1955

## Genus *Ellipsosaccus* Pautsch

### *Ellipsosacus subcarpaticus* Pautsch

Pl. VI, fig. 3

| | | | | |
|---|---|---|---|---|
| Dimensions: | length of specimens: | 166—209 μ | mean | 195 μ |
| | breadth of specimens: | 101—132 μ | „ | 125 μ |
| | length of body: | 65— 98 μ | „ | 83 μ |
| | breadth of body: | 58— 98 μ | „ | 77 μ |
| | smallest length of bladder: | 11— 24 μ | „ | 19 μ |
| | largest length of bladder: | 47— 65 μ | „ | 57 μ |
| | trilete mark rays: | 7— 12 μ | | |
| | diameter of infrareticulum lumina: | up to 8 μ | | |

Number of specimens: 6, all suitable for measurement.

Distribution: Lower Keuper of Trzciana.

Description: Large monosaccate sporomorph oval in shape. Body round or slightly oval. Its proximal and distal part without bladder. The wall of the body almost smooth. On the proximal side of the body a trilete shaped laesura. The bladder, surrounding the body ringwise at the equator, has infrareticulum, and is much shorter at the ends of the broad axis of the sporomorph. The inside diameter of infrareticulum lumina attains up to 8 μ.

INFRATURMA MONOLETESACCITI PAUTSCH

## Genus *Aratrisporites* Leschik 1955, emend. Klaus 1960, emend. Pautsch

Presumable synonyms: Genus *Simplicesporites* Leschik 1955
„ *Striatisporites??* Leschik 1955
„ *Trizonatisporites* Leschik 1955
„ *Thomsonisporites* Leschik 1955
„ *Saturnisporites* Klaus 1960

Spores *Aratrisporites* correspond morphologically to the microspores of the contemporaneous genus *Isoëtes*. The roof-shaped swelling of exoexine above the laesura in the contemporaneous genus *Isoëtes* (G. Erdtman, 1957, p. 68) is not, for the most part, shrunken in the herbarial material. In the fossil *Aratrisporites* the swelling is always wrinkled and shrunken. This shrinkage is probably the result of fossilization. However, it may well be that initially the swelling was smaller in *Aratrisporites*. In 1960 Klaus drew attention to the resemblance of *Aratrisporites* to microspores of the presumable *Isoëtales* (*Lycostrobus scotti* Nathorst).

Spores of the *Aratrisporites* type of structure were found in 1965 by Helby and Martin in cones of the genus *Cylostrobus* Helby et Martin in sediments of the Lower Triassic of New South Wales. These authors suggest that there is a relationship between these cones and the stems of *Lycopsida* found by them in the same layers. Referring to the stem of the genus *Grammaephloios* described by Harris (1935) from the Rhaetic-Lias of Greenland, they consider it certain that arborescent *Lycopsida* occurred in the Mesozoic.

Nathorst (1908, p. 8) is also of the opinion that *Lycostrobus scotti* is a cone of an arborescent species of *Lycopodiinae*.

Microspores of *Cylostrobus sydneyensis* Walkom, emend. Helby et Martin (26—29 μ), *C. major* Helby et Martin (30—34 μ), and *C. grandis* Helby et Martin (31—42 μ) are smaller than the microspores of *Aratrisporites* Leschik, emend. Klaus occurring as sporae dispersae in Europe (with the exception of *Aratrisporites rotundus* Mädler). However, it is not known whether the encountered spores of the genus *Cylostrobus* proceed from mature cones. Mädler (1964), on the basis of material from the Lower Keuper of the Harz Mts Foreland, considers that the difference in morphology between the genera *Saturnisporites* Klaus and *Aratrisporites* (Leschik) Klaus is not sufficient to prove the existence of two genera, and keeps to the name of the older genus, i.e. *Aratrisporites*. Sporomorphs of this type of structure in the material from the Alps Carnian are extremely finely developed and well preserved, as I observed in a material offered me by W. Klaus. In the material from Trzciana sporomorphs of this type are not nearly so well preserved and have less distinctly developed features. I suppose that Mädler's material in this respect was presumedly similar, and he therefore decided to consider the two above discussed genera as one. On account of the state of preservation of the Trzciana material I am of Mädler's opinion in this matter.

Neither do Bharadwaj and Singh (1964) distinguish *Saturnisporites* as a separate genus. These authors rightly interpret the external envelope of *Aratrisporites* as a bladder, but, on the other hand, do not notice the swelling and laesura.

***Aratrisporites saturni*** Thiergart, emend. Mädler, emend. Pautsch

Pl. V, fig. 4

| | | | |
|---|---|---|---|
| Dimensions: | length of bladder: | 37—57 μ | mean 47 μ |
| | breadth of bladder: | 26—42 μ | „ 34 μ |
| | length of body: | 27—44 μ | „ 35 μ |
| | breadth of body: | 21—31 μ | „ 26 μ |

Number of specimens: 297, 42 of which suitable for measurement.

Distribution: Middle Keuper of North Germany, Lower Keuper of the Harz Mts Foreland, Lower and Upper Keuper of Trzciana, and presumably Carnian of the Eastern Alps.

Description: Spore oval in polar view, with monolete laesura, surrounded by a bladder also oval in outline. The bladder in this species protrudes beyond the body by about one sixth of its breadth, and a little more at the ends of the long axis. The swelling of the bladder in the proximal part is slightly contracted, being bent or undulate in the middle part. The exine is granulate or infragranulate with no tendency to secondary folds. In some species there occur spinae about 1 μ long, very loosely dispersed on the surface of the wall. The colour of the sporomorph varies from greenish-yellow to light brown. Thiergart (1949) described a sporomorph of similar structure from the Middle Keuper of Holstein, naming it *Pollenites saturni*. Klaus (1960) considers that Thiergart's form differs from those found by him in the Alps Carnian in its smooth exine. Mädler (1964), on the other hand, maintais that Thiergart's species is identical with *Saturnisporites granulatus* Klaus and gives it the name of *Aratrisporites saturni* Thiergart, emend. Mädler. It would be difficult to settle this question without seeing Thiergart's original material, since the photograph included in his work is not distinct enough, and the description rather short. Until no other elaboration of Thiergart's material is carried out Mädler's opinion may be accepted, since it simplifies the problem.

***Aratrisporites virgatus*** Leschik, emend. Mädler, emend. Pautsch

Pl. VII, fig. 2

| | | | |
|---|---|---|---|
| Dimensions: | length of bladder: | 39—47 μ | mean 41 μ |
| | breadth of bladder: | 27—40 μ | „ 33 μ |
| | length of body: | 22—35 μ | „ 30 μ |
| | breadth of body: | 16—32 μ | „ 23 μ |

Number of specimens: 90, 21 of which suitable for measurement.

Distribution: Middle Keuper from Neuwelt near Basel, Lower Keuper of the Harz Mts Foreland, Lower and Upper Keuper of Trzciana.

Description: Oval monosaccate sporomorphs with monolete laesura. Exine infragranulate or granulate. In polar view the bladder extends beyond the outline of the body by 1/10—1/3 of its breadth. The body is slightly darker than the bladder. The wall of the bladder is thin, light-coloured, with strongly marked secondary folds, owing to which the outline of the bladder is usually irregular. The proximal convex swelling of the bladder is often hardly distinguishable from the secondary folds.

Species *Aratrisporites rotundus* Mädler is very similar to *A. virgatus*. A diagram of the frequency of the occurrence of dimensions common for the two species, shows a two-summit curve with a violent fall of frequency for values of 35—39 μ. These values should therefore be regarded as limit values for the two species. The specific appurtenance of forms 36—38 μ in size remains doubtful (Table No 2). The size of *Aratrisporites virgatus* ranges for the most part from 40 to 42 μ.

### *Aratrisporites rotundus* Mädler, emend. Pautsch

Pl. VI, fig 1

| | | | |
|---|---|---|---|
| Dimensions: | length of bladder: | 27—35 μ | mean 32 μ |
| | breadth of bladder: | 21—32 μ | „ 28 μ |
| | length of body: | 17—29 μ | „ 25 μ |
| | breadth of body: | 14—26 μ | „ 21 μ |

Number of specimens: 71, 21 of which suitable for measurement.

Distribution: Lower Keuper of the Harz Mts Foreland, Lower and Upper Keuper of Trzciana.

Description: In polar view the outline of bladder and body is a rounded oval. The body is darker than the bladder. Exine infragranulate, thin, usually with secondary folds. The smallest *Aratrisporites* species occurring at Trzciana is morphologically very similar to *Aratrisporites virgatus* Leschik, emend. Mädler. Coinciding limits of values of the size of the two sporomorph species. Specimens 36—38 μ in size may belong to the two species. On the other hand, specimens ranging from 27 to 35 μ in size in all probability belong to *Aratrisporites rotundus* Mädler, emend. Pautsch.

### *Aratrisporites pilosus* Leschik, emend. Mädler, emend. Pautsch

Pl. V, fig. 3

| | | | |
|---|---|---|---|
| Dimensions: | length of bladder: | 40—49 μ | mean 43 μ |
| | breadth of bladder: | 40—44 μ | „ 42 μ |
| | length of body: | 32—42 μ | „ 37 μ |
| | breadth of body: | 27—31 μ | „ 29 μ |

Number of specimens: 4, all suitable for measurement.

Distribution: Middle Keuper from Neuwelt near Basel, Lower Keuper of the Harz Mts Foreland, Upper Keuper of Trzciana.

Description: Sporomorph oval, monosaccate with monolete laesura. Exine granulate, fairly thick and rigid, showing no tendency to secondary folds, with sparsely disposed spinae up to 6 μ in length. The sporomorph is of light-brown or greyish-yellow colour. The bladder is not lighter in colour than the body. The breadth of the swelling of exoexine on the proximal side amounts to 4 μ. The specimens from Trzciana are slightly larger than those from the Lower Keuper of the Harz Mts Foreland.

### *Aratrisporites scabratus* Klaus, emend. Pautsch

Pl. V, fig. 5

| | | | |
|---|---|---|---|
| Dimensions: | length of bladder: | 49—63 μ | mean 55 μ |
| | breadth of bladder: | 32—47 μ | „ 43 μ |
| | length of body: | 34—47 μ | „ 39 μ |
| | breadth of body: | 21—31 μ | „ 29 μ |

Number of specimens: 20, 16 of which suitable for measurement.

Distribution: Carnian of the Eastern Alps, Lower and Upper Keuper of Trzciana, Lunzen beds.

Description: Oval sporomorph with monolete laesura, surrounded with bladder. On the proximal side a distinct elevated, wrinkled fold. Exoexine infragranulate or granulate. Body darker than bladder. The bladder protrudes beyond the outline of the body by 1/4—1/7 of its breadth. Secondary folds of bladder fairly frequent. *Aratrisporites scabratus* was described by Klaus from Carnian sediments containing *Cardita gümbeli*. According to this author, it is one of the most characteristic species of sediments of this age.

### *Aratrisporites* cf. *fischeri* Klaus, emend. Pautsch

Pl. VIII, fig. 3

| | | | |
|---|---|---|---|
| Dimensions: | length of bladder: | 60—81 μ | mean 71 μ |
| | breadth of bladder: | 60—76 μ | „ 66 μ |
| | length of body: | 37—49 μ | „ 42 μ |
| | breadth of body: | 20—35 μ | „ 29 μ |

Number of specimens: 13, 7 of which suitable for measurement.

Distribution: Upper Keuper of Trzciana.

Description: Relatively large sporomorphs with a large, strongly folded bladder. The ridge on the proximal side runs sinuously beyond the outline of the body. Body darker than bladder. Bladder thin, granulate or

infragranulate, light-coloured. On its surface sparsely implanted single spinae about 1 μ in length. They are probably bases of broken hairs. Klaus described from layers with *Halobia rugosa* from the Eastern Alps very similar but larger sporomorphs with hairs 2—3 μ in length, calling them *Saturnisporites fischeri*. Since genus *Saturnisporites* was joined to genus *Aratrisporites*, this species ought to be called now *Aratrisporites fischeri*.

INFRATURMA ALETESACCITI LESCHIK 1955

## Genus *Circulisaccus* Pautsch

### *Circulisaccus major* Pautsch

Pl. VII, fig. 1 and 4, Pl. VIII, fig. 1

| | | | | |
|---|---|---|---|---|
| Dimensions: | diameter of specimens: | 122—252 μ | mean | 182 μ |
| | diameter of body: | 57—117 μ | „ | 91 μ |
| | length of bladder: | 37— 68 μ | „ | 50 μ |
| | diameter of infrareticulum lumina: | 3— 9 μ | | |

Number of specimens: 50, 35 of which suitable for measurement.

Distribution: Lower and Upper Keuper of Trzciana.

Description: Large, light-coloured, disk-shaped sporomorph, composed of a body and bladder surrounding it annularly. Body in polar view approximately circular, brown, without trilete mark or monolete laesura. The majority of specimens from Trzciana already have no body. There only remains on the distal side (?) a single thin wall, transparent, smooth, or with a very delicate reticulum, usually with numerous, thin secondary folds lying irregularly. Of the 50 specimens found only 5 had a body. Initially the body was probably circular or convex-lenticular, since in fossil state it is secondarily folded. The bladder is circular, placed in the equatorial part peripherally to the body. It is thin-walled, light yellow, circularly bulging in the uncrushed state. Its shape is reminiscent of a tyre. Infrareticulum irregular. Lumina of reticulum in the internal part of the bladder are often radially elongated. Around the central part there frequently occurs a cylindrical circular thickening at the distal and proximal root of the bladder.

### *Circulisaccus minor* Pautsch

Pl. VI, fig. 2 and 6

| | | | | |
|---|---|---|---|---|
| Dimensions: | diameter of specimens: | 37—57 μ | mean | 48 μ |
| | diameter of body: | 24—35 μ | „ | 33 μ |
| | length of bladder: | 3—14 μ | „ | 8 μ |
| | diameter of infrareticulum lumina: | 2— 6 μ | | |

Number of specimens: 16, 14 of which suitable for measurement.

Destribution: Lower and Upper Keuper of Trzciana.

Description: Sporomorph of medium size disk-shaped. Outline circular in polar view or slightly three-valve. The sporomorph is composed of a roughly circular body and bladder surrounding it in the equatorial part. The body is usually very light in colour or (in rare cases) brown. A loosely arranged infrareticulum occurs on it, or single muri, in which case the central part is mostly smooth. The body usually subsists with no tendency to form secondary folds. The bladder is for the most part smooth in outline, with infrareticulum often disposed radially. It is of greyish-yellow colour. Its roots are generally distinct.

## Genus *Institisporites* Pautsch

### *Institisporites crispus* Pautsch

Pl. IX, fig. 1 and 4

| | | | |
|---|---|---|---|
| Dimensions: | length of specimens: | 75—93 μ | mean 87 μ |
| | length of body: | 49—71 μ | „ 61 μ |
| | breadth of body: | 57—66 μ | „ 61 μ |
| | length of bladders: | 26—37 μ | „ 32 μ |
| | breadth of bladders: | 32—45 μ | „ 37 μ |
| | length of flounce: | 9—19 μ | „ 13 μ |

Number of specimens: 5, all suitable for measurement.

Distribution: Lower and Upper Keuper of Trzciana.

Description: Sporomorph bi- or less frequently trisaccate with bladders joined by a creased stripe of inflated exoexine. Body with a relatively thick, brown, fine-granulate wall. Grana partly protrude above the wall, causing the outline of the body to look dentate. On the distal side an oval part of thinner wall visible in the centre. Bladders and flounce situated entirely on the distal side. Light in colour, without infrareticulum, probably punctate or infragranulate. Smooth outline of bladders and flounce. The bladders are five times the length of the wavy stripe. One specimen has an additional third bladder, slightly smaller than the others.

SUBTURMA DISACCITES COOKSON 1947

INFRATURMA STRIATITI PANT 1954

## Genus *Taeniaesporites* Leschik 1955

### *Taeniaesporites* cf. *kräuseli* Leschik

Pl. IX, fig. 2

| | | | |
|---|---|---|---|
| Dimensions: | length of specimens: | 50—78 μ | mean 62 μ |
| | length of body: | 32—53 μ | „ 41 μ |
| | breadth of body: | 34—44 μ | „ 39 μ |

| | |
|---|---|
| length of bladders: | 16—32 μ „ 24 μ |
| breadth of bladders: | 32—49 μ „ 42 μ |

Number of specimens: 5, all suitable for measurement.

Distribution: Lias from Höganäs, Keuper from Neuwelt near Basel, Carnian of the Eastern Alps, Lower and Upper Keuper of Trzciana.

Description: Light-coloured, bisaccate sporomorph; body with taeniae. The body has three striae. Reticulum occurs on the proximal side of the body, disappearing gradually on the sides of the sporomorph. The distal side of the body almost smooth. The distal roots of bladders straight. No joining of bladders occurs in the equatorial part.

Sporomorphs *Taeniaesporites kräuseli* Leschik from the Keuper from Neuwelt near Basel, from the Carnian of the Eastern Alps, and from the Lias of Höganäs are smaller than the specimens found at Trzciana. The length of the body of specimens from Neuwelt is 30—36 μ, that of the bladders 18—23 μ. They sometimes have a larger number of taeniae than the specimens from Trzciana, but the essential character of the structure is the same.

## Genus ***Ovalipollis*** Krutzsch 1955, emend. Klaus 1960

### ***Ovalipollis lunzensis*** Klaus

Pl. VIII, fig. 2

| | | |
|---|---|---|
| Dimensions: | length of specimens | 73 μ |
| | length of body: | 49 μ |
| | breadth of body: | 37 μ |
| | length of bladders: | 24—29 μ |
| | breadth of bladders: | 39—42 μ |

Number of specimens: one.

Distribution: Carnian of the Eastern Alps, Lower Keuper of Trzciana. Keuper of the Pomerania-Kujawy Anticlinorium.

Description: Elongated, bisaccate sporomorph with monolete laesura. Body rhomboidal, infragranulate, with monolete straight laesura reaching the roots of bladders. Bladders wider than the body, with proximal root running along the rhomboidal margin of the body, the distal roots poorly visible, rather straight. Infrareticulum of bladders fairly small.

## Genus ***Striatites*** Pant 1955

### ***Striatites limpidus*** Balme et Hennelly emend. Jansonius

Pl. X, fig. 3

| | | |
|---|---|---|
| Dimensions: | length of specimens: | 62—80 μ mean 75 μ |
| | length of body: | 31—42 μ „ 39 μ |
| | breadth of body: | 42—63 μ „ 55 μ |

| | | | |
|---|---|---|---|
| length of bladders: | 17—34 μ | „ | 29 μ |
| breadth of bladders: | 45—68 μ | „ | 61 μ |

Number of specimens: 6, all suitable for measurement.

Distribution: Permian of Australia, Africa, and Canada, Lower and Upper Keuper of Trzciana, and probably Lower Keuper of the Harz Mts Foreland.

Description: Light-coloured, bisaccate sporomorph with striate body and bladders tending to join in the equatorial part. Body oval, broader than long. On the proximal sile has narrow, poorly visible striae, separated by taeniae 3—8 μ in breadth. The striae run irregularly, often branching or converging. Bladders more or less arcuate entirely surrounding the body. They often adjoin or join at the equator, owing to which the sporomorph seems to be monosaccate.

Similar sporomorphs were described by Mädler (1964) from the Lower Keuper of the Harz Mts Foreland as *Mesostriatites hercynicus*. However, the two specimens found by Mädler are secondarily deformed and without having examined well preserved specimens of this species it would be difficult to join it to, or separate it from *Striatites limpidus*. Mädler's description rather suggests a synonymity of the two species.

### *Striatites elongatus* Pautsch

Pl. X, fig. 2

| Dimensions: | | | | |
|---|---|---|---|---|
| | length of specimens: | 68—111 μ | mean | 90 μ |
| | length of body: | 40— 94 μ | „ | 61 μ |
| | breadth of body: | 35—62 μ | „ | 48 μ |
| | length of bladders: | 24—47 μ | „ | 36 μ |
| | breadth of bladders: | 36—66 μ | „ | 54 μ |
| | breadth of taeniae: | 2— 8 μ | | |
| | number of striae: | 6— 9 μ | | |
| | distance between the distal roots of bladders: | 6—22 μ | „ | 14 μ |

Number of specimens: 21, 19 of which suitable for measurement.

Distribution: Lower and Upper Keuper of Trzciana.

Description: Sporomorph light yellow, bisaccate, elongated, with striae on the body. Body oval, longer than broad. Reticulum occurs on its proximal side, the exoexine of this part being cut by narrow striae. Taeniae and striae run elong the long axis of the body. The striae do not always run regularly; they thin out, joining or else branching. The breadth of taeniae ranges from 2 to 8 μ. The distal part has no sculpture. Bladders semicircular with distal roots straight or slightly concave and proximal

roots without thickenings. Infrareticulum of bladders irregular with polygonal lumina. The distance between the bladders on the distal side is about 1/3 of the body length.

