5. TRANSMISSION ELECTRON MICROSCOPY OF THE PARTIALLY DEGRADED POLLEN GRAINS FROM THE THANETIAN LAYERS OF MENAT (FRANCE) II.

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Abstract

The new partial degradation experiments damaged the ultrastructure of the pollen grains heavily. The 2-aminoethanol and the $KMnO_4$ treatment 24 hours was destructive. In several cases the nearer determination of the pollen grain was impossible. In this way at this fossil material the previously used solvent, the merkaptoethanol seems to be appropriate for the moderate, partial dissolution to discover ontogenetically or taphonomically important ultrastructural elements.

Key words: Palynology, Paleocene, Menat, France, experimental ultrastructure.

Introduction

In our previous paper (KEDVES and MADARÁSZ, 2000) moderately degraded pollen grains were investigated with the TEM method. To continue this research program we increased the intensity of the partial degradation. Two experiments were carried out.

The aim of this paper to establish the resistance of the originally well preserved fossil Paleocene material.

Materials and Methods

Two kinds of experiment were carried out: 1. M-69: 20 mg dry organic material + 1 ml 2-aminoethanol, temperature 30 °C, length of time: 24h. 2. M-70: 20 mg dry organic material + 1 ml 2-aminoethanol, temperature 30 °C, length of time 24h. After washing with distilled water 10 ml $KMnO_4$ aq. dil. was added to the organic remnants for 24h at 30 °C. For TEM studies the washed material was postfixed in OsO_4 aq. dil and embedded in Araldite (Durcupan, Fluka). The ultrathin sections were made on a Porter Blum ultramicrotome with glass knives. In contrast to the previous experiments the stronger degradation made it possible to section the whole organic material. The investigations were made on a Tesla BS-540 instrument (resolution 6-7 Å) in the EM Laboratory of the Department of Biophysics of the Biological Research Center of the Hungarian Academy of Sciences.

Results

1.a. Block: M-69-1, cf. *Cupuliferoidaepollenites quisqualis* (POTONIÉ 1934) POTONIÉ 1960, *Fagaceae* or *Leguminosae* (Plate 5.1., figs. 3,4)

Thick perforated tectum and foot layer was observed. The infratectal layer was in all probability degraded. The embedding organic material sometimes closely connected to the tectum. Lamellar structures are characteristic in general without electron dense globular units.

1.b. Block: M-69-3, cf. *Cupuliferoidaepollenites quisqualis* (POTONIÉ 1934) POTONIÉ 1960, *Fagaceae* or *Leguminosae* (Plate 5.1., figs. 1,2)

On the tectum electron dense layer of the embedding organic material is closely connected to the surface. The perforations of the tectum are perceptible in the semitangential part of the section. The granular infratectal layer is not so well perceptible.

Remark. - The preservation of the ultrastructure of the two similar pollen types is completely different.

2. Block: M-69-2, cf. *Triporopollenites* fsp. (Plate 5.1., fig. 5)

The embedding material is characteristically, lamellar. The exact determination of the ectexine layer was not possible. A peculiar electron dense layer can be seen on the surface of the tectum. Exoaperture with annulus is perceptible, but the infratectal layer and the foot layer disintegrated.

3. Block: M-70-4, cf. *Classoidites* fsp. ectexine (Plate 5.2., fig. 1)

Compressed and damaged ectexine was observed. Spinae are on the surface of the tectum, which is in all probability perforated. Tiny columellar layer is connected to the originally large infratectal layer composed of irregular elements. A secondary homogenisation is also well illustrated. The endexine was not perceptible.

4. Block: M-70-2, Echinate *Brevaxones* pollen (Plate 5.2., figs. 2,3)

In all probability the ectexine of a large tri- or subtriporate pollen grain was observed. Echinate tectum, and columellar infratectal layer was observed. There are electron dense granules or filaments in the more or less homogeneous ectexine.

