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DINOFLAGELLATE CYSTS FROM CALLOVIAN OF ŁUKÓW
(POLAND)

Abstract.—Dinoflagellate cysts from the Łuków deposit of Callovian clays, are described. They belong to the families Gonyaulacystaceae, Microdiniaceae, Eodiniaceae, Adnatosphaeridiaceae, Hystrichosphaeridiaceae, Nelsoniellaceae, Endoscriniaceae and Membranilarnaciaceae. A new genus and species *Verrucosphaera lukoviensis* have been described within microorganisms incertae sedis.

INTRODUCTION

The occurrence at Łuków of a deposit of dark clays containing calcareous concretions of syngenetic origin, was originally reported towards the end of the last century (Krischtafowitsch, 1896).

Many geologists here expressed their opinions concerning the origin of this formation. Rychłowski (1905) maintained that the clays were of Oligocene age, whereas the concretions, which contain a Callovian fauna, had been transported from the north by a glacier. Lewiński & Samsonowicz (1918), as well as Siemiradzki (1923) considered the deposit of Łuków to be composed wholly of Jurassic sediments transported to their present position by glacial action. In contrast, Brinkman (1927) treated the Jurassic of Łuków as a formation "in situ". Łuniewski & Świdziński (1929) shared the views of those authors who considered the Jurassic clays as an erratic mass.

The fauna from Łuków, mainly of Ammonites, was studied by Makowski (1947, 1952 and partly, 1962). This author (1952) shared the opinion regarding the glacial transportation of the clays at Łuków. On the basis of the composition of the fauna, he considered that these clays belong to the Upper Callovian, *Kosmoceras spinosum* (Sowerby) zone. This fauna, boreal in character, is made up of a mixture of eastern and western elements, which may result from the fact that these sediments were deposited in a region through which there existed a communication bet-

ween the seas of Eastern and Western Europe, as a consequence of the transgression that took place in the Callovian.

The data concerning the geological structure of the region of Łuków suggest that this erratic mass was carried by a continental glacier from some not very distant area (Makowski, 1952).

The micro- and macrofauna described by Makowski (1947, 1952, 1962) belong to the Foraminifera, Vermes, Bryozoa, Brachiopoda, Lamellibranchiata, Gastropoda, Cephalopoda and Echinodermata. The presence of the Scolecodonta, Hydroidea and of a representative of the *Rhabdopleura* (*Rhabdopleura kozłowskii* Kulicki) in calcareous concretions disseminated through the Callovian clays of Łuków found in the Łapiguz claypit, has recently been recorded by Kulicki (1969). The presence of remains of wood fragments, numerous spores and other plant remains indicate the proximity of a land.

The cysts of the Dinoflagellata, described below, confirm the age of the Łuków clays as Middle to Upper Callovian. The specimens under study were isolated from the calcareous concretions by dissolving the latter in hydrochloric acid. They were embedded in glycerogelatin. All slides (80) are housed in the collection of the Warsaw University's Palaeontological Laboratory under the nos: CW1, CW2 ..., to CW20, CX1, CX2 ..., to CX20, CY1, CY2 ..., to CY20 and CZ1, CZ2 ..., to CZ20.

I would like to extend my warmest thanks to Prof. Roman Kozłowski for his indications and valuable remarks. I am very indebted to Prof. Georges Deflandre (Laboratoire de Micropaléontologie, Ecole Pratique des Hautes Etudes, Paris) for some advices, to Prof. W. A. S. Sarjeant (Department of Geology, University of Nottingham) who carefully read my manuscript and made many useful criticisms. Thanks are also due to Miss L. Łuszczewska for taking photographs and Mrs E. Gadomska for making drawings.

Studies on the Callovian microorganisms

Studies on the Callovian microplankton, based on erratic boulders from the Baltic region, were initiated by Eisenack (1935, 1936a, b) and continued by Deflandre (1947a). Sarjeant's (1959) studies concerned the Upper Cornbrash (*Macrocephalites macrocephalus* zone) of Yorkshire, England. Later, this author (1961, 1962) also described microorganisms from the Lower (*Sigaloceras calloviense* zone), Middle (*Kosmoceras jason* and *Erymnoceras coronatum* zones) and Upper Callovian (*Peltoceras athleta* zone) (1962) of England. Analogous studies were also undertaken by Sarjeant in Normandy where he examined both the Lower (1965) and the Upper Callovian (*Lamberticeras lamberti* zone) (1968).

On the basis of literature and my own studies, I find that *Gonyaulacysta jurassica* (Defl.) and *Gon. cladophora* (Defl.) is the most abundant species in all Jurassic horizons. Such species as *Gon. jurassica* (Defl.), *Scriniodinium crystallinum* (Defl.), *Gon. cladophora* (Defl.) and *Adnatosphaeridium aemulum* (Defl.) are widely distributed geographically, the latter two being represented even in Australia.

In the microfauna of Łuków, the most abundant species are *Lithodinia jurassica* Eisenack, *Gonyaulacysta cladophora* (Defl.) and *Adnatosphaeridium aemulum* (Defl.). Less numerous are *Gon. jurassica* (Defl.) and *Endoscrinium galeritum reticulatum* (Defl.), the latter species having a known range from Upper Callovian to Upper Oxfordian (Sarjeant, 1968). Sporadically occurring species are *Eodinia pachythea* Eisenack, first described by Eisenack (1936b) from the Upper Callovian erratics of the Baltic region, *Cordosphaeridium costatum* (Davey & Williams), whose range stretches from the Upper Bathonian to the Kimmeridgian, and *Scriniodinium crystallinum* (Defl.), whose known range is from Lower Oxfordian to Lower Kimmeridgian (Sarjeant, 1968, Gitmez, 1970).

The occurrence of the microorganisms referred to above in both clays and calcareous concretions of Łuków may indicate that they belong to the Middle and Upper Callovian. It also supports the contention that dinoflagellates are to a considerable extent independent of facies and type of deposit and that they may appear in marine deposits of all types. No Acritarcha have been found.

The lack in Łuków of the forms, typical of the Lower Callovian described by Sarjeant (1959) indicates that this stage does not occur at Łuków, which is also confirmed by the absence of the fauna of ammonites typical of this stage.

SYSTEMATIC DESCRIPTIONS

Class **Dinophyceae** Pasher

Subclass **Dinoferothecidae** Bergh

Family **Gonyaulacystaceae** Sarjeant & Downie, 1966

Genus *Gonyaulacysta* Deflandre ex Norris & Sarjeant, 1965 emend. Sarjeant in Davey, Downie, Sarjeant & Williams, 1969

Diagnosis. — Cyst of the proximate type, spherical, oviform, elliptic or polyhedral with an apical horn composed of the periplasm. Reflected tabulation expressed by the following formula: 3-4', 0-1a-6", 6c, 5-6"', 1p, 0-1, p. v. 1''', 0-×5. Cingulum more or less helicoidal; cingular, postcingular and antapical horns lacking. Sutures marked by narrow edges or ridges (smooth, serrate or spiny, perforate or non-perforate). Precingular

archaeopyle corresponding to the position of plate 3", sometimes undeveloped. Surface of periphragm smooth, granulate, punctuate or reticulate.

Type species: G. jurassica (Deflandre)

Gonyaulacysta jurassica (Deflandre)

(Pl. I, Fig. 3a, b; Text-fig. 1)

1965. *Gonyaulacysta jurassica* (Deflandre); H. Górká, *Les microfossiles du jurassique...*, pp. 298–299, Pl. 1, Fig. 4a, b (earlier synonymy included).

1967. *Gonyaulacysta jurassica* (Deflandre); L. Dodekova, *Les dinoflagellés...*, pp. 16–17, Pl. 2, Fig. 1.

Material. — One well preserved specimen.

