

Dinoflagellate cysts from the Bathonian — Tithonian (Jurassic) of North Bulgaria. II. Taxonomy of Oxfordian and Kimmeridgian dinoflagellate cysts

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Л. Додкова — Цисты динофлагеллат бата-титона (юра) в Северной Болгарии. II. Таксономия оксфордских и киммериджских цист динофлагеллат. Исследованы диноцисты оксфордских и киммериджских отложений по разрезам 39 нефтяных скважин. Их таксономия и стратиграфическое распространение является предметом этой статьи. Публикуются 72 вида 39 родов, распределенные в 4 группы в соответствии с их археопильной формацией. Особенно важное значение для указанного хроностратиграфического интервала имеют виды следующих родов: *Acanthaulax*, *Amphorula*, *Atlantodinium*, *Dinopterigium*, *Dissiliodinium*, *Epiplosphaera*, *Histiophora*, *Hystrichosphaerina*, *Leptodinium*, *Meristaulax*, *Scriniodinium*, *Systematophora*, *Taeniophora* и *Xenicodinium*. Для некоторых видов из этих родов характерно их массовое присутствие в Средиземноморской провинции. Это следующие виды: *Atlantodinium jurassicum*, *Epiplosphaera areolata*, *E. bireticulata*, *E. reticulospinosa*, *Histiophora ornata*, *Meristaulax granulata*, *Taeniophora filamentosa*, *T. iunctispina*, *Xenicodinium densibarbatum*. Здесь описаны 8 новых и потенциально новых видов: *Aldorfia* sp., *Hystrichosphaerina crusta* sp. n., *Hystrichosphaerina?* sp. aff. *H. sarjeantii*, *Kalyptea* sp. aff. *K. para*, *Scriniodinium* sp. aff. *S. luridum*, *Tehamadinium konarae* sp. n., *Tehamadinium* sp. aff. *T. konarae*, *Stephanelytron* sp. aff. *S. redcliffense*. Составлены две новые комбинации: *Lithodinia bejui* comb. n. и *Polygonifera bavarica* comb. n. Показано стратиграфическое распространение этих видов в Болгарии.

Abstract. The dinocysts in the Oxfordian and Kimmeridgian sedimentary rocks in 39 boreholes have been studied. Their taxonomy and stratigraphic range are object of this paper. The 72 species belonging to 39 genera are considered. They are divided into 4 groups according to the archeopyle type. Especially important for this chronostratigraphic interval are the species of the following genera: *Acanthaulax*, *Amphorula*, *Atlantodinium*, *Dinopterigium*, *Dissiliodinium*, *Epiplosphaera*, *Hystrichosphaerina*, *Leptodinium*, *Meristaulax*, *Scriniodinium*, *Systematophora*, *Taeniophora* and *Xenicodinium*. Some species of these genera are particularly numerous in the Mediterranean Province. These species are: *Atlantodinium jurassicum*, *Epiplosphaera areolata*, *E. bireticulata*, *E. reticulospinosa*, *Histiophora ornata*, *Meristaulax granulata*, *Taeniophora filamentosa*, *T. iunctispina*, *Xenicodinium densibarbatum*. The following new and potential new species are described: *Aldorfia* sp., *Hystrichosphaerina crusta* sp. n., *Hystrichosphaerina?* sp. aff. *H. sarjeantii*, *Kalyptea* sp. aff. *K. para*, *Scriniodinium* sp. aff. *S. luridum*, *Tehamadinium konarae* sp. n., *Tehamadinium* sp. aff. *T. konarae*, *Stephanelytron* sp. aff. *S. redcliffense*. Two new combinations are proposed: *Lithodinia bejui* comb. n. and *Polygonifera bavarica* comb. n. The stratigraphic distribution of the recorded species is given.

Introduction

The present paper is the second of a series of works on the results of taxonomic and biostratigraphic studies of Jurassic dinocysts in Bulgaria. It is scoped on the taxonomy of Oxfordian and Kimmeridgian dinocyst species.

The model of the texts of the papers and the used terminology are discussed in the introduction of the first paper (D o d e k o v a, 1990).

The longranging species, starting in the Bathonian and Callovian are not re-described here. They are given only in the range-chart showing the stratigraphic distribution of the species (fig. 2). At the same time species which start in the Oxfordian or the Kimmeridgian and continue to develop in the Tithonian will not be discussed in the next paper.

The Oxfordian and Kimmeridgian marine sediments in North Bulgaria have been drilled in boreholes but in far less locations than the sediments of the other Middle and Upper Jurassic stages. They were studied in 39 borehole sections (fig. 1) but the available core material commonly did not cover the whole chronostratigraphic interval Oxfordian-Kimmeridgian. Furthermore, the core material from the earlier cored boreholes has been repeatedly rearranged and reduced as a result of sampling for other types of analyses and for this reason some results of the present study are approximate.

Apart from the limited rock material, infavourable conditions for development and preservation of dinoflagellates and absence of dinocysts in a large part of the clays and marls of Provadija Formation and the dolomites of Drinovo Formation were serious obstacles to create a stable concept on the dinocyst successions during the Oxfordian and the Kimmeridgian in this country.

Some new species are represented by single or few specimens. This did not allow to study in more detail their diagnostic features, characteristics and intraspecific

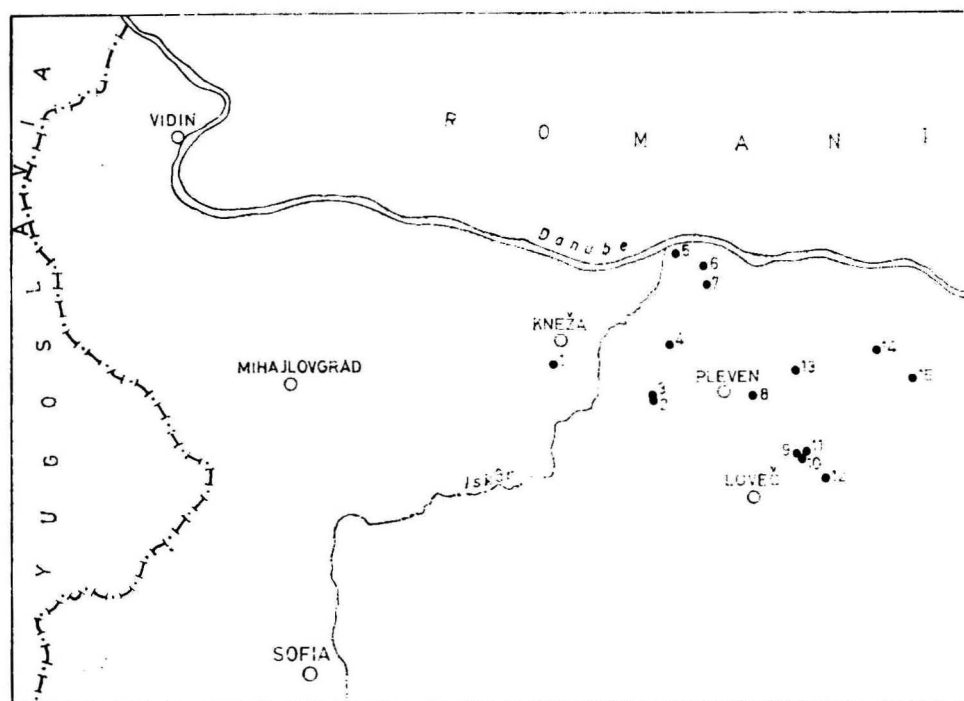


Fig. 1. Location of the studied boreholes with Oxfordian — Kimmeridgian sediments
 1 — R-1 Kneža, 2 — R-5 Dolni Dâbnik, 3 — R-1 Dolni Dâbnik, 4 — R-1 Trâstenik, 5 — R-1 Gigen, 6 — R-2 Dâbovan, 7 — R-3 Brest, 8 — D-2 Grivica, 9 — R-3 Devetaki, 10 — R-4 Devetaki, 11 — R-8 Devetaki, 12 — R-1 Brestovo, 13 — R-1 Slavjanovo, 14 — R-1 Stežerovo, 15 — R-2hg Ovča mogila, 16 — R-1 Čapaevo, 17 — R-1 Kavlak, 18 — S-30 Kardam, 19 — S-1 Raz-

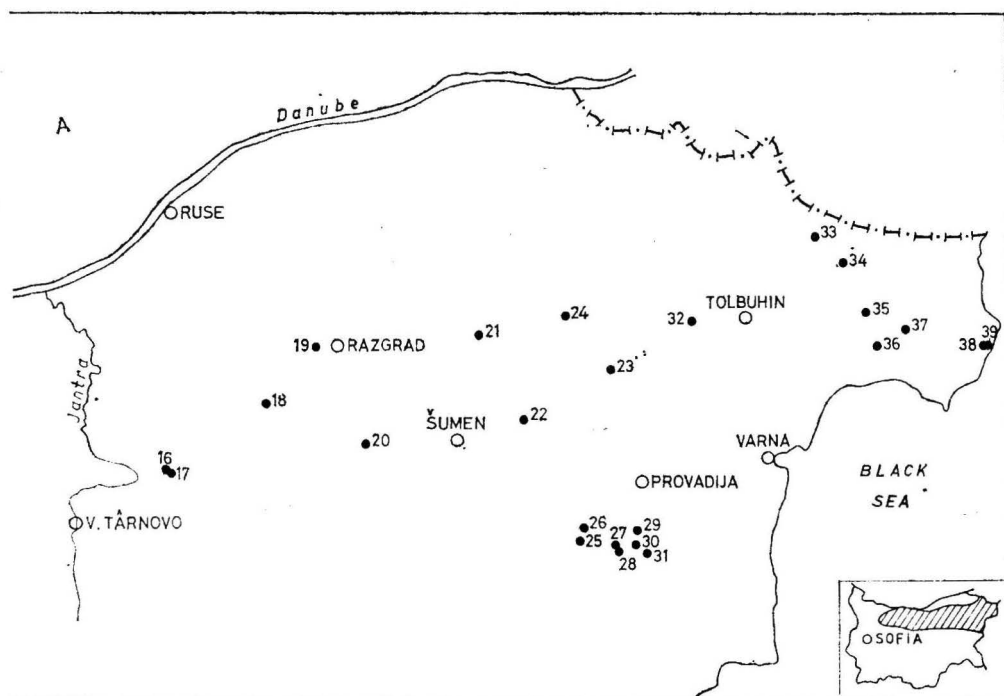
variability. They are indicated by microphotographs accompanied by short descriptions and notes. For the same reasons part of the studied dinocysts remained unidentified and were not included in this paper.

Dinoflagellate cysts, used for stratigraphic subdivision of the Upper Jurassic sediments in borehole sections, have been published by Николова, Сапунов (1985), Додикова in Сапунов et al. (1986a), Додикова in Сапунов et al. (1986b) and Додикова in Сапунов, Чумаченко (1987).

The chronostratigraphic subdivision of the Oxfordian and Kimmeridgian in Bulgaria, the ammonite successions related to the formal lithostratigraphic scheme and the motivation of the ammonite zones are published by Сапунов (1976a, 1976b, 1977) and Сапунов (1979). The substages and the ammonite zones of the Oxfordian and Kimmeridgian are shown in table 1.

The lithostratigraphic units, used in this paper, are described in the publication of Сапунов, Чумаченко (1986).

All dinocyst species studied and figured here are kept in the collections of the Geological Institute of the Bulgarian Academy of Sciences.



grad, 20 — R-3 Brjag, 21 — S-33 Esenica, 22 — S-21 Kalugerica, 23 — S-31 Esenica, 24 — S-24 Nikola Kozlevo, 25 — R-5 Tutrakanci, 26 — R-4 Mirovo, 27 — R-8 Sultanci, 28 — R-7 Sultanci, 29 — R-1 Junak, 30 — R-3 Junak, 31 — R-14 Grozdjovo, 32 — S-32 Dolina, 33 — R-9 Kardam, 34 — S-10 Černookovo, 35 — S-55 Konare, 36 — R-109 Vranino, 37 — S-140A Makedonka, 38 — R-3 Tjulenovo, 39 — R-1 Tjulenovo

DINOFLAGELLATE CYSTS	AGE		LATE JURASSIC					
			OXFORDIAN			KIMMERIDGIAN		
			EARLY	MIDDLE	LATE	EARLY	MIDDLE	LATE
1	2	3	4	5	6	7		
1. <i>Atopodinium prostaticum</i>	←							
2. <i>Pareodinia prolongata</i>	←							
3. <i>Gonyaulacysta centriconata</i>	←							
4. <i>Lagenadinium callovianum</i>	←							
5. <i>Lithodinia jurassica</i>	←							
6. <i>Pareodinia ceratophora scopaeus</i>	←							
7. <i>Lithodinia reticulata</i>	←							
8. <i>Mendicodinium groenlandicum</i>	←							
9. <i>Rigaudella apiculata</i>								
10. <i>Stephanelytron</i> sp. aff. <i>S. redcliffense</i>								
11. <i>Cleistosphaeridium lumectum</i>								
12. <i>Limbodinium absidatum</i>								
13. <i>Valensiella ampula</i>	←							
14. <i>Cleistosphaeridium tribuliferum</i>	←							
15. <i>Systematophora vestita</i>								
16. <i>Apteodinium nuciformis</i>								
17. <i>Prolixosphaeridium</i> cf. <i>anasillum</i>								
18. <i>Belodinium asaphum</i>	←							
19. <i>Sirmiodiniopsis orbis</i>	←							
20. <i>Gonyaulacysta jurassica</i>	←							
21. <i>Tubotuberella vozzhennikovae</i>	←							
22. <i>Nannoceratopsis pellucida</i>	←							
23. <i>Stephanelytron redcliffense</i>	←							
24. <i>Scriniodinium crystallinum</i>	←							
25. <i>Ctenidodinium ornatum</i>	←							
26. <i>Compositosphaeridium polonicum</i>	←							
27. <i>Korystocysta pachyderma</i>	←							
28. <i>Tubotuberella dangeardii</i>	←							
29. <i>Scriniodinium galeritum reticulatum</i>	←							
30. <i>Kalyptea stegasta</i>	←							
31. <i>Gonyaulacysta eisenackii</i>	←							
32. <i>Scriniodinium galeritum fornicatum</i>								
33. <i>Scriniodinium dictyophorum</i>								

fig. 2. Range-chart of the Bulgarian Oxfordian — Kimmeridgian dinocyst species

1	2	3	4	5	6	7
34. <i>Scriniodinium luridum</i>						
35. <i>Tehamadinium konarae</i>						
36. <i>Trichodinium capillatum</i>						
37. <i>Sentusidinium pelionense</i>					---	
38. <i>Lithodinia arcanitabulata</i>					---	
39. <i>Scriniodinium dictyotum osmingtonense</i>					---	
40. <i>Ctenidodinium chondrum</i>					---	
41. <i>Dissiliiodinium globulum</i>					---	
42. <i>Dingodinium minutum</i>	←					---
43. <i>Sentusidinium creberbarbatum</i>						---
44. <i>Stephanelytron scarburghense</i>	←					
45. <i>Acanthaulax granuligera</i>						
46. <i>Gonyaulacysta dualis</i>						
47. <i>Rhynchodiniopsis cladophora</i>	←					→
48. <i>Escharisphaeridia pocockii</i>	←					→
49. <i>Sentusidinium rioultii</i>	←					→
50. <i>Scriniodinium galeritum galeritum</i>	←					→
51. <i>Adnatosphaeridium caulleryi</i>	←					→
52. <i>Cleistosphaeridium polytrichum</i>	←					→
53. <i>Ellipsoidictyum cinctum</i>	←					→
54. <i>Rigaudella aemula</i>	←					→
55. <i>Chytroeisphaeridia chytroeides</i>	←					→
56. <i>Rigaudella filamentosa</i>	←					→
57. <i>Sirmiodinium grossi</i>	←					→
58. <i>Pareodinia ceratophora</i>	←					→
59. <i>Valensiella ovula</i>	←					→
60. <i>Systematophora areolata</i>						→
61. <i>Systematophora penicillata</i>						→
62. <i>Scriniodinium dictyotum dictyotum</i>						→
63. <i>Polygonifera bavarica</i>						→
64. <i>Caddasphaera halosa</i>						
65. <i>Scriniodinium dictyotum papillatum</i>						
66. <i>Kalyptea</i> sp. aff. <i>K. para</i>						
67. <i>Leptodinium mirabile</i>						
68. <i>Liesbergia scarburghensis</i>						
69. <i>Meristaulax granulata</i>						
70. <i>Taeniophora filamentosa</i>						
71. <i>Taeniophora iunctispina</i>		---				---

1	2	3	4	5	6	7
72. <i>Leptodinium subtile</i>						
73. <i>Cleistosphaeridium iaculigerum</i>						
74. <i>Aldorfia</i> sp.						
75. <i>Scrinioidinium</i> sp. aff. <i>S. luridum</i>						
76. <i>Tehamadinium</i> sp. aff. <i>T. konarae</i>						
77. <i>Cribrroperidinium</i> sp. A						
78. <i>Chlamydothorella wallala</i>						
79. <i>Lithodinia bejui</i>						
80. <i>Hystrichosphaerina orbifera</i>						
81. <i>Acanthaulax granulata</i>						
82. <i>Dinopterigium dimorphum</i>						
83. <i>Dingodinium jurassicum</i>						
84. <i>Hystrichodinium?</i> <i>lanceatum</i>						
85. <i>Rhynchodiniopsis gongylos</i>						
86. <i>Leptodinium</i> cf. <i>ambiguum</i>						
87. <i>Gochteodinia verrucosa</i>						
88. <i>Systematophora</i> sp. A						
89. <i>Scrinioidinium inritibilum</i>						
90. <i>Hystrichosphaerina crusta</i>						
91. <i>Rigaudella perforata</i>						
92. <i>Epiplosphaera areolata</i>						
93. <i>Epiplosphaera bireticulata</i>						
94. <i>Epiplosphaera reticulospinosa</i>						
95. <i>Amphorula dodekovae</i>						
96. <i>Prolixosphaeridium mixtispinosum</i>						
97. <i>Systematophora varispinosa</i>						
98. <i>Gonyaulacysta?</i> <i>crassicornuta</i>						
99. <i>Acanthaulax venusta</i>						
100. <i>Hystrichosphaerina sarjeantii</i>						
101. <i>Hystrichosphaerina?</i> sp. aff. <i>H. sarjeantii</i>						
102. <i>Xenicodinium densispinosum</i>						
103. <i>Histiophora ornata</i>						
104. <i>Atlantodinium jurassicum</i>						
105. <i>Lanterna emitecta</i>						
106. <i>Leptodinium clathratum</i>						
107. <i>Leptodinium mamilliferum</i>						
108. <i>Scrinioidinium playfordii</i>						
109. <i>Tehamadinium aculeatum</i>						
110. <i>Tubotuberella apatela</i>						

Table 1

Substages and ammonite zones of the Oxfordian and Kimmeridgian in Bulgaria (after Sapunov, 1976b, 1977)

Kimmeridgian

- Upper Kimmeridgian
 - Hybonoticer* *beckeri* Zone
- Middle Kimmeridgian
 - Aspidoceras sesquinodosum* Zone
 - Crussolicer* *Aspidoceras sesquinodosum* Interval Zone
- Lower Kimmeridgian
 - Crussolicer* *divisum* Zone
 - Ataxioceras* (*Ataxioceras*) *hypselocyclum* Zone
 - Ataxioceras* (*Parataxioceras*) *desmoides* Zone

Oxfordian

- Upper Oxfordian
 - Idoceras planula* Zone
 - Epipeltoceras bimammatum* Zone
 - Perisphinctes* (*Dichotomoceras*) *bifurcatus* Zone
- Middle Oxfordian
 - Gregorycer* *razi* Zone
 - Perisphinctes* (*Dichotomosphinctes*) *antecedens* Zone
 - Perisphinctes* (*Dichotomosphinctes*) *episcopalis* Zone
- Lower Oxfordian
 - Creniceras renggeri* Zone
 - Peltomorphites athletoides* Zone

Taxonomy

Dynocysts with apical archeophyle

Genus *Amphorula* Dodekova, 1969 emend. Zotto et al., 1987

Type species (by original designation): *Amphorula metaelliptica* Dodekova, 1969.

