10. X-RAY EFFECT ON THE ULTRASTRUCTURE OF THE POLLEN GRAINS OF GINKGO BILOBA L.

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Abstract

Pollen grains of *Ginkgo biloba* L. were irradiated with CuKα X-ray at 35 KV, 20 mA. Length of time of irradiations were as follows: 5', 15', 35' and 60'. The biopolymer system of the ectexine is relatively resistant to the irradiation, sub-units were not observed. Desintegration in the ultrastructure was observed in the first place at the intine and the endexine. In the apertural region degradation of the foot layer was also observed.

Key words: Palynology, recent, *Ginkgo biloba*, X-ray effect, TEM.

Introduction

The monosulcate/monocolpate LM morphology of the pollen grains of *Ginkgo biloba* L. has been well known for a long time together with the similarity to some *Cycadales* and *Palmales* genuses. KEDVES (1961) discussed the morphology and the problems of the botanical affinities of the fossil forms. First TEM data were published by UENO (1960). AUDRAN and MASURE (1978) described in detail the fine structure of the different layers of the exine. The lamellar ultrastructure of the sexine and its occurrence in the germinal area is a very important contribution to the fine structure morphology of these pollen grains. WANG (1989) emphasized, that his observations confirm the results of UENO (1960) and of AUDRAN and MASURE (1978). In 1990 WANG pointed out that it is difficult to distinguish pollen grains of *Ginkgo* from that of *Cycadales* in the light-microscope, but ultrastructurally they are quite different. Foot layer is distinct and the endexine is lamellated. Following XI and WANG (1989) and XI (1990) the endexine of the pollen grains of *Ginkgo biloba* is very thin, 2-3 lamellate with indistinct boundaries between lamellae.

During our investigations of the X-ray effect to the sporomorphs the alterations of the LM morphology of the pollen grains of *Ginkgo biloba* were also published (KEDVES and GÁSPÁR, 1995). This paper presents the TEM results of the X-ray irradiated pollen grains.

The aim of this paper is in the first place whether the alterations in the LM morphology aren't connected with ultrastructural desintegrations.

Materials and Methods

Locality: Újszeged, Garden of the Biological Centre of the Hungarian Academy of Sciences. Collected: I. GÁSPÁR on 22.04.1992. Irradiation: on the 05.08.1993, with a BRON-OM1 apparatus in the Radiological Laboratory of the Department of Mineralogy, Petrology and Geochemistry of the J. A. University, Szeged. Radiation data: 35 KV, 20 mA, CuKα beam. Length of time and numbers of experiments: 5' 1731, 15' 1732, 35' 1733, 60' 1734. The irradiated pollen grains were postfixed with 1% OsO_4 aquous dilution and embedded in Araldite. The ultrathin sections were made at the Hungarian Academy of Sciences Biological Research Center EM Laboratory on a Porter Blum ultramicrotome. The TEM photographs were taken on an Opton EM-902 (resolution 2-3 Å), and on a Tesla BS-540 (resolution 5 Å).

Results

The ultrastructure of the non-experimental fresh pollen grains for comparison is represented in Plate 10.1., figs. 1–5. Illustrated are: the thick tectum, the peculiar, more or less columellar infratectal layer, the thin foot layer, the lamellar endexine, in particular at the bordering of the apertural and inter-apertural area, the intine and the protoplasm.

Experiment No: 1731 (Plate 10.2., figs. 1–4). – The originally finely lamellar intine desintegrated or disappeared, e. g.: figs. 2, 4 in Plate 10.2. There are also alterations at the characteristic lamellae of the endexine, but the elements are discernible. The substance and the ultrastructure of the ectexine layers have not been altered.

Experiment No: 1732 (Plate 10.3., figs. 1–5). – The desintegration of the endexine and intine progressed. In the inter-apertural area, in several places it is not so easy to distinguish the endexine from the foot layer, cf. fig. 1, in Plate 10.3. The elements of the peculiar infratectal layer are well illustrated in the above mentioned picture.