5. Block: M-69-4, compressed mass of pollen grains (Plate 5.2., fig. 4,5)

Different kinds of ectexine were compressed. Fig. 4, in plate 5.2., illustrates a damaged ectexine: the illustrated wall remnant may be the damaged tectum of the pollen grains. On the surfaces there are electron dense globular units. A relative well preserved, and compressed ectexine is illustrated in picture 5. Tectum with spinae, the infratectal layer is columellar. The foot layer of the two opposite ectexine are compressed. Characteristic lamellar embedding material is more or less connected to the surfaces.

6. Block: M-69-5 (Plate 5.3., fig. 1), similar to the previous ultrastructure illustrated in picture 4, plate 5.2.

7. Block: M-69-6, mass of compressed pollen or spore wall or disintegrated ectexine (Plate 5.3., fig. 2)

More or less homogeneous wall remnants were observed with electron dense superficial globular units.

8. Block: M-69-8. Fragments of small *cupuliferoid* ectexines. The tectum was partially preserved. There are lamellar embedding organic material on the surfaces (Plate 5.3., fig. 3).

9. Block: M-70-1 (Plate 5.3., fig. 4). *Cupuliferoid* ectexine, the tectum, the damaged infratectal layer and the foot layer are illustrated.

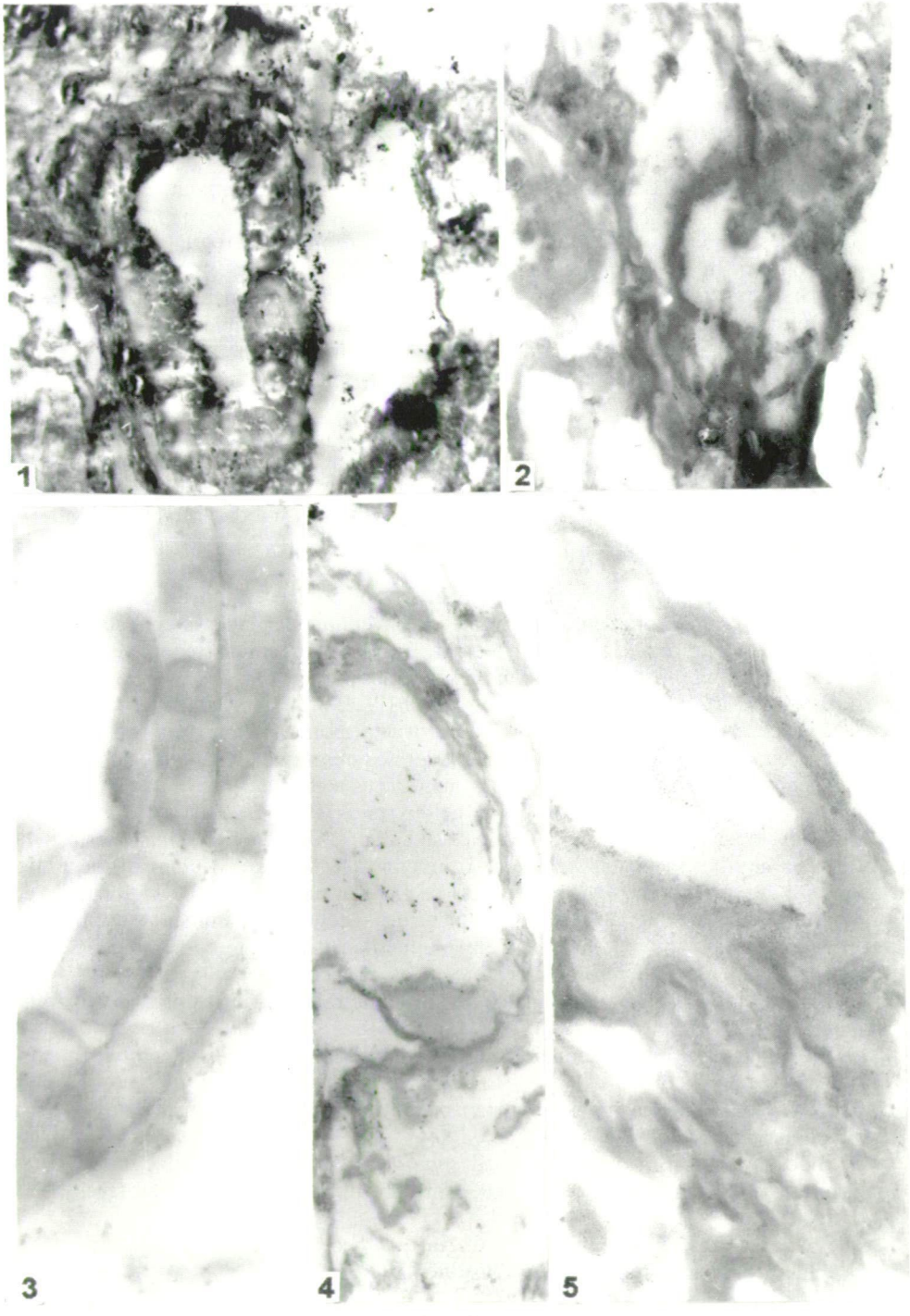

Plate 5.1.

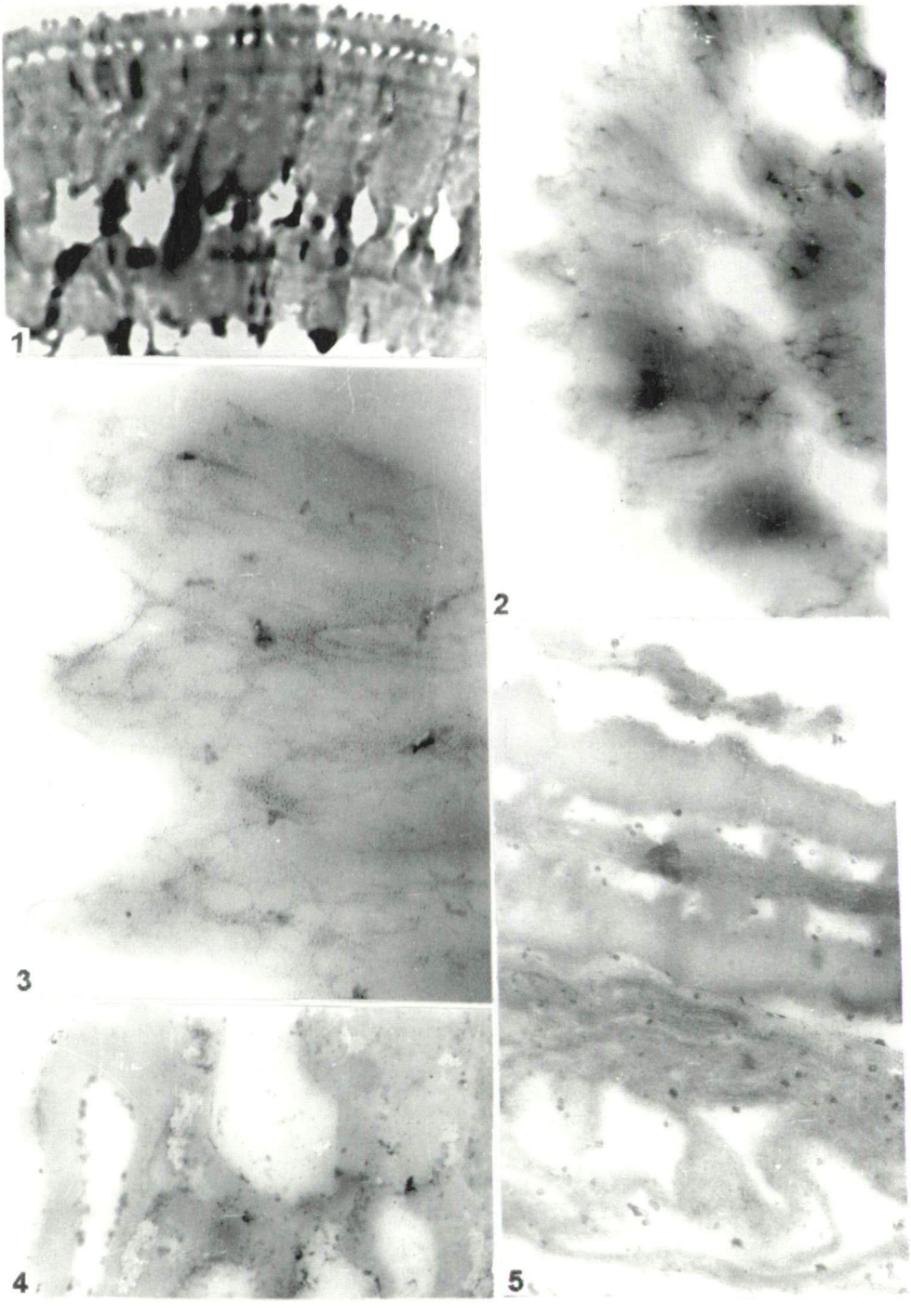

Plate 5.2.

