8. REDEPOSITED SPOROMORPHS FROM HOLOCENE LAKE SEDIMENTS OF CAUCASUS

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Abstract

The redeposited sporomorphs isolated from the Holocene sediments of the Samurskoe Lake are presented in this contribution. The greatest part of the secondary sporomorphs are spores with some bisaccate *gymnosperm* pollen grains. The redeposited spores are mostly of *Gleicheniaceae* type which are characteristic for the Lower and Middle Cretaceous sediments. Similar *gleicheniaceous* spores of the Lower Cretaceous were published by DÖRING from Germany, and BOLKHOVITINA from Russia.

Key words: Palynology, fossil, redeposited sporomorphs, Caucasus.

Introduction

There are a number of publications concerning the investigation of the redeposited sporomorphs (IVERSEN, 1936, M. GRICHUK, 1950, V. GRICHUK, 1950, FRIIS, 1953, ANANOVA, 1960, CUSHING, 1962, 1964, WILSON, 1964, KEDVES, ENDRÉDI and SZELEY, 1966, STANLEY, 1966, 1967, MUIR, 1967, VENKATACHALA, 1969, SCOTT and SRIVASTAVA, 1984, LIIVRAND, 1976, 1989, BATTEN, 1996). Concerning this problem KEDVES (1986) emphasized the following; p. 14: "As a result of latest progress in this field, palynology has turned out to be in many cases the only tool to establish the fact of allochtony or to determine the age of the redeposited sediments. Nowadays the method itself is applied to several purposes: 1. Classical method based on a wide, comprehensive knowledge of the sporomorphs characteristic of the different geological ages. 2. Separation of allochtonous sporomorphs by colouring techniques. 3. Use of fluorescence microscopy."

The redeposited sporomorphs of the recent and Holocene sediments of the Caucasus Mountains were discussed in previous papers, by KVAVADZE (1984, 1991, 1996), KVAVADZE and EFREMOV (1998a,b).

The aim of our paper is to investigate the redeposited spores and pollen grains from the Samurskoe Lake, and compare the secondary sporomorphs with the Lower and Middle Cretaceous assemblages of other regions of the Northern Hemisphere.

Materials and Methods

The sediments were prepared in the Laboratory of Tbilisi, and three samples with organic material were sent to the Cell Biological and Evolutionary Micropaleontological

Laboratory of the J.A. University in Szeged. The LM investigation of the sedimentary autochton sporomorphs were investigated by Dr. E. KVAVADZE in Tbilisi, the redeposited forms by Dr. M. KEDVES and his co-workers in Szeged. The LM pictures of the secondary forms were taken in the C.B.E.M. Laboratory of the Dept. of Botany of the J.A. University in Szeged. All the pictures are unretouched.

Results

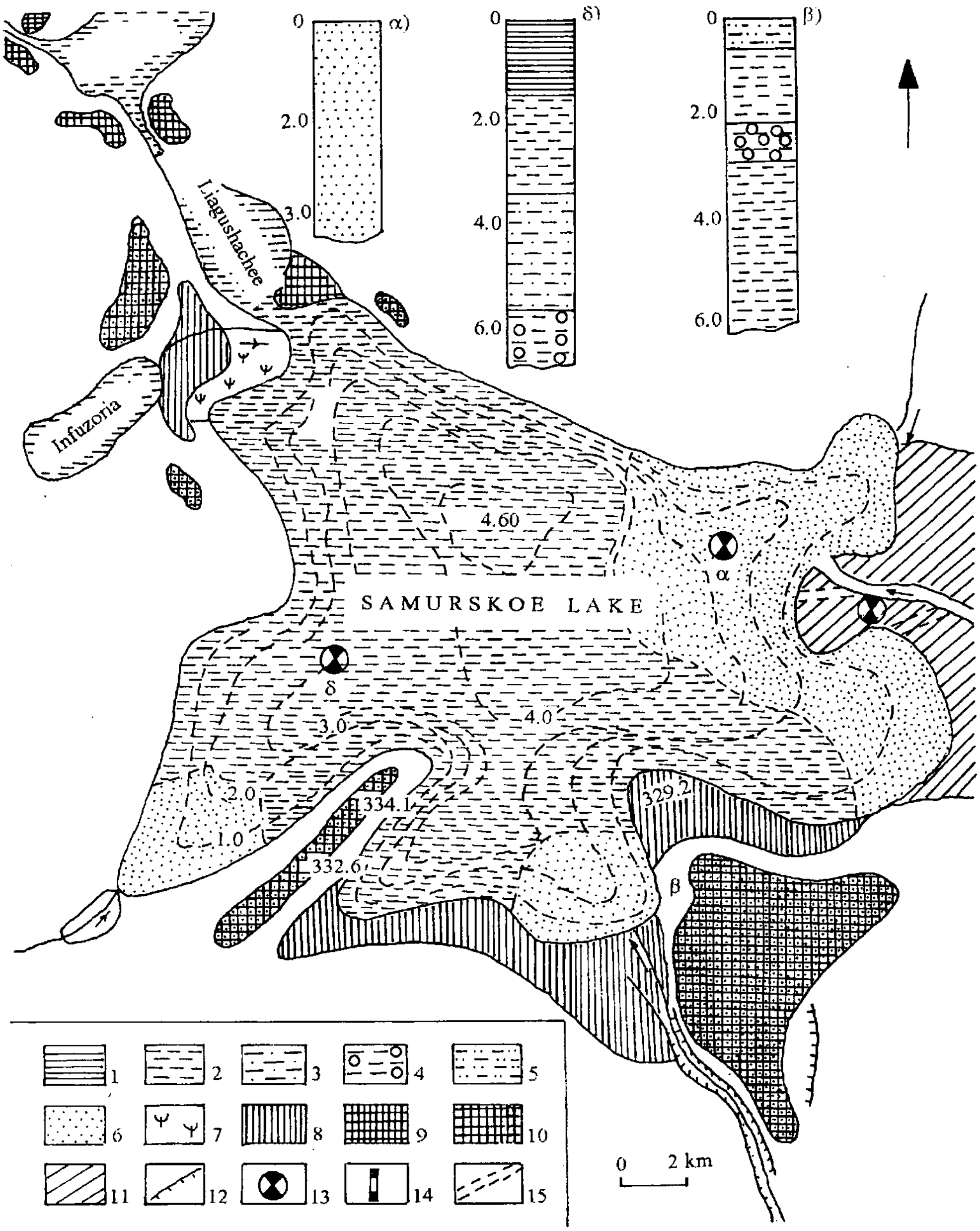
The localities of the sampling including the morphogenetic precipitation complexes in the water surface of Samurskoe Lake are illustrated in Text-fig. 8.1.

