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UPPER EOCENE AND LOWER OLIGOCENE SPOROMORPHS OF THE ORAVSKÁ VRCHOVINA HIGHLANDS

Figs. 4, Pls. 10)

A b s t r a c t: The paper is dealing with biostratigraphical and paleontological study of spores and pollen grains obtained from Paleogene rocks of the Oravská vrchovina highlands. The species composition of pollen assemblage proves that the sediments were deposited in the Upper Eocene to Lower-Oligocene. After assignment of individual species to families of the botanic system we may suppose a tropical — subtropical climate in the period of sedimentation of claystone and flysch lithofacies with moderately sinking temperature during sedimentation of the flysch lithofacies.

Р е з ю м е: Работа занимается биостратиграфической и палеонтологической разработкой спор и пыльцебых зерен полученных из палеогенных пород Оравской возвышенности. Видовой состав пыльцевого сообщества доказывает, что осадки отложились в верхнем эоцене по нижний олигоцен. Присоединив отдельные виды к семействам ботанической системы можно предполагать тропическо-субтропический климат во время седиментации аргиллитовой и флишевой литофаций с незначительным понижением температуры в течение седиментации флишевой литофации.

Introduction

The area studied, belonging geomorphologically to the Oravská vrchovina highlands on the basis of the geological structure is ranged to the Inner Carpathian development of the Paleogene. In geological mapping of this area P e t e r č á k o v á (1981) distinguished three fundamental types of lithofacies: basal transgressive lithofacies (carbonate conglomerates and organodetrital to organogenic limestones), claystone lithofacies and flysch lithofacies. The subject of our study were claystones of flysch and claystone lithofacies, from which we took 24 samples. Biostratigraphically or paleontologically we evaluated 5 samples from claystone and 7 samples from flysch lithofacies (Fig. 1). We obtained spores and pollen grains, which have not been described from sediments in Slovakia so far (e. g. *Sciadopityspollenites quintus* KRUTZSCH, *Milfordia incerta)* THOMSON et PFLUG (KRUTZSCH, *Cupanieidites minimum* KRUTZSCH etc.).

Qualitative and quantitative evaluations of sporomorphs assemblages are shown in Figs. 2,3 and stratigraphic range of some important species in Fig. 4.

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Biostratigraphy

On the basis of species analysis we may state that characteristic of the claystone lithofacies is the frequent occurrence of pollen grains of angiosperms, in relation to which pollen grains of gymnosperms as well as spores of pteridophytes retreat to the background. In the samples taken we determined 26 species of spores and pollen grains (Figs. 2,3).

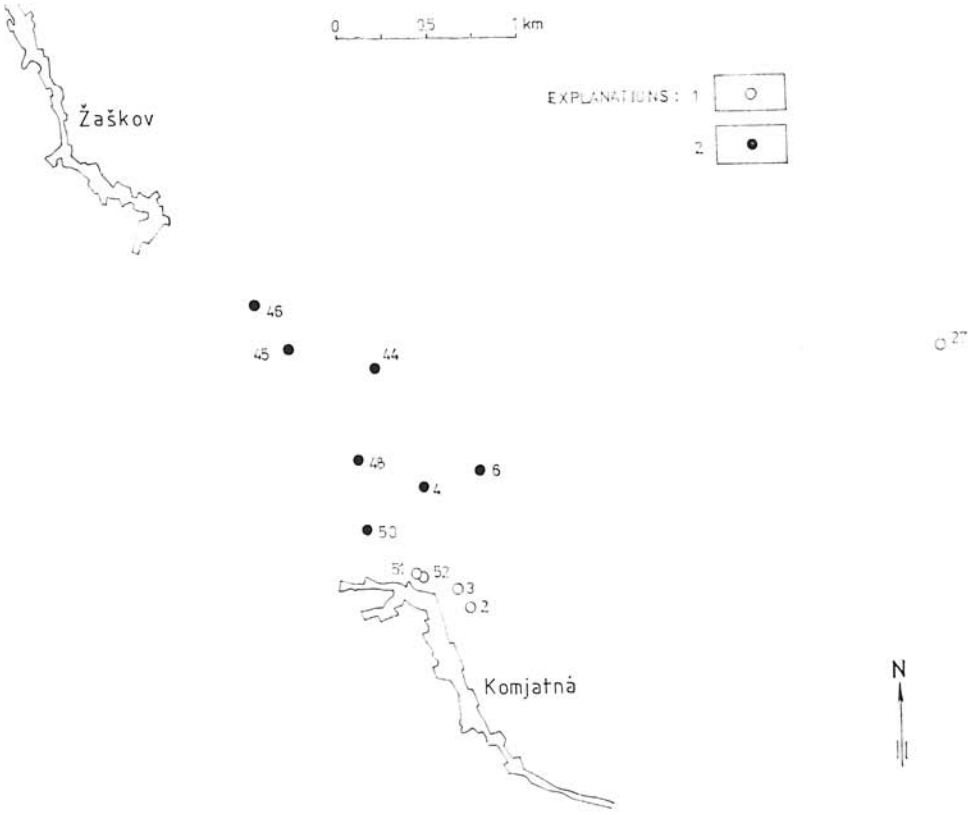

Fig. 1. Situation map of the taken samples. 1. Samples from the claystone lithofacies. 2. Samples from the flysch lithofacies.

Relatively frequent is the occurrence of sponge-like remmants and spores of sponges, which were established in each sample. From sporadical occurrences of *Phylophytina* as most abundant we could designate only the family *Schizeaceae*, represented by the genus *Leiotrilites*. From *Gymnospermophyta* rarely found are pollen grains of the family *Cycadaceae*, genus *Cycadopites*, scarcely also grains of the family *Pinaceae*, genus *Pityosporites* and *Taxodiaceae*, genus *Inaperturopollenites*. In relation to the pollen grains of gymnosperms the occurrence of pollen grains of *Angiospermae* is

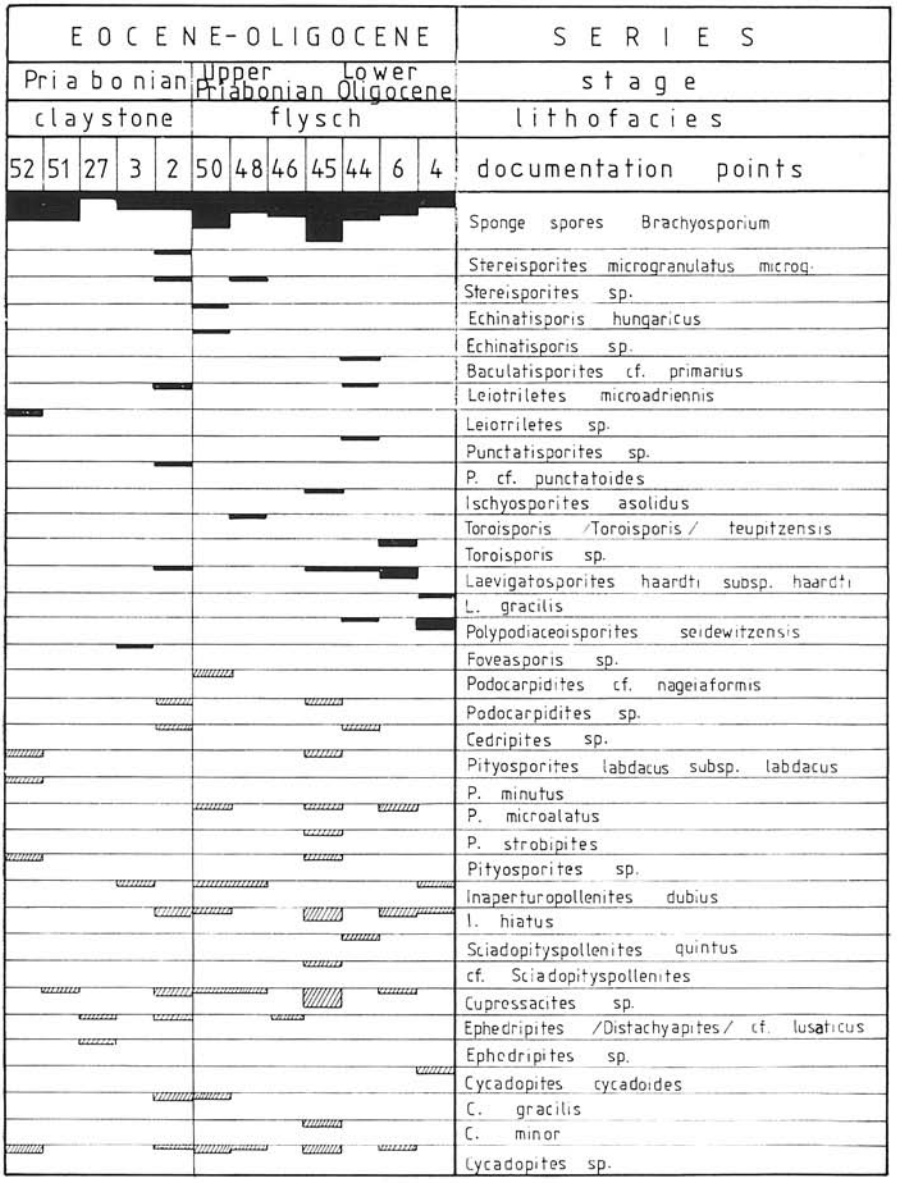

Fig. 2. Quantitative representation of spores and pollen grains of Gymnospermae.

more abundant. Distinctly prevailing are grains of the family *Fagaceae*, mainly the species: *Cupuliferoipollenites oviformis* (POTONIÉ) POTONIÉ, *Quercoidites henrici* (POTONIÉ) POTONIÉ, *Tricolporopollenites microhenrici* (POTONIÉ) KRUTZSCH, less already grains of the family *Juglandaceae*, genus *Engelhardtioidites* and family *Aquifoliaceae*, genus *Ilexpollenites*.

