SVERIGES GEOLOGISKA UNDERSÖKNING

SER C NR 669 AVHANDLINGAR OCH UPPSATSER ÅRSBOK 65 NR 15

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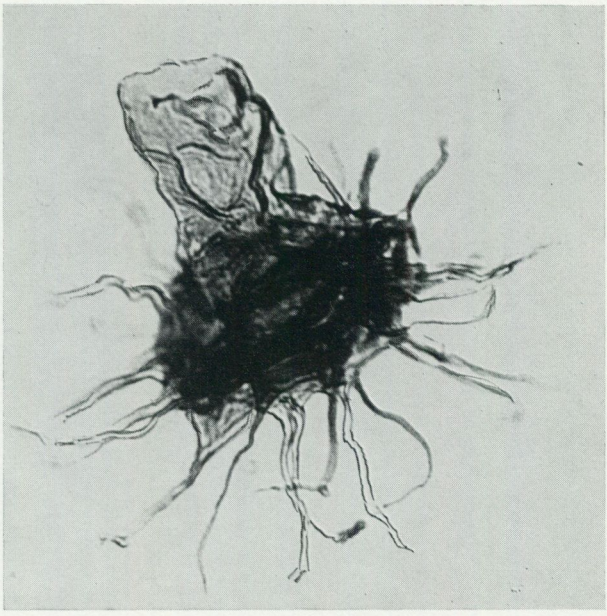
C. DAVIDSONS BOKTRYCKERI AB, VÄXJÖ



CONTENTS

ABSTRACT

The present study deals with a group of Middle Ordovician phytoplankton with organic tests derived from a continuously cored well drilled at Grötlingbo in Gotland, Sweden. Twenty-two species belonging to the genera *Aremoricanium*, *Baltisphaeridium*, *Electoriskos*, *Goniosphaeridium*, *Orthosphaeridium*, and *Peteinosphaeridium* are described. Eleven new species are proposed: *Baltisphaeridium brevituberculatum* n. sp., *B. folkeslundianum* n. sp., *B. magnoporatum* n. sp., *B. multitrabeculosum* n. sp., *B. pauciverrucosum* n. sp., *B. pustulatum* n. sp., *B. regnellii* n. sp., *Goniosphaeridium multipustulosum* n. sp., *Orthosphaeridium densigranosum* n. sp., *O. densiverrucosum* n. sp., and *Peteinosphaeridium asperum* n. sp. The new combinations *Baltisphaeridium klabavense* (VAVRDOVÁ, *1965) and Goniosphaeridium mochtiensis* (GÓRKA, 1969) and *Goniosphaeridium uncinatum* (MARTIN, 1965) are proposed.

INTRODUCTION

The present investigation forms part of a series of publications dealing with organic-walled microplankton obtained from continuously cored wells drilled in Balto-Scandia (Kjellström 1971). This paper reports further microplankton belonging to a group with probable phytoplanktonic affinities from the Middle Ordovician (Viruan) of the Grötlingbo Borehole No. 1 in Gotland. The material, mainly consisting of grey limestones, is derived from the upper part of the Lower Viruan (ASS. II in Kjellström 1971, p. 60, 63), possibly corresponding to Folkeslunda and Lower Uhaku beds (cf. Kjellström 1971, p. 59, Table 1). A sampling interval of 50 cm was chosen.

The terminology and the taxonomy of the baltisphaerids have been previously discussed (Kjellström 1971, p. 9–16). The nomenclature and the classification recently proposed by Lister (1970) can not be adopted in this paper owing to the fact that the present material does not yield appropriate information about the archetypal excystment mechanism.

The laboratory processing of the slides has been refined by using the MILLIPORE STERIFIL ASEPTIC FILTRATION SYSTEM (Millipore, Bedford).

The slides, labelled SGU Grötlingbo-1, are stored in the Department of Research and Applied Geology, the Geological Survey of Sweden, Stockholm.

SYSTEMATICS

Incertae Sedis
Group Acritarcha EVITT, 1963
Sub-group Acanthomorphitae DOWNIE, EVITT & SARJEANT, 1963
Genus *Aremoricanium* DEUNFF, 1955

Aremoricanium deflandrei HENRY, 1969
Fig. 1

1969 *Aremoricanium deflandrei* HENRY. – Henry: Micro-organismes . . ., p. 78, Pl. 4, fig. 26, 29.

DIAGNOSIS. – "Micro-organisme brun foncé dont la coque interne, de teinte légèrement plus sombre, se distingue assez mal; cette coque était probablement sphérique à l'origine et son diamètre moyen peut être évalué à 30 μ. Pore non visible. La coque externe, de coleur plus claire, porte de très nombreaux appendices grêles et souples dont la longueur peut atteindre 50 μ; l'expansion tubulaire mesure 20 à 25 μ de hauteur, sa largeur variant de 15 à 20 μ. L'envergure totale est de l'ordre de 100 μ." (Henry 1969.)

DESCRIPTION. – *Aremoricanium* sp. with moderately thick, spherical to subspherical, shagrinate internal body surrounded by a thin, psilate vesicle. No excystment structure recorded. Curved proximal process junction with the vesicle. Free communication between the basal process interior and the space between internal body and vesicle cavity. Processes, about 25 in number, in length less than vesicle dimension, psilate at the base, mostly with strongly developed conical bases extending into thread-like spines, homomorphic, simple with acuminate, whip-like distal terminations. Vesicle with well defined cylindrical expansion.

DIMENSIONS. – Vesicle diameter; 42–55 μ; internal body: 38–46 μ; process length: 29–33 μ; process breadth (at the base): 8 μ, above the base: < 1 μ; process separation: 8–10 μ; cylindrical expansion, length: 29–32 μ, breadth: 24 μ.

REMARKS. – As has been pointed out by Henry (1969) this species is readily distinguished from *A. rigaudae* DEUNFF, 1955 by "ses dimensions plus faible, le nombre élevé d'appendices, et sa coque interne moins épaisse". In the present material, furthermore, differences exist in the outline of the expansion of the vesicle (conical and cylindrical expansions). Further studies of the vesicle ex-

pansion are proposed in order to evaluate the importance of the expansion outline contra process number as a specific criterion (cf. Deunff 1955, 1958; Henry 1969; Henry & Thadeu 1971).

MATERIAL. – Grötlingbo Borehole No. 1, Gotland; SGU slide no. 452:1; 454:1.

OCCURRENCE. – Grötlingbo Borehole No. 1, Gotland; Middle Ordovician (Lower Viruan), Folkeslunda – Lower Uhaku beds, 452.10 m, 454.10 m. – Juvigné (Mayenne), France; Ordovician, Llanvirnian.

Aremoricanium rigaudae, DEUNFF, 1955
Fig. 2

1955 *Aremoricanium rigaudae* DEUNFF. – Deunff: *Aremoricanium* . . ., p. 228, textfig. 1–3.
1958 *Aremoricanium rigaudae*. – Deunff: Microorganismes . . ., p. 32, Pl. 5, fig. 42–48.
1964 *Aremoricanium rigaudae*. – Downie & Sarjeant: Bibliography . . ., p. 86.
1969 *Aremoricanium rigaudae*. – Henry: Micro-organismes . . ., Pl. 4, fig. 79–82.
1971 *Aremoricanium rigaudae*. – Henry & Thadeu: Intéret stratigraphique . . ., Pl. 1, fig. 1, 6.

DIAGNOSIS. – "La coque interne mesure de 30 à 55 μ. La coque externe, sans les processus, atteint 45 à 60 μ. Diamètre du pore interne: 10 μ environ. Envergure totale 60 à 100 μ. Longeur des processus: 15 à 40 μ. Hauteur de l'expansion tubuliforme: 20 à 30 μ. (Deunff 1958.)

DESCRIPTION. – *Aremoricanium* sp. with moderately thick, spherical, shagrinate internal body surrounded by a thin, psilate vesicle. No excystment structure recorded. Curved proximal process junction with the vesicle. Free communication between the basal process interior and the space between internal body and vesicle cavity. Processes, about 12 in number, in length less than the vesicle dimension, at the base psilate, mostly with strongly developed conical bases extending into threadlike spines, homomorphic, simple with acuminate distal terminations. Vesicle with well defined conical expansion.