The quantitative data of the spore-pollen assemblage of the recent sediments of the Samurskoe Lake including the quantity of the redeposited pollen grains are illustrated in Text-fig. 8.2. The dominance of the quantity of the *Alnus* pollen grains is well shown. From the point of view of our present study the occurrences of the redeposited sporomorphs are also worth of mentioning.

The different taxa of the redeposited spores and pollen grains are presented in four plates (Plate 8.1.-8.4.). The following form-genera and species were observed:

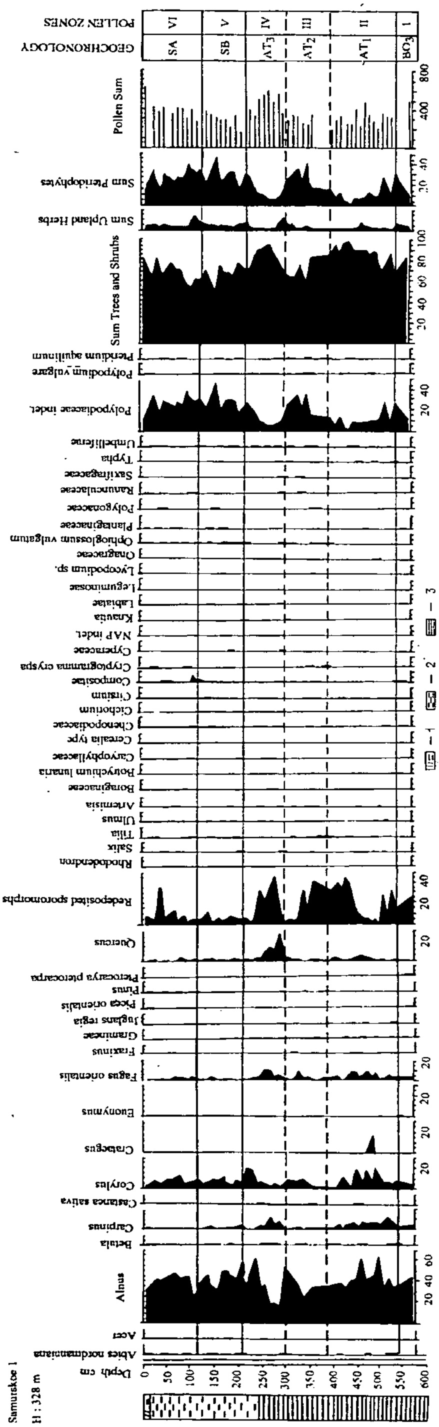
Sporites

Dandotiaspora dilata (MATH.) SAH, KAR et SINGH 1971 (Plate 8.1., fig. 1); *Leiotriletes sphagnoides* KEDVES et SIMONCSICS 1964, (Plate 8.1., fig. 2); *Obtusisporis obtusangulus* (POTONIÉ 1934) JANSONIUS et HILLS 1976 (Plate 8.1., fig. 3); *Gleicheniidites senonicus* ROSS 1949 (Plate 8.1., fig. 4); *Gleicheniidites umbonatus* (BOLKHOVITINA 1953) KRUTZSCH 1959 (Plate 8.2., figs. 3,15); DEÁK (1965) published this species from the Aptian from Transdanubia (Hungary). Based on the monograph of BOLKHOVITINA (1968) the occurrence of this species is from the Hauterivian until the Tertiary; *Gleicheniidites (Triremisporites) latifolius* DÖRING 1965b (Plate 8.2., fig. 4); *Gleicheniidites (Gleicheniidites) major* DÖRING 1965b (Plate 8.2., fig. 5); *Gleicheniidites (Triremisporites) rasilis* (BOLKHOVITINA 1953) KRUTZSCH 1959, (Plate 8.2., fig. 7-11); *Gleicheniidites (Triremisporites) rasilis/posttriplex* (Plate 8.2., fig. 12); *Gleicheniidites (Triplexisporis) posttriplex* DÖRING 1965a (Plate 8.2., figs. 13,14,16,17, plate 8.3., figs. 1,2); *Clavifera triplex* (BOLKHOVITINA 1953) BOLKHOVITINA 1966 (Plate 8.3., figs. 3,4); DEÁK and COMBAZ (1967) published this species as *Gleicheniidites triplex* and for occurrences the Aptian-Albian and Lower Cenomanian were given. HERNGREEN (1973) published this type of spore from the Valanginian sediments in the eastern Netherlands. *Clavifera rudis* BOLKHOVITINA 1968 (Plate 8.3., figs. 5-10); *Clavifera tuberosa* BOLKHOVITINA 1968 (Plate 8.3., figs. 11-15); *Asbeckiasporites* fsp. (Plate 8.2., fig. 1); *Asbeckiasporites wirthi* v.d. BRELIE 1964 (Plate 8.2., figs. 2,6); *Biretisporites* fsp. (Plate 8.1., fig. 5); *Maculatisporites microverrucatus* DÖRING 1964 (Plate 8.1., fig. 6); *Vadaszisporites sacali* DEÁK et COMBAZ 1967 (Plate 8.1., fig. 7); *Macroleptolepidites* $fsp._1$ (Plate 8.1., figs. 8,9); *Macroleptolepidites* $fsp._2$ (Plate 8.1., fig. 10); cf. *Macroleptolepidites* fsp. (Plate 8.1., fig. 11); *Polypodiaceoisporites* ex gr. *hungaricus* KEDVES 1961, (Plate 8.1., figs. 12-15); *Distaltriangulisporites maximus* SINGH 1971 (Plate 8.1., figs. 16-21). SINGH (1971) described this species from the Middle Albian, Loon River Formation of the Peace River Area, Canada. WINGATE (1980) published the *D. perplexus* (SINGH) SINGH 1971, and *D. mutabilis* SINGH 1971 from the Denton Shale Member of the Bokchito Formation (Lower Cretaceous, Albian) in Southern Oklahoma, U.S.A.