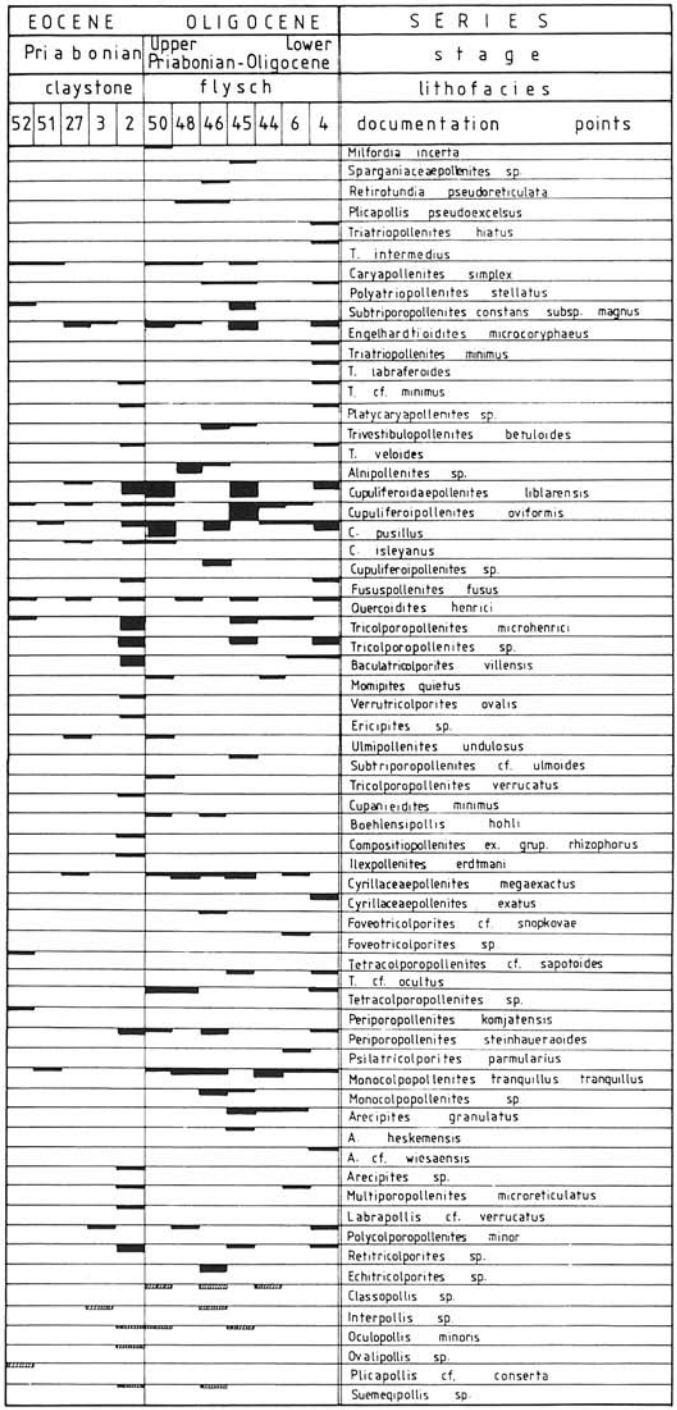

Fig. 3. Quantitative representation of pollen grains Angiospermae.

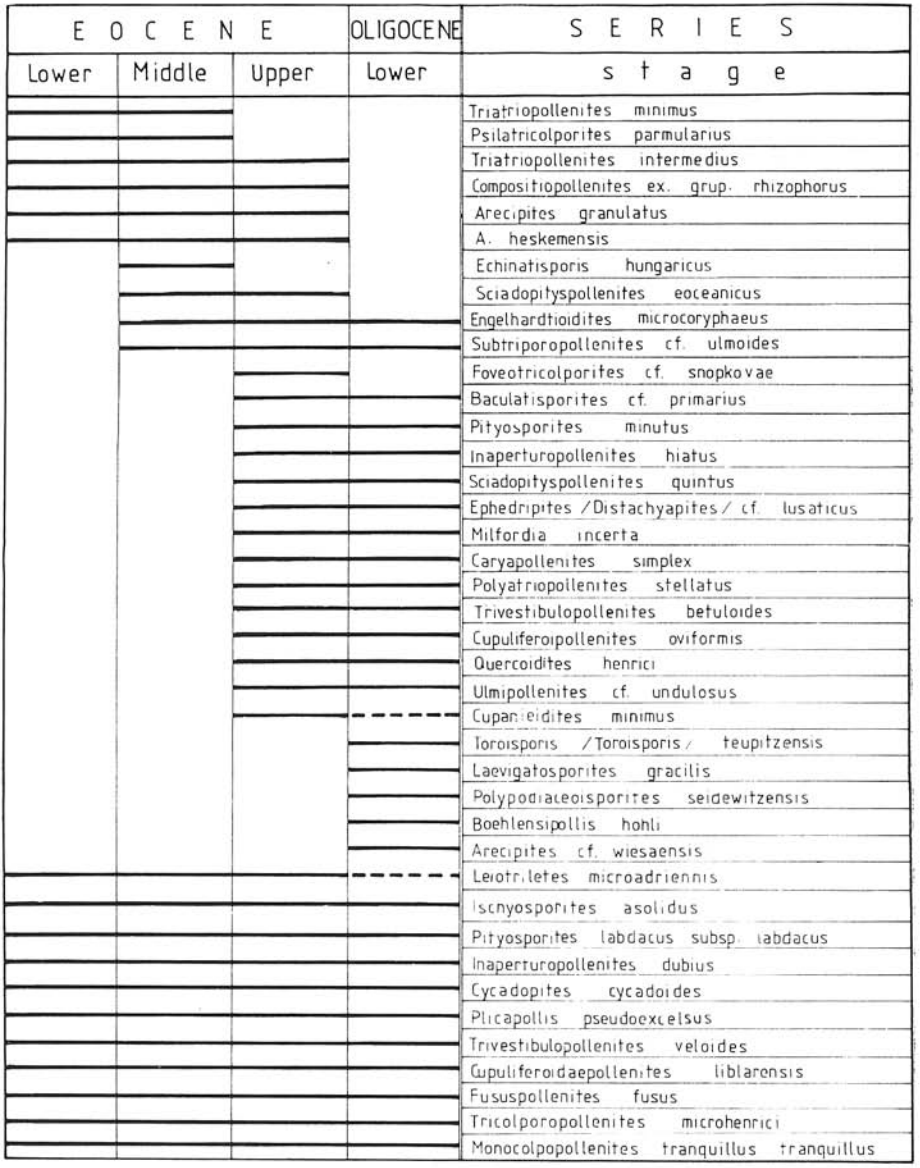

Fig. 4. Stratigraphic distribution of some species of spores and pollen grains of the Oravská vrchovina highlands (according to literary data).

On the whole we could characterize this lithofacies as qualitatively and quantitatively poorer in sporomorphs in relation to flysch lithofacies. On the basis of the occurrence of sporomorph assemblages we can range the claystone lithofacies to the Priabonian.

We determined from rocks of the flysch lithofacies 55 species of spores and pollen grains (Figs. 2, 3). The sporomorph assemblages are characterized by frequent occurrence of *Angiospermae*, less often *Gymnospermae* are found. Spores of sponges are abundant, more rare are sponges of *Phyllophytina*, represented by the family *Polypodiaceae*, the species *Laevigatosporites gracilis* WILSON et WEBSTER of which appears first in the Lower Oligocene. Of equal stratigraphic range are the species *Polypodiaceoisporites seidewitzensis* KRUTZSCH and *Toroisporis teupitzensis* KRUTZSCH (family *Gleicheniaceae*). From *Gymnospermae* are abundant the species *Inaperturopollenites dubius* (POTONIÉ et VENITZ) THOMSON et PFLUG and *Inaperturopollenites hiatus* (POTONIÉ) THOMSON et PFLUG (family *Taxodiaceae*) in rocks of this lithofacies. Less frequent are pollen grains of the families *Pinaceae*, *Cupressaceae* and *Cycadaceae*.

From richly represented pollen grains of *Angiospermae* the occurrence of the species *Boehlensipollis hohli* KRUTZSCH and *Arecipites wiesaensis* KRUTZSCH is of stratigraphic importance, found first as late as the Lower Oligocene. Frequent is also the occurrence of the genera *Cupuliferoidaepollenites* and *Cupuliferoipollenites* (family *Fagaceae*) and of species of the family *Arecaceae*. We may correlate the obtained pollen assemblages with Snopková (Gross — Köhler et al., 1980) with the assemblages in the Liptovská kotlina depression, determined by Snopková, where the Upper Priabonian to Lower Oligocene age was established.

After correlation with the botanical system we may state the prevalence of sporomorphs belonging to tropical — subtropical plants. In claystone lithofacies mostly Eocene sporomorphs are found — of paleotropical plants (*Subtriporopollenits, Fususpollenites, Momipites, Cupanieidites* etc.), only sporadically elements of cold-loving (Arctotertiary) flora *(Alnipollenites, Caryapollenites*) are found.

In flysch lithofacies to Eocene — paleotropical plant elements *(Monocolpopollenites, Cupanieidites, Fususpollenites* etc.) more abundant elements of Arctotertiary flora join *(Alnipollenites, Caryapollenites, Polyatriopollenites, Ulmipollenites, Sciadopityspollenites).* It is evident from the mentioned facts that in the time of sedimentation of the flysch lithofacies moderate cooling of until that time distinct tropical — subtropical climate was taking place.

Mycophyta

Fungi (Pf. 1, Figs. 1—4; Pl. 7, Fig. 1, Pl. 9, Fig. 1

Remark: In samples of the claystone and flysch lithofacies we found small unicellular durable spores as well as two celled and multicellular teleutospores. Many sponge-like remnants (*Brachyosporium*) were also found.