Amphorula dodekoveae Zotto et al., 1987

Pl. I, fig. 1-3

Type. Holotype illustrated by Zotto et al. (1987, pl. 2, fig. 1).

Occurrence. Boreholes: R-1 Slavjanovo (depth 1815 m, Kaspičan Formation, Middle? — Late Kimmeridgian); R-3 Brest (depth 1818.5 m, Kaspičan Formation, Middle? — Late Kimmeridgian); R-2 Dabovan (depth 1634.5 m, Kaspičan Formation, Middle? — Late Kimmeridgian); R-1 Trástenik (depth 2192 m, Plevén Formation, Late Kimmeridgian — Early Tithonian); R-5 Dolni Dábnik (depth 2655-2658 m, Plevén Formation, Middle? — Late Kimmeridgian); R-1 Junak (depth 1605 m, Tiča Formation, Middle Tithonian, *Chitinoidella* sp. indet., *Chitinoidella* Zone found at depth 1601.5 m); R-109 Vranino (depth 1289 m, Černookovo Formation, Early Kimmeridgian).

Genus *Atlantodinium* Zotto et al., 1987

Type species (by original designation): *Atlantodinium jurassicum* Zotto et al., 1987.

Atlantodinium jurassicum Zotto et al., 1987

Pl. I, figs 4, 5

Type. Holotype is illustrated by Zotto et al. (1987, pl. 4, fig. 6).

Occurrence. Boreholes: R-1 Slavjanovo (depth 1815 m, Kaspičan Formation, Middle? — Late Kimmeridgian); R-3 Brest (depth 1818.5 m, Kaspičan Formation, Middle? — Late Kimmeridgian); R-5 Dolni Dábnik, depth 2655-2658 m, Pleven Formation, Middle? — Late Kimmeridgian); R-1 Junak (depth 1605 m, Tiča Formation, Middle Tithonian, *Chitinoidella* sp. indet., *Chitinoidella* Zone found at depth 1601.5); R-109 Vranino (depth 1257 m, Černookovo Formation, Early Tithonian).

Genus *Chlamydophorella* Cookson & Eisenack, 1958 emend. Duxbury, 1983

Type species (by original designation): *Chlamydophorella nyei* Cookson & Eisenack, 1958.

Chlamydophorella wallala Cookson & Eisenack, 1960b

Pl. I, figs 6, 7.

Type. Holotype is illustrated by Cookson & Eisenack (1960b, pl. 38, fig. 13).

Comments. *C. wallala* is of mass occurrence in the Bulgarian Late Oxfordian—Early Kimmeridgian dinocyst assemblages and is a very good indicator of the Upper Oxfordian and the Lower Kimmeridgian.

Occurrence. Boreholes: S-1 Razgrad (depth 913.5 m, Drinovo Formation, Late Oxfordian—Early Kimmeridgian); R-7 Sultanci (depth 1840 m, Provadija Formation, Late Oxfordian, *Microbiplicites divergens* (Oppenheimer, 1907), *E. bimammatum* Zone, found at 1840.4 m); S-24 Nikola Kozlevo (depth 659-670 m, Černookovo Formation, Early Kimmeridgian); S-30 Kardam (depth 1114 m, Late Oxfordian; 1104 m, Early Kimmeridgian, Drinovo Formation); R-3 Tjulenovo (depth 954 m, Černookovo Formation, Late Oxfordian); R-109 Vranino (depth 1289 m, Černookovo Formation, Early Kimmeridgian); S-140A Makedonka (depth 1288 m, Černookovo Formation, Early Kimmeridgian, *Crussoliceria* sp. indet., *C. divisum* Zone, found at depth 1289.3 m); S-10 Černookovo (Černookovo Formation, depth 919 m, Late Oxfordian; 903 m, Late Oxfordian — Early Kimmeridgian; 892-898 m, Early Kimmeridgian); R-55 Konare (depth 1029-1033 m, Černookovo Formation, Early Kimmeridgian).

Genus *Cleistosphaeridium* Davey et al., 1966

Type species (by original designation): *Cleistosphaeridium diversispinosum* Davey et al., 1966.

Cleistosphaeridium iaculigerum (Klement, 1960) Brenner, 1988

Pl. I, fig. 9

Type. Holotype illustrated by Klement (1960, pl. 7, fig. 10), by Sarjeant (1984a, pl. 2, fig. 5) and by Brenner (1988, pl. 14, fig. 7).

Occurrence. Borehole: S-10 Černookovo (depth 933.2 m, Černookovo Formation, Late Oxfordian).

Cleistosphaeridium lumectum (Sarjeant, 1960a) Davey et al., 1969

Pl. I, fig. 8

Type. Holotype illustrated by Sarjeant (1960a, pl. 6, fig. 1, text-fig. 2).

Occurrence. Borehole: R-5 Tutrakanci (depth 1765 m, Provadija Formation, Early Oxfordian).

Genus *Dingodinium* Cookson & Eisenack, 1958

Type species (by original designation): *Dingodinium jurassicum* Cookson & Eisenack, 1958.

Dingodinium jurassicum Cookson & Eisenack, 1958

Pl. I, fig. 10

Type. Holotype illustrated by Cookson & Eisenack (1958, pl. 1, fig. 10)

Occurrence. Boreholes: S-10 Černookovo (depth 924-936 m, Černookovo Formation, Late Oxfordian); R-4 Mirovo (depth 1293 m, Tiča Formation, Tithonian); R-1 Junak (depth 1495 m, Tiča Formation, Late Tithonian, *Crassicollaria* Zone — *Crassicollaria brevis* Remane, 1962, *C. parvula* Remane, 1962, *Calpionella alpina* Lorenz, 1902; and the boreholes published by Додикова (1971, p. 6) — R-1 Dolni Dábník (depth 2519 m, Plevén Formation, Tithonian); R-1 Kneža (depth 2835 m, Plevén Formation, Tithonian); R-1 Trásteník (depth 2193 m, Plevén Formation, Late Kimmeridgian — Early Tithonian); R-1 Stežerovo (depth 1523 m, Plevén Formation, Tithonian).

Genus *Epiplosphaera* Klement, 1960 emend. Brenner, 1988

Type species (by original designation): *Epiplosphaera bireticulata* Klement, 1960.

Epiplosphaera areolata Klement, 1960

Pl. I, figs 11-13

Type. Holotype published by Klement (1960, pl. 8, figs 5-9) and by Brenner (1988, pl. 15, fig. 5).

Remarks. The affiliation of the species *E. areolata* to genus *Lithodinia*? (with some uncertainty) proposed by Sarjeant (1984a, p. 166) and accepted by Lentin & Williams (1989, p. 228) is rejected here. I support the opinion of Brenner (1988, p. 50, 51) and Courtinat (1989, p. 176) and retain the species to genus *Epiplosphaera*. This is the first, most simple member of a morpho-line represented by the species created by Klement: *E. areolata*, *E. reticulospinosa*, *E. biretikulata*.

The spines on the sutures in *E. areolata* are much more complex than those in the type species *L. jurassica* Eisenack, 1935 of genus *Lithodinia*. In the former the spines are with branched proximal ends, commonly coalesced with the adjacent spines and form a linear reticulum preserved only on the sutures. In *E. reticulospinosa* and *E. biretikulata* this reticulum extends also on the plate but the gonyaulacacean type of tabulation may be also observed, though with difficulty.

Occurrence. Boreholes: R-2 Dábovan (depth 1634.5 m, Kaspíčan Formation, Middle? — Late Kimmeridgian); R-1 Trásteník (depth 2192 m, Plevén Formation, Late Kimmeridgian — Early Tithonian); R-1 Tjulenovo (depth 800-806 m, Černookovo Formation, Early Tithonian); S-140A Make-donka (depth 1288 m, Černookovo Formation, Early Kimmeridgian, *Crussoliceras* sp. indet., *C. divi-sum* Zone found at 1289.3 m); R-1 Čapaevó (depth 2022 m, Drinovo Formation, Early Kimmeridgian).

Epiplosphaera bireticulata Klement, 1960

Pl. II, figs 1-3

Type. Holotype published by Klement (1960, pl. 8, figs 1-4) and Brenner (1988, pl. 15, fig. 1).

Occurrence. Boreholes: R-2 Ovča mogila (depth 1549 m, Pleven Formation, Kimmeridgian); R-1 Slavjanovo (depth 1815 m, Kaspičan Formation, Middle? — Late Kimmeridgian); R-3 Brest (depth 1818 m, Kaspičan Formation, Middle? — Late Kimmeridgian); R-2 Dabovan (depth 1634.5 m, Kaspičan Formation, Middle? — Late Kimmeridgian); R-1 Trástenik (depth 2192 m, Pleven Formation, Late Kimmeridgian — Early Tithonian); R-2 Grivica (depth 2385 m, Pleven Formation, Middle? — Late Kimmeridgian); S-24 Nikola Kozlevo (depth 657-669 m, Černookovo Formation, Early Kimmeridgian); R-109 Vranino (depth 1289-1291 m, Černookovo Formation, Early Kimmeridgian); S-10 Černookovo (depth 892 m, Černookovo Formation, Early Kimmeridgian); R-55 Konare (depth 1029 m, Černookovo Formation, Early Kimmeridgian); R-140A Makedonka (depth 1282 m, Černookovo Formation, Early Kimmeridgian); R-1 Čapaev (depth 2022 m, Drinovo Formation, Early Kimmeridgian).

***Epipliosphaera reticulospinosa* Klement, 1960**

Pl. II, figs 4-5

Type. Holotype figured by Klement (1960, pl. 8, figs 10, 11) and by Brenner (1988, pl. 15, fig. 3).

Occurrence. Boreholes: R-2 Ovča mogila (depth 1549 m, Pleven Formation, Kimmeridgian); R-3 Brest (depth 1747 m, Kaspičan Formation, Early Tithonian); R-2 Dabovan (depth 1634.5 m, Kaspičan Formation, Middle? — Late Kimmeridgian); R-1 Trástenik (depth 2192 m, Pleven Formation, Late Kimmeridgian — Early Tithonian); R-5 Dolni Dábnik (depth 2655-2658 m, Pleven Formation, Middle? — Late Kimmeridgian); S-24 Nikola Kozlevo (depth 669 m, Černookovo Formation, Early Kimmeridgian); S-30 Kardam (Drinovo Formation, depth 1065 m, Kimmeridgian; depth 1104 m, Early Kimmeridgian); R-1 Tjulenov (depth 800-806 m, Černookovo Formation, Early Tithonian); R-109 Vranino (depth 1289-1291 m, Černookovo Formation, Early Kimmeridgian; 1267-1270 m, Late Kimmeridgian — Early Tithonian; 1247.7-1250 m, Middle Tithonian, *Richterella cf. richteri* (Oppel, 1865) found at 1249.5 m); S-140A Makedonka (depth 1288 m, Černookovo Formation, Early Kimmeridgian, *Crussoliceras* sp. indet, *C. divisum* Zone found at 1289.3 m); S-32 Dolina (depth 716 m, Černookovo Formation, Early Kimmeridgian) and the borehole published by Додєкова (1971, p. 15, pl. 4, fig. 6) — R-1 Dolni Dábnik (depth 2519.5 m, Pleven Formation, Tithonian).

Genus *Histiophora* Klement, 1960

Type species (by original designation): *Histiophora ornata* Klement, 1960.

***Histiophora ornata* Klement, 1960**

Pl. II, figs 6-8.

Type. Holotype illustrated by Klement (1960, pl. 6, figs 11-13) and by Brenner (1988, pl. 19, fig. 10).

Occurrence. Boreholes: R-1 Slavjanovo (depth 1815 m, Kaspičan Formation, Middle? — Late Kimmeridgian, where it forms over 30% of the assemblage); R-3 Brest (depth 1818.5 m, Kaspičan Formation, Middle? — Late Kimmeridgian, over 30% of the assemblage); R-2 Dabovan (depth 1634.5 m, Kaspičan Formation, Middle? — Late Kimmeridgian); R-1 Trástenik (depth 2192 m, Plevan Formation, Late Kimmeridgian — Early Tithonian); R-2 Grivica (depth 2385 m, Plevan Formation, Middle? — Late Kimmeridgian); R-5 Dolni Dábnik (depth 2655-2658 m, Plevan Formation, Middle? — Late Kimmeridgian); R-109 Vranino (depth 1269 m, Černookovo Formation, Late? Kimmeridgian).

Genus *Hystrichosphaerina* Alberti, 1961

Type species (by original designation): *Hystrichosphaerina schindewolfi* Alberti, 1961.

Remarks. Sarjeant (1966c, p. 209) and Brenner (1988, p. 83) assume that genus *Hystrichosphaerina* is a junior synonym of genus *Systematophora*. This

assumption is rejected. I support the opinion of Stover & Evitt (1978, p. 57), Duxbury (1980, p. 125), Lentin & Williams (1981, p. 149; 1989, p. 190), Davey (1982b, p. 17) who retained the status of genus *Hystriospharina*. The distally linked by ring trabeculae intratabular complex processes distinguish the species of genus *Hystriospharina* from the distally free, with diverse termination, intratabular complex processes in the species of genus *Systematophora*.

***Hystriospharina crusta* sp. n.**

Pl. III, figs 1-3, 6, 9

Type. Holotype is the specimen shown in pl. III, figs 1-3, slide 3051-3, borehole R-2 Dabovan, depth 1634.5 m, Kaspičan Formation, Middle? — Late Kimmeridgian, Central North Bulgaria.

Derivation of name. Latin: crusta — carapace, relief ornamentation, related to the beautiful beaker-like relief processes.

Material. 3 specimens.

Dimensions (in μm). Holotype: length of central body, without apex — 65, breadth of central body — 68, height of processes — 15. Range: length — 65-68, breadth — 68-78, processes — 8-15.

Diagnosis. Phragmochorate cyst with subspherical central body and penitabular processes with beaker-like form and linearly arranged cingular processes. The tabulation is with gonyaulacacean tabulation formula: $4', 6'', 5-6''', 1p, 1pv, 1''''$, Xs. Cingulum formed of 6 pairs of slender processes. Archeopyle — apical, type A, operculum free with unknown structure.

Description. The wall is two-layered, the two layers being closely appressed at the central body. The periphragm forms the processes. Between them, it is scabrate to finely reticulate. Processes are beaker-like or tubiform, with strongly widened distal end. Their base is round or in the larger processes — with a flat side towards the cingulum. The wall is irregularly perforated (pl. III, fig. 2), lace-like to fenestrate. There is a thickening of the periphragm in the base of the processes. The width of the latter is varying depending on the position of the process, in analogy to the plates in the tabulate proximate cysts. The cingulum is formed of 6 pairs of slender processes, capitate or bifurcate distally. Sulcus structure not distinct. The archeopyle is apical, wide and with zig-zag margin and accessory archeopyle sutures. Operculum is free. All specimens have an archeopyle and the structure of the operculum is not known.

I have at my disposal few specimens and cannot evaluate the intraspecific variability in *H. crusta*. There are differences in the height of the beaker-like processes.

Remarks. The proportionally lower and not so intensively perforated process in *H. crusta* distinguish the species from the other species of genus *Hystriospharina*. The new species reminds of the species of genus *Amphorula* but the latter show arcuate penitabular processes opened towards the cingulum. *H. crusta* is similar to *Oligosphaeridium* sp. 1 Davey (1982b, pl. 2, figs 6, 8) but the latter lack cingular processes.

Occurrence. Boreholes: R-2 Dabovan (depth 1634.5 m, Kaspičan Formation, Middle? — Late Kimmeridgian); S-30 Kardam (depth 1111 m, Drinovo Formation, Early Kimmeridgian).

***Hystriospharina orbifera* (Klement, 1960) Stover & Evitt, 1973**

Pl. III, fig. 4

Type. Holotype illustrated by Klement (1960, pl. 9, fig. 9) and by Brenner (1988, pl. 16, fig. 1).

Occurrence. Boreholes: R-10 Černookovo (Černookovo Formation, depth 892.4 m, Early—Middle Kimmeridgian; 933 m, Oxfordian); S-24 Nikola Kozlevo (Černookovo Formation, depth 641.4 m, Late Kimmeridgian, 677.7 m, Late Oxfordian); S-30 Kardam (depth 1062.5–1111 m, Drinovo Formation, Kimmeridgian); R-109 Vranino (Černookovo Formation, depth 1250.9 m, Middle Tithonian, *Richterella* cf. *richteri* (O p p e l, 1865); 1269 m, Late Kimmeridgian).

Hystrichosphaerina sarjeanti (G i t m e z, 1970) D u x b u r y, 1980

Pl. III, fig. 7

Type. Holotype is illustrated by G i t m e z (1970, pl. II, fig. 4, text-fig. 25) and by G i t m e z & S a r j e a n t (1972, pl. 12, figs 8, 9).

Remarks. The species is illustrated only by the type specimen in both publications cited above. No data on a probable intraspecific variability are given, too. Information on identification of this species in other occurrences is lacking in the literature. D a v e y (1979c, p. 65, pl. 3, figs 4, 5) defined as *Polystephanephorus sarjeantii* several forms from the Early Ryazanian in East England but later D a v e y (1982b, p. 17) re-defined them as *Stiphrosphaeridium dictyophorum* on the basis of absence of cingular processes.

The cingular processes in *H. sarjeanti* are represented by 6 pairs of slender, solid, capitate or more frequently distally branched processes. They are analogous to the cingular processes described in genera *Amphorula*, *Systematophora* and *Periseiasphaeridium*. Their identification is difficult due to the complex morphology of the cysts.

Occurrence. Borehole R-2 Dábovan (depth 1634.5 m, Kaspičan Formation, Middle? — Late Kimmeridgian).

Hystrichosphaerina?* sp. aff. *H. sarjeantii (G i t n e z, 1970) D u x b u r y, 1980

Pl. IV, figs. 1-7

Description. The Kimmeridgian sediments drilled in borehole R-2 Dábovan (depth 1634.5 m) contain numerous specimens of cyst which resembles to *Stiphrosphaeridium dictyophorum* (C o o k s o n & E i s e n a c k, 1958) D a v e y, 1982b but shows well formed cingular processes. The latter are represented by 6 pairs of slender, solid processes, proximally linked with a low ridge. Distally they are capitate but most commonly bifurcate or double bifurcate. They are analogous to the cingular processes in genera *Amphorula*, *Systematophora* and *Periseiasphaeridium*.

The cyst is spherical to subspherical in shape, intermediate type between phragmochorate and skolochorate. The wall is two-layered. The penitabular processes do vary in size depending on their position on the cyst. Antiapical and postcingular dorsal processes are widest. In some specimens they form annulate complexes linked distally by ring trabeculae, similarly to the complexes in the species of *Hystrichosphaerina*. In other specimens the same processes are intratabular, funnel or tubiform, hollow and more or less fenestrate. The slenderer processes — 1'', 6'', 2''', 4'''' and 1p, and the sulcal processes are tubiform with very wide and fenestrate distal half. Less commonly the perforation begins immediately in their proximal margin where variable thickenings of the periphragm are observed.