Text-fig. 8.1.

Morpholithogenetic precipitation complexes in the water surface of Samurskoe Lake.
1 - clays; 2 - detrituses; 3 - loams; 4 - loams with inclusions of ferrit and sulfide concretions; 5 - loamy sand; 6 - sand; 7 - low swamply near-lake areas (0.2-0.5 m); 8 - first terrace (0.7-2.5 m); 9 - second terrace (3.0-4.0 m); 10 - third terrace (4.7-7.0 m); 11 - delta plains; 12 - escarps; 13 - bore-holes; 14 - pit holes; 15 - dead river-beds.



Text-fig. 8.2.

Spore-pollen diagram of Samurskoe Lake sediments. 1 – soil; 2 – detrituses; 3 – clays.

Pollenites

Gymnospermatophyta

Pteruchipollenites thomasii COUPER 1958 (Plate 8.4., fig. 1). Occurrences: Jurassic, Great Britain, COUPER (1958), Plate 26, figs. 10-12. Similar forms: *Pinus* sp. *Haploxylon,* Aptian-Albian, Turgai and Aral Region, KRUCHININA and ROMANOVSKAYA (1964), Plate XX, fig. 7, *Pseudopinus textilis* BOLKH., Valanginian, Baikal Region, SEDOVA (1964), (Plate LVIII, fig. 9); *Parvisaccites radiatus* COUPER 1958 (Plate 8.4., fig. 2). Synonymy by SINGH (1964), a number of occurrences in the monograph of SINGH (1971) from "Late Jurassic to early Cenomanian". Occurrences: Wealdian and Aptian; Great Britain, COUPER (1958), Plate 29, figs. 5-8, plate 30, figs. 1,2; Pre-Barremian - L. Albian SW Scania, Sweden, VAJDA-SANTIVANEZ (1998b), Plate 5 D,E. Similar forms: *Dacrydium* sp. 1,2, Aptian, Bug, ZAUER and TABACHNIKOVA (1964), Plate IV, figs. 2,3, *Cedrus cristata* ZAUER, Aptian-Albian, Turgai and Aral Region, KRUCHININA and ROMANOVSKAYA (1964), Plate XX, figs. 8,9; *Cedrus cristata* ZAUER, Hauterivian-Barremian, Ryavskinskaya, Bore-hole 3-P, KOLT'ZOVA, KRUCHININA and STEL'MAK (1964), Plate XLVIII, fig. 5; *Parvisaccites* fsp.$_1$ (Plate 8.4., fig. 3). Similar forms: *Cedrus cristata* SAUER, Aptian-Albian, Barabinskaya Bore-hole 1-P, KOLT'ZOVA, KRUCHININA and STEL'MAK (1964), Plate LIV, fig. 8; *Cedrus cristata* ZAUER, Valanginian, Baikal Region, SEDOVA (1964), Plate LVII, fig. 6; *Parvisaccites enigmatus* COUPER 1958 (Plate 8.4., fig. 4). Occurrences: Middle Jurassic, Great Britain, COUPER (1958), Plate 30, figs. 3-5; *Parvisaccites* fsp.$_2$ (Plate 8.4., fig. 5). Similar forms: *Cedrus pachyderma* ZAUER, Hauterivian-Barremian, N. Ural, KOLT'ZOVA and MARTYNOVA (1964), Plate XLI figs. 3-5; *Alisporites rotundus* ROUSE 1959 (Plate 8.4., fig. 6). Similar forms: Pinus sp. 1,2, *Haploxylon,* Aptian, Bug, ZAUER and TABACHNIKOVA (1964), Plate IV, figs. 4,5; *Cedrus cristata* ZAUER, Aptian, Bug, ZAUER and TABACHNIKOVA (1964), Plate VI, fig. 9; *Cedrus pachyderma* ZAUER, Albian, Turkmenia, PANOVA (1964), Plate XIII, fig. 2; *Pinus divulgata* BOLCH., Valanginian, Berezovska Bore-hole 1-P, KOLT'ZOVA, KRUCHININA and STEL'MAK (1964), Plate XLV, fig. 8; Pinus sp. 4, *Haploxylon*, Aptian-Albian, Barabinskaya, Bore-hole 1-P, KOLT'ZOVA, KRUCHININA and STEL'MAK (1964), Plate LV, fig. 4.