Lepidophytina

Familia *Selaginellaceae*

Echinatisporis hungaricus KEDVES, 1973 (Pl. 1, Fig. 7)

Phyllophytina

Familia: *Osmundaceae*

Baculatisporites cf. *primarius* (WOLFF, 1934) KRUTZSCH, (Pl. 1, Fig. 5) Fig. 5)

Familia: *Schizeaceae*

Leiotriletes microadriennis KRUTZSCH, 1959 (Pl. 6, Fig. 5)
Botanic competence: cf. *Lygodium*

Punctatisporites cf. *punctatoides* KRUTZSCH, 1959 (Pl. 6, Fig. 4)

Ischyosporites asolidus (KRUTZSCH, 1959) KRUTZSCH, 1967 (Pl. 1, Fig. 6)

Familia *Gleicheniaceae*

Genus: *Toroisporis* W. Krutzsch, (1959)
Type species: *Toroisporis torus* (Pflug) Krutzsch

Toroisporis (Toroisporis) teupitzensis KRUTZSCH, 1962 subsp. *medioris* KRUTZSCH, 1962 (Pl. 1, Fig. 8)

1962 *Toroisporis (Toroisporis) teupitzensis* Kr. *medioris* n. subsp. — W. Krutsch: Atlas der mittel-und jungtertiären etc., p. 80, tab. 33, figs. 1—14.

Description: Microspores are of triangular shape. Their tops are rounded. The rays Y of the scar reach the wall margins. and are slightly fork-shaped extended at the ends. The size varies around 25 μm.

Familia *Polypodiaceae*

Genus: *Laevigatosporites* Ibrahim, 1933
Type species: *Laevigatosporites vulgaris* (Ibrahim) Ibrahim

Laevigatosporites haardti (POTONIÉ et VENITZ, 1934) THOMSON et PFLUG, 1953 subsp. *haardti* KRUTZSCH, 1967 (Pl. 6, Fig. 3)

1934 *Sporites haardti* n. sp. — R. Potonié et H. Venitz: Zur Mikrobotanik der miozänen Humodils etc., p. 13—14, tab. 1, fig. 13.
1967 *Laevigatosporites haardti* (R. POT. et. VEN., 1934) TH. et PF. 1953 subsunp. *haardti* — W. Krutzsch: Atlas der mittel — und jungtertiären etc., p. 146—148, tab. 52, figs. 12—21.

Description: Monolete, smooth-walled spores of kidney shape around 28 μm in size. The surface of spore is smooth or fine-punctuated.

Incertae sedis

Polypodiaceoisporites seidewitzensis KRUTZSCH, 1971 (Pl. 1, Fig. 9)

Gymnospermophyta

Familia *Podocarpaceae*

Podocarpidites cf. *nageiaformis* (ZAKLINSKAJA, 1957) KRUTZSCH, 1971 (Pl. 2, Fig. 1)

Familia *Pinaceae*

Genus: *Pityosporites* Seward, 1914
Type species: *Pityosporites antarctitus* Seward, 1914

Pityosporites labdacus (POTONIÉ, 1931) THOMSON et PFLUG, 1953 subsp. *labdacus* KRUTZSCH, 1971 (Pl. 6, Fig. 6)

Botanic competence: *Pinus* — *Pinus silvestris*

Pityosporites microalatus (POTONIÉ, 1931) THOMSON et PFLUG, 1953 (Pl. 2, Fig. 3)

1931 *Piceae — pollenites microalatus* n. sp. — R. Potonié: Pollenformen aus tertiären Braunkohle, p. 5, fig. 34, (non vidi)
1953 *Pityosporites microalatus* (R. Pot.) nov. comb. — P. Thomson et H. Pflug: Pollen und Sporen des mitteleuropäischen Tertiärs, p. 67—68, tab. 5, figs. 54, 47.

Description: Pollen grains with oval central body size 45 μm and hemispherical aerial sacks (size 45 x 33 μm). These are fixed to the central body with the whole surface. The surface of the body and aerial sacks is considerably corroded.

Botanic competence: *Pinus*, subgenus *Haploxylon*.

Pityosporites minutus (ZAKLINSKAJA, 1957) KRUTZSCH, 1971 (Pl. 6, Fig. 7)

Botanic competence: *Pinus* sp.

Pityosporites strobipites (WODEHOUSE, 1933) KRUTZSCH, 1971

Botanic competence: *Pinus* sp. (Pl. 2, Fig. 4)

Familia *Taxodiaceae*

Genus: *Inaperturopollenites* Thomson et Pflug, 1953
Type species: *Inaperturopollenites dubius* (Potonié et Venitz) Thomson et Pflug

Inaperturopollenites dubius (POTONIÉ et VENITZ, 1934) THOMSON et PFLUG, 1953 (Pl. 1, Fig. 11)

Inaperturopollenites hiatus (POTONIÉ, 1931) THOMSON et PFLUG, 1953 (Pl. 1, Fig. 12; Pl. 6, Figs. 8—9; Pl. 9, Fig. 4)

1931 *Pollenites hiatus* n. sp. — R. Potonié: Pollenformen aus tertiären Braunkohle, Pl. 3, Fig. 23
1953 *Inaperturopollenites hiatus* (R. Pot.) n-comb. — P. Thomson, H. Pflug: Pollen und Sporen des mitteleuropäischer Tertiärs, p. 65, tab. 5, figs. 14—20.

Description: Pollen grains of round shape with characteristic "splitting", which reaches approximately into the half of the pollen grain body. The surface of grains is smooth. Lingula is not visible.

Botanic competence: cf. *Taxodium*.

Genus: *Sciadopityspollenites* Raatz, resp. Thiergart, 1937 ex R. Potonié, 1958

Type species: *Sciadopityspollenites serratus* (Potonié et Venitz) Thiergart

Sciadopityspollenites quintus KRUTZSCH, 1971 (Pl. 2, Fig. 6)

1971 *Sciadopityspollenites quintus* n. sp. — W. Krutzsch: Atlas der mittel- und jungtertiären etc., p. 180, tab. 55, figs. 1—16.

Description: The pollen grain is of circular shape 44 μm in size, the wall of exina is 1.5 — 1 μm. The sculptural elements are formed by dense, small papillae, free, in places connected. The papillae surpass the margin of exina.

Botanic competence: *Sciadopitys* sp.

Remark: This species has not been described from Paleogene sediments of Slovakia so far.

Familia *Ephedraceae*

Ephedripites (Distachyapites) cf. *lusaticus* KRUTZSCH, 1961 (Pl. 2, Fig. 5; Pl. 6, Fig. 10)

Botanic competence: *Ephedra* sp.

Familia *Cycadaceae*

Cycadopites cycadoides (ZAKLINSKAJA, 1957) KEDVES, 1968 (Pl. 3, Fig. 1)

Cycapites minor (KEDVES, 1961) KEDVES, 1968 (Pl. 3, Fig. 4)

Incertae sedis

Cycadopites gracilis KRUTZSCH, 1970 (Pl. 3, Fig. 2)

Angiospermophyta

Familia *Restionaceae*

Genus: *Milfordia* Erdtman, 1960

Type species: *Milfordia incerta* (Thomson et Pflug) W. Krutzsch

Milfordia incerta (THOMSON et PFLUG, 1953) KRUTZSCH, 1961 (Pl. 3. Fig. 5)

1953 *Inaperturopollenites incertus*, n. sp. (Pf. et Th.) subsp. *foveolatus*, n. subsp. (Pf. et Th.) — P. W. Thomson, H. Pflug: Pollen und Sporen des mitteleuropäischen Tertiärs, p. 66, tab. 5, figs. 31—35.

1961 *Milfordia incerta* (Th. et Pf. 1953) n. comb. — W. Krutzsch: Beitrag zur Sporenpaläontologie etc., p. 325

1970 *Milfordia incerta* (Th. et Pf. 1953) W. Kr., 1961 — W. Krutzsch: Atlas der mittel-und jungtertiären etc., p. 72—74, tab. 9, fig. 1—25.

Description: The size of the pollen grain is 40 μm. Oval to disc-shaped. The surface of exina is foveolate. Exina is 2 μm thick. The figured specimen is largely corroded.

Remark: This specimen is described first from Paleogene sediments of Slovakia.

Familia *Myricaceae*

Plicapollis pseudoexcelaus (KRUTZSCH, 1958) KRUTZSCH, 1961 (Pl. 3, Fig. 7)

Triatriopollenites hiatus CHATEAUNEUF, 1980 (Pl. 3, Fig. 9)

Triatriopollenites intermedius (GLADKOVA, 1965) KEDVES, 1974 (Pl. 3, Fig. 10)

Familia *Junglandaceae*

Genus: *Caryapollenites* Potonié, 1960 — Raatz, 1937 emend. Krutzsch, 1961
Type species: *Caryapollenites simplex* (Potonié) Potonié

Caryapollenites simplex (POTONIÉ, 1931) POTONIÉ, 1960 (Pl. 3, Fig. 11)

1931 *Pollenites simplex* n. sp. — R. Potonié: Pollenformen aus tertiären Braunkohle, p. 3, fig. 3.
1960 *Caryapollenites (al. Pollenites) simplex)* R. Pot. 1931) Raatz 1937 — R. Potonié: Synopsis der Gattungen etc., p. 123—124, tab. 7, figs. 162—163.

Description: The size of the pollen grains varies from 25—35 μm. The shape is oval to convex triangular. The characteristic three pores are situated subequatorially. The surface of exinae is smooth, secondary folds are frequent.

Botanic competence: *Carya* sp.

Genus: *Polyatriopollenites* Pflug, 1953
Type species: *Polyatriopollenites stellatus* (Potonié, Pflug).

