5. BIOPOLYMER STRUCTURE OF THE PARTIALLY DEGRADED CUTICLES OF CYCAS RUMPHII MIQ.: A PRELIMINARY REPORT

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During our previous research programs we carried out symmetry operations on the biopolymer structure of partially degraded pollen grains and the wall of *Botryococcus braunii* KÜTZ isolated from Hungarian oil shale. Under a new joint research program investigations are in progress on the pollen grains and leaf cuticles of *Cycas rumphii* MIQ. collected from the garden of the Birbal Sahni Institute of Palaeobotany. After partial degradation of these materials with different methods, investigations were made by LM, SEM and TEM. Results of these studies on pollen grains are presented in this number (TRIPATHI, MADHAV KUMAR, KEDVES and VARGA, 2003).

Sequel to partial degradation of cuticles the biopolymer structure was also discovered. Transmission Electron Microscopic studies revealed several kinds of biopolymer organization. In this preliminary report a new and unexpected result, the presence of the quasi-crystalloid biopolymer network in the leaf cuticle of *Cycas rumphii* (Experiment: T-12-162. - 2 mg mature leaf + 2 ml 2-aminoethanol, duration: 48 hours, washing, + 10 ml $KMnO_4$ 1% for 24 hours, at 30 °C temperature) has been communicated. A negative regular pentagon was observed for the first time (Plate 5.1., figs 1,2). We used the five-fold, and the tenfold rotation (Plate 5.2., figs. 1-3). This method verified the presence of quasi- crystalloid skeleton in the leaf cuticles. Concerning the fivefold rotation we have given the rotation picture also which was not made from the centre of the fivefold biopolymer unit. This is the second time when we have presented such a picture but these deficient rotation pictures provide interesting informations about the organization of biopolymer system.

Negative quasi-crystalloid biopolymer network was first observed in the partially degraded exospore of *Equisetum arvense* L. (KEDVES and PÁRDUTZ, 1993). Later, KEDVES, PÁRDUTZ, TÈRBE and HORVÁTH (2001) made rotation in negative regular pentagon unit observed in partially degraded ectexine of *Encephalartos ferox* BERTOL.

In this preliminary report we would like to point out the following:

1. The history of the chemistry of the resistant biopolymer of the pollen wall started with the paper of JOHN (1814). This was followed by several publications among which reports by ZETZSCHE and his coworkers are important (ZETZSCHE and VICARI, 1931, ZETZSCHE et al., 1931). ZETZSCHE and HUGGLER (1928) for the first time established the polyterpene structure for the sporin. In a comprehensive paper TOMSOVIC (1960) pointed out that the sporopollenin is a highly polymerized terpene derivative similar to cutin. The British School (BROOKS and SHAW, 1968,1972) suggested that sporopollenin

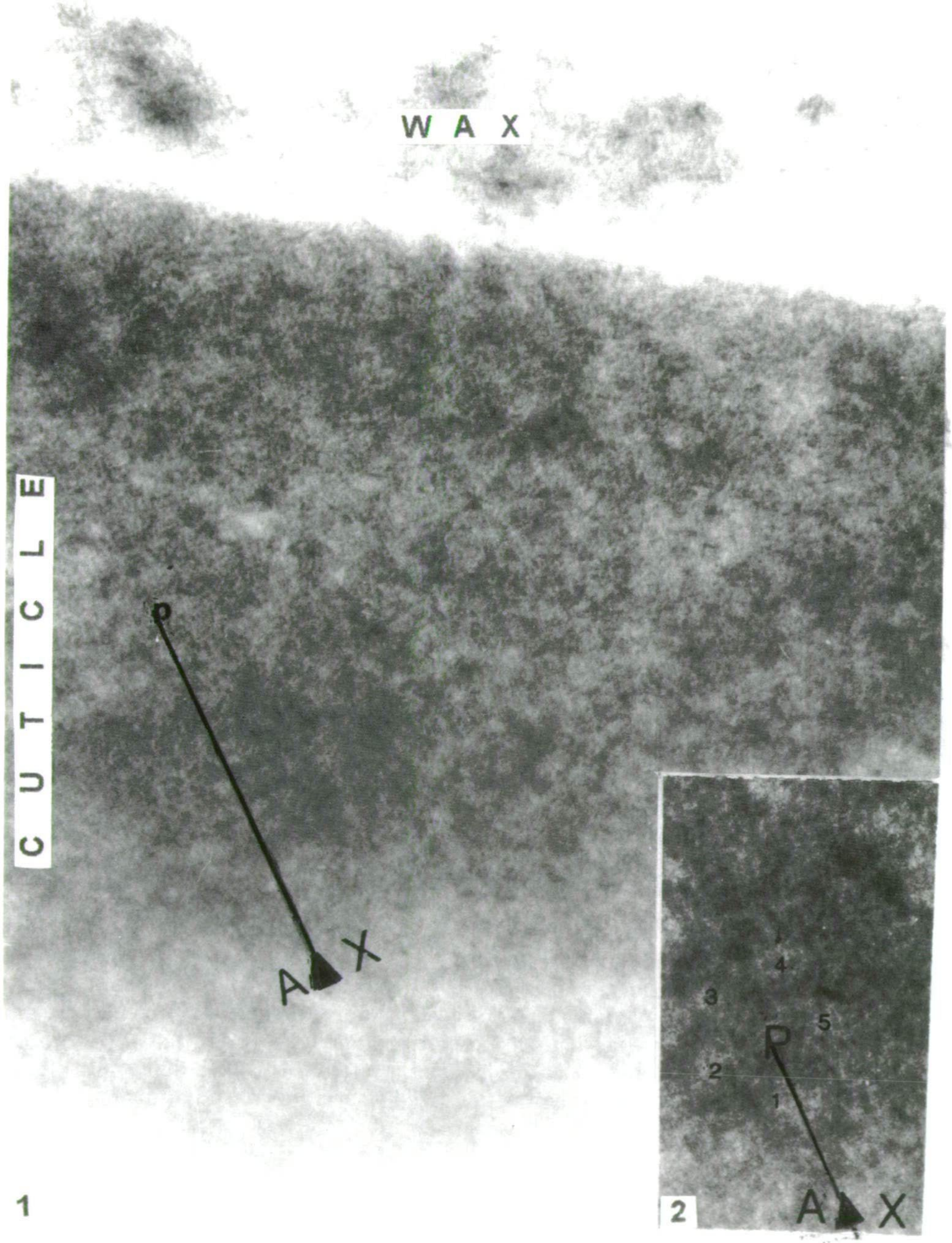
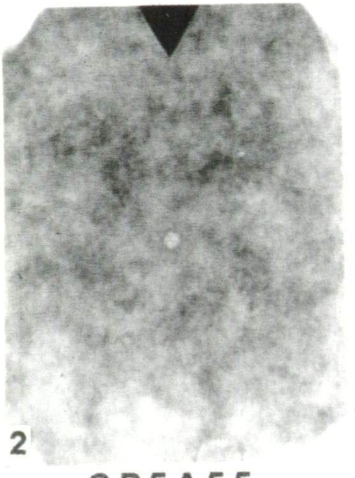