Dimensions (in μ) of the spec. No. CW 20:

total length	95.00
width of theca	62.50
length of epitract with horn	55.00
length of apical horn	ca 25.00
length of hypotract	30.00
width of cingulum	5.00

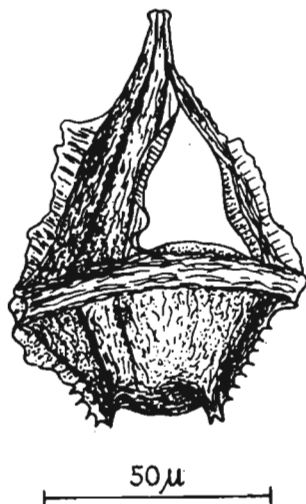


Fig. 1. — *Gonyaulacysta jurassica* (Deflandre). Spec. CW20.

Description. — Theca elongate, divided by a spiral and sinistral cingulum into an epi- and hypotract. Epitract elongate-conical, provided with a cylindrical, apical horn with a tapering, truncate cone. Hypotract, smaller, trapezoidal, with a rounded antapical pole. Sulcus present. Tabulation corresponding to the formula: 4', 1a, 6", 6c, 6"', 1p, 1'''. Archeopyle trapezoidal, situated in the place of occurrence of the third pre-equatorial (3'') plate. Sutures between plates provided with delicate, finely-serrate

crests. On the hypotract, these crests considerably extend antapically and terminate in processes, two of them being clearly visible in corners between plates. Surface of periphragm finely reticulate.

Remarks. — See Górka (1965, p. 299).

Occurrence. — See Górka (1965). Bulgaria: Oxfordian; Poland: Callovian of Łuków.

Gonyaulacysta cladophora subsp. *cladophora* (Deflandre)

(Pl. I, Fig. 4; Pl. II, Figs. 1a-c, 2a, b; Text-fig. 2a, b)

1938. *Gonyaulax cladophora* n. sp.; G. Deflandre, Sur le microplancton..., p. 688, Fig. 4.
 1938. *Gonyaulax cladophora* Deflandre; G. Deflandre, Microplancton des mers jurassiques..., pp. 173-176, Pl. 7 Figs. 1-5; Text-figs. 5, 6.
 ?1941. *Gonyaulax cladophora* Deflandre; G. Deflandre, Le microplancton kiméridgien..., p. 9, Pl. 3, Figs. 4, 5.
 1960. *Gonyaulax cladophora cladophora* Deflandre; K. W. Klement, Dinoflagellaten und Hystrichosphaerideen..., p. 35, Pl. 3, Figs. 1-9; Text-figs. 11-13.
 1962. *Gonyaulax cladophora* subsp. *cladophora* (Deflandre); G. & M. Deflandre, Fichier Micropaléont. Gén. sér. 11, 1776-1780.
 1962. *Gonyaulax cladophora* subsp. *cladophora* (Deflandre); A. Eisenack, Katalog der Fossilen Dinoflagellaten..., 331.

Material. — Three specimens, including one well-preserved.

Dimensions (in μ):

	1 spec. CW5	2 spec. CZ19	3 spec. CW1
total length of theca with apical horn	107.50	112.50	127.50
length of apical horn	15.00	17.50	15.00
width of theca without processes	100.000	92.50	100.00
length of epittract with horn			
oblique position		67.50	70.00
length of hypotract	62.50	45.00	52.50
width of cingulum	invisible	5.00	5.09
length of spines on slats	5.00-7.50	5.00-10.00	2.50-10.00

Description. — Theca rounded to somewhat subpolyhedral. Cingulum strongly helicoidal, divided into two almost equal parts, epi- and hypotract. Epittract rounded at the sides, provided with an apical horn, having two apparent notches at its apex, formed by the junction of crests. Hypotract somewhat smaller, also with rounded sides. Sulcus extending conspicuously from apex to antapex, almost constant in width throughout its entire length. Tabulation marked by plates which are limited by short, straight spines particularly strongly developed at the corners of plates.

Epitract consisting of four apical (1'-4'), one anterior intercalary (1a) and six pre-equatorial (1''-6'') plates. A trapezoidal archeopyle occurs in the place of the third pre-equatorial plate (3''). Hypotract formed by six post-equatorial plates (1'''-6''') of which plate 1''' is reduced in size, and a posterior intercalary plate (1p) very clearly visible. Antapical plate trapezoidal is connected with two post-equatorials. Surface of periphragm finely reticulate.

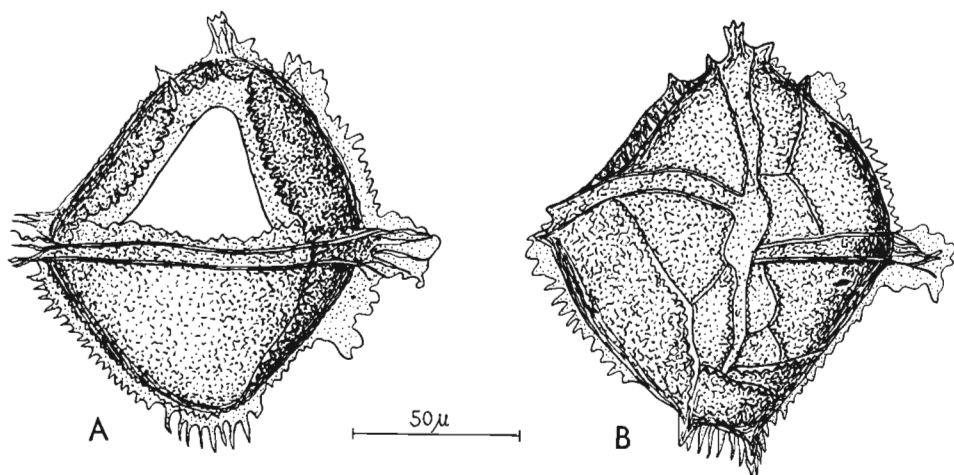


Fig. 2.—*Gonyaulacysta cladophora* subsp. *cladophora* (Deflandre): a dorsal view, b ventral view. Spec. CW1.

Remarks. — Deflandre (1938, p. 173) emphasized that *Gon. cladophora* is marked by a considerable variability of shape. Klement (1960) distinguished, in addition to *Gonyaulacysta cladophora* subsp. *cladophora* (Deflandre), several other subspecies from the Malm of SW Germany.

Occurrence. — France: Oxfordian and Kimmeridgian; S. W. Germany: Malm; Poland: Callovian of Łuków.

Family **Microdiniaceae** Eisenack, 1964, emend Sarjeant & Downie, 1966
Genus *Lithodinia* Eisenack, 1935

Diagnosis of the genus. — Theca hexagonal, rounded, divided by cingulum into an epi- and hypotract. Sulcus present. Tabulation expressed by the formula: 3', 6'', 6''', 1p, 1'''. Archaeopyle apical.

Lithodinia jurassica Eisenack, 1935
(Pl. III, Figs. 1-6; Text-fig. 3)

1935. *Lithodinia jurassica* n. sp.; A. Eisenack, Mikrofosilien aus Doggergeschieben..., pp. 175-177, Pl. 4, Figs. 5-8; Texte-figs. 1-4.

1961. *Lithodinia jurassica* Eisenack; G. Alberti, Zur Kenntnis..., p. 44.

1961. *Lithodinia jurassica* Eisenack; A. Eisenack, Einige Erörterungen..., p. 311, Pl. 37, Fig. 6.
1961. *Lithodinia jurassica* Eisenack; W. R. Evitt, Observations on the morphology..., p. 390, Pl. 1, Figs. 10-13; Pl. 2, Fig. 6.
1962. *Lithodinia jurassica* Eisenack; G. & M. Deflandre, Fichier Micropal. Gén. sér. 11, 1885-1887.
1964. *Lithodinia jurassica* Eisenack; A. Eisenack, Katalog der fossilen Dinoflagelaten..., pp. 505-506.

Material. — Very numerous, fairly well preserved specimens, frequently filled with grains of pyrite.

Dimensions (in μ):

	1 spec. CY10	2 spec. CZ5	3 spec. CZ20
height (without processes)	50.00	55.50	62.50
width (without processes)	47.50	52.50	50.50
length of processes	2.50-5.00	2.50-3.00	2.50-7.50

Description. — Theca hexagonal, rounded, flattened dorsoventrally, divided by a relatively wide helicoid suture into a somewhat smaller epi- and longer hypotract. On the ventral side, sulcus, reaching apical plate(?) 1', extends towards hypotract. Boundaries of plates and sulci are determined by fairly closely spaced short processes, slightly extended at the base and usually somewhat more massive in the corners of plates. Tabulation expressed by the formula 3', 6'', 6''', 1p, 1'''. Archaeopyle apical present in all specimens, is irregular in shape, notched. Periphragm finely reticulate.