Polyatriopollenites stellatus (POTONIÉ, 1931) PFLUG, 1953 (Pl. 3, Fig. 12)

1931 *Pollenites stellatus* n. sp. — R. Potonié; Pollenformen der miozänen Braunkohlen, p. 3, fig. 20
1937 *Pterocaryapollenites stellatus* (R. Pot.) — T. Thiergart: Die Pollenanalyse der Niederlausitzer etc., p. 311, tab. 24, fig. 19.
1953 *Polyatriopollenites stellatus* (R. Pot. et Ven. n. comb. H. Pflug: Zur Entstehung Entwicklung etc. p. 115, tab. 24, fig. 47.

Description: The size of pollen grain is 34 μm. The pollen grain has several pores, the pores are situated subequatorially. They have developed a weak labrum and very small atrium. The exina is thin, fine punctuated.

Botanic competence: *Pterocarya* sp.

Genus: *Engelhardtioidites* Potonié, 1931
Type species: *Engelhardtioidites microcoryphaeus* (Potonié) Potonié

Engelhardtioidites microcoryphaeus (POTONIÉ, 1931) POTONIÉ, 1960, (Pl. 7, Fig. 7)

1931 *Pollenites microcoryphaeus* n. sp. — R. Potonié: Zur Mikroskopie der Braunkohle, p. 329, tab. 2, fig. 13.
1960 *Engelhardtioidites* (al. *Pollenites) microcoryphaeus* (R. Pot. — 1931) Pot., Thomson et Thiergart, 1950 — R. Potonié: Synopsis der Gattungen etc., p. 118, tab. 7, fig. 148—149.

Description: The pollen grains of size 10—25 μm are of triangular shape, rounded in the corners. Exina thin, fine-punctuated. The atrium and small annulus are well developed.

Remark: The figured specimen differs from the species mentioned in synonymy in being somewhat larger.

Botanic competence: cf. *Engelhardtia.*

Genus: *Triatriopollenites* Thomson et Pflug, 1953
Type species: *Triatriopollenites rurensis* (Thomson et Pflug)

Triatriopollenites labraferoides KRUTZSCH, 1961 (Pl. 7, Fig. 2)

1961 *Triatriopollenites labraferoides* n. sp. — W. Krutzsch: Beitrag zur Sporenpaläontologie etc., p. 316, tab. 4, fig. 76—79, text. fig. 5.

Description: The pollen grain is of convex — triangular shape. Its size is 16 μm. The wall of exina is two-layered, in the area of pores not thickened. The atrium is little visible. The surface of exina is fine-punctated.

Triatriopollenites minimus KEDVES, 1974 (Pl. 4, Fig. 2)

Familia *Betulaceae*

Genus: *Trivestibulopollenites* Thomson et Pflug, 1953
Type species: *Trivestibulopollenites betuloides* Pflug

Trivestibulopollenites betuloides PFLUG, 1953 (Pl. 4, Fig. 4)

1953 *Trivestibulopollenites betuloides* n. sp. — Pflug in P. Thomson, H. Pflug: Pollen und Sporen etc., p. 85, tab. 9, fig. 25—34.
1980 *Trivestibulopollenites betuloides* Pf. 1953 — P. Snopková. Paleogene Sporomorphs from West Carpathians, p. 207, tab. 46, fig. 8—9.

Description: The size of oval — triangular pollen grains is 20 μm. The annulus and endannulus are well developed. The vestibulum is small, little visible. The exina is smooth, fine-punctuated in the figured individual. The figured pollen grain is partly corroded. At the surface of the exina are formed secondary folds.

Botanic competence: *Betula* sp.

Trivestibulopollenites veloides KRUTZSCH (Pl. 7, Fig. 4)

Familia *Fagaceae*

Genus: *Cupuliferoipollenites* Potonié, 1960
Type species: *Cupuliferopollenites (al. Pollenites) pusillus* Potonié)

Cupuliferoipollenites oviformis (POTONIÉ, 1931) POTONIÉ, 1960 (Pl. 7, Fig. 5)

1931 *Pollenites oviformis* n. sp. — R. Potonié: Zur Mikroskopie der Braunkohle, p. 332, tab. 1, fig. 20.

1953 *Tricolporopollenites cingulum* (R. Pot.) n. comb. subsp. *oviformis* (R. Pot.) n. comb. — P. Thomson, H. Pflug: Pollen und Sporen etc., p. 100, tab. 12, fig. 42—49.
1978 *Cupuliferoipollenites oviformis* (R. Pot., 1931) Potonié, 1960, Fagaceae, Castanea — M. Kedves: Paleogene fossil sporomorphs etc., p. 38, tab. 7, fig. 7, 9.

Description: Small pollen grains of size 16 μm are of oviform shape. Three colpae and three pores are well visible. The exina is smooth to sligthly intragranulate.

Botanic competence: *Castanea* sp.

Cupuliferoipollenites isleyanus (TRAVERSE, 1935) POTONIÉ, 1960, (Pl. 7, Fig. 8)

Cupuliferoipollenites pusillus (POTONIÉ, 1934), POTONIÉ, 1960 (Pl. 4, Fig. 7; Pl. 7, Fig. 1)

Botanic competence: *Castanea* sp.

Cupuliferoidaepollenites liblarensis (THOMSON in POTONIÉ, THOMSON, THIERGART, 1950) POTONIÉ, 1960 (Pl. 4, Fig. 6; Pl. 7, Fig. 6)

Fususpollenites fusus (POTONIÉ, 1931) KEDVES, 1978 (Pl. 4, Fig. 8)

Bacutricolporites villensis (THOMSON, 1960) KEDVES, 1978 (Pl. 4, Fig. 10; Pl. 7, Fig. 13)

Genus: *Quercoidites* Potonié, 1960 ex Pot. Thomson et Thiergart, 1950
Type species: *Quercoidites henrici* (Potonié) Potonié ex Potonié, Thomson et Thiergart

Quercoidites henrici (POTONIÉ, 1931) et POTONIÉ, 1960 ex POTONIÉ, THOMSON et THIERGART, 1950 (Pl. 4, Fig. 9; Pl. 7, Fig. 9)

1931 *Pollenites henrici* n. sp. — R. Potonié: Zur Mikroskopie der Braunkohle, p. 329, tab. 2, fig. 19.
1960 *Quercoidites (al. Pollenites) henrici* (R. Pot., 1931), Pot. Thoms. et Thier. — R. Potonié: Synopsis der Gattungen etc., p. 95, tab. 2, fig. 30—42.

Description: The size of pollen grains is 25—30 μm. The shape is spindle-like. The colpae are well visible in both individuals, the pores only in individual in Plate 4, Fig. 9. The exina is clearly intrabaculate although its surface is a little corroded.

Botanic competence : cf. *Quercus*

Genus: *Tricolporopollenites* Thomson et Pflug, 1953
Type species: *Tricolporopollenites dolium* (Potonié) Thomson et Pflug

Tricolporopollenites microhenrici (POTONIÉ, 1931) KRUTZSCH, 1961 (Pl. 7, Fig. 10)

1931 *Pollenites microhenrici* n. sp. — R. Potonié, Zur Mikroskopie der Braunkohle, p. 26, tab. 1, fig. V, 19c.
1953 *Tricolporopollenites microhenrici* (R. Pot.) n. comb. — P. Thomson, H. Pflug: Pollen und Sporen etc., p. 96, tab. 11, fig. 66—68, 74—75, 84, 100—105.
1961 *Tricolporopollenites microhenrici* (R. Pot., 1931) n. comb. (included subsp.) — W. Krutzsch: Beitrag zur Sporenpaläontologie etc., p. 322.

Description: The shape of pollen grain is ellipsoidal, size 35 μm. The colpae are well visible in both individuals. The exina is thin, its surface is covered with fine granules.

Botanic competence: cf. *Quercus*

Familia *Momiaceae*

Momipites cf. *quietus* (POTONIÉ, 1931) NICHOLS, 1973 (Pl. 4, Fig. 11)

Familia *Fabaceae*

Verrutricolporites ovalis (POTONIÉ, 1934) KEDVES, 1978 (Pl. 7, Fig. 14)

Familia *Ulmaceae*

Ulmipollenites undulosus WOLFF, 1934 (Pl. 7, Fig. 16)

Botanic competence: cf. *Ulmus*

Subtripollenites cf. *ulmoides* CHATEAUNEUF, 1980 (Pl. 4, Fig. 12)

Remark: Because of bad quality of photograph I do not mention the description of this pollen grain obtained for the first time from Paleogene sediments of Slovakia.

Familia *Salicaceae*

Tricolporopollenites verrucatus RÁKOSI, 1973 (Pl. 4, Fig. 13)

Familia *Myrtaceae*

Genus: *Cupanieidites* Cookson et Pike, 1954

Type species: *Cupanieidites orthoteichus* Cookson et Pike

Cupanieidites minimum KRUTZSCH, 1961 (Pl. 7, Fig. 17)

1961 *Cupanieidites minimum* n. sp. — W. Krutzsch: Beitrag zur Sporenpaläontologie etc., p. 312, tab. 2, fig. 46—50.

Description: The size of pollen grain of slightly sonvex triangular shape is 16 μm. Small endocolpae and characteristic double Y — mark are well visible. Its width is about 0.5—1 μm. The structure is fine reticulate.

Remark: This species has not been described in Paleogene sediments of Slovakia so far.

Duplopollis sp. M. KEDVES, 1974 (Pl. 7, Fig. 18)

Familia *Eleagnaceae*

Genus: *Boehlensipollis* Krutzsch, 1962

Type species: *Boehlensipollis hohli* Krutzsch

Boehlensipollis hohli KRUTZSCH, 1962 (Pl. 3, Fig. 14)

1962 *Boehlensipollis hohli* n. sp. — W Krutzsch: Stratigraphisch bzw. botanisch etc., p. 273, tab. 3, fig. 18—30.

