INVESTIGATIONS INTO THE NEOGENIC MICROPLANKTON OF HUNGARY

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THE Neogenic successions surrounding the Mesozoic block of the Mecsek Mts., South Hungary, have been subjected to a thorough palynological treatment. The results of the respective investigations have been partially reported by a number of papers (NAGY & PÁLFALVY: 1958, 1960; NAGY: 1960, 1962a, b, 1963a, b, c; 1965a, b).

During the research works — along with the spores and pollen grains of terrestrial and aquatic plants (often referred to as pseudoplankton because their preservation, i.e. fossilization requires a wet medium) planktonic organisms have also been encountered. The planktonic organisms not only permit to interprete spore and pollen, but furnish useful information of other kind as well. In fact, they directly inform us on the ancient sedimentary basin and permit—like the other aquatic, especially animal organisms — to draw conclusions as to the physical properties of the medium, i.e. the water that once represented their biotope its salinity, temperature and the pure or polluted condition (MAIER, 1959, pp. 331-332, etc.).

After having studied amplegamme of relevant literature, the author arrived at the conclusion that planktonic organisms had played a more considerable role in those geological epochs when the surface of our Globe had been dominated by sea to a larger extent. The author's conclusion is confirmed by plenty of literature data concerning the Mesozoic and, all the more, the Paleozoic (EISENACK, 1931, 1938, 1951; WETZEL, 1933, 1937; DEFLANDRE, 1935, 1936, 1937, 1938, 1952; PASTIELS, 1948; etc.). As regards the Cenozoic planktonic organisms, and particularly the Neogenic ones, they have been discussed in few earlier papers. The papers dealing with their occurrence in the Neogene are as follows: Maier 1959, Gerlach 1961 in Europe; Cookson 1953, Deflandre & Cookson 1955 in Australia; Norem 1955, Traverse 1955, Evitt 1963 in America. In Hungary where the respective research has just been started papers reporting on results are particularly scant (HAJÓS 1959, 1963, 1964; BÁLDI-BEKE 1960, 1964, BÓNA 1964). This is chiefly due to the fact that during the investigations considerably fewer planktonic organisms have been found in the Neogenic deposits, in contrast with the copious spore-pollen finds which have offered possibilities for interpretation.

However, the relative scarcity of planktonic organisms cannot imply that these microfossils should be disregarded, since — as already mentioned — their presence permits to draw conclusions which cannot be inferred from the spore-pollen material. In addition, such evidence may substantiate palynological and paleobotanical conclusions, contribute to the reconstruction of paleogeographical paltterns and facilitate paleoecologic and paleocoenologic conclusions. Last but not least, it can be a help in stratigraphic identification, too.

II

The results arrived at while evaluating the planktonic organisms found during the study of spores and pollen grains from the Mecsek Mts are summarized under three headings:

(a) SYSTEMATIC RESULTS

The material studied so far permits to conclude that the majority of the planktonic microfossils belong to Phytoplankton: Dinoflagellata and Hystrichosphaeridae. The rest is represented in part by organisms of obscure origin so that they can be classified only as Incertae sedis. For most of them, it is even impossible to determine whether they are of vegetal or of animal origin. In fact, there is a lot of analogy and convergency among the various cells, larvae and zoospores of the nowliving Protista and of other higher plants and animals (*see* DEFLANDRE 1947, FIG. 2). The authors of the classification of Protista, themselves, point out the difficulties faced in determining the vegetal or animal origin of certain unicellular organisms (*see* Traité de Zoologie I. p. 134). The third group of our planktonic material is surely of animal origin, being represented partly by chitinous foraminiferal tests, partly by remains of Scolecodonta.

Some of the planktonic organisms found are new forms. Out the 57 organisms determined so far, 7 new genera including 8 new species and 14 new species of known genera were described by this author (1965).

Here we present the description of 1 new species of a known genus and two new species of a new genus.

ORDO: PERIDINALES

FAMILIA: PERIDINAE KOFOID

Genus *Peridinium* Ehrenberg 1832

In successive samples taken from the Pannonian deposits penetrated by borehole Hidas No. 53 (135·5-137, 134·9-135·5, 132·5-134·8 m) a considerable number of shells identifiable with this genus can be encountered. On most of these forms certain tabulation can be recognized, though some of them are inadequate for far-reaching conclusions. The relatively smooth, unsculptured shells suggest that we have to do with fresh-water forms. Concerning the fresh-water versus marine forms, the following statement is made in the Traité de Zoologie I (p. 350): "Schiller (1935) note que les premières sont en général de forme pleine et lisse, tandis que les secondes sont de profil anfractueux, à reliefs prononcés."