DIMENSIONS. – Vesicle diameter: 53–59 μ; internal body: 48–53 μ; process length: 30–34 μ; process breadth (at the base): 7 μ, above the base: < 1 μ; process separation: too irregular to be measured; conical expansion, length: 20–22 μ; breadth (at the base): 30 μ, above the base: 11 μ.

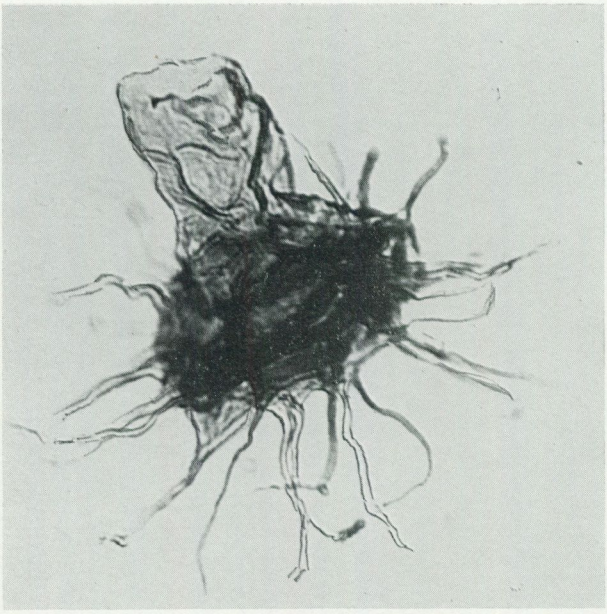


Fig. 1. *Aremoricanium deflandrei* HENRY, 1969, 760 X.

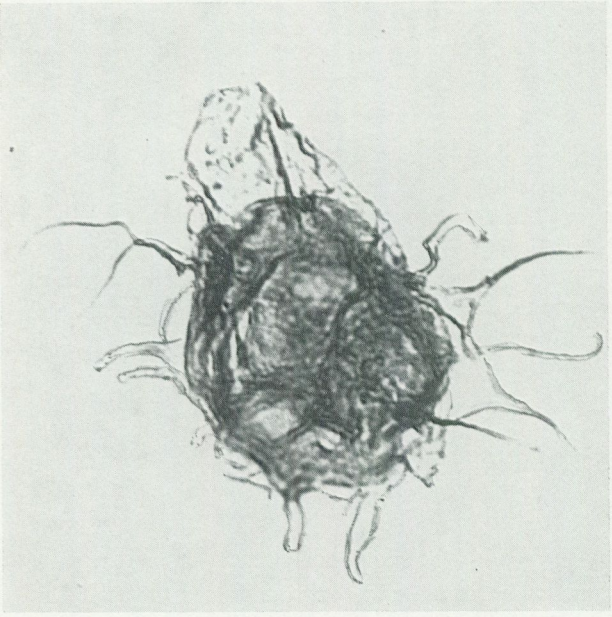


Fig. 2. *Aremoricanium rigaudae* DEUNFF, 1955, 760 X.

MATERIAL. – Grötlingbo Borehole No. 1, Gotland; SGU slide no. 452:1.

OCCURRENCE. – Grötlingbo Borehole No. 1, Gotland; Middle Ordovician (Lower Viruan), Folkeslunda – Lower Uhaku beds, 452.10 m. – Veryhac'h, France; Ordovician. Kerglintin, France; Ordovician, Caradocian. – La Sierra de Buçaco, Portugal; Ordovician, Caradocian.

Genus *Baltisphaeridium* EISENACK, 1958 emend. EISENACK, 1969

Baltisphaeridium brevituberculatum n. sp.
Fig. 3

DERIVATION OF NAME. – Latin: *brevi*, short; *tuberculatus*, provided with tubes. With reference, to the short tubular processes.

DIAGNOSIS. – *Baltisphaeridium* sp. with moderately thick, single walled, spherical, shagrinate vesicle. No excystment structure recorded. Angular proximal process junction with the vesicle. Separation of the interior of the processes from the vesicle cavity. Numerous short processes, cylindrical, homomorphic, simple with evexate distal terminations.

DIMENSIONS. – Vesicle diameter: 68–72 μ; process length: 3 μ; process breadth: 1–1.5 μ; process separation: 3–4.5 μ.

REMARKS. – The significant diagnostic features of this species are the numerous, short, tubular processes.

HOLOTYPE. – SGU slide no. 454:1. Fig. 3.

TYPE LOCALITY AND TYPE STRATUM. – Grötlingbo Borehole No. 1, Gotland; Middle Ordovician (Lower Viruan), Folkeslunda – Lower Uhaku beds, 454.10 m.

Baltisphaeridium digitiforme GÓRKA, 1969
Fig. 4

1969 *Baltisphaeridium digitiforme* GÓRKA. – Górka: Microorganismes . . ., p. 42, Pl. 12, fig. 1; textfig. 14.

DIAGNOSIS. – "Coque sphérique, pourvue d'environ 20 appendices digitiformes, dont les bases sont en forme d'entonnoir et qui rétrécissent vers les extrémités arrondies." (Górka 1969.)

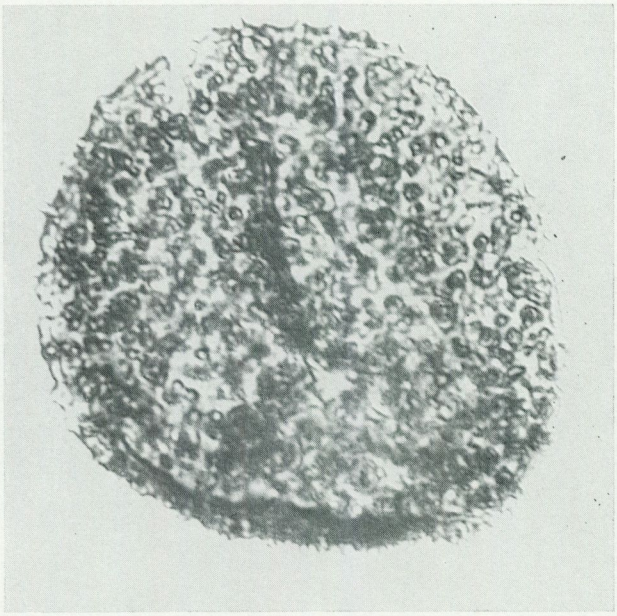


Fig. 3. *Baltisphaeridium brevituberculatum* n. sp., holotype, 900 X.

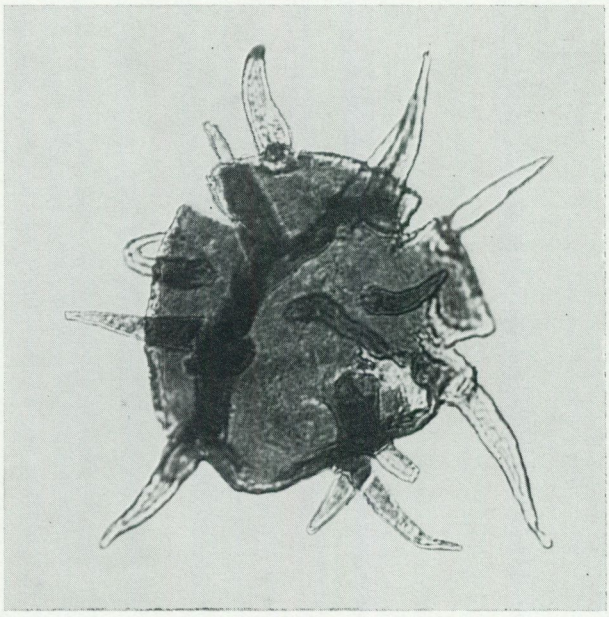


Fig. 4. *Baltisphaeridium digitiforme* Górka, 1969, 500 X.

DESCRIPTION. – *Baltisphaeridium* sp. with moderately thick, single walled, spherical, shagrinate vesicle. No excystment structure recorded. Angular proximal process junction with the vesicle. Separation of the interior of the process from the vesicle cavity. Processes, about 20 in number, in length almost equal to the vesicle radius, shagrinate, conical, broad base area, homomorphic, simple with bulbous distal terminations.

DIMENSIONS. – Vesicle diameter: 82–95 μ; process length: 40–54 μ; process breadth (at the base): 6–7 μ; process separation: 17–30 μ.

