

Scanning electron micrographs of pollen from two *Tilia* species

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Stockmarr, Jens: Scanning electron micrographs of pollen from two *Tilia* species. *Danm. geol. Unders., Årbog 1973*, pp. 107–109, pls. 11–14. København, 7. oktober 1974.

Pollen grains from *Tilia platyphyllos* Scop. and *Tilia cordata* Mill. have been studied in a scanning electron microscope for further description of the structure and sculpture of the exine.

The structure and sculpture of *Tilia* pollen grains have in recent years been treated by Chambers and Godwin (1961, 1971), Pragłowski (1962) and Andrew (1971) and the main problems are now solved. In particular the scanning electron micrographs published by Chambers and Godwin in 1971 give a good impression of the so-called bacula-centric reticulation with more or less hollow bacula that forms funnels towards the surface of the grain. The funnels have minute lateral channels which connect the void in the exine with the surface of the funnel.

Both *Tilia cordata* Mill. and *Tilia platyphyllos* Scop. have been studied in a JEOL scanning electron microscope model S 1 at the Geological Survey of Denmark.

The *Tilia cordata* pollen is from tree No. 1504 in section 386 of Draved forest, Southern Jutland, and the *Tilia platyphyllos* pollen is from tree No. 1 on the island in Brændegård lake, Funen. Both collections seem to be representative for the species. The pollen has been treated by acetolysis, coated with coal and gold, and photographed with an accelerating voltage of 10 kV. The magnifications were x 2,000, x 10,000 and x 30,000, while in the plates the magnifications are x 1,500, x 7,500 and x 22,500.

Some pollen grains are heteropolar with rougher sculpture on the distal pole than on the proximal pole (i.e. the pole nearest to the center in the tetrad). The furrows or the pores may also be dislocated a little towards the proximal pole. This heteropolarity is seen in most *Tilia* (plate 11, No. 6, plate 12, No. 6 and plate 14, Nos. 2 and 5) and *Ulmus* pollen grains (Stockmarr, in

press), and may also occur in other species. Another feature, in *Tilia* pollen, which is not often seen under the light microscope is that the proximal pole is often divided by three smooth ridges, which match the space between the three other grains in the tetrad. When the pollen grains collapse it is often the proximal pole that falls in, due to the weakness in this end of the pollen grain.

The polar and equatorial views of *Tilia platyphyllos* and *Tilia cordata* are seen in plates 11 and 12. It is seen that funnels with lateral openings are found in both species, but that the funnels are more irregular in *Tilia platyphyllos* than in *Tilia cordata*. On the distal pole, funnels without visible lateral openings are most common in *Tilia cordata*. The funnels on the proximal pole are almost exclusively of the simple type without visible lateral openings in *Tilia cordata*, while in *Tilia platyphyllos* this sculptural type is only found on the proximal pole in a minor part of the grains, as also pointed out by Miss Andrew (l.c.). Unfortunately the micrographs from the proximal pole are not the best ones.

In the light microscope it can be seen that there is a relationship between the sculpture on the two poles, so that grains with a relatively rough distal pole have a relatively rough proximal pole, too, and a similar relationship is found in grains with fine sculpture. It should therefore be sufficient to compare either distal or proximal poles for separating the two species.

In plates 13 and 14 some fractures are shown. Plate 13, Nos. 1 and 3 are from the intercolpium near the furrow and so is No. 5 on the same plate, but from another grain. As *Tilia platyphyllos* has the roughest sculpture, this species has been preferred for the structural studies.

In plate 13, No. 3 are shown two bacula, which in the upper part divide into several branches that together form a funnel, not with lateral channels, but with space between the branches of the bacula. The spaces thus act as channels between the funnel surface and the void. The top of some of these branches are united with the branches of the neighbouring bacula, forming a tectum in a reticuloid pattern which could be called an interreticulum. No. 4 in the same plate shows the same feature but from the distal pole and here is seen a short and thick single bacula, the branches of which occupy the main part. No. 5 shows a cut through a bacula with the central channel reaching the foot-layer. This can also be seen in the transmission electron micrographs, and the model, of Chambers and Godwin (1961).

The structural elements may be described as a group of unequally sized columns which are partly fused into a tube-like form in the lower part and a funnel-like form in the upper. No principal difference in structure between *Tilia platyphyllos* and *Tilia cordata* occurs, only a difference in size of the bacula, which may derive from the number of columns that are fused. Some bacula have a long tube and almost no funnel due to a total fusion of the columns.

Acknowledgements. The photographic developing and printing has been carried out by the photographers at the Geological Survey, O. Neergaard Rasmussen and Irma Christiansen.

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