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The Early Miocene Lignite Deposit of Oberdorf N Voitsberg (Styria, Austria) | Editor: F.F. Steininger

# Palynological Investigations from the Early Miocene Lignite Opencast Mine Oberdorf (N Voitsberg, Styria, Austria)

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1 Table and 2 Plates

*Styria*
*Pannonian Basin*
*Styrian Basin*
*Lignite*
*Paleobotany*
*Palynomorphs*

*Österreichische Karte 1 : 50.000*
*Blatt 163*

## Contents



## Palynologische Untersuchungen im untermiozänen Braunkohlentagebau Oberdorf (N Voitsberg, Steiermark, Österreich)

### Zusammenfassung

Aus den Kohleablagerungen des Tagebaues Oberdorf, N Köflach, Steiermark, Österreich, konnte eine reiche Mikroflora gewonnen werden.

Diese Mikroflora wird durch das Vorherrschen von Gattungen aus den Familien der Taxodiaceae, Juglandaceae, Fagaceae, Oleaceae, Betulaceae and Rosaceae charakterisiert. Diese palynologischen Daten lassen im wesentlichen auf die Existenz eines gut entwickelten Sumpfwaldes, einer flußbegleitenden Pflanzengesellschaft und eines artenreichen mesophytischen Mischwaldes schließen. Auf Grund der Artenzusammensetzung und des Auftretens bestimmter Elemente wie z.B. *Alangium, Lithocarpus, Engelhardia* und *Mastixia* kann auf ein warm temperiertes Klima geschlossen werden.

### Abstract

A rich palynomorph assemblage was recovered from the Early Miocene lignite deposits of the opencast mine in Oberdorf, N Voitsberg, Styria, Austria.

The assemblage is dominated by pollen taxa of Taxodiaceae, Juglandaceae, Fagaceae, Oleaceae, Betulaceae and Rosaceae. The palynological data indicate the existence of a swamp forest, an associated riparian vegetation and mesophytic broad-leaved forest. The occurrence of certain palynomorphs (*Alangium, Lithocarpus, Distylium, Engelhardia, Mastixia*) suggest a warm temperate climate.

## 1. Introduction

One of the first palynological studies in the Köflach-Voitsberg embayment was undertaken by KLAUS (1954). Although the aim of this work was the stratigraphic classification of the coal-bearing succession, approximately 70 microfloral elements were identified.

The palynological investigations in the Oberdorf open pit mine undertaken by the author to date focus on the systematic and botanical description of the microfloral elements. By combining these data with the macrofloral data (diaspores and leaves), a better knowledge of the floristic composition of this area will be gained.

Additional investigations of plant remains from the Oberdorf open pit mine (KOVAR-EDER, J. et al., MELLER, B. et al., in press) include morphological descriptions of

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several pollen taxa and an overview of general floristic composition.

## 2. Materials and Methods

The generally poor preservation of pollen and spores in the samples from many of the sedimentary sequences prevents their detailed investigation. Only a few samples, mostly from the footwall layers, were suitable for the combined LM-SEM method described by ZETTER (1989).

## 3. Interpretation

All spore and pollen taxa found to date in the Köflach-Voitsberg area are summarized in Table 1. Samples within the basal layers and from the hanging wall exhibit only a few differences in their microfloral composition, based mostly on changing percentages of the most frequently found elements (Taxodiaceae, Juglandaceae, Fagaceae).

By examining the distribution of the important taxa more closely, the following impression emerges: Spores of pteridophytes are found regularly in all samples from the entire profile. These consist of Osmundaceae, Polypodiaceae, Pteridaceae, Lycopodiaceae and Selaginellaceae. The percentages of Osmundaceae spores surpass those of the Polypodiaceae and Pteridaceae. The frequent but minor occurrence of Sphagnum spores in all samples of the profile is notable.

In the case of the Gymnosperms in all investigated samples, the pollen of Taxodiaceae dominate, although preservation of the pollen grains is often quite poor. Consequently, a more detailed identification into different genera was not possible. Pinaceae pollen could be identified as *Pinus* (haploxylon as well diploxylon taxa) *Cathaya, Abies* and *Picea*.