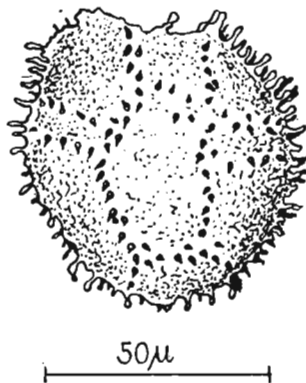


Fig. 3. — *Lithodinia jurassica* Eisenack. Spec. CY20.

Remarks. — In its hexagonal outline and tabulation, *Lithodinia jurassica* Eisenack is similar to *Gonyaulacysta cladophora cladophora* (Defl.) from the Malm of SW Germany (Klement, 1960, p. 35, Pl. 3, Figs. 1-9, Text-

figs. 11–13). In the last-named species, processes on sutures are longer, archaeopyle situated in the place of pre-equatorial plate 3" and, in addition, apical process is present. In the hexagonal shape and similar tabulation, it is also similar to *Gon. cladophora* subsp. *hemipolyedrica* Klement from the Malm of Germany (Klement, 1960, p. 36, Pl. 3, Figs. 10–12; Text-figs. 14, 15), in which the archaeopyle is situated in the place of plate 3".

L. jurassica resembles in the apical situation and shape of archaeopyle Form A (*Gonyaulacysta*?) from the Lower Cretaceous and Albian of Pakistan (Evitt, 1961, p. 390, Pl. 1, Fig. 14; Pl. 2, Fig. 7). It differs from the latter in tabulation and, within its range, in mutual proportions. In addition, the transverse sulcus in Form A is wider.

Occurrence. — Callovian erratic boulders of the Baltic region; Pakistan: Cretaceous; Germany: Dogger; Poland: Callovian of Łuków.

Family **Eodiniaceae** Eisenack, 1961, emend Sarjeant & Downie, 1966

Genus *Eodinia* Eisenack, 1936

Diagnosis of the genus. — Theca spherical, ellipsoidal to oviform, flattened, divided by a helicoidal suture into an epi- and hypotract. Epitract provided with an apical horn. Tabulation lacking. Archaeopyle either present or lacking.

Type species: *E. pachytheca* Eisenack, 1936.

Eodinia pachytheca Eisenack, 1936

(Pl. I, Figs. 1 and 2a, b; Pl. II, Fig. 3; Text-fig. 4)

1936. *Eodinia pachytheca* n. sp.; A. Eisenack, *Eodinia pachyteca* n. gen. n. sp. ..., p. 73, Text-figs. 1–5.
1936. *Eodinia pachytheca* Eisenack; A. Eisenack, *Dinoflagellaten...*, p. 60, Pl. 4, Figs. 7–11.
1961. *Eodinia pachytheca* Eisenack; A. Eisenack, *Einige Erörterungen...*, Pl. 33, Figs. 1–2.
1962. *Eodinia pachytheca* Eisenack; A. Eisenack, *Katalog der fossilen Dinoflagellaten...*, pp. 283–284.
1967. *Eodinia pachytheca* Eisenack; T. F. Vozzhennikova, *Iskopaemye...*, p. 58, Pl. 15, Fig. 6.

Material. — Few, variously preserved specimens.

Dimensions (in μ):

	1 spec. CX15	2 spec. CW2	3 spec. CY8
height of theca (without apical horn)	47.50	87.50	95.00
total width of theca	55.50	92.50	87.50
height of apical horn	damaged	17.50	30.00
width of margin	damaged	7.50	10.00

Description. — Theca oval to quadrilateral, flattened, divided by a slightly marked equatorial suture into an epitract with a conical apical horn and a rounded, somewhat smaller hypotract. A V-shaped folding is visible on hypotheca in optical section. Archaeopyle present, situated pre-circularly in the place of plates 2'' or 3'' (spec. CX15). Periphragm coarsely perforate.

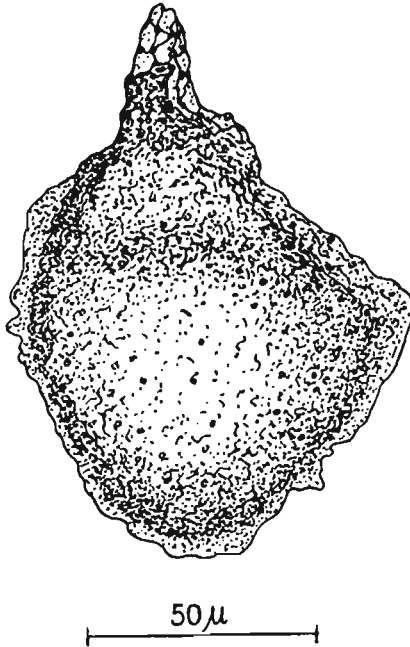


Fig. 4. — *Eodinia pachythea* Eisenack. Spec. CY8.

Remarks. — Sulcus hardly discernible, in some specimens placed in a depression stretching halfway the height of hypotract. Specimens from Łuków are somewhat smaller than those from the Callovian of Germany.

Occurrence. — Callovian of the Baltic region; Poland: Callovian of Łuków.

Family **Adnatosphaeridiaceae** Sarjeant & Downie, 1966

Genus *Adnatosphaeridium* Williams & Downie, 1966

Diagnosis. — A cyst of the chorate type, provided with either tubular or massive intratabular processes varying in number on individual plates. Processes are connected with each other by trabeculae. Archaeopyle apical.

Type species: *A. vittatum* Williams & Downie, 1966 from the Eocene of London limestones (Williams & Downie in Davey et al, 1966, pp. 215–216, Pl. 24, Figs. 3, 7, Text-fig. 56).

Adnatosphaeridium aemulum (Deflandre)
(Pl. IV, Fig. 1a, b, Pl. V, Figs. 3, 4a, b; Text-fig. 5).

1965. *Cannosphaeropsis aemula* (Deflandre); H. Górka, *Les microfossiles...*, pp. 304–305, Pl. 3, Figs. 7, 8. (earlier synonymy included).
1966. *Adnatosphaeridium aemulum* (Deflandre); G. I. Williams & C. Downie in R. J. Davey, C. Downie..., *Studies on Mesozoic...*, p. 218.
1968. *Adnatosphaeridium aemulum* (Deflandre) Williams & Downie; W. A. S. Sarjeant, *Microplankton from the Upper Callovian...*, p. 235.

Material. — A dozen or so well-preserved specimens, some of them filled with pyrite.

Dimensions (in μ):

	1 spec. CZ2	2 spec. CY1	3 spec. CY2
diameter of central body (without processes)	45.00	45.00	45.00
length of processes	25.00	32.50	45.00

Description. — Central body spherical to subspherical, provided with about 15 tubular intratabular processes equal in length in one and the same specimen but varying in width. Halfway their length, processes branch dichotomously and the distal ends of adjacent branches are attached to each other. In addition each processes is connected with adjacent processes by thin trabeculae. Archaeopyle apical.

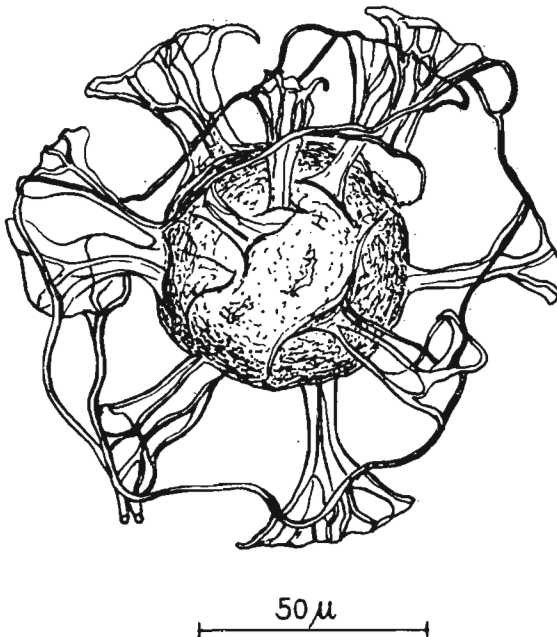


Fig. 5. — *Adnatosphaeridium aemulum* (Deflandre). Spec. CY1.