MATERIAL. – Grötlingbo Borehole No. 1, Gotland; SGU slide no. 452:1.

OCCURRENCE. – Grötlingbo Borehole No. 1, Gotland; Middle Ordovician (Lower Viruan), Folkeslunda – Lower Uhaku beds, 452.10 m. – Erratic boulders of Mochty, Poland; Ordovician.

Baltisphaeridium folkeslundianum n. sp.
Fig. 5

DERIVATION OF NAME. – After Folkeslunda. With reference to the Balto-Scandian stage name.

DIAGNOSIS. – *Baltisphaeridium* sp. with moderately thick, single walled, subspherical, shagrinate vesicle. Excystment structure formed as a partial rupture. Angular proximal process junction with the vesicle. Separation of the interior of the process from the vesicle cavity. Processes, about 40 in number, widely distributed, short, roughly conical, small base area, homomorphic, simple with bulbous distal terminations.

DIMENSIONS. – Vesicle diameter: 77×58 μ (figured specimen); process length: 5–6 μ; process breadth: < 1 μ; process separation: 5–8 μ.

REMARKS. – This species differs fundamentally from previously described forms by having a large number of short, widely distributed processes with bulbous distal terminations.

HOLOTYPE. – SGU, slide no. 454:1. Fig. 5.

TYPE LOCALITY AND TYPE STRATUM. – Grötlingbo Borehole No. 1, Gotland; Middle Ordovician (Lower Viruan), Folkeslunda – Lower Uhaku beds, 454.10 m.

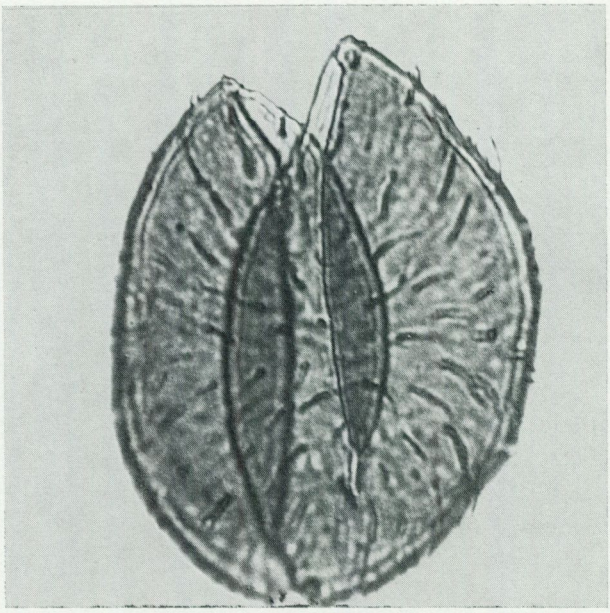


Fig. 5. *Baltisphaeridium folkeslundianum* n. sp., holotype, 810 X.

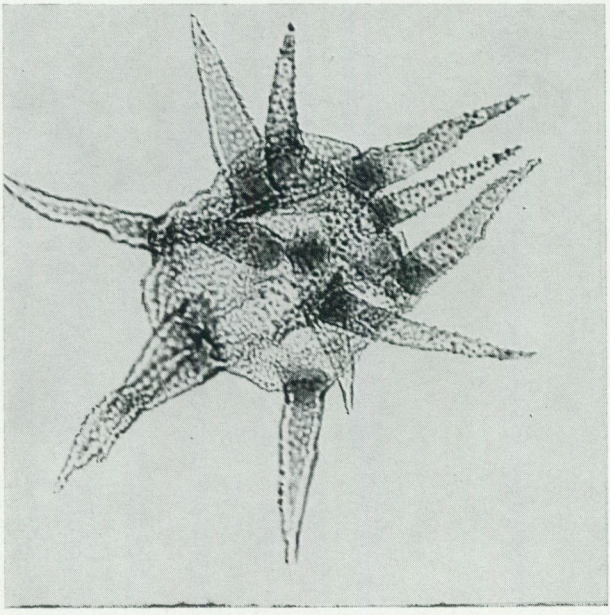


Fig. 6. *Baltisphaeridium klabavense* (Vavrdová, 1965) n. comb., 600 X.

Baltisphaeridium klabavense (VAVRDOVÁ, 1965) n. comb.
Fig. 6

1965 *Baltisphaeridium longispinosum* var. *klabavensis* VAVRDOVÁ. – Vavrdová: Ordovician acritarchs . . ., p. 353, Pl. 2, fig. 1; textfig. 1.

DIAGNOSIS. – "A variety of *Baltisphaeridium longispinosum* EISENACK with a relatively great number of processes. The surface covered with small spines about 1 micron in size." (Vavrdová 1965.)

DESCRIPTION. – *Baltisphaeridium* sp. with thin, single walled, sub-spherical, verrucate vesicle. Excystment structure formed as a partial rupture. Constricted proximal process junction with the vesicle. Separation of the interior of the process from the vesicle cavity. Processes, about 12 in number, in length never exceeding the vesicle diameter, verrucate, conical, homomorphic, simple with acuminate distal terminations.

DIMENSIONS. – Vesicle diameter: 53–60 μ; process length: 30–36 μ; process breadth (above constricted area): 8–9 μ; process separation: 15–18 μ.

REMARKS. – The verrucate structure of the wall and the process length never exceeding the vesicle diameter (in *B. longispinosum* the processes always exceed the vesicle dimension) cause the present writer to consider that *B. klabavense* n. comb. merits elevation to specific level. This species resembles *Baltisphaeridium verrucatum* KJELLSTRÖM 1971 and *B. postulatum* n. sp. but differs by possessing a single layered vesicle wall, constricted processes and acuminate distal process terminations.

MATERIAL. – Grötlingbo Borehole No. 1, Gotland; SGU slide no. 456:2.

OCCURRENCE. – Grötlingbo Borehole No. 1, Gotland; Middle Ordovician (Lower Viruan), Folkeslunda – Lower Uhaku beds, 456.10 m. – Klabava, Bohemia; Lower Ordovician, Arenig.

Baltisphaeridium magnoporatum n. sp.
Fig. 7

DERIVATION OF NAME. – Latin: *magnus,* large; *poratus,* provided with opening. With reference to the large excystment structure.

DIAGNOSIS. – *Baltisphaeridium* sp. with thick, single walled, spherical, shagrinate vesicle. Large excystment structure. Angular proximal process junction with the vesicle. Separation of the interior of the process with the vesicle cavity.

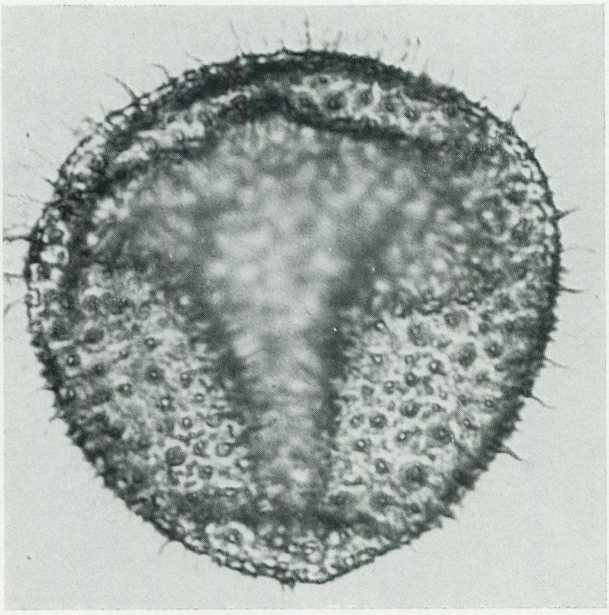


Fig. 7. *Baltisphaeridium magnoporatum* n. sp., holotype, 900 X.