Experiment No: 1733 (Plate 10.4., figs. 1–3). – Cross-sectional picture of the pollen grain well illustrate the general morphology of this kind of pollen grain. Sulcus and colpus are together. Sulcus is as it was illustrated by ERDTMAN (1957), the ultrastructure of the colpus as it was published by ROLAND (1968). Worth of mentioning is, the presence of microbial organisms, mostly fungi in the "sulcus hole." The desintegration of the inner layers continued (Plate 10.4., figs. 2,3), this is very characteristic in the colpus.

Experiment No: 1734 (Plate 10.5., figs. 1–6). – The desintegration of the protoplasm is characteristic (Plate 10.5., fig. 1). The intine is completely or partially destroyed. The lamellae of the endexine are relatively well preserved (Plate 10.5., figs. 4–6). In our material the number of the lamellae near the colpus is four and two in the bordering area. The ectexine in the extra-apertural region is not desintegrated the foot layer and the endexine in the apertural area are damaged only (Plate 10.5., figs. 2,5).

Discussion and Conclusions

Based on our up-to-date knowledges we can concluded the following:

1. The biopolymer system of the ectexine of the pollen grains of *Ginkgo biloba* L. is very resistant to X-ray irradiation. In contrast to the previous observations on the pollen grains of *Alnus glutinosa* (L.) GAERTN., cf. KEDVES and PÁRDUTZ (1992).

Biopolymer subunits were not discovered in the ectexine, desintegration was observed only in the colpus area.

2. Desintegration was observed in the first place at the inner part of the wall. The finely lamellar ultrastructure of the intine is very easily destroyed. Alterations were observed in the lamellar ultrastructure of the endexine in the apertural area.
3. The morphological terms sulcus and colpus may be discussed at these pollen grains. To this the basic work of ERDTMAN (1957) and ROLAND (1968) may be pointed out.
4. The presence of the microbial organisms, in the first place of *Fungi*, is interesting in the sulcus hole. These organisms may contribute to several further alterations.

4.1. Microbial, enzymatic desintegration may be supposed in the apertural area, in the colpus region.

4.2. It can be taken into consideration at the pollen allergological studies that the surface of pollen grains can be covered and transported microscopical *Fungi* and other organisms which can also be factors of the allergological symptomes.

Acknowledgements

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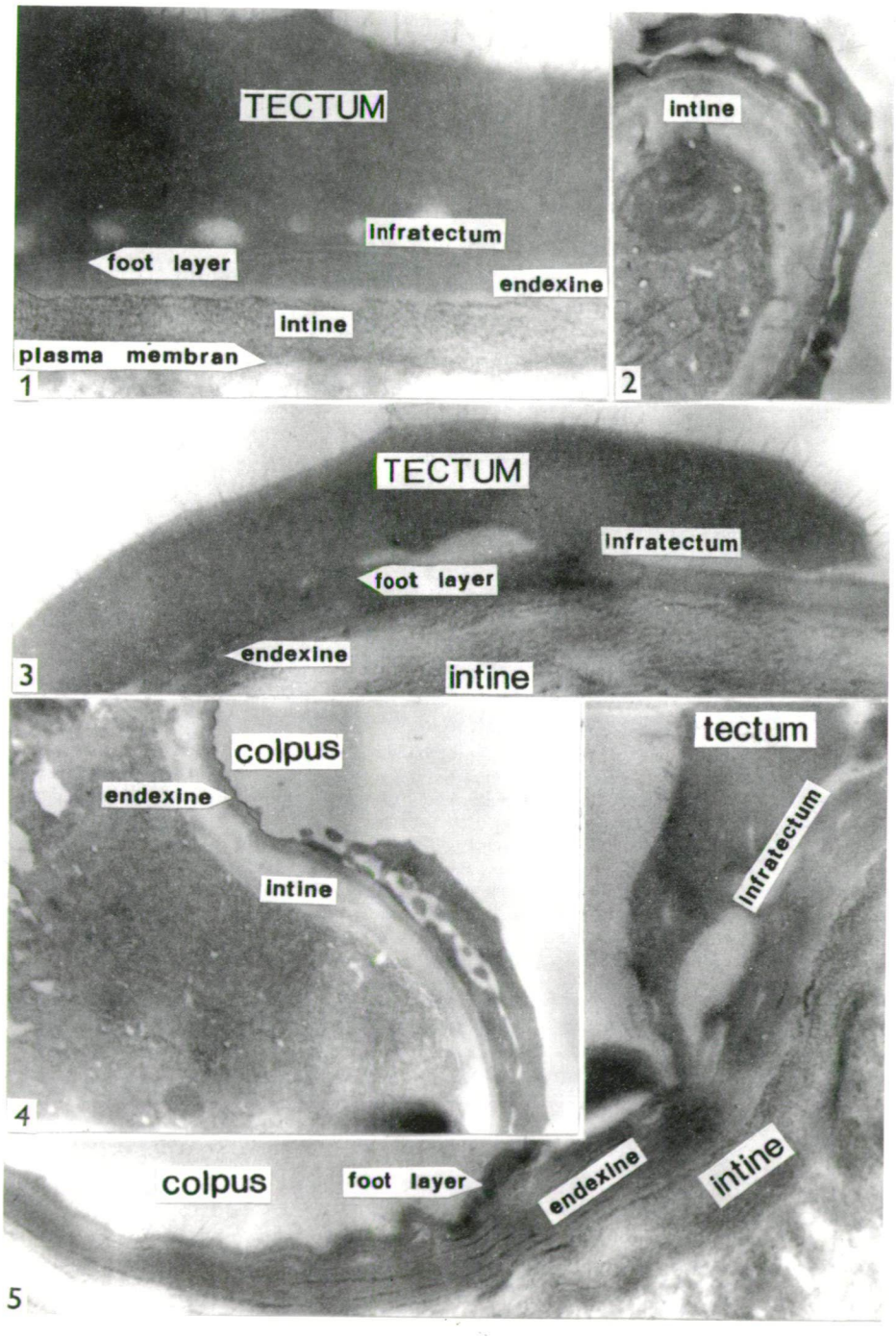
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Plate 10.1.