## Genus *Faunipollenites* Bharadwaj 1962

### *Faunipollenites subcarpaticus* Pautsch

Pl. X, fig. 1

| | | | | |
|---|---|---|---|---|
| Dimensions: | length of specimens: | 86—98 μ | mean | 93 μ |
| | length of body: | 50—53 μ | „ | 51 μ |
| | breadth of body: | 60—70 μ | „ | 65 μ |
| | length of bladders: | 29—35 μ | „ | 32 μ |
| | breadth of bladders: | 58—70 μ | „ | 63 μ |
| | distance between distal roots: | 24—31 μ | „ | 27 μ |
| | breadth of the part with striae: | 32—42 μ | „ | 36 μ |
| | diameter of infrareticulum lumina: | 2— 4 μ | | |

Number of specimens: 3, all suitable for measurement.

Distribution: Lower Keuper of Trzciana.

Description: Bisaccate sporomorph, widely oval, with striae running archwise; light in colour. Body thin-walled, infragranulate. On the proximal side striae occur, occupying the central part. The marginal striae run archwise, the area occupied by them being roughly oval in shape. The width of this area is slightly larger than half the body width. There usually occur 4 distinct striae, running in accordance with the long axis of the sporomorph. The two external striae are ellipsoidally bent, the internal ones being straight. The internal striae sometimes thin out or branch. In one specimen an additional striae was noted beyond the oval central part. It shows a greater curvature than that of the striae of the oval. Bladders semicircular. Distal roots distinct, straight, parted to a distance of about 27 μ. Infrareticulum rather fine.

## Genus *Infirmisporites* Pautsch

### *Infirmisporites fragilis* Pautsch

Pl. IX, fig. 3, pl. X, fig. 4

| | | | | |
|---|---|---|---|---|
| Dimensions: | length of sporomorphs: | 70—81 μ | mean | 73 μ |
| | length of body: | 47—52 μ | „ | 50 μ |
| | breadth of body: | unknown | | |
| | length of bladders: | 19—26 μ | „ | 24 μ |
| | breadth of bladders: | 42—60 μ | „ | 49 μ |
| | breadth of stripes of thickened exine: | 6— 8 μ | „ | 7 μ |
| | breadth of thickenings near proximal roots: | 3— 6 μ | „ | 4 μ |

Number of specimens: 13, 5 of which suitable for measurement.

Distribution: Lower and Upper Keuper of Trzciana.

Description: Bisaccate sporomorph of medium size, with delicate exine of the body and two thickened stripes on it. Body: oval, longer than broad. Wall of body very thin, light-coloured, entirely devoid of sculpture. In well preserved specimens two longitudinally disposed thickened exine stripes about 7 μ in breadth occur on the proximal side. The stripes run slightly obliquely and convergently in the shape of the letter X towards the proximal pole. Most of the specimens have a poorly preserved body, the proximal part often being torn out. The poor state of preservation makes it impossible to determine the actual breadth of the body. Bladders much better preserved, often encountered separately. Crescent-shaped. Their greatest breadth occurs at the root. Along the proximal root a crescent-shaped part of thickened exine extends with a smooth surface. The average breadth of this part in its widest place is 4 μ. Sometimes there also occurs a thickened zone without sculpture in the equatorial part of the bladders near their root. Infrareticulum fairly fine and rather irregular. The largest lumina of reticulum are up to 4 μ in diameter.

## Genus *Umbrellisaccus* Pautsch

### *Umbrellisaccus sulcatus* Pautsch

Pl. XI, fig. 1 and 3

Synonym: *Pollenites sulcatus* Pautsch 1958

| Dimensions: | | | |
|---|---|---|---|
| length of specimens: | 88—173 μ | mean | 113 μ |
| length of body: | 49—101 μ | „ | 71 μ |
| breadth of body: | 34— 81 μ | „ | 58 μ |
| length of bladders: | 32— 78 μ | „ | 49 μ |
| breadth of bladders: | 58—107 μ | „ | 78 μ |
| distance between distal roots: | 3— 22 μ | „ | 14 μ |
| thickness of bladders wall: | 2— 6 μ | „ | 3 μ |
| number of striae: | 2— 4 μ | „ | 3 μ |

Number of specimens: 21, 20 of which suitable for measurement.

Distribution: Keuper of the Pomerania-Kujawy Anticlinorium, Lower Keuper and lower part of the Upper Keuper of Trzciana.

Description: Large, brown, bisaccate sporomorph. Body with striae and thick-walled bladders broader than the body. Body oval, always longer than broad. On the proximal side entirely covered with exoexine, which gradually disappears in the distal direction. Exoexine disrupted by narrow taeniae, running longitudinally over the whole body up to the root of bladders. That is why in polar view the outline of the body near the proximal roots of bladders presents a notched line. The convex parts are the places covered by exoexine, whereas the notches correspond to

the section of striae. Taeniae are 2 to 4 in number. No fissures were noted in intexine. On the proximal pole a stripe of exoexine usually occurs, or less frequently a stria. The polar exoexine stripe is limited on the sides by two striae, which appear to be essential, since they occur in all specimens. Sporomorphs of this species found by the author in the Keuper of Świerczyna (Pomerania-Kujawy Anticlinorium) showed no more than two striae. Those occurring in the Keuper of Trzciana have a variable number of striae. In this material branches of striae are often encountered, this leading to the formation of additional islets of exoexine, between the basic exoexine stripes. Sometimes the stria does not run over the whole body but crosses only 1/4 or 3/4 of its length. The exoexine of the body is infragranulate, smooth in outline. Bladders semicircular or shorter, rigid, with a thick wall (2—6 μ). In lateral view convex triangular. Straight distal root of bladders. The breadth of bladders always much larger than that of the body. In polar view the bladders protrude beyond the body. They are darker than the latter and possess a thicker wall, which gives a characteristic appearance, reminiscent of a mushroom top or umbrella. Reticulum of bladders very fine; the inside diameter of lumina ranges from 2 to 4 μ.

INFRATURMA DISACCITRILETI LESCHIK 1955

## Genus *Illinites* Kosanke 1950

### *Illinites chitonoides* Klaus

Pl. XI, fig. 4, pl. XII, fig. 1

Synonyms: *Sahnisporites thuringensis* Schulz
*Succinctisporites grandior* Leschik in Mädler 1964

| Dimensions: | | | |
|---|---|---|---|
| length of specimens: | 71—135 μ | mean | 98 μ |
| length of body: | 57— 93 μ | „ | 74 μ |
| breadth of body: | 60— 98 μ | „ | 72 μ |
| distance between external striae: | 44— 76 μ | „ | 53 μ |
| length of bladders: | 32— 60 μ | „ | 45 μ |
| breadth of bladders: | 57— 99 μ | „ | 74 μ |
| distance between distal roots: | 0— 32 μ | „ | 9 μ |
| diameter of reticulum lumina: | 3— 8 μ | | |

Number of specimens: 198, 79 of which suitable for measurement.

Distribution: Upper Roethian of Thuringia, Lower Keuper of the Harz Mts Foreland, Lower and Upper Keuper of Trzciana.

Description: Bisaccate sporomorph, oval in outline, with three

more or less visible fissures on the proximal side of the body. Body of medium length slightly larger than the mean breadth. On its proximal side three longitudinal fissures, one of which is disposed centrally, and the two others at a distance of 1/6—1/8 of the body breadth, counting from its margin. The middle fissure (laesura) is usually straight or much less frequently bent at an angle, the lateral ones being semicircularly curved. Their curvature is greater than that of the margin of the body in polar view. The breadth of fissures amounts to only 1 μ. Under the microscope they appear as transparent thinnings of exine. The margins of fissures are not thickened, in this species a specimen without secondary folds covering the striae was hardly ever found. The length of fissures, especially of the lateral ones, is fairly variable. The breadth of the body equals or is a little smaller than that of the bladders. The distal roots of bladders are straight and set apart 9 μ on the average. Between them is a stripe of thinner wall without sculpture. The colour of the sporomorph varies from yellow to brown. The diameter of infrareticulum lumina amounts to 8 μ.

## Genus *Angustisulcites* Freudenthal 1964, emend. Visscher, 1966

### *Angustisulcites klausii* Freudenthal

Pl. XI, fig. 2

| | | | |
|---|---|---|---|
| Dimensions: | length of specimens: | 65—91 μ | mean 75 μ |
| | length of body: | 37—65 μ | „ 46 μ |
| | breadth of body: | 37—55 μ | „ 42 μ |
| | length of bladders: | 27—44 μ | „ 33 μ |
| | breadth of bladders: | 39—68 μ | „ 48 μ |
| | length of laesura: | 31—40 μ | „ 35 μ |
| | diameter of reticulum lumina: | 2— 8 μ | |

Number of specimens: 6, all suitable for measurement.

Distribution: Lower Keuper of Trzciana.

Description: Bisaccate sporomorph of medium size, dark yellow with bent laesura running through the proximal pole. Body round or oval, in which case its length is larger than breadth. Wall of body fairly thick, granulate, darker than the wall of bladders. On the proximal side of the body along the long axis a straight or bent laesura. At an acute angle to it another short laesura occurs in some specimens. The bladders are broader than the body and relatively large. Near their distal roots two secondary folds occur, parallel to the transverse axis of the sporomorph.

INFRATURMA DISACCIATRILETI LESCHIK 1955

## Genus *Caytonipollenites* Couper 1958

### *Caytonipollenites pallidus* Reissinger, emend. Couper

Pl. VI, fig. 4—5

| | | | |
|---|---|---|---|
| Dimensions: | length of specimens: | 35—40 μ | mean 37 μ |
| | length of body: | 10—16 μ | „ 14 μ |
| | breadth of body: | 16—24 μ | „ 20 μ |
| | length of bladders: | 13—17 μ | „ 15 μ |
| | breadth of bladders: | 19—27 μ | „ 22 μ |

Number of specimens: 11, 8 of which suitable for measurement.

Distribution: Lias of Germany, Lias from Höör, Lower Keuper of the Harz Mts Foreland, Upper Keuper of Trzciana.

Description: Very small bisaccate sporomorph with transparent exine. Body oval, much broader than long. Exine of body without sculpture or any trace of trilete mark. Bladders semicircular in polar view. At their proximal roots a narrow thickened exine stripe (1—2 μ). The bladders near the thickening somewhat wrinkled. Outline of proximal root of bladders slightly crescent-shaped. Straight distal roots of bladders. On the distal side the bladders lie several microns apart. Reticulum lumina 1—1·5 μ in diameter, roughly round. The breadth of bladders usually slightly larger than that of the body. Sporomorphs of this genus were first described by Reissinger (1950) from the Lower Lias of Nurnberg. In 1958 Couper presented a photograph of forms removed from anthers of *Caythonianthus arberi* Thomas, emend. Harris comparing them rightly to the forms found by Reissinger. In 1964 Mädler found similar sporomorphs in the Lower Keuper of the Harz Mts Foreland, accepting for them the name given by Reissinger and emended by Couper, i.e. *Caytonipollenites pallidus* Reissinger, emend. Couper. On the other hand, Mädler considers that the forms found by Couper in the Jurassic and Cretaceous of England, being sporae dispersae, belong to a different species. The vertical area of distribution of *Caytonipollenites pallidus* Reissinger, emend. Couper sensu Mädler extends, according to this author (1964), from the Lower Keuper to the Dogger.

## Genus *Alisporites* Daugherty 1941, emend. Mädler 1960

### *Alisporites aequalis* Mädler

Pl. XIII, fig. 1—2

| | | | |
|---|---|---|---|
| Dimensions: | length of specimens: | 81—129 μ | mean 99 μ |
| | length of body: | 57— 93 μ | „ 73 μ |
| | breadth of body: | 60— 98 μ | „ 81 μ |

| | | | |
|---|---|---|---|
| length of bladders: | 31— 52 μ | „ | 42 μ |
| breadth of bladders: | 59— 98 μ | „ | 77 μ |
| distance between distal roots of bladders: | 4— 24 μ | „ | 13 μ |
| diameter of reticulum lumina: | 3— 8 μ | | |

Number of specimens: 236, 33 specimens were measured.

Distribution: Lower Keuper of the Harz Mts Foreland, Lower and Upper Keuper of Trzciana.

Description: Bisaccate sporomorph, oval in outline, light yellow. Body oval, of broad axis larger on the average than the long axis, without laesura on the proximal side. The sculpture of the body composed of a very fine reticulum. On the distal side between the roots of the bladders a stripe of thinner wall without sculpture. The distal roots of bladders usually straight. The bladders on the distal side distinctly separated. Infrareticulum irregular with a greatly varying diameter of lumina in one specimen. Crumpled specimens are difficult to distinguish from *Illinites chitonoides* Klaus. Mädler (1964) found a single specimen of the *Alisporites aequalis* species in the Lower Keuper of the Harz Mts Foreland and chose it as the holotype. The disposition of this specimen (Pl. X, fig. 11) is not perfectly polar, not showing therefore the actual ratio of the body breadth to that of the bladders. The breadth of the latter is slightly smaller on the average in this species than the body breadth, as follows from the data obtained in the material from Trzciana. As concerns the length of the body of the holotype, it cannot be wholly measured since its margins near the proximal roots are slightly turned up. The other specimen (Pl. X, fig. 12) assigned by Mädler to *Alisporites aequalis* belongs to a species different from the holotype. It differs from the latter in the presence of a sulcus grooved on the distal side, and in different shaped bladders.

## Genus *Complicatisaccus* Pautsch

### *Complicatisaccus perlucidus* Pautsch

Pl. XIV, fig. 2—3

| Dimensions: | | | | |
|---|---|---|---|---|
| length of specimens: | 57—75 μ | mean | 64 μ |
| length of body: | 32—44 μ | „ | 36 μ |
| breadth of body: | 37—53 μ | „ | 45 μ |
| length of bladders: | 17—29 μ | „ | 23 μ |
| breadth of bladders: | 35—50 μ | „ | 45 μ |

Number of specimens: 7, all suitable for measurement.

Distribution: Lower and Upper Keuper of Trzciana.

Description: Bisaccate sporomorph, light in colour, of medium size, oval, without trilete mark or monolete laesura, with characteristic secondary folds along the proximal roots of bladders. Body in well

preserved specimens curls in crescent-shaped secondary folds near the proximal roots of the bladders. Exine of the body infragranulate or fine-reticulate, not transparent, greyish-yellow, not differing in colour from the exine of bladders, or only slightly darker. Bladders: proximal roots covered with secondary folds. Distal roots straight. Infrareticulum fairly regular, reticulum lumina polygonal, approximately round. Diameter of lumina up to three microns. Body and bladders of the same breadth.

## Genus *Diaphanisporites* Pautsch

### *Diaphanisporites diaphanus* Pautsch

Pl. XII, fig. 3

Synonym: *Caytoniales — Pollenites diaphanus* Pautsch 1958.

| Dimensions: | | | |
|---|---|---|---|
| length of sporomorphs: | 37—62 μ | mean | 50 μ |
| length of body: | 14—32 μ | „ | 27 μ |
| breadth of body: | 31—45 μ | „ | 39 μ |
| length of bladders: | 13—24 μ | „ | 17 μ |
| breadth of bladders: | 24—45 μ | „ | 37 μ |
| diameter of reticulum lumina: | 3— 4 μ | | |

Number of specimens: 24, 14 of which suitable for measurement.

Distribution: Keuper of the Pomerania-Kujawy Anticlinorium, Lower and Upper Keuper of Trzciana.

Description: Small, bisaccate sporomorph, oval. Body transparent and light-coloured, bladders yellow. Body oval, much broader than long. Exine of the body smooth, sometimes with single muri or loose reticulum. Body slightly broader than the bladders. Bladders: the distal root crescent or less frequently almost straight. In polar view the proximal and distal roots overlap or lie close to each other. The greatest breadth of bladders occurs at their root, rapidly decreasing towards their end. The length of the bladders is on the average two thirds that of the body. At their proximal root a thickened stripe of exine is often visible. The specimens from Trzciana are very similar in shape, structure, and colour to those from the Pomerania-Kujawy Anticlinorium (borehole Świerczyna, 1958), differing only in being slightly larger in size. The length of the sporomorph in the specimens from the Anticlinorium amounts to 35—46 μ in those from Trzciana it ranges from 37 to 62 μ.

### *Diaphanisporites major* Pautsch

Pl. XII, fig. 4, pl. XIII, fig. 4

| Dimensions: | | | |
|---|---|---|---|
| length of specimens: | 63—70 μ | mean | 66 μ |
| length of body: | 25—32 μ | „ | 28 μ |
| breadth of body: | 39—44 μ | „ | 42 μ |

| | | | |
|---|---|---|---|
| length of bladders: | 18—26 μ | „ | 23 μ |
| breadth of bladders: | 40—45 μ | „ | 42 μ |

Number of specimens: 4, all suitable for measurement.

Distribution: Lower and Upper Keuper of Trzciana.

Description: Not very large bisaccate sporomorph angular-oval in outline. Body light in colour, much broader than long, infragranulate with a more or less distinct sulcus on the distal side. Bladders and body of the same breadth. The bladders possess an exine thickening along the proximal roots. Distal roots crescent. The length of bladders is on the average three fourths that of the body. The greatest breadth of bladders occurs at some distance from their roots. The arc of curvature of their termination (in polar view) is very broad, which gives the impression that they have a slightly angular shape. The bladders are of a greyish-yellow colour.

*Diaphanisporites major* Pautsch is similar in structure to pollens of *Caytonianthus oncodes* Harris, being, however, of a larger size.

## Genus *Cuneatisporites* Leschik 1955

### *Cuneatisporites* cf. *radialis* Leschik

Pl. XIII, fig. 3

| Dimensions: | | | | |
|---|---|---|---|---|
| length of specimens: | 65—106 μ | mean | 92 μ |
| length of body: | 37— 55 μ | „ | 47 μ |
| breadth of body: | 35— 52 μ | „ | 38 μ |
| length of bladders: | 37— 49 μ | „ | 42 μ |
| breadth of bladders: | 39— 55 μ | „ | 46 μ |
| diameter of infrareticulum lumina: | 3— 6 μ | | |

Number of specimens: 18, 14 of which suitable for measurement.

Distribution: Middle Keuper from Neuwelt near Basel, Lower and Upper Keuper of Trzciana.

Description: Bisaccate, elongated sporomorph with brown body. Body light or dark brown, oval or roundish, more or less distinctly granulate, with no traces of laesura on the proximal pole. On the average slightly longer than broad. Bladders very characteristically developed. Distal roots straight, set apart. Between them a distinct sulcus. The breadth of bladders at the distal root smaller than in their middle part. Reticulum lumina near the distal root narrow, elongated radially, whereas in the external part of the bladders roundish or polygonal. *Cuneatisporites radialis* found by Leschik in the Middle Keuper of Neuwelt has slightly smaller dimensions and the breadth of the sporomorph is comparatively smaller in relation to its length. The body is broader than long. However, the character of the structure of bladders and body is the same as in the specimens from Trzciana.

## Genus *Falcisporites* Leschik 1956, emend. Klaus 1960

### *Falcisporites keuperianus* Pautsch

Pl. XII, fig. 2

| | | | |
|---|---|---|---|
| Dimensions: | length of specimens: | 81—122 µ | mean 99 µ |
| | length of body: | 40— 73 µ | „ 60 µ |
| | breadth of body: | 49— 78 µ | „ 53 µ |
| | length of bladders: | 24— 42 µ | „ 32 µ |
| | breadth of bladders: | 44— 78 µ | „ 59 µ |
| | length of sulcus: | 4— 19 µ | „ 16 µ |
| | diameter of reticulum lumina: | 2— 8 µ | „ 4 µ |

Number of specimens: 61, 44 of which suitable for measurement.

Distribution: Lower and Upper Keuper of Trzciana.

Description: Light-coloured, elongated, bisaccate sporomorph, of fairly large size. Body usually longer than broad. Near the proximal roots of bladders crescent-shaped darkening of the wall (probably thickenings). No secondary folds were observed here. Near the proximal pole there are no thickenings of exine, neither does there appear a different sculpture or laesura. On the distal side of the body a distinct sulcus groove 16 µ long occurs. Bladders broader than long. Distal roots indistinct. Reticulum of bladders often almost reaches the groove.

Mädler (1964) presents in Plate 10, fig. 12 a photograph of a specimen coming from the Lower Keuper of the Harz Mts Foreland with a distinct sulcus groove on the distal side. This specimen is slightly smaller in length than in breadth as compared with the means for *Falcisporis keuperianus* from Trzciana, but still it could lie within the limits of variability accepted for this species.