Peridinium lambdoideum sp. nov.

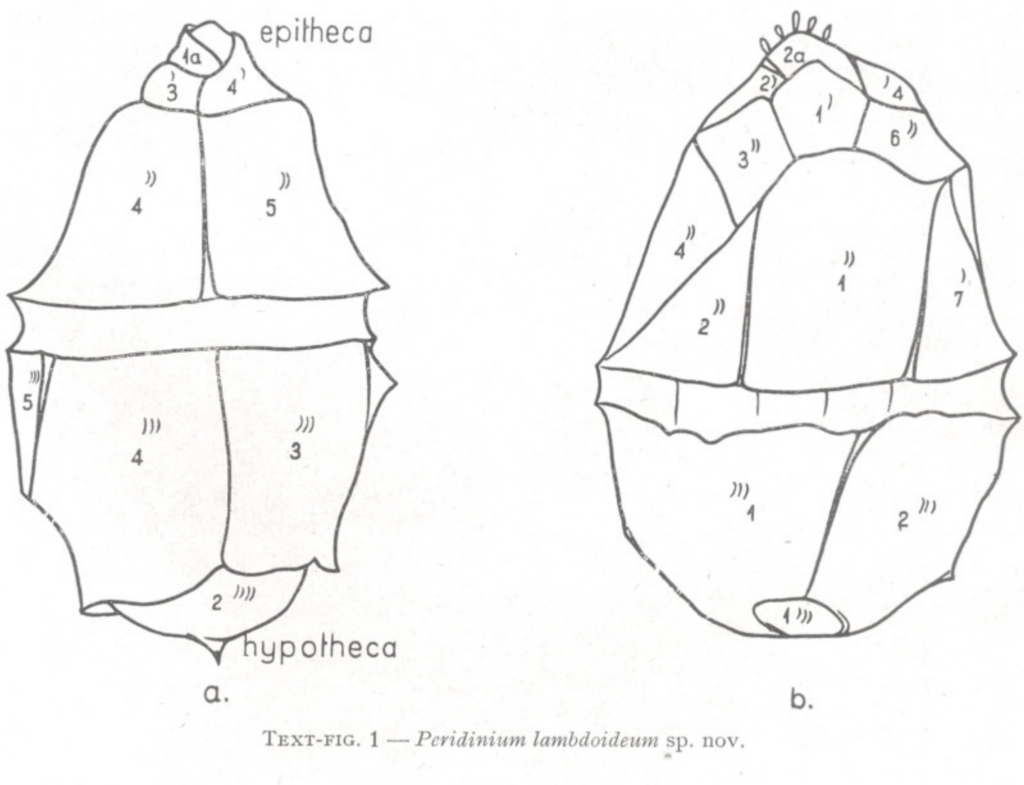
Pl. 1, Figs. 1-3

Holotypus—Pollen Laboratory, Hungarian Geological Institute, borehole Hidas 53, sample 5, slide 3. Coordinates: 46·1-109·3.

Locus typicus—Hidas.

Stratum typicum—Pannonian, silty clayey marl, borehole H. 53, 134·8-135·5 m.

Description and diagnosis—Shell ellipsoidal, 52×66 μ. Epitheca slightly elongated, about as long as hypotheca (FIG. 1). Epitheca exhibiting following tabulation: 4′,



TEXT-FIG. 1 — *Peridinium lambdoideum* sp. nov.

2a, 7'', 5''', 2''''. Apical tabulation 2a, antapical tabulation 2''''. Surface roughly granular. The pointed sculpture visible at the angles of the tabulations are similar to those on the apex and antapex. In the apical region there are baculum-like projections, too.

Differential diagnosis: The junction of the apical and pre-equatorial tabulations shows a characteristic line such as those occurring in figures of *P. cinctum* O.F.M. and *P. bipes* Stein (*l.c.* p. 349, FIG. 354), now-living species of Dinoflagellata. On the apex of *Peridinium bipes* Stein some baculum-like projections can also be found.

INCERTAE SEDIS

Genus *Savitrinia* gen. nov.

Derivatio nominis—Dedicated to Mrs. Savitri Sahni, president of the Institute of Palaeobotany, Lucknow.

