STUDIES ON THE POLLEN GRAINS OF RECENT CASTANEOIDEAE. I

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Abstract

Pollen grains of the genera *Castanea, Castanopsis, Chrysophylla* and *Pasania* were investigated. Light microscopically almost all pollen grains were psilate, tricolporate. On the basis of light microscopic features, it was possible to differentiate various types which can be also used to establish botanical relationships of fossil forms. The Castaneoideae pollen grains were in many cases similar to the pollen of the genus *Elaeocarpus*. Lesser or greater similarities can occur also with other taxa, which should be considered in the judgement of the botanical relationships of the fossil pollen grains of Castaneoideae. Several problems can be only solved by electron microscopic methods.

Introduction

According to POTONIÉ's (1931, 1934) basic works and the monograph by THOMSON and PFLUG (1953) our knowledge of fossil pollen grains of Castaneoideae ranges from the Cretaceous period to the Upper Tertiary. Its modern nomenclature has been termed by POTONIÉ (1960). Many other works contributed to the knowledge of these pollen grains, e.g. TRAVERSE (1955), AGRANOVSKAIA et al. (1960) and KEDVES (1963). Transmission electron microscopic (TEM) data originate from KEDVES and PÁRDUTZ (1973) as well as CREPET and DAGHLIAN (1980).

It is indispensable to consider also data on pertaining recent forms to make our knowledge of fossil forms accurate. A number of literary data are available on the recent pollen grains of Castaneoideae. THANIKAIMONI (1972) mentions 13 literary data on *Castanea*, 10 on *Castanopsis* and 2 on *Chrysolepis*. WANG et al. (1960) reported data on the light microscopic morphology of the pollen grains of the genera *Castanea, Castanopsis, Lithocarpus* and *Pasania*, while KUPRIANOVA (1965) on those of *Cyclobalanopsis, Trigonobalanus, Castanea, Lithocarpus, Castanopsis* and *Chrysolepis*. The first data on the scanning electron microscopic (SEM) morphology of *Lithocarpus densifolia* are known from MARTIN and DREW (1969). HUANG (1972) published data on *Castanopsis, Cyclobalanopsis, Lithocarpus* and *Pasania*. In the course of his studies on pollenkitt, HESSE (1978) also investigated the TEM ultrastructure of *Castanea sativa*. Worthy of mention are LIEUX's (1980) recent SEM results and PRAGLOWSKI's (1980) following statement: "Castaneoideae are rather stenopalynous, while two entirely different pollen types are obvious in the Fagoideae and Quercoideae".

The following problems should be stressed here on the basis of available literature:

1. Intergeneral similitudes can occur also within Castaneoideae, moreover,

some of the pollen grains cannot be easily distinguished from those of Elaeocarpaceae *(Elaeocarpus)* by light microscopy. Palynological similitude was observed among other families to Araliaceae *(Anomopanax schlechteri)*, Crassulaceae *(Sedum tatarinowii)*, Elatinaceae *(Elatine alsinastrum)*, Grubbiaceae *(Grubbia rosmarinifolia)*, Leguminosae *(Sophora japonica)*, Loganiaceae, Buddlejovideae.

2. In the light of recent data, the fossil taxons — form-species — are heterogeneous.

It is these problems, that called for complex investigations. These are in process now. This paper, which forms the first chapter of these investigations approaches the question by the limited possibilities of the light microscopic method. Despite that, however, these studies are also necessary, because this method is currently used for the routine investigation of fossil materials. Our knowledge in this field will be complemented later with TEM and SEM data.

Materials and Methods

The material of investigation was made available from the Botanical Collection of the Hungarian Natural History Museum by the courtesy of Director JULIA SZUJKÓ, for which I express my grateful thanks also here. After the name of the species investigated the number of that herbarium sheet is given from which the sample was taken.