Discussion and Conclusions

The redeposited forms may be characterized in the first place with the spores of *Gleicheniaceae.* As characteristic forms *Gleicheniidites (Triremisporites) rasilis, Clavifera triplex, C. rudis* and *C. tuberosa* may be emphasized.

DÖRING (1965a) published the taxonomy and the stratigraphy of the taxa of *Gleicheniidites* and *Trubasporites* from the Jurassic/Cretaceous boundary. The *gleicheniaceous* spores are rich in the Wealden, Valanginian and Hauterivian. *Gleicheniidites (Triplexisporites) posttriplex* DÖR. and *G. (Triremisporites) rasilis* (BOLCH.) DÖR. was published by DÖRING (1966) from the "Lower Cretaceous H" (± Valanginian) of South Brandenburg (Germany). BOLKHOVITINA (1966), p. 11 wrote the following: "During the Early Cretaceous *Gleicheniaceae* got an enormous distribution throughout the Earth's surface. Their abundant remnants, especially their spores, were found in many localities of Eurasia, North America and Australia and it is with this time that coincides the greatest polymorphism of the family." JUHÁSZ (1977) pointed out, that the spores of the *Gleicheniaceae* are important in the spore-pollen assemblages of the Upper Barremian to Lower Aptian of the Mts. Bakony (Hungary) and Albian sediments of the Mts. Villány. Based on the results of VAJDA-SANTIVANEZ (1998a) in the late Aptian and early Albian the relative frequency of the genus *Gleicheniidites* increases. *Clavifera triplex* was published from southern Scandinavia and according to several authors she emphasized, that the *Gleicheniidites bulbosus* [=*Gleicheniidites (Triremisporites) rasilis*] extinct at the end of the early Albian.

In addition to the *Gleicheniaceae* spores the relative abundance of the spores of *Distaltriangulisporites maximus* are also important concerning the age of the redeposited sediments. SINGH (1971) published this species from this form-genus from the Middle Albian of Canada. WINGATE (1980) published two form-species of *Distaltriangulisporites* from Lower Albian sediments in Southern Oklahoma, U.S.A.

It is worth mentioning the lack of the pollen grains of *Operculati (Classopollis)*, and other characteristic *gymnosperm* pollen grains such as *Spheripollenites, Monosulcites*, etc. It seems that the resistance of the sporopollenin of the saccate forms is extremely important in contrast to the other *gymnosperm* pollen grains. The lack of the striate *Schizaeaceae* spores is also worth mentioning taking into consideration the paper of VAJDA-SANTIVANEZ (1998b).

Finally, the redeposited sediments are without doubt of Lower Cretaceous age. Nearer Aptian and/or Albian stages are probable.

Acknowledgements

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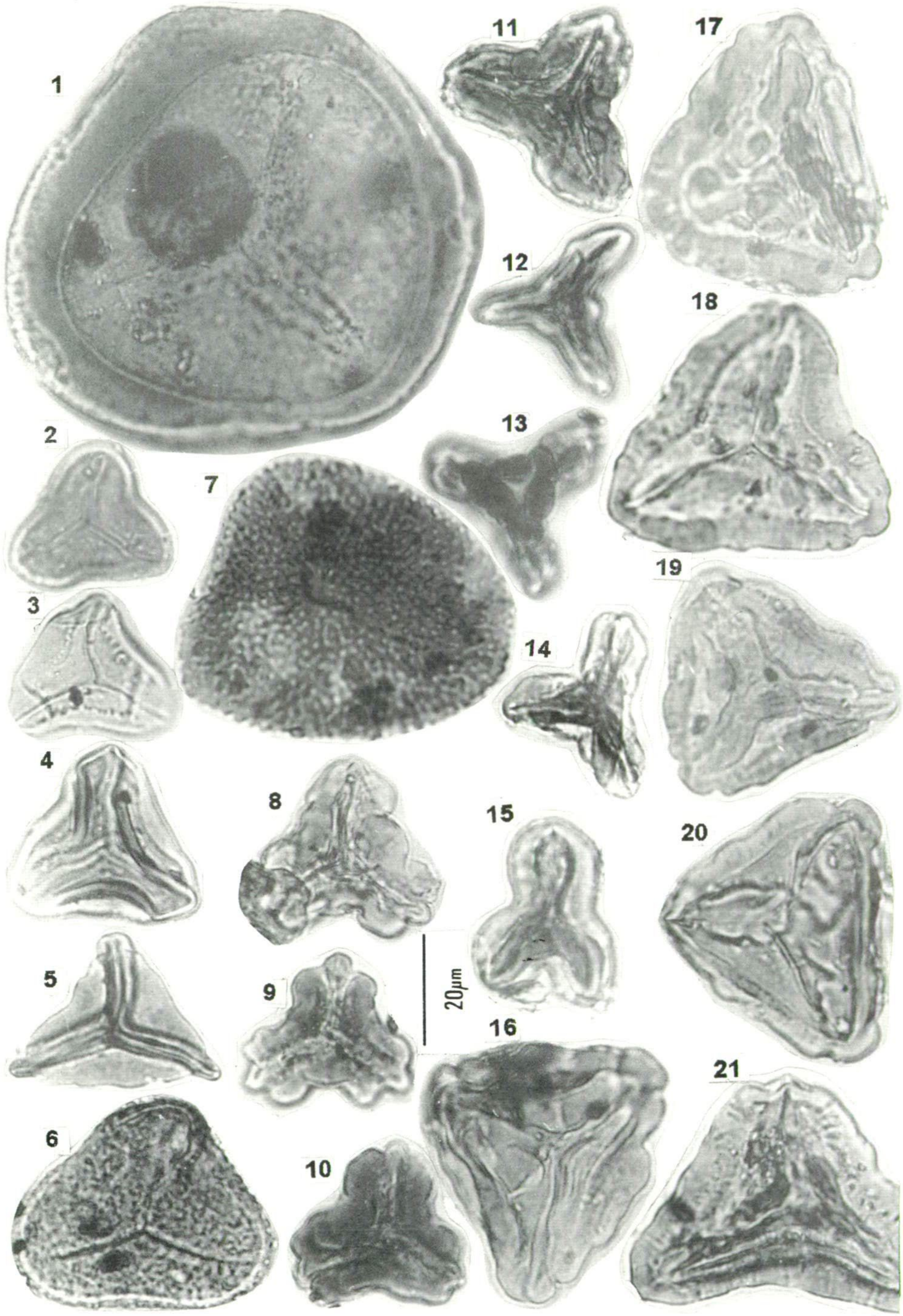