Genotypus—*Savitrinia miocenica* gen. et sp. nov.

Locus typicus—Mecsek Mts.

Stratum typicum—Tortonian, brown coal formation.

Diagnosis—Central body from globular to polygonal, with an equatorial membrane, mostly polygonal, sometimes circular. The formations are composed of extremely thin membranes.

Differential diagnosis—Owing to their shape assuming particular geometries, these forms cannot be included in any of the categories established so far for planktonic organisms.

Savitrinia miocenica gen. et sp. nov.

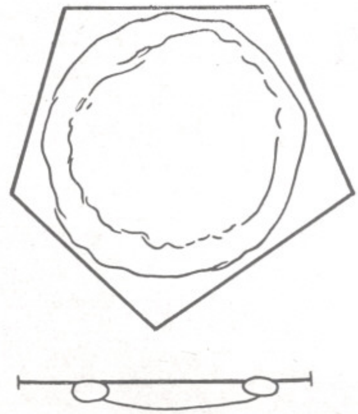
Pl. 2, Figs. 1-8

Holotypus—Pollen Laboratory, Hungarian Geological Institute, sample 1 from seam II. Hidasbánya, slide 1. Coordinates: 31·9-108·4 (PL. 2 FIGS. 3-8).

Locus typicus—Hidasbánya.

Stratum typicum—Tortonian, fine-sandy clay.

Description and diagnosis—Total diameter 42 μ. Central body of 37 μ diameter, surrounded by a polygonal, mostly pentagonal membrane 2-5 μ wide. Outer membrane situated not in the equatorial plane of the central body, but in one of the circles close to the point admitted as pole. Surface finely folded. Edge finely granulate having a very unevenly undulated, finely-patterned outline. Membrane extremely thin, sculptured by fine granuli roughly perpendicular to the edge (FIG. 2).



TEXT-FIG. 2 — *Savitrinia miocenica* gen. et sp. nov.

Differential diagnosis: In addition to the holotype, some 5-6 specimens were observed in the samples. Most of them are polygonal. However, there are specimens in which both the central body and the membrane are oval.

Savitrinia magna sp. nov.

Pl. 1, Figs. 4, 5

Holotypus—Pollen Laboratory, Hungarian Geological Institute, sample 23 from borehole H. 53, slide 1. Coordinates: 45-110·6.

Locus typicus—Hidas.

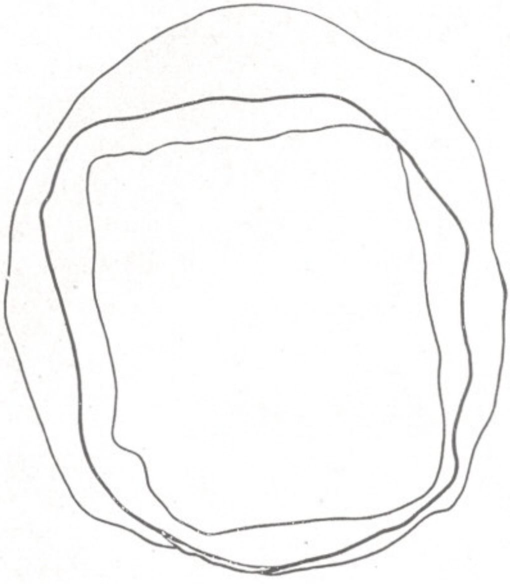
Stratum typicum—Helvetian, clayey marl, borehole Hidas 53, 630·8-632 m.

Description and diagnosis—Envelope 90 × 79 μ, oval, membraneous. Central body globular, 77 × 64 μ. Its material is thicker. The centre of the inner shell is thickened, issuing projections of various sizes. The envelope is adhered to one side of the central body giving rise to a roughly rectangular opening (FIG. 3).

Differential diagnosis—This species is less membranaceous as compared with *Savitrinia miocenica* gen. et sp. nov. though the position of the envelope and the inner shell and the adhering of the former to the latter indicate a close relationship between the two species.

(b) FACIOLOGICAL CONCLUSIONS

During the determination of the fossil material the author gained useful informa-



TEXT-FIG. 3 — *Savitrinia magna* gen. et sp. nov.

tion on the facial characteristics of the sediments. Part of the planktonic organisms are indicative of a fresh-water environment [*Ovoidites ligneolus* R. Pot., *Tetraporina quadrata* Bolch. (PL. 2, FIG. 9), *Pediastrum* sp.].

