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ABSTRACTS

论文摘要集

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Ginkgoalean female reproductive structures and leaves from the Middle Jurassic of Angren (Uzbekistan)

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The studied material comes from the Middle Jurassic Angren Formation in the Angren coal-mine situated near Tashkent (Uzbekistan). The first record of ginkgoalean female reproductive structures in Angren was described as *Ginkgo gomolitzkyana* (Nosova, 2012). The fossil remains are represented by numerous detached seeds and some ovules with minor pedicel fragments. They were found in association with leaves of *Ginkgo gromykoi* Nosova (Nosova, 1998). One more finding of a ginkgoalean female reproductive structure from the Angren Formation was described as *Nagrenia samylinae* Nosova (Nosova, 2013). Originally, Samylina (1990) regarded these structures as terminal cupules of a seed fern. Later they were reinterpreted as elements of generative axes consisting of peduncles, pedicels, and collars, similar to female fructifications of modern and fossil members of *Ginkgo* L. (Nosova, Gordenko, 2012; Nosova, 2013).

Seeds of four types have been discovered in the Angren Formation. Three types of seeds are placed within *Allicospermum* Harris: *Allicospermum angrenicum* Nosova (2013), *A. budantsevii* Gordenko (2015) and *Allicospermum* sp. (in preparation); and one type was described as *Ginkgo gomolitzkyana*. Seeds of these species differ in sizes as well as in the structure of the outer integument epidermis and the megaspore membrane (Nosova, 2012, 2013; Gordenko, 2015).

Seeds of *A. angrenicum* and *A. budantsevii* were found in association with *N. samylinae* and leaves of *Sphenobaiera angrenica* (Samylina) Nosova. At first, both species of *Allicospermum* were considered ginkgoalean (Nosova, 2013). Maceration revealed three acid-resistant membranes comparable with those of *Ginkgo biloba* L.: a thick outer cuticle of the integument, the cuticle of the nucellus, and the megaspore membrane. The nucellus is free from the integument in the upper half or upper one-third. Numerous resin bodies were discovered. Unlike seeds of *A. budantsevii, G. gomolitzkyana* and *G. biloba*, stomata on the outer cuticle of the integument of *A. angrenicum* are not clearly visible and appear abortive with undeveloped guard cells. The patterned layer of the megaspore membrane in *A. budantsevii, G. gomolitzkyana, Allicospermum* sp. and *G. biloba* is composed of oblique or horizontal bacula, in contrast to *A. angrenicum*, with its vertical and more closely arranged bacula. In *A. budantsevii* and *A. angrenicum,* the thickness of the outer cuticle is the same as in the leaves of *S. angrenica* and reproductive structures of *N. samylinae*. Unlike *A. angrenicum,* the stomatal structure of *A. budantsevii* is similar to that of *N. samylinae*. Epidermal features of the seeds of *A. budantsevii* and *A. angrenicum* are comparable to those in *N. samylinae*, and it cannot be decided, therefore, seeds of which of these two species were borne on the collars of *N. samylinae*.

A nucellar beak and pollen chamber of some seeds of *A. budantsevii* and *A. angrenicum* contained monosulcate pollen grains. They show identical general

morphology, which does not contradict their ginkgoalean interpretation. The exine ultrastructure of the pollen grains from *A. budantsevii* does not contradict the ginkgoalean interpretation too, as far as we can judge by comparison with *G. biloba,* the only member of ginkgoaleans so far studied in terms of the exine ultrastructure (Zavialova et al., 2014). However, the exine ultrastructure of the pollen grains from *A. angrenicum* differs from that of the pollen grains found in the seed of *A. budantsevii* as well as from that of *G. biloba*. The ultrastructure of pollen grains extracted from *A. angrenicum* shows much in common with that of pollen grains extracted from pollen cones of *Hastystrobus muirii* van Konijnenburg-van Cittert, originally described as a cycad and later reinterpreted as a supposed gnetophyte (Tekleva and Krassilov, 2009). However, unlike the pollen grains under present study, pollen grains of *H. muirii* bear three sulci. The pollen grains from *A. angrenicum* are also very similar by their exine ultrastructure to cycad pollen, e.g., pollen from cones of *Androstrobus manis* Harris. In addition, pollen grains of both pools are of monosulcate *Cycadopites*-type.

The *Allicospermum* type of seed structure excludes such gymnosperm groups as the Bennettitales and Caytoniales which form seeds with a thickly cutinized nucellus, and lacking a thick megaspore membrane (Reymanowna, 1968). Seeds of *Erdtmanispermum* (Erdtmanithecales) have a distinct megaspore membrane, several envelopes surrounding the nucellus, and a long, narrow micropylar tube. They differ from *Allicospermum* in their wall structure, much smaller sizes and in having three longitudinal sutures in the sclerified layer; only tricolpate pollen of *Eucommiidites* type have been found in such seeds (Pedersen et al., 1989).

The structure of seeds of the Jurassic cones *Beania* Carruthers (Cycadophyta, Nilssoniales) in its general features agrees with that of other fairly large seeds of gymnosperms: *Ginkgo*, certain conifers and certain pteridosperms (Harris, 1964). Isolated *Beania* seeds have no general distinguishing character which would separate them from seeds of *Ginkgo* and *Allicospermum.* So some seeds of *Allicospermum* can have cycad affinity. Of interest is that *Androstrobus manis* and *Beania gracilis* Carruthers are believed to be remnants of the same parent cycad plant. Unlike *A. angrenicum*, the outer cuticle of the integument of *Beania* seeds is about 10 times thicker, and the megaspore membrane is 2-3 times thicker, fragile and quickly destroyed by over-maceration.

The Angren locality is rich in fossil plants, which are dominated by diverse gymnosperms, such as cycads, bennettites, czekanowskialeans, ginkgoaleans, and conifers, and contamination by alien pollen grains is conceivable, even by pollen grains of the same morphological type, but produced by a different plant group. For instance, a seed of *Allicospermum* sp. contained definitely alien bisaccate pollen.

To conclude, based on the structure of the pollen grains from the nucellar beak and pollen chamber of the seeds of *Allicospermum angrenicum,* we have no confidence in ginkgoalean affinity of these seeds. On the other hand, we could not place them in Cycadophyta, since their morphology and epidermal structure agrees with that both of *Ginkgo* and cycads.

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Keywords: *Allicospermum*, reproductive structures, pollen ultrastructure, Jurassic.

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