1980 *Boehlenpollis hohli* W. KRUTZSCH, 1962 — P. Snopková in P. Gross, E. Köhler et col.; Geológia Liptovskej kotliny, p. 210, tab. 47, fig. 2.

Description: The size of pollen grain is 28 μm. It is of triangular shape with multi-layered wall of exina. The structure of the germinal apparatus is quite complicated. In the figured specimen, as the surface is quite corroded, the labrum, interloculum and less characteristic colpus are well visible only. The surface of exina is fine baculate.

Remark: This species is mentioned by P. Snopková, 1980 from the flysch lithofacies of the Liptovská kotlina depression.

Familia *Icacinaceae*

Compositiopollenites ex grup. *rhizophorus* (POTONIÉ, 1934) POTONIÉ, 1960 (Pl. 7, Fig. 19)

Familia *Aquifoliaceae*

Ilexpollenites erdtmani KEDVES, 1978 (Pl. 7, Fig. 20)

Familia *Cyrillaceae*

Cyrillaceaepollenites megaexactus (POTONIÉ, 1931) POTONIÉ, 1960 (Pl. 4, Fig. 14)

cf. *Cyrillaceaepollenites exactus* (POTONIÉ, 1931) POTONIÉ, 1960 (Pl. 4, Fig. 15)

Familia *Euphorbiaceae*

Genus: *Foveotricolporites* Pierce, 1961
Type species: *Foveotricolporites voluminonus* Gonzáles — Guzmán

Foveotricolporites cf. *snopkovae* KEDVES, 1978 (Pl. 4, Fig. 16)

1978 *Foveotricolporites snopkovae* n. fsp. — M. Kedves: Paleogene fossil sporomorphs etc., p. 75—76, fig. 17—19, text. fig. 29.

Description: The size of oval — ellipsoidal pollen grain is 20 μm. The colpae and pores are little visible as a consequence of corrosion of the exina surface. The structure is intragranulate.

Botanic competence: *Euphorbiaceae*

Remark: This species has not been described from Paleogene sediments of Slovakia so far.

Familia *Sapotaceae*

Tetracolporopollenites cf. *sapotoides* (PFLUG et THIERGART, 1953 (Pl. 8, Fig. 1)

Tetracolporopollenites cf. *occultus* THOMSON et PFLUG, 1953 (Pl. 4, Fig. 18)

Familia *Hamamelidaceae*

Periporopollenites komjatensis SNOPKOVÁ et PETERČÁKOVÁ 1982 (Pl. 8, Fig. 4)

Botanic competence: cf. *Hamamelidaceae*

Periporopollenites steinhaueraoides KRUTZSCH, 1973 (Pl. 8, Figs. 2—3)

Familia *Eucommiaceae*

Genus: *Psilatricolporites* (Van der Hammen (1956) Van der Hammen et Wijmstra, 1964)

Type species: *Psilatricolporites parmularius* (Potonié) Kedves

Psilatricolporites parmularius (POTONIÉ, 1934) KEDVES, 1978 (Pl. 4, Fig. 20)

1934 *Pollenites parmularius* n. sp. — R. Potonié — Zur Mikrobotanik der miozänen Humodils etc., tab. 6, fig. 11.

1978 *Psilatricolporites parmularius* (R. Pot., 1934) n. comb. — M. Kedves: Paleogene fossils sporomorphs etc., p. 32, tab. 5, fig. 1—9.

Description: The size of pollen grain is 20 μm the shape is ellipsoidal. The colpae and small pores are well visible. The surface of exina is partly corroded.

Familia *Arecaceae*

Genus: *Arecipites* Wodehouse, 1933

Type species: *Arecipites punctatus* Wodehouse

Arecipites granulatus (KEDVES, 1961) KEDVES, 1973 (Pl. 5, Fig. 3)

1961 *Monocolpopollenites granulatus* n. sp., *Palmae* — M. Kedves: Études palynologiques etc., p. 150, tab. 10, fig. 22—23.

1974 *Arecipites granulatus* (Keds., 1961) n. comb. — M. Kedves: Paleogene fossil sporomorphs etc., p. 19, tab. 7, fig. 16—18.

Description: The size of pollen grain is 33 μm. The monocolpate pollen grain is of ellipsoidal shape. The colpa extends from pole to pole. It is about 0.5—1 μm wide, well visible. The exina is covered with dense granules, which in places are passing into foveolate structure.

Arecipites cf. *wiesaensis* KRUTZSCH, 1970 (Pl. 5, Fig. 5)

1970 *Arecipites wiesaensis* n. sp. — W. Krutzsch: Atlas der mittel-jungtertiären etc., p. 106, tab. 22, fig. 20—28.

Description: The size of the oval — elongated pollen grain is 26 μm. The exina is two-layered, about 1.5 μm thick. The colpa is well visible. The surface of exina is covered with fine network.

Remark: This species has not been described from Paleogene sediment of the West Carpathians so far.

Arecipites heskemensis (HUTTER, 1961) RÁKOSI, 1973 (Pl. 5, Fig. 4)

Genus: *Monocolpopollenites* Thomson et Pflug, 1953

Type species: *Monocolpopollenites tranquillus* (Potonié) Thomson et Pflug

Monocolpopollenites tranquillus (POTONIÉ, 1934) THOMSON et PFLUG, 1953 (Pl. 5, Fig. 1; Pl. 10, Figs. 3, 4)

1934 *Pollenites tranquillus* n. sp. — R. Potonié: Zur Mikrobotanik der miozänen Humodils etc., p. 51, tab. 2, fig. 3,8.
1953 *Monocolpopollenites tranquillus* (R. Pot.) n. comb. — P. Thomson, H. Pflug: Pollen und Sporen etc., p. 62, tab. 4, fig. 24—37.

Description: The size of the pollen grains of ellipsoidal shape with slightly rounded corners is 25 μm. The surface of exina is punctated. The exina is about 1 μm thick. The 1 cm wide colpa is well visible.

Incertae sedis

Retirotundia pseudoreticulata KRUTZSCH, 1970 (Pl. 3, Fig. 8)

1970 *Retirotundia pseudoreticulata* n. sp. — W. Krutzsch: Atlas der mittel — und jungtertiären etc., p. 90, tab. 16, fig. 1—30.

Description: The pollen grain of round shape is 20 μm large. Characteristic are sculpture elements forming "eyes" of the size 3—5 μm. These are mutually connected or free. If free, they look like pores. The figured individual (Pl. 3, Fig. 8) has the eyes mutually connected. They are similar to network.

Remark: The pollen grain has been described for the first time from Paleogene sediments of Slovakia.

Multiporopollenites microreticulatus KRUTZSCH, 1961 (Pl. 5, Fig. 6)

Labrapollis cf. *verrucatus* KRUTZSCH, 1968 (Pl. 8, Fig. 6)

Redeposited pollen grains

Oculopollis minoris KRUTZSCH, 1961 (Pl. 5, Fig. 11)
Redeposited from the Upper Cretaceous.

Plicapollis cf. *conserta* PFLUG, 1953 (Pl. 5, Fig. 12)
Redeposited from the Upper Cretaceous.

Suemegipollis sp. (Pl. 8, Fig. 8)
Redeposited from the Upper Cretaceous.

Classopollis sp. (Pl. 5, Fig. 10)
Redeposited from the Triassic to Middle Cretaceous.

Ovalipollis sp. (Pl. 8, Fig. 9)
Redeposited from the Triassic.

Translated by J. Pevný

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Plate 1

Fig. 1. *Brachyosporium*, doc. p. 45
Figs. 2—4. Spores of sponges, doc. p. 45
Fig. 5. *Baculatisporites* cf. *primarius* (WOLF) KRUTZSCH, doc. p. 44
Fig. 6. *Ischyosporites asolidus* (KRUTZSCH) KRUTZSCH, doc. p. 45
Fig. 7. *Echinatisporis hungaricus* KEDVES, doc. p. 50
Fig. 8. *Toroisporis teupitzensis* KRUTZSCH, doc. p. 48
Fig. 9. *Polypodiaceoisporites seidewitzensis* KRUTZSCH, doc. p. 4
Fig. 10. *Laevigatosporites gracilis* WILSON et WEBSTER, doc. p. 6
Fig. 11. *Inaperturopollenites dubius* (POTONIÉ et VENITZ) THOMSON et PFLUG, doc. p. 50
Fig. 12. *Inaperturopollenites hiatus* (POTONIÉ) THOMSON et PFLUG, doc. p. 6
Flysch lithofacies, Komjatná, manigf, 1000 x.

Plate 2

Fig. 1. *Podocarpidites* cf. *nageiaformis* (ZAKLINSKAJA) KRUTZSCH, doc. p. 50
Fig. 2. *Cedripites* sp., doc. p. 44
Fig. 3. *Pityosporites microallatus* (POTONIÉ) THOMSON et PFLUG, doc. p. 6
Fig. 4. *Pityosporites strobipites* (WODEHOUSE) KRUTZSCH, doc. p. 45
Fig. 5. *Ephedripites (Distachyapites)* cf. *lusaticus* KRUTZSCH, doc. p. 46
Fig. 6. *Sciadopityspollenites quintus* KRUTZSCH, doc. p. 45
Flysch lithofacies Komjatná, magnif. 1000 x.