Castanea americana RAF. = *C. dentata* BORCKH. 77101, *C. evansii* ELM., 77105, *C. pumila* MILL. var. *angustifolia* 77132, *C. sativa* MILL. 77047, *Pasania calathiformis* (SKAN.) H. et C. 286417, *P. hypoglauca* HU 286499, *Castanopsis argyrophylla* KING, 77112, *C. indica* DC. 7721, *C. longispicata* HU 77121, *Chrysolepis chrysophylla* (A. DC.) HJELMQVIST 77093.

For variation analysis at least 200 grains were measured. The longitudinal axis resp. the ratio of the longitudinal axis to the meridional one were taken into consideration.

Results

Genus: *Castanea* MILL.

1. *Castanea americana* RAF. (Plate I, 1–6).

Psilate, tricolporate pollen grains, amb elliptical. Colpi bending towards one another at the poles. Colpi surrounded by narrow caverns. Endopori ellipsoid, measuring 2 μm on the average. Longitudinal axis measures 11.25 μm to 19.55 μm. Its maximum is protracted, between 14.7 μm and 16.65 μm. The meridional axis varies from 8.85μ m, to 16.15 μm, with a maximum at 9.8 μm. The ratio of the longitudinal axis to the meridional one is between 1 and 1.9, maximum is 1.5–1.6. Exine 1 μm thick, structure difficult to recognize, perhaps intrabaculate.

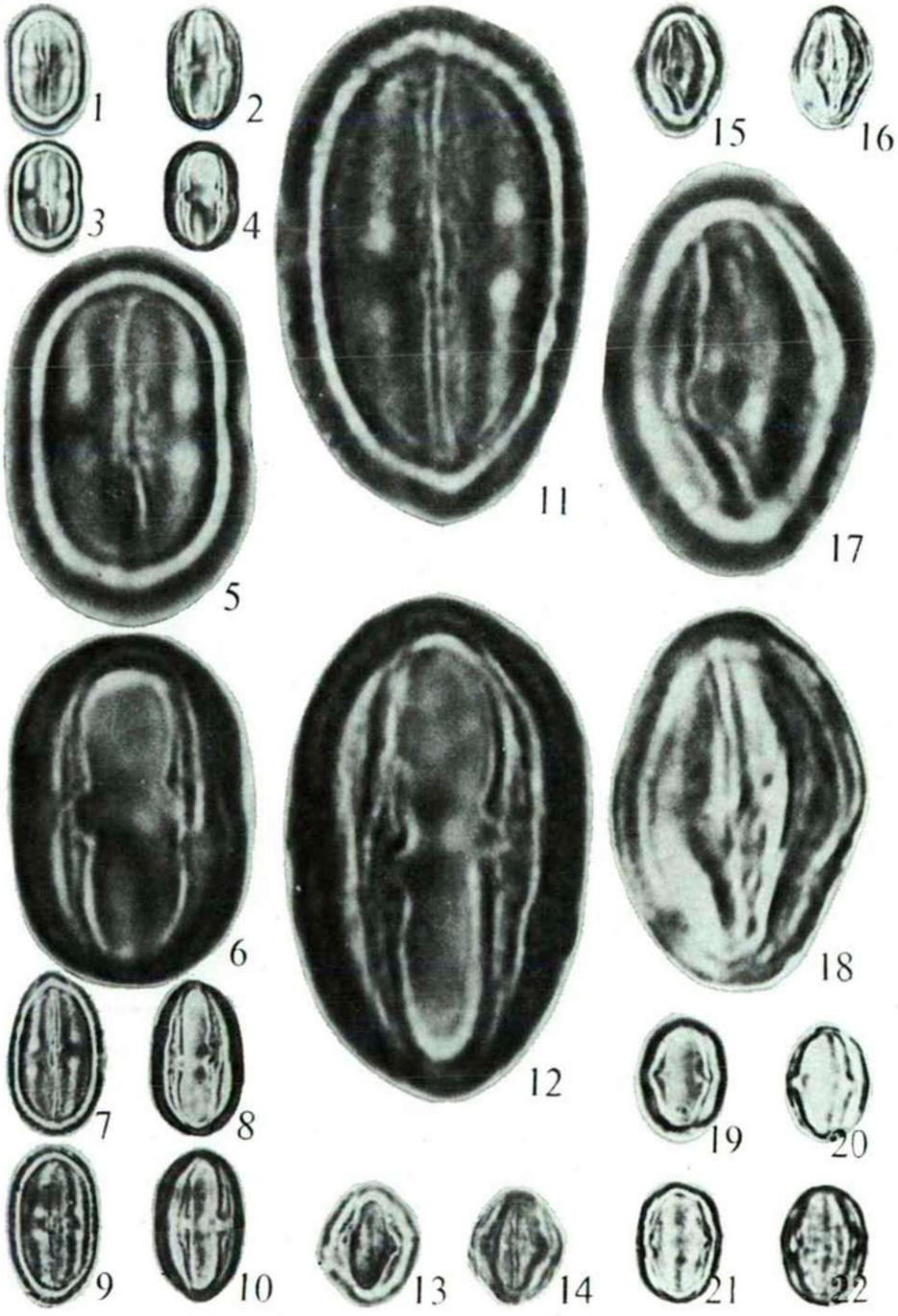
2. *Castanea evansii* ELM. (Plate I. 7–12).