The surface of the periphragm is scabrate while around and on the proximal margin of the processes it is striated. The wall is thin, easily breakable and deformable. Most of the specimens are broken, irrespective of the good state of the fossil material. This hampers the identification of the tabulation. With some uncertainty I suggest the following tabulation formula: 4'?, 6'', 6c, 6''', 1p, 1ps, 1''', Xs. The archeopyle is apical, with zig-zag margin and accessory archeopyle sutures, type 4A. The operculum is free.

D i m e n s i o n s (in μm). Average diameter of central body — 56-64, length of processes — 26-48, maximum diameter of processes in proximal end — 23-30, minimum diameter of processes in proximal end — 4 (12 specimens measured).

R e m a r k s. The described cyst in the assemblage associates with *Hystrichosphaerina sarjeantii*. The two species form the two ends of a morphological series. *H. sarjeantii* is a cyst with dominating annulate complex processes and rare single tubiform, hollow processes while in *Hystrichosphaerina?* sp. tubiform hollow processes predominate. Between the two end morphological types there are all possible transitions. Forms with mixed type processes dominate: unreduced or reduced annulate complexes for antapical and dorsal postsingular processes and tubiform processes with fenestrate distal end. The variations are related only to the width and degree of perforation of the processes. Analogous variations are observed in the type species of *Hystrichosphaerina* — *H. schindewolfii* Alberti, 1961. They mislead some authors to refer such forms to other genera — *Hystriosphæridium anthophorum* sensu Eisenack (1958, p. 402, pl. 26, figs. 1, 2) = *Periseiasphaeridium eisenacki* Davey & Williams (1969, p. 6); Davey (1974, p. 60, pl. 6, fig. 5) which Davey & Verdier (1974, p. 640) and Duxbury (1980, p. 126) include in the range of the species *H. schindewolfii*.

Kumar (1986, p. 396, pl. 2, fig. 5) indicated a form with processes analogous to *Hystrichosphaerina?* sp. as *Oligosphaeridium pulcherrimum* (Deflandre & Cookson, 1955) Davey & Williams, 1966 but in this case no information for circular processes is presented. *Hystrichosphaerina?* sp. may be included in the range of *H. sarjeantii* if in the type material there are forms which possess larger number of funnel/tubiform processes and if at the same time we enlarge the diagnosis of *Hystrichosphaerina*. Or it may be used as a base to create a new genus, morphologically similar to *Stiphosphaeridium* Davey (1982b, p. 16), but possessing linearly arranged circular processes.

O c c u r r e n c e. Borehole R-2 Dabovan (depth 1634.5 m, Kaspičan Formation, Middle? — Late Kimmeridgian); R-1 Junak (depth 1605 m, Tiča Formation, Middle Tithonian).

Genus **Lanterna** Dodekova, 1969

T y p e s p e c i e s (by original designation): *Lanterna bulgarica* Dodekova, 1969.

Lanterna emitecta Courtinat, 1989

Pl. II, figs. 10, 11

T y p e. Holotype is illustrated by Courtinat (1989, pl. 23, fig. 16).

O c c u r r e n c e. Boreholes: R-3 Devetaki (depth 2546-2548 m, Kaspičan Formation, Tithonian); R-1 Slavjanovo (depth 1815 m, Kaspičan Formation, Middle? — Late Kimmeridgian); R-1 Gigen (depth 1644.5 m, Kaspičan Formation, Tithonian); R-3 Brest (depth 1818.5 m, Kaspičan Formation, Middle? — Late Kimmeridgian); R-2 Dabovan (depth 1634.5 m, Kaspičan Formation, Middle? — Late Kimmeridgian); R-2 Grivica (depth 2385 m, Pleven Formation, Middle? — Late Kimmeridgian); R-109 Vranino (depth 1265-1269 m, Černookovo Formation, Late Kimmeridgian-Early Tithonian).

Genus **Lithodinia** Eisenack, 1935 emend. Gocht, 1975 b

T y p e s p e c i e s (by original designation): *Lithodinia jurassica* Eisenack, 1935.

***Lithodinia arcanitabulata* Brenner, 1988**

Pl. III, fig. 10

Type. Holotype figured by Brenner (1988, pl. 18, fig. 4).

Occurrence. Boreholes: S-9 Kardam (depth 877.5 m, Černookovo Formation, Early Oxfordian); S-24 Nikola Kozlevo (depth 669-670 m, Černookovo Formation, Early Kimmeridgian); S-10 Černookovo (depth 893.8-898 m, Early Kimmeridgian; 903 m, Late Oxfordian—Early Kimmeridgian; 919-934 m, Middle—Late Oxfordian, Černookovo Formation); R-55 Konare (depth 1029 m, Černookovo Formation, Early Kimmeridgian); R-109 Vranino (depth 1275 m, Middle? Kimmeridgian; 1289-1291 m, Early Kimmeridgian, Černookovo Formation).

***Lithodinia bejui* (Zotto et al., 1987) comb. n.**

Pl. II, figs 12, 13

Type. Holotype published by Zotto et al. (1987, pl. 1, fig. 1).

Occurrence. Boreholes: R-1 Trăstenik (depth 2192 m, Pleven Formation, Late Kimmeridgian—Early Tithonian); S-10 Černookovo (depth 933 m, Černookovo Formation, Late Oxfordian); S-140A Makedonka (depth 1282-1285 m, Černookovo Formation, Early Kimmeridgian).

Genus *Polygonifera* Habib, 1972 emend. Mehrotra & Sarjeant, 1984c emend. Brenner, 1988

Type species (by original designation): *Polygonifera evittii* Habib, 1972.

***Polygonifera bavarica* (Lund & Ecke, 1988) comb. n.**

Pl. II, fig. 9

1988. *Ambonosphaera bavarica* Lund & Ecke, p. 348, pl. 1, figs 2, 4.

1988. *Polygonifera* cf. *calloviana* Brenner, p. 69, pl. 12, fig. 6.

Type. Holotype figured by Lund & Ecke (1988, pl. 1, fig. 2, text-fig. 3a).

Remarks. Brenner (1988, p. 68) assumed genus *Ambonosphaera* Fensome, 1979 to be junior subjective synonym of *Polygonifera* Habib, 1972 which is accepted here. Therefore I refer the species *A. bavarica* to genus *Polygonifera* and on the basis of the published illustrations assume that the latter is identical to *P. cf. calloviana* Brenner as well to the Bulgarian specimens of the Upper Jurassic dinocyst assemblages.

Occurrence. Boreholes: R-2xg Ovča mogila (depth 1549 m, Pleven Formation, Kimmeridgian); R-1 Slavjanovo (depth 1815 m, Kaspician Formation, Middle? — Late Kimmeridgian); R-3 Brest (depth 1818 m, Kaspician Formation, Middle? — Late Kimmeridgian); R-2 Dâbovan (depth 1634.5 m, Kaspician Formation, Middle? — Late Kimmeridgian); R-1 Trăstenik (depth 2192 m, Pleven Formation, Late Kimmeridgian—Early Tithonian); S-10 Černookovo (depth 917.8-932.8 m, Černookovo Formation, Late Oxfordian); R-5 Tutrakanci (depth 1765 m, Provadija Formation, Early Oxfordian).

Genus *Prolixosphaeridium* Davey et al., 1966 emend. Davey, 1969a

Type species (by original designation): *Prolixosphaeridium deirense* Davey et al., 1966, which is accepted by Davey & Verdier (1974, p. 636) as a junior subjective synonym of *P. parvispinum* (Deflandre, 1937b) Davey et al. (1969, p. 17).

***Prolixosphaeridium* cf. *anasillum* Erkm en & Sarjeant, 1980**

Pl. III, fig. 9

Type. Holotype figured by Erkm en & Sarjeant (1980, pl. 4, figs 2, 9).

Remarks. The Bulgarian specimens have a larger number of processes as compared to the original material.

Occurrence. Boreholes: Tutrakanci (depth 1765 m, Provadija Formation, Early Oxfordian); R-109 Vranino (depth 1298 m, Provadija Formation, Early Oxfordian, *Neocampylites* (*Neocampylites*) cf. *helveticus* (Jeannet, 1951); S-10 Černookovo (depth 903 m, Černookovo Formation, Late Oxfordian).

***Prolixosphaeridium mixtispinosum* (Klement, 1960) Davey et al., 1969**

Pl. III, fig. 11

Type. Holotype of species figured by Klement (1960, pl. 6, figs 17, 18) and Brenner (1988, pl. 14, fig. 13).

Occurrence. Boreholes: R-3 Devetaki (depth 2546-2548 m, Kaspičan Formation, Tithonian); R-4 Devetaki (depth 2869-2871 m, Pleven Formation, Tithonian); R-1 Slavjanovo (depth 1815 m, Kaspičan Formation, Middle? — Late Kimmeridgian); R-1 Gigen (depth 1544.5 m, Kaspičan Formation, Tithonian); P-3 Brest (depth 1818.5 m, Kaspičan Formation, Middle? — Upper Kimmeridgian); R-2 Dâbovan (depth 1634.5 m, Kaspičan Formation, Middle? — Late Kimmeridgian); R-1 Trâstenik (depth 2192 m, Pleven Formation, Late Kimmeridgian — Early Tithonian); R-2 Grivica (depth 2385 m, Pleven Formation, Middle? — Late Kimmeridgian); R-5 Dolni Dâbnik (depth 2655-2658 m, Pleven Formation, Middle? — Late Kimmeridgian); R-1 Junak (depth 1605 m, Tiča Formation, Middle Tithonian); S-30 Kardam (depth 1104.8 m, Drinovo Formation, Early Kimmeridgian); R-1 Tjulenovo (depth 800-806 m, Černookovo Formation, Early Tithonian); R-109 Vranino (depth 1253 m, Middle Tithonian, *Richterella* cf. *richteri* (Oppel, 1865); 1270 m, Late Kimmeridgian — Early Tithonian, Černookovo Formation); R-1 Čapaevo (depth 2022 m, Drinovo Formation, Early Kimmeridgian) and the boreholes published by Додикова (1971, p. 13, pl. 5, fig. 4): R-1 Dolni Dâbnik (depth 2560.5 m, Pleven Formation, Tithonian); R-1 Stežerovo (depth 1523 m, Pleven Formation, Tithonian).

Genus *Rigaudella* Below, 1982b

Type species (by original designation): *Hystrichosphaeridium aemulum* Deflandre, 1938b.

***Rigaudella apiculata* (Cookson & Eisenack, 1960b) sensu Below, 1982b**

Pl. VI, fig. 1

Type. Holotype figured by Cookson & Eisenack (1960b, pl. 39, fig. 15).

Remarks. When this paper was already prepared I received the latest "Index" of Lentin & Williams (1989, p. 279). They point out that Davey (1988, p. 88) chose *Cannosphaeropsis apiculata* Cookson & Eisenack, 1960b as type species of his new genus *Papudinium* Davey, 1988. Unfortunately I did not possess this paper of Davey. Like this I compare Bulgarian specimens with the specimens identified by Bellow (1982b, p. 148, figs 7, 24, 26) as *Rigaudella apiculata* from Upper Callovian—Lower Oxfordian, Southern Germany.

Occurrence. Borehole R-109 Vranino (Provadija Formation, depth 1298-1303 m, Early Oxfordian, *Neocampylites* (*Neocampylites*) *delmontanus* (Oppel, 1863) found at 1299 m; *Neocampylites* (*Neocampylites* cf. *helveticus* (Jeannet, 1951) found at 1300 m).

***Rigaudella perforata* (Alberti, 1961) Below, 1982b**

Pl. VI, fig. 2

Type. Holotype figured by Alberti (1961, pl. 9, fig. 14).

Occurrence. Borehole S-30 Kardam (depth 1062.5 m, Drinovo Formation, Kimmeridgian).

Genus *Sentusidinium* Sarjeant & Stover, 1978

Type species (by original designation): *Tenua rioultii* Sarjeant, 1968.

Remarks. *Sentusidinium* Sarjeant & Stover, 1978 is a large-embraced genus which can be divided according to: 1. overall form — elongate-ovoidal ambitus (*S. creberbarbatum*) or broadly subspheroidal ambitus, apteate (*S. rioultii*); 2. length and type of processes — relatively short spines with simple tips and ornaments with low relief (*S. verrucosum*, *S. pelionense*, *S. myriatrichum*) or relatively longer processes with various distal tips (*S. rioultii*).

Courtinat (1989, pp. 185, 190, 192) established two new genera *Barbatocysta* and *Pilosidinium* for a part of the species of *Sentusidinium* and emended the diagnosis of the latter. All this needs additional reasoning and did not accept in this paper. The genus *Barbatocysta* is characterized by Courtinat with gonyaulacacean tabulation and determined tabulation formula. As a matter of fact the original diagnosis of the type species *Sentusidinium creberbarbatum* Erkmén & Sarjeant, 1980 (p. 52, fig. 2) do not possess any tabulation pattern except the archeopyle margin. The same refer to all species included in *Barbatocysta*. The emendation of the genus *Sentusidinium* by Courtinat (1989, p. 192) includes also tabulation indicated by sutural arranged processes. The type species *S. rioultii*, as all other species of the genus, do not possess tabulation features except the archeopyle and accessory archeopyle sutures. At any rate, in this paper, the original diagnosis of Sarjeant & Stover (1978, p. 49) for *Sentusidinium* is supported.

***Sentusidinium creberbarbatum* Erkmén & Sarjeant, 1980**

Pl. III, fig. 5

Type. Holotype figured by Erkmén & Sarjeant, 1980, text-fig. 2.

Occurrence. Boreholes: S-9 Kardam (depth 877.5 m, Černookovo Formation, Early Oxfordian); S-33 Esenica (depth 753-756 m, Černookovo Formation, Early Oxfordian); S-21 Kalugerica (depth 884.4-889 m, Černookovo Formation, Early Oxfordian); R-5 Tutrakanci (depth 1579 m, Kimmeridgian; 1765 m, Early Oxfordian, Provadija Formation); S-24 Nikola Kozlevo (depth 668-670 m, Černookovo Formation, Early Kimmeridgian); R-109 Vranino (Černookovo Formation, depth 1275 m, Kimmeridgian; 1291 m, Early Kimmeridgian; Provadija Formation, 1293.8 m, Late Oxfordian, *Idoceras* sp. found at 1294.2 m; 1299 m, Early Oxfordian with *Neocampylites* (*Neocampylites*) *delmontanus* (Oppel, 1863); 1300 m, Early Oxfordian); S-10 Černookovo (Černookovo Formation, depth 903 m, Late Oxfordian — Early Kimmeridgian; 932.8-938 m. Middle — Late Oxfordian).

***Sentusidinium pelionense* Fensome, 1979**

Pl. V, fig. 6

Type. Holotype figured by Fensome (1979, pl. I, figs 5, 7).

Occurrence. Boreholes: R-2hg Ovča mogila (depth 1549 m, Pleven Formation, Kimmeridgian); S-10 Černookovo (depth 933 m, Černookovo Formation, Late Oxfordian); S-9 Kardam (depth 877.5 m, Černookovo Formation, Early Oxfordian); S-21 Kalugerica (depth 889.5 m, Černookovo Formation, Early? Oxfordian); S-140A Makedonka (depth 1282 m, Černookovo Formation, Early Kimmeridgian); R-109 Vranino (depth 1291.6 m, Černookovo Formation, Early Kimmeridgian).

Genus *Stephanelytron* Sarjeant, 1961a emend. Stover et al., 1977

Type species (by original designation): *Stephanelytron redcliffense* Sarjeant, 1961a.

Stephanelytron sp. aff. *S. redcliffense* Sarjeant, 1961a

Pl. IX, figs 5, 7, 10

Description and remarks. I possess only one good preserved specimen similar to *S. redcliffense* Sarjeant, 1961a but with rare tubiforme processes. Some precingular and postcingular sutural rows include only 2-3 processes. The latter are thin, slender with truncate distal ends. It is possibly this differentiation to be in the scope of intraspecific variability in *S. redcliffense*.

Dimensions (in μm). Length — 46, breadth — 36, length of processes — 5, length of corona — 6.

Occurrence. Borehole S-9 Kardam (depth 877.5 m, Černookovo Formation, Early Oxfordian).

Genus *Systematophora* Klement, 1960

Type species (by original designation): *Systematophora areolata* Klement, 1960.

Systematophora areolata Klement, 1960

Pl. V, fig. 3

Type. Holotype illustrated by Klement (1960, pl. 9, figs 1-3).

Occurrence. Boreholes: R-1 Slavjanovo (depth 1815 m, Kaspičan Formation, Middle? — Late Kimmeridgian); R-1 Trštenik (depth 2192 m, Pleven Formation, Late Kimmeridgian — Tithonian); R-5 Dolni Dabnik (depth 2655-2658 m, Pleven Formation, Middle? — Late Kimmeridgian); S-32 Dolina (depth 738 m, Černookovo Formation, Early — Middle Oxfordian, *Creniceras* cf. *renggeri* (Oppel, 1863), *C. renggeri* Zone, found at 743 m); S-24 Nikola Kozlevo (depth 669-670 m, Černookovo Formation, Early Kimmeridgian); S-30 Kardam (depth 1104 m, Drinovo Formation, Early Kimmeridgian); S-10 Černookovo (depth 833-888 m, Černookovo Formation, Kimmeridgian — Dodekova, 1967, p. 23, pl. 3, figs 7, 8).

Systematophora penicillata (Ehrenberg, 1854) Sarjeant, 1980a

Pl. V, fig. 4

Type. Holotype of the species refigured by Sarjeant (1980a, p. 282, pl. 37).

Remarks. Dodekova (1967, p. 24, pl. 3) published this species as *S. fasciculigera* Klement, 1960. Sarjeant (1980a, p. 282) point out that the latter is a junior subjective synonym of *S. penicillata* (Ehrenberg, 1854).

Occurrence. Boreholes: R-4 Devetaki (depth 2869-2871 m, Pleven Formation, Tithonian); R-2hg Ovča mogila (depth 1549 m, Pleven Formation, Kimmeridgian); R-1 Slavjanovo (depth 1815 m, Middle? — Late Kimmeridgian, Kaspičan Formation); R-1 Stežerovo (depth 1620 m, Kaspičan Formation, Tithonian); R-3 Brest (depth 1818.5 m, Kaspičan Formation, Middle? — Late Kimmeridgian); R-2 Dabovan (depth 1634.5 m, Kaspičan Formation, Middle? — Late Kimmeridgian); R-1 Trštenik (depth 2193.7 m, Pleven Formation, Late Kimmeridgian — Tithonian); R-2 Grivica (depth 2385 m, Pleven Formation, Middle? — Late Kimmeridgian); R-5 Dolni Dabnik (depth 2655-2658 m, Pleven Formation, Middle? — Late Kimmeridgian); S-1 Razgrad (depth 933.5 m, Drinovo Formation, Oxfordian); S-9 Kardam (depth 872.2 m, Černookovo Formation, Early Oxfordian); S-33; Esenica (depth 744.3 m, Černookovo Formation, Middle Oxfordian — Early Kimmeridgian); S-21 Kalugeri-ca (depth 884.4 m, Černookovo Formation, Oxfordian); S-24 Nikola Kozlevo (depth 638.8 m, Drino-

vo Formation, Early Tithonian); S-10 Černookovo (depth 892.4 m, Early Kimmeridgian; 933 m, Late Oxfordian, Černookovo Formation); S-32 Dolina (depth 738 m, Černookovo Formation, Early — Middle Oxfordian, *Creniceras* cf. *renggeri* (O p p e l, 1863), *C. renggeri* Zone found at 743 m); S-30 Kardam (Drinovo Formation, depth 1104 m, Early Kimmeridgian; 1115.4 m, Early — Middle Oxfordian); R-109 Vranino (depth 1275 m, Černookovo Formation, Kimmeridgian); R-1 Kavlak (depth 2330 m, Drinovo Formation, Oxfordian).