Plate 3

Fig. 1. *Cycadopites cycadoides* (ZAKLINSKAJA) KEDVES, doc. p. 4
Fig. 2. *Cycadopites gracilis* KRUTZSCH, doc. p. 50
Fig. 3. *Cycadopites* sp., doc. p. 45
Fig. 4. *Cycadopites minor* (KEDVES) KEDVES, doc. p. 45
Fig. 5. *Milfordia incerta* (THOMSON et PFLUG) KRUTZSCH, doc. p. 50
Fig 6. *Sparganiaceaepollenites* sp., doc. p. 45
Fig. 7. *Plicapollis pseudoexcelsus* (KRUTZSCH) KRUTZSCH, doc. p. 48
Fig. 8. *Retirotundia pseudoreticulata* KRUTZSCH, doc. p. 46
Fig. 9. *Triatriopollenites hiatus* CHATEAUNEUF, doc. p. 4
Fig. 10. *Triatriopollenites intermedius* (GLADKOVA) KEDVES, doc. p. 4
Fig. 11. *Caryapollenites simplex* (POTONIÉ) POTONIÉ, doc. p. 50
Fig. 12. *Polyatriopollenites stellatus* (POTONIÉ) PFLUG, doc. p. 4
Fig. 13. *Subtriporopollenites constans* (PFLUG) *magnus* KRUTZSCH, doc. p. 45
Fig. 14. *Boehlensipollis hohli* KRUTZSCH, doc. p. 50
Flysch lithofacies, Komjatná, magnif. 1000 x.

Plate 4

Fig. 1. cf. *Triatriopollenites*, doc. p. 4
Fig. 2. *Triatriopollenites minimus* (GLADKOVA) KEDVES, doc. p. 4
Fig. 3. *Platycaryapollenites* sp., doc. p. 4
Fig. 4. *Trivestibulopollenites betuloides* PFLUG, doc. p. 46
Fig. 5. *Alnipollenites* sp., doc. p. 48
Fig. 6. *Cupuliferoidaepollenites liblarensis* (THOMSON) POTONIÉ, doc. p. 50
Fig. 7. *Cupuliferoipollenites pusillus* POTONIÉ, doc. p. 4

Fig. 8. *Fususpollenites fusus* (POTONIÉ) KEDVES, doc. p. 4
Fig. 9. *Quercoidites henrici* (POTONIÉ) POTONIÉ, doc. p. 48
Fig. 10. *Bacutricolporites villensis* (THOMSON) KEDVES, doc. p. 6
Fig. 11. *Momipites* cf. *quietus* (POTONIÉ) NICHOLS, doc. p. 44
Fig. 12. *Subtripollenites* cf. *ulmoides* CHATEAUNEUF, doc. p. 45
FIg. 13. *Tricolporopollenites verrucatus* RÁKOSI, doc. p. 50
Fig. 14. *Cyrillaceaepollenites megaexactus* (POTONIÉ) POTONIÉ, doc. p. 6.
Fig. 15. cf. *Cyrillaceaepollenites exactus* (POTONIÉ) POTONIÉ, doc. p. 4
Fig. 16. *Foveotricolporites* cf. *snopkovae* KEDVES, doc. p. 46
Fig. 17. *Foveotricolporites* sp., doc. p. 6
Fig. 18. *Tetracolporopollenites* cf. *occultus* THOMSON et PFLUG, doc. p. 4
Fig. 19. *Periporopollenites* sp., doc. p. 46
Fig. 20. *Psilatricolporites parmularius* (POTONIÉ) PFLUG, doc. p. 6
Flysch lithofacies, Komjatná, magnif. 1000 x.

Plate 5

Fig. 1. *Monocolpopollenites tranquillus* (POTONIÉ) THOMSON et PFLUG, doc. p. 44
Fig. 2. *Monocolpopollenites* sp., doc. p. 46
Fig. 3. *Arecipites granulatus* (KEDVES) RÁKOSI, doc. p. 45
Fig. 4. *Arecipites heskemensis* (HUTTER) RÁKOSI, doc. p. 45
Fig. 5. *Arecipites* cf. *wiesaensis* KRUTZSCH, doc. p. 4
Fig. 6. *Multiporopollenites microreticulatus* KRUTZSCH, doc. p. 6
Fig. 7. *Polycolporopollenites minor* RÁKOSI, doc. p. 48
Fig. 8. *Reticolporites* sp., doc. p. 4
Fig. 9. *Echitricolporites* sp., doc. p. 46
Fig. 10. *Classopollis* sp., doc. p. 50
Fig. 11. *Oculopollis minor* KRUTZSCH, doc. p. 50
Fig. 12. *Plicapollis* cf. *çonserta* PFLUG, doc. p. 50
Fig. 13. *Chiropteridium* cf. *aspinatum* (GERLACH) BRONNIS, doc. p. 48
Fig. 14. *Thalasiphora* sp., doc. p. 50
Flysch lithofacies, Komjatná, magnif. 1000 x.

Plate 6

Fig. 1. Spore of sponges, doc. p. 51
Fig. 2. *Hydrosporium*, sp., doc. p. 52
Fig. 3. *Laevigatosporites haardti* (POTONIÉ et VENITZ) THOMSON et PFLUG subsp. *haardti* KRUTZSCH, doc. p. 2
Fig. 4. *Punotatisporites* cf. *punctatoides* KRUTZSCH, doc. p.2
Fig. 5. *Leiotriletes microadriennis* KRUTZSCH, doc. p. 2
Fig. 6. *Pityosporites labdacus* (POTONIÉ) THOMSON et PFLUG subsp. *labdacus* KRUTZSCH, doc. p. 52
Fig. 7. *Pityosporites minutus* (ZAKLINSKAJA) KRUTZSCH, doc. p. 52
Figs. 8—9. *Inaperturopollenites hiatus* (POTONIÉ) THOMSON et PFLUG, doc. p. 2
Fig. 10. *Ephedripites (Distachyapites)* cf. *lusaticus* KRUTZSCH, doc. p. 27
Fig. 11. *Cycadopites* sp., doc. p. 52
Fig. 12. *Subtriporopollenites* sp., doc. p. 52
Claystone lithofacies, Komjatná, magnif. 1000 x.

Plate 7

Fig. 1. *Cupuliferoipollenites pusillus* (POTONIÉ) POTONIÉ, doc. p. 2
Fig. 2. *Triatriopollenites labraferoides* KRUTZSCH, doc. p. 51
Fig. 3. *Platycaryapollenites* sp., doc. p. 2
Fig. 4. *Trivestibulopollenites veloides* KRUTZSCH, doc. p. 2
Fig. 5. *Cupuliferoipollenites oviformis* (POTONIÉ) POTONIÉ, doc. p. 27
Fig. 6. *Cupuliferoidaepollenites liblarensis* (THOMSON) POTONIÉ, doc. p. 2
Fig. 7. *Engelhardtioidites microcoryphaeus* (POTONIÉ) POTONIÉ, doc. p. 27

Fig. 8. *Cupuliferoipollenites isleyanus* (TRAVERSE) POTONIÉ, doc. p. 27
Fig. 9. *Quercoidites henrici* (POTONIÉ) POTONIÉ, doc. p. 52
Fig. 10. *Tricolporopollenites microhenrici* (POTONIÉ), KRUTZSCH, doc. p. 2
Fig. 11. *Tricolporopollenites* cf. *microhenrici* (POTONIÉ) KRUTZSCH, doc. p. 2
Fig. 12. *Tricolporopollenites* sp., doc. p. 2
Fig. 13. *Bacutricolporites villensis* (THOMSON) KEDVES, doc. p. 2
Fig. 14. *Verrutricolporites ovalis* (POTONIÉ) KEDVES, doc. p. 2
Fig. 15. *Ericipites* sp., doc. p. 2
Fig. 16. *Ulmipollenites undulosus* WOLFF, doc. p. 27
Fig. 17. *Cupanieidites minimum* KRUTZSCH, doc. p. 2
Fig. 18. *Duplopollis* sp., KEDVES, doc. p. 3
Fig. 19. *Compositioapollenites* ex grup. *rhizophorus* (POTONIÉ) POTONIÉ, doc. p. 2
Fig. 20. *Ilexpollenites erdtmani* KEDVES, doc. p. 2
Fig. 21. *Retitricolporites* sp., doc. p. 2
Claystone lithofacies, Komjatná, magnif. 1000 x.

Plate 8

Fig. 1. *Tetracolporopollenites* cf. *sapotoides* PFLUG et THIERGART, doc. p. 52
Fig. 2—3. *Periporopollenites steinhaueraoides* KRUTZSCH, doc. p. 2
Fig. 4. *Periporopollenites komjatensis* SNOPKOVÁ et PETERČÁKOVÁ, doc. p. 52
Fig. 5. *Monocolpopollenites* sp., doc. p. 52
Fig. 6. *Labrapollis* cf. *verrucatus* KRUTZSCH, doc. p. 2
Fig. 7. *Interpollis* sp., doc. p. 3
Fig. 8. *Suemegipollis* sp., doc. p. 2
Fig. 9. *Ovalipollis* sp., doc. p. 2
Fig. 10. *Phthanoperidinium* sp., doc. p. 52
Figs. 11—12. *Thalasiphora* sp., doc. p. 52
Claystone lithofacies, Komjatná, magnif. 1000 x.

Plate 9

Fig. 1. Spore of sponges, flysch lithofacies, Komjatná, doc. p. 45, magnif. 4500 x.
Fig. 2. *Toroisporis* sp., flysch lithofacies, Komjatná, doc. p. 48, magnif. 1250 x.
Fig. 3. *Polypodiisporites alienus* (POTONIÉ) NAGY, claystone lithofacies, Komjatná, doc. p. 52, magnif. 2500 x.
Fig. 4. *Inaperturopollenites hiatus* (POTONIÉ) THOMSON et PFLUG, flysch lithofacies, Komjatná, doc. p. 6, magnif. 1250 x.
Fig. 5. *Echinatisporis* sp., flysch lithofacies, Komjatná, doc. p. 50, magnif. 7500 x.
Fig. 6. *Echinatisporis* sp. (detail), flysch lithofacies, Komjatná, doc. p. 50, magnif. 12 250 x.