Pollen grains of monocotyledon angiosperms (Cyperaceae, Poaceae, and Arecaceae) are seldom found, and their preservation is generally poor, with the exception of some rare palm pollen. From these pollen alone we know that palms lived in the study area, although a detailed identification of them has not been attempted yet.

Pollen of dicotyledon angiosperms characterize the Oberdorf pollen assemblage. The absolute dominance by Juglandaceae pollen (*Carya, Engelhardia, Platycarya*, and *Pterocarya*) is characteristic for nearly all the samples studied. When all genera are assessed at the family level, up to 45 % consist of Juglandaceae, as was also reported by KLAUS (1954).

Four genera represent the Fagaceae (*Fagus, Lithocarpus, Quercus, Trigonobalanopsis*). The pollen of *Fagus* is rare, Quercus is represented by deciduous as well as evergreen species, and the pollen of *Trigonobalanopsis* ("Cingulum type") dominate over all other Fagaceae genera.

Four genera of Hamamelidaceae (*Distylium, Liquidambar, Parrotia* – Plate 1, Figs. 1–3, and one not yet identified in detail – Plate 1, Figs. 4–6) have been observed.

The oldest stratigraphic evidence of the genus *Podocarpium (Podogonium*/Fabaceae – Plate 1, Figs. 7–9) from Austria was found in one sample of the footwall layer at Oberdorf. The genus *Apios* – Plate 1, Figs. 10–13, represents a second member of the Fabaceae at this site. The regular occurrences of *Mastixia* (Mastixiaceae), Styracaceae and Sapotaceae are significant. Four taxa of Sapotaceae can be distinguished with the help of SEM.

One special feature in the investigated section is the frequent occurrence of Rosaceae pollen grains. Besides *Prunus* – Plate 2, Figs. 1–3, and *Rubus* – Plate 1, Figs. 14–16, two other taxa are distinguishable by their morphological features. Examined only under LM, such pollen grains often will be identified as Cyrillaceae or Clethraceae, but there is no evidence for the existence of these genera in Oberdorf.

The semi-parasitic genera *Arceuthobium* and *Loranthus* occur frequently, but only in small quantities.

Oleaceae pollen occur consistently and relatively abundantly in many samples of the sedimentary sequence, and two genera (*Fraxinus* and *Olea*) were identified.

An interesting accumulation of herbaceous pollen grains of the families Apiaceae – Plate 2, Figs. 7–9, Caryophyllaceae – Plate 2, Figs. 10–12, Compositae, Dipsacaceae, Plantaginaceae – Plate 2, Figs. 4–6, Theligonaceae and Valerianaceae – Plate 2, Figs. 13–15, was found in some samples from the footwall and the hanging wall layers.

Based on this study it is reasonable to suggest that a differentiated wetland forest with elements such as Taxodiaceae, *Nyssa, Myrica, Ilex, Alnus*, Ericaceae, Osmundaceae, Polypodiaceae, Pteridaceae, *Lycopodium, Selaginella* and *Sphagnum*, covered the study area. The complete lack of water plants suggests an absence of open water. Minor occurrences of only a few reed-facies elements do not necessarily support the existence of a distinct reed facies.

Elements such as Taxodiaceae, *Nyssa, Alnus, Acer, Fraxinus, Carya, Cercidophyllum, Ulmus* and *Zelkova* could represent riparian vegetation.

Herbaceous plant associations along the shores of small ponds are represented by Cyperaceae, Apiaceae, Dipsacaceae, Lythraceae (*Decodon*), Polygonaceae (*Polygonum*) and Valerianaceae.

Well-drained mesophytic broad-leaved forest habitats were situated in areas slightly elevated above ground water level, and contained Aceraceae (*Acer* ssp.), Alangiaceae (*Alangium*), Araliaceae, Betulaceae (*Carpinus*), Buxaceae (*Buxus*), Fagaceae (*Fagus, Lithocarpus, Quercus* ssp., *Trigonobalanopsis*), Ebenaceae (*Diospyros*), Hamamelidaceae (*Distylium, Parrotia*), Juglandaceae (*Carya, Engelhardia, Platycarya, Pterocarya*), Mastixiaceae (*Mastixia*), Oleaceae (*Fraxinus, Olea*), Platanaceae (*Platanus*), Rosaceae (*Prunus*), Rutaceae (*Zanthoxylum*), Sterculiaceae (*Reveesia*), Styracaceae (*Rhederodendron*), Symplocaceae (*Symplocos*), Theaceae, and Ulmaceae (*Ulmus* and *Zelkova*).