Remarks. — The presence of an apical archaeopyle and intratabular processes in *A. aemulum* enabled the separation of the species under study from the genus *Cannosphaeropsis* O. Wetzel, to which it was previously assigned. The presence of processes distally connected by trabeculae is a common character of the two genera.

Occurrence. — See Górká (1965, p. 305). France: Upper Callovian and Lower Oxfordian of Normandy. Poland: Callovian of Łuków.

Family **Hystrichosphaeridiaceae** Evitt, 1963 emend. Sarjeant & Downie, 1966

Genus *Cordosphaeridium* Eisenack emend. Davey & Williams, 1966

Diagnosis. — A subspherical cyst of the chorate type, with reflected tabulation expressed by the formula: 1', 6'', 6c, 6''', (1p), 1'''''. Central body composed of two layers: endo and periphragm forming intratabular processes, tubiform to buccinate, solid or hollow, and with a variable number of sulcal processes. Archaeopyle apical and haplotabular.

Type species: *Hystrichosphaeridium inodes* Klump from the Eocene of Germany (Klumpp, 1953, pp. 391–392, Pl. 18, Figs. 1–2).

Cordosphaeridium costatum (Davey & Williams)

(Pl. V, Figs. 1a, b; Pl. VI, Fig. 7, Text-fig. 6)

1966. *Hystrichosphaeridium costatum* sp. nov.; R. J. Davey & G. L. Williams in R. J. Davey & C. Downie..., *Studies on...*, p. 62, Pl. 10, Fig. 4 (earlier synonymy included).

Material. — Two specimens, one well preserved, the other damaged. Dimensions (in μ):

	1 spec. CY3	2 spec. CY7
diameter of central body (without processes)	37.50	50.00
length of processes	22.50	17.50

Description. — Central body spherical to ovoid, composed of two layers: endo- and periphragm, provided with about 20 tubiform processes having sub-quadrate distal openings. Margins of distal processes may be "serrate, undulate" or even "aculeate". Very often at the angles of their margin are small spines. One sulcal process is present. (Pl. 5, Fig. 1a). Walls of processes formed of periphragm only, provided with fine ribs parallel to the longer axis (Pl. 5, Fig. 1b). A perforation is observed on some of the processes. A reflected tabulation is typical for this genus. An apical archaeopyle clearly visible on one of the specimen (CY7).

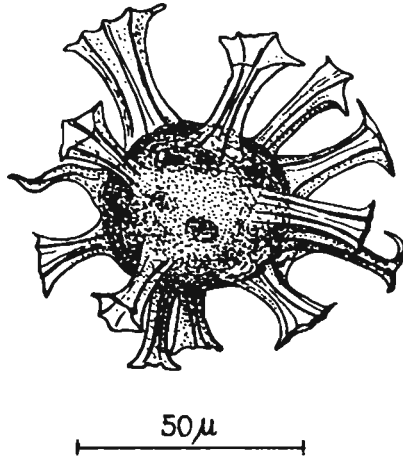


Fig. 6. — *Cordosphaeridium costatum* (Davey & Williams). Spec. CY3.

Remarks. — *Cordosphaeridium costatum* is similar in the morphology and structure of processes to *Hystrichosphaeridium salpingophorum* (Deflandre) from the Upper Cretaceous of France (Deflandre, 1935, p. 232, Pl. 9, Fig. 1), but differs from it in lacking of the thickened ribs extending along its length. However Deflandre (1938, Pl. 10, Figs. 1–3) described *H. salpingophorum* from the Oxfordian noting the ribbed processes. And for that reason, many representatives of *H. salpingophorum* belong now to genus *Cordosphaeridium*. On the Polish specimens ribbing on the surface of the central body was not noticed as well as Deflandre's specimens.

Occurrence. — France, Germany, Belgium: Upper Bathonian to Kimmeridgian; Poland: Callovian of Łuków.

Family **Nelsoniellaceae** Eisenack, 1961 emend. Sarjeant & Downie, 1966
Genus *Scriniodinium* Klement, 1957

Diagnosis. — A cyst of the cavate type. Endoblast oval or spherical, surrounded by a periblast bearing a cingulum. Sulcus and tabulation very feebly indicated or lacking.

Type species: *Scr. luridum* (Deflandre) from the Upper Jurassic of France (Deflandre, 1938, p. 166, Pl. 5, Figs. 4–6).

Scriniodinium crystallinum (Deflandre, 1938)

(Pl. V, Fig. 2)

1965. *Scriniodinium crystallinum* (Deflandre); H. Górka. Les microfossiles..., pp. 294–298, Pl. 1, Fig. 2 (earlier synonymy included).
1967. *Scriniodinium crystallinum* (Deflandre); L. Dodekova, Les dinoflagellates et acritarches..., pp. 11–12, Pl. 1, Figs. 1, 2.
1970. *Scriniodinium crystallinum* (Deflandre), emend Klement; G. U. Gitmez, Dinoflagellate cysts..., pp. 308–310, Pl. 7, Fig. 6; Text-fig. 32.

Material. — One slightly damaged specimen.

Dimensions (in μ):

	spec. CZ8
total length	70.00
total width	80.00
diameter of inner body	62.50
max. width of periphragm	10.00

Description. — A cyst of the cavate type. Endoblast spherical, composed of endophragm, surrounded by a thin-walled periblast forming together the cyst. A narrow cingulum divides the periblast into two almost equal parts, that is, epi- and hypotract, both rounded. Sulcus and tabulation are lacking. Small, secondary folds on the surface of inner body (endophragm) were formed as a result of a damage to the specimen. Archaeopyle in the place of pre-equatorial plate ?3". Peri- and endophragm, finely reticulate.

Remarks. — See Górká (1965, p. 295). As a result of a poor state of preservation of the specimen, no elevation is observed in the apical part of the surrounding membrane (periphragm). It is also lacking in many specimens of this species coming from the Oxfordian of England (Sarjeant, 1961, p. 98, Pl. 14, Figs. 9–12; Pl. 2, Fig. 2) and Bulgaria (Dodekova, 1965, pp. 294–296, Pl. 1, Fig. 2). In Polish specimens, as well as in those of the authors referred to above, no difference in shape is visible between epi- and hypotract.

Occurrence. — See Górká (1965). Bulgaria: Middle Jurassic; Poland: Callovian of Łuków.

Family **Endoscriniaceae** Vozzhennikova, 1965 emend. Sarjeant & Downie, 1965

Genus *Endoscrinium* Klement, 1960 emend Vozzhennikova, 1965

Diagnosis of the genus. — A cyst of the cavate type. Endoblast oval or sphaerical, surrounded by a thin periblast. Cingulum present, sulcus less frequent. Tabulation according to the formula: 3–4', 6", 5"', 0–1p, 0'''. Archaeopyle frequently developed.

Type species: *E. galeritum* (Deflandre) from the Jurassic of France (Deflandre, 1938, p. 167, Pl. 5, Figs. 7–9; Pl. 6, Fig. 1).

Endoscrinium galeritum subsp. *reticulatum* Klement, 1960

(Pl. VI, Fig. 5ab)

1960. *Scriniodinium galeritum reticulatum* n. subsp.; K. W. Klement, *Dinoflagellaten und Hystrichosphaerideen...*, pp. 26–27, Pl. 2, Figs. 1, 2.

1962. *Scriniodinium galeritum* (Deflandre) subsp. *reticulatum* Klement; A. Eisenack, *Katalog der fossilen Dinoflagellaten...*, p. 765.

1965. *Scriniodinium (Endoscrinium) galeritum Deflandre reticulatum* Klement; G. & M. Deflandre, Fichier Micropaléont. Gén. sér. 14, p. 2763.