***Systematophora varispinosa* Brenner, 1988**

Pl. V, figs 8, 9

Type. Holotype figured by Brenner (1988, pl. 16, fig. 2).

Occurrence. Boreholes: R-2hg Ovča mogila (depth 1549 m, Pleven Formation, Kimmeridgian); R-1 Slavjanovo (depth 1815 m, Kaspičan Formation, Middle? — Late Kimmeridgian); R-3 Brest (depth 1818.5 m, Kaspičan Formation, Middle? — Late Kimmeridgian); R-2 Gričica (depth 2385 m, Pleven Formation, Middle? — Late Kimmeridgian); R-5 Dolni Dâbnik (depth 2655-2658 m, Plevan Formation, Middle? — Late Kimmeridgian).

***Systematophora vestita* (Deflandre, 1938b) Davey, 1982b**

Pl. V, fig. 1

Type. Holotype figured by Deflandre (1938b, pl. 11, fig. 5).

Occurrence. Boreholes: S-10 Černookovo (depth 924.5 m, Černookovo Formation, Late Oxfordian); S-9 Kardam (depth 877.5 m, Černookovo Formation, Early Oxfordian); R-5 Tutrakanci (depth 1765 m, Provadija Formation, Early Oxfordian); R-109 Vranino (depth 1298 m, Provadija Formation, Early Oxfordian, *Neocampylites* (*Neocampylites*) *delmontanus* (O p p e l, 1863) found at 1299 m).

***Systematophora* sp. A Dürer, 1988**

Pl. V, figs 5, 10

Remarks. I have 6 specimens of this species. Morphological features coincide completely with description of the species by Dürer (1988, p. 102, pl. 11, figs 9, 10). Dimensions (in μm) of the Bulgarian specimens are smaller than the German: length — 60, breadth — 48-52, height of processes — 6-8.

Occurrence. Boreholes: R-55 Konare (depth 1029 m, Černookovo Formation, Early Kimmeridgian); S-24 Nikola Kozlevo (depth 668 m, Černookovo Formation, Early Kimmeridgian); R-1 Junak (depth 1605 m, Tiča Formation, Middle Tithonian).

Genus ***Taeniophora* Klement, 1960 emend. Sarjeant, 1984a**

Type species (by original designation): *Taeniophora iunctispina* Klement, 1960.

Remarks. In this paper I support the opinion of Sarjeant (1984a, pp. 166-168) that *Taeniophora* differs categorically in morphology from *Systematophora*. Sarjeant (ibid., p. 169, text-fig. 6) argued and illustrated very well the distinctions between the two genera.

***Taeniophora filamentosa* Klement, 1960 emend. Sarjeant & Gocht in Sarjeant, 1984a**

Pl. V, fig. 7

Type. Holotype figured by Klement, (1960, pl. 10, fig. 5), by Sarjeant (1984a, pl. 2, figs 3, 4) and by Brenner (1988, pl. 17, fig. 3).

Occurrence. Boreholes: S-10 Černookovo (depth 903 m, Late Oxfordian — Early Kimmeridgian); S-30 Kardam (depth 1114 m, Drinovo Formation, Late Oxfordian); R-3 Tjulenovovo (depth 954 m, Černookovo Formation, Oxfordian); S-140A Makedonka (depth 1282-1285 m, Černookovo Formation, Early Kimmeridgian, *Crussolicerias* sp. indet., *C. divisum* Zone, found at 1289.3 m); S-9 Kardam (depth 877.5 m, Černookovo Formation, Early Oxfordian).

Taeniophora iunctispina Klement, 1960 emend. Sarjeant & Gocht in Sarjeant, 1984a

Pl. V, fig. 2

Type. Holotype figured by Klement (1960, pl. 10, figs 1, 2), by Sarjeant (1984a, pl. 3, figs 1, 2) and by Brenner (1988, pl. 17, fig. 3).

Occurrence. Boreholes: S-10 Černookovo (depth 903-911 m, Černookovo Formation, Late Oxfordian — Early Kimmeridgian); R-55 Konare (depth 1029-1033 m, Černookovo Formation, Early Kimmeridgian); S-21 Kalugerica (depth 875 m, Černookovo Formation, Middle — Late Oxfordian); R-5 Tutrakanci (depth 1580 m, Provadija Formation, Early Kimmeridgian); S-30 Kardam (Drinovo Formation, depth 1104 m, Early Kimmeridgian; 1114 m, Late Oxfordian); R-109 Vranino (depth 1275 m, Černookovo Formation, Kimmeridgian).

Dinocysts with intercalary archeopyle

Genus ***Gochteodinia*** Norris, 1978

Type species (by original designation): *Imbatodinium villosum* Vozzhennikova, 1967.

Gochteodinia verrucosa (Vozzhennikova, 1967) Dörhöfer & Davies, 1980

Pl. VI, fig. 3

Type. Holotype figured by Vozzhennikova (1967, pl. 12, fig. 6).

Occurrence. Borehole S-109 Vranino (depth 1291.6 m, Černookovo Formation, Early Kimmeridgian).

Genus ***Kalyptea*** Cookson & Eisenack, 1960b emend. Wiggins, 1975

Type species (by original designation): *Kalyptea diceras* Cookson & Eisenack, 1960b.

Kalyptea para (Gitmez, 1970) comb. n.

Type. Holotype figured by Gitmez (1970, pl. 9, fig. 4).

Remarks. Wiggins (1975, p. 110) accepts *Netrelytron parum* Gitmez (1970, p. 314) as junior subjective synonym of *Netrelytron trinetron* Sarjeant (1966, p. 199) and transferred it to genus *Kalyptae* Cookson & Eisenack (1960b, p. 256). I keep up the opinion of Wiggins that *Netrelytron* is a junior subjective synonym of the genus *Kalyptea* but for stratigraphic reasons I retain *K. para* as a separate species. The latter is known from the Early Kimmeridgian and *K. trinetron* is from the Middle Barremian. There is a big gap without any data for finds of the one or the other species. Their morphological features are identical with insignificant differentiation in size only. If there are some data for their occurrence in the interval between Kimmeridgian and Barremian they must be accepted as synonyms as noted Wiggins (1975, p. 110).

Kalyptea sp. aff. **K. para** (G i t m e z, 1970)

Pl. VII, fig. 1

Description and remarks. Proximate cyst, subspherical kalypteoid in shape with strong apical horn and blunt short mamilliform antapical prominence. The wall is single-layered with many folds as noted W i g g i n s (1975, pp. 99, 110). In some parts of the cyst these folds absent which is in contradiction with an endocyst. The archeopyle is intercalary, type 21. Kalyptra and apicular structure exist. The auto-phragm is granulate to verrucose. Some neighbouring verrucae may have coalesced bases. The verrucae are denser on the antapical cyst end. These ornaments differ the Bulgarian specimens from the specimens published by G i t m e z (1970, p. 314).

Dimensions (in μm). Length — 75, breadth — 56, apical horn — 15, antapical prominence — 4.

Occurrence. Boreholes: S-10 Černookovo (depth 936 m, Černookovo Formation, Middle — Late Oxfordian); R-109 Vranino (depth 1291.6 m, Černookovo Formation, Early Kimmeridgian).

Dinocysts with precingular archeopyle

Genus **Acanthaulax** S a r j e a n t, 1968 emend. B r e n n e r, 1988

Type species (by original designation): *Gonyaulax venusta* K l e m e n t, 1960.

Acantaulax granulata (K l e m e n t, 1960) B r e n n e r, 1988

Pl. VII, fig. 2

Type. Holotype of the species is specimen figured by K l e m e n t (1960, pl. 4, figs 10, 11), not the specimen indicated by J a n d u C h ê n e et al. (1986a, pl. 27, fig. 6). B r e n n e r (1988, p. 35) note that the type specimen of K l e m e n t is not found. The lectotype denoted by S a r j e a n t (1982a, pl. 3, figs 3, 4) and by J a n d u C h ê n e et al. (1986a, pl. 27, figs 7-10) is from sample which not come from the type horizon of K l e m e n t (B r e n n e r, 1988, p. 35 and p. 65). The lectotype from the type horizon of K l e m e n t is figured by B r e n n e r (1988, pl. 1, fig. 3).

Occurrence. Boreholes: R-8 Devetaki (depth 2327.2 m, Pleven Formation, Tithonian); S-1 Razgrad (depth 727.3 m, Drinovo Formation, Late Kimmeridgian—Tithonian); S-10 Černookovo (depth 892-903 m, Černookovo Formation, Late Oxfordian — Early Kimmeridgian); R-5 Tutrakanci (depth 1579 m, Provadija Formation, Kimmeridgian); R-1 Tjulenov (depth 800-806 m, Černookovo Formation, Early Tithonian); R-1 Dolni Dabnik (depth 2519.5 m, Pleven Formation, Tithonian).

Acantaulax granuligera (K l e m e n t, 1960) B r e n n e r, 1988

Pl. VI, figs 4, 5

Type. Holotype figured by K l e m e n t (1960, pl. 5, figs 4, 5), by S a r j e a n t (1984a, pl. 1, figs 3, 4), by J a n d u C h ê n e et al. (1986a, pl. 27, figs 11-14) and by B r e n n e r (1988, pl. 2, fig. 1).

Occurrence. Boreholes: R-3 Brest (depth 1818.5 m, Kaspičan Formation, Middle? — Late Kimmeridgian); R-2 Dabovan (depth 1634.5 m, Kaspičan Formation, Middle? — Late Kimmeridgian); S-10 Černookovo (depth 933 m, Černookovo Formation, Late Oxfordian); S-9 Kardam (depth 877.5 m, Černookovo Formation, Early Oxfordian).

Acantaulax venusta (Klement, 1960) Sarjeant, 1968

Pl. VII, fig. 3

Type. Holotype figured by Klement (1960, pl. 5, figs 10, 11) but at revision of the original slide of Klement, the holotype and the paratype are not found. Like this, Brenner (1988, pl. 1, fig. 1) designated and figured lectotype from the type material of Klement.

Occurrence. Boreholes: R-3 Devetaki (depth 2546-2548 m, Kaspičan Formation, Tithonian); R-8 Devetaki (depth 2328 m, Plevan Formation, Tithonian); R-2hg Ovča mogila (depth 1549 m, Plevan Formation, Kimmeridgian); R-1 Slavjanovo (depth 1815 m, Kaspičan Formation, Middle? — Late Kimmeridgian); R-3 Brest (depth 1818.5 m, Kaspičan Formation, Middle? — Late Kimmeridgian); R-2 Dabovan (depth 1634.5 m, Kaspičan Formation, Middle? — Late Kimmeridgian); R-1 Trštenik (depth 2192-2193.4 m, Plevan Formation, Late Kimmeridgian — Early Tithonian); R-2 Grivica (depth 2385 m, Plevan Formation, Middle? — Late Kimmeridgian); S-30 Kardam (depth 1062 m, Drinovo Formation, Late Kimmeridgian); R-1 Tjuleno (depth 800-806 m, Černookovo Formation, Early Tithonian); R-109 Vranino (depth 1250-1275 m, Černookovo Formation, Kimmeridgian — Middle Tithonian).

Genus *Aldorfia* Stover & Evitt, 1978

Type species (by original designation): *Gonyaulacysta aldorfensis* Gocht, 1970b.

***Aldorfia* sp.**

Pl. VI, figs 7, 8, 10, 11

Description and remarks. Proximate subspherical cyst with apical prominence and thick two-layered cyst wall (by Brenner, 1988, p. 32, fig. 14C). The tabulation is obscure, indicated by cingulum and precingular archeopyle, type P (3''). The cyst ornamentation is irregular reticulum and resemble "noneycomb" with polygonal or rounded outline of the meshes. Diameter of the latter varies from 0.5 μ m to 1.5 μ m.

Dimensions (in μ m). Length — 79-86, width — 68-71 (two specimens measured). The reticulum of the cyst wall differs *Aldorfia* sp. from the other species of the genus.

Occurrence. Borehole S-10 Černookovo (depth 932.8-933 m, Černookovo Formation, Late Oxfordian).

Genus *Apteodinium* Eisenack, 1958 emend. Sarjeant, 1985a

Type species (by original designation): *Apteodinium granulatum* Eisenack 1958.

Apteodinium nuciformis (Deflandre, 1938b) Stover & Evitt, 1978

Pl. VII, fig. 5

Type. Holotype figured by Deflandre (1938, pl. 8, fig. 6) and by Janduchène et al. (1986a, pl. 11, figs 1-3).

Occurrence. Boreholes: S-9 Kardam (depth 877.5 m, Černookovo Formation, Early Oxfordian); S-10 Černookovo (depth 917.8 m, Černookovo Formation, Late Oxfordian); S-2! Kalugerica (depth 884.5 m, Černookovo Formation, Oxfordian); R-109 Vranino (depth 1293.8 m, Provađija Formation, Late Oxfordian, *Idoceras* sp., *I. planula* Zone, found at 1294.2 m).

Genus **Cribroperidinium** Neale & Sarjeant, 1962 emend. Helenes, 1984

Type species (by original designation): *Cribroperidinium sepimentum* Neale & Sarjeant, 1962.

Cribroperidinium sp. A. Brenner, 1988

Pl. VI, figs 6, 9

Remarks. I possess two specimens of this species which coincide by dimensions (in μm , length — 109, width — 72, apical horn — 15), description and stratigraphic occurrence with the species described by Brenner (1988, p. 44, pl. 3, fig. 1).

Occurrence. Borehole S-30 Kardam (depth 1111.3-1114.5 m, Drinovo Formation, Late Oxfordian — Early Kimmeridgian).

Genus **Gonyaulacysta** Deflandre, 1964 emend. Stover & Evitt, 1978 emend Sarjeant, 1982a

Type species (by original designation): *Gonyaulax jurassica* Deflandre, 1938b.

Gonyaulacysta dualis (Brideaux & Fisher, 1976) Stover & Evitt, 1978

Pl. VII, fig. 6

Type. Holotype figured by Brideaux & Fisher (1976, pl. 1, figs. 4, 5) and by Janduchêne et al. (1986a, pl. 37, figs 11, 12).

Remarks. Sarjeant (1982a, p. 29) considered this species to be a junior subjective synonym of *G. jurassica*. This opinion is here rejected. I support Janduchêne et al. (1986a, p. 131) and Brenner (1988, p. 54) and retain *G. dualis* as a distinct and separate species.

Occurrence. Boreholes: S-10 Černookovo (depth 892.4 m, Černookovo Formation, Early Kimmeridgian); S-30 Kardam (depth 1104 m, Drinovo Formation, Early Kimmeridgian); P-109 Vranino (depth 1275 m, Černookovo Formation, Kimmeridgian); R-9 Kardam (depth 877.5 m, Černookovo Formation, Early Oxfordian).

Gonyaulacysta? crassicornuta (Klement, 1960) Sarjeant, 1969 emend. Sarjeant, 1984a

Pl. VII, figs 9, 10

Type. Holotype figured by Klement (1960, pl. 5, fig. 1), by Sarjeant (1984a, pl. 2, figs 1, 2, text-fig. 2) and by Janduchêne et al. (1986a, pl. 45, figs 1-4).

Occurrence. Boreholes: R-2hg Ovča mogila (depth 1549 m, Plevan Formation, Kimmeridgian); R-2 Dabovan (depth 1634.5 m, Kaspician Formation, Middle? — Late Kimmeridgian).

Genus **Leptodinium** Klement, 1960 emend. Sarjeant, 1982b

Type species (by original designation): *Leptodinium subtile* Klement, 1960.

Leptodinium cf. **ambiguum** (Deflandre, 1939) Helenes, 1984

Pl. VII, fig. 3

Type. Holotype figured by Deflandre (1939, pl. 6, fig. 2) and by Janduchêne et al. (1986a, pl. 68, figs 1-3).

Occurrence. Borehole S-140A Makedonka (depth 1285 m, Černočkovovo Formation, Early Kimmeridgian, *Crussoliceras* sp. indet., *C. divisum* Zone found at 1289.3 m).

Leptodinium clathratum (Cookson & Eisenack, 1960b) Sarjeant in Davey et al., 1969

Pl. VII, fig. 15

Type. Holotype figured by Cookson & Eisenack (1960b, pl. 37, fig. 5, text-fig. 2) and by Janduchêne et al. (1986a, pl. 71, figs 10-12).

Occurrence. Boreholes: R-2 Dabovan (depth 1634.5 m, Kaspičan Formation, Middle? — Late Kimmeridgian); R-1 Brestovo (depth 2960 m, Pleven Formation, Late Tithonian); R-2hg Ovča mogila (depth 1549 m, Pleven Formation, Kimmeridgian); R-109 Vranino (depth 1263.8 m, Černočkovovo Formation, Late Kimmeridgian — Early Tithonian); S-30 Kardam (depth 1065-1104 m, Dri-novo Formation, Kimmeridgian) and boreholes published by Додикова (1971, p. 10): R-1 Dolni Dabnik (depth 2498 m, Pleven Formation, Tithonian); R-1 Trăstenik (depth 2193 m, Pleven Formation, Tithonian).

Leptodinium mamilliferum (Deflandre, 1939) Helenes, 1984

Pl. VIII, fig. 1

Type. Holotype figured by Deflandre (1939, pl. 6, fig. 1) and by Janduchêne et al. (1986a, pl. 72, figs 1-8).

Occurrence. Boreholes: R-1 Gigen (depth 1644.5 m, Kaspičan Formation, Tithonian); R-2 Dabovan (depth 1634.5 m, Kaspičan Formation, Middle? — Late Kimmeridgian); R-7 Sultanci (depth 1765 m, Tiča Formation, Late Tithonian); R-1 Stežerovo (depth 1523 m, Pleven Formation, Tithonian); R-1 Kneža (depth 2835 m, Pleven Formation, Tithonian).

Leptodinium mirabile Klement, 1960 emend. Sarjeant, 1984a

Pl. VIII, figs 4, 5

Type. Holotype figured by Klement (1960, pl. 6, figs 7, 8, text-figs. 25, 26), by Sarjeant (1984a, pl. 4, figs 1, 2, text-fig. 5), by Janduchêne et al. (1986a, pl. 67, figs 5-8) and by Brenner (1988, pl. 6, fig. 4).

Remarks. Dodekova (1967, p. 19) incorrectly transferred this species to *Gonyaulacysta* on the basis of the tabulation only. This transfer was rejected by Lentin & Williams (1973, p. 87) and their opinion is here accepted.