Plate 5.1.

C.P.5.A.5.5.



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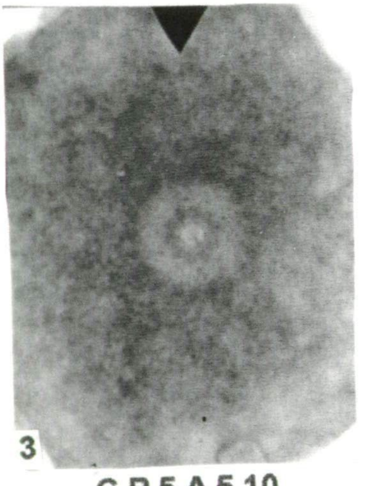

C.P.5.A.5.10.

Plate 5.2.

Plate 5.1.

Cycas rumphii MIQ. Ultrastructure of partially degraded cuticle. 1. General survey picture of the wax and the cuticle, 200.000x. 2. Negative regular pentagon of the partially degraded cuticle 500.000x.

Plate 5.2.

Primary rotations pictures of the negative regular pentagon. 250.000x.

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is a biopolymer of βcarotene and its oxidized esters. With the help of extensive investigations the sporopollenin was found to occur in the pollen walls of higher plants, some algae and fungi, in the walls of fossil *Tasmanites* and Carboniferous megaspores. Further studies later verified the complexity in biopolymer structure of the plant cell walls.

2. After the period, which may be marked as the time of general characterization and occurrence of the sporopollenin, based on the new data several categories were identified for the substances which constituted the plant cell walls. The term algaenan was used by LARGEAU et al. (1986), KADOURI et al. (1988), TEGELAAR et al. (1989), DE LEEUW, VAN BERGEN et al. (1991) for some algal walls, botryococcene for the highly unsaturated isoprenoid hydrocarbons (DUBREUIL, DERENNE, LARGEAU et al., 1989) and botryococcane for the fossil biopolymer (DERENNE, LARGEAU, CASADEVALL and CONNAN, 1988a,b, DUBREUIL, DERENNE, LARGEAU et al., 1989, BRENNER, 1998).

3. Several papers concerning chemistry of leaf cuticle have been published. KOLATTUKUDY and ESPELIE (1985), MARTIN and JUNIPER (1970), RIEDERER (1991) VAN BERGEN, SCOTT, BARRIE, DE LEEUW and COLLINSON (1994) opined that they are composed of a vax fraction, soluble in organic solvents and an insoluble matrix. This matrix consists either of the biopolyester cutin or of an insoluble, non-hydrolyzable biomacromolecule, recently named as cutan (TEGELAAR et al., 1989) or most commonly, a mixture of both.

The composition of biopolymer systems of plant cell walls are thus different. Several types were identified within the so-called sporopollenin and also in the biopolymers. The basic structure of the biopolymer is composed by the highly organized molecules of different levels. Biopolymer units of angstrom and nanometer dimensions have already been established (KEDVES 1989). It appears that inspite of differences in the chemical nature of plant cell walls there exist analogies or similarities at the organization level.

The quasi-crystalloid system is well established in the ectexines of different taxa of gymnosperms and angiosperms, in the botryococcane and now we have demonstrated it in the cutin for the first time, by in vitro method.

This work was supported by Grant OTKA T 31715. S.K.M. TRIPATHI wishes to thank the authorities of Indian National Science Academy, New Delhi and the Hungarian Academy of Sciences, Budapest for cooperation because these works were finalised during his visit to Szeged under the Exchange of Scientists Programme. He is also thankful to Prof. A.K. SINHA, Director, Birbal Sahni Institute of Palaeobotany for his kind cooperation and encouragement throughout the collaborative researches between BSIP and CBEM Lab, Szeged, Hungary.

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