5. X-RAY EFFECT TO THE LM MORPHOLOGY OF SOME GYMNOSPERM AND ANGIOSPERM POLLEN GRAINS

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Abstract

Pollen grains of the following species were the subject of our investigations: 1. Inaperturate *gymnosperm (Juniperus virginiana)* and *angiosperm (Populus canadensis)*, 2. Monosulcate *angiosperm (Magnolia kobus)*, 3. Brevaxonate, vestibulate *angiosperm* pollen grains *(Betula verrucosa, Alnus subcordata)*. Length of irradiation: 35' with 35 KV, 20 mA, CuK_{α}. The alterations of the light-microscopical palynological characteristic features were the subject of our investigations, in particular the development of the pollen tube. Among the results the X-ray indicated germination at inaperturate *gymnosperm* pollen grains *(Juniperus virginiana)* may be pointed out. On the basis of the first results in this research program it is believed, that this alteration occurs at the *angiosperm* pollen grains.

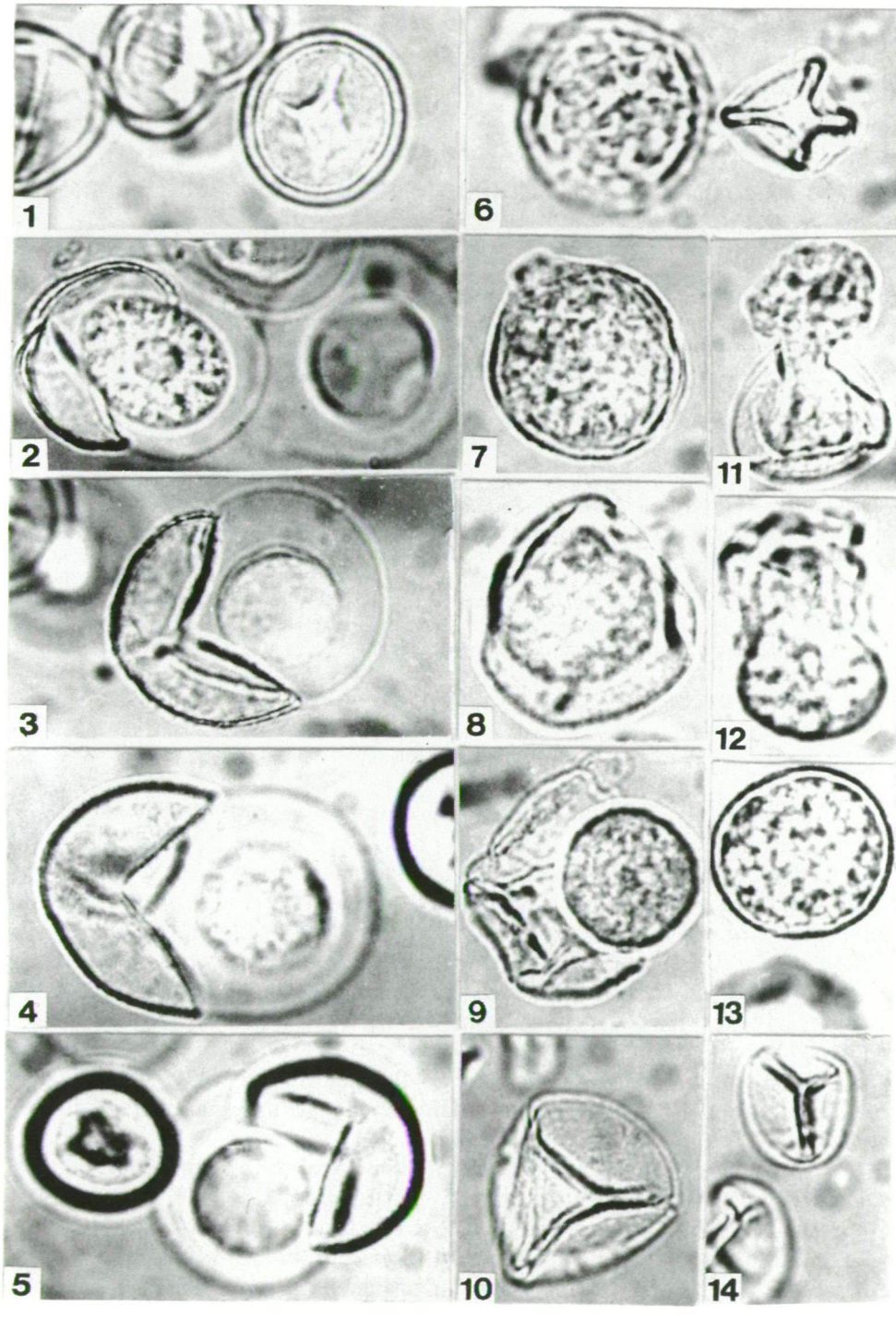
Key words: Palynology, *gymnosperm, angiosperm,* X-ray effect, light microscopy.