However, there are fossils characteristic of marine waters as well: *Emslandia australiense* (Defl. & Cooks.), *Crassospheaera concinna* Cooks. & Man ., *Cystidiopsis certus* Nagy, *Tytthodiscus* sp., *Foraminifera*, and *Scolecodonta.*

Actynocyclus ehrenbergii Ralfs and *Thalassiphora pelagica* Eis. & Gocht are indices of a brackish environment.

Starting from the ecological nature of the known microfossils, the author attempted to determine that of the new species. We find *Savitrinia miocenica* gen. et sp. nov., *S. magna* sp. nov. and *Geiselodinium miocenicum* Nagy to be indices of freshwater, *Cooksonella circularis* Nagy, *Cymatiosphaera hungarica* Nagy, and *Peridinium lambdoideum* sp. nov. to be those of brackish water and *Margosphaera velata* Nagy, *Tytthodiscus mecsekensis* Nagy and the species of the genus *Hidasia* to be indices of marine environment.

Both the known and the new species include several ones whose ecology (tolerance of salinity) is obscure. For instance, *Botryococcus braunii* Kützig would be encountered everywhere in waters of any salinity as shown in literature (TRAVERSE, 1955, p. 344). In the material studied by the author it has also proved to be tolerant of a rather wide range of salinity. However, in strictly fresh-water sediments it has not yet been found. It is represented by locally considerable amounts in both saline and brackish sediments particularly in those exposed by drillings Hidas 53 and Zengővárkony 59.

The author's conclusions have been correlated with the results of foraminiferal studies. So the ecological mode of emplacement of *Fülöpia fimbriata* Nagy indicates the presence of a marine environment, as suggested by its comparison with radiolarian tests and spiculae of Spongia. However, the settling of this question requires additional evidence, since the afore-mentioned species hasso far been represented by a single specimen.

In some cases, e.g. in sample 13 (30·9-34 m) from borehole Zengővárkony 59, the ecological nature of the fossils could be determined. In this sample the common occurrence of *Cystidiopsis certus* Nagy and *Margosphaera velata* Nagy, forms held by Kuprianova for larvas of Hystrichosphaeridae (1960, p. 78, pl. 14, fig. 1), with the fossil representatives of Foraminifera and with *Emslandia australiense* (Defl. & Cooks.) Nagy and *Crassosphaera concinna* Cooks. & Man. has ascertained that both species represent marine planktonic microfossils. Lithologically, the sample under consideration is made up of Lower Tortonian sandy clay with lagenids. The species *Tytthodiscus miocenicus* Nagy recovered from a slightly deeper (34·0-37·5 m.) sample was also encountered together with *Crassosphaera concinna* Cooks. & Man. The presence of *Thalassiphora pelagica* Eis. & Gocht and *Cymatiosphaera microreticulata* Nagy, proves in the same way, that *Hidasia velata* and *Hidasia flexibilis*, new species associated with the former, are indices of marine ecologies.

The diatom species *Actinocyclus ehrenbergii* Ralfs is the index of a littoral brackish facies and so is the species *Cooksonella circularis* Nagy associated with it. On the basis of this species, the author had to consider also the sample from the ravine Kisrét at Magyaregregy as brackish sediment.

One of the species of the new genus described in the present paper, i.e. *Savitrinia* *miocenica* sp. nov. indicates, together with *Tetraporina quadrata* Bolch. and *Ovoidites ligneolus* R. Pot., a strictly fresh-water environment.

Along with the planktonic microfossils, the pollen grains of aquatic plants, such as Nymphaeaceae and Sparganiaceae have also been considered. The latter forms indicate the presence of a fresh-water sedimentary basin.

The scarcity of data available may, of course, lead to erroneous conclusions, but if all evidence possible is taken into consideration (geology, sedimentation, paleozoological results), the risk of error will be considerably reduced.

On the ground of the above, the material collected in the Mecsek Mts permitted to distinguish the following facial patterns.

This material was correlated with geological and palaeontological evidence along an idealized profile combined from several cross-sections (six boreholes, one brown coal seam and three outcrops) as follows:

The formation — mostly conglomerates — penetrated by borehole *Szászvár* 8 are of Lower Helvetian age and locally contain *Ovoidites ligneolus* R. Pot. indicating a fresh-water origin.