Material. — One well-preserved specimen.

Dimensions (in μ):

	spec. CW3
total width	115.00
total height	105.00
diameter of inner body	87.50

Description. — A cyst of the cavate type. Inner body spherical, composed of a thin endophragm, of equal thickness to the surrounding periphragm which is damaged at the apical pole and trapezoidal, with two notches on the antapical pole. Cingulum clearly visible on the outer face of the periphragm, dividing the theca into a smaller epi- and larger hypotract. Sulcus and tabulation not visible. Precingular archaeopyle present. Endo- and periphragm conspicuously perforate. In some places, perforation forms a reticulum with large, irregularly polygonal meshes.

Remarks. — In addition to *Scriniodinium galeritum reticulatum*, two more subspecies, *Scr. gal. fornicatum* and *Scr. gal. galeritum* (Defl.) from which this subspecies differs in external shape and primarily in a reticulate surface of membrane, are distinguished by Klement (1960, pp. 23–26).

Occurrence. — Germany: Upper Malm; Poland: Callovian of Łuków.

Family **Membranilarnaciaceae** Sarjeant & Downie, 1969
Genus *Chlamydophorella* Cookson & Eisenack, 1958 emend.

Emended diagnosis. — Membrane oval, spherical to angular in outline. Equatorial suture and apical process present or lacking. Surface covered with short, branched processes on which a thin outer membrane is stretched. Archaeopyle present.

Type species: *Chl. neyi* Cookson & Eisenack from the Upper and Lower Cretaceous of Australia (Cookson & Eisenack, 1958, pp.56–57, Pl. 11, Figs. 1–3).

Chlamydophorella sp.
(Pl. VI, Fig. 6)

Material. — One slightly damaged specimen.

Dimensions (in μ):

	spec. CZ8
diameter (without processes)	ca 45.00
length of processes	5.00

Description. — Membrane subspherical in outline, densely covered with short, rigid processes, branched apically. In most processes, these branchings are perpendicular to the surface of membrane. A thin membrane is stretched between processes. Transverse suture and apical process lacking. An irregular archaeopyle occurs on one of the poles.

Remarks. — *Chlamydothorella* sp. resembles in the morphology of apices of processes *Chl. neyi* Cooks. & Eis. from the Lower and Upper Cretaceous of Australia (Cookson & Eisenack, 1958, pp. 56–57, Pl. 11, Figs. 1–3) from which it differs in the lack of apical process and *Chl. wallala* Cooks. & Eis. from the Lower Kimmeridgian of Western Australia (Cookson & Eisenack, 1960, p. 255, Pl. 38, Fig. 13, Pl. 39, Fig. 11) from which it differs in a general shape. The presence of archaeopyle apical; process and “cingulum” in some of the species of the genus *Chlamydothorella* indicates a relationship to Dinoflagellata.

Incertae sedis organisms

Genus *Verrucosphaera* n. gen.

Diagnosis. — Membrane spherical, covered with tubercles, with a central placed aperture.

Dimensions. — Diameter 50.00 to 75.00 μ .

Derivation of the name: Lat. *verruca* = wart, *sphaera* = sphere.

Verrucosphaera lukoviensis n. gen. n. sp.

(Pl. VI, Figs. 1–4; Text-figs. 7, 8)

1964. “Warzenhüllen” Gocht; H. Gocht, Planktonische Kleinformen..., p. 128, Pl. 16, Fig. 14; Texte-fig. 40.

1965. *Problematicum* gen. et sp. indet.; H. Górka, Les microfossiles jurassiques..., p. 313, Pl. IV, Fig. 1.

Holotype: Spec. CW 10 (Pl. VI, Fig. 1; Texte-fig. 7)

Type stratum: Callovian.

Type locality: Łuków.

Derivation of the name: *lukoviensis* — coming from Łuków.

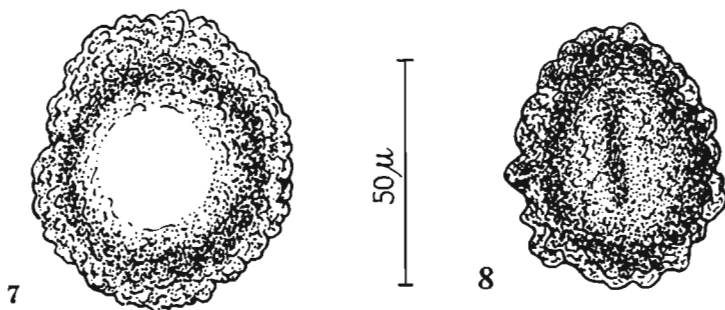
Diagnosis. — Membrane spherical covered with mamilliform tubercles. Aperture situated centrally.

Material. — Fairly numerous, well-preserved specimens, some of them encrusted with pyrite grains.

Dimensions (in μ):

	holotype spec. CW10	1 spec. CY17	2 spec. CY19	3 spec. CW14
diameter	57.5	52.50	57.50	75.00

Description. — Membrane spherical to oval, covered with many convex and rounded tubercles which closely adhere to each other and have a constant diameter of $5\ \mu$. A centrally situated aperture (archaeopyle?), round or irregular in outline, occurs in all specimens.



Figs. 7, 8. — *Verrucosphaera lukoviensis* n. gen., n. sp.: 7 holotype, spec. CW10; 8 paratype, spec. CZ1.

Remarks. — In its general outline, *Verrucosphaera lukoviensis* n. gen. n. sp. resembles the representatives of the genus *Palambages* O. Wetzel, also of an unknown relationship, compared by Manum & Cookson (1964, pp. 23–24) to the colonies of Protococcales?. *Palambages* O. Wetzel is also composed of many cells closely adhering to each other and sometimes displaying a foam structure (Górka 1963, pp. 75–76, Pl. 11, Fig. 1) but without an aperture typical of *V. lukoviensis* n. gen. n. sp. In its shape and the presence of aperture it also resembles *Tenua hystrix* Eisenack from the Aptian of Northern Germany (Eisenack, 1958, p. 410, Pl. 23, Figs. 1–4; Text-fig. 10) from which it differs in the presence of a vesicular structure, lack of processes and smaller dimensions. *V. lukoviensis* n. gen. n. sp. was first found (a single specimen) in the Astartian of Magnuszew (at a depth of 1265 m) and described as *Problematicum* gen. et sp. indet. (Górka, 1965).

Occurrence. — Germany: Lias and Dogger; Poland: Astartian of Magnuszew and Callovian of Łuków.

Palaeozoological Laboratory
of the Warsaw University
Warszawa, May 1970

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HANNA GÓRKA

CYSTY DINOFLAGELLATA Z KELOWEJU ŁUKOWA

Streszczenie

Kelowejska kra lodowcowa okolic Łukowa w postaci ilów, przyniesiona przez łądołód przypuszczalnie z niewielkiej odległości, stanowi źródło różnorodnych makro- i mikroskamieniałości. Skamieniałości te skoncentrowane są prawie wyłącznie w luźno rozsianych w ilach konkrecjach wapiennych. Makrofauna, głównie Cephalopoda, była przedmiotem opracowań Makowskiego (1947, 1952, 1962). Ostatnio Kulicki (1969) stwierdził obecność w konkrecjach rodzaju *Rhabdopleura* (Pterobranchia) oraz fragmentów Hydroida i Scolecodonta. Autorka opracowała cysty Dinoflagellata należące do rodziny: Gonyaulacystaceae, Microdiniaceae, Eodiniaceae, Adnatosphaeridiaceae, Hystrichosphaeridiaceae, Nelsoniellaceae, Endoscriniaceae i Membranilarniaceae. W obrębie mikroorganizmów incertae sedis wyróżniono jeden nowy rodzaj i gatunek *Verrucosphaera lukoviensis*.