## Genus *Brachysaccus* Mädler 1964

### *Brachysaccus* cf. *neomundanus* Leschik, emend. Mädler

Pl. XIV, fig. 1

| | | | |
|---|---|---|---|
| Dimensions: | length of sporomorphs: | 117—160 µ | mean 145 µ |
| | length of body: | 81—140 µ | „ 116 µ |
| | breadth of body: | 94—138 µ | „ 116 µ |
| | length of bladders: | 49— 88 µ | „ 68 µ |
| | breadth of bladders: | 94—151 µ | „ 119 µ |
| | diameter of infrareticulum lumina: | 3— 8 µ | |

Number of specimens: 58, 15 of which suitable for measurement.

Distribution: Lower and Upper Keuper of Trzciana.

Description: Large bisaccate sporomorphs rounded oval in shape, light brown. Body round or oval, usually poorly visible. Exine slightly

thickened on the proximal pole. However, no distinct comb occurs. Bladders semicircular with very fine infrareticulum. Their breadth equals that of the body. Straight distal roots. The specimens found by the author in the borehole at Trzciana are a little larger than those of L e s c h i k from the Keuper of Basel and relatively wider.

*Brachysaccus neomundanus* Leschik, emend. M ä d l e r also occurs in the Carnian of the Eastern Alps, its frequency there being greater in marine sediments than in terrestrial (K l a u s 1960).

*Brachysaccus neomundanus* sporomorphs were reported by M ä d l e r from the Lower Keuper of the Harz Mts Foreland as well.

*Brachysaccus aurentius* Pautsch, emend. Mädler from the Pomerania--Kujawy Anticlinorium is still larger than the specimens of *Brachysaccus* found at Trzciana and has a wall distinctly thinned in the equatorial part between the distal roots of bladders.

## Genus *Minutisaccus* Mädler 1964

### *Minutisaccus subcarpaticus* Pautsch

Pl. XV, fig. 1—2

| | | | |
|---|---|---|---|
| D i m e n s i o n s: | length of body: | 32—49 μ | mean 40 μ |
| | breadth of body: | 27—34 μ | „ 30 μ |
| | height of body: | 21—35 μ | „ 27 μ |
| | length of bladders: | 6—11 μ | „ 8 μ |
| | breadth of bladders: | 11—17 μ | „ 13 μ |
| | height of bladders: | 11—13 μ | „ 12 μ |

N u m b e r o f s p e c i m e n s: 139, 42 of which suitable for measurement.

D i s t r i b u t i o n: Lower and Upper Keuper of Trzciana.

D e s c r i p t i o n: Small bisaccate sporomorph with longitudinal body and comparatively very small, short bladders. Body oval. In straightened specimens the length distinctly larger than the breadth. Infragranulate sculpture of the distal side. In the deeper part of the wall fine indistinct reticulum with lumina of about 1 μ in diameter. Distal side smooth and with a thinner wall than dorsal side. The boundary between the area with and without sculpture is not always well defined. It runs archwise in the lateral view of the sporomorph. The part with the thinner wall is often grooved, owing to which the outline of the sporomorph becomes much shorter and the bladders are shifted to the distal side. The specimens in this position, disregarding the presence of bladders, are reminiscent of the *Cycadophyta* pollen. Bladders comparatively very small, short, fairly broad. Approximate in shape to semicircular warts being broadest at the base. Distinct reticulum. Light colour of body and bladders. Similar sporomorphs were described by M ä d l e r from the Lower

Keuper of the Harz Mts Foreland by the name of *Minutisaccus schizeatus*. However, this species differs from the specimens of *Minutisaccus subcarpaticus* Pautsch from Trzciana in the absence of infrareticulum in the proximal part of the body and in the presence of a more distinct sulcus disposed transversely to the long axis of the body. Moreover, it presumably has a slightly shorter and broader body. The length of *M. schizeatus* amounts to 30—38 μ, whereas in *M. subcarpaticus* it is 40 μ on the average; the breadth of the body in *M. schizeatus* ranges from 35 to 36 μ in *M. subcarpaticus* it amounts to 30 μ on the average. *M. schizeatus* possesses larger bladders (14 × 17 μ) than *M. subcarpaticus* (8 × 13 μ). *M. schizeatus* also differs in the sculpture of the body, which is infrapunctate, so that the wall has a smooth outline, whereas in *M. subcarpaticus* it usually is sligthly notched.

### *Minutisaccus ornatus* Pautsch

Pl. XV, fig. 5—6

| | | | |
|---|---|---|---|
| Dimensions: | length of body: | 22—34 μ | mean 29 μ |
| | breadth of body: | 19—29 μ | „ 23 μ |
| | length of bladders: | 5—12 μ | „ 8 μ |
| | breadth of bladders: | 8—14 μ | „ 11 μ |
| | height of bladders: | 9—14 μ | „ 11 μ |

Number of specimens: 16, all suitable for measurement.

Distribution: Lower and Upper Keuper of Trzciana.

Description: Small bisaccate sporomorph with characteristic ornamentation. Body: oval, always longer than broad. The wall of the proximal part of the body has two visible layers. Its ornamentation is composed of irregular granula half-raised, giving a slightly notched outline. The ornamented proximal part is brown, the distal being of a much lighter colour. Optically the wall of the distal part is one-layered. The boundary between the ornamented and non-ornamented part is sharply marked, running semicircularly in lateral view. No specimens with a grooved distal part were found, the thick and rigid proximal part having presumably prevented its forming. The bladders are small, broader than long of a light colour. *Minutisaccus potoniei* Mädler differs in its infragranulate body and shows no distinct boundary of the thinner distal part.

## Genus *Granisaccus* Mädler 1964

### *Granisaccus elongatus* Pautsch

Pl. XVI, fig. 1 and 3

| | | | |
|---|---|---|---|
| Dimensions: | length of specimens: | 63—89 μ | mean 76 μ |
| | length of body: | 55—80 μ | „ 66 μ |
| | breadth of body: | 45—78 μ | „ 56 μ |

| | | | |
|---|---|---|---|
| height of body: | 40—60 μ | „ | 51 μ |
| length of bladders: | 24—40 μ | „ | 31 μ |
| breadth of bladders: | 40—65 μ | „ | 52 μ |
| diameter of warts: | 2— 8 μ | | |
| diameter of reticulum lumina: | 1— 3 μ | | |

Number of specimens: 21, 16 of which suitable for measurement.

Distribution: Lower and Upper Keuper of Trzciana.

Description: Bisaccate sporomorph. Body covered with large irregular warts. Bladders thin and light-coloured. Body oval in polar view, high-vaulted in lateral view. On the proximal side uniformly covered with warts irregular in shape and size. Wall of body and warts of dark brown colour. Sharp boundary between the sculptured proximal part and the smooth distal part. The distal roots of bladders are set slightly apart, usually being arcuate and narrower than the body. On the long axis of the sporomorph the bladders project beyond the outline of the body. Their surface is covered with a very fine reticulum (1—2 μ). Absence of infrareticulum. Colour of bladders very light. Thin walls.

## Genus *Plicatisaccus* Pautsch

### *Plicatisaccus badius* Pautsch

Pl. XVIII, fig. 5

| | | | | |
|---|---|---|---|---|
| Dimensions: | length of specimens: | 53—73 μ | mean | 64 μ |
| | length of body: | 38—60 μ | „ | 50 μ |
| | breadth of body: | 34—49 μ | „ | 41 μ |
| | length of bladders: | 21—40 μ | „ | 31 μ |
| | breadth of bladders: | 32—49 μ | „ | 41 μ |

Number of specimens: 26, 20 of which suitable for measurement.

Distribution: Lower and Upper Keuper of Trzciana.

Description: Brown, bisaccate sporomorph with bladders radially folded or undulated. Body oval, thick-walled, much longer than broad. Sculpture probably infragranulate. In lateral view the outline of the body approximately triangular. In polar view the wall of the body bends and overlaps, giving the impression of a ruff around the body in the equatorial part. The breadth of this pseudo-ruff amounts to 5 μ on the average, at the most to 8 μ. Bladders brown with radially disposed rows of reticulum lumina and radial foldings of the wall, especially on the distal side. Distal roots of bladders crescent-shaped with indistinct boundary. The majority of specimens found at Trzciana have bladders secondarily and centripetally drawn together, so that a narrow parallel space is forming

between them. This space has undulate margins on account of the ridges of radial foldings of the wall of the bladders.

The sporomorph is very characteristic and easy to distinguish.

## Genus *Radiatisaccus* Pautsch

### *Radiatisaccus fulvus* Pautsch

Pl. XV, fig. 3—4

| | | | |
|---|---|---|---|
| Dimensions: | length of specimens: | 71—98 μ | mean 84 μ |
| | length of body: | 52—73 μ | „ 63 μ |
| | breadth of body: | 53—91 μ | „ 69 μ |
| | length of bladders: | 31—52 μ | „ 38 μ |
| | breadth of bladders: | 49—91 μ | „ 66 μ |
| | distance between distal roots of bladders: | 2—14 μ | „ 8 μ |
| | diameter of reticulum lumina: | 3— 8 μ | „ 4 μ |

Number of specimens: 19, 12 of which suitable for measurement.

Distribution: Lower Keuper and lower part of the Upper Keuper of Trzciana.

Description: Bisaccate, rufous sporomorphs. Bladders with radially disposed rows of reticulum lumina on the proximal side. Body: walls about 2 μ thick. Slightly broader than long. Sculpture fine, reticulate or infragranulate. Outline of proximal part almost smooth. Bladders fairly large. Less broad than the body. In polar view about one fourth of their length protrudes beyond the outline of the body. In the protruding part infrareticulum has radially disposed rows of lumina, reaching the margin of the body and breaking off there. In the other parts of the bladder irregular infrareticulum. Distal roots of bladders are straight. The distance between them ranges from 2 to 14 μ (8 μ on the average).

## Genus *Platysaccus* Naumowa, emend. R. Potonié et Klaus 1954

### *Platysaccus* cf. *papilionis* R. Potonié et Klaus

Pl. XVIII, fig. 1

| | | | |
|---|---|---|---|
| Dimensions: | length of specimens: | 114—155 μ | mean 135 μ |
| | length of body: | 50— 81 μ | „ 69 μ |
| | breadth of body: | 53— 84 μ | „ 67 μ |
| | length of bladders: | 45— 75 μ | „ 63 μ |
| | breadth of bladders: | 73—106 μ | „ 88 μ |
| | length of fissure: | up to 14 μ | |
| | infrareticulum lumina: | 3— 9 μ | |

Number of specimens: 15, 12 of which suitable for measurement.

Distribution: Permian of the Southern Alps, Lower Keuper of Trzciana.

Description: Large, bisaccate sporomorph with round body. Bladders larger than the body. Body mostly round or less frequently slightly oval, with relatively thick light- or dark-brown wall. Bladders usually light-coloured, sometimes brown, larger than semicircle, distinctly separated and set apart. The space between their distal roots amounts to 14 μ. Sometimes there occur foldings of the body accompanying these roots.

*Platysaccus papilionis* R. Potonié et Klaus was described from the „Kernsalz" of Hallstatt beds and subsequently reported by Klaus from the Gröden and Bellerophon beds of the Southern Alps (Permian). According to the dimensions given by Klaus, specimens of this species have a body slightly smaller (53 μ) than those found in the Lower Keuper of the Carpathians Foreland. The other morphological features are very much the same.

### ***Platysaccus nitidus*** Pautsch

Pl. XVI, fig. 2, pl. XVII, fig. 3

| | | | | |
|---|---|---|---|---|
| Dimensions: | length of sporomorphs: | 62—94 μ | mean | 78 μ |
| | length of body: | 40—71 μ | „ | 50 μ |
| | breadth of body: | 35—66 μ | „ | 48 μ |
| | height of body: | 45 μ | | |
| | length of bladders: | 24—49 μ | „ | 34 μ |
| | breadth of bladders: | 35—78 μ | „ | 55 μ |
| | height of bladders: | 29—31 μ | „ | 30 μ |
| | distance between distal roots: | 4—21 μ | „ | 10 μ |

Number of specimens: 50, 24 of which suitable for measurement.

Distribution: Lower and Upper Keuper of Trzciana.

Description: Light-coloured bisaccate sporomorph of medium size, usually with a secondary fold around the body appearing in polar view. Body slightly oval or round, without laesura. In polar view its proximal part bends forming a circular secondary fold very characteristic of this species. Wall fairly thin, indistinctly infragranulate or reticulate. Bladders of the same colour as the body. In polar view semicircular or larger than semicircle, always much broader than the body. The proximal roots overlap the internal margin of the secondary fold of the body. The distal roots straight, set apart to a mean distance of 10 μ.

Initially the wall of this species must have been very soft, hence the undulate outline of many specimens.

### *Platysaccus niger* Mädler

Pl. XVII, fig. 2

| | | | |
|---|---|---|---|
| Dimensions: | length of specimens: | 71—98 μ | mean 84 μ |
| | length of body: | 35—52 μ | „ 45 μ |
| | breadth of body: | 34—49 μ | „ 39 μ |
| | length of bladders: | 31—49 μ | „ 41 μ |
| | breadth of bladders: | 45—65 μ | „ 32 μ |

Number of specimens: 24, 18 of which suitable for measurement.

Distribution: Lower Keuper of the Harz Mts Foreland, Lower Keuper of the borehole at Trzciana, and single specimens in the Upper Keuper of Trzciana.

Description: Bisaccate sporomorph of medium size with a dark body and large light-coloured bladders, which are not always distinctly separated on the distal side. Body round or oval, brown, smooth or infragranulate. Specimens with oval body usually have longitudinal irregular foldings or splits in the wall. These splits often give the impression of a wavy laesura, or recall a tetraedric mark. Bladders broader than the body, light yellow. Some specimens have bladders which seem to be joined in the equatorial part. Reticulum polygonal. Some lumina are up to 8 μ in diameter. A specimen with distinctly separated bladders was described by Mädler from the Lower Keuper of the Harz Mts Foreland by the name of *Platysaccus niger*. Pollen of *Ullmannia Bronni* Goeppert described by Florin (1944, Plate CLXIX/XLXX figs 6—9) resembles this form, but is slightly smaller and narrower.

### *Platysaccus subcarpaticus* Pautsch

Pl. XVII, fig. 1

| | | | |
|---|---|---|---|
| Dimensions: | length of sporomorphs: | 119—185 μ | mean 152 μ |
| | length of body: | 52— 98 μ | „ 74 μ |
| | breadth of body: | 52— 89 μ | „ 67 μ |
| | length of bladders: | 55— 94 μ | „ 75 μ |
| | breadth of bladders: | 71—114 μ | „ 92 μ |
| | diameter of reticulum lumina: | 3— 9 μ | |

Number of specimens: 18, 16 of which suitable for measurement.

Distribution: Lower and Upper Keuper of Trzciana.

Description: Very large bisaccate sporomorph with bladders larger than the body. Body oval, longitudinal axis larger than the lateral. Outline usually not very distinct — marked by a darker stripe of exine. Body and bladders of the same colour. Bladders of the *Platysaccus* type — in polar view larger than a semicircle, sometimes wrinkled at the distal root. Distal roots straight, lying close together. Between them a narrow sulcus with thin wall and parallel borders.

TURMA PLICATES NAUMOWA 1939 EMEND. R. POTONIÉ 1960

SUBTURMA MONOCOLPATES IVERSEN ET TROELS-SMITH 1950

## Genus *Monosulcites* Cookson 1947, emend. Couper 1958

### *Monosulcites minimus* Cookson

Pl. XVIII, fig. 6—7

| | | |
|---|---|---|
| Dimensions: length of sporomorphs: | 22—36 μ | mean 30 μ |
| Dimensions: breadth of sporomorphs: | 17—24 μ | „ 20 μ |

Number of specimens: 11, all suitable for measurement.

Distribution: Tertiary of Australia, Jurassic and Cretaceous of England, Lower and Upper Keuper of Trzciana.

Description: Oval sporomorph with single sulcus running the whole of its length. The sulcus is surrounded by folds. Thin, light-coloured wall, smooth or scabrate.

According to Couper (1958), *Monosulcites minimus* Cookson derives from *Ginkgo huttoni* Sternberg, emend. Heer, which pollen it actually closely resembles. The dimensions reported by Couper for his specimens are 18(30)33 μ. Their mean size is therefore the same as that of the specimens from Trzciana. As for their breadth, the specimens from Trzciana are on the average by 2 μ narrower than the values reported by Couper 15(22)33 μ.

### *Monosulcites perforatus* Mädler

Pl. XVIII, fig. 2

| | | |
|---|---|---|
| Dimensions: length of sporomorphs: | 35—40 μ | mean 37 μ |
| breadth of sporomorphs: | 22—29 μ | „ 26 μ |

Number of specimens: 7, 6 of which suitable for measurement.

Distribution: Lower Keuper of the Harz Mts Foreland, Lower and Upper Keuper of Trzciana.

Description: Sporomorphs oval in outline, yellow. The proximal side has a thicker wall with hollows of varying shape and inside diameter amounting to 3 μ. The arrangement of the hollows resembles reticulum. This sculpture gradually disappears, becoming almost smooth on the distal side. The wall on the distal side is thinner and grooved, forming a sulcus with two accompanying folds running with the long axis of the sporomorph.

The specimens occur in very small numbers but are, however, found in all the investigated samples, i.e. both in the Lower and Upper Keuper. The Mädler's specimens from the Harz Foreland are slightly larger

(34—46 × 25—33 μ) than those from Trzciana. With regard to sculpture and structure, specimens of this species recall the contemporaneous pollen of *Cycas wadei* (G. Erdtman, 1965, fig. 8, p. 29).

### *Monosulcites salebrosus* Pautsch

Pl. XVIII, fig. 3

| | | |
|---|---|---|
| Dimensions: | length of sporomorphs: | 31—40 μ mean 35 μ |
| | breadth of sporomorphs: | 24—34 μ „ 29 μ |
| | breadth of sulcus: | 1— 5 μ |
| | thickness of wall: | ca. 1 μ |

Number of specimens: 25, 16 of which suitable for measurement.

Distribution: Lower and Upper Keuper of Trzciana.

Description: Sporomorph rounded oval with a single sulcus not reaching its outline. Two folds usually accompany the sulcus. The wall is up to 1 μ thick. Exine greyish-yellow. The sculpture is composed of distinct granules less than 1 μ in diameter, lying close together, of uneven height. The wall of the sulcus is of a lighter colour and without sculpture.

In shape *Monosulcites salebrosus* recalls the pollen grains of *Androstrobus manis* Harris, or else of *A. wonnacotti* Harris, photographs of which are presented by Couper (1958) in Plates No 26 figs 15 and 16 and No 26 figs 17 and 18. It differs from them in the more distinct sculpture and slightly shorter sulcus.

## Genus *Micrhystridium* (Deflandre 1937) Staplin 1961

### *Micrhystridium subcarpaticum* sp. n.

Pl. XVIII, fig. 4

| | | |
|---|---|---|
| Dimensions: | length of specimens: | 11—19 μ mean 15 μ |
| | breadth of specimens: | 9—16 μ „ 13 μ |
| | length of spinae: | 1— 4 μ „ 2 μ |

Number of specimens: 82, 58 of which suitable for measurement.

Distribution: Lower and Upper Keuper of Trzciana.

Diagnosis: Shape round, rounded oval, or subtriangular. Wall regularly accompanied by secondary folds. The wall is one-layered, transparent, of a light greyish-yellow colour. Spinae sometimes longer on one part of the specimen than on the other, with rounded ends.

*Micrhystridium* cf. *inconspicuum* (Defl) described by Jansonius is smaller (10—12 μ in length, spinae 3—4 μ) with pointed spinae.

*Micrhystridium breve* Jansonius is of larger size (15—25 μ, spinae 3—5 μ). Pointed spinae.

*Micrhystridium triassicum* Jansonius is a smaller form (9—12 μ) with a relatively thick, rigid, brown wall.

*Micrhystridium setasessitante* Jansonius is slightly larger 11(22) 25 μ with setaceous spinae implanted on warts 1 μ high. Club-shaped tips of setae.

The specimen of genus *Hystrichosphaeridae* reported by K l a u s from layers with *Cardita gümbeli* is much larger (18—28μ) and has relatively longer spinae.

## CHARACTERIZATION OF THE POLLEN SPECTRUM OF TRZCIANA AND PRESUMABLE CAUSES OF CHANGES IN ITS COMPOSITION DURING THE SEDIMENTATION OF THE INVESTIGATED PROFILE

In the spectrum of sporomorphs from Trzciana the majority of species is represented by spores with a trilete mark and by bisaccate sporomorphs.

At a depth of 1132—1140 m sporomorphs of these two types of structure occur in more or less equal number (Table 1 and the Diagram). At a depth of 1119—1123 m the number of spore species with a trilete mark sharply decreases, whereas that of bisaccate sporomorphs markedly increases. At a depth of 1116—1119 m the number of sporomorph species of these two types of structure is again approximately the same. However, they are less numerous here, since there is an increase in the number of species of *Arathrisporites* spores and *hinutisaccus* pollen grains.