As to the ecology of formations exposed in borehole *Pusztakisfalu VI*, the planktonic organisms provide only vague information. According to geological interpretation, these are fresh-water sediments as suggested by the brown-coal samples surrounded by sandy barren rocks. Microfaunistic studies have recorded the presence of spiculae of sponges. In one sample there are radiolarian tests too (depth range from 9·5 to 10·5 m). Owing to its scarcity and to its obscure origin, the ecological evaluation of *Heliospermopsis hungaricus* Nagy occurring within the depth range of 15·0 to 17·0 cannot be performed until additional data are obtained.

Micropaleontological evidence suggests that the samples from the succession exposed in borehole *Zengővárkony* 45 and held so far for fresh-water formations are but in part of fresh-water origin: the lignite stringers and the congerian limestones (depth range from 16·4 to 13·2 m). The samples with radiolarian tests and spiculae taken from the underlying rocks indicate a marine environment, while the occurrence of fish remains and ostracod shells (determined by I. LAKY) is indicative of brackish water. The marine nature of the sediments under consideration is confirmed by the presence of redeposited fossil material in the same samples (*see* below).

In the samples from the region *Magyaregregy* there are relatively few identifiable planktonic microfossils. In the material sampled in the ravine Kisrét the species *Cooksonella circularis* Nagy indicating a brackish environment can be found. The presence of *Cymatiosphaera elliptica* Nagy and *Micrhystridium* sp. in a tuff sample from the outcrop Almáspatak II is a proof for marine environment as shown by the analogy with closely related species. Nevertheless, until these species are found in other rock materials, their ecologic characteristics cannot be evaluated with more precision.

The samples from borehole *Hidas* 53 furnished a rather abundant planktonic assemblage. However, not all can be equally interpreted. Some of these fossils are redeposited forms (*see* below), others are new species which, as already mentioned, can only be evaluated when completed with additional material. It is only the third group of the fossils that can be used for reliable conclusions.

In the Helvetian member of the succession (983-984·5 m) *Tytthodiscus* sp., a marine form, occurs. The studies by Laky have shown that this member contains foraminifers exhibiting the same ecology. Laky suggests a marine ingression to have taken place during the deposition of the sediments within the depth range of 941·0 to 942·5 m.

The evaluation of this member of the succession exposed by borehole Hidas 53 was given in an earlier paper (NAGY 1962b, p. 325-326) in which the assemblage remains of foraminifers and Hystrichosphaeridae and the pollen grains of Chenopodiaceae were taken into consideration. A similar marine environment is indicated by the sample from the Helvetian sediments within the range of 837·9-839 m (*l.c.*).

From the base of the Tortonian sequence, i.e. from 763-764·6 m upwards we encounter either foraminiferal microfossils, or planktonic organisms, or both which all indicate a marine sedimentation. It fact, this is indicated by *Cystidiopsis certus* Nagy and *Micrhystridium microreticulatum* Nagy at 755-757 m and by *Hidasia duigana* Nagy, *H. flexibilis* Nagy and foraminiferal tests at 735·0-738·0 m. In addition, these are redeposited forms, too. The presence of

Crassosphaera sp., Foraminifera and Scolecodonta remains as well as that of *Cymatiosphaera microreticulata* Nagy and *Hidasia duigana* Nagy indicates a deepening of the near-coast sea zone which is also confirmed by Laky.

The samples from Tortonian brown coals already record a brackish to fresh-water environment: *Tetraporina quadrata* Bolch. and *Savitrinia magna* gen. et sp. nov. at 630·8-632·0 m, *Ovoidites ligneolus* R. Pot. at 592·7-593·1 m and 590·2-590·7 m. The occurrence of *Micrhvstridium microreticulatum* Nagy and of other planktonic microfossils in the rocks overlying the coal seams is indicative of a transgression.

Indices of the Sarmatian brackish sea are *Thalassiphora pelagica* Eis. & Gocht, *Cymatiosphaera microreticulata* Nagy and some specimens of *Hidasia* sp.

In the Pannonian chiefly *Ovoidites ligneolus* R. Pot., particularly its smooth variety, is encountered. Nota bene, it would be of interest to check if this form is present in slightly brackish sediments also. Compared with their now-living equivalents, some species of Dinoflagellata suggest a fresh-water to slightly brackish environment.