ХАННА ГУРКА

ЦИСТЫ DINOFLAGELLATA ИЗ КЭЛЛОВЕЯ ЛУКОВА (ПОЛЬША)

Резюме

Отторженец кэлловейских глин в окрестности Лукова, привлеченный предположительно из недалеко ледником во время четвертичного периода, является источником разнообразных макро- и микроокаменелостей. Эти окаменелости сконцентрированы почти исключительно в известковых конкрециях рассеян-

ных изредка в глинах. Макрофауна, главным образом Cephalopoda, была обработана Маковским (Makowski, 1947, 1952, 1962). В последнее время Кулицки (Kulicki, 1969) обнаружил в конкрециях представителей рода *Rhabdopleura* (Pterobranchia), а также фрагменты Hydroida и Annelida (сколекодонты).

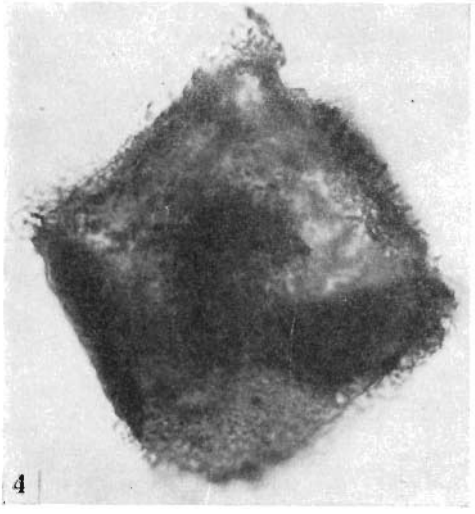
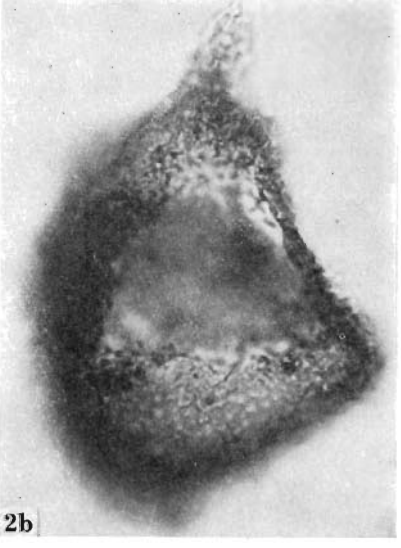
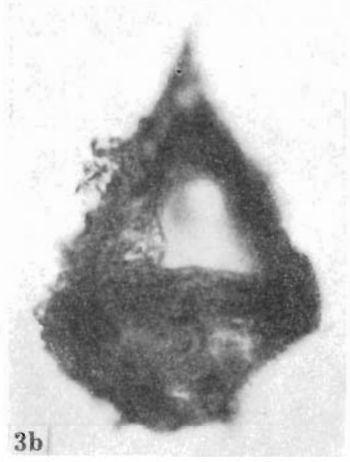
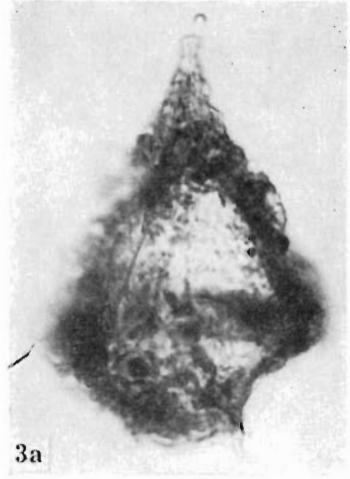
Автором обработаны цисты Dinoflagellata, принадлежащие к семействам: Gonyaulacystaceae, Microdiniaceae, Eodiniaceae, Adnatosphaeridiaceae, Hystrichosphaeridiaceae, Nelsoniellaceae, Endoscriniaceae и Membranilarnaciaceae. Среди проблематических микроорганизмов выделен один новый род и вид *Verrucosphaera lukoviensis* n. gen., n. sp.

PLATES

Plate I

- Fig. 1. *Eodinia pachythea* Eisenack
Apical horn. Spec. CW2.
- Figs. 2a, b. *Eodinia pachythea* Eisenack
Dorsal view. Spec. CY8.
- Figs. 3a, b. *Gonyaulacysta jurassica* (Deflandre)
Dorsal view. Spec. CW20.
- Fig. 4. *Gonyaulacysta cladophora* subsp. *cladophora* (Deflandre)
Spec. CZ19.

All figures $\times 600$



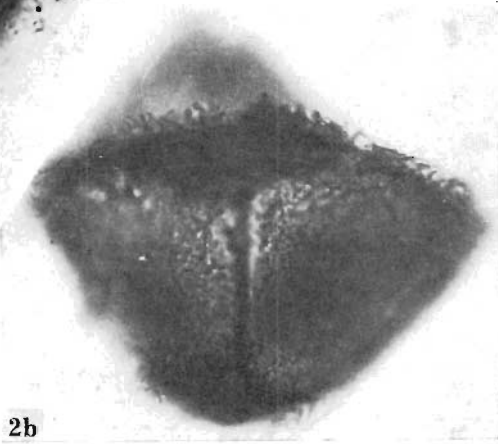
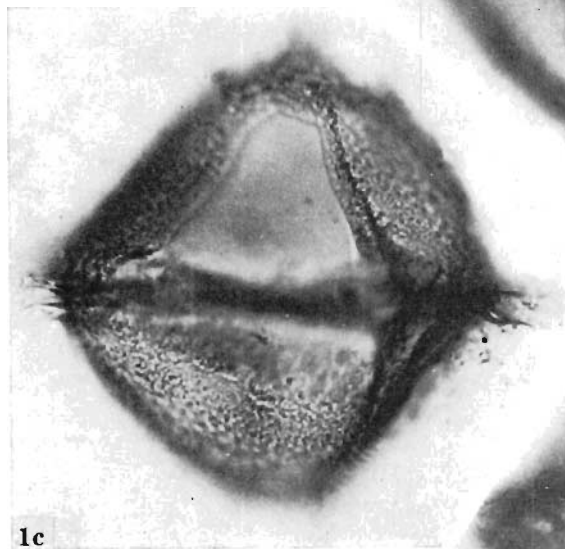
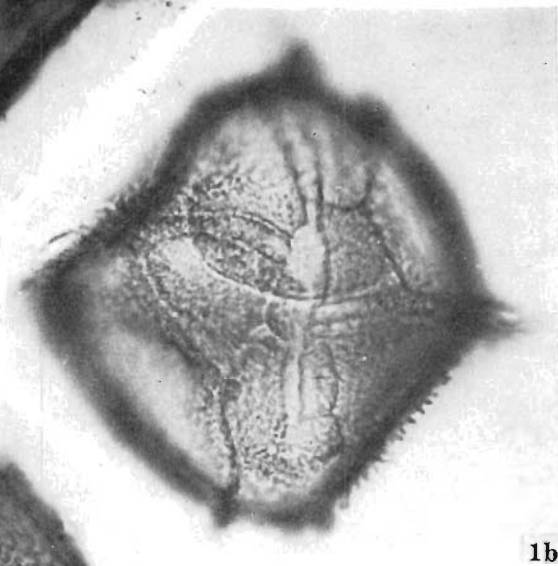
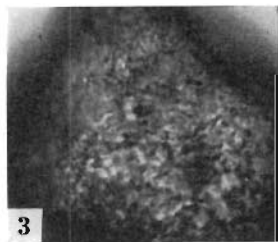
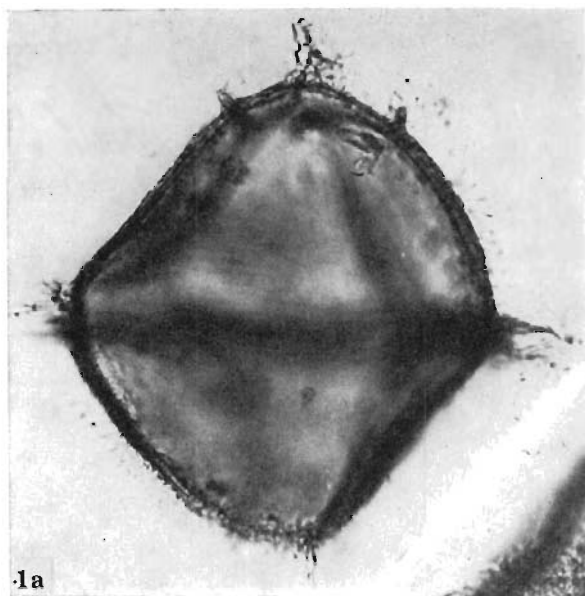


Plate II

- Figs. 1a, b, c. *Gonyaulacysta cladophora* subsp. *cladophora* (Deflandre)
a apical horn well shown, b ventral view, c dorsal view with trapezoidal
archeopyle. Spec. CW1.
- Figs. 2a, b. *Gonyaulacysta cladophora* subsp. *cladophora* (Deflandre)
a apical horn, b oblique view. Spec. CW5.
- Fig. 3. *Eodinia pachythea* Eisenack
Fragment of theca. Spec. CW2.