Clearings within the forests along riverbanks and lake margins were covered by shrubs such as *Rubus* (Rosaceae), *Actinidia* (Actinidiaceae), *Weigela* (Caprifoliaceae) and lianas such as *Apios* (Leguminose), *Parthenocissus, Vitis* (Vitaceae) or *Clerodendrum* (Verbenaceae).

Because of the rare fossil pollen record of Gymnosperms such as *Abies, Picea* and some *Pinus-Diploxylon* species, these were probably restricted to a few sites only within the Köflach-Voitsberg embayment. However, in the case of one *Pinus* species (a haploxylon type), which occurs frequently in pollen clumps, it is thought that this species was a member of a wetland forest community, presumably inhabiting sandy soils.

Well-drained and sun-exposed fluvial sand banks and gravel bars are inferred to have been overgrown by herbaceous plants such as Chenopodiaceae, *Eleagnus* (Eleagnaceae) and *Ephedra* (Ephedraceae).

Table 1.

| **Pollen/Spores** | | | |
|---|---|---|---|
| | | | |
| FAMILY | Genus | Taxa | Frequency |
| | | | |
| **Bryophytes** | | | |
| Sphagnaceae | *Sphagnum* | | x |
| | | | |
| **Fern and fern-allies** | | | |
| Polypodiaceae | gen. indet. | 4 | xxx |
| Selaginellaceae | *Selaginella* | 2 | x |
| Lycopodiaceae | *Lycopodium* | | x |
| Osmundaceae | *Osmunda* | 2 | xxxx |
| | | | |
| **Gymnosperms** | | | |
| Cupressaceae | gen. indet. | | xx |
| Ephedraceae | *Ephedra* | | x |
| Pinaceae | *Abies* | | x |
| Pinaceae | *Cathaya* | | xx |
| Pinaceae | *Picea* | | x |
| Pinaceae | *Pinus* | | xx |
| Sciadopitaceae | *Sciadopitys* | | x |
| Taxociaceae | gen. indet. | | xxxx |
| | | | |
| **Angiosperms** | | | |
| **Dicotyledons** | | | |
| | | | |
| Aceraceae | *Acer* | 2 | xx |
| Actinidiaceae | *Actinidia* | | x |
| Alangiaceae | *Alangium* | | x |
| Apiaceae | gen. indet. | 2 | xx |
| Aquifoliaceae | *Ilex* | 2 | xx |
| Araliaceae | gen. indet. | | x |
| Betulaceae | *Alnus* | | xxx |
| Betulaceae | *Betula* | | xx |
| Betulaceae | *Carpinus* | | xx |
| Buxaceae | *Buxus* | | x |
| Caprifoliaceae | *Lonicera* | | x |
| Caprifoliaceae | *Weigela* | | x |
| Caryophyllaceae | gen. indet. | | x |
| Cercidiphyllaceae | *Cercidiphyllum* | | xx |
| Chenopodiaceae | *Chenopodium* | | xx |
| Compositae | *Cirsium* | | x |
| Compositae | gen. indet. | | x |
| Cornaceae | *Cornus* | | x |
| Dipsacaceae | gen. indet. | | x |
| Ebenaceae | *Diospyros* | | x |
| Elaeagnaceae | *Elaeagnus* | | x |
| Ericaceae | *Rhododendron* | | x |
| Ericaceae | gen. indet. | 2 | xx |
| Euphorbiaceae | gen. indet | | x |
| Fagaceae | *Fagus* | | x |
| Fagaceae | *Lithocarpus* | | xx |
| Fagaceae | *Quercus* | | xxx |
| Fagaceae | *Trigonobalanopsis* | | xxx |
| Hamamelidaceae | *Distylium* | | x |
| Hamamelidaceae | *Liquidambar* | | x |
| Hamamelidaceae | *Parrotia* | | x |
| Hamamelidaceae | gen. indet. | | x |
| Juglandaceae | *Carya* | | xxxx |
| Juglandaceae | *Pterocarya* | | xxx |
| Juglandaceae | *Engelhardia* | 2 | xxx |
| Juglandaceae | *Platycarya* | | xx |
| Leguminosae | *Apios* | | x |
| Leguminosae | *"Podocarpium"* | | x |
| Loranthaceae | *Arceuthobium* | | x |
| Loranthaceae | *Loranthus* | | x |
| Lythraceae | *Decodon* | | x |
| Mastixiaceae | *Mastixia* | | xx |
| Mastixiaceae | gen. indet. | | x |
| Myricaceae | *Myrica* | | xx |
| Nyssaceae | *Nyssa* | | xx |
| Oleaceae | *Fraxinus* | | xx |
| Oleaceae | gen. indet. | | xx |
| Onagraceae | *Ludwigia* | | x |
| Plantaginaceae | *Plantago* | | x |
| Platanaceae | *Platanus* | | xx |
| Polygonaceae | *Polygonum* | | xx |
| Rhamnaceae | gen. indet. | | x |
| Rosaceae | *Prunus* | | xx |
| Rosaceae | *Rubus* | | xx |
| Rosaceae | gen. indet. | 2 | xxx |
| Rutaceae | *Zanthoxylum* | | x |
| Salicaceae | *Salix* | | xx |
| Sapotaceae | gen. indet. | 4 | xx |
| Sterculiaceae | *Reveesia* | 2 | xx |
| Sterculiaceae | gen. indet. | | x |
| Styracaceae | *Rehderodendron* | | x |
| Styracaceae | gen. indet. | | xx |
| Symplocaceae | *Symplocos* | 3 | xx |
| Theaceae | gen. indet. | | x |
| Theligonaceae | *Theligonum* | | xx |
| Tiliaceae | *Tilia* | | xx |
| Tiliaceae | gen. indet. | | x |
| Ulmaceae | *Ulmus* | | xx |
| Ulmaceae | *Zelkova* | | xx |
| Valerianaceae | *Valeriana* | | x |
| Verbenaceae | *Clerodendrum* | | x |
| Vitaceae | *Parthenocissus* | | xx |
| Vitaceae | *Vitis* | | xx |
| Vitaceae | gen. indet. | | xx |
| | | | |
| **Angiosperms** | | | |
| **Monocotyledons** | | | |
| | | | |
| Arecaceae | gen. indet. | | x |
| Cyperaceae | gen. indet. | | x |
| Poaceae | gen. indet. | | x |