The colonies of planktonic organisms such as *Botryococcus braunii* Kützg. prevail throughout the succession exposed by borehole *Zengővárkony* 59. Its occurrence proves that this form is tolerant of salinity within a wide range. In fact, it is abundant in both brackish and completely saline samples, while is lacking in the sample containing *Ovoidites ligneolus* R. Pot., a typical fresh-water form. As shown by planktonic microfossils, the base of the succession begins with brackish beds which freshen out between 73·5 and 76 m. From 73 m upwards we find, again, brackish sediments as confirmed by the presence of *Botryococcus braunii* Kützg., *Actinocyclus ehrenbergii* Ralfs, *Cooksonella circularis* Nagy. Farther up in the succession the facies go on changing and planktonic indices of more and more saline water are encountered. This horizon had yielded foraminifers which were identified by Laky with *Rotalia papillosa* Brady, *R. beccari* (L.), *Orbulina triloba* d'Orb., *Globigerina bulloides* d'Orb., etc. as well as it furnished representatives of Ostracoda and needles of Echinodermata. In the same sample the following planktonic microfossils were found: *Crassosphaera concinna* Cooks. & Man., *Tytthodiscus mecsekensis* Nagy (37·5-34·0 m). A sample from the depth range of 34·5-30·9 m contained *Emslandia australiense* (Defl. & Cooks.), *Margosphaera velata* Nagy, *Cystidiopsis certus* Nagy and chitinous foraminiferal tests, along with specimens of *Crassosphaera* and *Botryococcus*. The samples farther up in the succession also contained microfossils typical of marine sediments: the sample from 28·8 to 29·2 m yielded specimens of coccolithophorids (Báldi-Beke, 1964, p. 162), those from 28·6 to 28·8 m furnished *Crassosphaera concinna* Cooks. & Man. and *Botryococcus braunii* Kützg.

(c) EVALUATION OF THE REDEPOSITED MATERIAL

During the determination of planktonic microfossils it was found that many of them had been redeposited from rocks of older geological age. The problem of redeposition has been discussed in numerous papers dealing with spore-pollen studies (Thomson *in* Thomson & Pflug, 1952, p. 1-9; Grichuk, 1950, p. 24; Alberti, 1961, p. 41, etc.). In agreement with these authors, I admit the risk of misinterpretations resulting from the erroneous identification of fossils when their allochtonous nature is not recognized, but I consider that the usefulness of information they may provide concerning the circumstances of transport cannot be denied.

The quantity of pollen transported permit to conclude consequencies as we may suppose that the transgressions are those which provoke considerable removal of the material. This is confirmed by the results of the investigations we have carried out so far as well as by their correlation with the evidence on Foraminifera obtained by Laky.

After having surveyed the Neogenic successions in the Mecsek Mts, we can state that the small-sized Mesozoic chiefly Jurassic, planktonic organisms were redeposited at greatest distances. However, the redeposition of Paleozoic froms is not unfrequent either. Although in the present state of our investigations it would be premature to afford definitive judgement, yet it is presumable that the Mesozoic sea itself had been a secondary sedimentary basin. Sedimentary petrology, e.g. studies on gravel roundness may provide a considerable evidence to the interpretation of fossil material. In the present paper, however, I do not intend to enter into the details of these questions.

The planktonic microfossils could not always be determined up to species. In fact, it was sometimes the inadequate state of preservation, sometimes the presence of impurities that impeded any more precise identification. However, in other cases, they were precisely identified which was substantiated by the presence of some spores and pollen grains.

In the basis of borehole *Szászvár* 8 representing a succession abundant in conglomerates there are naturally a lot of data suggesting redeposition. At 434·5-435 m there is *Baltisphaeridium brevispinosum* (Eis. 1931) Eis. 1958 indicative of Paleozoic; *Aequitriradites dubius* Delc. & Sprum. occurring at 433·8-434·1 m and *A. inconspicuus* Delc. & Sprum. at 432·7-433·5 m are Jurassic forms; *Micrhystridium* cf. *M. fragile* Defl. is the representative of the Cretaceous. Similarly Mesozoic, precisely Jurassic, redeposition is indicated by *Micrhystridium* cf. *M. fragile* Defl. (1947) at 156·9-157·3 m.

The presence of *Baltisphaeridium* cf. *B. brevispinosum* (Eis.) in sample 5 (17·2-17·8 m) from borehole *Zengővárkony* 45 substantiates the marine facies of the enclosing sediment. In sample 4 there is a redeposited representative of the Cretaceous Angiospermae (16·4-17·2 m).