The frequency of specimens of the particular species is the following: in the lower level with sporomorphs (1132—1140 m) the dominant forms are *Microreticulatisporites opacus* Leschik, emend. Klaus (25%), *Todisporites minor* Couper (12%), and *Alisporites aequalis* Mädler (12%). (Table 1 and the Diagram). In the next level (1119—1123 m) these species play no part at all, being replaced by *Aratrisporites saturni* Thiergart, emend. Mädler, emend. Pautsch (36%), *Micrhystridium subcarpaticum* n. sp. (25%), and *Minutisaccus subcarpaticus* Pautsch (10%).

In the upper layer (1116—1119 m) the greatest number of forms is still represented by *Aratrisporites saturni* Thiergart, emend. Mädler, emend. Pautsch (15%) and *Minutisaccus subcarpaticus* Pautsch (10%), but they are accompanied here by *Illinites chitonoides* Klaus (13%). On the other hand, the occurrence of *Micrhystridum subcarpaticum* n. sp. decreases to an altogether insignificant quantity.

In the sample from the depth of 1123 m the number of *Hystrichosphaeridae* increases sharply. This presumably testifies to the deepening of the sedimentary basin. Probably at the same time there also occurred a shifting of its border with some parts of the land having turned into

Table 1
Tabela 1

The sporomorphs found in the Keuper sediments of the borehole Trzciana (in percent)
*Sporomorfy znalezione w złożach kajpru z wiercenia w Trzcianie (w procentach)*

| | 1132—1140 m | 1119—1123 m | 1116—1119 m |
|---|---|---|---|
| *Calamospora tener* | 0,20 | 2,30 | 5,00 |
| *Punctatisporites crassexinis* | 0,20 | — | — |
| *Punctatisporites magnus* | 0,20 | — | 0,30 |
| *Punctatisporites subcarpaticus* | 0,50 | — | 0,70 |
| *Crispetectatisporites punctatus* | 0,15 | — | — |
| *Todisporites minor* | 13,00 | 5,40 | 5,50 |
| *Retusotriletes mesozoicus* | — | 0,65 | 0,50 |
| *Carnisporites hercynicus* | 0,20 | 0,75 | 0,20 |
| *Carnisporites* cf. *ornatus* | — | — | 0,20 |
| *Carnisporites* cf. *telephorus* | 0,20 | 2,00 | 2,20 |
| *Paraconcavisporites* sp. | 0,10 | 0,55 | 0,20 |
| *Converrucosisp. conferteornatus* | 1,00 | — | — |
| *Converrucosisp. diverseornatus* | 0,20 | — | 0,40 |
| *Cyclogranisporites rugosetectatus* | 0,70 | — | 0,30 |
| *Baculatisporites comaumensis* | 0,10 | — | 0,80 |
| *Conbaculatisporites mesozoicus* | 0,10 | — | 0,30 |
| *Keuperisporites baculatus* | 0,10 | — | — |
| *Distalanulisporites punctus* | — | — | 0,30 |
| *Microreticulatisporites opacus* | 25,00 | 0,75 | — |
| *Lycopodiacidites kuepperii* | 0,10 | — | — |
| *Camarozonosporites rudis* | 0,20 | 0,75 | 0,30 |
| *Spiralisporites insignis* | 0.15 | — | — |
| *Bianulisporites badius* | 0,30 | — | 0,20 |
| *Styxisporites granulatus* | 0,20 | — | — |
| *Leschikiisporis aduncus* | 1,20 | — | 0,70 |
| *Echinitosporites iliacoides* | 0,20 | — | 0,30 |
| *Laricoidites subcarpaticus* | 0,80 | 1,00 | 0,50 |
| *Ellipsosaccus subcarpaticus* | 0,60 | — | — |
| *Aratrisporites saturni* | 5,80 | 34,50 | 16,00 |
| *Aratrisporites virgatus* | 3,50 | 7,15 | 2,50 |
| *Aratrisporites pilosus* | — | 0,75 | 0,50 |
| *Aratrisporites rotundus* | 2,00 | 8,25 | 1,50 |
| *Aratrisporites* cf. *fischeri* | — | — | 2,10 |
| *Aratrisporites scabratus* | 1,00 | — | 0,80 |
| *Circulisaccus major* | 1,50 | — | 4,00 |
| *Circulisaccus minor* | 0,50 | 0,75 | 0,70 |
| *Institisporites crispus* | 0,10 | — | 0,70 |
| *Taeniaesporites kräuseli* | 0,15 | 0,65 | 0,30 |
| *Ovalipollis lunzensis* | 0,10 | — | — |
| *Striatites limpidus* | 0,50 | 0,45 | 0,20 |

| | 1132—1140 m | 1119—1123 m | 1116—1119 m |
|---|---|---|---|
| *Striatites elongatus* | 0,90 | 0,75 | 0,50 |
| *Faunipollenites subcarpaticus* | 0,20 | — | — |
| *Infirmisporites fragilis* | 0,30 | 2,30 | 0,30 |
| *Umbrellisaccus sulcatus* | 1,10 | 0,45 | — |
| *Illinites chitonoides* | 6,80 | 2,00 | 14,00 |
| *Angustisulcites klausii* | 0,40 | — | — |
| *Caytonipollenites pallidus* | — | 0,75 | 1,60 |
| *Alisporites aequalis* | 12,50 | 2,50 | 3,50 |
| *Complicatisaccus perlucidus* | 0,15 | — | 0,80 |
| *Diaphanisporites diaphanus* | 0,80 | 1,50 | 1,10 |
| *Diaphanisporites major* | 0,15 | — | 0,30 |
| *Cuneatisporites* cf. *radialis* | 0,40 | 1,00 | 1,50 |
| *Falcisporites keuperianus* | 1,10 | 2,80 | 5,30 |
| *Brachysaccus* cf. *neomundanus* | 1,40 | — | 6,60 |
| *Minutisaccus subcarpaticus* | 2,80 | 9,75 | 11,00 |
| *Minutisaccus ornatus* | 0,15 | 2,00 | 1,50 |
| *Granisaccus elongatus* | 0,90 | 1,00 | 0,30 |
| *Plicatisaccus badius* | 1,10 | 1,35 | 0,30 |
| *Radiatisaccus fulvus* | 0,90 | 1,00 | — |
| *Platysaccus* cf. *papilionis* | 0,90 | — | — |
| *Platysaccus niger* | 1,20 | 0,65 | 0,30 |
| *Platysaccus nitidus* | 2,50 | 1,00 | 0,50 |
| *Platysaccus subcarpaticus* | 0,90 | 0,65 | 0,20 |
| *Monosulcites minimus* | 0,20 | 0,45 | 1,20 |
| *Monosulcites perforatus* | 0,20 | 0,45 | 0,50 |
| *Monosulcites salebrosus* | 1,20 | 1,00 | 0,30 |

a marsh, since the curve of occurrence of particular sporomorphs species reacts very characteristically. The number of *Aratrisporites*, *Infirmisporites*, *Calamospora*, *Carnisporites* cf. *telephorus*, *Minutisaccus*, *Diaphanisporites*, and *Cuneatisporites* spores grows larger. *Caytonipollenites* appears.

According to Helby and Martin, genus *Aratrisporites* derives from genus *Cylostrobus*, the remains of which were found by these authors in the Trias of Australia and assigned to *Lycopsida*, presumably arborescent. A considerable development of *Lycopsida* during transgression is fairly evident. *Calamospora* in Mesozoic sediments is regarded as spores of genus *Equisetites*, and *Caytonipollenites* as pollen of the genus *Sagenopteris*. These two genera presumably lived also in damp habitats. *Diaphanipollenites diaphanus* and *Carnisporites telephorus* sporomorphs were found in the Pomerania-Kujawy Anticlinorium in zones of grey shales alternating with variegated shales. The grey shales probably formed in the period of the climatic becoming damp (Pautsch 1958). The extension of the basin had an unfavourable effect on the occurrence of genera *Todisporites* (*Osmundaceae*, Couper 1958), *Leschikiisporis* (*Maratiaceae*,

Bharadway et Singh 1956), *Punctatisporites* (presumably chiefly *Filicinae*), *Umbrellisaccus, Brachysaccus* cf. *neomundanus, Illinites thuringensis,* and *Alisporites aequalis.*

*Umbrellisaccus* occurs in the Keuper of the Pomerania-Kujawy Anticlinorium in shales with gypsum, thus in a warm climate and on a rather dry substratum (Pautsch 1958).

Submersion had no effect on the occurrence of some genera of sporomorphs. Some of them develops while others disappear during the whole period of sedimentation of the investigated age section. The developing forms are *Falcisporites keuperianus* and *Monosulcites minimus,* the those disappearing being *Platysaccus* div. sp., *Monosulcites salebrosus, Granisaccus, Plicatisaccus,* and *Radiatisaccus. Monosulcites minimus* is probably the pollen of *Ginkgo huttoni* (Couper 1958). The full development of the *Ginkgoinae* class occurs in the Jurassic. The increase in the occurrence of pollen of genus *Ginkgo* is therefore in accordance with the trend of development of this class.

On the other hand, the disappearance of genus *Platysaccus* is caused by the gradual extinction of species of this genus in the course of the Triassic (Klaus 1963, Mädler 1964).

## ACKNOWLEDGEMENTS

The present work was mainly carried out at the Institute of Botany of the Polish Academy of Sciences in Cracow within the framework of a doctoral scholarship granted by that Academy. Here I wish to thank the late Professor W. Szafer for his encouraging attitude towards the undertaking palynological investigation of the Triassic. My grateful acknowledgements are also due to Professor J. Dyakowska, promotor of this work, and Professor A. Środoń for their ready and valuable advice in the course of its realization.

I obtained the material from the borehole Trzciana from the Laboratory of Micropalaeontology of the State Oil Prospecting Enterprise in Cracow where I carried out the age expertise. I should like to thank Dr. Z. Kirchner, chief of this Laboratory, for encouraging me to work out the morphological analysis of the sporomorphs. I wish also to thank Dr. J. Kruczek, the chief geologist of the Enterprise, for permission to elaborate and publish this material. I am also indebted to Professor W. Klaus from the Geol. Bundesanstalt in Vienna for offering me comparative material from the Alps Permian and Carnian and for putting at my disposal some necessary literature.

*Institute of Botany of the Polish Academy of Sciences in Kraków*
*Department of Palaeobotany.*

## REFERENCES


1. Balme B. E., Hennelly J. P. F. 1955. Bisaccate sporomorphs from Austrialian Permian Coals. Austr. Journ. Bot. **3**, 1 : 89—98, 6 pl. Melbourne.
2. Balme B. E., Hennelly J. P. F. 1956 a. Monolete, Monocolpate and Alete sporomorphs from Australian Permian sediments. Austr. Journ. Bot. **4**, 1 : 54—67, 3 pl. Melbourne.
3. Balme B. E., Hennelly J. P. F. 1956 b. Trilete spormorphs from Australian Permian sediments. Austr. Journ. Bot. **4**, 3 : 240—260, 10 pl., 2 figs, 1 tab. Melbourne.
4. Bharadwaj D. G., Sah S. C., Tiwari R. S. 1964/65. Sporological analysis of some coals and carbonaceous shales from Barren Measure stage (Lower Gondwana) of India. Palaeobotanist **13**, 2 : 222—226, 3 pl. Lucknow.
5. Bharadwaj D. C., Singh H. P. 1956. *Asterotheca meriani* (Brongn.) Stur and its spores from the Upper Triassic of Lunz (Austria). Palaeobotanist, **5**, 2 : 51—55, 2 pl. 2 figs. Lucknow.
6. Bharadwaj D. C., Singh H. P. 1963. An Upper Triassic miospore assemblage from the coals of Lunz, Austria. Palaeobotanist **12**, 1 : 28—44, 5 pl. Lucknow.
7. Bharadwaj D. C. 1964. *Potonieisporites* Bharad., ihre Morphologie, Systematik und Stratigraphie. Fortschr. Geol. Rheinld. Westf. 12 : 45—54, 1 Taf., 1 Abb., 1 Tab. Krefeld.
8. Bursh G. S., Barghoorn E. S. 1962. Identification and structure of Cordaitean Pollen. Journ. Palaeontol. **36**, 6 : 1357—1360, 2 pl. Lucknow.
9. Clarke R. F. A. 1965. Keuper miospores from Worcestershire, England, Palaeontology, 8, no. 2 : 294—321, 5 pl., 13 figs. London.
10. Clarke R. F. A. 1965. British Permian saccate and monosulcate miospores. Palaeontology 8, 2 : 322—354, 5 pl., 16 figs. London.
11. Couper R. A. 1953. Upper Mesozoic and Cainozoic spores and pollen grains from New Zealand. Geol. Surv. Palaeont. Bull. 22 : 1—77. Wellington.
12. Couper R. A. 1958. British Mesozoic miospores and pollen grains, a systematic and stratigraphic study. Palaeontographica B 103 : 75—179, 17 pl., 11 figs., 12 tab. Stuttgart.
13. Erdtman G. 1957. Pollen and spore morphology (Plant taxonomy: *Gymnospermae, Pteridophyta, Bryophyta.*) 151 p., 5 pl., 265 figs. Stockholm.
14. Freudenthal T. 1964. Palaeobotany of the mesophytic. I. Palynology of Lower Triassic rock salt, Hengelo, the Netherlands. Acta Bot. Neerl. **13**, 2 : 209—236, 5 pl., 4 figs. Amsterdam.
15. Florin R. 1945. Die Koniferen des Oberkarbons und des Unteren Perms. Palaeontographica B 85 : 1—654, 186 Taf., 65 Abb., 5 Tab., 2 Kart. Stuttgart.
16. Grebe H., Schweitzer H. J. 1964. Die sporae dispersae des niederrheinischen Zechsteins. Fortschr. Geol. Rheinld. u. Westf., 12 : 201—224, 12. Taf., 9 Abb., 2 Tab. Krefeld.
17. Gignoux M. 1956. Geologia stratygraficzna. Wyd. Geol., Warszawa.
18. Harris T. M. 1941. *Caytonanthus*, the microsporophyll of *Caytonia*. Ann. of Botany, N. S., V. 17 : 47—58, 1 pl., 8 figs.

19. Hart G. F. 1960. Microfloral investigation of the Lower Coal Measures (K2), Ketewaka Mchuchuma Coalfield, Tanganyika. Bull. Geol. Survey Tanganyika, 30 : 1—18, 3 pl., 4 figs. Dar Es Salaam.
20. Helby R., Martin A. R. H. 1965. *Cylostrobus* gen. nov., cones of Lycopsidean plants from the Narrabeen Group (Triassic) of New South Wales. Austr. Journ. of Botany, 13 : 389—404, 3 pl., 1 tab. Melbourne.
21. Hoffmeister W. S., Staplin F. L., Malloy R. E. 1955. Geologic range of Botany, 13 : 389—404, 3 pl., 1 tab. Melbourne.
New York.
22. Jansonius J. 1962. Palynology of Permian and Triassic sediments, Peace River Area, Western Canada. Palaeontographica B 110 : 35—98, 6 pl., 3 figs, 4 tab. Stuttgart.
23. Klaus W. 1953. Zur Einzelkornpreparation fossiler Sporomorphen. Zentralbl. f. mikroskop. Forsch. u. Method. 8, 1/2 : 1—14, 2 Taf., 6 Abb. Wien.
24. Klaus W. 1960. Sporen der karnischen Stufe der ostalpinen Trias. Jahrb. Geol. Bundesanst. Sonderbd 5 : 107—183, 11 Taf., 14 Abb. Wien.
25. Klaus W. 1963. Sporen aus dem südalpinen Perm. Jahrb. Geol. Bundesanst. 106 : 229—363, 20 Taf., 38 Abb. Wien.
26. Klaus W. 1964. Zur sporenstratigraphischen Einstufung von gipsführenden Schichten in Bohrungen. Erdöl-Zeitschr. **80**, 4 : 119—132, 4 Taf. Wien.
27. Kremp G. 1965. Morphologic Encyclopedia of Palynology. Univ. of Arizona Press, 186 p., 38 pl. Tucson.
28. Krutzsch W. 1955. Über einige liassische „angiospermide" Sporomorphen. Z. Geol. 4 : 65—76, 4 Taf. Berlin.
29. Krutzsch W. 1959. Mikropaläontologische (sporenpaläntologische) Untersuchungen in der Braunkohle des Geiseltales. Z. Geologie 8. Berlin.
30. Lele K. M., Maithy P. K. 1964. An unusual monosaccate spore from the Karharbari stage, Giridih Coalfield. Palaeobotanist 12, 3 : 307—312, 1 pl., 2 figs. Lucknow.
31. Leschik G. 1955. Die Keuperflora von Neuwelt bei Basel. II. Iso- und Mikrosporen. Schweiz. Paläont. Abh. 72 : 1—70, 10 Taf. 1 Abb. Basel.
32. Leschik G. 1956. Sporen aus dem Salzton des Zechsteins von Neuhof bei Fulda. Palaeontographica B 100 : 122—142, 3 Taf. Stuttgart.
33. Maithy P. K. 1964. Studies in the *Glossopteris* flora of India. Sporae dispersae from the Karharbari Beds in the Giridih Coalfield, Bihar. Palaeobotanist, **13**, 3 : 291—307, 7 pl. Lucknow.
34. Manum S. 1960. On the Genus *Pityosporites* Seward 1914. Nytt. Mag. Bot. **8** : 11—15, 1 pl. Oslo.
35. Mädler K. 1964. Bemerkenswerte Sporenformen aus dem Keuper und unteren Lias. Fortschr. Geol. Rheinld. Westf., Bd. 12 : 169—200, 3 Taf., 1 Abb. Krefeld.
36. Mädler K. 1965. Die geologische Verbreitung von Sporen und Pollen in der Deutschen Trias. Beih. Geol. Jahrb. 65 : 1—147, 12 Taf., 1 Abb., 3 Tab. Hannover.
37. Nathorst A. G. 1908. *Lycostrobus scotti*, eine grosse Sporophyllähre aus den rhätischen Ablagerungen Schonens. (Paläobot. Mitt. 3) Kgl, Svensk. Vetensk. Arkad. Handl. 43, 6 : 1—9, 2 Taf. Uppsala-Stockholm.
38. Nilson T. 1958. Über das Vorkommen eines mesozoischen Sapropelgesteins in Schonen. Lunds Univ. Arsskrift N. F. Avd. 2, **54**, 10 : 1—111, 8 Taf., 14 Abb., 5 Tab. Lund.
39. Orłowska-Zwolińska T. 1966. Dolnoliasowy wiek warstw wielichowskich na tle badań sporowo-pyłkowych na Niżu Polskim. Kwart. Geol., **10**, 4 : 1003—1021. 13 Tab., 1 diagr. Warszawa.
40. Pant D. D., Nautiyal D. D. 1960. Some seeds and sporangia of *Glossopteris*

flora from Raniganj Coalfield, India. Palaeontographica B 107 : 41—65, 4 pl. 16 figs. Stuttgart.
41. Pautsch M. E. 1958. Keuper sporomorphs from Świerczyna, Poland, Micropaleontology 4, 3 : 321—325, 1 pl. New York.
42. Pautsch M. E. 1963. Palynologičeskie issledowania otloženii kaipera predkarpatskogo progiba. Karpato-Balk. Geol. Assoc., VI-ci 4 str. Warszawa—Kraków.
43. Pautsch M. E. 1971. Some new Keuper sporomorphs from the Polish Carpathian Foreland. Micropaleontology — in press.
44. Potonié R. 1956. Synopsis der Gattungen der sporae dispersae. I. Teil, Beih Geol. Jb. 23 : 1—103, 11 Taf. Hannover.
45. Potonié R.: 1958. Synopsis der Gattungen der sporae dispersae. II. Teil, Beih. Geol. 31 : 1—114, 11 Taf. Hannover.
46. Potonié R. 1960. Synopsis der Gattungen der sporae dispersae. III. Teil, Beih. Geol. 39 : 1—189, 9 Taf. Hannover.
47. Potonié R. 1967. New phylogenetic fact on fossil spores. Rev. Palaeobotany and Palynology 1 : 75—82. Amsterdam.
48. Potonié R., Kremp G. 1955. Die sporae dispersae des Ruhrkarbons, ihre Morphographie und Stratigraphie, mit Ausblicken auf Arten anderer Gebiete und Zeitabschnitte. Teil I, Palaeontographica B 98 : 1—136, 16 Taf., 37 Abb., 1 Tab. Stuttgart.
49. Potonié R., Kremp G. 1956. Die sporae dispersae des Ruhrkarbons, ihre Morphographie und Stratigraphie, mit Ausblicken auf Arten anderer Gebiete und Zeitabschnitte. Teil II, Palaeontographica B 99 : 85—191, 6 Taf., 51 Abb., Stuttgart.
50. Potonié R., Kremp G. 1956. Die sporae dispersae des Ruhrkarbons, ihre Morphographie und Stratigraphie, mit Ausblicken auf Arten anderer Gebiete und Zeitabschnitte. Teil. III, Palaeontographica 100 : 65—121, 3 Tab. Stuttgart.
51. Rheinhardt P. 1964. Über die sporae dispersae der Thüringer Trias. Monatsber. Deutsch. Akad. Wiss. 6, 1 : 46—56. Berlin.
52. Reissinger A. 1940. Die „Pollenanalyse" ausgedehnt auf alle Sedimentgesteine der geologischen Vergangenheit. Teil I. Palaeontographica 84 : 1—20. Stuttgart.
53. Reissinger A. 1950. Die „Pollenanalyse" ausgedehnt auf alle Sedimentgesteine der geologischen Vergangenheit. Teil II. Palaeontographica B 90 : 90—126, 9 Taf. Stuttgart.
54. Rogalska M. 1954. Analiza sporowo-pyłkowa liasowego węgla blanowickiego z Górnego Śląska. Inst. Geol. Biul. 89 : 1—46, 12 tabl. Warszawa.
55. Rogalska M. 1956. Analiza sporowo-pyłkowa liasowych osadów obszaru Mroczków—Rozwady w powiecie opoczyńskim. Inst. Geol. Biul. 104 : 1—89, 32 tabl., 3 zest. Warszawa.
56. Romanowskaja G. M. 1966. Trijasowye sporowo-pylcevye kompleksy SSSR. Trudy Wses. N. I. G. in-ta, wyp. 141 : 121—134. Moskwa.
57. Roselt G. 1955/56. Eine neue männliche Gymnospermenfruktifikation aus dem Unter-Keuper von Thüringen und ihre Beziehungen zu anderen Gymnospermen. Wiss. Z. Univ. Jena, H 1/2 : 75—118. Jena.
58. Schulz E. 1956. Über einige neue sporae dispersae aus dem älteren Mesozoicum Deutschlands. Geologie 15, Beih. 55 : 130—155, 7 Taf., 2 Abb. Berlin.
59. Schulz E. 1964. Sporen und Pollen aus dem mittleren Buntsandstein des germanischen Beckens. Monatsber. Deutsch. Akad. Wiss. 6, 8 : 597—606, 2 Taf. Berlin.
60. Schulz E. 1965. Sporae dispersae aus der Trias von Thüringen. Mitt. G. I. 1 : 257—287, 3 Taf., 1 Abb., 1 Tab. Berlin.
61. Schulz E., Krutzsch W. 1961. *Echinitosporites iliacoides* nov. fgen. et fsp., eine neue Sporenform aus dem Keuper der Niederlausitz. Geologie 10, Beih. 32 : 122—127, 1 Taf. Berlin.