# Plate 1

***Parrotia* sp.**

Fig. 1: Polar view.
850× LM.

Fig. 2: Polar view.
1250× SEM.

Fig. 3: Detail of the exine surface.
10000× SEM.

***Hamamelidaceae* gen. et spec. indet.**

Fig. 4: Polar view.
850× LM.

Fig. 5: Polar view.
1500× SEM.

Fig. 6: Detail of the exine surface.
10000× SEM.

***Podocarpium* sp. (*Podogonium* sp.)**

Fig. 7: Polar view.
850× LM.

Fig. 8: Polar view.
1200× SEM.

Fig. 9: Detail of the exine surface.
11000× SEM.

***Apios* sp.**

Fig. 10: Polar view.
850× LM.

Fig. 11: Equatorial view.
850× LM.

Fig. 12: Polar view.
1200× SEM.

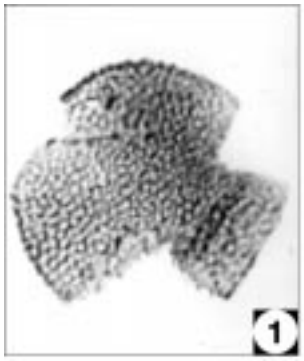
Fig. 13: Detail of the exine surface.
12000× SEM.

***Rubus* sp.**

Fig. 14: Equatorial view.
850× LM.

Fig. 15: Equatorial view.
2000× SEM.

