3. BIOPOLYMER ORGANIZATION OF THE PARTIALLY DEGRADED OIL SHALE WITH THE FRAGMENTATION METHOD

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The plant microfossils of the oil shale were first investigated by WODEHOUSE (1933) from the Eocene of Green River (Colorado, USA). A great number of papers were published later dealing with the occurrence and importance of the *Botryococcus* alga, the major component of the oil shale (e.g.: RAO and MISRA, 1943, TRAVERSE 1955, MAZANCOVÁ, 1960, SAH and KAR, 1970, MARTIN, 1973, MILDENHALL, 1977). TEM data of the fossil *Botryococcus braunii* KÜTZ. from the Upper Tertiary oil shale of Pula (Hungary) were published by KEDVES (1983). BERKALOFF et al. (1983) established that the resistant polymers of the outer wall of *Botryococcus braunii* do not derive from carotenoids. In this way it cannot be considered as sporopollenin (cf. KADOURI et al., 1988). LARGEAU et al. (1986) investigated the immature Torbatine by pyrolysis and the resistant biopolymer (PRB A) was isolated from extant alga (*B. braunii*). KEDVES (1986a) investigated with the LM and TEM the partially degraded colonies of *B. braunii* with the *Helix* enzyme method and with merkapto-ethanol. Globular units arranged into filaments were observed. Another paper (KEDVES, 1986b) summarizes the results of combined investigations of the oil shale of Pula. Using the thin-layer chromatography, pigment remnants were demonstrated.

The first comprehensive model of the biopolymer organization of the sporoderm attempted to synthetize the different molecular levels (KEDVES, 1989). On the basis of the configuration of the basic quasi-crystalloid biopolymer structures the sub-units were modelled in nanometer dimension. Some of these biopolymer structures are represented on the Fig. 1, p. 63. It were not certified at the time of the compilation of this scheme.

Another research program started with the aim to elaborate new methods to get direct information about the biopolymer structures in different levels. The first results of the Recent pollen grains of *Alnus glutinosa* (L.) GAERTN. were remarkable in this point of view (KEDVES and ROJIK, 1989). On the TEM picture of P. 75 the basic biopolymer units, are well shown, arranged in spherical ones. These globular units form a network. In this way three kinds of biopolymer organization levels are represented in one TEM picture. We need to emphasize, that not only the advantages, but also the disadvantages were pointed out in the above mentioned paper. On the basis of the first positive results this method were or will used to