Tricolporate pollen grains, amb elliptical, surface psilate. Colpi bent towards one another at the poles and surrounded by narrow (0.3–0.4 μm) caverns. Endopori

Plate I

1—4. *Castanea americana* **Raf.** x1000.
5, 6. *Castanea americana* **Raf.** x3000.
7—10. *Castanea evansii* **Elm.** x1000.
11, 12. *Castanea evansii* **Elm.** x3000.
13—16. *Castanea pumila* **Mill.** var. *angustifolia* x1000.
17, 18. *Castanea pumila* **Mill.** var. *angustifolia* x3000.
19—22. *Castanea sativa* **Mill.** x1000.

Plate I



circular or meridional ellipsoid, 1.5 μm in diameter on the average. Longitudinal axis varies from 18.7 to 23.4 μm, maximal length is 20.66 μm. Meridional axis measures 9.8 μm to 13.7 μm, with a maximum of 11.2 μm–13.2 μm. The ratio of the longitudinal axis to the meridional one is 1.1–2.2, with a maximum between 1.5 and 2.0. Exine 1 μm in diameter, infratectum more distinct than in the case of the former species, finely intrabaculate.

3. *Castanea pumila* MILL. var. *angustifolia* (Plate I, 13–18).

Pollen grains ellipsoidal, or approx isodiametric psilate, tricolporate. The caverns surrounding the colpi are very narrow, often missing. Colpi not always bent towards one another at the poles. Endopores very small, pollen grains often poroidate and not tricolporate. Endopores measure 0.5 μm on the average. Longitudinal axis varies from 14.2 μm to 20.05 μm, with a maximum at 14.7 μm. Meridional axis varies from 7.15 μm to 16.65 μm, its maximum is at 14.7 μm. The ratio of longitudinal axis to the meridional one is between 1.0 and 1.9, the maximum between 1.2 and 1.4. Exine always below 1 μm in thickness, the structure is difficult to observe under the light microscope.

4. *Castanea sativa* MILL. (Plate I, 19–22, Plate II, 1, 2).

Psilate, tricolporate pollen grains, amb elliptical. Colpi bending towards one another at the poles. Caverns surrounding the colpi very narrow, but distinct, generally 0.5 μm wide. Endopores 1–1.5 μm in diameter, mostly circular. Longitudinal axis varies from 11.25 μm to 17.15 μm, the meridional one from 7.0 μm to 14.7 μm, with maxima of 17.7 μm resp. 10.75 μm. Ratio of longitudinal axis to the meridional one ranges from 1 to 2.1, maximum at 1.3. Thickness of exine always below 1 μm, exine stratification is not distinctly observable, structure uncertain on the basis of light microscopic data.