62. Singh H. P. 1964/65. Saccate pollen grains from the Lower Triassic of Hallstatt, Austria. Palaeobotanist, **13**, 1. Lucknow.
63. Singh H. P., Srivastava S. K., Roy S. K. 1963/64. Studies on the Upper Gondwana of Cutch. 1. Mio- and macrospores. Palaeobotanist **12**, 3 : 282—306, 10 pl. Lucknow.
64. Thiergart F. 1949. Der stratigraphische Wert mesozoischer Pollen und Sporen. Palaeontographica B 89 : 1—34, 5 Taf., 1 Abb., 2 Diagr. Stuttgart.
65. Tiwari R. S. 1964. Miospore assemblage in some coals of Barakar stage (Lower Gondwana) of India. Palaeobotanist **13**, 2 : 168—214, 9 pl., 4 figs. Lucknow.
66. Tokarski A. 1962. Struktura Niwisk. Pr. Geol. 13 : 1—60. Warszawa.
67. Townrow J. A. 1962. On *Pteruchus*, a microsporophyll of the *Corystospermaceae*. Bull. of the British Museum (Nat. Hist.) Geology. **6**, 2 : 289—320. London.
68. Townrow J. A. 1962. On some disaccate pollen grains of Permian age to Middle Jurassic age. Grana Palynologica 3 : 13—14, Uppsala.
69. Venkatachala R. S., Goczan F. 1964. The spore pollen flora of the hungarian „Kössen facies". Acta Geol. Acad. Scient. Hung. **8**, 1—4: 203—228, 3 pl., 8 figs, 3 tab. Budapest.
70. Visscher H. 1966. Palaeobotany of the Mesophyticum III. Plant microfossils from the Upper Bunter of Hengelo, the Netherlands. Acta Bot. Neerl. **15**, 2. Amsterdam.

## STRESZCZENIE

### SPOROMORFY GÓRNEGO TRIASU Z WIERCENIA W TRZCIANIE KOŁO MIELCA

W osadach kajpru Przedgórza Karpat na odcinku położonym między miejscowościami Niwiska na wschodzie a Radzanów na zachodzie znaleziono bogaty zespół sporomorf. Pobrane próbki pochodzą z odwiertu Trzciana, wykonanego przez Państwowe Przedsiębiorstwo Poszukiwań Naftowych w Krakowie. Odwiert ten, położony w wymienionym rejonie centralnie, posiada opublikowaną dokumentację geologiczną (A. Tokarski 1962).

Profil litologiczny badanego odcinka przedstawia się w przybliżeniu następująco: na głębokości 1116—1123 m występują łupki ciemnoszare do zielonych i piaskowce drobnoziarniste zielonkawe i brunatnofioletowe, na głębokości 1123—1132 m łupki brunatnoczerwone i ciemnozielone, a od głębokości 1132—1140 m łupki ciemnoszare, wapienie ciemnoszare i czarne z laminacją łupków i wkładkami piaskowca drobnoziarnistego. Pomiędzy poszczególnymi seriami brak wyraźnych granic. Warstwy przechodzą w litologicznie różne stopniowo, poprzez przewarstwowania i wkładki, co wskazuje na zmiany w warunkach sedymentacji (Cz. Fik, B. Cisek, Archiwum P.N.). Sporomorfy znalazłam tylko w trzech poziomach w osadach szarych łupków. Najniższy poziom z głębokości 1132—1140 m jest wieku kajpru dolnego i pochodzi z serii ciemnych pelitów, natomiast poziom z głębokości 1119—1123 m pochodzi z kajpru górnego z serii pelitów pstrych. Co do wieku poziomu z głębokości 1116—1119 m panuje niezgodność poglądów. A. Tokarski (1962) przydziela warstwy z tej głębokości już do retyku, natomiast Cz. Fik i B. Cisek (Archiwum P.N.) jeszcze do kajpru. Z tej samej głębokości Cz. Pachucki (Archiwum P. N.) opisał dobrze zachowanego małża *Anodontophora lettica* Qu., który — jego zdaniem — występuje w osadach górnego wapienia muszlowego i w niektórych utworach kajpru.

W materiale z odwiertu Trzciana stwierdzono obecność 66 gatunków należących do 47 rodzajów sporomorf. Ich występowanie w profilu ilustruje tabela 1 oraz diagram. Najwyższą liczbę gatunków osiągają spory z blizną trójlistwową i sporomorfy dwuworkowe.

Na głębokości 1132—1140 m występują oba typy sporomorf w równej mniej więcej ilości, na głębokości 1119—1123 m udział gatunków spor z blizną trójlistwową gwałtownie maleje, a sporomorf dwuworkowych

wzrasta, natomiast na głębokości 1116—1119 m oba typy występują znów w zbliżonych do siebie ilościach. Jest ich już jednak stosunkowo mniej, ponieważ zwiększa się liczba gatunków należących do *Aratrisporites* Leschik, emend. Pautsch i *Monosulcites*. Cookson, emend. Couper.

Frekwencja okazów poszczególnych gatunków przedstawia się następująco. W dolnym poziomie (1132—1140 m) dominuje *Microreticulatisporites opacus* Leschik, emend. Klaus (25%), *Todisporites minor* Couper (12%) oraz *Alisporites aequalis* Mädler (12%). W następnym poziomie (1119—1123 m) gatunki te nie odgrywają już żadnej roli. Ich miejsce zajmują *Aratrisporites saturni* Thiergart, emend. Mädler (34%), *Micrhystridium subcarpaticum* n. sp. (25%) oraz *Minutisaccus subcarpaticus* Pautsch (10%). W górnym poziomie (1116—1119 m) najobficiej występuje nadal *Aratrisporites saturni* Thiergart, emend. Mädler (15%) i *Minutisaccus subcarpaticus* Pautsch (10%), ale dołącza się do nich jeszcze *Illinites chitinoides* Klaus (13%) natomiast udział *Micrhystridium subcarpaticum* n. sp. spada do ilości bardzo nieznacznej.

W próbce z głębokości 1123 m ilość *Hystrichosphaeridae* gwałtownie wzrasta, co prawdopodobnie świadczy o pogłębieniu się zbiornika sedymentacyjnego. Prawodopodobnie nastąpiło równoczesne przesunięcie się brzegu zbiornika i zabagnienie przyległego lądu, ponieważ krzywa występowania poszczególnych gatunków sporomorf ma charakterystyczny przebieg. Następuje wzrost udziału *Aratrisporites* div. sp., *Infirmisporites* Pautsch, *Calamospora tener* Leschik, emend. de Jersey, *Carnisporites* cf. *telephorus* Pautsch, emend. Mädler, *Minutisaccus* div. sp., *Diaphanisporites diaphanus* Pautsch i *Cuneatisporites* cf. *radialis* Mädler. Pojawia się *Caytonipollenites pallidus* Reissinger emend. Couper. Rodzaj *Aratrisporites* Leschik pochodzi, według R. Helby i A. R. H. Martin, od rodzaju *Cylostrobus* Helby et Martin, którego szczątki znalezione w triasie Australii przydzielili do *Lycopsida*, i to przypuszczalnie drzewiastych. Znaczny rozwój *Lycopsida* w czasie transgresji jest dość oczywisty. *Calamospora* Schopf et Bentall jest uważana w osadach mezozoiku za zarodniki rodzaju *Equisetites* Sternberg, a *Caytonipollenites* Couper za pyłek rodzaju *Sagenopteris* Presl. Te dwa rodzaje rosły przypuszczalnie również na terenach podmokłych. Sporomorfy *Diaphanipollenites diaphanus* Pautsch oraz *Carnisporites telephorus* Pautsch, emend. Mädler znalazłam na Wale Pomorsko-Kujawskim w osadach szarych łupków, które występowały na zmianę z pstrymi. Szare łupki powstały prawdopodobnie w okresie zwilgocenia klimatu, a pstre w okresie pustynnym (M. E. Pautsch 1958). Przesunięcie linii brzegowej zbiornika wpłynęło ujemnie na występowanie *Todisporites* Couper (*Osmundaceae* R. A. Couper 1958), *Leschikiisporis* R. Potonié (*Maratiaceae*, Bharadwaj i Singh 1956), *Punctatisporites* Ibrahim, emend. R. Potonié et Kremp (przypuszczalnie głównie *Filicinae*), *Umbrellisaccus* Pautsch, *Brachysaccus* Mädler, *Circulisaccus* Pautsch, *Illinites chitonoides* Klaus, *Alisporites*

*aequalis* Mädler. *Umbrellisaccus* Pautsch występuje w kajprze Wału Pomorsko-Kujawskiego w łupkach z gipsami wskazujących na klimat ciepły i raczej na suche podłoże (M. E. Pautsch 1958).

Na występowanie niektórych rodzajów sporomorf przesunięcie się linii brzegowej nie wywarło żadnego wpływu. Udział jednych wzrasta, a innych zanika przez cały okres sedymentacji badanego odcinka wiekowego. Wzrasta udział *Falcisporites keuperianus* Pautsch i *Monosulcites minimus* Cookson, zanikają natomiast *Platysaccus* Naumowa emend. R. Potonié et Klaus, *Monosulcites salebrosus* Pautsch, *Granisaccus elongatus* Pautsch, *Plicatisaccus badius* Pautsch i *Radiatisaccus fulvus* Pautsch. *Monosulcites minimus* Cookson jest przypuszczalnie pyłkiem *Ginkgo huttoni* Sternberg, emend. Heer (R. A. Couper 1958). Największy rozkwit klasy *Ginkgoinae* przypada na jurę, a tym samym wzrost udziału pyłku *Ginkgo* jest zgodny z tendencją rozwoju tej klasy. Zanik udziału *Platysaccus* Naumowa, emend. R. Potonié et Klaus jest prawdopodobnie związany z wymieraniem gatunków tego rodzaju na przestrzeni triasu (W. Klaus 1963, K. Mädler 1964).

Obecny stan badań pozwala już na stwierdzenie w kajprze geograficznego zróżnicowania w składzie sporomorf. Potwierdza się istnienie hipotetycznych prowincji roślinnych Wochramiejewa. Spektra z Trzciany należącej do prowincji europejskiej nie mają ani jednego gatunku wspólnego ze spektrami z prowincji azjatyckiej czy też syberyjskiej (Pokrowskaja 1966). Zaznacza się przy tym w prowincji europejskiej dalsze zróżnicowanie florystyczne. Z obszaru alpejskiego opisano inne spektra z osadów głębokomorskich (Carditaschichten, Halobienschiefer, W. Klaus 1960) i przybrzeżnych (Schilfsandstein, G. Leschik 1955 oraz Lunzerschichten, D. C. Bharadwaj i H. P. Singh 1964), inne z terenów osuszającego się lądu zachodniej części Europy środkowej (K. Mädler 1964 a, b), inne z jej części wschodniej — na Przedgórzu Karpat (M. E. Pautsch 1963 i niniejsze opracowanie), inne z pobliża brzegu ówczesnej tarczy lądu (M. E. Pautsch 1958), inne wreszcie z przypuszczalnie pustynnych obszarów w Worcestershire (R. F. A. Clarke 1965).

## Plate I

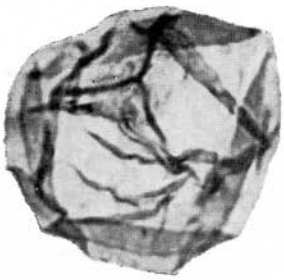
1. *Calamospora tener*, 39 μ, single sporomorph slide no 1, p. 9.
2. *Punctatisporites subcarpaticus*, holotype, 60 μ, single sporomorph slide no 6, p. 10.
3. *Punctatisporites crassexinis*, 49 μ, single sporomorph slide no 3, p. 9.
4. *Todisporites minor*, 45 μ, single sporomorph slide no 8, p. 11.
5. *Punctatisporites magnus*, holotype, 111 μ, single sporomorph slide no 4, p. 10.
6. *Carnisporites hercynicus*, 31 μ, single sporomorph slide no 18, p. 12.
7. *Retusotriletes mesozoicus*, 32 μ, Leitz 41/133, T3 no 1, p. 12.

## Tablica I

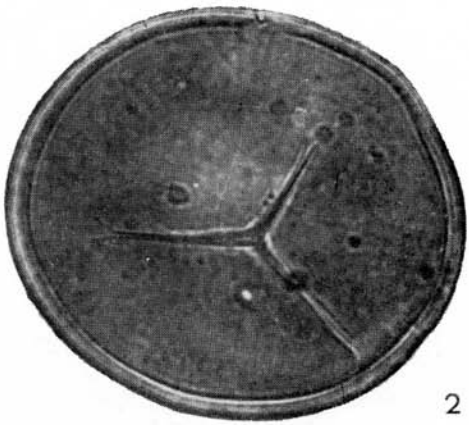
1. *Calamospora tener*, 39 μ, preparat izolowanych sporomorf nr 1, str. 9.
2. *Punctatisporites subcarpaticus*, holotyp, 60 μ, preparat izolowanych sporomorf nr 6, str. 10.
3. *Punctatisporites crassexinis*, 49 μ, preparat izolowanych sporomorf nr 3, str. 9.
4. *Todisporites minor*, 45 μ, preparat izolowanych sporomorf nr 8, str. 11.
5. *Punctatisporites magnus*, holotyp, 111 μ, preparat izolowanych sporomorf nr 4, str. 10.
6. *Carnisporites hercynicus*, 31 μ, preparat izolowanych sporomorf nr 18, str. 12.
7. *Retusotriletes mesozoicus*, 32 μ, Leitz 41/133, T3 nr 1, str. 12.

Phot. *M. Pautsch*
Fot. *M. Pautsch*

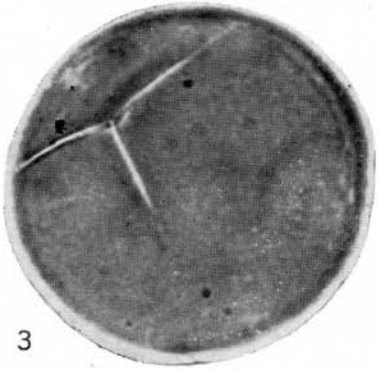
Plate I
Tablica I



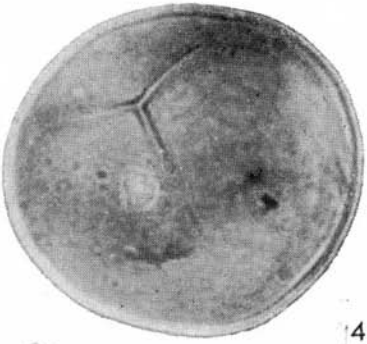
1



2

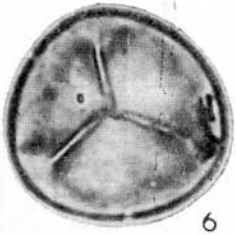


3



4

5



6

7

## Plate II

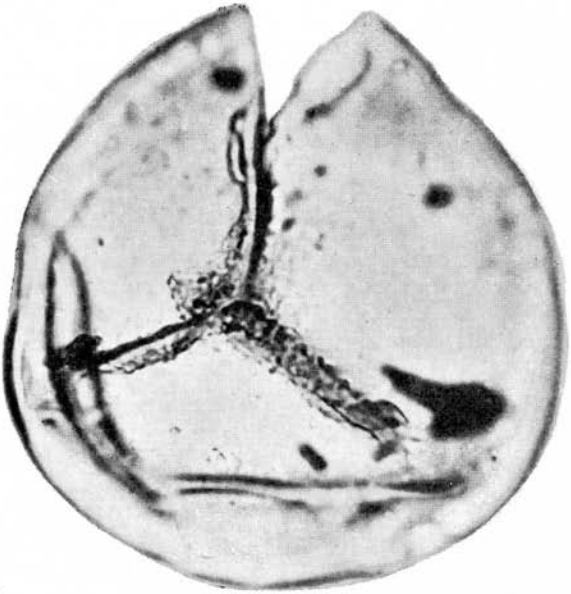
1. *Crispotectatisporites punctatus,* holotype, 88 μ, single sporomorph slide no 17, p. 11.
2. *Paraconcavisporites* sp., 35 μ, single sporomorph slide no 23, p. 14.
3. *Carnisporites* cf. *telephorus,* 29 μ, single sporomorph slide no 22, p. 13.
4—5. *Carnisporites* cf. *ornatus,* 32 μ, single sporomorph slide no 20, p. 13.
6. *Baculatisporites comaumensis,* 50 μ, single sporomorph slide no 34, p. 16.
7. *Converrucosisporites conferteornatus,* 76 μ, single sporomorph slide no 28, p. 14.

## Tabilca II

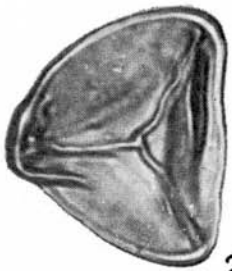
1. *Crispotectatisporites punctatus,* holotyp, 88 μ, preparat izolowanych sporomorf nr 17, str. 11.
2. *Paraconcavisporites* sp., 35 μ, preparat izolowanych sporomorf nr 23, str. 14.
3. *Carnisporites* cf. *telephorus,* 29 μ, preparat izolowanych sporomorf nr 22, str. 13.
4—5. *Carnisporites* cf. *ornatus,* 32 μ, preparat izolowanych sporomorf nr 20, str. 13.
6. *Baculatisporites comaumensis,* 50 μ, preparat izolowanych sporomorf nr 34, str. 16.
7. *Converrucosisporites conferteornatus,* 76 μ, preparat izolowanych sporomorf nr 28, str. 14.