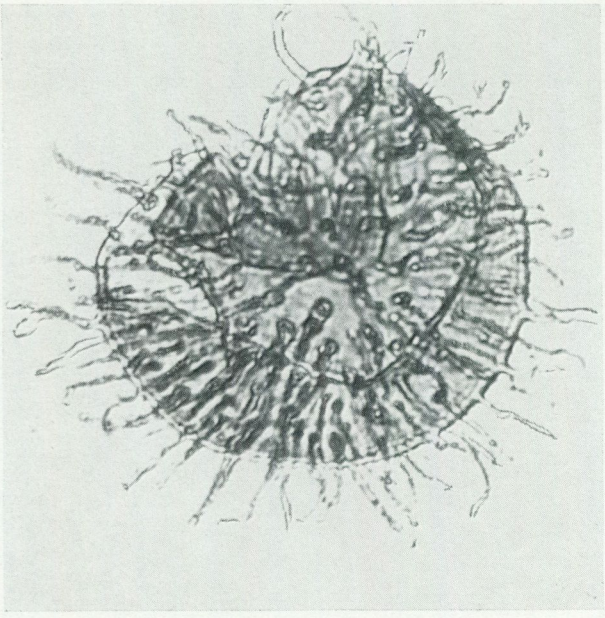


Fig. 8. *Baltisphaeridium multitrabeculosum* n. sp., holotype, 725 X.

Numerous short processes, slender, homomorphic, simple with acuminate distal terminations.

DIMENSIONS. – Vesicle diameter: 65–71 μ; process length: 4–6 μ; process breadth: < 1 μ; process separation: 3–4 μ.

REMARKS. – The prominent features of *Baltisphaeridium magnoporatum* n. sp. are the large vesicle dimension, the extensive excystment structure and the numerous short, slender processes.

HOLOTYPE. – SGU slide no. 456:2. Fig. 7.

TYPE LOCALITY AND TYPE STRATUM. – Grötlingbo Borehole No. 1, Gotland; Middle Ordovician (Lower Viruan), Folkeslunda – Lower Uhaku beds 456.10 m.

Baltisphaeridium multitrabeculosum n. sp.
Fig. 8

DERIVATION OF NAME. – Latin: *multi*, several; *trabeculosus*, provided with steps. With reference to the great number of processes with ladder-like internal ornamentation.

DIAGNOSIS. – *Baltisphaeridium* sp. with thin, single walled, spherical, shagrinate vesicle. Excystment structure formed as a partial rupture. Angular proximal process junction with the vesicle. Separation of the interior of the process from the vesicle cavity. Numerous processes in length about 1/5 of vesicle diameter, trabeculate, flagelliforme, homomorphic, simple with bulbous distal terminations.

DIMENSIONS. – Vesicle diameter: 79–83 μ; process length: 14–17 μ; process breadth: 1 μ; process separation: 6–7 μ.

REMARKS. – The processes of *Baltisphaeridium multitrabeculosum* n. sp. possess an outline approaching the flagelliforme spines of *B. flagellicum* KJELLSTRÖM, 1971. The typical trabeculate internal ornamentation of *B. multitrabeculosum* n. sp. is, however, missing in *B. flagellicum*.

HOLOTYPE. – SGU slide no. 454:1. Fig. 8.

TYPE LOCALITY AND TYPE STRATUM. – Grötlingbo Borehole No. 1, Gotland; Middle Ordovician (Lower Viruan), Folkeslunda – Lower Uhaku beds, 454.10 m.

Baltisphaeridium pauciverrucosum n. sp.
Fig. 9

DERIVATION OF NAME. – Latin: *pauci,* few; *verrucosus,* provided with warts. With reference to the few, widely spaced verrucate knobs of the process wall.

DIAGNOSIS. – *Baltisphaeridium* sp. with thin, single walled, sub- spherical, shagrinate vesicle. No excystment structure recorded. Curved proximal process junction with the vesicle. Separation of the interior of the process from the vesicle cavity. Processes, about 22 in number, in length almost equal to the vesicle diameter, broad bases, verrucate, conical, simple with acuminate whip-like distal terminations.

DIMENSIONS. – Vesicle diameter: 68–75 μ; process length: 40–44 μ; process breadth: 4 μ; process separation: too irregular to be measured.

REMARKS. – The processes with their widely distributed warts and acuminate, whip-like distal terminations are the significant and distinctive morphographical characteristics of *Baltisphaeridium pauciverrucosum* n. sp.

HOLOTYPE. – SGU slide no. 452:1. Fig. 9.

TYPE LOCALITY AND TYPE STRATUM. – Grötlingbo Borehole No. 1, Gotland; Middle Ordovician (Lower Viruan), Folkeslunda – Lower Uhaku beds, 452.10 m.

Baltisphaeridium plicatispinae GÓRKA, 1969
Fig. 10

1931 *Ovum hispidum longispinosum* n. subsp. EISENACK pars. – Eisenack: Neue Mikrofossilien . . ., p. 110, Pl. 5, fig. 14, 17.
1938 *Hystrichosphaeridium longispinosum* EISENACK pars. – Eisenack: Hystrichosphärideen . . ., p. 12, Pl. 1, fig. 1.
1969 *Baltisphaeridium plicatispinae* GÓRKA, 1969. – Górka: Microorganismes . . ., p. 37, Pl. 10, fig. 1; textfig. 1.

DIAGNOSIS. – "Coque sphérique ou un peu allognée, avec 5–10 appendices, élargies à leurs bases et rétrécis vers les extrémités pointues. Ils sont ondulés sur toute leur longueur." (Górka 1969.)

DESCRIPTION. – *Baltisphaeridium* sp. with moderately thick, single walled, subspherical to spherical, shagrinate vesicle. No excystment structure recorded. Faintly constricted proximal process junction with the vesicle. Separation of

the interior of the process from the vesicle cavity. Processes, about 12 in number, in length not exceeding the vesicle diameter, shagrinate, wrinkled, homomorphic, simple with acuminate distal terminations.

DIMENSIONS. – Vesicle diameter: 60–70 μ; process length: 47–55 μ; process breadth: 3–4 μ; process separation: 20–30 μ.

REMARKS. – *Baltisphaeridium plicatispinae* GÓRKA, 1969 is easily separated from other species in having characteristically wrinkled (plicate) processes. The present writer agrees with Górka (1969) that the figured specimens of *Ovum hispidum longispinosum* in Eisenack (1931, Pl. 5, fig. 14, 15) and the specimen of *Hystrichosphaeridium longispinosum* in Eisenack (1938, Pl. 1, fig. 1) are referable to *B. plicatispinae*. The specimen of *H. longispinosum* (Eisenack 1938, Pl. 1, fig. 1) has been quoted in Kjellström (1971, p. 28) as a synonym of *B. latiradiatum* but is from now considered referable to *B. plicatispinae*.

MATERIAL. – Grötlingbo Borehole No. 1, Gotland; SGU slide no. 452:1.

OCCURRENCE. – Grötlingbo Borehole No. 1, Gotland; Middle Ordovician (Lower Viruan), Folkeslunda – Lower Uhaku beds, 452.10 m. – Baltic erratics; Ordovician. – Żebrak Borehole No. 1, Poland; Ordovician, Llandeilo, Paslek. Borehole No. 1, Poland; Ordovician, Upper Ashgillian.

Baltisphaeridium pustulatum n. sp.
Fig. 11

DERIVATION OF NAME. – Latin: *pustulatus*, provided with pustules. With reference to the verrucate vesicle and process wall.

DIAGNOSIS. – *Baltisphaeridium* sp. with thin, single walled, spherical, verrucate, vesicle. Excystment structure formed as a partial rupture. Curved proximal process junction with the vesicle. Separation of the interior of the process from the vesicle cavity. Processes, about 11 in number, in length not exceeding the vesicle diameter, broad bases , verrucate, conical, homomorphic, simple with acuminate distal terminations.

DIMENSIONS. – Vesicle diameter: 75–80 μ; process length: 51–56 μ; process breadth: 6–7 μ; process separation: 20–30 μ.

REMARKS. – This species shows similarities with *Baltisphaeridium verrucatum* KJELLSTRÖM, 1971 and with *B. klabavense* (VAVRDOVÁ, 1965) n. comb. It differs, however, by having a single walled vesicle (double walled in *B. verrucatum*),

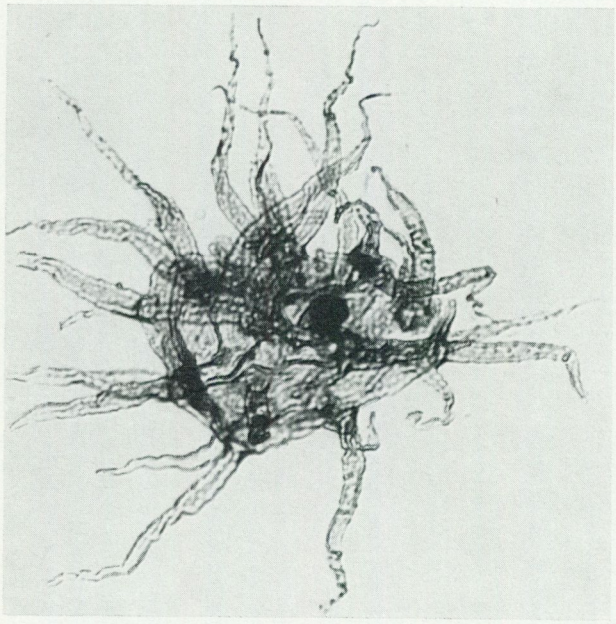


Fig. 9. *Baltisphaeridium pauciverrucosum* n. sp., holotype, 525 X.