Genus: *Pasania* (MIG.) OERSTED = *Lithocarpus* BLUME.

1. *Pasania calathiformis* (SKAN.) H. et C. (Plate II, 3–10).

Psilate, tricolporate pollen grains, amb elliptical. Colpi usually surrounded by 0.3 μm wide caverns. Colpi bent towards one another at the poles. Endopores of variable size and shape, circular or elliptical, 1–2.5 μm. Longitudinal axis varies from 11.25 to 20 μm, protracted maximum from 15.15 μm to 19.5 μm. Meridional axis ranges from 8.35 μm to 13.2 μm, maximum is 9.8 μm. Ratio of longitudinal axis to meridional one from 1.2 to 2.2, maximum 1.8. Exine 1–1.2 μm thick, finer structure is not visible under the light microscope.

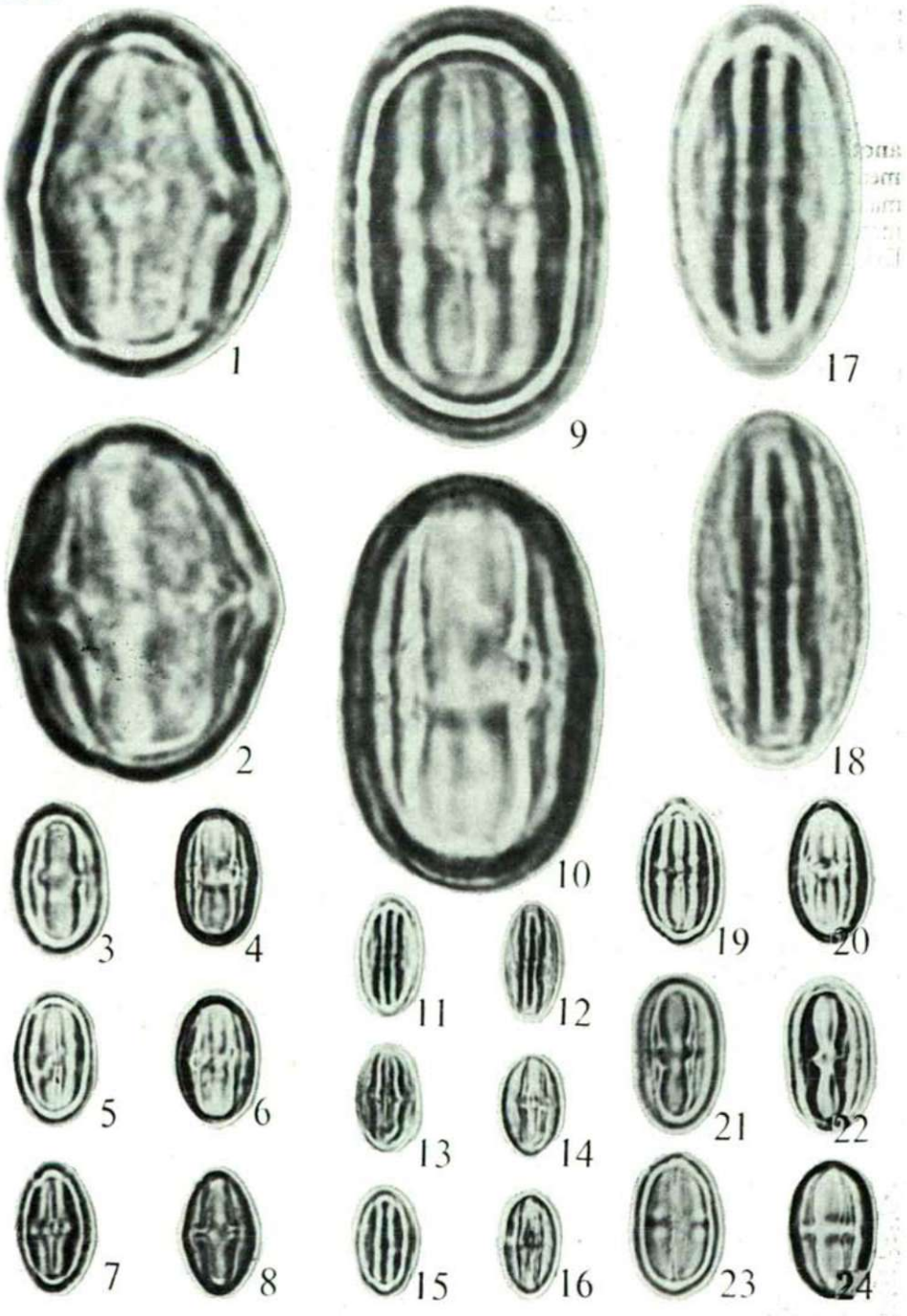
3. *Pasania hypoglauca* HU (Plate II, 11–18).