Phot. *M. Pautsch*
Fot. *M. Pautsch*

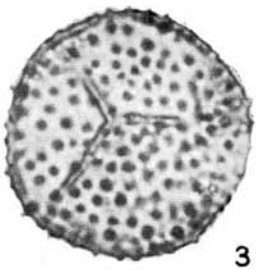
Plate II
Tablica II



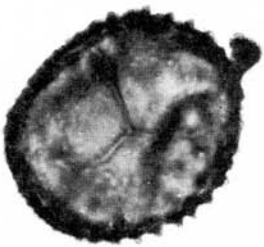
1



2

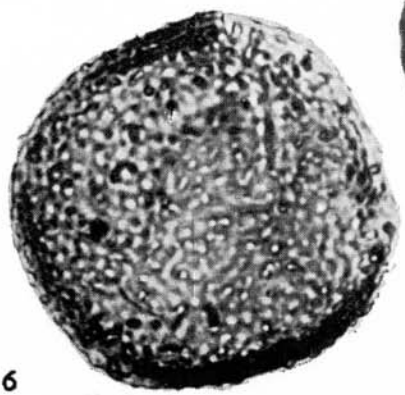


3

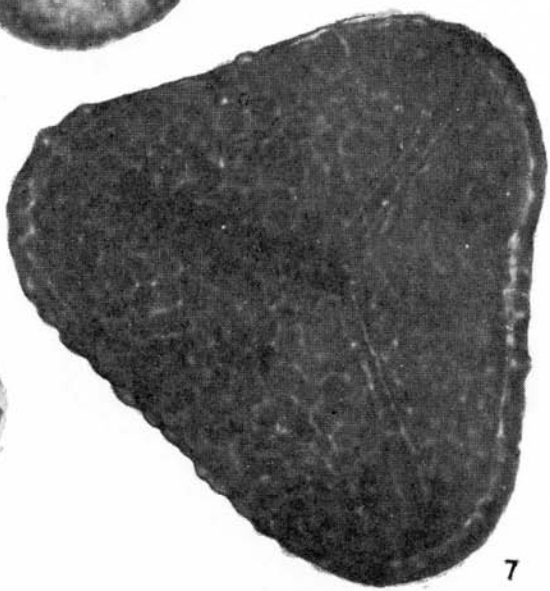


4

5



6



7

*M. Pautsch*
Acta Palaeobotanica XII/1

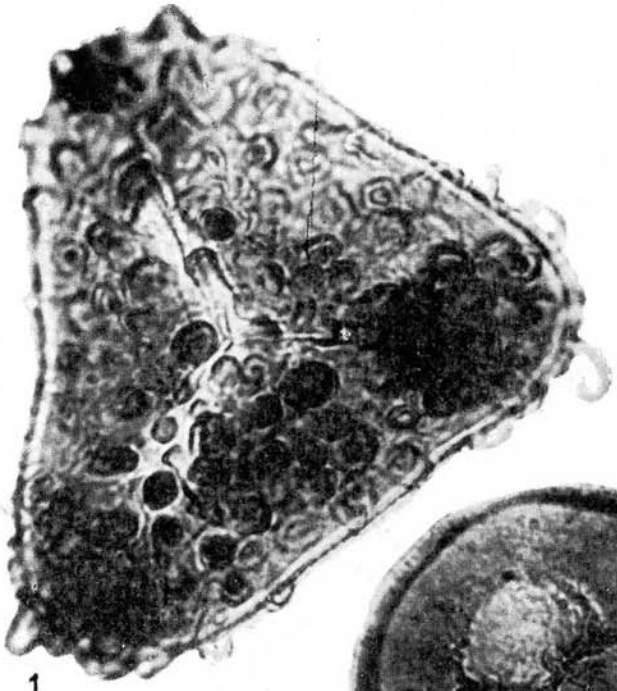
## Plate III

1. *Converrucosisporites diverseornatus*, holotype, 89 μ, single sporomorph slide no 30, p. 15.
2. *Distalanulisporites punctus*, 32 μ, single sporomorph slide no 41, p. 17.
3. *Camarozonosporites rudis*, 52 μ, single sporomorph slide no 50, p. 18.
4. *Cyclogranisporites rugosetectatus*, holotype, 58 μ, single sporomorph slide no 32, p. 15.
5. *Microreticulatisporites opacus*, 71 μ, single sporomorph slide no 43, p. 17.
6. *Conbaculatisporites mesozoicus*, 62 μ, single sporomorph slide no 38, p. 16.

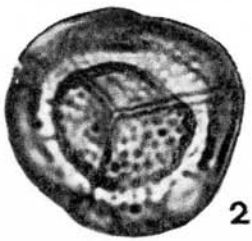
## Tablica III

1. *Converrucosisporites diverseornatus*, holotyp, 89 μ, preparat izolowanych sporomorf nr 30, str. 15.
2. *Distalanulisporites punctus*, 32 μ, preparat izolowanych sporomorf nr 41, str. 17.
3. *Camarozonsporites rudis*, 52 μ, preparat izolowanych sporomorf nr 50, str. 18.
4. *Cyclogranisporites rugosetectatus*, holotyp, 58 μ, preparat izolowanych sporomorf nr 32, str. 15.
5. *Microreticulatisporites opacus*, 71 μ, preparat izolowanych sporomorf nr 43, str. 17.
6. *Conbaculatisporites mesozoicus*, 62 μ, preparat izolowanych sporomorf nr 38, str. 16.

Phot. *M. Pautsch*
Fot. *M. Pautsch*

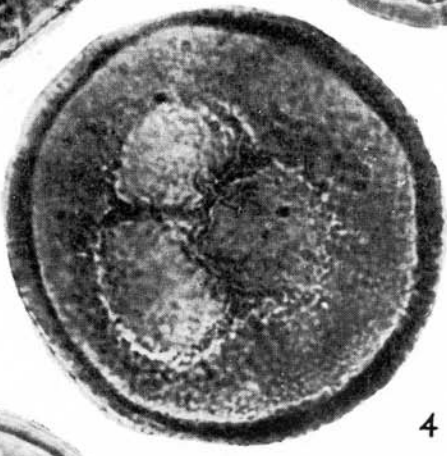


1

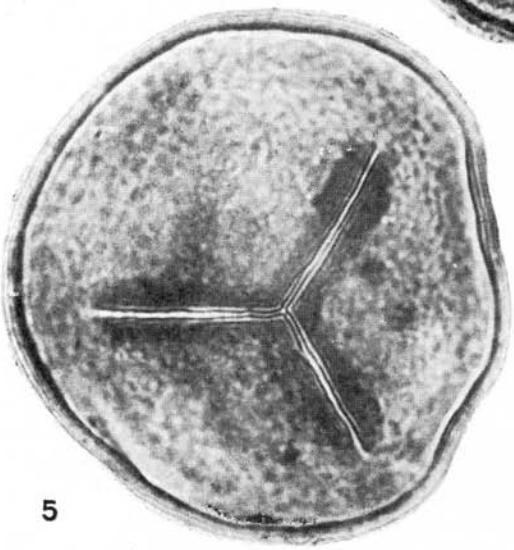


2

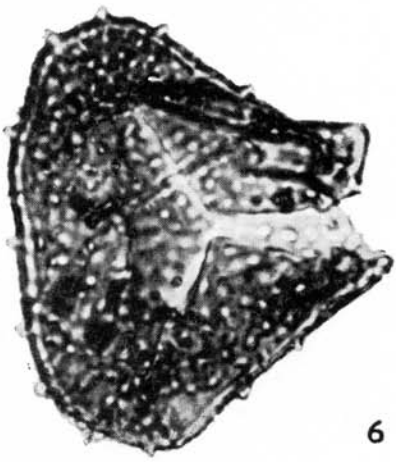
3



4



5



6

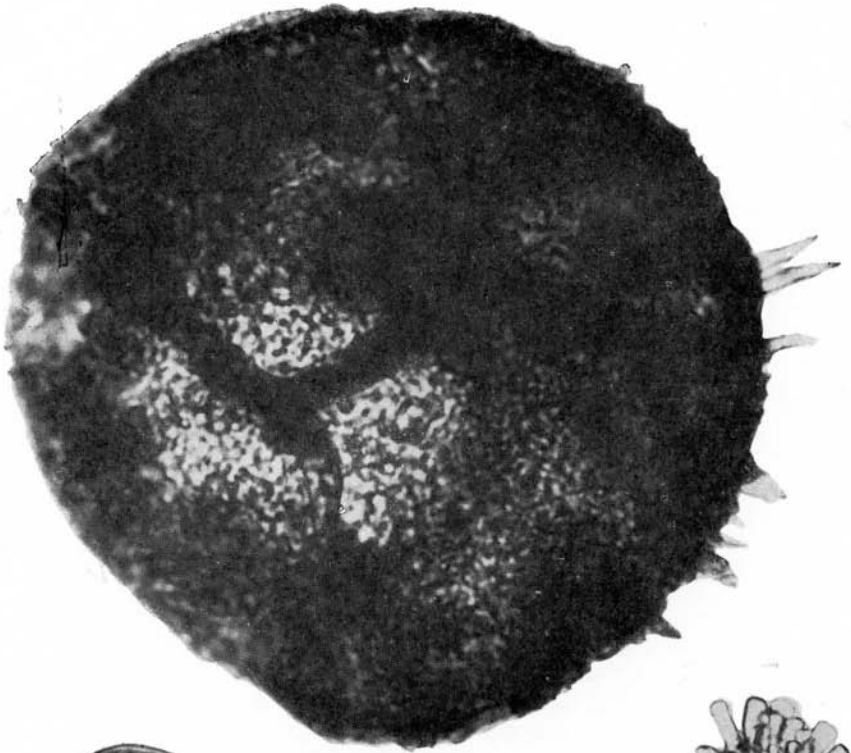
## Plate IV

1. *Keuperisporties baculatus*, 114 μ, Leitz 25/110, T5 no 1, p. 16.
2. *Leschikiisporis aduncus*, 31 μ, single sporomorph slide no 67, p. 20.
3. *Leschikiisporis aduncus*, 30 μ, single sporomorph slide no 73, p. 20.
4. *Echinitosporites illiacoides*, 40 μ, single sporomorph slide no 78, p. 22.
5. *Lycopodiacidites kuepperi*, 58 μ, Leitz 39/118 T5, no 1, p. 18.
6. *Banulisportes badius*, 42 μ, single sporomorph slide no 63, p. 19.

## Tablica IV

1. *Keuperisporites baculatus* 114 μ, Leitz 25/110, T5 nr 1, str. 16.
2. *Leschikiisporis aduncus*, 31 μ, preparat izolowanych sporomorf nr 67, str. 20.
3. *Leschikiisporis aduncus*, 30 μ, preparat izolowanych sporomorf nr 73, str. 20.
4. *Echinitosporites illiacoides*, 40 μ, preparat izolowanych sporomorf nr 78, str. 22.
5. *Lycopodiacidites kuepperi*, 58 μ, Leitz 39/118, T5 nr 1, str. 18.
6. *Bianulisporites badius*, 42 μ, preparat izolowanych sporomorf nr 63, str. 19.

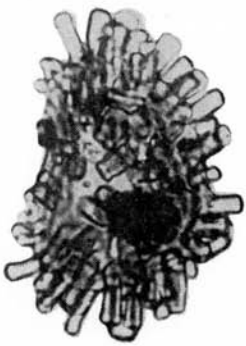
Phot. *M. Pautsch*
Fot. *M. Pautsch*



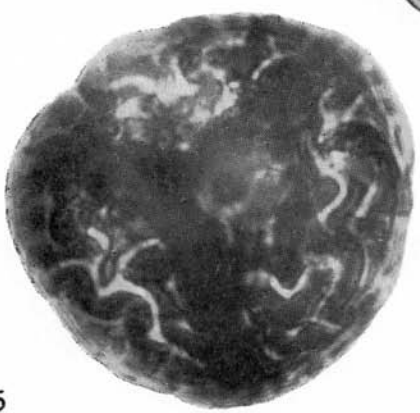
1

2

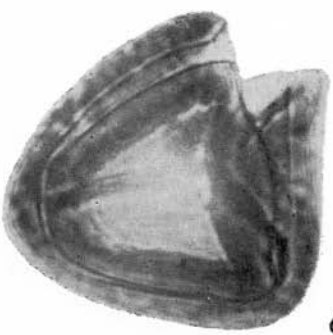
3



4



5



6

## Plate V

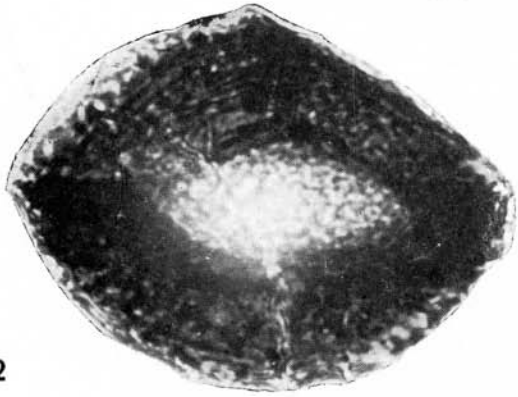
1. *Spiralisporites insignis*, holotype, 124 μ, Leitz 59, 9/117, T5 no 4, str. 19.
2. *Styxisporites granulatus*, holotype 65 μ, single sporomorph slide no 66, p. 20.
3. *Aratrisporites pilosus*, 49 μ, Leitz 32/128, T3 no 1, p. 26.
4. *Aratrisporites saturni*, 47 μ, single sporomorph slide no 80, p. 25.
5. *Aratrisporites scabratus*, 49 μ, single sporomorph slide no 91, p. 27.

## Tablica V

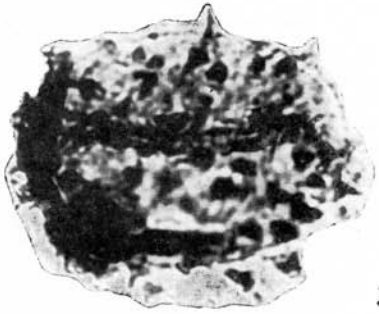
1. *Spiralisporites insignis*, holotyp, 124 μ, Leitz 59, 9/117, T5 nr 4, str. 19.
2. *Styxisporites granulatus*, holotyp, 65 μ, preparat izolowanych sporomorf nr 66, str. 20.
3. *Aratrisporites pilosus*, 49 μ, Leitz 32/128, T3 nr 1, str. 26.
4. *Aratrisporites saturni*, 47 μ, preparat izolowanych sporomorf nr 80, str. 25.
5. *Aratrisporites scabratus*, 49 μ, preparat izolowanych sporomorf nr 91, str. 27.

Phot. *M. Pautsch*
Fot. *M. Pautsch*

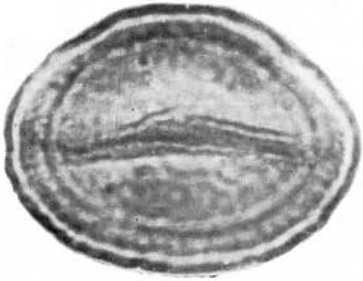
1



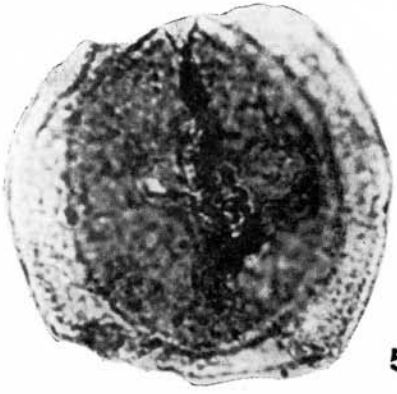
2



3



4



5

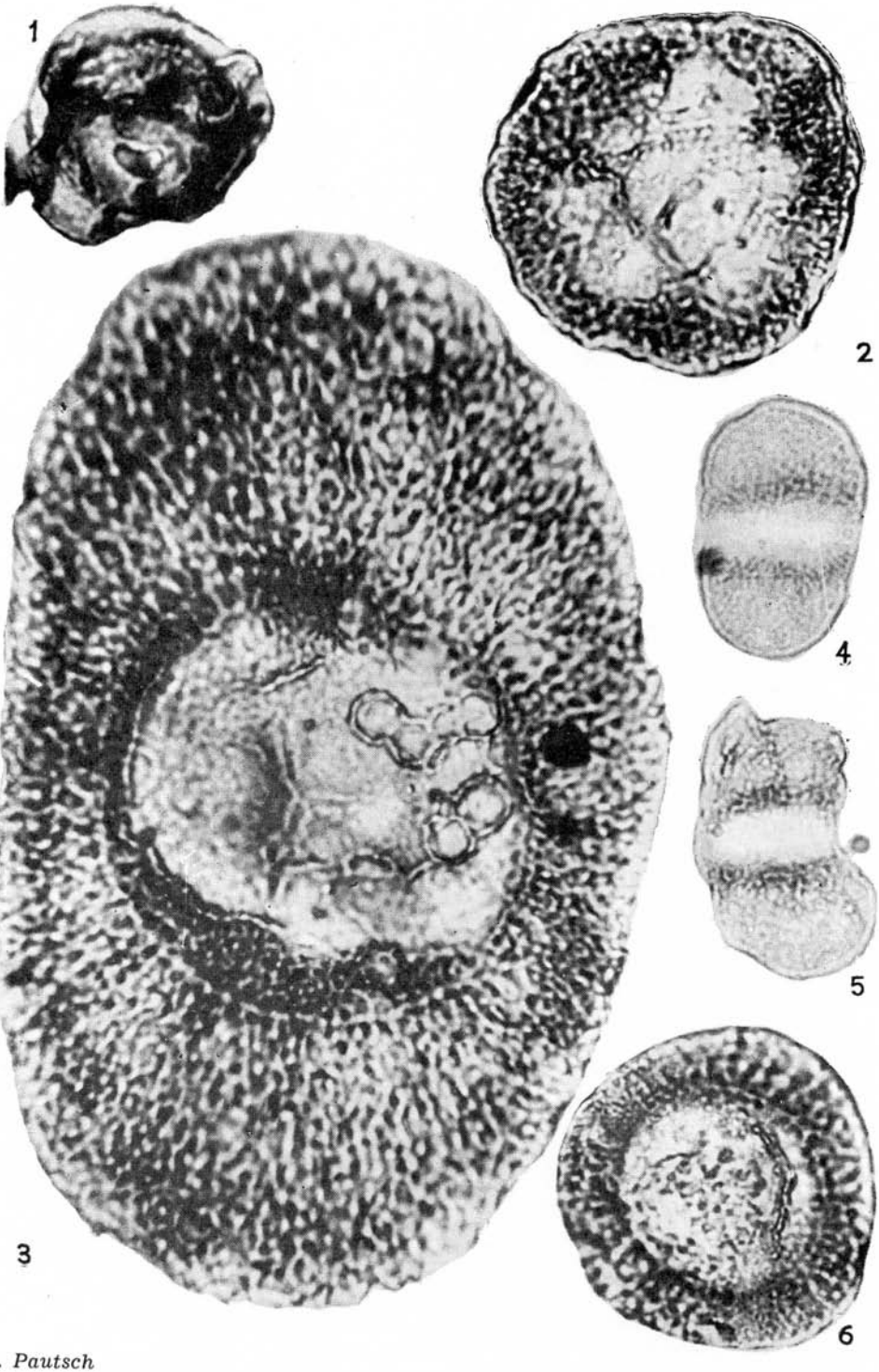
## Plate VI

1. *Aratrisporites rotundus*, 32 μ, Leitz 37/120, T5 no 1, p. 26.
2. *Circulisaccus minor*, 53 μ, single sporomorph slide no 117, p. 28.
3. *Ellipsosaccus subcarpaticus*, holotype, 199 μ, single sporomorph slide no 99, p. 23.
4. *Caytonipollenites pallidus*, 40 μ, single sporomorph slide no 163, p. 36.
5. *Caytonipollenites pallidus*, 42 μ, single sporomorph slide no 165, p. 36.
6. *Circulisaccus minor*, holotype, 57 μ, single spormorph slide no 115, p. 28.

## Tablica VI

1. *Aratrisporites rotundus*, 32 μ, Leitz 37/220, T5 nr 1, str. 26.
2. *Circulisaccus minor*, 53 μ, preparat izolowanych sporomorf nr 117, str. 23.
3. *Ellipsosaccus subcarpaticus*, holotyp, 199 μ, preparat izolowanych sporomorf nr 99, str. 23.
4. *Caytonipollenites pallidus*, 40 μ, preparat izolowanych sporomorf nr 163, str. 36.
5. *Caytonipollenites pallidus*, 42 μ, preparat izolowanych sporomorf nr 165, str. 36.
6. *Circulisaccus minor*, holotyp, 57 μ, preparat izolowanych sporomorf nr 115, str. 28.

Phot. *M. Pautsch*
Fot. *M. Pautsch*


1
2
3
4
5
6

## Plate VII

1. *Circulisaccus major*, 138 μ, Leitz 26/112, T5 no 1, p. 28.
2. *Aratrisporites virgatus*, 42 μ, single sporomorph slide no 88, p. 25.
3. *Laricoidites subcarpaticus*, 106 μ, single sporomorph slide no 76, p. 22.
4. *Circulisaccus major*, 223 μ, single sporomorph slide no 107, p. 28.