The study of the Bulgarian specimens confirms the tabulation scheme of the sulcal region and plate 1''' as it is presented by Dodekova (1967, p. 20, fig. 2) and by Janduchêne et al. (1986a, p. 219, pl. 65). The scheme of Sarjeant (1984a, p. 165, text-fig. 5) with 7 sulcal plates and separate precingular plate 1''' is not confirmed. In the construction of the apical region are established 2 preapical plates, 4 apical plates and 2 small triangular intercalary plates by analogy with the apical model of the genera *Ctenidodinium* and *Korystocysta* (Woolam, 1983; Benson, 1985) and of the species *Gonyaulacysta jurassica* and *Rhynchodiniopsis aptiana* (Stover &

E v i t t, 1978, p. 276, fig. 2). E v i t t (letter communication, 21 May 1968) took me notice of the existence of two anterior intercalary plates of *Leptodinium mirabile*: "One detail I noticed in the Alaskan specimens of *L. mirabile*. . . This is the presence of two small unequally sized intercalary areas between the apical fields and the archeopyle (3'). . ." I fell in with some specimens in suitable position for investigation of the apex which support the observations of E v i t t. The exploded diagram of tabulation pattern of *L. mirabile* (H e l e n e s, 1984a in J a n d u C h ê n e et al., 1986a, p. 218, pl. 65) exhibit one anterior intercalary plate only. In my opinion the tabulation formula of *L. mirabile* is: 2pr, 4', 2a, 6'', 6c, 6''', 1p, 1'''', 6s.

O c c u r r e n c e. Boreholes: S-10 Černookovo (depth 920-936 m, Černookovo Formation, Middle? — Late Oxfordian); S-9 Kardam (depth 874 m, Černookovo Formation, Middle? Oxfordian); S-33 Esenica (depth 744 m, Černookovo Formation, Middle Oxfordian — Early Kimmeridgian); S-21 Kalugerica (depth 875 m, Černookovo Formation, Middle — Late Oxfordian).

***Leptodinium subtile* K l e m e n t, 1960**

Pl. VII, fig. 14

T y p e. Holotype figured by K l e m e n t (1960, pl. 6, figs 1, 2, text-figs. 23, 24) and by B r e n n e r (1988, pl. 6, fig. 5).

R e m a r k s. *L. subtile* possess suturocavation which must be confirmed in type material of Klement.

O c c u r r e n c e. Boreholes: R-8 Devetaki (depth 2328 m, Pleven Formation, Tithonian); R-55 Konare (depth 1050 m, Provadija Formation, Early Kimmeridgian); S-24 Nikola Kozlevo (depth 641.4 m, Drinovo Formation, Late Kimmeridgian); R-109 Vranino (depth 1269 m, Černookovo Formation, Early Kimmeridgian); S-30 Kardam (depth 1104 m, Drinovo Formation, Early Kimmeridgian); S-21 Kalugerica (depth 875 m, Černookovo Formation, Middle-Late Oxfordian); S-140A Makedonka (depth 1282-1285 m, Černookovo Formation, Early Kimmeridgian); R-1 Junak (depth 1605 m, Tiča Formation, Middle Tithonian, relatively abundant); R-3 Junak (depth 1756 m, Tiča Formation, Early Tithonian) and boreholes published by Д о д е к о в а (1971, p. 11).

Genus *Liesbergia* B e r g e r, 1986

T y p e s p e c i e s (by original designation): *Liesbergia liesbergensis* B e r g e r, 1986.

***Liesbergia scarburghensis* (S a r j e a n t, 1964) B e r g e r, 1986**

Pl. VIII, fig. 2

T y p e. Holotype figured by S a r j e a n t (1960a, pl. 13, fig. 13) and by J a n d u C h ê n e et al. (1986a, pl. 3, figs 1, 2).

O c c u r r e n c e. Boreholes: S-10 Černookovo (Černookovo Formation, depth 898 m, Early Kimmeridgian; 917 m, Late Oxfordian; 930 m, Middle? — Late Oxfordian); S-21 Kalugerica (depth 875 m, Černookovo Formation, Middle — Late Oxfordian).

Genus *Meristaulax* S a r j e a n t, 1984a

T y p e s p e c i e s (by original designation): *Meristaulax granulata* S a r j e a n t, 1984a, non *Gonyaulax granulata* K l e m e n t, 1960.

R e m a r k s. I endorse here the opinion of B r e n n e r (1988, p. 65) for retention of the genus *Meristaulax* as separate genus on account of its foveolate structure of the wall. J a n d u C h ê n e et al. (1986a, p. 76) considered this genus to be a junior synonym of *Cribroperidinium* N e a l e & S a r j e a n t, 1962.

Meristaulax granulata Sarjeant, 1984a

Pl. IX, fig. 2

Type. Holotype figured by Sarjeant (1984a, pl. 3, figs 3, 4), by Jan du Chêne et al. (1986a, pl. 27, figs 7-10) and by Brenner (1988, pl. 3, fig. 2).

Occurrence. Boreholes: S-10 Černookovo (depth 893.8-898 m, Early Kimmeridgian; 903 m, Late Oxfordian — Early Kimmeridgian; 932-933 m, Middle? — Late Oxfordian); R-55 Konare (depth 1029 m, Černookovo Formation, Early Kimmeridgian); S-24 Nikola Kozlevo (depth 659 m, Černookovo Formation, Early Kimmeridgian).

Genus ***Rhynchodiniopsis*** Deflandre, 1935 emend. Sarjeant, 1982b

Type species (by original designation): *Rhynchodiniopsis aptiana* Deflandre, 1935.

Rhynchodiniopsis gongylos (Sarjeant, 1966b) Sarjeant, 1982b

Pl. VI, figs 12, 13

Type. Holotype figured by Sarjeant (1966b, pl. 13, figs 1, 2, text-fig. 23) and by Jan du Chêne et al. (1986a, pl. 93, figs 10-13).

Occurrence. Boreholes: R-55 Konare (depth 1029 m, Černookovo Formation, Early Kimmeridgian); R-109 Vranino (depth 1289-1291 m, Černookovo Formation, Early Kimmeridgian).

Genus ***Scriniodinium*** Klement, 1960

Type species (by original designation): *Gymnodinium crystallinum* Deflandre, 1938b.

Scriniodinium crystallinum (Deflandre, 1938b) Klement, 1957

Pl. X, fig. 10

Type. Holotype figured by Deflandre (1938b, pl. 5, figs 1, 2) and by Jan du Chêne et al. (1986a, pl. 104, figs 1-4).

Occurrence. Boreholes: R-3 Junak (depth 1770.3 m, Tiča Formation, Oxfordian); S-9 Kardam (depth 877.5 m, Černookovo Formation, Early Oxfordian); S-31 Esenica (depth 750.5 m, Černookovo Formation, Early Oxfordian); S-33 Esenica (depth 753-756 m, Černookovo Formation, Early Oxfordian); S-32 Dolina (depth 743 m, Černookovo Formation, Early Oxfordian, *C. renggeri* Zone); R-5 Tutrakanci (depth 1765 m, Provadija Formation, Early Oxfordian); R-3 Tjuleno (depth 954 m, Černookovo Formation, Oxfordian); R-109 Vranino (depth 1300 m, Provadija Formation, Early Oxfordian, *Neocampylites* (*Neocampylites*) cf. *helveticus* (Jennett, 1951); S-10 Černookovo (depth 903-937 m, Černookovo Formation, Oxfordian).

Scriniodinium dictyophorum (Deflandre, 1938b) Brenner, 1988

Pl. IX, fig. 1

Type. Holotype figured by Deflandre (1938b, pl. 8, fig. 1) and by Jan du Chêne et al. (1986a, pl. 7, figs 1-5).

Occurrence. Boreholes: R-3 Junak (depth 1785.3 m, Provadija Formation, Late? Callovian — Early Oxfordian); S-10 Černookovo (depth 930.3 m, Černookovo Formation, Middle? — Late Oxfordian); S-9 Kardam (depth 877.5 m, Černookovo Formation, Early Oxfordian); S-21 Kalugeri-ca (depth 888 m, Černookovo Formation, Oxfordian); S-31 Esenica (depth 752.8 m, Černookovo Formation, Early Oxfordian); S-33 Esenica (depth 745-756 m, Černookovo Formation, Oxfordian — Kimmeridgian); R-109 Vranino (depth 1289.4 m, Černookovo Formation, Early Kimmeridgian).

Scriniodinium dictyotum subsp. *dictyotum* Cookson & Eisenack, 1960b

Pl. IX, fig. 9

Type. Holotype of the nominate species figured by Cookson & Eisenack (1960b, pl. 37, fig. 9) and by Janduchène et al. (1986a, pl. 7, fig. 6).

Remarks. Brenner (1988, p. 75) noticed discrepancy of the morphologic features of *S. dictyotum* with the generic diagnosis of the genera *Scrinioicassis* and *Aldorfia* to which consecutively was transferred this species (Beju, 1971, p. 299; Davey, 1982b, p. 25). Brenner retained it in the genus *Scriniodinium* taking into account the construction of the wall. This opinion is endorsed here.

Occurrence. Boreholes: R-1 Trâstenik (depth 2192 m, Plevan Formation, Late Kimmeridgian — Early Tithonian); S-9 Kardam (depth 878 m, Černookovo Formation, Early Oxfordian); S-21 Kalugerica (depth 884.4 m, Černookovo Formation, Early Oxfordian); R-109 Vranino (depth 1275 m, Černookovo Formation, Kimmeridgian; 1294 m, Provadija Formation, Late Oxfordian, *Idoceras* sp., *I. planula* Zone); R-140A Makedonka (depth 1285 m, Černookovo Formation, Early Kimmeridgian, *Crussolicerias* sp. indet., *C. divisum* Zone); S-10 Černookovo (depth 919-933 m, Černookovo Formation, Middle? — Late Oxfordian).

Scriniodinium dictyotum subsp. *osmingtonense* Gitzmeiz, 1970

Pl. VIII, fig. 10

Type. Holotype figures by Gitzmeiz (1970, pl. 9, fig. 12).

Occurrence. Boreholes: R-2hg Ovča mogila (depth 1549 m, Plevan Formation, Kimmeridgian); S-140A Makedonka (depth 1282 m, Černookovo Formation, Early Kimmeridgian, *Crussolicerias* sp. indet., *C. divisum* Zone, found at 1289.3 m); S-9 Kardam (depth 877.5 m, Černookovo Formation, Early Oxfordian); S-10 Černookovo (depth 933-936 m, Černookovo Formation, Middle? — Late Oxfordian); S-21 Kalugerica (depth 884 m, Černookovo Formation, Early Oxfordian); S-24 Nikola Kozlevo (depth 670 m, Černookovo Formation, Early Kimmeridgian); R-109 Vranino (depth 1289 m, Černookovo Formation, Early Kimmeridgian).

Scriniodinium dictyotum subsp. *papillatum* Gitzmeiz, 1970

Pl. IX, fig. 11

Type. Holotype figured by Gitzmeiz (1970, pl. 9, fig. 11).

Occurrence. Boreholes: R-109 Vranino (depth 1291.6 m, Černookovo Formation, Late Oxfordian, *Idoceras* sp., *I. planula* Zone, found at 1294 m); S-10 Černookovo (depth 933.2 m, Černookovo Formation, Middle? — Late Oxfordian).

Scriniodinium galeritum subsp. *fornicatum* Klement, 1960

Pl. VIII, fig. 9

Type. Holotype figured by Klement (1960, pl. 1, figs 7, 8).

Occurrence. Boreholes: S-10 Černookovo (depth 903 m, Černookovo Formation, Late Oxfordian — Early Kimmeridgian); S-32 Dolina (depth 716.5 m, Černookovo Formation, Early Kimmeridgian); S-9 Kardam (depth 877.5-880 m, Černookovo Formation, Early Oxfordian); S-31 Esenica (depth 752.8-755 m, Černookovo Formation, Early Oxfordian); S-33 Esenica (depth 744.3 m, Middle Oxfordian — Early Kimmeridgian; 753 m, Early Oxfordian, Černookovo Formation); S-21 Kalugerica (depth 884.4 m, Černookovo Formation, Early Oxfordian); S-24 Nikola Kozlevo (depth 659-670 m, Černookovo Formation, Early Kimmeridgian); S-30 Kardam (depth 1104 m, Drinovo Formation, Early Kimmeridgian); R-109 Vranino (depth 1290 m, Černookovo Formation, Early Kimmeridgian; 1300 m, Provadija Formation, Early Oxfordian, *Neocampylites* (*Neocampylites*) cf. *helveticus* (Jennett, 1951)); S-1 Razgrad (depth 933.3 m, Drinovo Formation, Oxfordian); R-2hg Ovča mogila (depth 1549 m, Plevan Formation, Kimmeridgian).

Scriniodinium irritibile Riley in Fisher & Riley, 1980

Pl. VIII, fig. 6

Type. Holotype figured by Riley in Fisher & Riley (1980, pl. 2, figs. 7, 9) and by Jan du Chêne et al. (1986a, pl. 111, fig. 5).

Occurrence. Boreholes: R-2hg Ovča mogila (depth 1549 m, Pleven Formation, Kimmeridgian); S-10 Černookovo (depth 892.4 m, Černookovo Formation, Early Kimmeridgian); R-3 Brest (depth 1818.5 m, Kaspičan Formation, Middle? — Late Kimmeridgian).

Scriniodinium luridum (Deflandre, 1938b) Klement, 1960

Pl. VIII, fig. 12

Type. Holotype figured by Deflandre (1938b, pl. 5, figs 4, 5) and by Jan du Chêne et al. (1986a, pl. 109, figs 6-8).

Occurrence. Boreholes: S-32 Dolina (depth 716.5 m, Černookovo Formation, Early Kimmeridgian); S-10 Černookovo (depth 924.5 m, Černookovo Formation, Late Oxfordian); S-33 Esenica (depth 753 m, Černookovo Formation, Early Oxfordian); S-21 Kalugerica (depth 881.8-884.4 m, Černookovo Formation, Early Oxfordian); R-5 Tutrakanci (depth 1765 m, Provadija Formation, Early Oxfordian).

Scriniodinium* sp. aff. *S. luridum (Deflandre, 1938b) Klement, 1960

Pl. IX, fig. 3

Description and remarks. Proximate circumcavate cyst with only minor dorso-ventral flattening and subhexagonal outline. Clear apical horn is lacking. Two ventro-lateral lobes exist, the right hand lobe being the larger. The tabulation is gonyaulacacean, analogous to the tabulation of *S. luridum* and *S. asymmetricum*, poorly indicated by low ridges with small spines on distal ends. Similar denticulations are observed in the type species of *S. luridum* (Deflandre, 1938b, pl. 5, figs 4, 5) and in the specimen figured by Klement (1960, pl. 1, figs 2, 3), but denticulations and uneven margin of *Scriniodinium* sp. are markedly much larger. Like this, I accept the latter as transitional form between *S. luridum* on the one part and *S. irregularare* (Cookson & Eisenack, 1958, p. 28, pl. 10, figs 1, 2) on the other part. Archeopyle precingular, type P (3'').

Dimensions (in μm). Overall length — 94, overall width — 83.

Occurrence. Borehole S-10 Černookovo (depth 924.5 m, Černookovo Formation, Late Oxfordian).

Scriniodinium playfordii Cookson & Eisenack, 1960

Pl. VIII, fig. 11

Type. Holotype figured by Cookson & Eisenack (1960, pl. 37, fig. 6).

Occurrence. Boreholes: R-3 Devetaki (depth 2546-2548 m, Kaspičan Formation, Early Tithonian); R-2 Dabovan (depth 1634.5 m, Kaspičan Formation, Middle? — Late Kimmeridgian); R-3 Brest (depth 1747 m, Tithonian; 1818.5 m, Middle? — Late Kimmeridgian, Kaspičan Formation); R-1 Trštenik (depth 2192 m, Pleven Formation, Late? Kimmeridgian — Early Tithonian); S-10 Černookovo (depth 932.8-934 m, Černookovo Formation, Middle? — Late Oxfordian); R-1 Junak (depth 1495 m, Tiča Formation, Late Tithonian, *Crassicollaria* Zone); R-3 Junak (depth 1756.4 m, Tiča Formation, Early Tithonian).

Genus ***Tehamadinium*** Jan du Chêne et al., 1986b in Jan du Chêne et al., 1986a

Type species (by original designation): *Occisucysta brixii* Below, 1982a.

Tehamadinium aculeatum (Klement, 1960) Brenner, 1988; Thomas & Cox, 1988

Plate VIII, figs 7, 8

Type. The holotype is figured by Klement (1960, pl. 5, figs 6, 7). Brenner (1988, p. 89) noticed that the holotype and one of the paratypes did not established in the slide indicated by Klement. The rest two paratypes are available (Brenner, 1988, pl. 5, figs 1, 2). Jan du Chêne et al. (1986a, pl. 2, figs 8-10) figured one paratype (as *Acanthaulax aculeata*) but did not indicate data for the numeration of the type collection of Klement.

Remarks. On the basis of the archeopyle type — 2P (2''+3'') and lacking of cavation Brenner (1988, p. 89) and Thomas & Cox (1988, p. 319) transferred this species to the genus *Tehamadinium*. The two papers are printed in September 1988. As I did not possess with exact data for priority of the authors made the new combination, I include the authors of the two publications alphabetically.

Occurrence. Boreholes: R-1 Gigen (depth 1644.5 m, Kaspician Formation, Tithonian); R-3 Brest (depth 1818.5 m, Kaspician Formation, Middle? — Late Kimmeridgian); R-2 Dabovan (depth 1634.5 m, Kaspician Formation, Middle? — Late Kimmeridgian); R-1 Trästenik (depth 2192 m, Plevan Formation, Late Kimmeridgian? — Early Tithonian); R-2 Grivica (depth 2385 m, Plevan Formation, Middle? — Late Kimmeridgian); S-24 Nikola Kozlevo (depth 641.4 m, Černookovo Formation, Late Kimmeridgian — Early Tithonian).

***Tehamadinium konarae* sp. n.**

Pl. X, figs 4-8

Type. The holotype is the specimen figured on pl. X, figs 4-7, slide 926-2, borehole R-55 Konare, depth 1029 m, Černookovo Formation, Early Kimmeridgian, Northeastern Bulgaria.

Derivation of name. The species is named after the type locality — village of Konare.

Material. 28 specimens.

Dimensions (in μm). Holotype: length — 73, breadth — 68, apical horn — 7, maximum length of sculptural elements — 3. Range: length — 68-77, breadth — 60-70, apical horn — 5-7, sculptural elements — to 3 (11 specimens measured).

Diagnosis. Proximate cyst, acavate, with spherical to subspherical shape and short distally ragged apical horn. The cyst wall represented by autophragm only (by Eviitt, 1969, p. 459). The tabulation is gonyaulacacean with formula: Xpr. 4', Xa, 6'', Xc, 6''', 1p, 1pv, 1''', poorly indicated by linearly aligned short sutural spines and verrucae inconstant joined proximally by low ridges. The autophragm is covered by structural elements of low relief (spinose to puncto-verrucate) irregular distributed. Archeopyle precingular, type 2P (2''+3''). Operculum free.

Description. The autophragm surface has scattered granules, verrucae and short spines which concealed the tabulation. The spines are acuminate, capitate or distally branched, irregularly disposed. The sutures are faintly indicated by discontinuous rows of spines proximally linked by low sutural ridges. Some specimens possess intratabular rows of spines which formed "anuli" (sensu Gocht, 1987, p. 710). Sulcus generally with less clearly expressed ornamentation features, lack sulcal plates. The intraspecific variability of *T. konarae* is expressed by differentiations in thickness and disposition of ornaments.

Remarks. *T. konarae* sp. n. differs from each other species of *Tehamadinium* by its poorly marked tabulation masked by all over sculptural elements. *T. konarae* sp. n. is similar to *T. coummium* (Bellow, 1981) from Albian and Early Cenomanian of Morocco in common shape, size, construction of apical horn and partly in ornamen-

tation. The former differs in having obscurer tabulation and lacking sulcal plates. *T. konarae* sp. n. possess an ornamentation which resembles that of some species of the genus *Acanthaulax*, but the latter has archeopyle type — 1P (3''). The archeopyle type — 2P (2''+3'') differs the new species from the species of the genus *Liesbergia* whose archeopyle types are — 1P (3'') and 2P (3''+4''). Possibly the specimens identified as *Occisucysta aculeata* sensu Zotto et al. (1987, p. 204, pl. 6, figs. 1, 3) refer to *T. konarae* sp. n.