Tricolporate pollen grains, amb elliptical, surface psilate. Colpi often parallel, but bending towards one another at the poles. Caverns around colpi 0.3 μm wide. Endopores narrow elliptical, measuring 0.5×1.5 μm. Longitudinal axis varies from 11.7 μm to 15.2 μm, maximum at 14.55 μm. Meridional axis 6.6–10.3 μm, maximum at 8.35 μm. Ratio of longitudinal axis to the meridional one varies from 1.3 to 2.3,

Plate II

1, 2. *Castanea sativa* **Mill.** x3000.
3—8. *Pasania calathiformis* **(Skan). H.** et **C.** x1000.
9, 10. *Pasania calathiformis* **(Skan.) H.** et **C.** x3000.
11—16. *Pasania hypoglauca* **Hu** x1000.
17, 18. *Pasania hypoglauca* **Hu** x3000.
19—24. *Castanopsis argyrophylla* **King** x1000.

Plate II



maximum is protracted, from 1.5 to 1.8. Exine about 0.8 μm thick, stratification is not observable under the light microscope.

Genus: *Castanopsis* (D. DON) SPACH.

1. *Castanopsis argyrophylla* KING (Plate II, 19–24, Plate III, 1, 2).

Psilate, tricolporate pollen grains, amb elliptical. Colpi bent towards one another at the poles. Caverns around colpi 0.3–0.4 μm wide. Endopores elliptical, measuring 1 to 1.5×2 to 2.5 μm. Longitudinal axis varies from 14.5 μm to 22.9 μm, maximum at 19.5 μm. Meridional axis ranges from 8.85 μm to 13.3 μm, with a maximum at 10.75 μm. Ratio of longitudinal axis to the meridional one is 1.4–1.8–2.1. Exine approx 1 μm thick, finer stratification is not visible under the light microscope.

2. *Castanopsis indica* DC. (Plate III, 3–8).

Psilate, tricolporate pollen grains, amb elliptical. Colpi bent towards one another. Caverns surrounding colpi vary from 0.2 μm to 0.3 μm in width. Endopori circular or elliptical, measuring maximally 2–3 μm. Longitudinal axis varies from 17.1 μm to 23.4 μm, with two maxima, one at 19.5 μm and another at 21.05 μm Meridional axis is 8.85 μm to 13.7 μm, maximal length 11.25 μm. The ratio of the longitudinal axis to the meridional one ranges from 1.4 to 2.3, with a maximum at 1.8. Exine about 1 μm thick, its finer stratification is not visible under the light microscope.

3. *Castanopsis longispicata* HU (Plate III, 9–14).

Psilate, tricolporate pollen grains, amb elliptical. Colpi often parallel, not always bent towards one another at the poles. Caverns surrounding colpi 0.4 μm wide. Endopori approx circular, 2–3 μm in diameter. Longitudinal axis measures 17.0 μm to 23.85 μm, maximum at 19.5 μm resp. 20.95 μm. Meridional axis varies from 9.8 μm to 17.05 μm, maximum between 10.75 and 12.7 μm. The ratio of the longitudinal axis to the meridional one is 1.1–1.7–2.0. Exine approx 1 μm thick, its fine stratification is not visible under the light microscope.