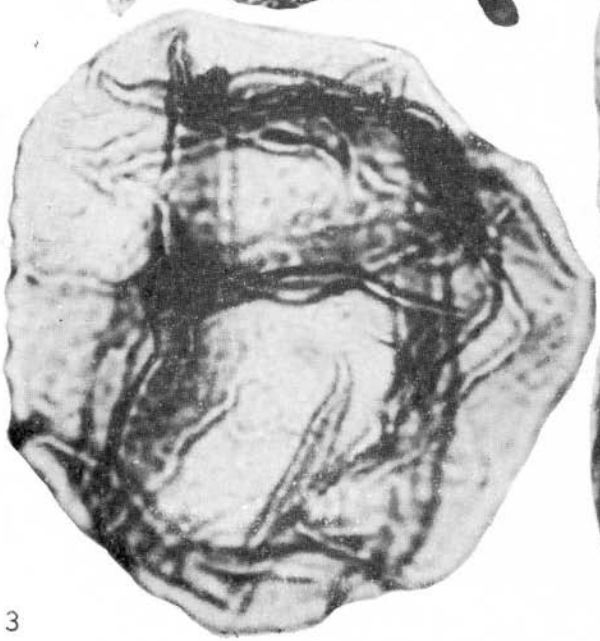
## Tablica VII

1. *Circulisaccus major*, 138 μ, Leitz 26/112, T5 nr 1, str. 28.
2. *Aratrisporites virgatus*, 42 μ, preparat izolowanych sporomorf nr 88, str. 25.
3. *Laricoidites subcarpaticus*, 106 μ, preparat izolowanych sporomorf nr 76, str. 22.
4. *Circulisaccus major*, 223 μ, preparat izolowanych sporomorf nr 107, str. 28.

Phot. *M. Pautsch*
Fot. *M. Pautsch*

1

2



3

4

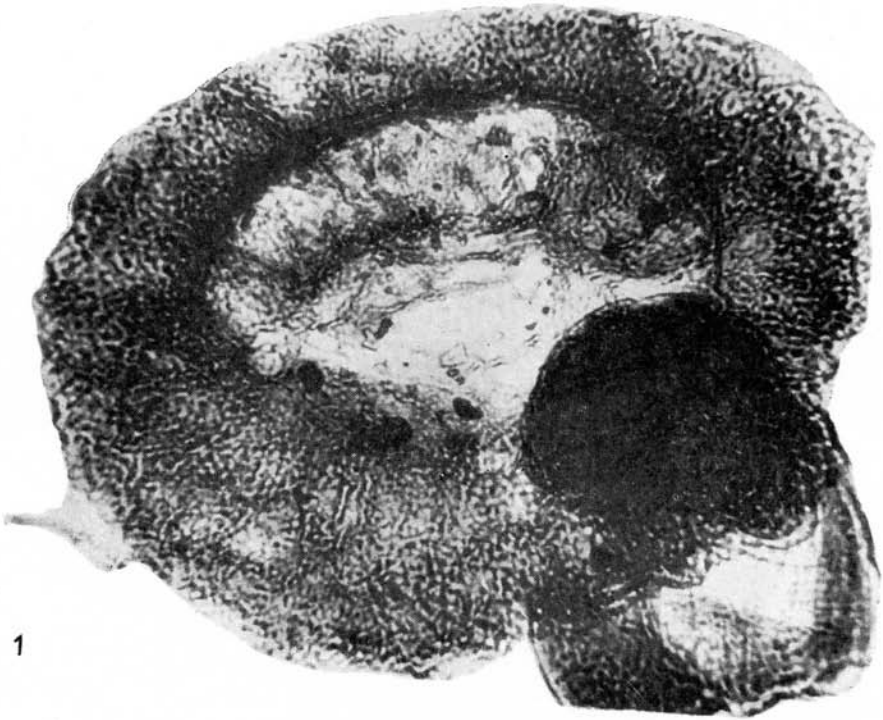
## Plate VIII

1. *Circulisaccus major,* 175 μ, single sporomorph slide no 104, p. 28.
2. *Ovalipollis lunzensis,* 73 μ single sporomorph slide no 124, p. 30.
3. *Aratrisporites* cf. *fischeri,* 81 μ, Leitz 31/116, T3 no 1, p. 27.

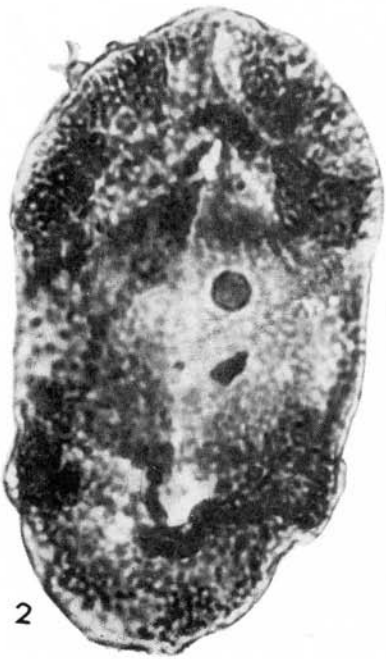
## Tabilca VIII

1. *Circulisaccus major,* 175 μ, preparat izolowanych sporomorf nr 104, str. 28.
2. *Ovalipollis lunzensis,* 73 μ, preparat izolowanych sporomorf nr 124, str. 30.
3. *Aratrisporites* cf. *fischeri,* 81 μ, Leitz 31/116, T3 nr 1, str. 27.

Phot. *M. Pautsch*
Fot. *M. Pautsch*



1



2

3

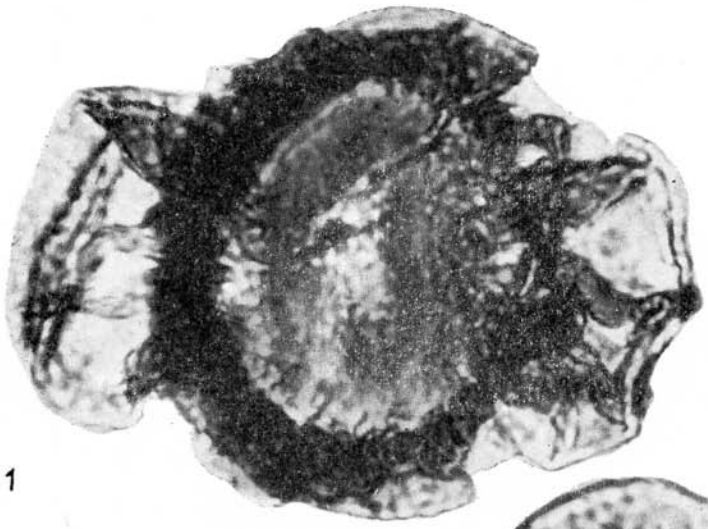
## Plate IX

1. *Institisporites crispus*, holotype, 75 μ, single sporomorph slide no 120, p. 29.
2. *Taeniaesporites kräuseli*, 62 μ, single sporomorph slide no 122, p. 29.
3. *Infirmisporites fragilis*, 81 μ, single sporomorph slide no 134, p. 32.
4. *Institisporites crispus*, 89 μ, single sporomorph slide no 119, p. 29.

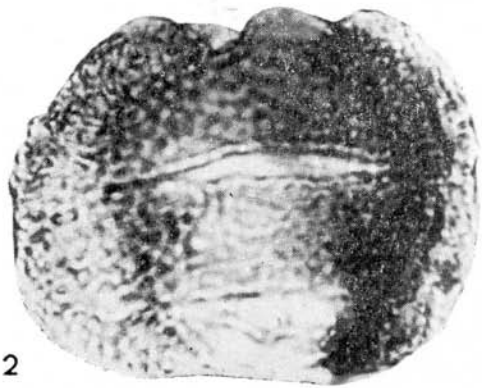
## Tablica IX

1. *Institisporites crispus*, holotyp, 75 μ, preparat izolowanych sporomorf, nr 120, str. 29.
2. *Taeniaesporites kräuseli*, 62 μ, preparat izolowanych sporomorf nr 122, str. 29.
3. *Infirmisporites fragilis*, 81 μ, preparat izolowanych sporomorf nr 134, str. 32.
4. *Institisporites crispus*, 89 μ, preparat izolowanych sporomorf nr 119, str. 29.

Phot. *M. Pautsch*
Fot. *M. Pautsch*

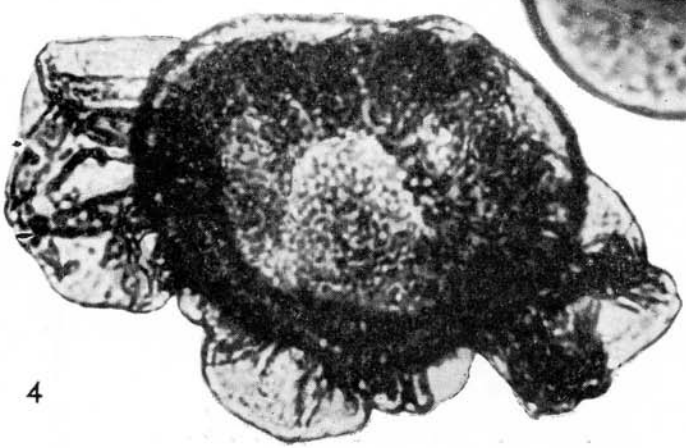


1



2

3



4

## Plate X

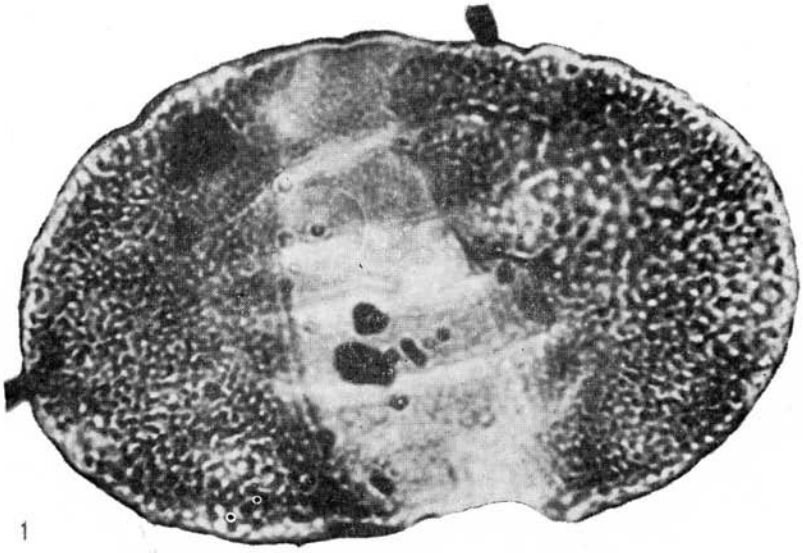
1. *Faunipollenites subcarpaticus*, holotype, 94 μ, single sporomorph slide no 132, p. 32.
2. *Striatites elongatus*, holotype, 150 μ single sporomorph slide no 127 p. 31.
3. *Striatites limpidus*, 80 μ, single sporomorph slide no 126, p. 30.
4. *Infirmisporites fragilis*, single sporomorph slide no 136, p. 32.

## Tablica X

1. *Faunipollenites subcarpaticus*, holotyp, 94 μ, preparat izolowanych sporomorf nr 132, str. 32.
2. *Striatites elongatus*, holotyp, 105 μ, preparat izolowanych sporomorf nr 127, str. 31.
3. *Striatites limpidus*, 80 μ, preparat izolowanych sporomorf nr 126, str. 30.
4. *Infirmisporites fragilis*, holotyp, preparat izolowanych sporomorf nr 136, str. 32.

Phot. *M. Pautsch*
Fot. *M. Pautsch*

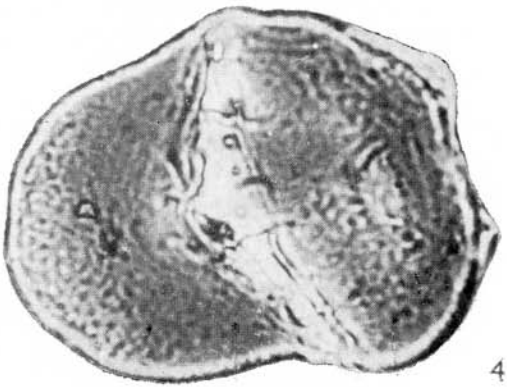
Plate X
Tablica X



1

2

3



4

*M. Pautsch*
Acta Palaeobotanica XII/1

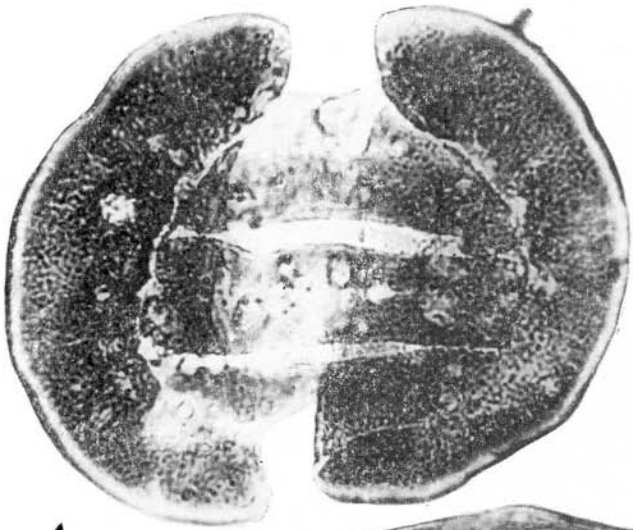
## Plate XI

1. *Umbrellisaccus sulcatus*, 104 μ, single sporomorph slide no 138, p. 33.
2. *Angustisulcites klausii*, 65 μ, single sporomorph slide no 160, p. 35.
3. *Umbrellisaccus sulcatus*, 104 μ, single sporomorph slide no 141, p. 33.
4. *Illinites chitonoides*, 117 μ, single sporomorph slide no 155, p. 34.

## Tablica XI

1. *Umbrellisaccus sulcatus*, 104 μ, preparat izolowanych sporomorf nr 138, str. 33.
2. *Angustisulcites klausi*, 65 μ, preparat izolowanych sporomorf nr 160, str. 35.
3. *Umbrellisaccus sulcatus*, 104 μ, preparat izolowanych sporomorf nr 141, str. 33.
4. *Illinites chitonoides*, 117 μ, preparat izolowanych sporomorf nr 155, str. 34.

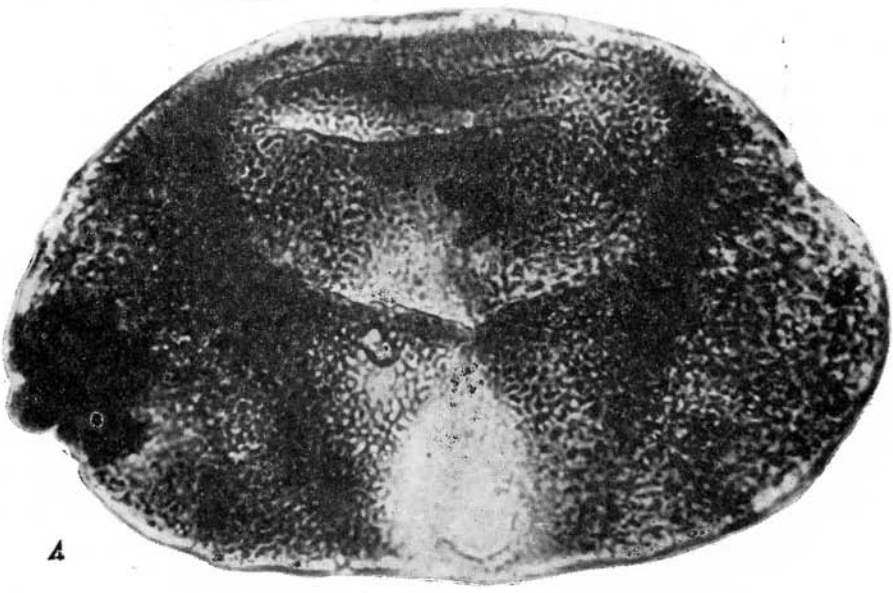
Phot. *M. Pautsch*
Fot. *M. Pautsch*



1

2

3



4

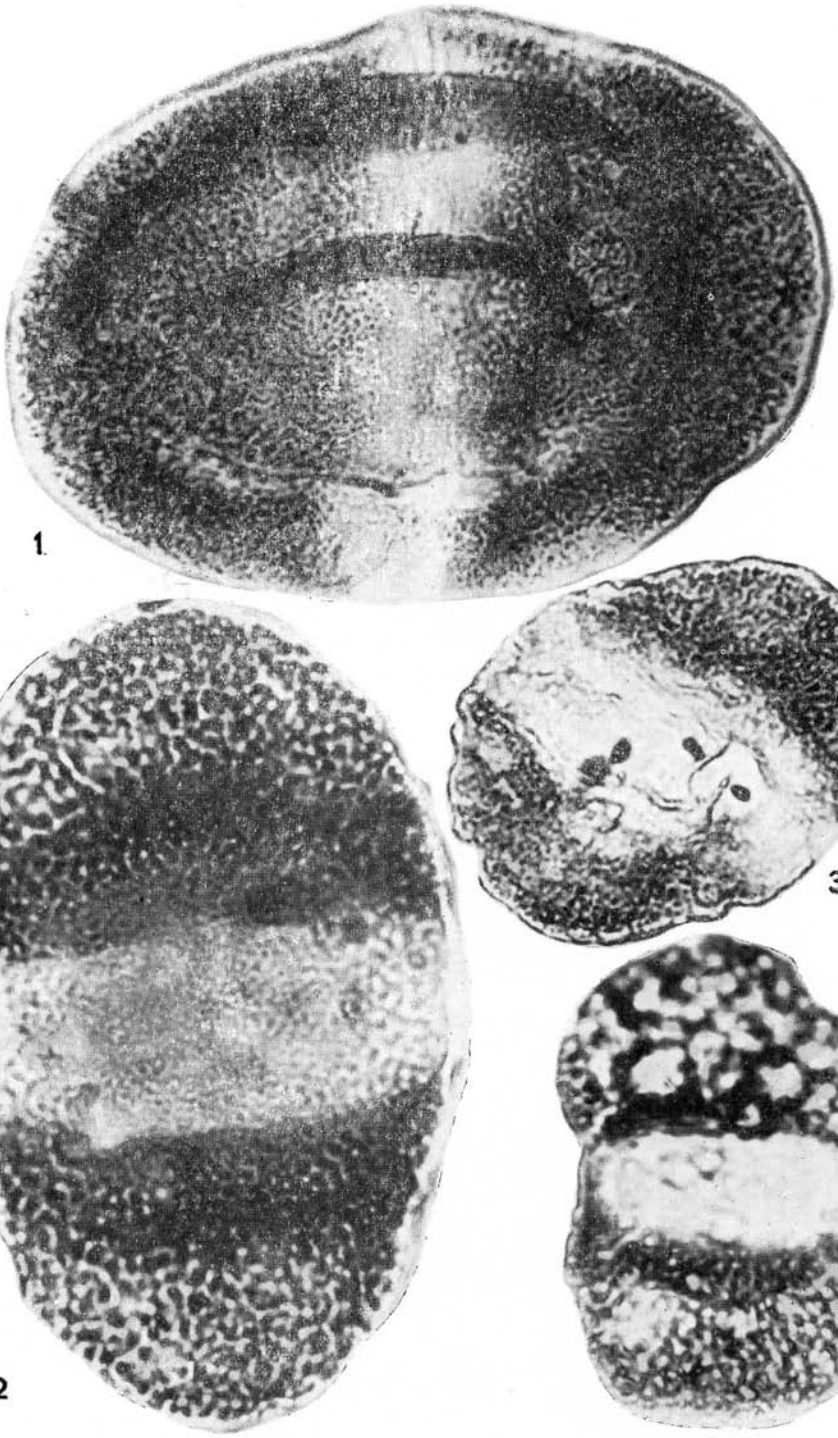
## Plate XII

1. *Illinites chitonoides*, 116 μ, single sporomorph, slide no 151, p. 34.
2. *Falcisporites keuperianus*, holotype, 112 μ, single sporomorph slide no 178, p. 40.
3. *Diaphanisporites diaphanus*, 60 μ, single sporomorph slide no 174, p. 38.
4. *Diaphanisporites major*, holotype, 63 μ, single sporomorph slide no 177, p. 38.

## Tablica XII

1. *Illinites chitonoides*, 116 μ, preparat izolowanych sporomorf nr 151, str. 34.
2. *Falcisporites keuperianus*, holotyp, 112 μ, preparat izolowanych sporomorf nr 178, str. 40.
3. *Diaphanisporites diaphanus*, 60 μ, preparat izolowanych sporomorf nr 174, str. 38.
4. *Diaphanisporites major*, holotyp, 63 μ, preparat izolowanych sporomorf nr 177, str. 38.