Plate 8.1.

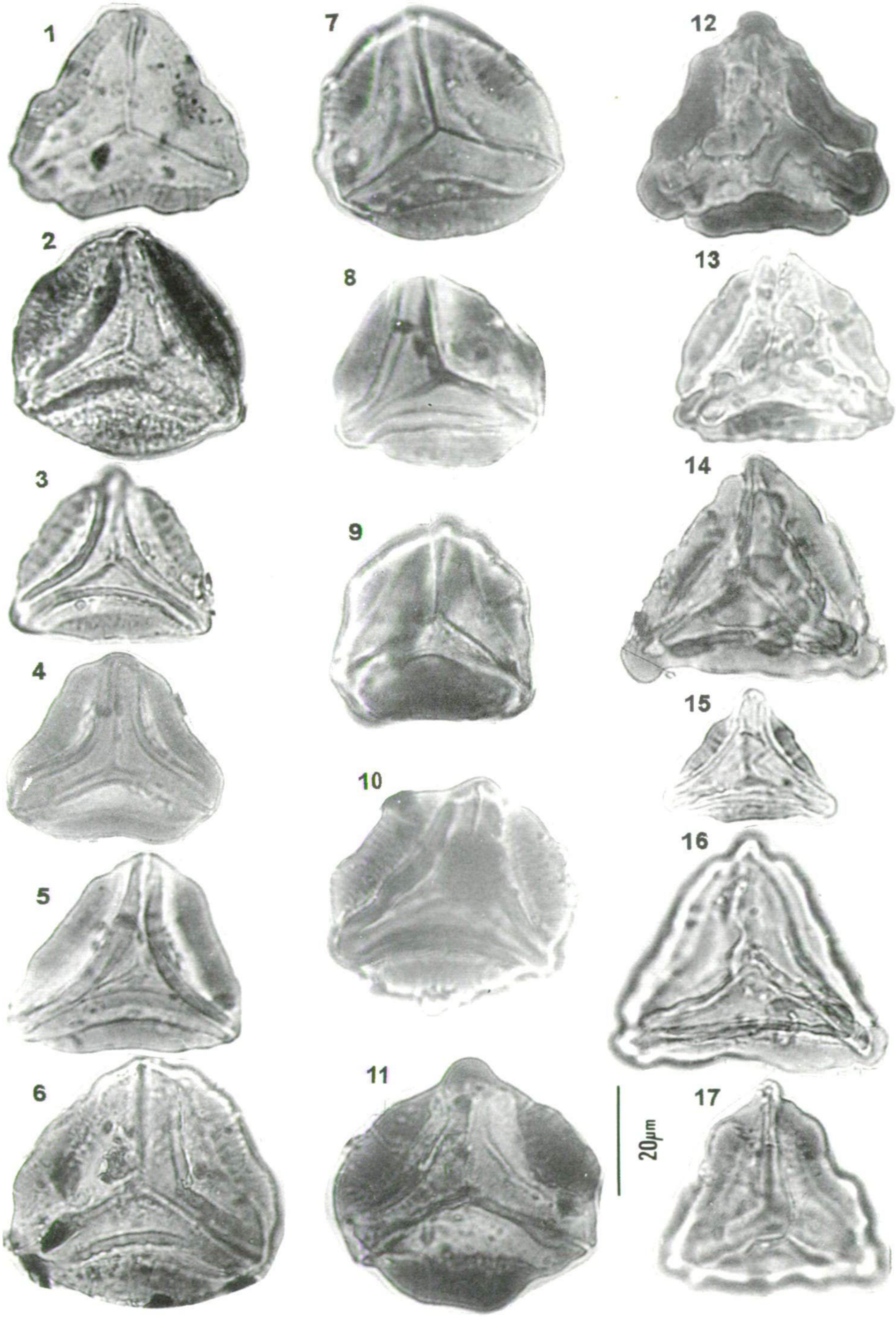

Plate 8.2.