As to borehole *Komló* 120, sample 115·a (400·5-406·1 m) contains Liassic *Eucomiidites* sp., sample 114 (398·3 m) — Liassic spores, sample 105 (372·0-374·4 m) — *Baltisphaeridium brevispinosum* (Eis.), sample 18 (178·0-178·8 m) — the latter species together with *Baltisphaeridium* sp. and *Zonalapollenites dampieri* Balme. All these forms are indices of redeposition.

The occurrence of *Hexagonifera* cf. *H. chlamydata* Cooks. & Eis. 1962 in clayey barren rock of the coal formation at *Hidasbánya* (sample 53) evidences redeposition from Cretaceous beds.

In borehole *Zengővárkony* 59 rather scarce material indicating secondary deposition can be found. A transgression is evidenced by the spore *Phaeocerosporites mecsekensis* sp. nov. in the brackish sample 33 (78-81 m) and by *Trudopollis* sp. and *Anemiidites echinatus* Ross in sample 17 (41·8-44·4 m).

In borehole *Hidas* 53 both the planktonic microfossils and the spore-pollen material refer to redeposition. *Baltisphaeridium* cf. *B. trifurcatum* (Eis.) Downie & Sarj. from the depth range of 755-757 m has been described from the Paleozoic, while *B. heteracanthum* (Defl. & Cooks.) from 735·0-738 m has been known from Cretaceous to Lower Tertiary deposits. *Kalyptea* sp. (711·0-713 m) has been known to occur in the Jurassic, *Micrhystridium* cf. *M. operosum* Deflandre (688·5-690 m) in the Cretaceous. In addition, the later sample contains a fragment of *Hystrichosphaeridium* sp., too.

The sample from the depth range of 688·0-688·5 m similarly contains *Hystrichosphaeridium*. In the subsequent sample from 686·5-688 m along with marine planktonic organisms recorded from the preceding one, there is a fossil *Scolecodonta* which resembles the analogous fossils occurring in the Cretaceous of France (Verdier, 1962, pl. 15). Redeposition is suggested by *Micrhystridium* cf. *M. operosum* Defl., a form described from the Cretaceous, occurring in 665·1-666·8 m, by the Jurassic *M.* cf. *deflandrei* Valensi from 534-537 m as well as by a few fossil remains of Hystrichosphaeridae from the same depth range.

In the upper, Pannonian member of the borehole profile redeposition from Paleocene, precisely Eocene beds is evidenced, along with *Baltisphaeridium oligacanthum* Sp. *stella* W. Wetzel and *Crassosphaera* sp., also by some spore forms described from Eocene deposits, such as *Verrucatosporites parasecundus* W. Kr. The investigations on *Coccolithophorida* carried out by Bóna also demonstrated the presence of redeposited Eocene sediments within the Pannonian member of the borehole under consideration (1964, p. 126). In addition, redeposition from Mesozoic formations into this same member of the borehole can also be presumed, as *Ornatisporites reticulatus* Nagy and *O. dentatus* Nagy are, by all probability, forms of mesozoic origin. According to the personal communication of Kedves and Simoncsics, this genus was encountered during the study of Liassic sediments. In the Pannonian member of the borehole a few Mesozoic, precisely Cretaceous, representatives of angiosperms can also be found.

III

In conclusion, we can state that the abundance of planktonic microfossils in the Mecsek Mts is considerably more limited compared to those occurring in older geological formations; yet these fossils permit to draw conclusions as to the facial characteristics of the ancient sedimentary basin. From the presence of redeposited planktonic organisms — when completed with data on associated spores and pollen grains — one can infer the age of primary deposition of the sediments.

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EXPLANATION OF PLATES

PLATE 1

1-3. *Peridinium lambdoideum* sp. nov. holotype, × 1000.

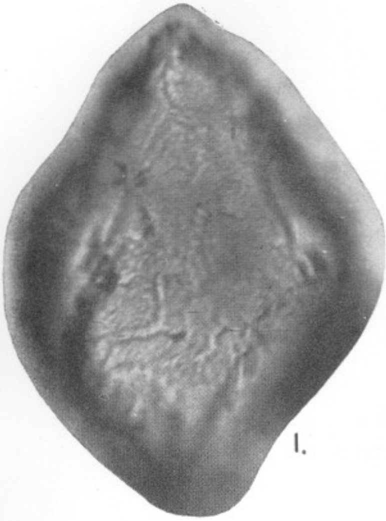
4-5. *Savitrinia magna* gen. et sp. nov., holotype, × 1000.