Introduction

Our research program in this field was focussed firstly to the secondary alterations of the biopolymer system of the sporoderm (cf. KEDVES and PÁRDUTZ, 1992). During these investigations with the TEM method also secondary, X-ray induced pollen tube development was observed. Later, KEDVES and GÁSPÁR (1995) investigated with the LM method the secondary alterations of the X-ray irradiation at the species as follows: *Ustilago maydis* (DE CANDOLLE) CORDA, *Equisetum arvense* L., *Pinus griffithii* MCCLELL, *Taxus baccata* L. and *Salix alba* L. The X-ray effect induced pollen tube development was observed only at the pollen grains of the *angiosperm Salix alba.* Based on the above mentioned few data the following problems arose:

1. Is this alteration indeed characteristic of the angiosperm pollen grains?
2. Taxonomic and/or phylogenetic conclusions may be draws an inference from these data?
3. What is the importance of the basic morphology of the sporomorphs?
4. The importance of peculiar protective materials in the wall and/or in the protoplasm? Melanins are in the first place in this respect (cf. PIROZYNSKI, 1977).

Taking into consideration the above mentioned problems in our laboratory a program of research was planned for the advancement in this field. This contribution is a part of this program.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Materials and Methods

The data of the investigated species are the following:

Juniperus virginiana L.

Locality: Botanical Garden of the J. A. University. Collected: J. PULICS, on 16. 03. 1995. Irradiation: on the 30. 03. 1995, LM investigation: on the 01. 04. 1995.

Populus canadensis MÖNCH. (*deltoides* MARSH x *nigra* L.).

Locality: Ujszeged the left river-side of Tisza. Collected: M. KEDVES, on 05. 04. 1995. Irradiation: on the 06. 04. 1995, LM investigation: on the 19. 04. 1995.

Magnolia kobus L.

Locality: University Garden (Egyetem u. 2) Collected: Á. KÁROSSY, on 03. 04. 1995. Irradiation: on the 06. 04. 1995, LM investigation: on the 19. 04. 1995.

Betula verrucosa EHRB.

Locality: Botanical Garden of the J. A. University. Collected: J. PULICS, on the 21. 03. 1995. Irradiation: on the 29. 03. 1995,

LM investigation: on the 29. 03. 1995.

Alnus subcordata C. A. MEY

Locality: Botanical Garden of the J. A. University. Collected: I. SZÖLLŐSI, on the 14. 03. 1995. Irradiation: on the 19. 04. 1995.

LM investigations on the 19. 04. 1995. The irradiations were made with the BRON–OM1 apparatus in the Radiological Laboratory of the Department of Mineralogy, Petrology and Geochemistry of the J. A. University, Szeged. Radiation data: 35KV, 20 mA, CuK_{α} beam. Length of irradiation: 35'.

Results

Juniperus virginiana L. (Plate 5.1., figs. 1–5)

Four kinds of pollen grains were observed after irradiation:

1. No alterations in the LM morphology; 43% (Plate 5.1., fig. 1).

2. No morphological alteration, but the degradation of the outer part of the ectexine is remarkable; 7.0%.

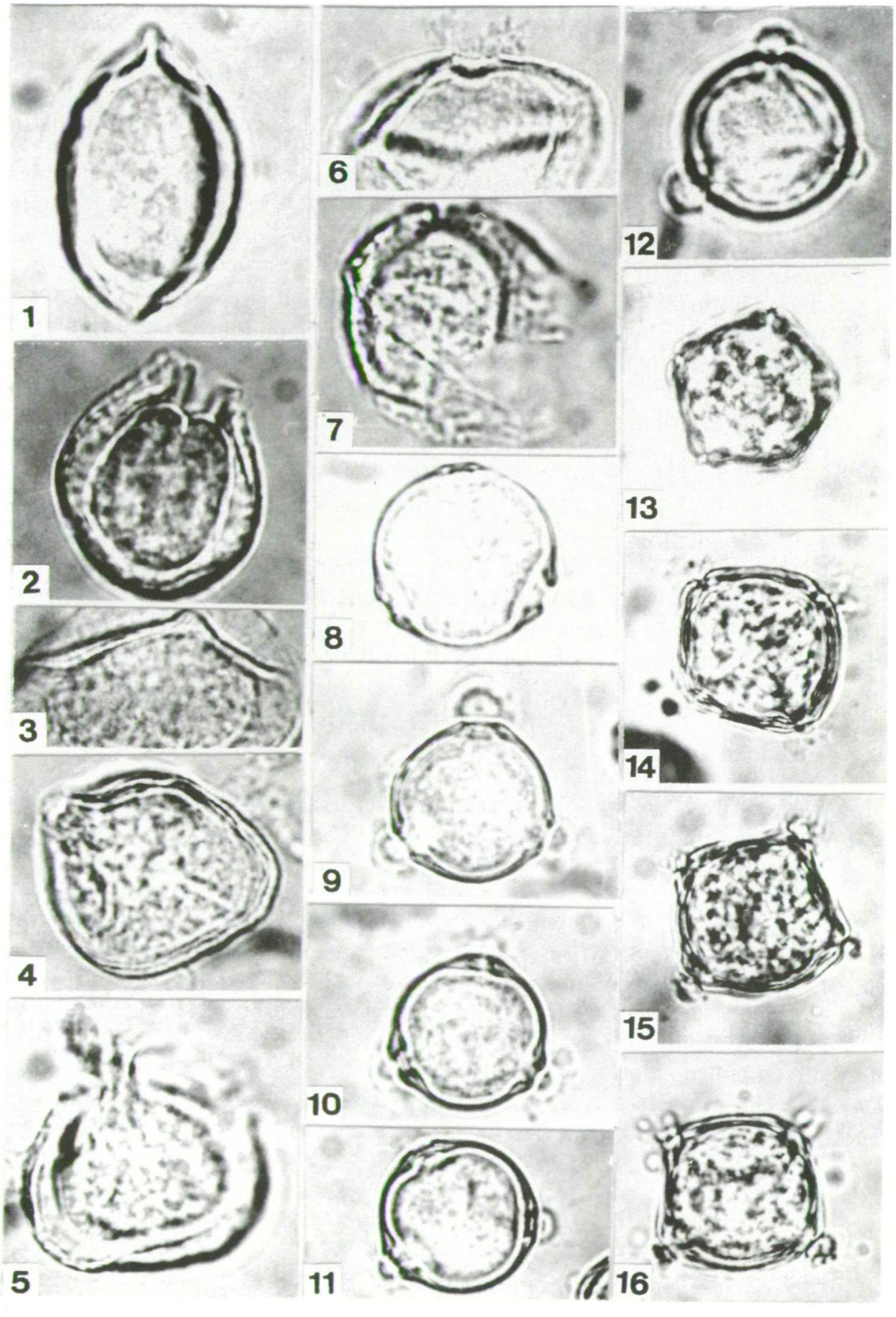
3. Opened "hiatus forms", with remarkable thickening of the inner wall layer, probably intine (Plate 5.1., figs. 2–5). In some specimens the nucleus is also well shown. This kind of pollen grains was observed in 47.5%.

4. Ectexine lost pollen grains, with an inner globular protoplasm surrounded by a thickened, probably intine, see the right pollen grain in fig. 2, Plate 5.1., 2.5% of such altered pollen grains were observed.

Populus canadensis MÖNCH. (*deltoides* MARSH x *nigra* L.) (Plate 5.1., figs. 6–14)

◂ Plate 5.1.