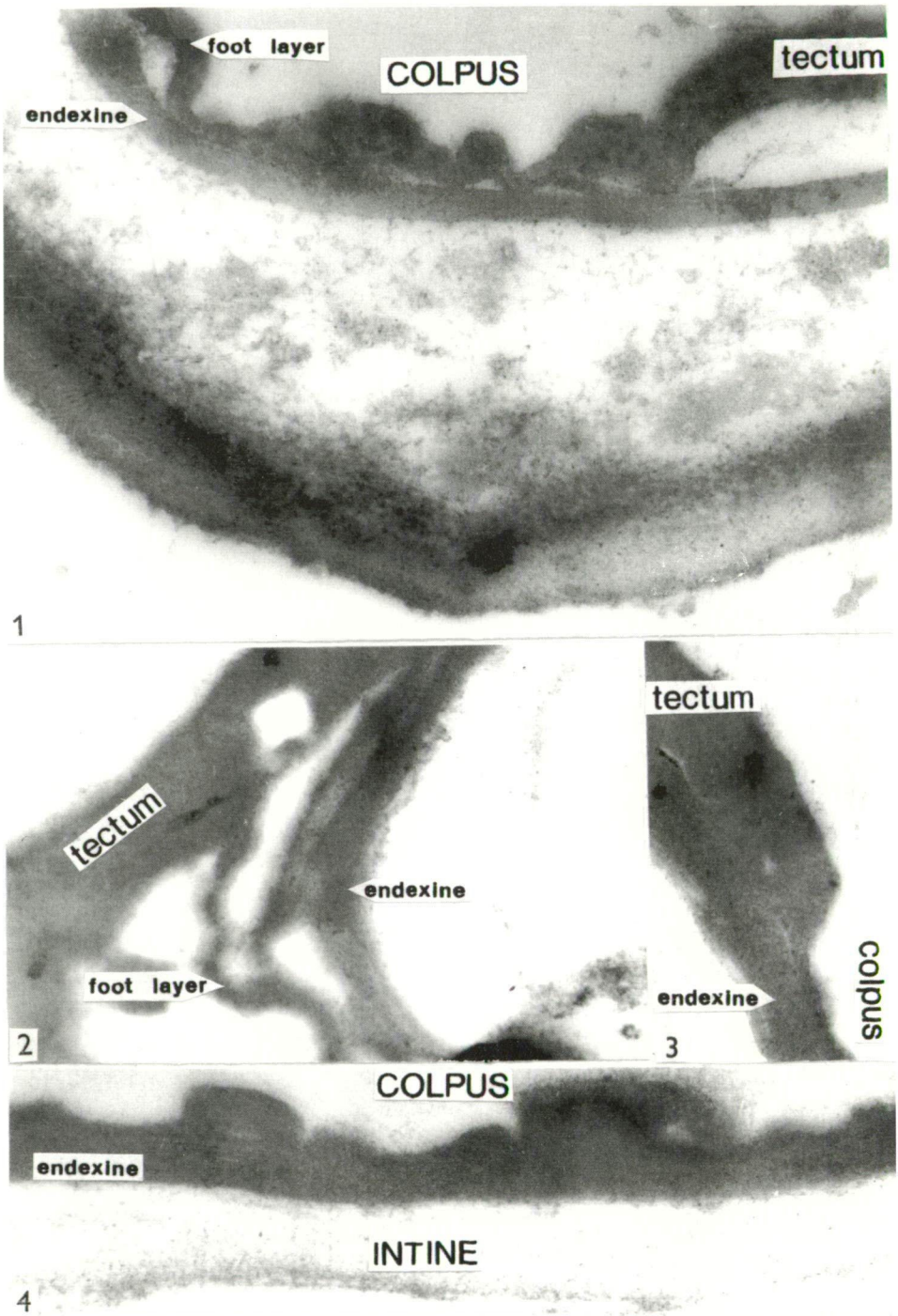
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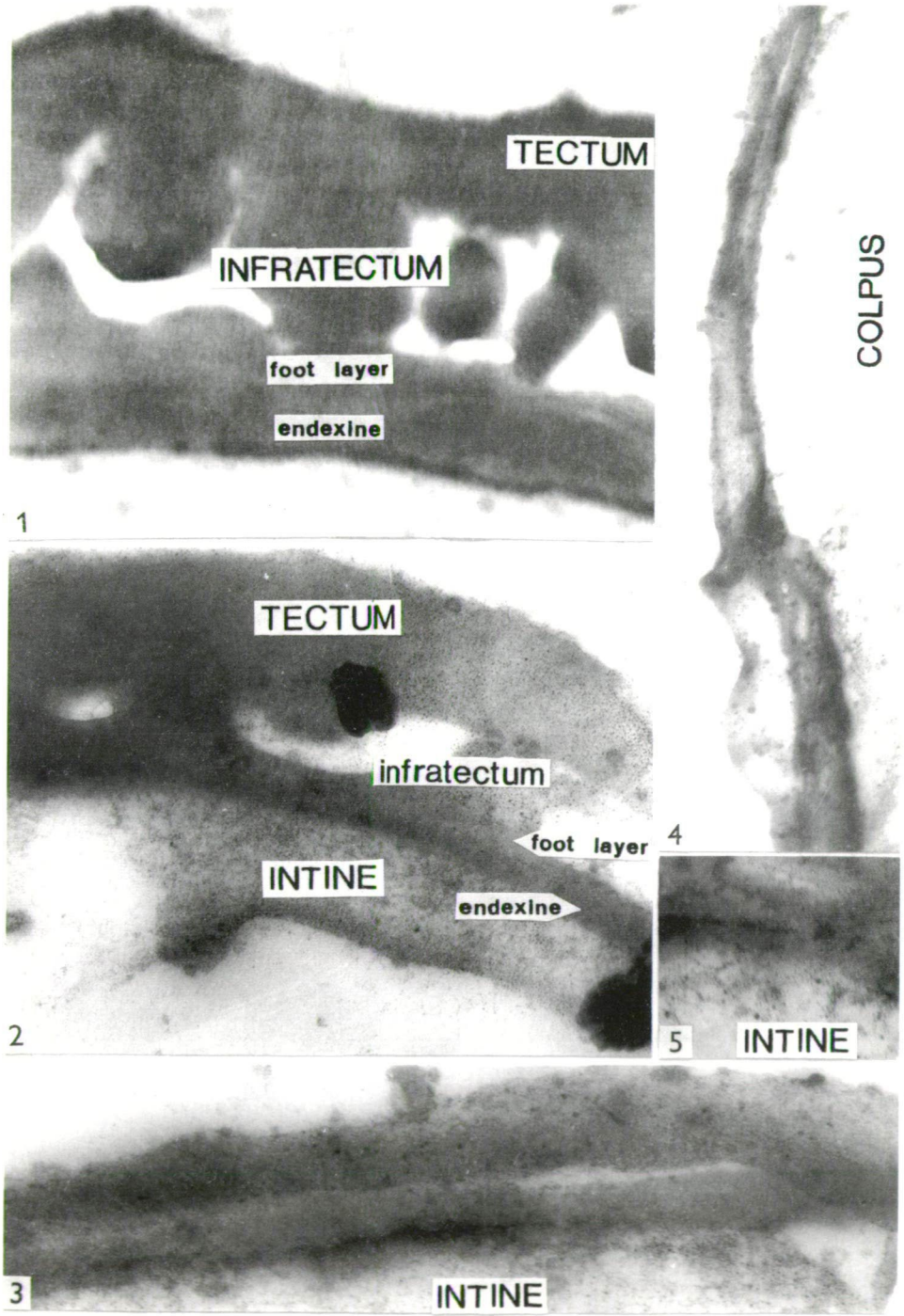
Plate 10.2.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COLPUS
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Plate 10.3.