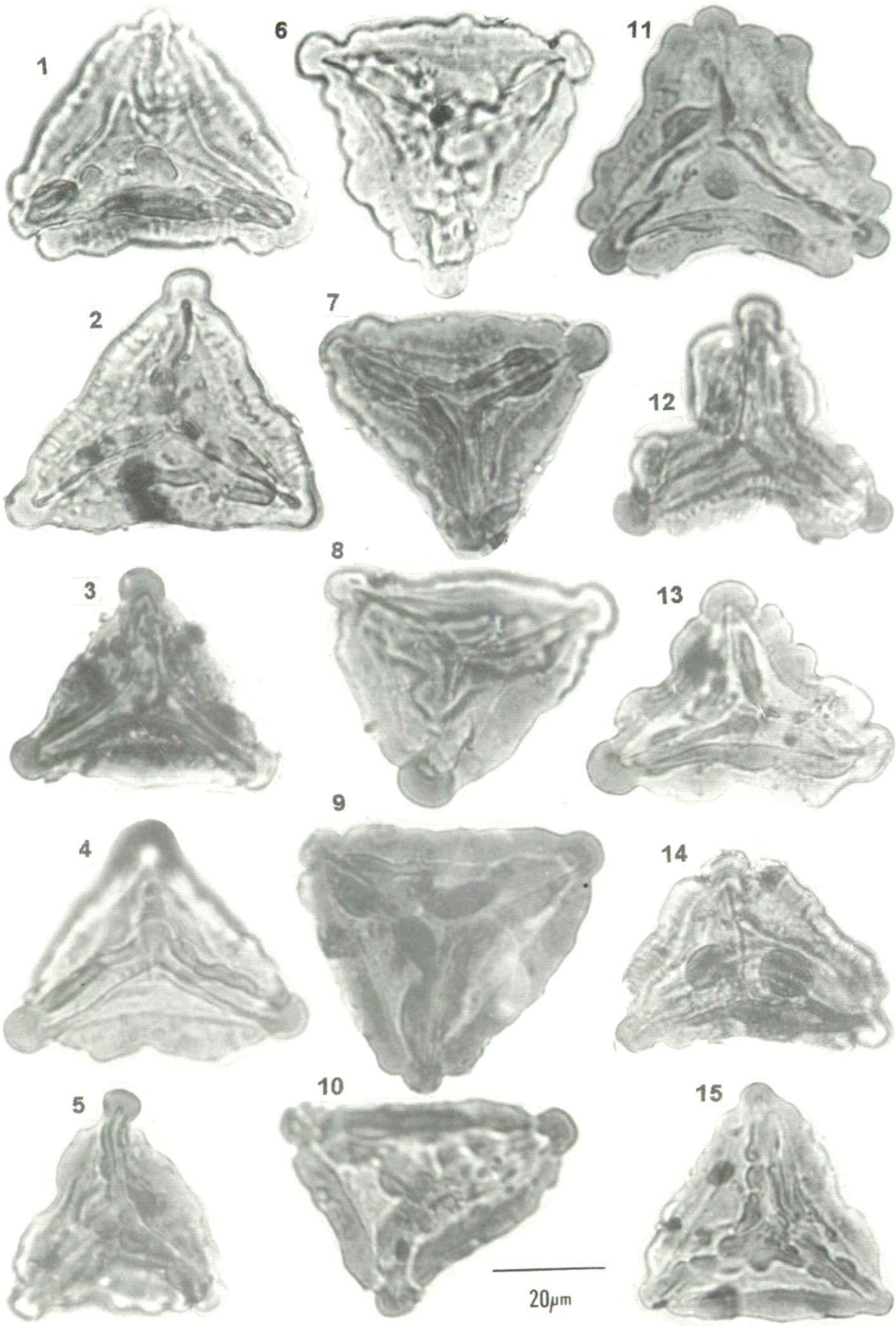

Plate 8.3.