Fig. 16: Detail of the exine surface.
10000× SEM.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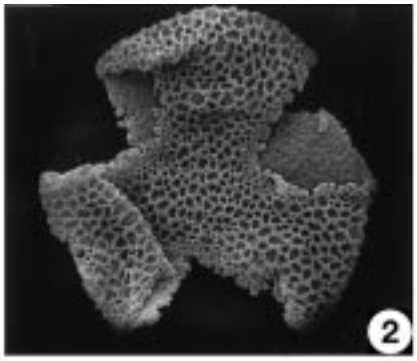
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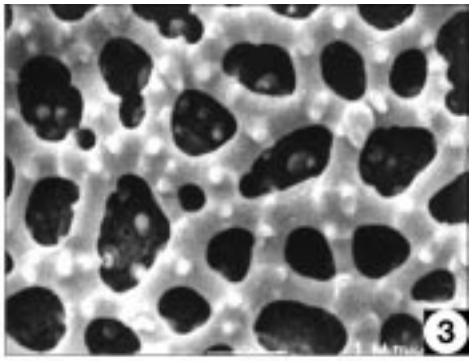
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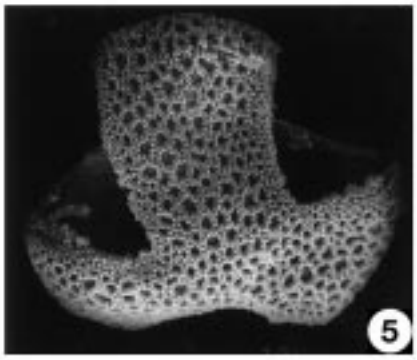
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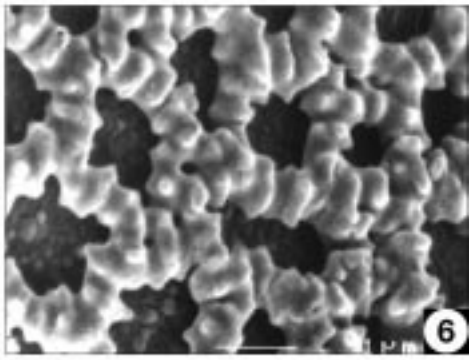
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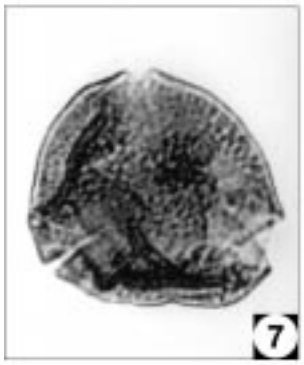
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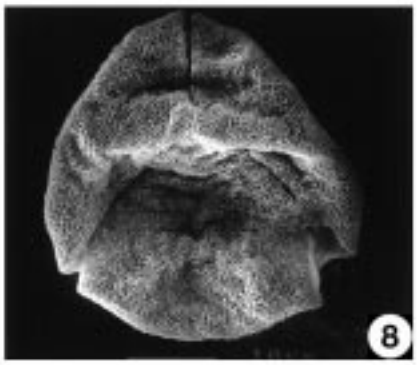
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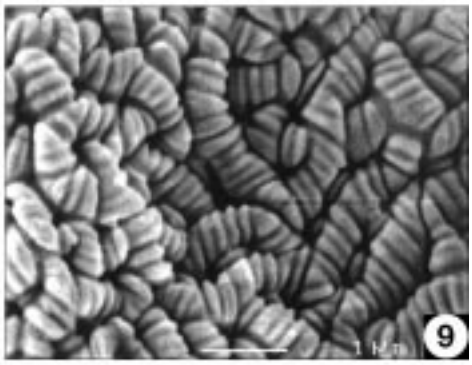
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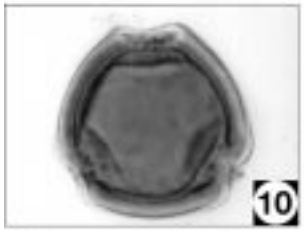
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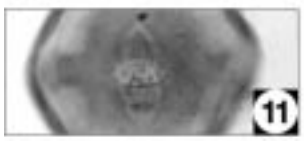
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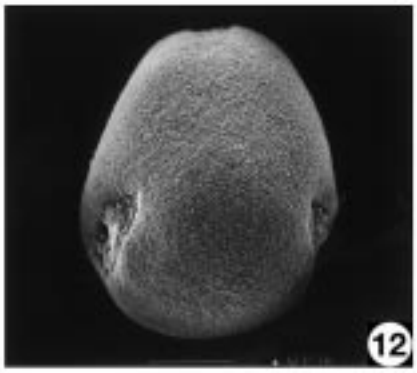
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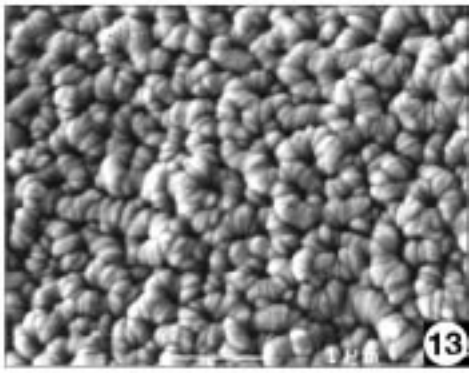
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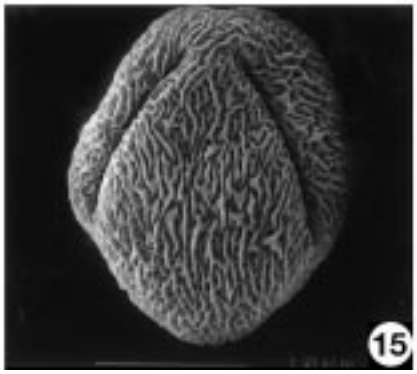
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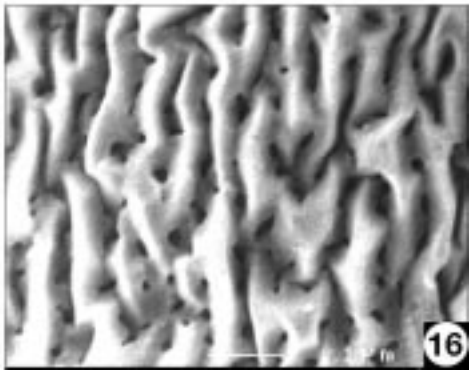
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# Plate 2