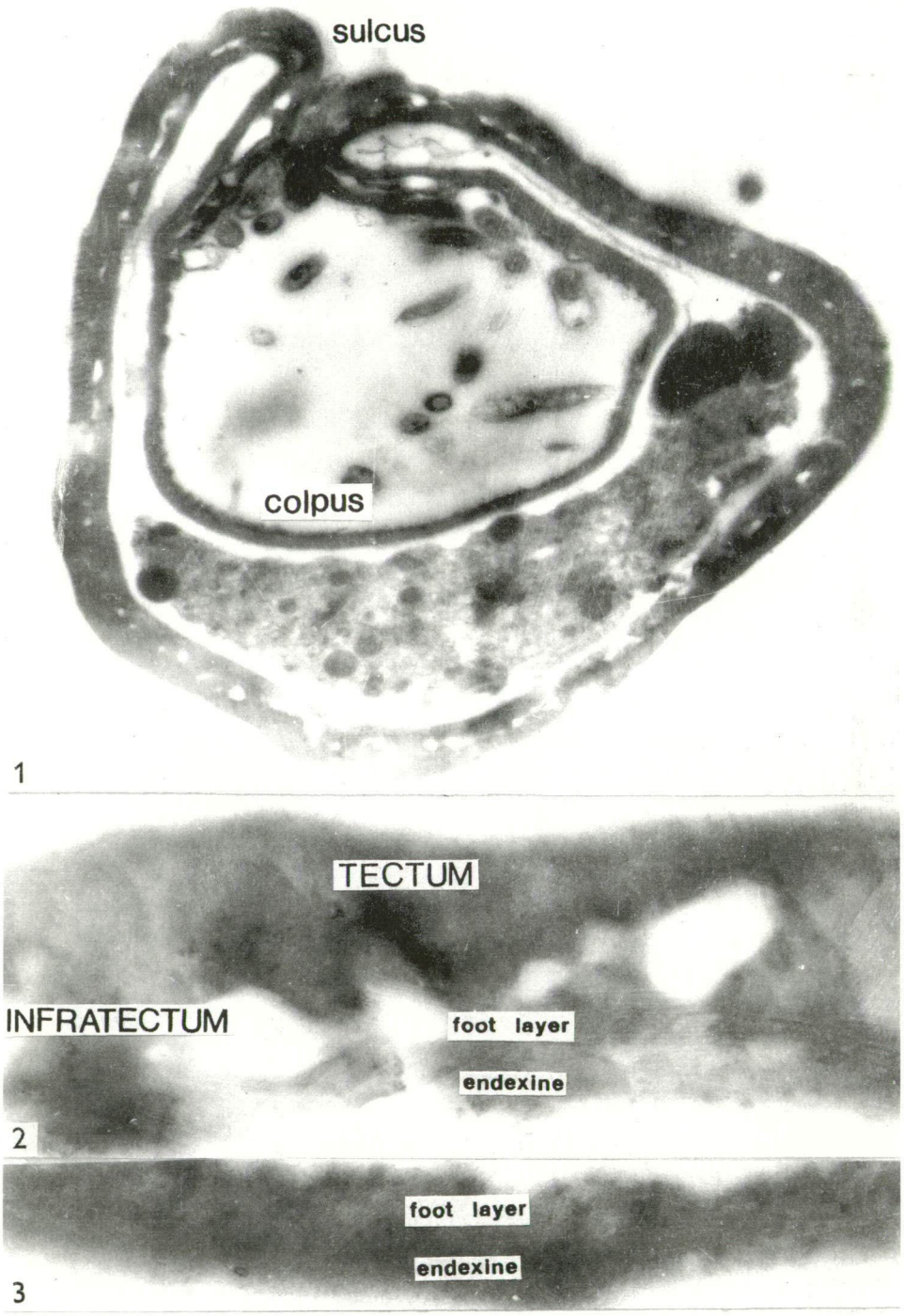
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