Genus: *Chrysolepis* HJELMQVIST.

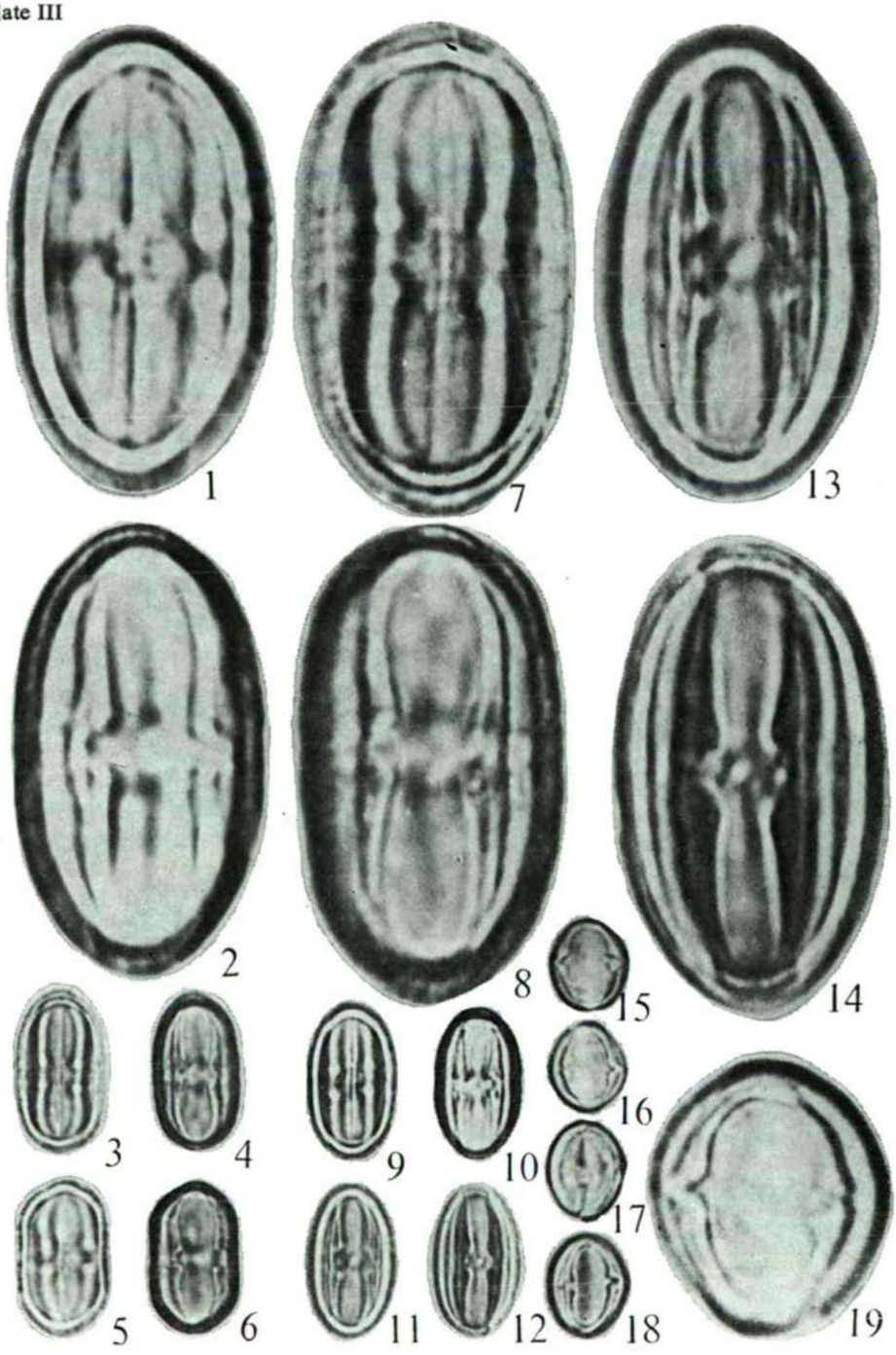
1. *Chrysolepis chrysophylla* (A.DC.) HJELMQVIST (Plate III, 15–19).