***Prunus* sp.**

Fig. 1: Polar view.
850× LM.
Fig. 2: Polar view.
2000× SEM.
Fig. 3: Detail of the exine surface.
10000× SEM.

***Plantago* sp.**

Fig. 4: Equatorial view.
850× LM.
Fig. 5: Equatorial view.
2500× SEM.
Fig. 6: Detail of the exine surface.
10000× SEM.

**Apiaceae gen. indet.**

Fig. 7: Equatorial view.
850× LM.
Fig. 8: Equatorial view.
3500× SEM.
Fig. 9: Detail of the exine surface.
10000× SEM.

**Caryophyllaceae gen. indet.**

Fig. 10: Equatorial view.
850× LM.
Fig. 11: Equatorial view.
2100× SEM.
Fig. 12: Detail of the exine surface.
14000× SEM.

**Valerianaceae gen. indet.**

Fig. 13: Polar view.
700× LM.
Fig. 14: Polar view.
700× SEM.
Fig. 15: Detail of the exine surface.
10000× SEM.


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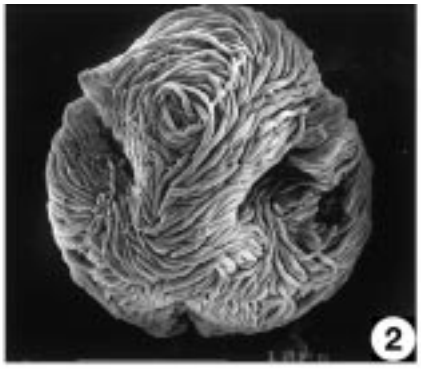