Occurrence. Boreholes: R-55 Konare (depth 1029 m, Černookovo Formation, Early Kimmeridgian); S-10 Černookovo (depth 903 m, Late Oxfordian — Early Kimmeridgian; 932.8 m, Middle? — Late Oxfordian, Černookovo Formation); S-21 Kalugerica (depth 889 m, Černookovo Formation, Early? Oxfordian); S-9 Kardam (depth 877.5 m, Černookovo Formation, Early Oxfordian); S-24 Nikola Kozlevo (depth 659 m, Černookovo Formation, Early Kimmeridgian).

***Tehamadinium* sp. aff. *T. konarae* sp. n.**

Pl. X, figs 1-3

Description and remarks. Proximate cyst with subspherical form and short ragged distally apical horn, built up by sculpture elements. The tabulation is gonyaulacacean indicated by linearly aligned short spines, proximally connected by low ridges. The autophragm is covered with granules, verrucae and rarely spines. Archeopyle precingular, type 2P (2''+3'').

In comparison with *T. konarae*, *Tehamadinium* sp. has more distinct tabulation, more rare intratabular spines and greater size (in μm) — length — 83, width — 75, apical horn — 7.

Occurrence. Boreholes: S-10 Černookovo (depth 903-930 m, Černookovo Formation, Late Oxfordian — Early Kimmeridgian); S-140A Makedonka (depth 1282 m, Černookovo Formation, Early Kimmeridgian).

Genus ***Trichodinium*** Eisenack & Cookson, 1960 emend. Clark & Verdier, 1967

Type species (by original designation): *Trichodinium pellitum* Eisenack & Cookson, 1960.

Trichodinium capillatum (Courtinat & Gaillard, 1980) Courtinat, 1989

Pl. VII, fig. 8

Type. Holotype figured by Courtinat & Gaillard (1980, pl. 2, fig. 15).

Remarks. Cingulum and precingular archeopyle in numerous Bulgarian specimens are not observed. There are much broken specimens but the archeopyle type is not clear.

Occurrence. Boreholes: S-10 Černookovo (depth 919-936 m, Černookovo Formation, Oxfordian); R-55 Konare (depth 1029-1033 m, Černookovo Formation, Early Kimmeridgian); S-9 Kardam (depth 877.5 m, Černookovo Formation, Early Oxfordian); S-21 Kalugerica (depth 888m, Černookovo Formation, Oxfordian); R-109 Vranino (depth 1300 m, Provadija Formation, Early Oxfordian, *Neocampylites* (*Neocampylites*) cf. *helveticus* (Jannet, 1951); S-24 Nikola Kozlevo (depth 668 m, Černookovo Formation, Early Kimmeridgian).

Genus ***Tubotuberella*** Vozzhennikova, 1967 emend. Sarjeant, 1982a emend. Dodekova, 1990

Type species (by original designation): *Tubotuberella rhombiformis* Vozzhennikova, 1967.

Tubotuberella apatela (Cookson & Eisenack, 1960b) Ioannides et al., 1977

Pl. VII, fig. 7

Type. Holotype figured by Cookson & Eisenack (1960b, pl. 37, fig. 12) and by Jan du Chêne et al. (1986a, pl. 124, figs 1, 2).

Occurrence. Boreholes: R-2hg Ovča mogila (depth 1549 m, Pleven Formation, Kimmeridgian); R-3 Brest (depth 1818.5 m, Kaspičan Formation, Middle? — Late Kimmeridgian); R-14 Grozdovo (depth 2532 m, Tiča Formation, Tithonian).

Genus ***Xenicodinium*** Klement, 1960

Type species (by original designation): *Xenicodinium densispinosum* Klement, 1960.

Xenicodinium densispinosum Klement, 1960

Pl. VII, figs 11, 12

Type. Holotype figured by Klement (1960, pl. 5, figs. 14, 15) and by Brenner (1988, pl. 2, figs. 6).

Occurrence. Boreholes: R-2hg Ovča mogila (depth 1549 m, Pleven Formation, Kimmeridgian); R-1 Slavjanovo (depth 1815 m, Kaspičan Formation, Middle? — Late Kimmeridgian); R-3 Brest (depth 1818.5 m, Kaspičan Formation, Middle? — Late Kimmeridgian); R-109 Vranino (depth 1265-1269 m, Černookovo Formation, Late Kimmeridgian — Tithonian); S-30 Kardam (depth 1104 m, Drinovo Formation, Kimmeridgian).

Dinocysts with combination archeopyle

Genus ***Ctenidinium*** Deflandre, 1938b emend. Woollam, 1983 emend. Benson, 1985

Type species (by original designation): *Lithodinia jurassica* var. *ornata* Eisenack, 1935.

Ctenidinium chondrum Drugg, 1978

Pl. IX, fig. 6

Type. Holotype figured by Drugg (1978, pl. 1, fig. 10).

Occurrence. Boreholes: R-2hg Ovča mogila (depth 1549 m, Pleven Formation, Kimmeridgian); S-10 Černookovo (depth 893.8-933.2 m, Černookovo Formation, Middle? Oxfordian — Early Kimmeridgian); S-140A Makedonka (depth 1282-1288 m, Černookovo Formation, Early Kimmeridgian, *Crussolicerias* sp. indet., *C. divisum* Zone, found at 1289.3 m); S-21 Kalugerica (depth 889 m, Černookovo Formation, Early? Oxfordian); R-5 Tutrakanci (depth 1765 m, Provadija Formation, Early Oxfordian); R-3 Tjulenovovo (depth 954 m, Černookovo Formation, Oxfordian); R-109 Vranino (depth 1289-1291 m, Černookovo Formation, Early Kimmeridgian; 1300 m, Provadija Formation, Early Oxfordian, *Neocampylites* (*Neocampylites*) cf. *helveticus* (Jeannot, 1951).

Genus *Dinopterigium* Deflandre, 1935 emend. Stover & Evitt, 1978

Type species (by original designation). *Dinopterigium cladoides* Deflandre, 1935.

Dinopterigium dimorphum (Ioannides et al., 1977) Drugg, 1978

Pl. IX, fig. 4

Type. Holotype figured by Ioannides et al. (1977, pl. 2, fig. 13).

Occurrence. Boreholes: S-10 Černookovo (depth 930.3-932.8 m, Černookovo Formation, Late Oxfordian); S-24 Nikola Kozlevo (depth 669-670 m, Černookovo Formation, Early Kimmeridgian); R-55 Konare (depth 1029-1035 m, Černookovo Formation, Early Kimmeridgian); R-1 Junak (depth 1605 m, Tiča Formation, Middle Tithonian); R-109 Vranino (depth 1250 m, Černookovo Formation, Middle Tithonian, *Richterella* cf. *richteri* (Oppel, 1865), *Virgatosisimoceras rothpletzi* Zone; 1265-1267 m, Late Kimmeridgian — Early Tithonian; 1275 m, Middle Kimmeridgian; 1291.6 m, Early Kimmeridgian).

Genus *Dissiliodinium* Drugg, 1978

Type species (by original designation): *Dissiliodinium globulum* Drugg, 1978.

Dissiliodinium globulum Drugg, 1978

Pl. X, fig. 9

Type. Holotype figured by Drugg (1978, pl. 4, fig. 5).

Occurrence. Boreholes: S-10 Černookovo (depth 924.5 m, Černookovo Formation, Late Oxfordian); S-31 Esenica (depth 753 m, Černookovo Formation, Early Oxfordian); S-33 Esenica (depth 744.3 m, Černookovo Formation, Middle? Oxfordian — Early Kimmeridgian); S-9 Kardam (depth 877.5 m, Černookovo Formation, Early Oxfordian); S-30 Kardam (depth 1065 m, Drinovo Formation, Kimmeridgian).

Genus *Limbodinium* Riding, 1987b

Type species (by original designation): *Dinopterigium absidatum* Drugg, 1978.

Limbodinium absidatum (Drugg, 1978) Riding, 1987b

Pl. IX, fig. 8

Type. Holotype figured by Drugg (1978, pl. 4, fig. 7).

Occurrence. Boreholes: S-32 Dolina (depth 743 m, Černookovo Formation, Early Oxfordian, *Creniceras* cf. *renggeri* (Oppel, 1863), *C. renggeri* Zone); S-9 Kardam (depth 878 m, Černookovo Formation, Early Oxfordian); R-5 Tutrakanci (depth 1765 m, Provadija Formation, Early Oxfordian); R-109 Vranino (depth 1298 m, Early Oxfordian, *Neocampylites* (*Neocampylites*) *delmontanus* (Oppel, 1863) found at 1299 m, Provadija Formation).

Genus *Hystrichodinium* Deflandre, 1935 emend. Clark & Verdier, 1967

Type species (by original designation): *Hystrichodinium pulchrum* Deflandre, 1935.

***Hystriochodinium? lanceatum* Davies, 1983**

Pl. VIII, fig. 3

Type. Holotype figured by Davies (1983, pl. 7, figs 1, 2).

Remarks. Davies refers temporarily this species to the genus *Hystriochodinium* annotated that archeopyle type — AP (3'') of *H? lanceatum* differs from the archeopyle type — P(3'') of the genus.

Occurrence. Borehole R-55 Konare (depth 1035 m, Černookovo Formation, Early Kimmeridgian).

Incertae sedis

Group ACRITARCHA E v i t t, 1963

Subgroup SPHAEROMORPHITAE D o w n i e et al., 1963

Genus *Caddasphaera* F e n t o n et al., 1980

Type species (by original designation): *Kalyptea halosa* F i l a t o f f, 1975.

Caddasphaera halosa (F i l a t o f f, 1975) F e n t o n et al., 1980

Pl. VII, fig. 4

Type. Holotype figured by F i l a t o f f (1975, pl. 29, fig. 10).

Occurrence. Borehole S-10 Černookovo (depth 924-936 m, Černookovo Formation, Middle — Late Oxfordian).

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EXPLANATIONS TO THE PLATES

PLATE I

- 1-3. *Amphorula dodekova* Zotto et al., 1987. Slide 3041-3, borehole R-1 Slavjanovo, depth 1815 m, Kaspičan Formation, Middle? — Late Kimmeridgian, $\times 500$
- 4, 5. *Atlantodinium jurassicum* Zotto et al., 1987. Kaspičan Formation, Middle? — Late Kimmeridgian. 4 — slide 3050-1, borehole R-3 Brest, depth 1818.5 m; 5 — slide 3041-3, borehole R-1 Slavjanovo, depth 1815 m, $\times 500$
- 6, 7. *Chlamydothorella wallata* Cookson & Eisenack, 1960b. Slide 1208-1, borehole S-10 Černookovo, depth 903 m, Černookovo Formation, Late Oxfordian—Early Kimmeridgian, $\times 500$
8. *Cleistosphaeridium lumectum* (Sarjeant, 1960a) Davey et al., 1969. Slide 1676-2, borehole R-5 Tutrakanci, depth 1765 m, Provadija Formation, Early Oxfordian, $\times 600$
9. *Cleistosphaeridium iaculigerum* (Klement, 1960) Brenner, 1988. Slide 1214-1, borehole S-10 Černookovo, depth 933.2 m, Černookovo Formation, Late Oxfordian, $\times 600$
10. *Dingodinium jurassicum* Cookson & Eisenack, 1958. Slide 1711-1, borehole R-4 Mirovo, depth 1293 m, Tiča Formation, Tithonian, $\times 500$
- 11-13. *Epiplosphaera areolata* Klement, 1960. 11, 12 — slide 3212-1, borehole R-1 Čapaev, depth 2022 m, Drinovo Formation, Early Kimmeridgian; $\times 600$; 13 — slide 3051-3, borehole R-2 Dabovan, depth 1634.5 m, Kaspičan Formation, Middle? — Late Kimmeridgian, $\times 500$

PLATE II

- 1-3. *Epiplosphaera bireticulata* Klement, 1960. Slide 3041-3, borehole R-1 Slavjanovo, depth 1815 m, Kaspičan Formation, Middle? — Late Kimmeridgian, $\times 500$
- 4, 5. *Epiplosphaera reticulospinosa* Klement, 1960. 1 — slide 3008-1, borehole R-2hg Ovča mogila, depth 1549 m, Pleven Formation, Kimmeridgian; 5 — slide 3051-3, borehole R-2 Dabovan, depth 1634.5 m, Kaspičan Formation, Middle? — Late Kimmeridgian, $\times 500$
- 6-8. *Histiophora ornata* Klement, 1960. Kaspičan Formation, Middle? — Late Kimmeridgian. 6 — slide 3050-4, borehole R-3 Brest, depth 1818.5 m; 7, 8 — slide 3041-3, borehole R-1 Slavjanovo, depth 1815 m, $\times 500$
9. *Polygonifera bavarica* (Lund & Ecker, 1988). Slide 3052-2, borehole R-1 Trštenik, depth 2192 m, Pleven Formation, Late Kimmeridgian — Early Tithonian, $\times 500$
- 10, 11. *Lanterna emitecta* Courtinat, 1989. Kaspičan Formation, Middle? — Late Kimmeridgian. 10 — slide 3050-4, borehole R-3 Brest, depth 1818.5 m; 11 — slide 3051-2, borehole R-2 Dabovan, depth 1634.5 m, $\times 500$
- 12, 13. *Lithodinia bejui* (Zotto et al., 1987). Slide 1214-1, borehole S-10 Černookovo, Černookovo Formation, Late Oxfordian, $\times 600$

PLATE III

- 1-3. *Hystrichosphaerina crusta* sp. n. Holotype, slide 3051-3, borehole R-2 Dabovan, depth 1634.5 m, Kaspičan Formation, Middle? — Late Kimmeridgian. 1, 3 — $\times 500$; 2 — detail, note the construction of the beaker-like processes, $\times 1200$
- 6, 9. *Hystrichosphaerina crusta* sp. n. Paratype, slide 3051-3, $\times 500$.
4. *Hystrichosphaerina orbifera* (Klement, 1960). Slide 984-1, borehole S-24 Nikola Kozlevo, depth 677.7 m, Černookovo Formation, Late Oxfordian, $\times 500$
5. *Sentusidinium creberbarbatum* Erkmén & Sarjeant, 1980. Slide 1215-1, borehole S-10 Černookovo, Černookovo Formation, depth 936 m, Oxfordian, $\times 500$
7. *Hystrichosphaerina sarjeantii* (Gitzme, 1970). Slide 3051-3, borehole R-2 Dabovan, depth 1634.5 m, Kaspičan Formation, Middle? — Late Kimmeridgian, $\times 500$
8. *Prolixosphaeridium* cf. *analism* Erkmén & Sarjeant, 1980. Slide 1208-1, borehole S-10 Černookovo, Černookovo Formation, depth 903 m, Late Oxfordian — Early Kimmeridgian, $\times 500$
10. *Lithodinia arcanitabulata* Brenner, 1988. Slide 1298-1, borehole S-9 Kardam, depth 877.5 m, Černookovo Formation, Early Oxfordian, $\times 500$
11. *Prolixosphaeridium mixtispinosum* (Klement, 1960). Slide 3041-3, borehole R-1 Slavjanovo, depth 1815 m, Kaspičan Formation, Middle? — Late Kimmeridgian, $\times 500$

PLATE IV

- 1-7. *Hystrichosphaerina?* sp. aff. *H. sarjeantii* (G i t m e z, 1970). Borehole R-2 Dăbovan, depth 1634.5 m, Kaspičan Formation, Middle? — Late Kimmeridgian 1, 3-5, 7 — slide 3051-3; 2, 6 — slide 3051-4. Note the tubiform processes without perforations on the most part of the stem (fig. 3); funnel-shaped processes complexly perforated (fig. 4); singular pairs slender processes (fig. 5); large perforations on the distal half of processes (fig. 7), $\times 500$

PLATE V

1. *Systematophora vestita* (D e f l a n d r e, 1938b). Slide 1211-1, borehole S-10 Černookovo, depth 924.5 m, Černookovo Formation, Late Oxfordian, $\times 500$
2. *Taeniphora iunctispina* K l e m e n t, 1960. Slide 1907-1, borehole S-24 Nikola Kozlevo, depth 657.5 m, Černookovo Formation, Early Kimmeridgian, $\times 500$
3. *Systematophora areolata* K l e m e n t, 1960. Slide 903-9, borehole S-32 Dolina, depth 743 m, Černookovo Formation, Early Oxfordian, $\times 500$
4. *Systematophora penicillata* (E h r e n b e r g, 1854). Slide 3051-3, borehole R-2 Dăbovan, depth 1634.5 m, Kaspičan Formation, Middle? — Late Kimmeridgian, $\times 500$
- 5, 10. *Systematophora* sp. A. D ü r r, 1988. Slide 926-2, borehole R-55 Konare, depth 1029 m, Černookovo Formation, Early Kimmeridgian, $\times 500$
6. *Sentusidinium pelionense* F e n s o m e, 1979. Slide 1298-1, borehole S-9 Kardam, depth 877.5 m, Černookovo Formation, Early Oxfordian, $\times 500$
7. *Taeniphora filamentosa* K l e m e n t, 1960. Slide 1208-1, borehole S-10 Černookovo, depth 903 m, Černookovo Formation, Late Oxfordian — Early Kimmeridgian, $\times 500$
9. *Systematophora varispinosa* B r e n n e r, 1988. Slide 3041-3, borehole R-1 Slavjanovo, depth 1815 m, Kaspičan Formation, Middle? — Late Kimmeridgian, $\times 500$

PLATE VI

1. *Rigaudella apiculata* sensu B e l o w, 1982b. Slide-1985, borehole R-109 Vranino, depth 1298-1303 m, Provadija Formation, Early Oxfordian, $\times 500$
2. *Rigaudella perforata* (A l b e r t i, 1961). Slide 1925-1, borehole S-30 Kardam, depth 1062.5 m, Drinovo Formation, Kimmeridgian, $\times 500$
3. *Gochteodinia verrucosa* (V o z z h e n n i k o v a, 1967). Slide 2002-1, borehole R-109 Vranino, depth 1291.6 m, Černookovo Formation, Early Kimmeridgian, $\times 500$
- 4, 5. *Acanthaulax granuligera* (K l e m e n t, 1960). Slide 3050-4, borehole R-3 Brest, depth 1818.5 m, Kaspičan Formation, Middle? — Late Kimmeridgian, $\times 500$
- 6, 9. *Cribroperidinium* sp. A B r e n n e r, 1988. Slide 1934-1, borehole S-30 Kardam, depth 1111.3-1114.5 m, Drinovo Formation, Late Oxfordian — Early Kimmeridgian, $\times 500$
- 7, 8, 10, 11. *Aldorfia* sp. Borehole S-10 Černookovo, Černookovo Formation, Late Oxfordian. 7, 8 — slide 1213-1; 10, 11 — slide 1214-1, $\times 500$
- 12, 13. *Rhynchodiniopsis gongylos* (S a r j e a n t, 1966b). Černookovo Formation, Early Kimmeridgian. 12 — slide 2001-1, borehole R-109 Vranino, depth 1289-1291 m; 13 — slide 926-2, borehole R-55 Konare, depth 1029 m, $\times 500$