Plate 5.1.

1-2. Block number: M-69-3, cf. *Cupuliferoidaepollenites quisqualis* (POTONIÉ 1934) POTONIÉ 1960, *Fagaceae* or *Leguminosae*. 1. Negative number: 7978, 5.000x, 2. Negative number: 7985, 15.000x.
3,4. Block number: M-69-1, cf. *Cupuliferoidaepollenites quisqualis* (POTONIÉ 1934) POTONIÉ 1960, *Fagaceae* or *Leguminosae*. 3. Negative number: 7592, 50.000x, 4. Negative number: 7596, 15.000x.
5. Block number: M-69-2, cf. *Triporopollenites* fsp. Negative number: 7600, 50.000x.

Plate 5.2.

1. Block number: M-70-4, cf. Classoidites fsp. Negative number: 7663, 5.000x.
2,3. Block number: M-70-2, Echinate *Brevaxones*. 2. Negative number: 7652, 15.000x, 3. Negative number: 7653, 50.000x.
4,5. Block number: M-69-4, 4. Negative number: 7610, 50.000x, 5. Negative number: 7619, 50.000x.

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10. Block: M-70-3 (Plate 5.3., fig. 5). General survey picture of a heavily disintegrated organic material, with a remnant of ectexine. The lamellar embedding material is also damaged.

11. Block: M-70-12 (Plate 5.3., fig. 6). Compressed and damaged probably angiosperm ectexinous remnants, organic material is more or less closely connected to the outer part of the wall.

12. Block: M-70-21 (Plate 5.4., fig. 1) Homogeneous wall remnant probably of small spore origin.

13. Block: M-70-5 (Plate 5.4., figs. 2,3). Probably a perispore bearing microspore. An inner more or less homogeneous thick wall, a cavea, and a differentiated outer wall composed of an outer homogeneous perforated wall, followed with a globular or irregular inner part are shown. This layer may be a perispore. But other kind of origin of this unusual ultrastructure remnant is also possible.

14. Block: M-70-16 (Plate 5.4., fig. 4). Heavily damaged organic material with remnants of ectexine of *Longaxones* pollen grains.

16. Secondary xylem remnants: Blocks: M-69-7, M-69-10, M-70-19 (Plate 5.4., figs. 5-7). More or less well preserved lamellar ultrastructure of the secondary wall are illustrated in pictures 5,6, plate 5.4. Fossil resin drops are illustrated in picture 7, they are in all probability of *gymnosperm* (*taxodiaceous*) woody remnants.

Plate 5.3.

1. Block number: M-69-5, negative number: 7623, 50.000x.
2. Block number: M-69-6, negative number: 7629, 15.000x.
3. Block number: M-69-8, negative number: 7987, 15.000x.
4. Block number: M-70-1, negative number: 7641, 50.000x.
5. Block number: M-70-3, negative number: 7657, 5.000x.
6. Block number: M-70-12, negative number: 7812, 15.000x.

Plate 5.4.

1. Block number: M-70-21, negative number: 7822, 15.000x.
2,3. Block number: M-70-5, 2. Negative number: 7668, 5.000x, 3. Negative number: 7670, 50.000x.
4. Block number: M-70-16, negative number: 7740, 5.000x.
5. Block number: M-69-7, negative number: 7631, 15.000x.
6. Block number: M-69-10, negative number: 7636, 50.000x.
7. Block number: M-70-19, negative number: 7818, 15.000x.