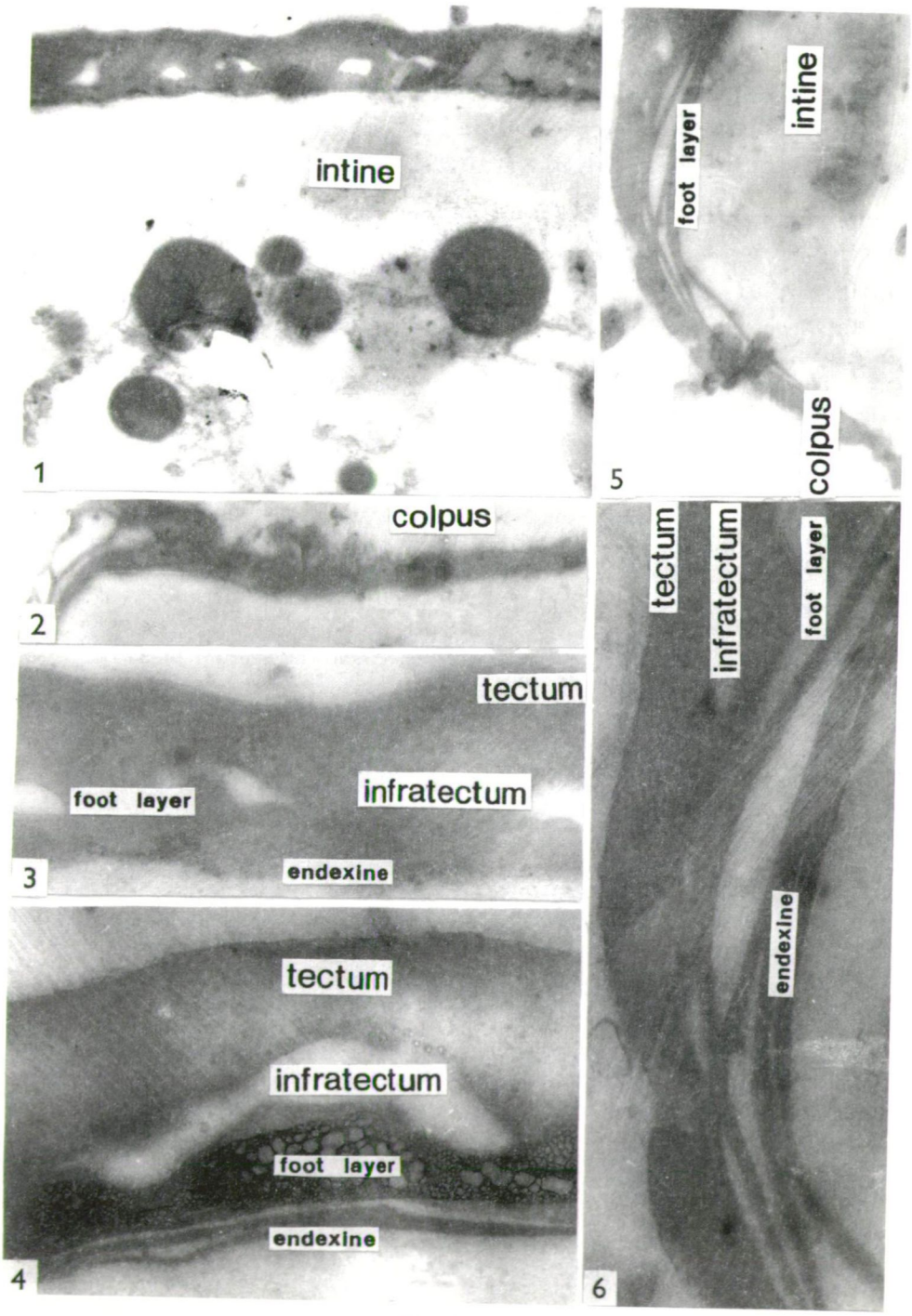
Plate 10.4.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endexine
6