Plate 10

Fig. 1. *Plicatopollis* sp., flysch lithofacies, Komjatná, doc. p. 46, magnif. 4000 x.
Fig. 2. *Boehlensipollis* sp., flysch lithofacies, Komjatná, doc. p. 50, magnif. 1500 x.
Fig. 3. *Monocolpopollenites tranquillus* (POTONIÉ) THOMSON et PFLUG, (detail), flysch lithofacies, Komjatná, doc. p. 44, magnif. 7000 x.
Fig. 4. *Monocolpopollenites tranquillus* (POTONIÉ) THOMSON et PFLUG, flysch lithofacies, Komjatná, doc. p. 44, magnif. 3000 x.
Fig. 5. *Arecipites* sp. (detail), claystone lithofacies, Komjatná, doc. p. 2, magnif. 5000 x.
Fig. 6. *Arecipites* sp., claystone lithofacies, Komjatná, doc. p. 2, magnif. 2000 x.

Plate 1

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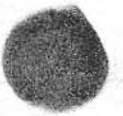

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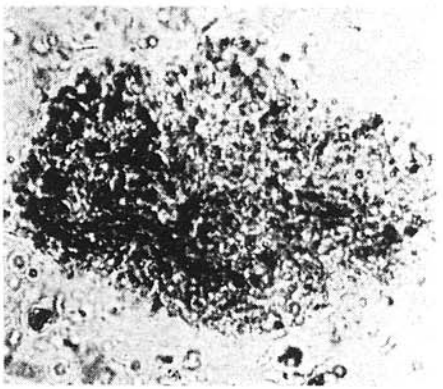

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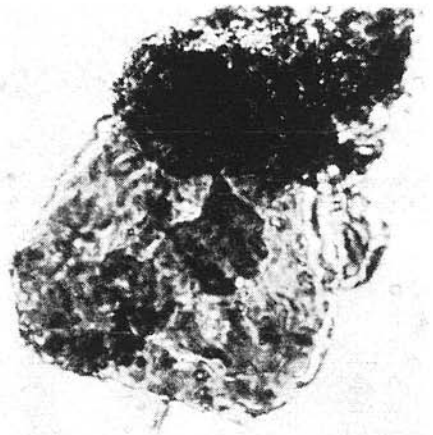

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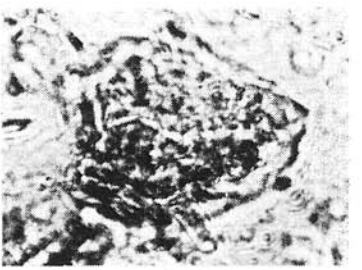

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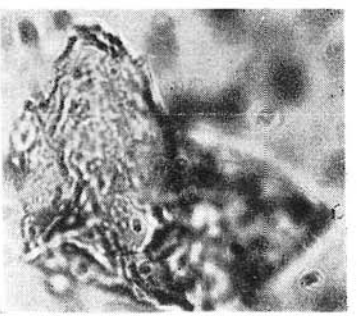

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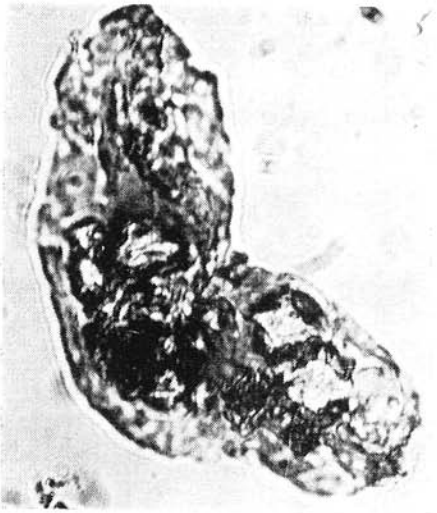

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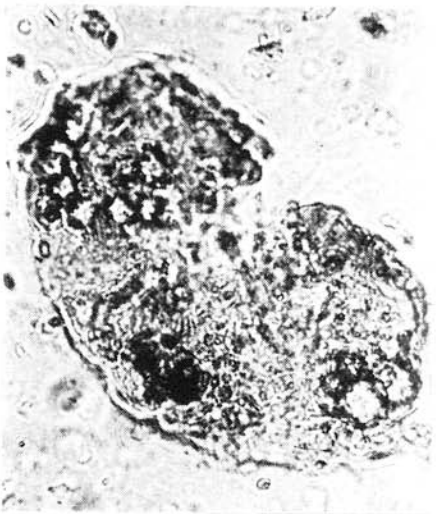

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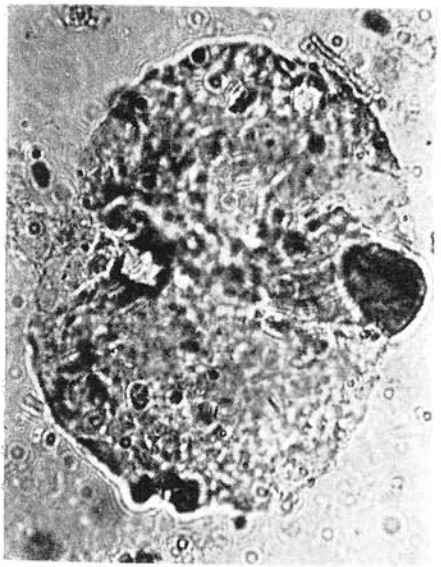

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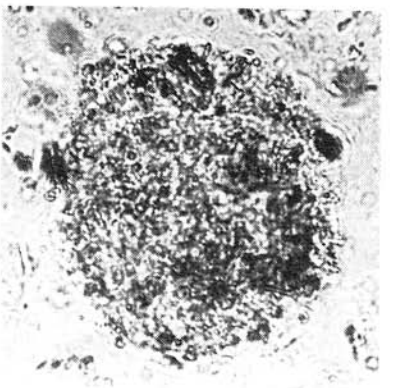

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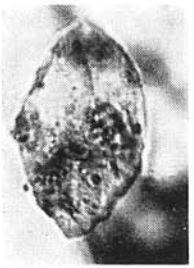
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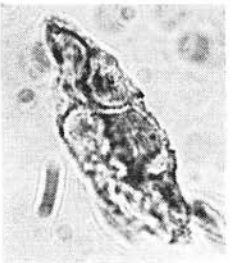
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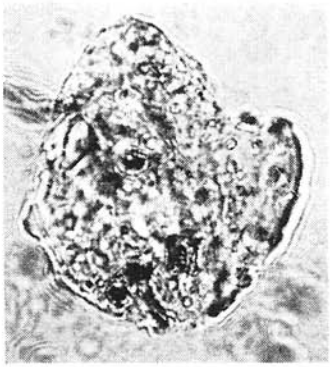
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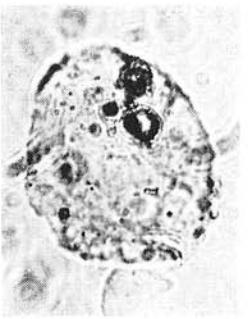
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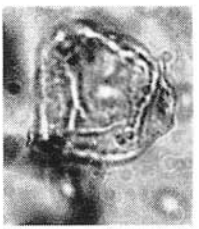
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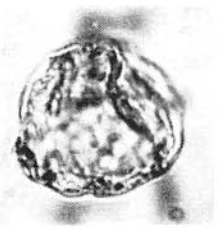
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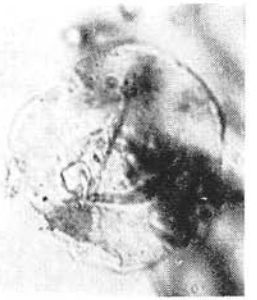
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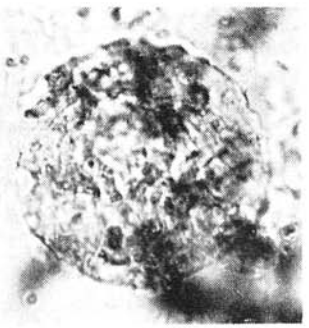
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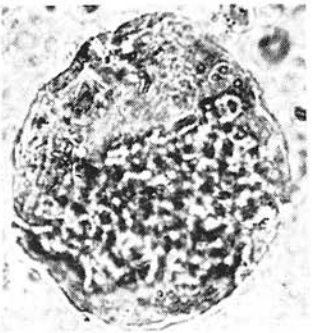
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Plate 4


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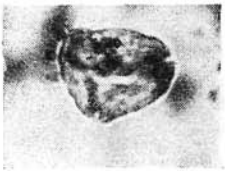
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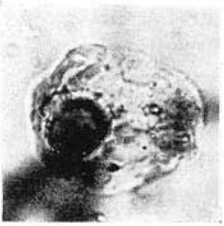
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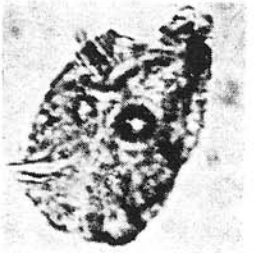

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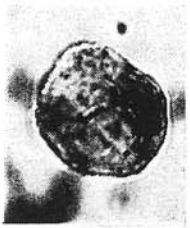

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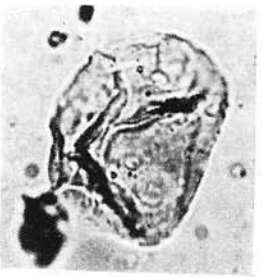

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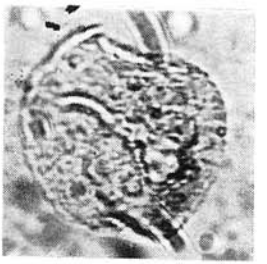