PLATE VII

1. *Kalypte* sp. aff. *K. para* (G i t m e z, 1970). Slide 1215-2, borehole S-10 Černookovo, depth 936 m, Černookovo Formation, Middle? — Late Oxfordian, $\times 500$
2. *Acanthaulax granulata* (K l e m e n t, 1960). Slide 2843-2, borehole S-1 Razgrad, depth 727.3 m, Drinovo Formation, Late Kimmeridgian — Early Tithonian, $\times 500$
3. *Acanthaulax venusta* (K l e m e n t, 1960). Slide 3041-3, borehole R-1 Slavjanovo, depth 1815 m, Kaspičan Formation, Middle? — Late Kimmeridgian, $\times 500$
4. *Caddasphaera halosa* (F i l a t o f f, 1975). Slide 1211-2, borehole S-10 Černookovo, depth 924-936 m, Černookovo Formation, Middle — Late Oxfordian, $\times 500$
5. *Apteodinium nuciformis* (D e f l a n d r e, 1938b). Slide 1209-1, borehole S-10 Černookovo, depth 917.8 m, Černookovo Formation, Late Oxfordian, $\times 500$
6. *Gonyaulacysta dualis* (B r i d e a u x & F i s h e r, 1976). Slide 1206-1, borehole S-10 Černookovo, depth 892.4 m, Černookovo Formation, Early Kimmeridgian, $\times 500$
7. *Tubotuberella apatela* (C o o k s o n & E i s e n a c k, 1960b). Slide 3008, borehole R-2hg Ovča mogila, depth 1549 m, Pleven Formation, Kimmeridgian, $\times 500$
8. *Trichodinium capillatum* (C o u r t i n a t & G a i l l a r d, 1980). Slide 1551-1, S-21 Kalugerica, depth 888 m, Černookovo Formation, Oxfordian, $\times 500$
- 9, 10. *Gonyaulacysta? crassicornuta* (K l e m e n t, 1960). Slide 3051-3, borehole R-2 Dâbovan, depth 1634.5 m, Kaspičan Formation, Middle? — Late Kimmeridgian, $\times 500$
- 11, 12. *Xenicodinium densispinosum* K l e m e n t, 1960. Slide 3008-1, borehole R-2hg Ovča mogila, depth 1549 m, Pleven Formation, Kimmeridgian, $\times 500$
13. *Leptodinium* cf. *ambiguum* (D e f l a n d r e, 1939). Slide 1551-1, borehole S-21 Kalugerica, depth 888 m, Černookovo Formation, Oxfordian, $\times 500$
14. *Leptodinium subtile* K l e m e n t, 1960. Slide 1947-1, borehole R-7 Nonevo, depth 926 m, Černookovo Formation, Middle Oxfordian — Early Kimmeridgian, $\times 600$
15. *Leptodinium clathratum* (C o o k s o n & E i s e n a c k, 1960b). Slide 1932-1, borehole S-30 Kardam, depth 1104.8 m, Drinovo Formation, Kimmeridgian, $\times 500$

PLATE VIII

1. *Leptodinium mamilliferum* (D e f l a n d r e, 1939). Slide 3454-6, borehole R-7 Sultanci, depth 1765 m, Tiča Formation, Late Tithonian, $\times 500$
2. *Liesbergia scarburghensis* (S a r j e a n t, 1964). Slide 1207-2, borehole S-10 Černookovo, depth 898 m, Černookovo Formation, Early Kimmeridgian, $\times 500$
3. *Hystriodinium? lanceatum* D a v i e s, 1983. Slide 929-3, borehole R-55 Konare, depth 1035 m, Černookovo Formation, Early Kimmeridgian, $\times 500$
- 4, 5. *Leptodinium miralile* K l e m e n t, 1960. Borehole S-10 Černookovo, Černookovo Formation, Middle? — Late Oxfordian. 4 — slide 1212-2, depth 930.3 m; 5 — slide 1215-2, depth 936 m, $\times 500$
6. *Scriniodinium inritibilum* R i l e y i n F i s h e r & R i l e y, 1980. Slide 3008-2, borehole R-2hg Ovča mogila, depth 1549 m, Pleven Formation, Kimmeridgian, $\times 500$
- 7, 8. *Tehamadinium aculeatum* (K l e m e n t, 1960). Slide 3051-4, borehole R-2 Dâbovan, depth 1634.5 m, Kaspičan Formation, Middle? — Late Kimmeridgian, $\times 500$
9. *Scriniodinium galeritum fornicatum* K l e m e n t, 1960. Slide 3008-1, borehole R-2hg Ovča mogila, depth 1549 m, Pleven Formation, Kimmeridgian, $\times 500$
10. *Scriniodinium dictyotum osmingtonense* G i t m e z, 1970. Slide 1298-1, borehole S-9 Kardam, depth 877.5 m, Černookovo Formation, Early Oxfordian, $\times 500$
11. *Scriniodinium playfordii* C o o k s o n & E i s e n a c k, 1960b. Slide 3051-3, borehole D-2 Dâbovan, depth 1634.5 m, Kaspičan Formation, Middle? — Late Kimmeridgian, $\times 500$
12. *Scriniodinium luridum* (D e f l a n d r e, 1938b). Slide 1211-1, borehole S-10 Černookovo, depth 924.5 m, Černookovo Formation, Late Oxfordian, $\times 500$

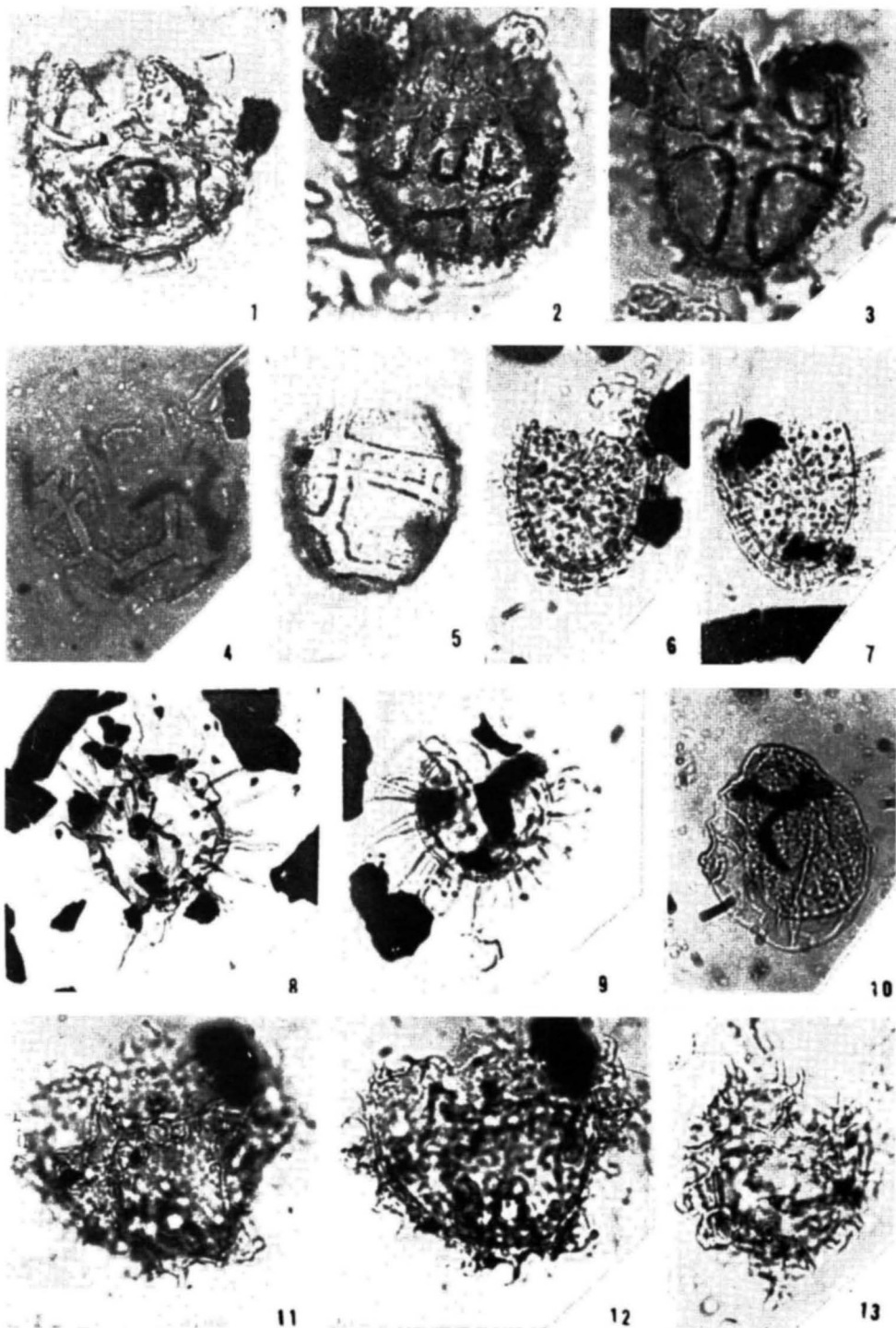


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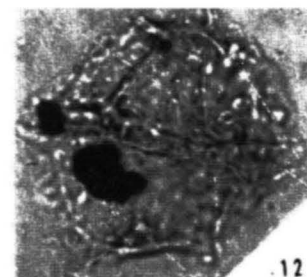
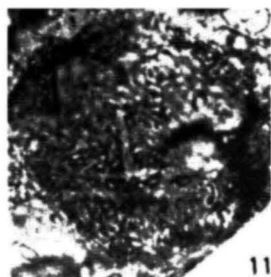
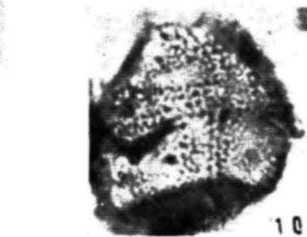
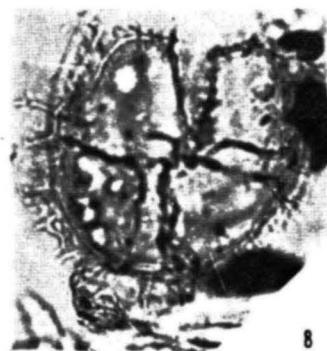
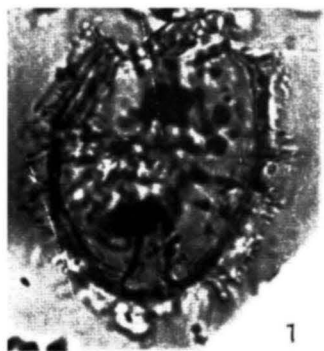
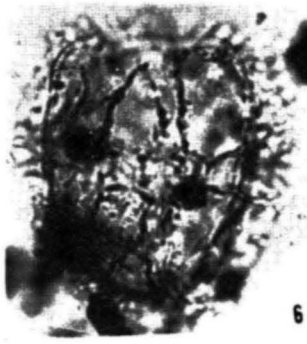
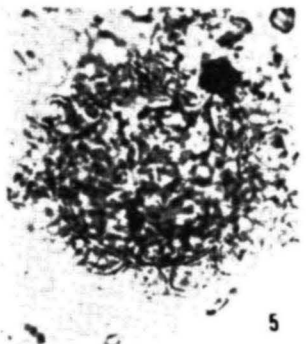
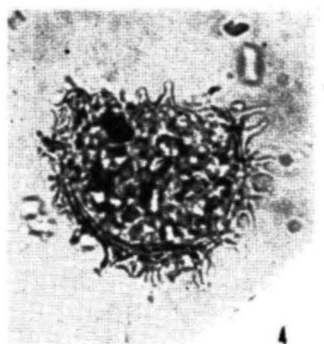
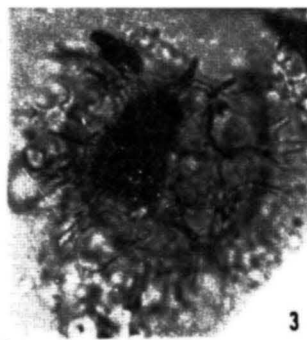
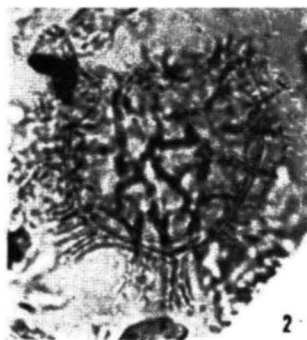
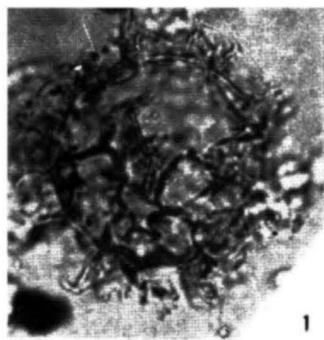


PLATE III

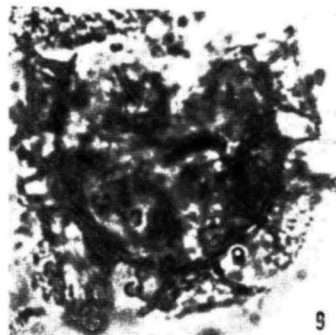
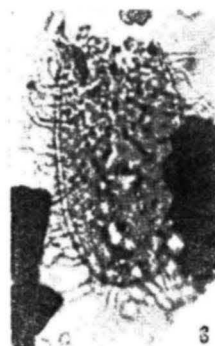
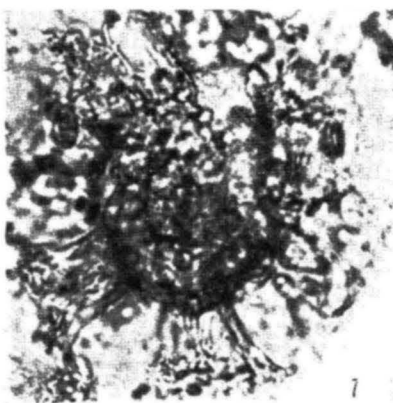
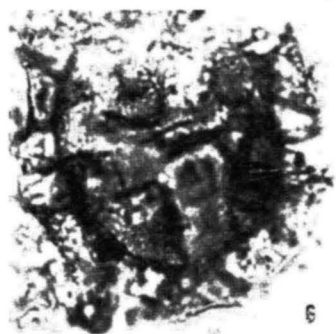
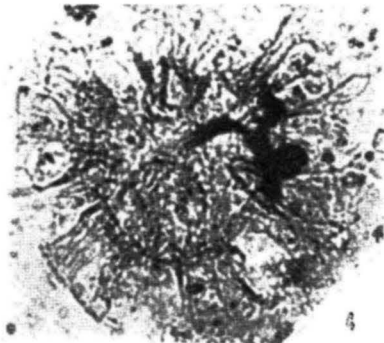
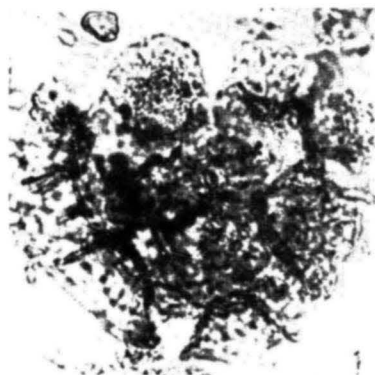


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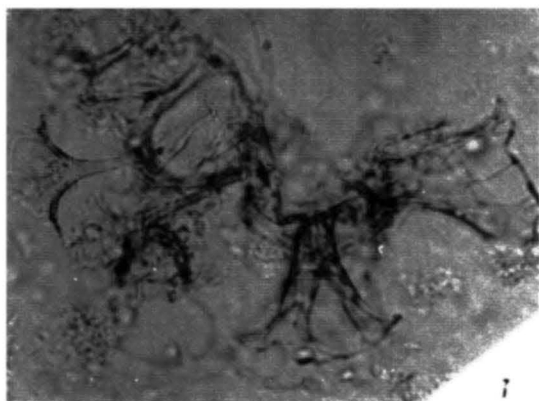
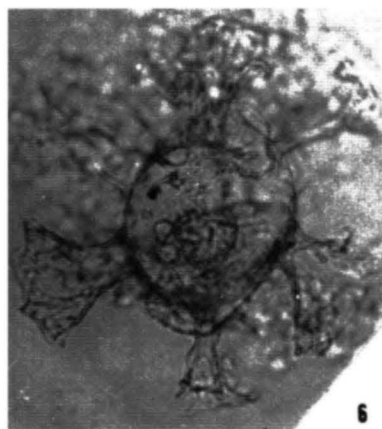
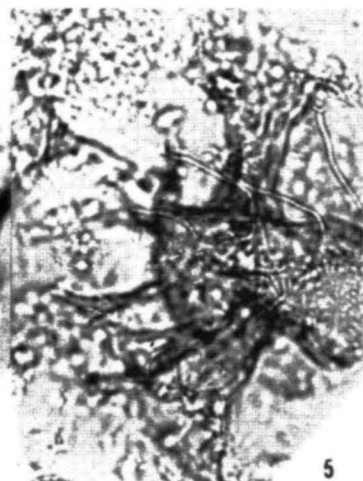
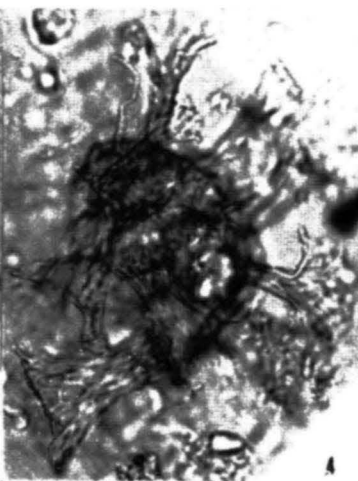
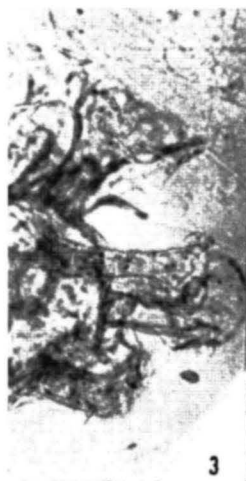
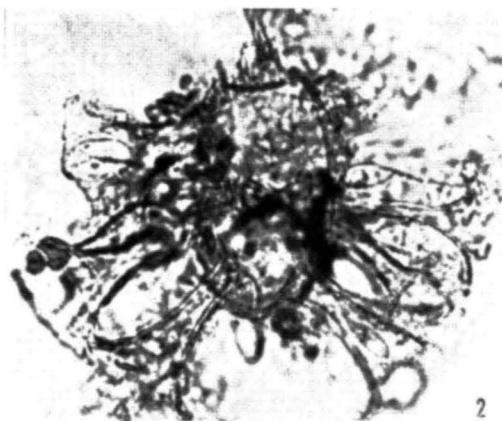
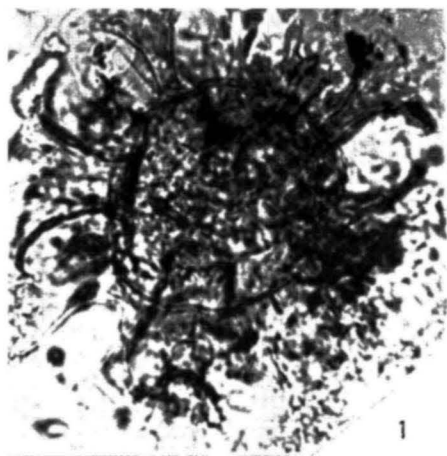