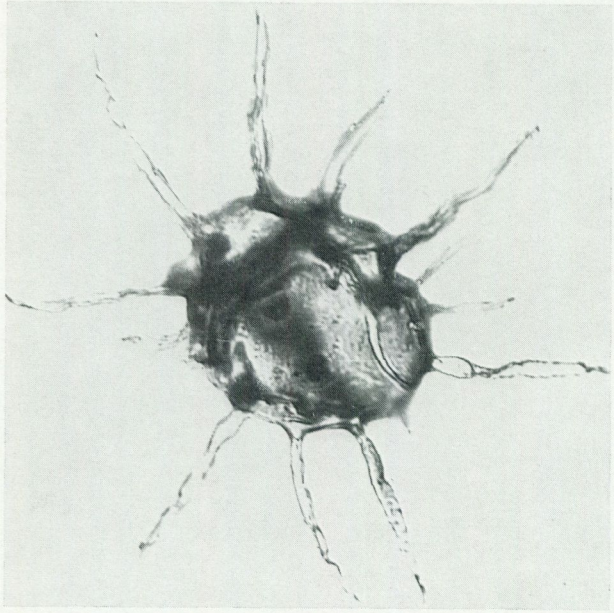


Fig. 10. *Baltisphaeridium plicatispinae* GÓRKA, 1969, 450 X.

conical proximal process contact with the vesicle (angular in *B. verrucatum* and constricted in *B. klabavense)* and acuminate distal process terminations (evexate in *B. verrucatum*).

HOLOTYPE. – SGU slide no. 456:2. Fig. 11.

TYPE LOCALITY AND TYPE STRATUM. – Grötlingbo Borehole No. 1, Gotland; Middle Ordovician (Lower Viruan), Folkeslunda – Lower Uhaku beds, 456.10 m.

Baltisphaeridium regnellii n. sp.
Fig. 12

DERIVATION OF NAME. – In honour of Professor Gerhard Regnéll, University of Lund, Sweden.

DIAGNOSIS. – *Baltisphaeridium* sp. with moderately thick, single walled, shagrinate vesicle with local, circular, psilate areas (about 5 μ in diameter) around each process base. No excystment structure recorded. Curved proximal process junction with the vesicle. Separation of the interior of the process from the vesicle cavity. Numerous short processes, shagrinate, conical, broad base area, homomorphic, simple with acuminate distal terminations.

DIMENSIONS. – Vesicle diameter: 52–58 μ; process length: 1–1.5 μ; process breadth (at the base): 3 μ; process separation: 7–9 μ.

REMARKS. – The circular psilate area around each conical process base is the fundamental distinguishing criterion for this species.

HOLOTYPE. – SGU slide no. 452:1. Fig. 12.

TYPE LOCALITY AND TYPE STRATUM. – Grötlingbo Borehole No. 1, Gotland; Middle Ordovician (Lower Viruan), Folkeslunda – Lower Uhaku beds, 452.10 m.

Baltisphaeridium trabeculaespinae GÓRKA, 1969
Fig. 13

1969 *Baltisphaeridium trabeculaespinae* GÓRKA. – Górka: Microorganismes . . ., p. 39, Pl. 9, fig. 1, 4; textfig. 12.

DIAGNOSIS. – "Coque sphérique, avec 5–11 appendices élargis à la base et se rétrécissant aux extrémités qui sont effilées et tronquées, ou insensiblement

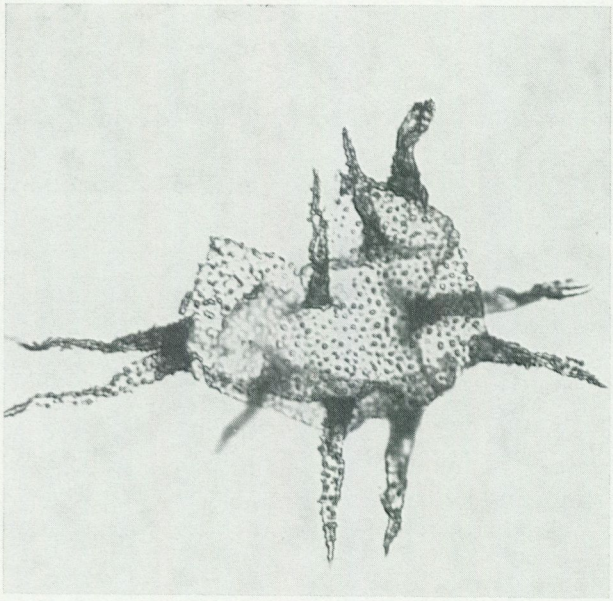


Fig. 11. *Baltisphaeridium pustulatum* n. sp., holotype, 500 X.

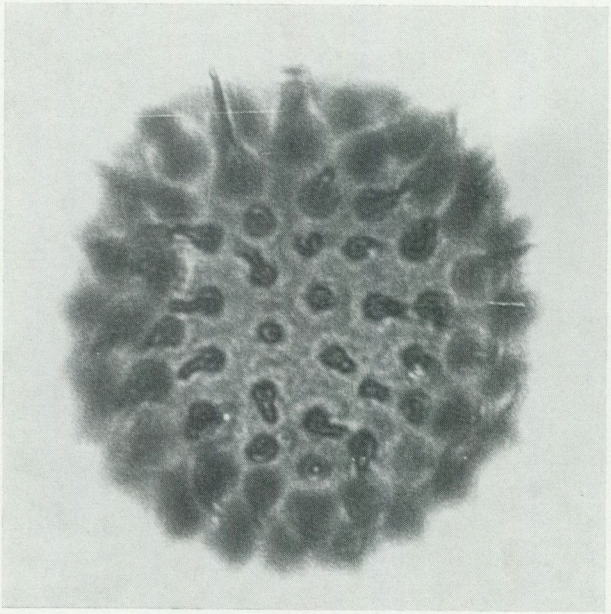


Fig. 12. *Baltisphaeridium regnellii* n. sp., holotype, 920 X.

épaissies en forme de petits boutons. Les appendices sont pourvus sur toute leur longueur de trabecules transversales." (Górka 1969.)

DESCRIPTION. – *Baltisphaeridium* sp. with thick, single walled, spherical, granulate vesicle. Excystment structure formed as a partial rupture. Angular proximal process junction with the vesicle. Separation of the interior of the process from the vesicle cavity. Processes, about 18 in number, in length never exceeding the vesicle diameter, trabeculate, faintly conical, homomorphic, simple with acuminate distal terminations.

DIMENSIONS. – Vesicle diameter: 80–86 μ; process length: 47–53 μ; process breadth: 3 μ; process separation: 20 μ.

REMARKS. – Although no bulbous knobs of the distal terminations of the processes have hitherto been recorded, the present species is treated as a *B. trabeculaespinae* mainly owing to the typical trabeculate ornamentation of the processes.

MATERIAL. – Grötlingbo Borehole No. 1, Gotland; SGU slide no. 456:2.

OCCURRENCE. – Grötlingbo Borehole No. 1, Gotland; Middle Ordovician (Lower Viruan), Folkeslunda – Lower Uhaku beds, 456.10 m. – Zbrza Borehole No. 1, Poland; Ordovician, Lower Caradocian. Erratic boulders of Mochty, Poland.

Baltisphaeridium varsoviensis GÓRKA, 1969
Fig. 14

1969 *Baltisphaeridium varsoviensis* GÓRKA. – Górka: Microorganismes . . ., p. 41, Pl. 8, fig. 4; textfig. 13.