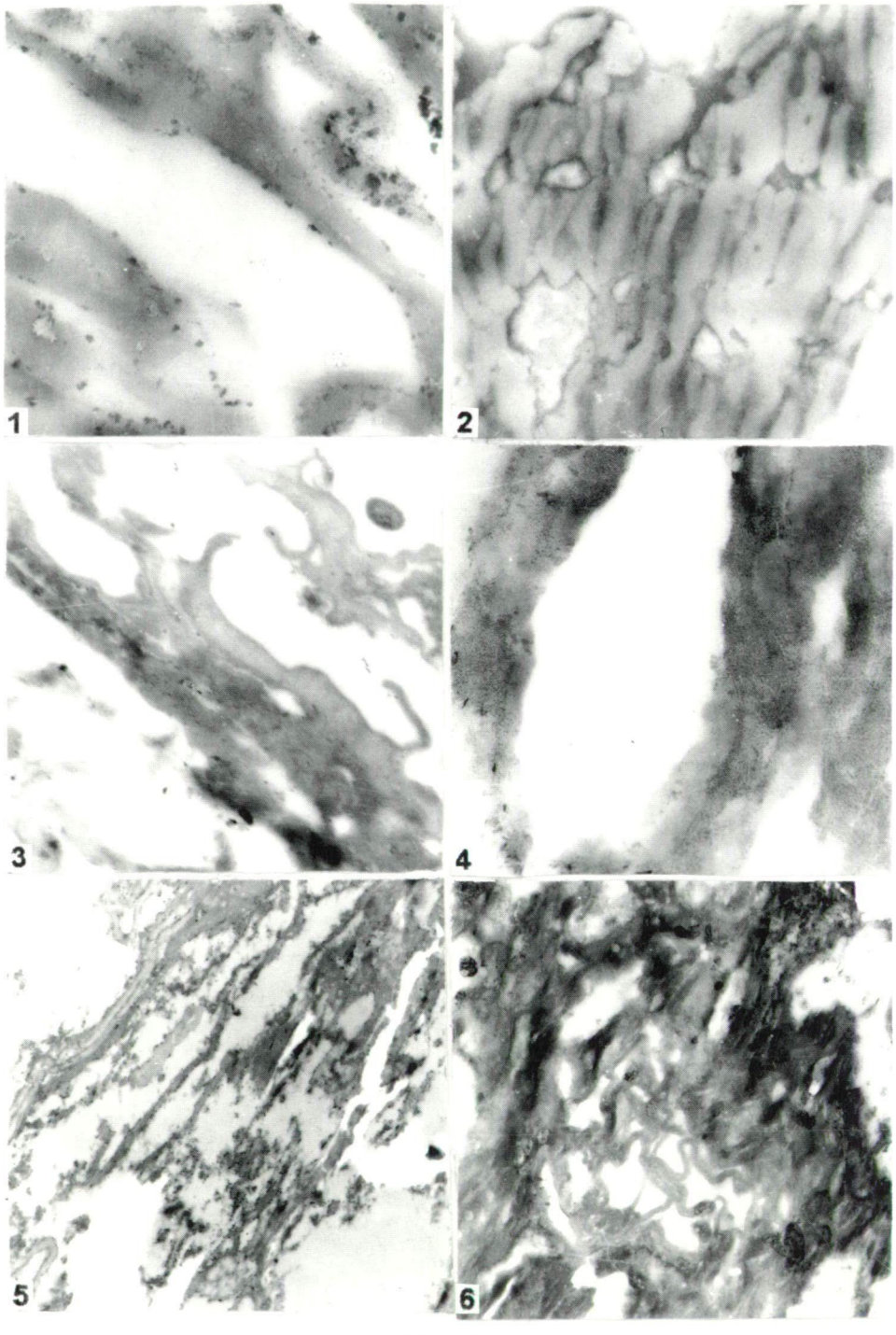

Plate 5.3.