Plate 10.5.

Plate 10.1.

1–5. *Ginkgo biloba* L. Recent. Ultrastructure of the non-experimental fresh pollen grains.
1. Detail of the exine ultrastructure of the inter-apertural area. 50.000x.
2. General survey picture of the ultrastructure of the pollen grains in the inter-apertural area. The relatively large nucleus is well shown. 10.000 x.
3. Detail of the exine ultrastructure near the apertural area. The finely lamellar ultrastructure of the intine are illustrated. 25.000 x.
4. General survey picture of the pollen grain in the apertural area. 10.000 x.
5. Detail of the exine ultrastructure in the apertural area. Worth of mentioning is the thin foot layer in the colpus region, and the endexine lamellae in the bordering area of the colpus. 50.000 x.

Plate 10.2.

1–4. *Ginkgo biloba* L. Recent. Experiment No: 1731.
1. Ultrastructure of the pollen grain at the bordering of the apertural area. Negative no: 6027. 50.000 x.
2. Characteristic lamellar endexine in the bordering of the apertural area. Negative no: 6024. 50.000 x.
3. Bordering of the inter-apertural and apertural area. Negative no: 6025. 50.000 x.
4. Ultrastructure of the colpus. The degradation of the ultrastructural elements of the endexine and in particular of the intine is well shown. Negative no: 6025. 50.000 x.

Plate 10.3.

1–5. *Ginkgo biloba* L. Recent. Experiment No: 1732.
1. Detail of the exine ultrastructure of the inter-apertural area. Illustrated are the thick tectum, the peculiar infratectal layer, the thin foot layer and the damaged endexine. Negative no: 6032. 50.000 x.
2. Detail of the exine ultrastructure near the apertural area. The degradation of the ultrastructural elements of the intine is well shown. Negative no: 6033. 50.000 x.
3. Detail of the exine ultrastructure in the colpus region. Negative no: 6030. 50.000 x.
4. General survey picture of the exine ultrastructure in the colpus area. Negative no: 6031. 25.000 x.
5. Detail of the degraded endexine and intine. Negative no: 6029. 50.000 x.

Plate 10.4.

1–3. *Ginkgo biloba* L. Recent. Experiment No: 1733.
1. General survey picture of the cross-section of the pollen grain. The different kinds of microorganisms in the sulcus hole are well shown. Negative no: 6039. 10.000 x.
2. Detail of the exine ultrastructure in the inter-apertural area. Negative no: 6037. 50.000 x.
3. Detail of the exine ultrastructure in the colpus region. Negative no: 6038. 50.000 x.

Plate 10.5.

1–6. *Ginkgo biloba* L. Recent. Experiment No: 1734.
1. General survey picture of the pollen grain in the inter-apertural area. Negative no: 6012. 15.000 x.
2. Detail of the exine ultrastructure in the apertural area. Negative no: 6015. 15.000 x.
3. Detail of the ectexine ultrastructure in the inter-apertural area. Negative no: 6013. 50.000 x.
4. Detail of the ectexine ultrastructure near the bordering of the apertural area. Two lamellae of the endexine are well shown. Negative no: 6018. 50.000 x.
5. General survey picture of the pollen grain at the bordering of the apertural area. Rectification: foot layer properly endexine. Negative no: 6014. 15.000 x.
6. Detail of the lamellar endexine in the bordering area of the aperture. The four lamellae are segregated. Negative no: 6019. 50.000 x.