Psilate, tricolporate pollen grains, amb circular or elliptical. Colpi often parallel, convergent at the poles. Caverns surrounding colpi very narrow, often missing. Longitudinal axis measures 8.8 μm to 15.6 μm, with a protracted maximum from 13.2 μm to 14.7 μm. Meridional axis measures 7.9 μm to 12.2 μm, with a projecting maximum at 9.8 μm. Ratio of the longitudinal axis to the meridional one is 1–1.3–1.8. Exine thin, approx 0.6 μm thick, its finer structure cannot be observed under the light microscope.

Plate III

1, 2. *Castanophis argyrophylla* **King** x3000.
3—6. *Castanopsis indica* **DC.** x1000.
7, 8. *Castanopsis indica* **DC.** x3000.
9—12 *Castonopsis longispicata* **Hu** x1000.
13, 14. *Castanopsis longispicata* **Hu** x3000.
15—18. *Chrysolepis chrysophylla* **(A. DC.) Hjelmqvist** x1000.
19. *Chrysolepis chrysophylla* **(A. DC.) Hjelmqvist** x3000.

Plate III



Discussion

It should be emphasized also here that the light microscopic investigations will be complemented with TEM and SEM data in the next future. The possibilities and limitations of the single methods emerged also in connection with the present investigations. The light microscopic method has the indisputable advantage of allowing mass analyses which are indispensable with fossil forms in many respects. On the other hand, light microscopic studies leave several questions open. E.g.

1. The fine ornamentation of tectum, which may perhaps be of differential value in respect of the pollen grains of similar morphology of Elaeocarpaceae and those of further taxons, cannot be resolved. Thus, practically, all pollen grains examined qualify as psilate.

2. The light microscopic method cannot be used to investigate the stratification of exine, the morphology of the channels of tectum, infratectum, the presence and submicroscopic morphology of endexine. In the case of fossil pollen grains of Castaneoideae KEDVES and PÁRDUTZ (1973) revealed the granular ultrastructure of endexine.

The results reported here can be useful in differentiating some types on the basis of measurements, form and the structure of endopori as well as the evaluation of fossil data. Taking into consideration HUANG's data (1972) two types were differentiated within Elaeocarpaceae: 1. *Elaeocarpus arthropus (E. caroliensis, E. decipiens)*, 2. *E. japonicus* and *Elaeocarpus joga* Merril (LEOPOLD, 1969), which is reminiscent of the pollen grains of Castaneoideae, and which should be considered in the judgement of fossil forms. In possession of our data the following types were established:

1. *Castanea americana* type *(C. evansii, Pasania calathiformis, Castanopsis argyrophylla, C. indica, C. longispicata)*. It resembles *Elaeocarpus japonicus*. Its fossil equivalent is Cupuliferoipollenites pusillus (R. POT. 1934) R. POT. 1960.

2. *Castanea pumila angustifolia* type. Here the poroidate character has differentiating value.

3. *Castanea sativa* type. Its fossil equivalent is Cupuliferoipollenites oviformis (R. POT. 1931) R. POT. 1960.

4. *Chrysolepis chrysophylla* type. It differentiates from the former by its smaller measurements and nearly globular forms. Its fossil equivalent is the smaller specimen of *C. oviformis*. On the other hand, this resembles best *Elaeocarpus arthropus* type pollen grains.

Finally attention should be called here also to similarities among further taxa mentioned in the introduction. For their accurate evaluation, however, EM, principally SEM methods are necessary.

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