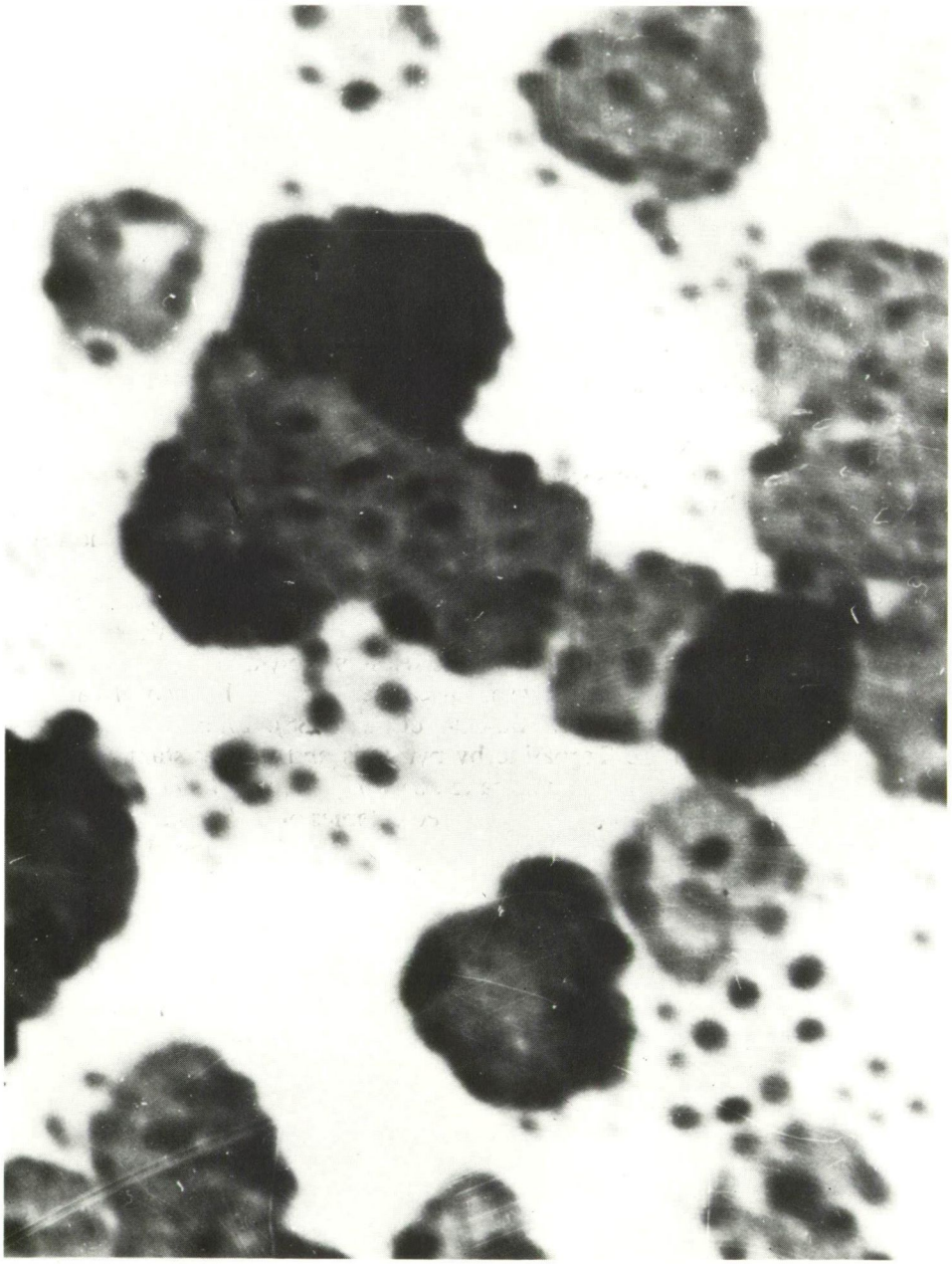

Plate 3.1.

TEM picture of the highly organized globular biopolymer units from the wall of *Botryococcus braunii* KÜTZ. The electron dense smaller globular units are well shown in larger ones. Experiment No 925 (10 mg. air dried material + 1 ml merkapto—ethanol, temperature 30 °C, length of time 48^{hrs}). Negative No 599. Magnification 3000.000 x.

further recent and fossil biological objects. It is clear that the investigation of the biopolymer system of the fossil material is much more complicated than those of the recent ones. That's why in the present day state of our research program of our investigations are mostly focussed to the Recent taxa. But taking into consideration our previous results were obtained by the combined methods on the *Botryococcus braunii* KÜTZ, from the oil shale of Pula, a new series of experiments were projected and is under elaboration. The concepts are as follows.

1. Use the so-called classical solvent and oxidizing method (2-aminoethanol, $KMnO_4$ aq dil., etc.)

2. Merkapto-ethanol as single solvent for relatively long times, maximum 15 days. After these processes, the remnants were fragmented, and investigated with the TEM method, with the instrument of Tesla BS—500.

Among the first results as a preliminary report the peculiar globular units were represented on the Plate 3.1. It seems to be interesting in our point of view. The highly organized structures are extremely ressembling to the globular scheme on p. 63, 1.3. and 1.7., KEDVES (1989). Such globular units were observed at the first time on fossil objects.

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