1–5. *Juniperus virginiana* L., Recent, Experiment No: 1/7–88.
6–14. *Populus canadensis* MÖNCH. (*deltoides* MARSH. x *nigra* L.), Recent, Experiment No: 1/7–91.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A number (70%) of pollen grains without protoplasm were observed. These are without doubt sterile pollens. It is interesting, that there are peculiar forms between them. Foldings similar to the "Y" tetrad mark (Plate 5.1., fig. 14), "tetralete form" (Plate 5.1., fig. 6, the pollen grain of the right corner of the picture) and "plicatoide types" similar to the *myrtaceous* pollen grains (Plate 5.1., fig. 10). The non-altered pollen grains with protoplasm (Plate 5.1., fig. 6, left corner of the picture, and fig. 13) represent 25.5%. The development of the pollen tube is interesting (Plate 5.1., figs. 7,11,12). Very small tube is illustrated in picture 7, of the Plate 5.1. Characteristic specimens are illustrated on the microphotographs 11, and 12 in the Plate 5.1. This kinds of pollen grains represent 4%. As the most interesting alteration, the forms which are similar to the altered pollen grains of *Juniperus virginiana* may be pointed out (Plate 5.1., figs. 8,9). The "hiatus form" (Plate 5.1., fig. 9) is rare (0.5%), the extremely thickened intine, with globular protoplasm is scarce (Plate 5.1., fig. 8). Worth of mentioning is that the ectexine was not seemingly damaged.

Magnolia kobus L. (Plate 5.2., figs. 1–7)

The typically monosulcate pollen grains (Plate 5.2., figs. 1,2) represents one of the earliest *angiosperm* pollen type. The morphological characteristic features of the apertural area are well shown in the polar view of the pollen grains (Plate 5.2., fig. 2). Pollen tube development in consequence of the X-ray irradiation was observed at 9.5% of the pollen grains (Plate 5.2., figs. 4–6). 4.5% of the altered pollen grains represent the opened (hiatus) forms, which are similar to the previous two species. Most per-cent (76.0%) of the pollen grains are non-altered (e. g.: Plate 5.2., fig. 1). Pollen grains without ectexine and with thickened intine were observed in 10.0% (Plate 5.2., fig. 3).

Betula verrucosa EHRB. (Plate 5.2., figs. 8–12)

The expansion of the onci were observed at nearly all of the pollen grains after irradiation. (Plate 5.2., fig. 8). The pollen tube development at all the apertures was observed at 49.0% of the pollen grains (Plate 5.2., figs. 9–12). At 51.0% of the irradiated pollen grains tube development was not observed.

Alnus subcordata C. A. MEY. (Plate 5.2., figs. 13–16)

After irradiation the onci slightly increased. The greatest part of the pollen grains are non-altered; 86.5% cf. Plate 5.2., fig. 13. The pollen tube development was observed at 13.5% of the pollen grains (Plate 5.2., figs. 14–16). But the pollen tube development at every aperture of the pollen grains was observed at 3.5% only.

◂ Plate 5.2.

1–7. *Magnolia kobus* L., Recent, Experiment No: 1/7–90.
8–12. *Betula verrucosa* EHRB., Recent, Experiment No: 1/7–87.
13–16. *Alnus subcordata* C. A. MEY., Recent, Experiment No: 1/7–89.

Discussion and Conclusions

The new data in comparison with the previous ones may be interpreted as follows:

1. The interesting secondary forms of the pollen grains of *Juniperus virginiana* are unexpected in contrast to the observations at the pollen grains of *Taxus baccata.* To this the results of DUHOUX (1975) are worth of mentioning, the observed aperture-like exine differentiations. The rich LM results of M. VAN CAMPO (1947, 1951, 1953) are also very important. It may be concluded, that the further investigations on inaperturate *gymnosperm* pollen grains will be resulted in future further interesting new data. As regards our up-to-date results on the pollen grains of *Populus canadensis* we can emphasize some similarities between the secondary forms of the pollen grains of *Juniperus virginiana.* In this way the similar or identical morphology may results in similar alterations or secondary forms. M. VAN CAMPO (1947) observed tetrad mark-like foldings at the pollen grains of *Cryptomeria japonica.*

2. X-ray effect induced pollen tube development was observed at the *angiosperm* monosulcate pollen grains of *Magnolia kobus.* Taking into consideration our previous results on the pollen grains of *Ginkgo biloba,* the similar morphology have not resulted in similar alterations in contrast to the above discussed inaperturate forms.

3. The differences in the percentages of the pollen tube development of the genuses *Betula* and *Alnus* are also interesting. This may be induced further multidisciplinary investigations.

In resumé on the basis of our present day knowledges in this subject we can established, that the X-ray induced pollen tube development at one group of the pollen grains is a remarkable contribution in the determination of the radioactivity of the recent sediments.

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