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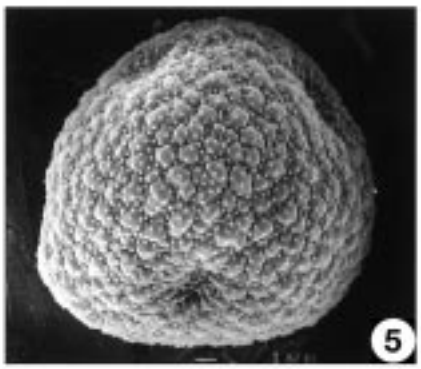
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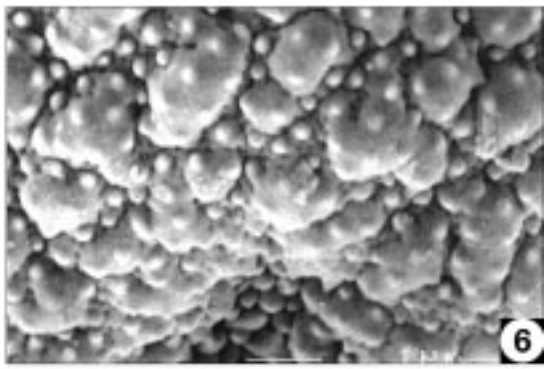
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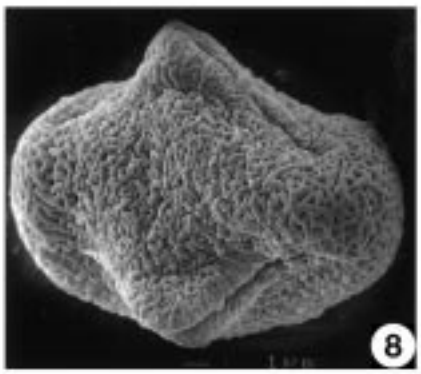
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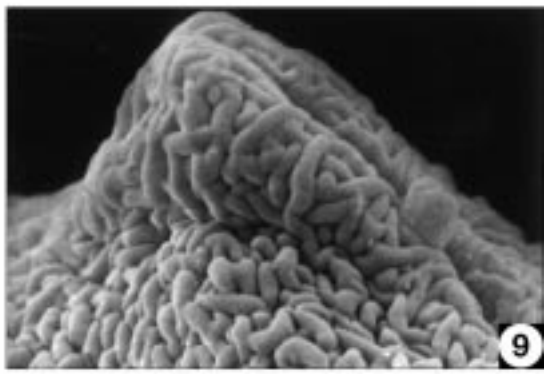
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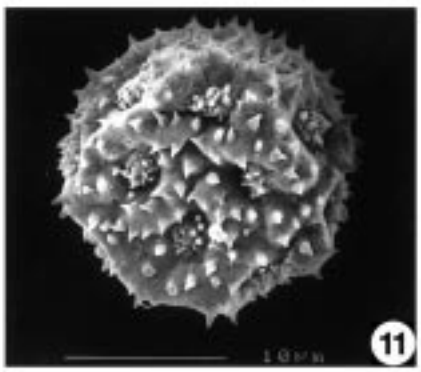
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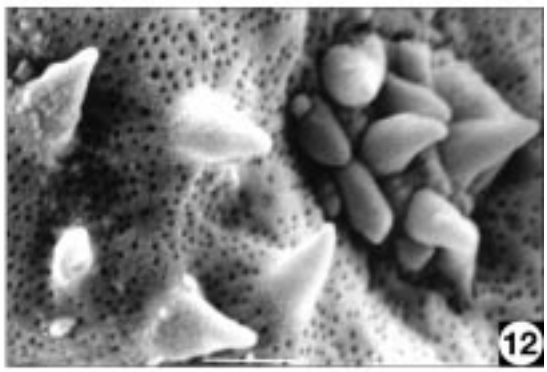
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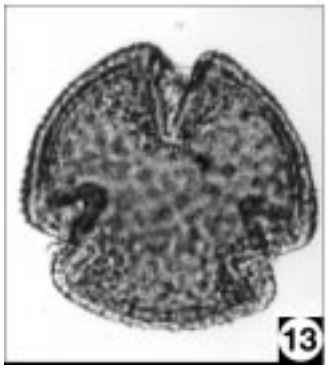
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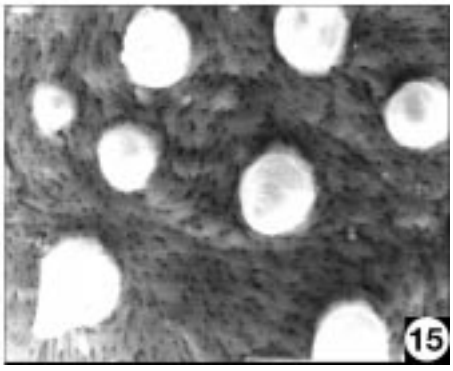
15

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