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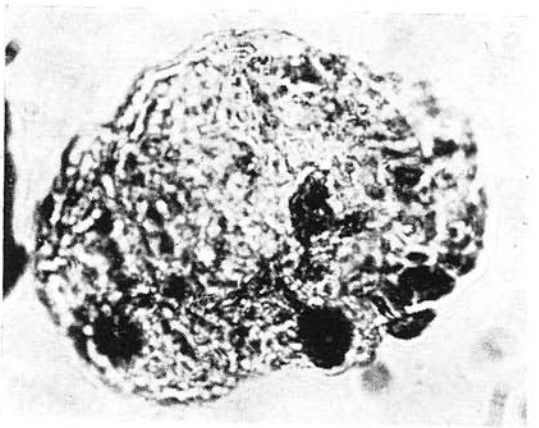

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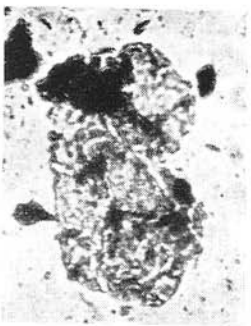

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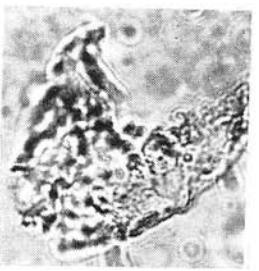

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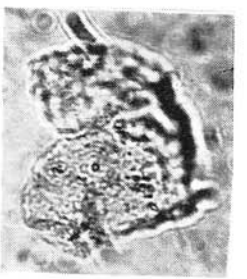

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Plate 7


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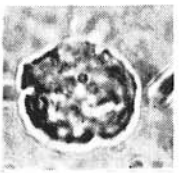
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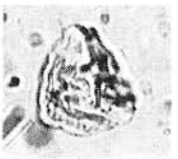
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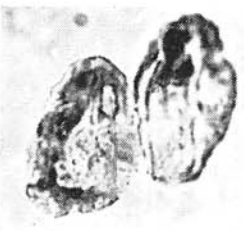
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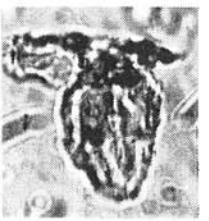
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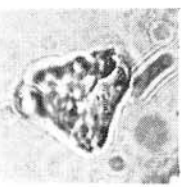
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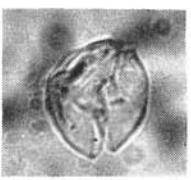
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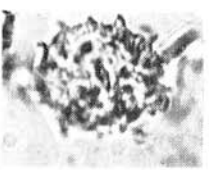
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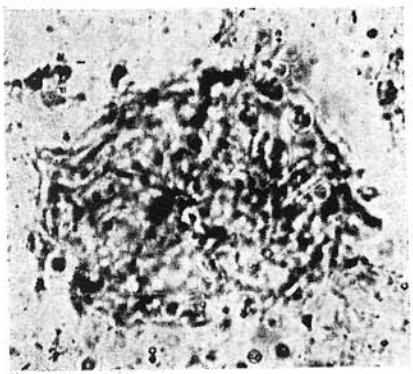

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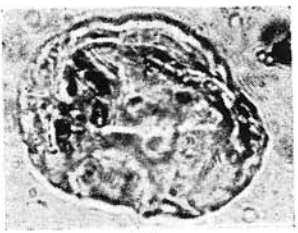

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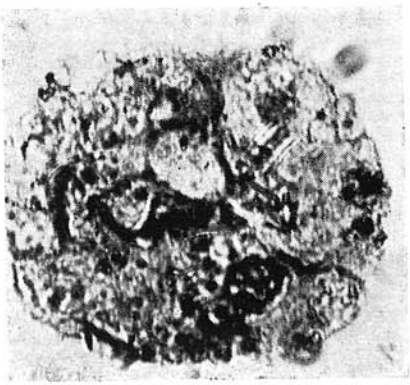

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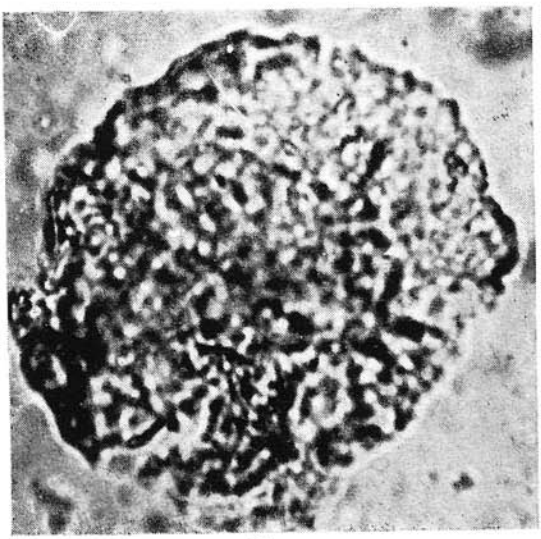

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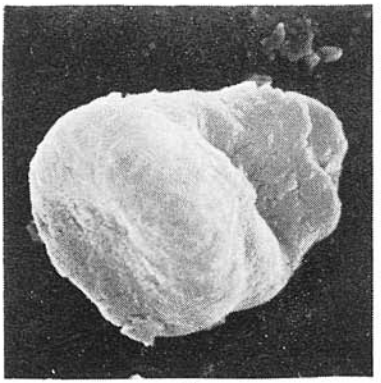
Plate 9



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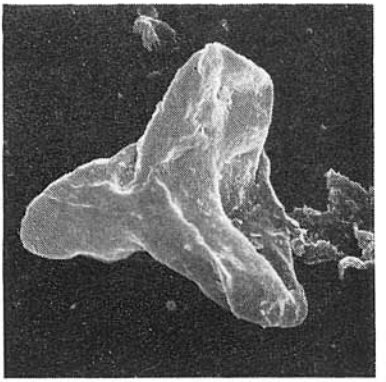

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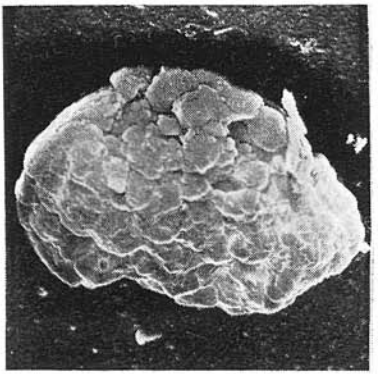

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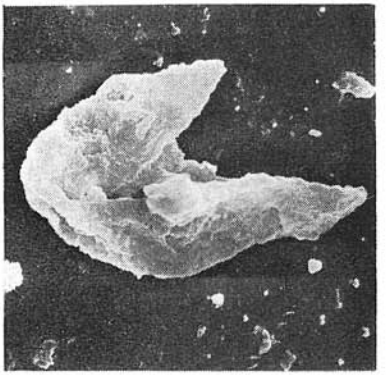

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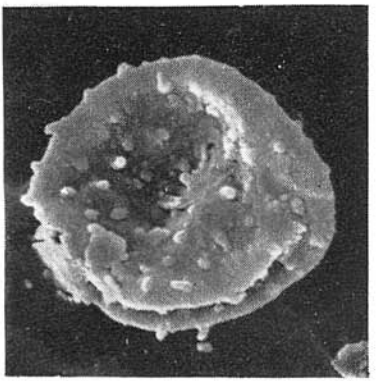

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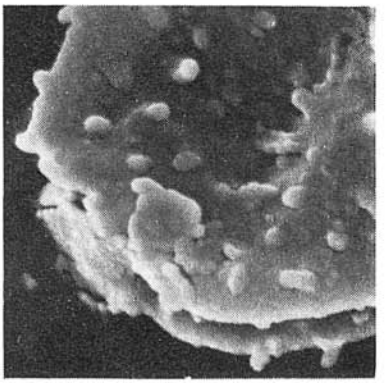

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Plate 10

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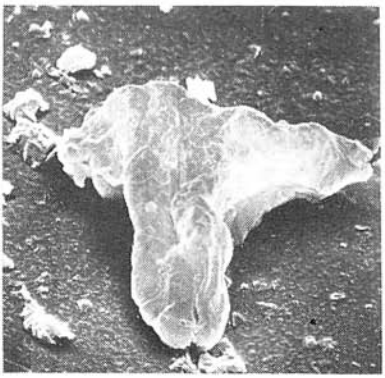

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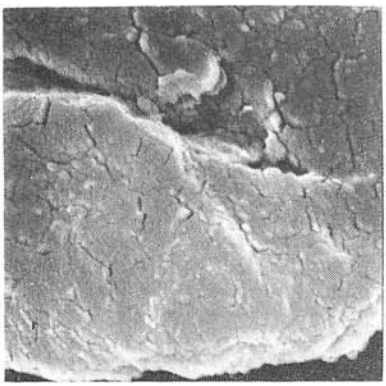

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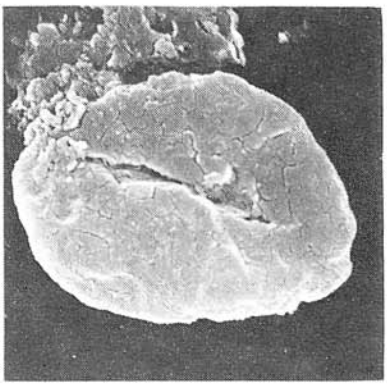

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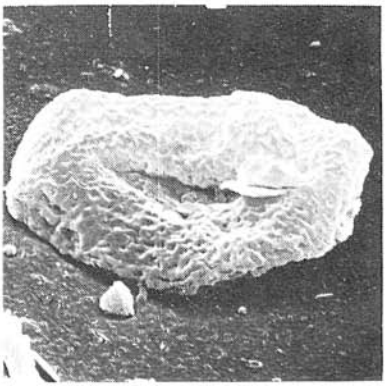

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