DIAGNOSIS. – "Coque arrondie, avec 15 appendices, dont les bases sont élargies en forme d'entonnoir, et les extrémités pointues ou en ferme de bouton. La surface de la coque est réticulée." (Górka 1969.)

DESCRIPTION. – *Baltisphaeridium* sp. with moderately thick, single walled, spherical, shagrinate-reticulate vesicle. No excystment structure recorded. Curved proximal process junction with the vesicle. Separation of the interior of the process from the vesicle cavity. Processes, about 13 in number, in length almost equal to the vesicle diameter, psilate, conical, broad base area, homomorphic, simple with bulbous distal terminations.

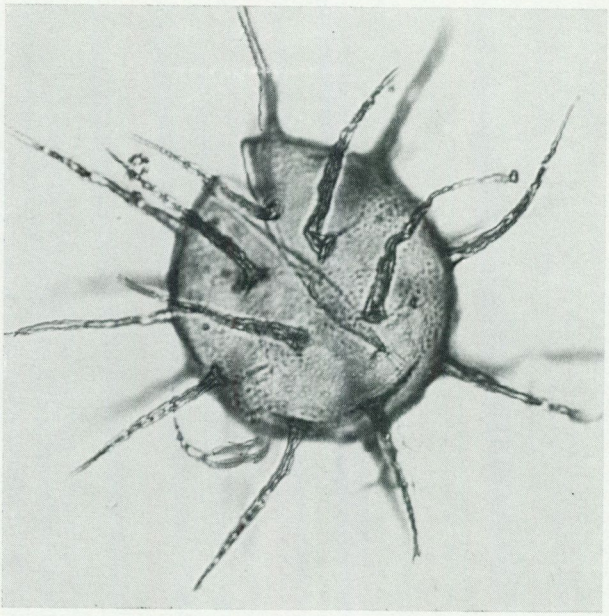


Fig. 13. *Baltisphaeridium trabeculaespinae* GÓRKA, 1969, 525 X.

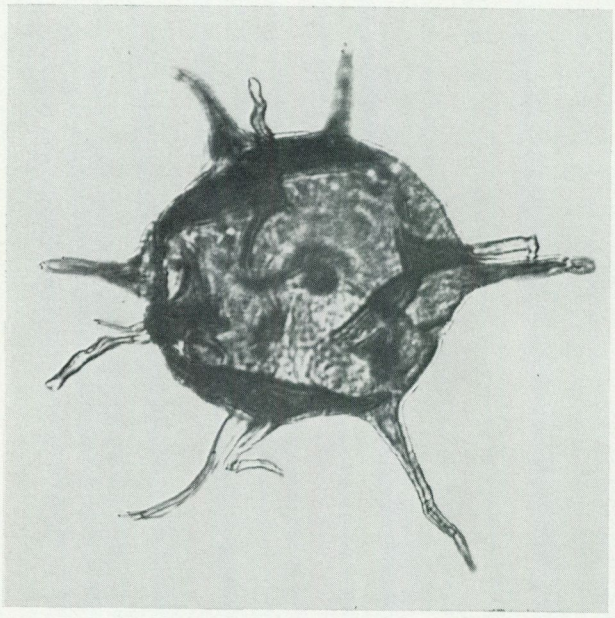


Fig. 14. *Baltisphaeridium varsoviensis* GÓRKA, 1969, 475 X.

DIMENSIONS. – Vesicle diameter: 81–86 μ; process length: 45–49 μ; process breadth (at the base): 6–7 μ; process separation: 30–35 μ.

MATERIAL.– Grötlingbo Borehole No. 1, Gotland; SGU slide no. 454:1.

OCCURRENCE. – Grötlingbo Borehole No. 1, Gotland; Middle Ordovician (Lower Viruan), Folkeslunda – Lower Uhaku beds, 454.10 m. – Erratic boulders of Mochty, Poland; Ordovician.

Genus *Electoriskos* LOEBLICH, 1971

Electoriskos aff. *pogonius* LOEBLICH, 1971
Fig. 15

?1969 *Baltisphaeridium chiggerum* CRAMER. – Cramer: Possible implications . . ., Pl. 70, fig. 18 (invalid, no description).

?1969 *Micrhystridium chiggerum*. – Cramer: Possible implications . . ., p. 486 (invalid, no description).

aff. 1971 *Electoriskos pogonius* LOEBLICH. – Loeblich: Morphology . . ., p. 718, Fig. 13 A, B.

DIAGNOSIS. – "Central body subcircular; wall thin, less than 1 μ in thickness, surface rough, strongly granulate, rare specimens rugulate to pustules up to 1.3 μ across; the margin of the central body in optical section showing large grana and pustules (on surface as well); numerous long clear processes, about 1 μ in diameter, tapering very little toward distal end, of nearly constant diameter through length, apparently solid and without communication with central body; central body opens by a simple splitting of the wall." (Loeblich 1971.)

DESCRIPTION. – Specimens with thin, single walled, sub-spherical, shagrinate vesicle. No excystment structure recorded. Angular proximal process junction with the vesicle (some processes have conical membraneous bases similar to the process bases of *Aremoricanium*). No communication between the interior of the process and the vesicle cavity can be seen. Numerous processes, in length never exceeding the vesicle diameter, thread-like, homomorphic, simple.

DIMENSIONS. – Vesicle diameter: 42–46 μ; process length: 30–35 μ; process breadth (above base): < 1 μ; process separation: too irregular to be measured.

REMARKS. –The present specimens, here treated as *Electoriskos* aff. *pogonius*, differ from *Electoriskos pogonius* in having a shagrinate vesicle wall and a larger overall vesicle diameter.

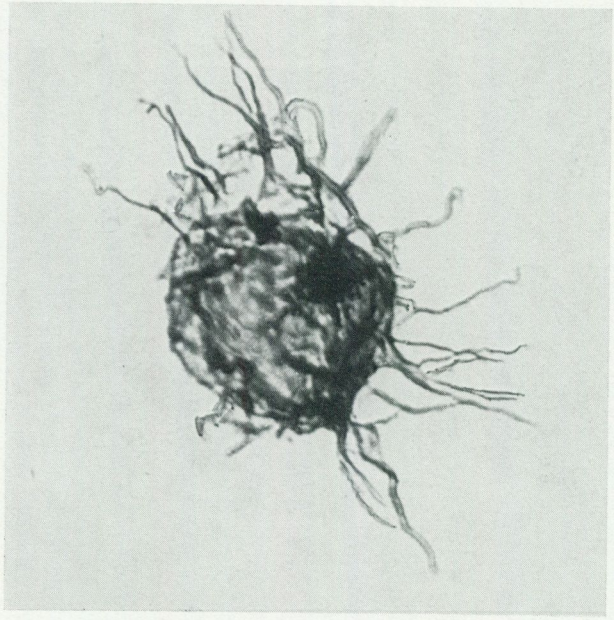


Fig. 15. *Electoriskos* aff. *pogonius* Loeblich, 1971, 600 X.

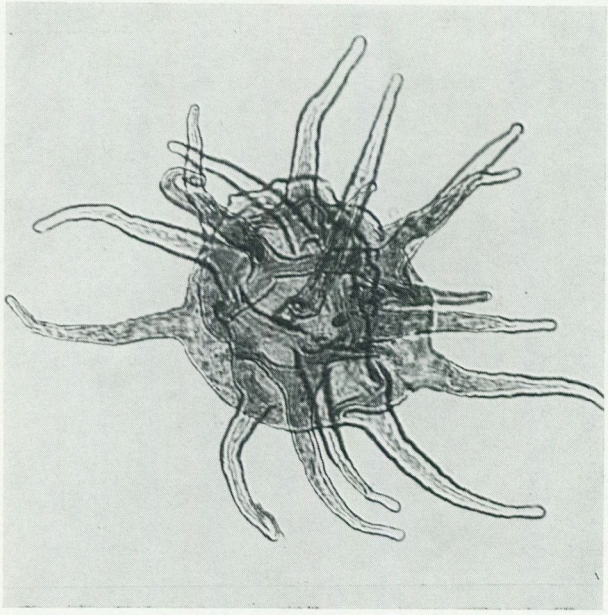


Fig. 16. *Goniosphaeridium mochtiensis* (Górka, 1969) n. comb, 450 X.