PLATE 2

1-2. *Savitrinia miocenica* sp. nov. × 1000.

3-8. *Savitrinia miocenica* sp. nov., holotype, × 1000.

9. *Tetraporina quadrata* Bolch. × 1000.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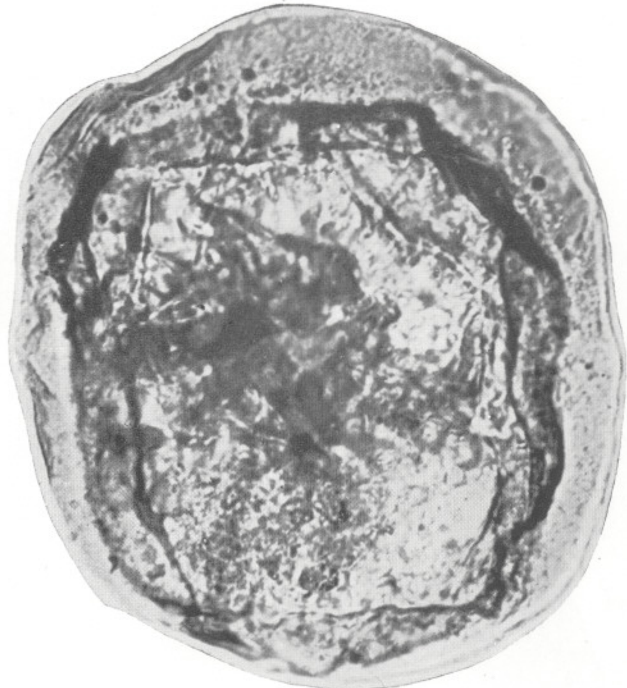
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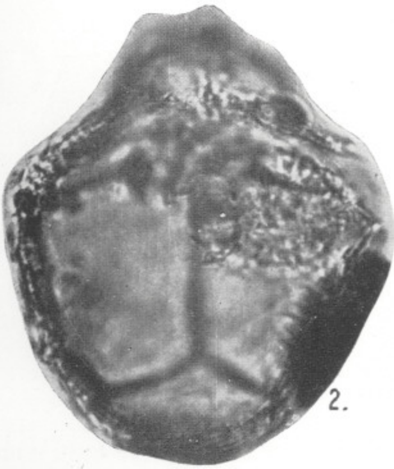
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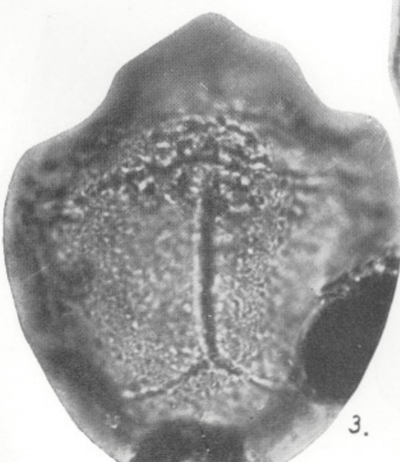
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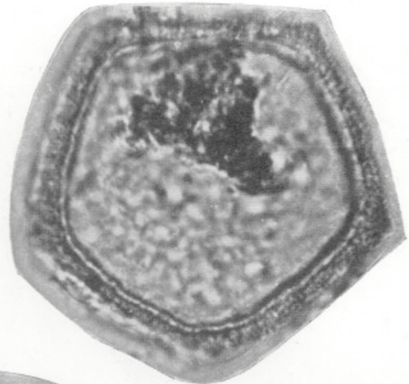

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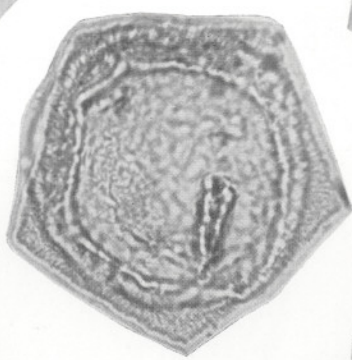

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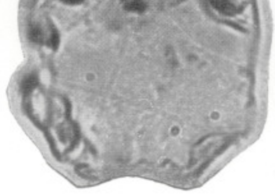

9.