Pollen morphology by the view of electron microscopy

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Pollen grains and spores of the higher plants belong to the gametophyte stage of the life cycle. They are small (most often 10-100 m in size) and simple, usually consisting of one-three cells. However, their wall (sporoderm) is very complex and composed of the most chemically inert biological polymer sporopollenin. Studies of spores and pollen grains are impossible without optical instruments. Since the advent of electron microscopes, they have been widely used in palynology FIG.1, 2, 3, 4.

Nowadays, morphological studies of pollen grains and spores of different groups of the higher plants necessarily include an integrated usage of various light microscopes (LM) and scanning (SEM) and transmission electron microscopes (TEM): for example, mosses [1] and FIG.5., pteridophytes [2] and FIG.6, and monocotyledon angiosperms [3].

A special method was developed to analyze the morphology of a single fossil pollen or spore. A pollen or spore is observed first in transmitted light, then with help of a scanning electron microscope, and finally in ultrathin sections in a transmission electron microscope. The method allows one to obtain the maximal information for biological interpretation from a single specimen and is particularly suitable for pollen grains and spores from dispersed palynological assemblages [4].

Transmission electron microscopy has made it possible to study the sporoderm development of pollen grains (spores) from the meiosis of the pollen mother cell to the pollen dispersion (e.g., [5] and FIG.8, 9). On the basis of such studies, Gabaraeva et al. [6] generated the concept of exine self-assembly from colloidal solutions of sporopollenin precursors.

Finally, molecular mechanisms of the development of the pollen grain (male gametophyte) and its wall appeared to become understood, as well as biosynthesis of sporopollenin and its precursors [7].

The range of working magnifications and the resolution of the electron microscopes correspond so well to the ultrastructure of spores, pollen grains and their sporoderms that electron microscopy has became a routine method in the morphology of pollen and spores.

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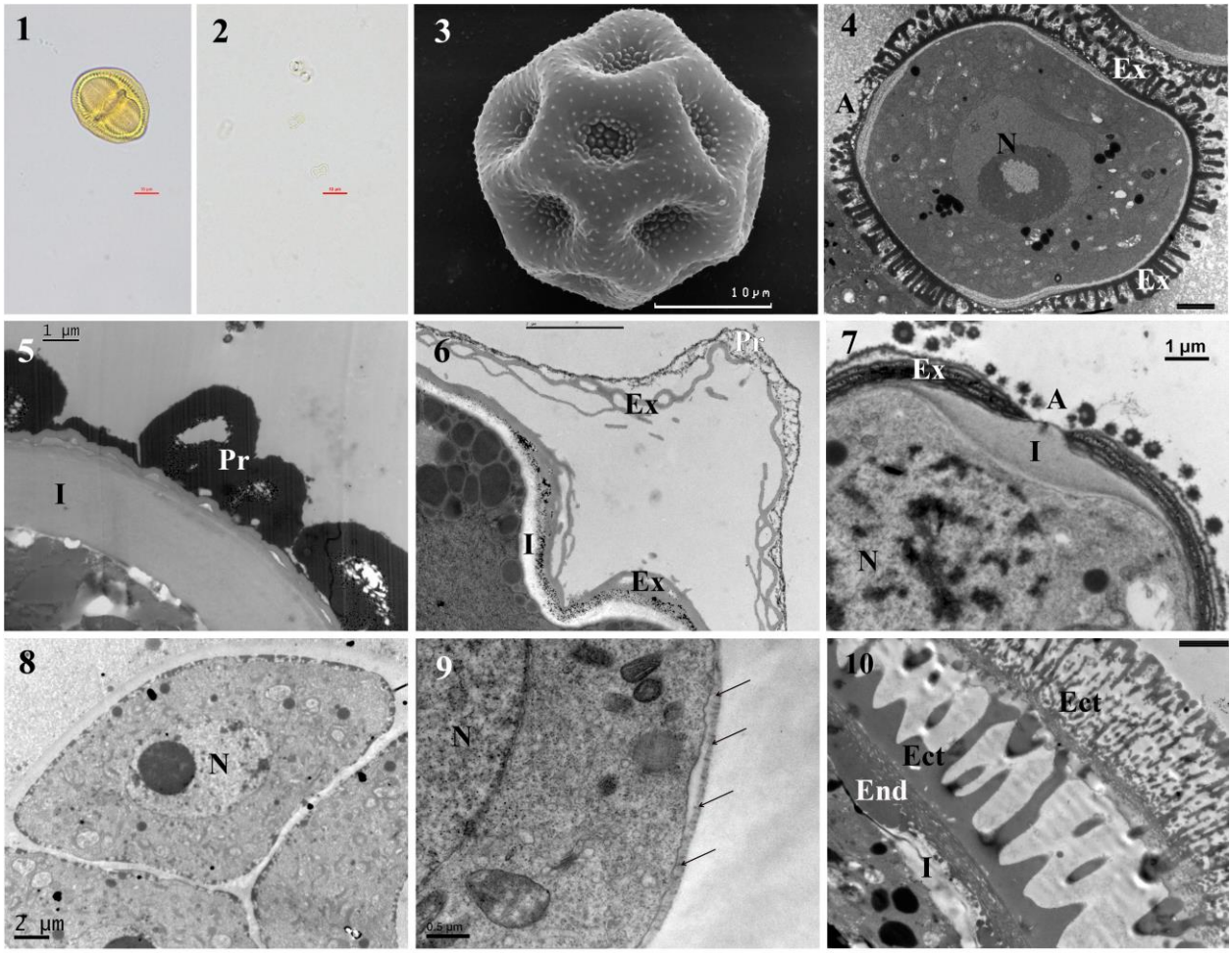

Fig.1.Cyanus segetum Hill, LM, acetolized pollen grain, scale bar 10 µm.

Fig.2.Myosotis scorpioides L. , LM, acetolized pollen grains, scale bar 10 µm.

Fig.3.Alisma plantago-aquatica L., SEM, intact pollen, scale bar 10 µm.

Fig.4.Alliaria petiolata (M.Bieb.) Cavara & Grande, TEM, pollen grain, A-aperture, Ex-exine, N-nucleus, scale bar 2 µm.

Fig.5.Encalypta longicollis Bruch, TEM, part of spore, I-intine, Pr-perispore, scale bar 1 µm.

Fig.6.Isoetes echinospora Durieu, TEM, part of spore, Ex-exine, I-intine, Pr-perispore, scale bar 2 µm.

Fig.7.Juniperus communis L., TEM, aperture part of pollen, I-intine, Ex-exine, scale bar 1 µm.

Fig.8.Aristolochia manshuriensis Kom., TEM, microspore in tetrade, N-nucleus, scale bar 2 µm.

Fig.9.Symphytum officinale L., TEM, primexine (black arrows), N-nucleus, scale bar 0.5 µm.

Fig.10.Echinops exaltatus Schrad., TEM, part of pollen, I-intine, Ect-ectexine, End-endexine, scale bar 2 µm.