MATERIAL. – Grötlingbo Borehole No. 1, Gotland; SGU slide no. 452:1.

OCCURRENCE. – Grötlingbo Borehole No. 1, Gotland; Middle Ordovician (Lower Viruan), Folkeslunda – Lower Uhaku beds, 452.10 m. – ?Maplewood Shale, Rochester, New York; Middle Silurian.

Genus *Goniosphaeridium* EISENACK, 1969 emend. KJELLSTRÖM, 1971

Goniosphaeridium mochtiensis (GÓRKA, 1969) n. comb.
Fig. 16

1969 *Baltisphaeridium mochtiensis* GÓRKA. – Górka: Microorganismes . . ., p. 43, Pl. 11, fig. 1; Pl. 12, fig. 2; textfig. 15.

DIAGNOSIS. – "Coque sphérique, avec 15–30 appendices, dont les bases sont un peu élargies; ils se rétrécissent vers les extrémités, qui sont pourvues de petits épaississements. Les appendices, d'inégale longueur, sont très souvent récourbés." (Górka 1969.)

DESCRIPTION. – *Goniosphaeridium* sp. with moderately thick, single walled, sub-spherical, shagrinate vesicle. No excystment structure recorded. Curved proximal process junction with the vesicle. Free communication between the process interior and the vesicle cavity. Processes, about 18 in number, in length almost equal to the vesicle diameter, shagrinate, broad base area, conical, homomorphic, simple with bulbous distal terminations.

DIMENSIONS. – Vesicle diameter: 67–78 μ; process length: 55–59 μ; process breadth (at the base): 12–14 μ; process separation: 15–20 μ.

REMARKS. – In her original description Górka (1969, p. 43) has mentioned the free communication between the vesicle cavity and the process interior. Following the proposed diagnosis given by Eisenack (1969) for the genera *Goniosphaeridium* and *Baltisphaeridium*, the present writer considers that *B. mochtiensis* should be transferred to *Goniosphaeridium*. *G. mochtiensis* differs from *B. bulbosum* KJELLSTRÖM, 1971 in having free communication between the vesicle cavity and process interior.

MATERIAL. – Grötlingbo Borehole No. 1, Gotland; SGU slide no. 452:1.

OCCURRENCE. – Grötlingbo Borehole No. 1, Gotland; Middle Ordovician (Lower Viruan), Folkeslunda – Lower Uhaku beds, 452.10 m. – Mielnik Borehole No. 1, Poland; Ordovician, Lower Caradocian. Erratic boulders of Sarbia and Mochty, Poland.

Goniosphaeridium multipustulosum n. sp.
Fig. 17

DERIVATION OF NAME.– Latin: *multi,* several; *pustulosum,* provided with pustules. With reference to the verrucate vesicle and process wall.

DIAGNOSIS. – *Goniosphaeridium* sp. with thick, single walled, polygonal to spherical, verrucate vesicle. Excystment structure formed as a partial rupture. Curved proximal process junction with the vesicle. Free communication between the process interior and vesicle cavity. Processes, about 10 in number, in length almost equal to the vesicle radius, never exceeding the length of the vesicle diameter, verrucate, broad base area, conical, homomorphic, simple with acuminate distal terminations.

DIMENSIONS. – Vesicle diameter: 62–76 μ; process length 30–35 μ, process breadth (at the base): 8–11 μ; process separation: 22–26 μ.

REMARKS. – In its combination of verrucate wall and free communicating vesicle cavity/process interior system *Goniosphaeridium multipustulosum* n. sp. conspicuously differs from previously described species.

HOLOTYPE. – SGU slide no. 456:2. Fig. 17.

TYPE LOCALITY AND TYPE STRATUM. – Grötlingbo Borehole No. 1, Gotland; Middle Ordovician (Lower Viruan), Folkeslunda – Lower Uhaku beds, 456.10 m.

Goniosphaeridium uncinatum (MARTIN) n. comb.
Fig. 18

?1951 *Hystrichosphaeridium* sp., ex aff. *longispinosum.* Eisenack: Über Hystrichosphären . . ., p. 191, Pl. 3, fig. 7.
1958 *Hystrichosphaeridium longispinosum* (EISENACK) var. *uncinatum* DOWNIE. – Downie: An assemblage . . ., p. 337, textfig. 2 a.
1964 *Baltisphaeridium longispinosum* (EISENACK) var. *uncinatum.* – Downie & Sarjeant: Bibliography . . ., p. 92.
1965 *Baltisphaeridium uncinatum.* – Martin: Les Acritarches de Sart-Bernard . . ., p. 425, textfig. 1.
1968 *Baltisphaeridium uncinatum.* – Martin: Les Acritarches de l'Ordovicien . . ., p. 66, Pl. 1, fig. 17, 21; Pl. 2, fig. 70, 96; Pl. 5, fig. 228; Pl. 6, fig. 267; textfig. 19.
1970 *Micrhystridium uncinatum.* – Cramer: Distribution . . ., p. 107, Pl. 6, fig. 97, 98, ? 101; textfig. 29 d.

DIAGNOSIS. – "Le diamètre du corps central est de 30 à 50 μ. Les appendices sont généralement incomplets, mais ils peuvent atteindre les deux tiers du diamètre du corps central. Leur nombre varie de 12 à 20 environ. Les appendices portent de épines à base robuste; leur longuer est de 0.5 à 2 μ. De rares exemplaires possèdent de épines de même type mais plus espacées que sur le corps central." (Martin 1965.)

DESCRIPTION. – *Goniosphaeridium* sp. with moderately thick, single walled, polygonal to spherical, psilate vesicle. No excystment structure recorded. Curved proximal process junction with the vesicle. Free communication between the process interior and the vesicle cavity. Processes, about 24 in number, in length almost equal to the vesicle radius, echinate, broad base area, conical, homomorphic, simple with acuminate distal terminations.

DIMENSIONS. – Vesicle diameter: 51–65 μ; process length: 23–27 μ; process breadth (at the base): 8–9 μ; process separation: 18–25 μ.

REMARKS. – The free communication between the process interior and the vesicle cavity motivates a removal of this species from the genus *Baltisphaeridium* to the genus *Goniosphaeridium*.

MATERIAL. – Grötlingbo Borehole No. 1, Gotland; SGU slide no. 452:1.

OCCURRENCE. – Grötlingbo Borehole No. 1, Gotland; Middle Ordovician (Lower Viruan), Folkeslunda – Lower Uhaku beds, 452.10 m. – Belgium; Ordovician, Tremadocian – Llanvirnian. – Baltic erratics; Ordovician, Arenig. – England; Ordovician, Tremadocian. – Spain; Middle Silurian.

Genus *Orthosphaeridium* EISENACK, 1968 emend. KJELLSTRÖM, 1971

Orthosphaeridium densigranosum n. sp.
Fig. 19

DERIVATION OF NAME. – Latin: *densus*, dense; *granosum*, provided with grains. With reference to the granulate vesicle wall.

DIAGNOSIS. – *Orthosphaeridium* sp. with thick, single walled, sub-quadrate, granulate vesicle. Transverse excystment structure (median split). Constricted proximal process junction with the vesicle. Separation of the interior of the process from the vesicle cavity. Processes, 8 in number, in length almost equal to the vesicle dimension, psilate, well developed solid process plugs at the bases, homomorphic, simple with evexate distal terminations.

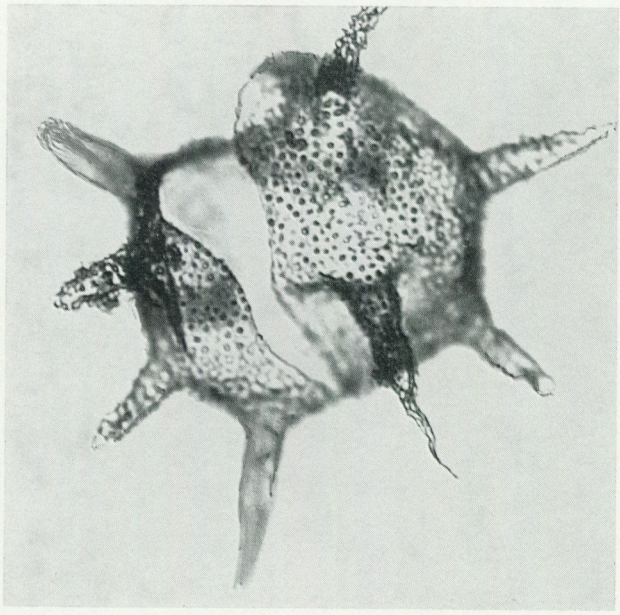


Fig. 17. *Goniosphaeridium multipustulosum* n. sp., holotype, 625 X.