All figures $\times 600$

Plate III

Lithodinia jurassica Eisenack

Figs. 1a, b. Spec. CY16.

Figs. 2a, b. Spec. CY20.

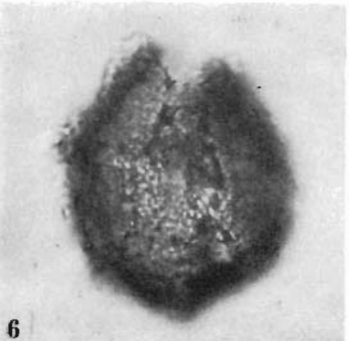
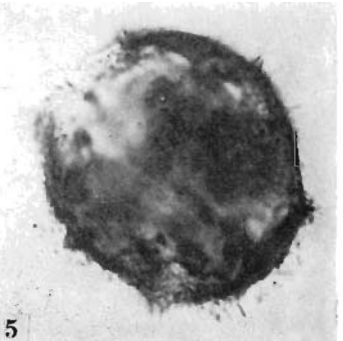
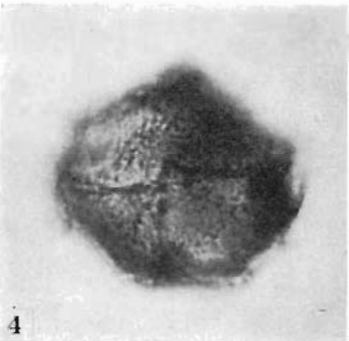
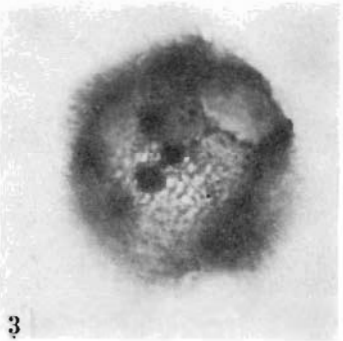
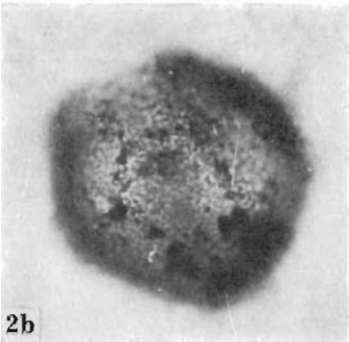
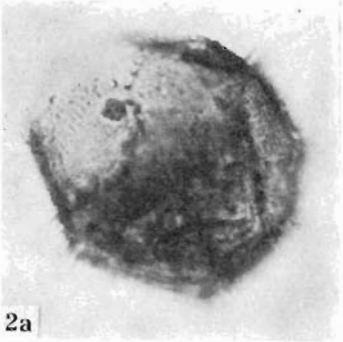
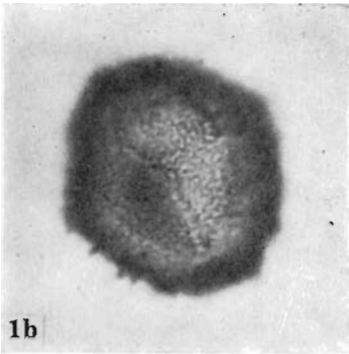
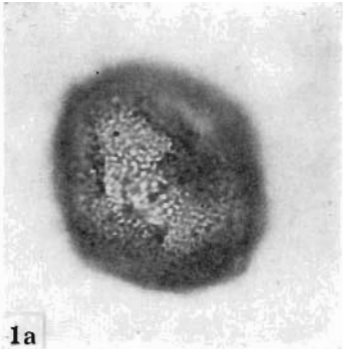
Fig. 3. Spec. CY18.

Fig. 4. Spec. CY5.

Fig. 5. Spec. CY4.

Fig. 6. Spec. CY9.

All figures $\times 600$



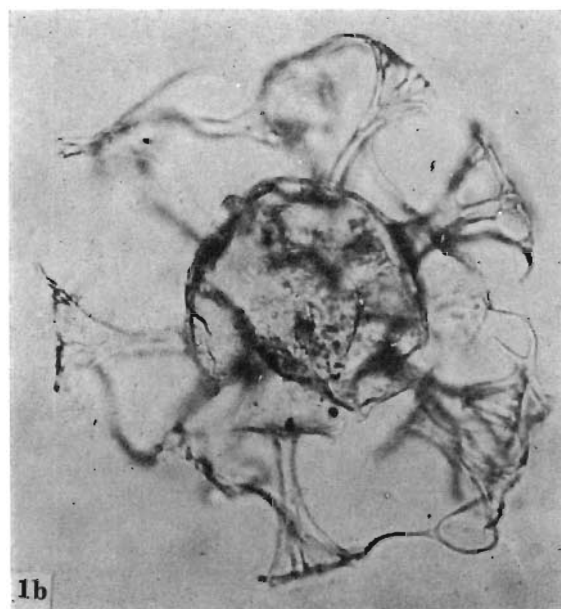
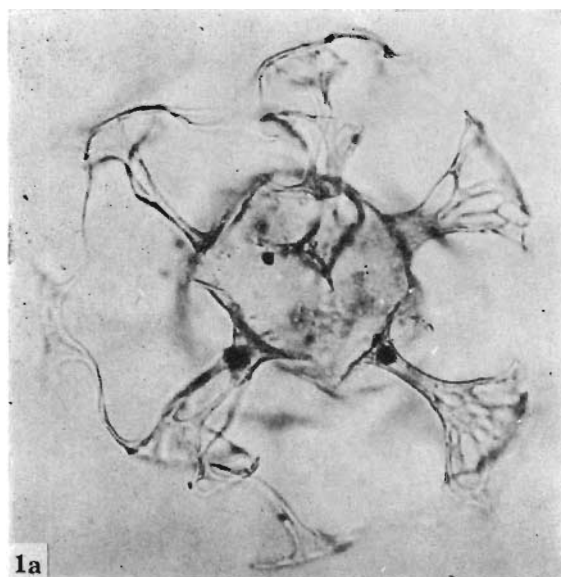