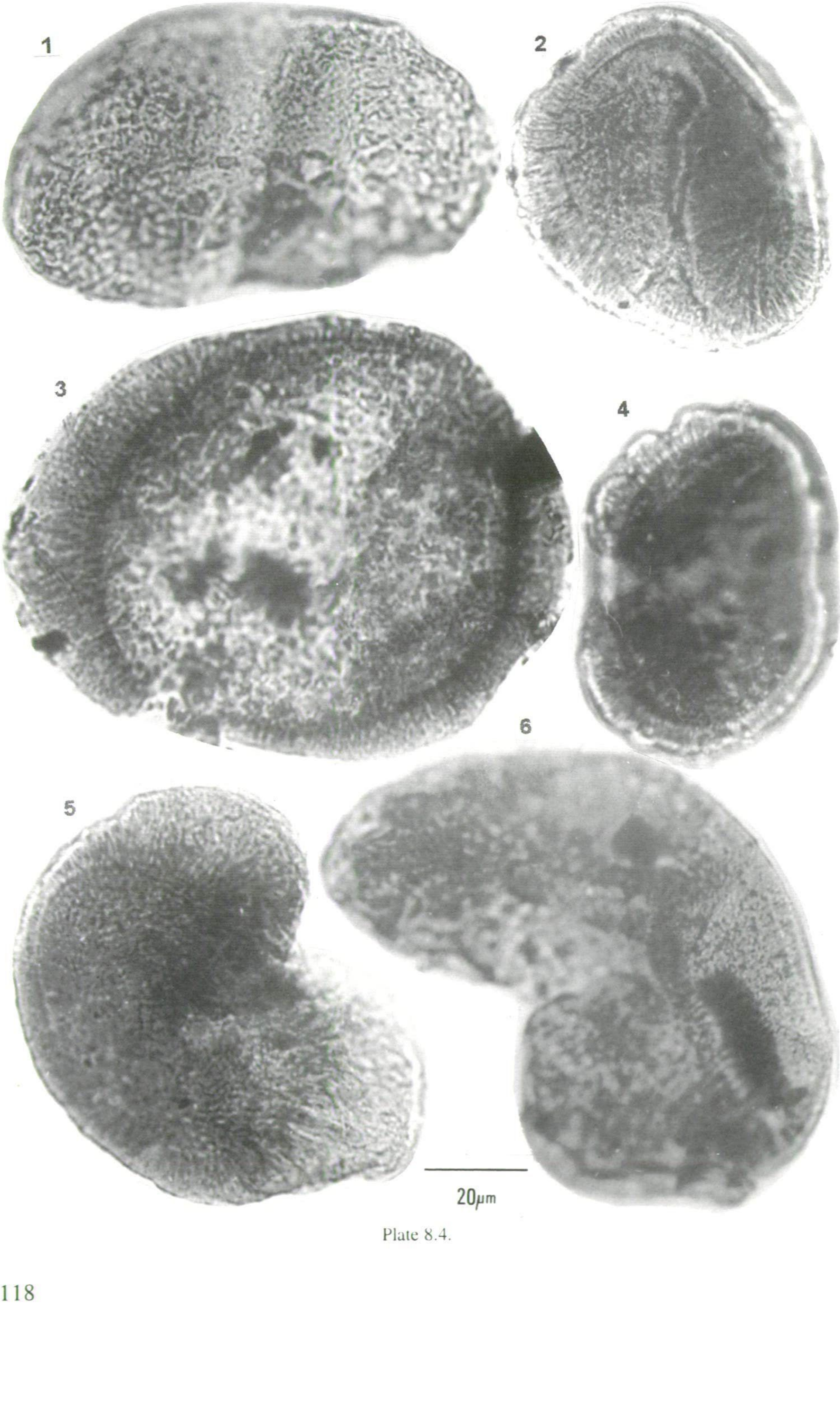

Plate 8.4.

Plate 8.1.

1. *Dandotiaspora dilata* (MATH.) SAH, KAR et SINGH 1971, slide: N-19-5, cross-table number: 21.4/123.8.
2. *Leiotriletes sphagnoides* KEDVES et SIMONCSICS 1964, slide: N-17-1, cross-table number: 24.3/144.3.
3. *Obtusisporis obtusangulus* (POTONIÉ 1934) JANSONIUS et HILLS 1976, slide: N-17-1, cross-table number: 15.9/129.8.
4. *Gleicheniidites senonicus* ROSS 1949, slide: N-19-4, cross-table number: 8.5/145.6.
5. *Biretisporites* fsp., slide: N-19-1, cross-table number: 18.3/125.2.
6. *Maculatisporites microverrucatus* DÖRING 1964, slide: N-19-4, cross-table number: 25.7/125.3.
7. *Vadaszisporites sacali* DEÁK et COMBAZ 1967, slide: N-17-3, cross-table number: 17.3/128.6.
8. *Macroleptolepidites* fsp.$_1$, slide: N-19-3, cross-table number: 22.1/138.8.
9. *Macroleptolepidites* fsp.$_1$, slide: N-19-1, cross-table number: 19.6/126.4.
10. *Macroleptolepidites* fsp.$_2$, slide: N-19-3, cross-table number: 16.8/144.9.
11. Cf. *Macroleptolepidites* fsp., slide: N-19-4, cross-table number: 23.5/134..3.
12. *Polypodiaceoisporites* fsp. ex gr. *hungaricus* KEDVES 1961, slide: N-19-5, cross-table number: 15./142.2.
13. *Polypodiaceoisporites* fsp. ex gr. *hungaricus* KEDVES 1961, slide: N-17-1, cross-table number: 17.2/129.4.
14. *Polypodiaceoisporites* fsp. ex gr. *hungaricus* KEDVES 1961, slide: N-19-5, cross-table number: 14.3/141.7.
15. *Polypodiaceoisporites* fsp. ex gr. *hungaricus* KEDVES 1961, slide: N-17-5, cross-table number: 16.5/131.7.
16. *Distaltriangulisporites maximus* SINGH 1971, slide: N-19-5, cross-table number: 24.3/125.7.
17. *Distaltriangulisporites maximus* SINGH 1971, slide: N-17-2, cross-table number: 21.2/140.0.
18. *Distaltriangulisporites maximus* SINGH 1971, slide: N-17-3, cross-table number: 16.9/137.0.
19. *Distaltriangulisporites maximus* SINGH 1971, slide: N-19-2, cross-table number: 10.1/132.2.
20. *Distaltriangulisporites maximus* SINGH 1971, slide: N-17-2, cross-table number: 21.9/133.9.
21. *Distaltriangulisporites maximus* SINGH 1971, slide: N-17-3, cross-table number: 5.5/138.4.

Plate 8.2.