Phot. *M. Pautsch*
Fot. *M. Pautsch*




*M. Pautsch*
Acta Palaeobotanica XII/1

## Plate XIII

1. *Alisporites aequalis*, 106 μ, single sporomorph slide no 166, p. 36.
2. *Alisporites aequalis*, 99 μ, single sporomorph slide no 167, p. 36.
3. *Cuneatisporites* cf. *radialis*, 73 μ, single sporomorph slide no 203, p. 39.
4. *Diaphanisporites major*, 65 μ, single sporomorph slide no 176, p. 38.

## Tablica XIII

1. *Alisporites aequalis*, 106 μ, preparat izolowanych sporomorf nr 166, str. 36.
2. *Alisporites aequalis*, 99 μ, preparat izolowanych sporomorf nr 167, str. 36.
3. *Cuneatisporites* cf. *radialis*, 73 μ, preparat izolowanych sporomorf nr 203, str. 39.
4. *Diaphanisporites major*, 65 μ, preparat izolowanych sporomorf, nr 176, str. 38.

Phot. *M. Pautsch*
Fot. *M. Pautsch*


1
2
3
4

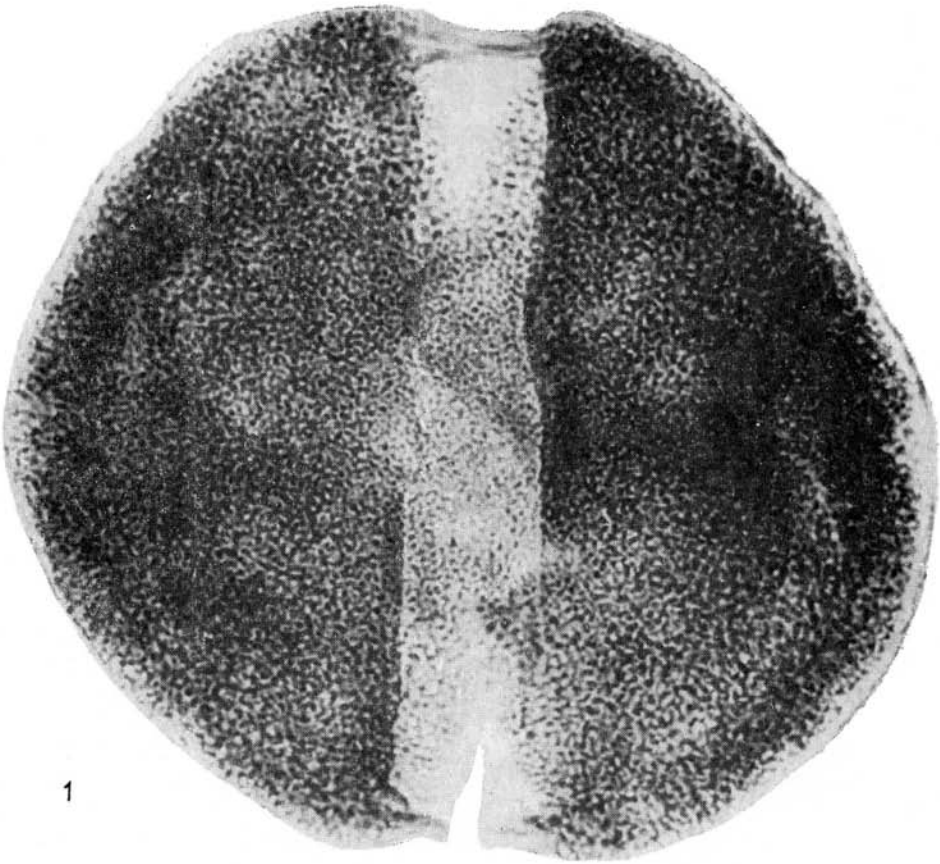
## Plate XIV

1. *Brachysaccus* cf. *neomundanus*, 130 μ, single sporomorph slide no 201, p. 40.
2. *Complicatisaccus perlucidus*, holotype, 62 μ, single sporomorph slide no 171, p. 37.
3. *Complicatisaccus perlucidus*, 62 μ, single sporomorph slide no 172, p. 37.

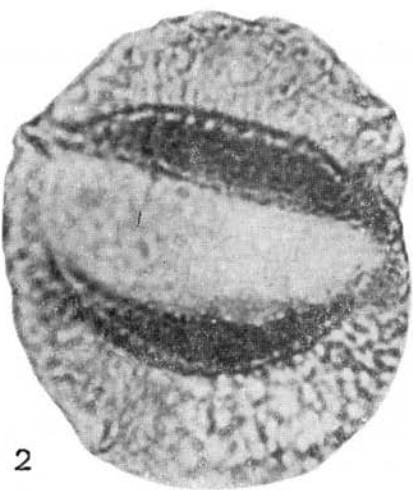
## Tablica XIV

1. *Brachysaccus* cf. *neomundanus*, 130 μ, preparat izolowanych sporomorf nr 201, str. 40.
2. *Complicatisaccus perlucidus*, holotyp, 62 μ, preparat izolowanych sporomorf nr 171, str. 37.
3. *Complicatisaccus perlicidus*, 62 μ, preparat izolowanych sporomorf nr 172, str 37.

Phot. *M. Pautsch*
Fot. *M. Pautsch*



1



2

3

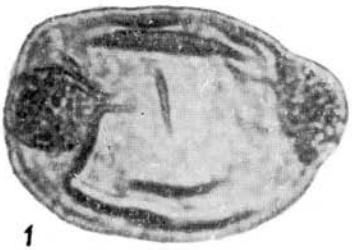
## Plate XV

1. *Minutisaccus subcarpaticus*, 44 μ, single sporomorph slide no 213, p. 41.
2. *Minutisaccus subcarpaticus*, holotype, 52 μ, single sporomorph slide no 211, p. 41.
3. *Radiatisaccus fulvus*, holotype, 98 μ, single sporomorph slide no 249, p. 44.
4. *Radiatisaccus fulvus*, 98 μ, single sporomorph slide no 250, p. 44.
5. *Minutisaccus ornatus*, holotype, 29 μ, single sporomorph slide no 235, p. 42.
6. *Minutisaccus ornatus*, 32 μ, single spormorph slide no 236, p. 42.

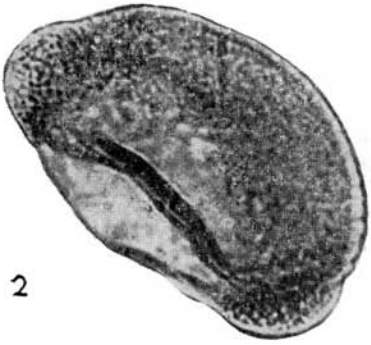
## Tablica XV

1. *Minutisaccus subcarpaticus*, 44 μ, preparat izolowanych sporomorf nr 213, str. 41.
2. *Minutisaccus subcarpaticus*, holotyp, 52 μ, preparat izolowanych sporomorf nr 211, str. 41.
3. *Radiatisaccus fulvus*, holotyp, 98 μ, preparat izolowanych sporomorf nr 249, str. 44.
4. *Radiatisaccus fulvus*, 98 μ, preparat izolowanych sporomorf nr 250, str. 44.
5. *Minutisaccus ornatus*, holotyp, 29 μ, preparat izolowanych sporomorf nr 235, str. 42.
6. *Minutisaccus ornatus*, 32 μ, preparat izolowanych sporomorf nr 236, str. 42.

Phot. *M. Pautsch*
Fot. *M. Pautsch*



1



2

3

4

5

6

*M. Pautsch*
Acta Palaeobotanica XII/1

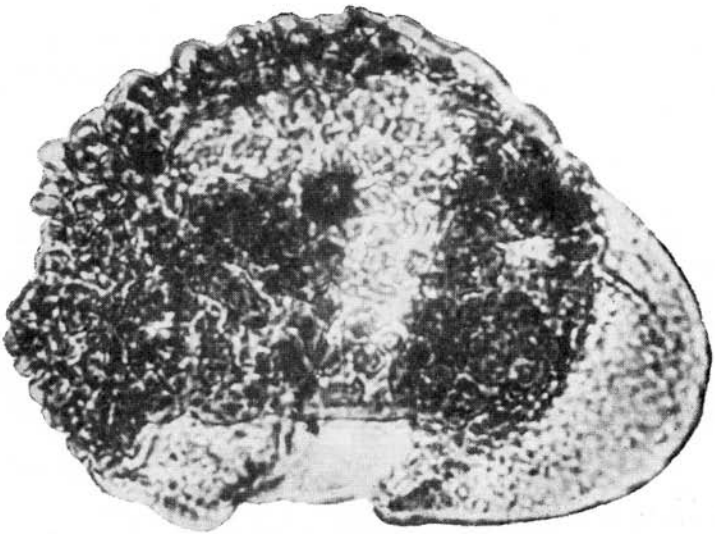
## Plate XVI

1. *Granisaccus elongatus*, 89 μ, single sporomorph slide no 238, p. 42.
2. *Platysaccus nitidus*, holotype, 84 μ, single sporomorph slide no 264, p. 45.
3. *Granisaccus elongatus*, holotype, 88 μ, single sporomorph slide no 239, p. 42.

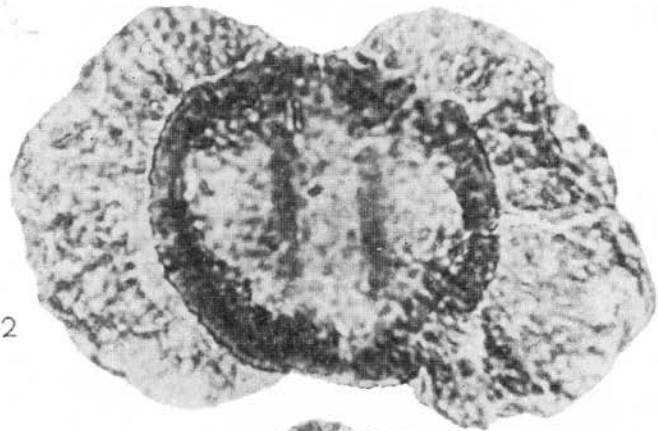
## Tablica XVI

1. *Granisaccus elongatus*, 89 μ, preparat izolowanych sporomorf nr 238, str. 42.
2. *Platysaccus nitidus*, holotyp, 84 μ, preparat izolowanych sporomorf nr 264, str. 45.
3. *Granisaccus elongatus*, holotyp, 88 μ, preparat izolowanych sporomorf na 239, str. 42.

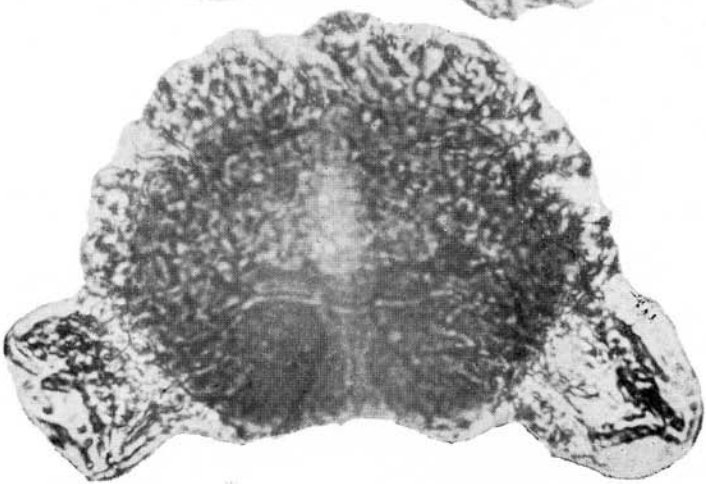
Phot. *M. Pautsch*
Fot. *M. Pautsch*



1



2



3

*M. Pautsch*
Acta Palaeobotanica XII/1

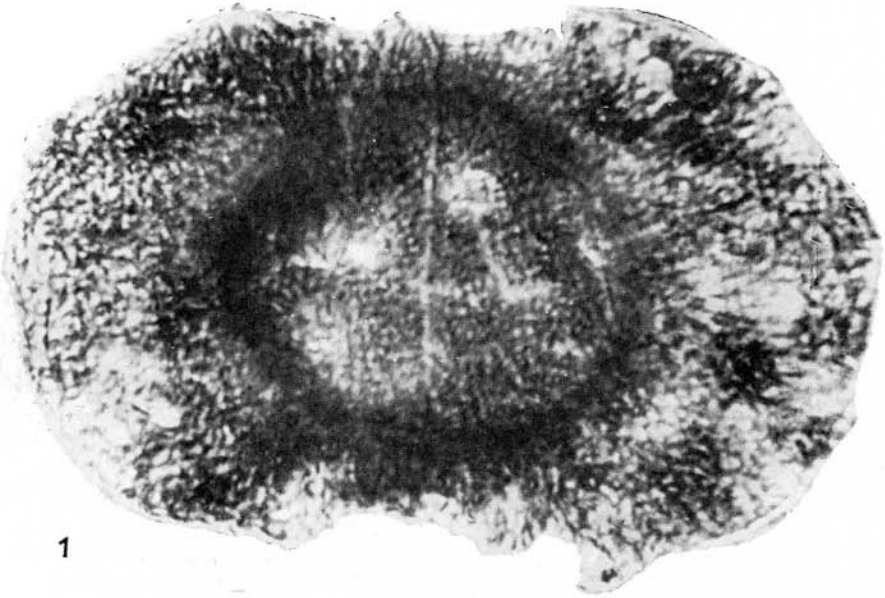
## Plate XVII

1. *Platysaccus subcarpaticus*, holotype, 132 μ, single sporomorph slide no 271, p. 46.
2. *Platysaccus niger*, 94 μ, single sporomorph slide no 263, p. 46.
3. *Platysaccus nitidus*, 89 μ, single sporomorph slide no 266, p. 45.

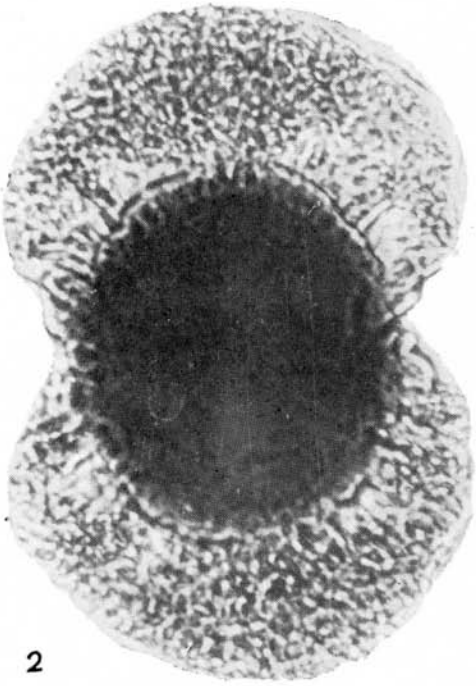
## Tablica XVII

1. *Platysaccus subcarpaticus*, holotyp, 132 μ, preparat izolowanych sporomorf nr 271, str. 46.
2. *Platysaccus niger*, 94 μ, preparat izolowanych sporomorf nr 263, str. 46.
3. *Platysaccus nitidus*, 89 μ, preparat izolowanych sporomorf nr 266, str. 45.

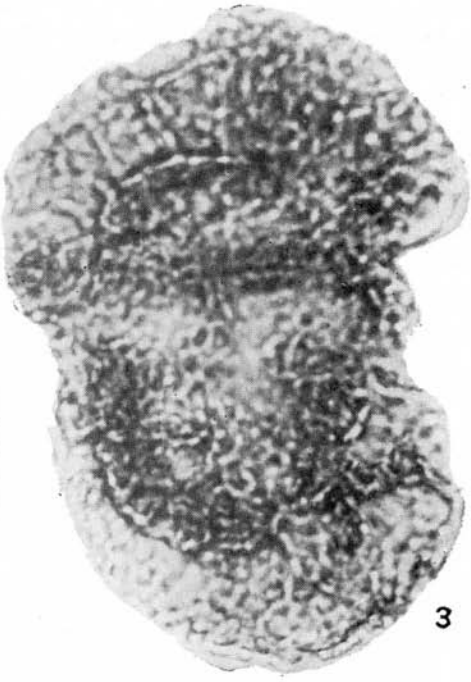
Phot. *M. Pautsch*
Fot. *M. Pautsch*



1



2



3

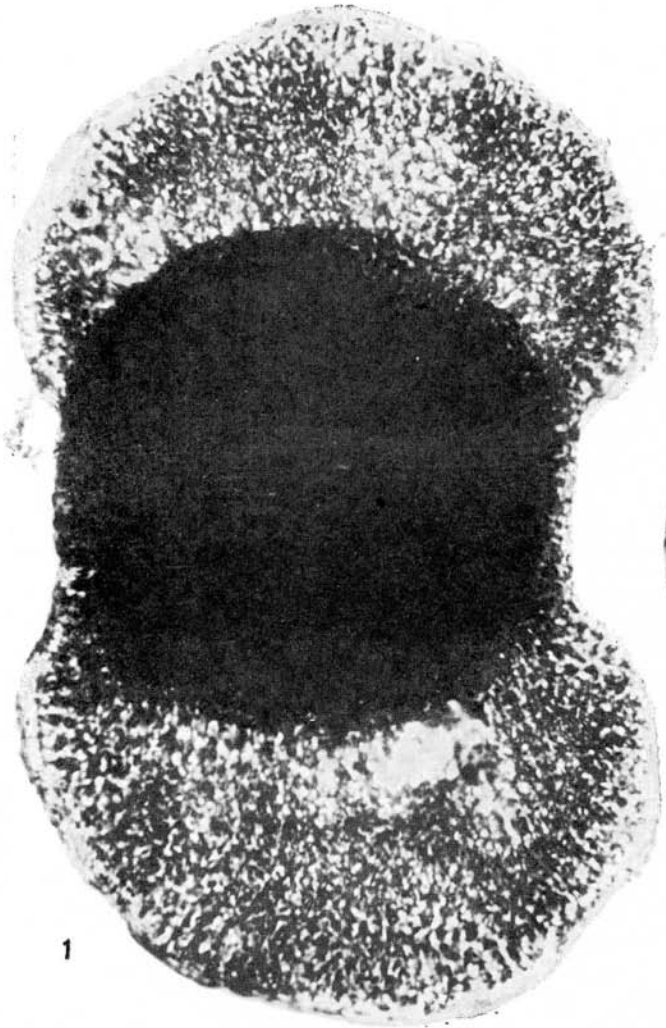
## Plate XVIII

1. *Platysaccus* cf. *papilionis*, 147 μ, single sporomorf slide no 256, p. 44.
2. *Monosulcites perforatus*, 34 μ, single sporomorph slide no 297, p. 47.
3. *Monosulcites salebrosus*, holotype, 40 μ, single sporomorph slide no 293, p. 48.
4. *Micrhystridium subcarpaticum*, holotype, 17 μ, single sporomorph slide no 303, p. 48.
5. *Plicatisaccus badius*, 60 μ, single sporomorph slide no 245, p. 43.
6. *Monosulcites minimus*, 35 μ, single sporomorph slide no 293, p. 47.
7. *Monosulcites minimus*, 36 μ, single sporomorph slide no 291, p. 47.

## Tablica XVIII

1. *Platysaccus* cf. *papilionis*, 147 μ, preparat izolowanych sporomorf nr 256, str. 44.
2. *Monosulcites perforatus*, 34 μ, preparat izolowanych sporomorf nr 297, str. 47.
3. *Monosulcites salebrosus*, holotyp, 40 μ, preparat izolowanych sporomorf nr 298, str. 48.
4. *Micrhystridium subcarpaticum*, holotyp, 17 μ, preparat izolowanych sporomorf nr 303, str. 48.
5. *Plicatisaccus badius*, 60 μ, preparat izolowanych sporomorf nr 245, str. 43.
6. *Monosulcites minimus*, 35 μ, preparat izolowanych sporomorf nr 293, str. 47.
7. *Monosulcites minimus*, 36 μ, preparat izolowanych sporomorf nr 291, str. 47.

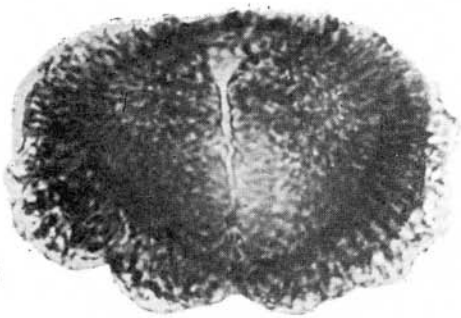
Fot. *M. Pautsch*


1


2


3


4


5


6


7