Plate IV

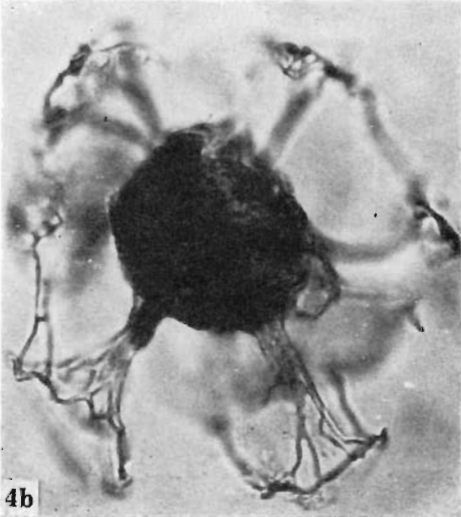
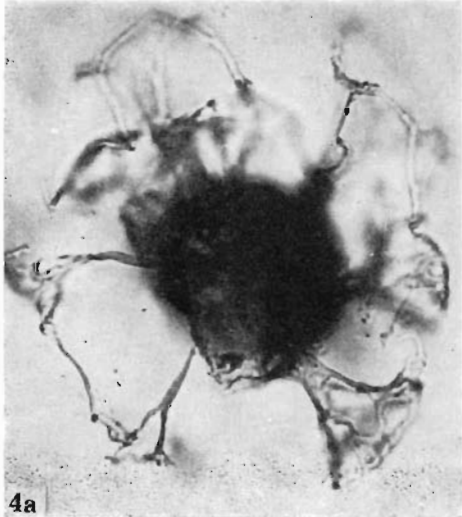
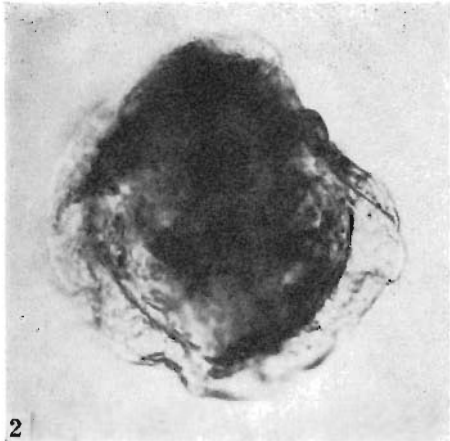
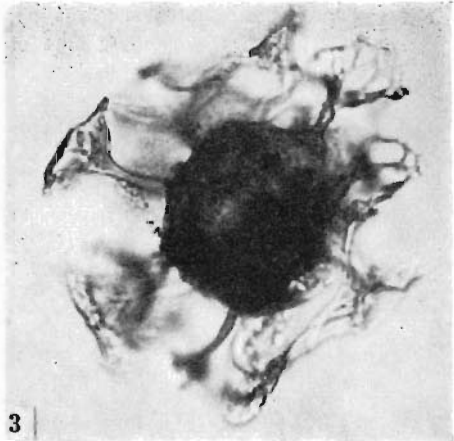
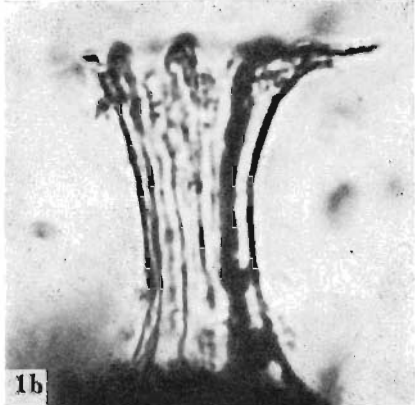
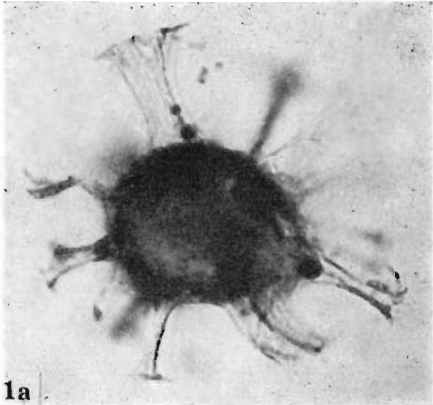
Adnatosphaeridium aemulum (Deflandre)

Figs. 1a, b. Spec. CY1.

All figures $\times 600$

Plate V

- Figs. 1a, b. *Cordosphaeridium costatum* (Davey & Williams)
a whole specimen, b one process of the same specimen
Spec. CY3.
- Fig. 2. *Scriniodinium crystallinum* (Deflandre)
Spec. CZ8.
- Fig. 3. *Adnatosphaeridium aemulum* (Deflandre)
Spec. CZ2.
- Figs. 4a, b. *Adnatosphaeridium aemulum* (Deflandre)
Spec. CY2.



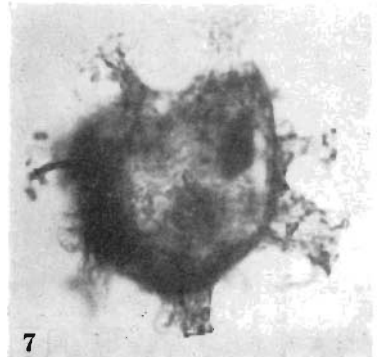
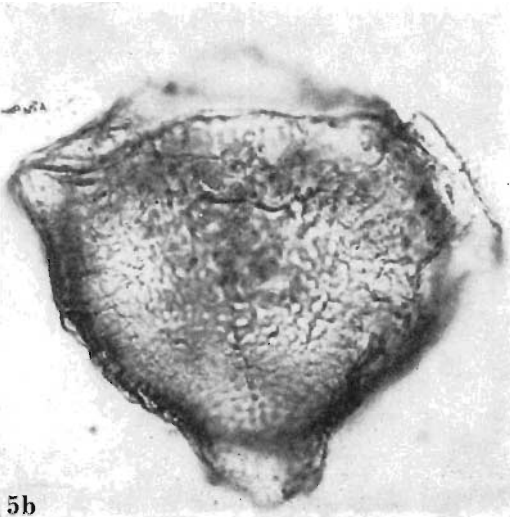
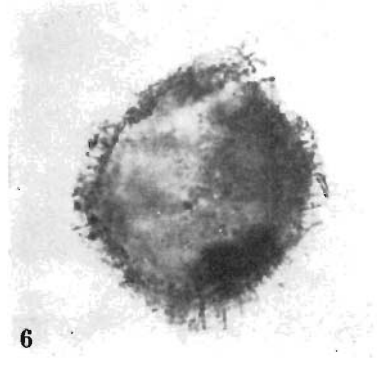
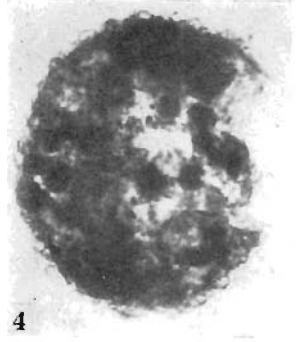
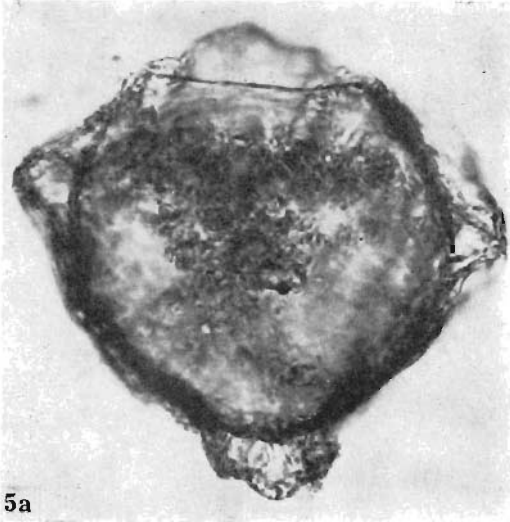
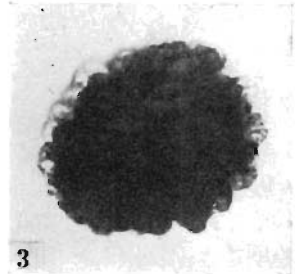
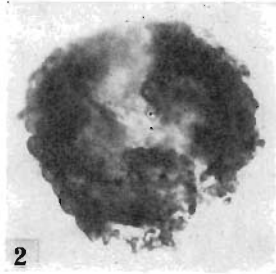
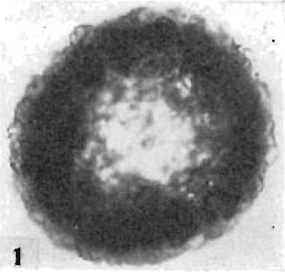


Plate VI

- Figs. 1-4. *Verrucosphaera lukoviensis* n. gen. n. sp.
Holotype: Fig. 1. Spec. CW10, Paratypes: Fig. 2. Spec. CZ17, Fig. 3. Spec. CZ1, Fig. 4. Spec. CY19.
- Figs. 5a, b. *Endoscrinium galeritum* subsp. *reticulatum* Klement
a with precingular archeopyle(?), *b* surface of membrane well marked.
Spec. CW3.
- Fig. 6. *Chlamydophorella* sp.
Spec. CZ8.
- Fig. 7. *Cordosphaeridium costatum* (Davey & Williams)
Spec. CY7.

All figures $\times 600$