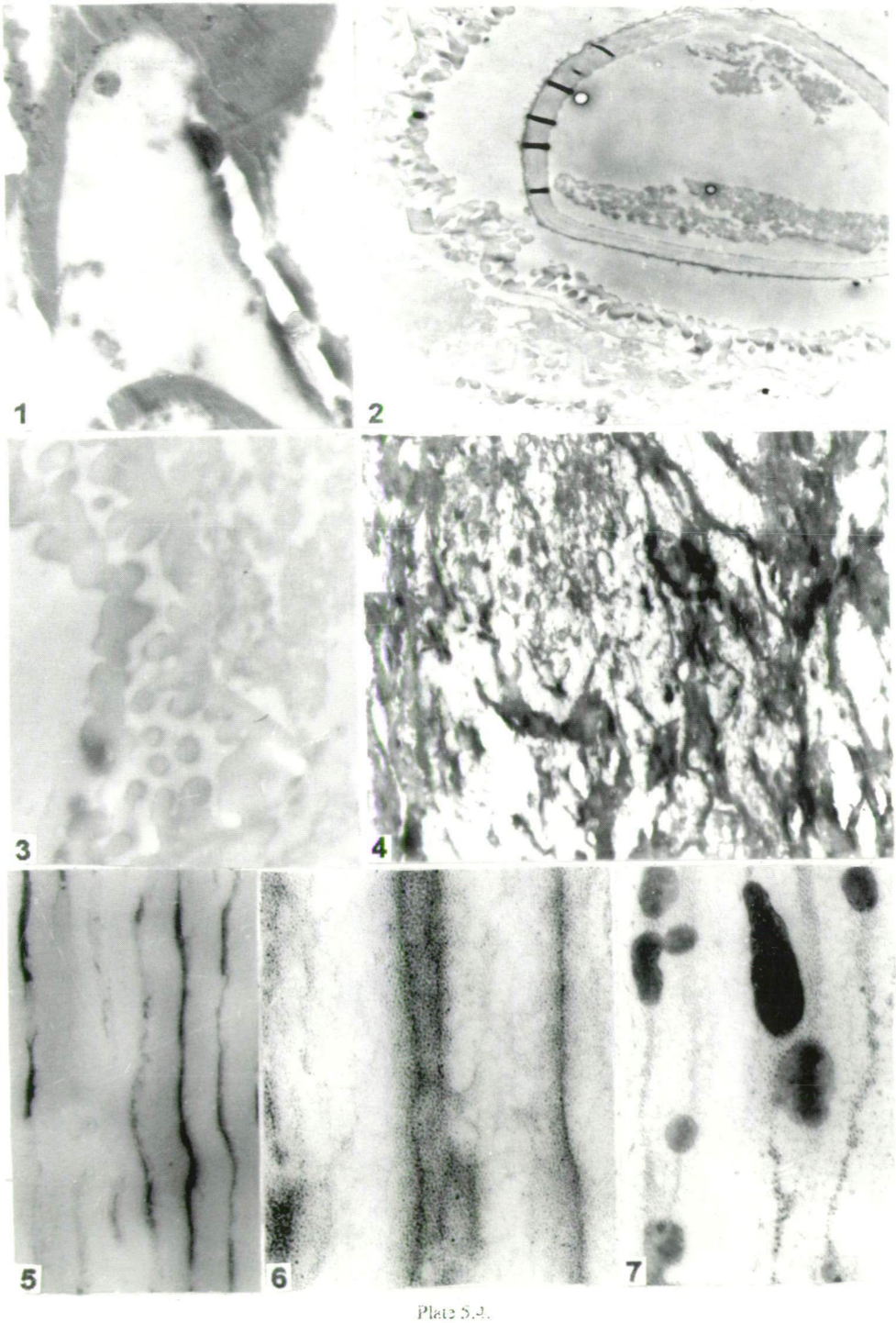

Plate S.9.

Discussion and Conclusions

1. This kind of experiments damaged heavily the ultrastructure of the pollen grains. In some cases the embedding material was disintegrated. In this way the taphonomical processes during the sedimentation is also an important factor of the ultrastructure preservation.

2. To discover the biopolymer system of the fossil pollen grains it seems that the oxidizing components, in the first place the $KMnO_4$, but the 2-aminoethanol also must be omitted.

3. The observed secondary woody remnants are similar to the previously published ones, cf. KEDVES and PÁRDUTZ (2000), p. 100, fig. 3, p. 103, fig. 3) from *Sequoioxylon gypsaceum* (GÖPPERT) GREGUSS 1967.

Acknowledgements

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