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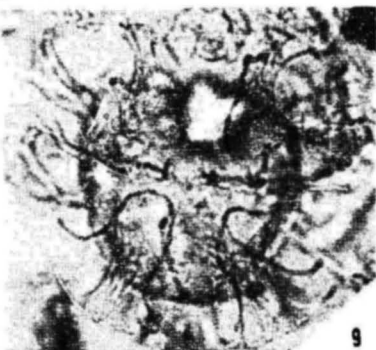
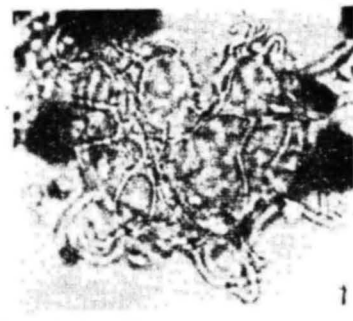
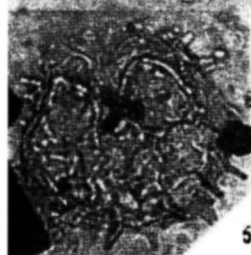
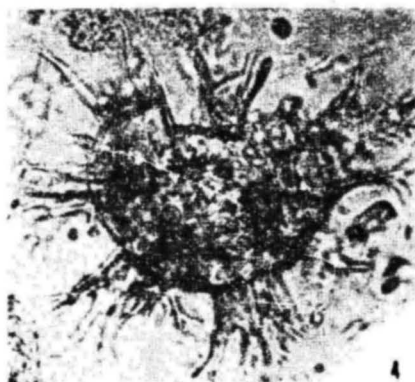
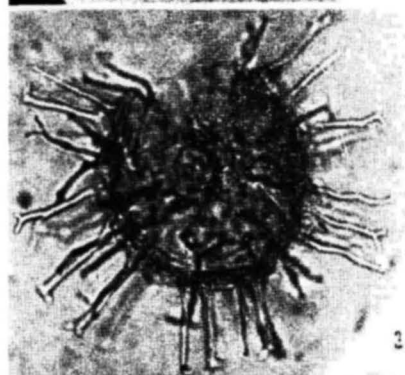
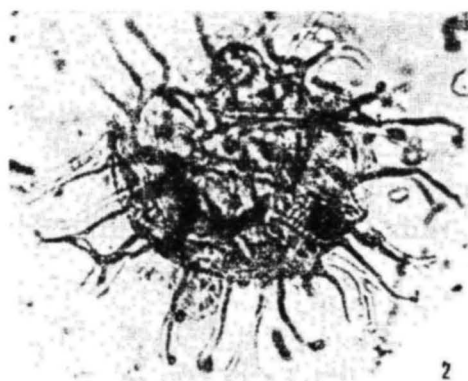
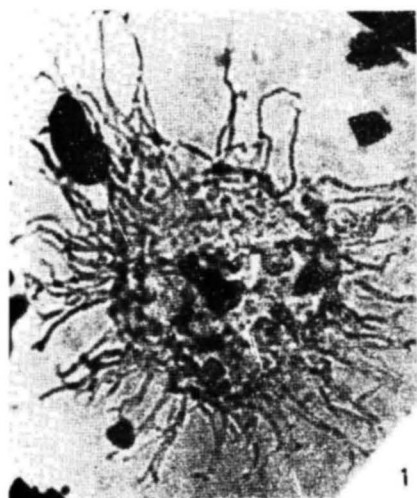


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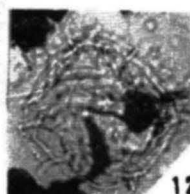
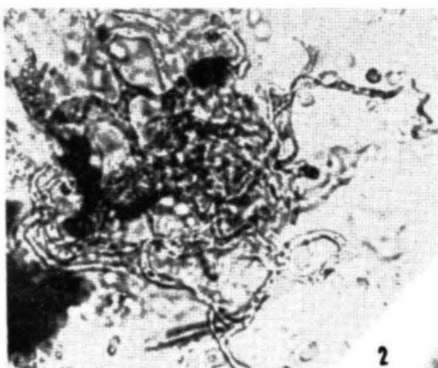
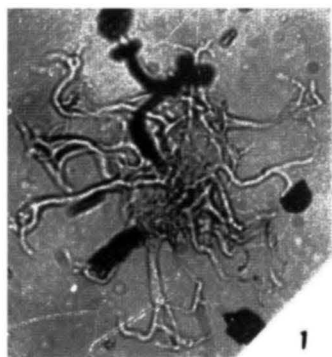


PLATE VII

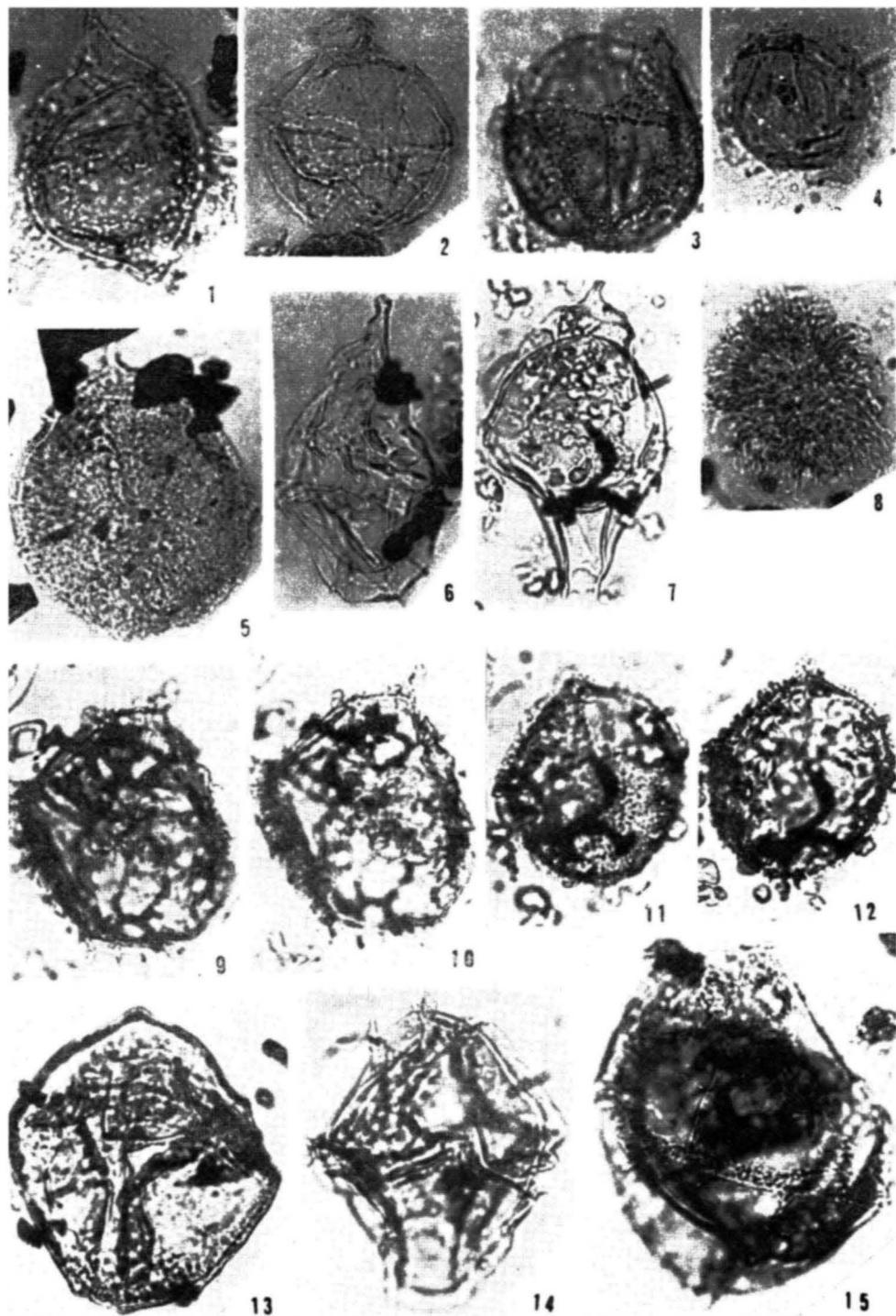


PLATE VIII

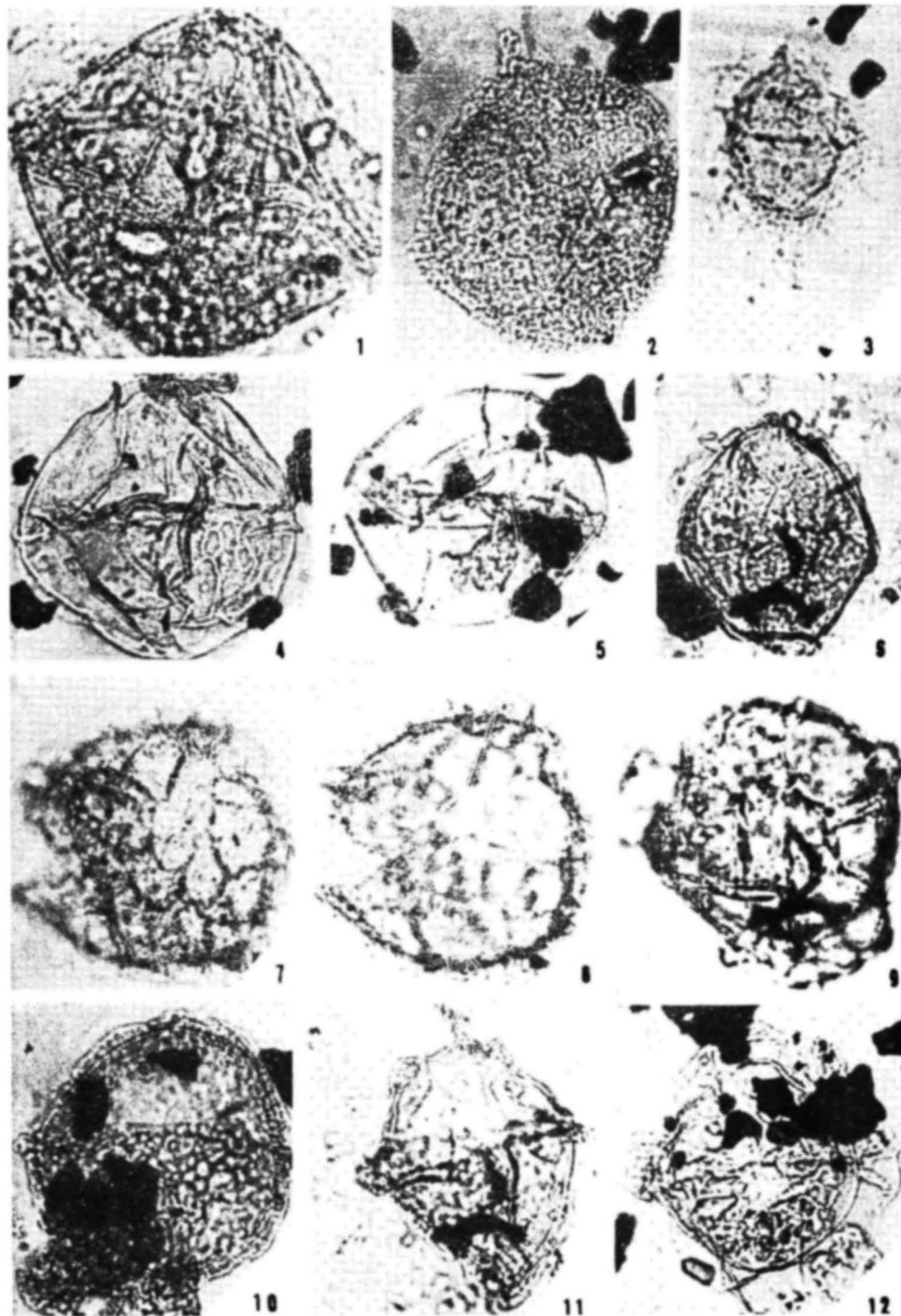
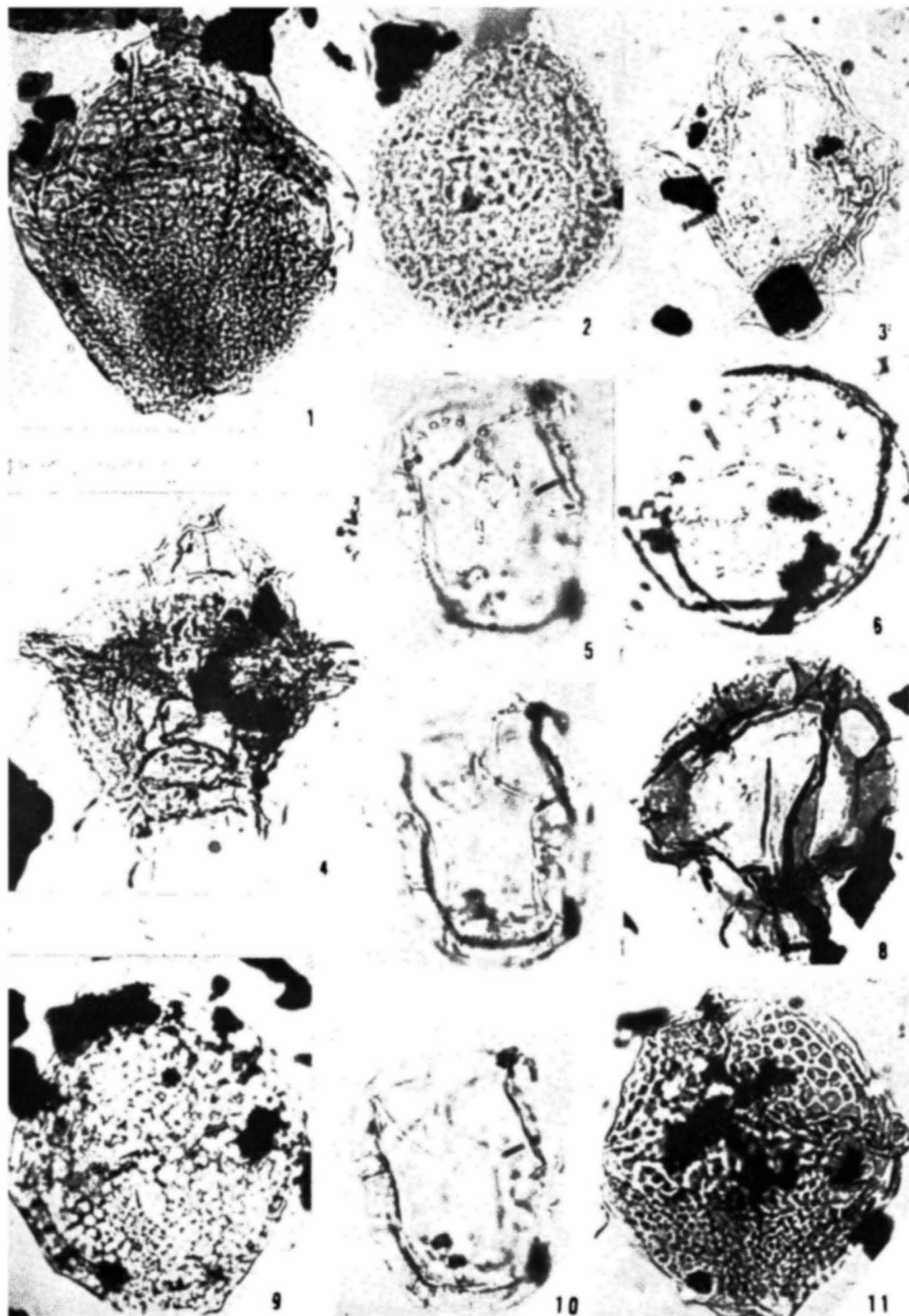


PLATE IX



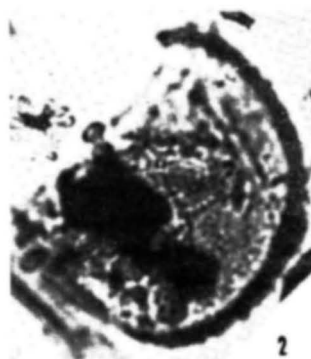
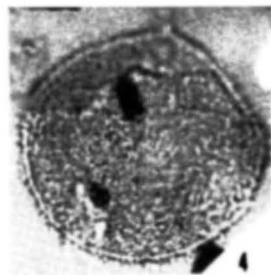
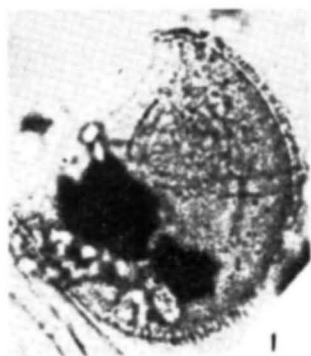


PLATE IX

1. *Scriniodinium dictyophorum* (Deflandre, 1938b). Slide 1551-1, borehole S-21 Kalugerica, depth 888 m, Černookovo Formation, Oxfordian, $\times 600$
2. *Meristaulax granulata* Sarjeant, 1984 a. Slide 926-3, borehole R-55 Konare, depth 1029 m, Černookovo Formation, Early Kimmeridgian, $\times 500$
3. *Scriniodinium* sp. aff. *S. luridum*. Slide 1211-1, borehole S-10 Černookovo, depth 924.5 m, Černookovo Formation, Late Oxfordian, $\times 500$
4. *Dinopterigium dimorphum* (Ioannides et al., 1977). Slide 3540-4, borehole R-1 Junak, depth 1605 m, Tiča Formation, Middle Tithonian, $\times 500$
- 5, 7, 10. *Stephanelytron* sp. aff. *S. redcliffense*. Slide 1298-5, borehole S-9 Kardam, depth 877.5 m, Černookovo Formation, Early Oxfordian, $\times 860$
6. *Ctenidodinium chondrum* Drugg, 1978. Slide 1552-1, borehole S-21 Kalugerica, depth 889.5 m, Černookovo Formation, Early? Oxfordian, $\times 600$
8. *Limbodinium absidatum* (Drugg, 1978). Slide 1676-2, borehole R-5 Tutrakanci, depth 1765 m, Provadija Formation, Early Oxfordian, $\times 500$
9. *Scriniodinium dictyotum dictyotum* Cookson & Eisenack, 1960b. Slide 1213-1, borehole S-10 Černookovo, Černookovo Formation, depth 919-933 m, Middle? — Late Oxfordian, $\times 500$
11. *Scriniodinium dictyotum papillatum* Gimez, 1970. Slide 2002-1, borehole R-109 Vranino, depth 1291.6 m, Černookovo Formation, Late Oxfordian, $\times 500$

PLATE X

- 1-3. *Tehamadinium* sp. aff. *T. konarae*. Slide 1208-1, borehole S-10 Černookovo, depth 903 m, Černookovo Formation, Late Oxfordian — Early Kimmeridgian. In lateral view, $\times 550$
- 4-7. *Tehamadinium konarae* sp. n. Holotype. Slide 926-2, borehole R-55 Konare, depth 1029 m, Černookovo Formation, Early Kimmeridgian. 4 — ventral surface with spinate and granulate ornamentation. Note the two opercular pieces adherent to internal ventral surface; 5 — in median focus, $\times 500$; 6 — dorsal side viewed by transparency; 7 — ventral side with densely ornaments, $\times 1000$
8. *Tehamadinium konarae* sp. n. Slide 1214-1, borehole S-10 Černookovo, depth 933 m, Černookovo Formation, Middle? — Late Oxfordian. In dorsal view, $\times 500$
9. *Dissiliodinium globulatum* Drugg, 1978. Slide 1298-5, borehole R-9 Kardam, depth 877.5 m, Černookovo Formation, Early Oxfordian, $\times 500$
10. *Scriniodinium crystallinum* (Deflandre, 1938a). Slide 1374-1, borehole S-33 Esenica, depth 753-756 m, Černookovo Formation, Early Oxfordian, $\times 500$