1. *Asbeckiasporites* fsp., slide: N-19-1, cross-table number: 3.9/138.6.
2. *Asbeckiasporites wirthi* v.d. BRELIE 1964, slide: N-2-5, cross-table number: 25.8/136.7.
3. *Gleicheniidites umbonatus* (BOLKHOVITINA 1953) BOLKHOVITINA 1968, slide: N-17-1, cross-table number: 9.8/135.9.
4. *Gleicheniidites (Triremisporites) latifolius* DÖRING 1965b, slide: N-19-3, cross-table number: 25.2/139.3.
5. *Gleicheniidites (Gleicheniidites) major* DÖRING 1965b, slide: N-19-2, cross-table number: 5.8/136.6.
6. *Asbeckiasporites wirthi* v.d. BRELIE 1964, slide: N-19-4, cross-table number: 26.7/128.9.
7. *Gleicheniidites (Triremisporites) rasilis* (BOLKHOVITINA 1953) KRUTZSCH 1959 syn.: *Gleicheniidites bulbosus* KEMP 1970, slide: N-17-9, cross-table number: 7.5/133.6.
8. *Gleicheniidites (Triremisporites) rasilis* (BOLKHOVITINA 1953) KRUTZSCH 1959 syn.: *Gleicheniidites bulbosus* KEMP 1970, slide: N-19-2, cross-table number: 23.6/125.9.
9. *Gleicheniidites (Triremisporites) rasilis* (BOLKHOVITINA 1953) KRUTZSCH 1959, slide: N-19-5, cross-table number: 14.2/128.7.
10. *Gleicheniidites (Triremisporites) rasilis* (BOLKHOVITINA 1953) KRUTZSCH 1959, slide: N-17-2, cross-table number: 7.2/140.2.
11. *Gleicheniidites (Triremisporites) rasilis* (BOLKHOVITINA 1953) KRUTZSCH 1959, slide: N-19-3, cross-table number: 23.3/129.3.
12. *Gleicheniidites (Triremisporites) rasilis/posttriplex*, intermediate form; slide: N-17-1, cross-table number: 24.4/137.9.
13. *Gleicheniidites (Triplexisporis) posttriplex* DÖRING 1965a, slide: N-17-3, cross-table number: 21.3/145.9.
14. *Gleicheniidites (Triplexisporis) posttriplex* DÖRING 1965a, slide: N-19-5, cross-table number: 17.8/138.4.
15. *Gleicheniidites umbonatus* (BOLKHIVITINA 1953) BOLKHOVITINA 1968, slide: N-17-5, cross-table number: 23.2/131.2.

16. *Gleicheniidites (Triplexisporis) posttriplex* DÖRING 1965a, slide: N-19-1, cross-table number: 13.9/132.1.
17. *Gleicheniidites (Triplexisporis) posttriplex* DÖRING 1965a, slide: N-19-5, cross-table number: 24.6/133.3.

Plate 8.3.

1. *Gleicheniidites (Triplexisporites) posttriplex* DÖRING 1965a, slide: N-19-5, cross-table number: 21.3/138.3.
2. *Gleicheniidites (Triplexisporites) posttriplex* DÖRING 1965a, slide: N-19-5, cross-table number: 14.2/132.2.
3. *Clavifera triplex* (BOLKHOVITINA 1953) BOLKHOVITINA 1966, slide: N-19-2, cross-table number: 8.5/133.5.
4. *Clavifera triplex* (BOLKHOVITINA 1953) BOLKHOVITINA 1966, slide: N-17-3, cross-table number: 13.4/133.5.
5. *Clavifera rudis* BOLKHOVITINA 1968, slide: N-17-3, cross-table number: 22.3/132.9.
6. *Clavifera rudis* BOLKHOVITINA 1968, slide: N-19-2, cross-table number: 18.6/130.0.
7. *Clavifera rudis* BOLKHOVITINA 1968, slide: N-17-5, cross-table number: 12.6/142.7.
8. *Clavifera rudis* BOLKHOVITINA 1968, slide: N-17-3, cross-table number: 7.8/138.2.
9. *Clavifera rudis* BOLKHOVITINA 1968, slide: N-17-4, cross-table number: 18.1/140.8.
10. *Clavifera rudis* BOLKHOVITINA 1968, slide: N-17-1, cross-table number: 14.9/140.0.
11. *Clavifera tuberosa* BOLKHOVITINA 1968, slide: N-17-4, cross-table number: 23.2/125.9.
12. *Clavifera tuberosa* BOLKHOVITINA 1968, slide: N-17-5, cross-table number: 8.4/145.9.
13. *Clavifera tuberosa* BOLKHOVITINA 1968, slide: N-19-4, cross-table number: 27.2/144.2.
14. *Clavifera tuberosa* BOLKHOVITINA 1968, slide: N-19-3, cross-table number: 25.8/132.2.
15. *Clavifera tuberosa* BOLKHOVITINA 1968, slide: N-19-1, cross-table number: 7.8/137.9.

Plate 8.4.

1. *Pteruchipollenites thomasii* COUPER 1958, slide: N-2-1, cross-table number: 13.5/130.8.
2. *Parvisaccites radiatus* COUPER 1958, slide: N-19-1, cross-table number: 26.4/130.9.
3. *Parvisaccites* fsp.$_1$, slide: N-17-1, cross-table number: 8.7/127.2.
4. *Parvisaccites enigmatus* COUPER 1958, slide: N-17-3, cross-table number: 20.0/125.3.
5. *Parvisaccites* fsp.$_2$, slide: N-19-1, cross-table number: 11.8/145.6.
6. *Alisporites rotundus* ROUSE 1959, slide: N-17-3, cross-table number: 12.1/137.6.