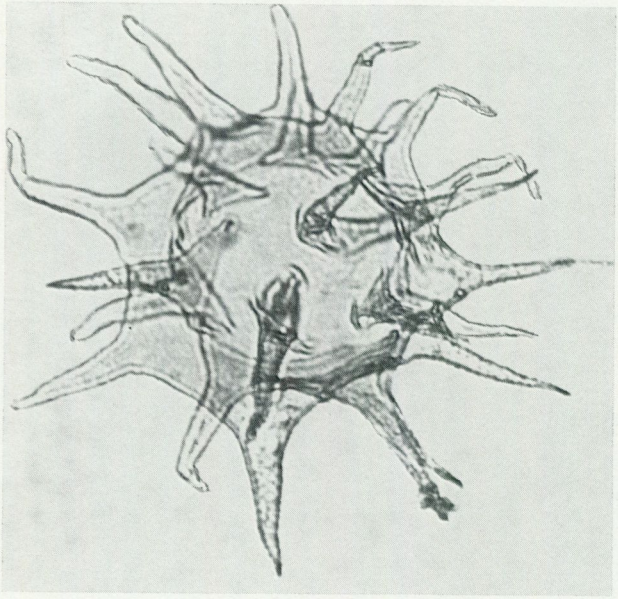


Fig. 18. *Goniosphaeridium uncinatum* (MARTIN, 1965) n. comb., 700 X.

DIMENSIONS. – Vesicle diameter: 39–45 μ×33–40 μ; process length: 35–45 μ; process breadth: 4 μ.

REMARKS. – *Orthosphaeridium densigranosum* n. sp. is similar to *O. insculptum* LOEBLICH, 1971, but differs in lacking the typical whip-like distal process terminations of *O. insculptum* (evexate in *O. densigranosum* n. sp.).

HOLOTYPE. – SGU slide no. 453:1. Fig. 19.

TYPE LOCALITY AND TYPE STRATUM. – Grötlingbo Borehole No. 1, Gotland; Middle Ordovician (Lower Viruan), Folkeslunda – Lower Uhaku beds, 453.10 m.

Orthosphaeridium densiverrucosum n. sp.
Fig. 20

DERIVATION OF NAME. – Latin: *densus,* dense; *verrucosus,* provided with warts. With reference to the verrucate vesicle and process wall.

DIAGNOSIS. – *Orthosphaeridium* sp. with thick, single walled, sub-quadrate, verrucate vesicle. Transverse excystment structure (median split). Constricted proximal process junction with the vesicle. Separation of the interior of the process from the vesicle cavity. Processes, 8 in number, in length almost equal to the vesicle dimension, verrucate, well developed solid process plugs at the bases, homomorphic, simple with acuminate distal terminations.

DIMENSIONS. – Vesicle diameter: 38–44 μ×33–39 μ; process length: 20–33 μ; process breadth: 4–5 μ.

REMARKS. – *Orthosphaeridium densiverrucosum* n. sp. is readily distinguished from *O. densigranosum* in having a verrucate ornamentation ($= > 0.5$ μ) on both vesicle and process wall (cf. verrucate and granulate terminology in Kjellström, 1971, p. 12–13).

HOLOTYPE. – SGU slide no. 456:2. Fig. 20.

TYPE LOCALITY AND TYPE STRATUM. – Grötlingbo Borehole No. 1, Gotland; Middle Ordovician (Lower Viruan), Folkeslunda – Lower Uhaku beds, 456.10 m.

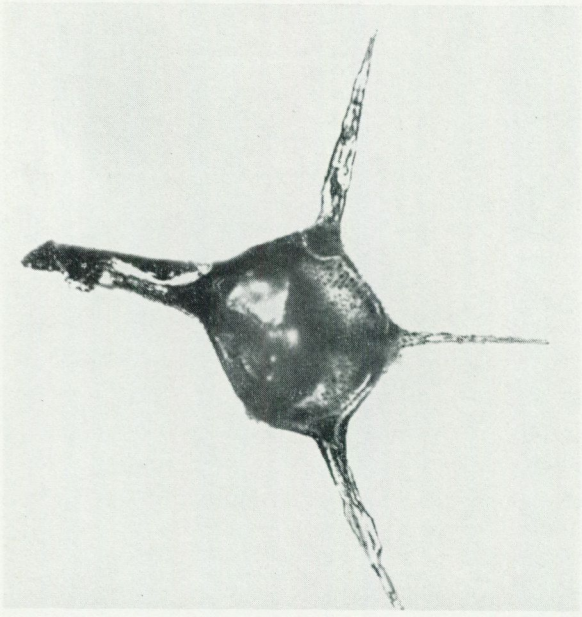


Fig. 19. *Orthosphaeridium densigranosum* n. sp., holotype, 500 X.

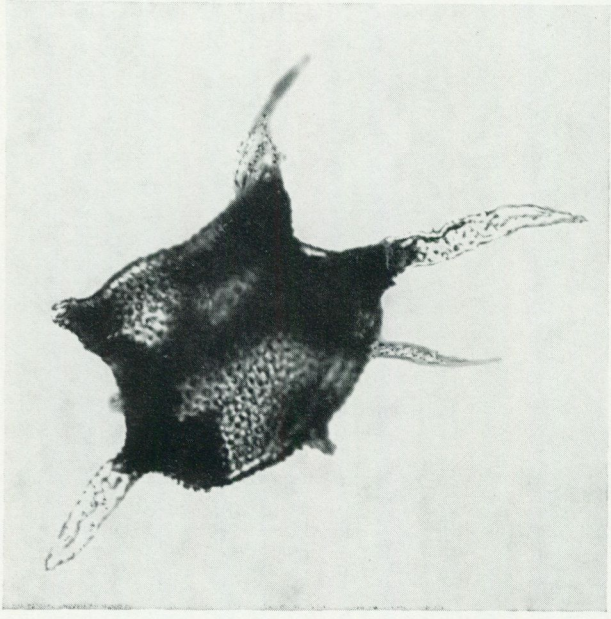


Fig. 20. *Orthosphaeridium densiverrucosum* n. sp., holotype, 600 X.

Genus *Peteinosphaeridium* Staplin, Jansonius & Pocock, 1965 emend. Eisenack, 1969

Peteinosphaeridium asperum n. sp.
Fig. 21

DERIVATION OF NAME. – Latin: *asper*, roughness. With reference to the shagrinate vesicle wall.

DIAGNOSIS. – *Peteinosphaeridium* sp. with thin, single walled, spherical, shagrinate vesicle. Excystment structure formed as a partial rupture. Angular proximal process junction with the vesicle. Separation of the interior of the process from the vesicle cavity. Processes, about 15 in number, in length 1/4 of the vesicle diameter, psilate, conical, homomorphic, furcate (bifurcate) with acuminate distal furca-tips.

DIMENSIONS. – Vesicle diameter: 78–83 μ; process length: 18–24 μ; process breadth (at the base): 4 μ; furca length (each furca): 4 μ; process separation: 25–30 μ.

REMARKS. – The most distinctive feature of *Peteinosphaeridium asperum* n. sp. is the combination of a shagrinate vesicle wall and a psilate process wall.

HOLOTYPE. – SGU slide no. 453:1. Fig. 21.

TYPE LOCALITY AND TYPE STRATUM. – Grötlingbo Borehole No. 1, Gotland; Middle Ordovician (Lower Viruan, Folkeslunda – Lower Uhaku beds, 453.10 m.

Peteinosphaeridium breviradiatum (Eisenack, 1959) Eisenack, 1969
Fig. 22

1931 *Ovum hispidum trifurcatum.* – Eisenack: Neue Mikrofossilien . . ., p. 112, Pl. 4, fig. 21.
1938 *Hystrichosphaeridium trifurcatum.* – Eisenack: Hystrichosphärideen..., p. 16, Pl. 2, fig. 1, 2, 4, 11.
1959 *Baltisphaeridium trifurcatum* f. *breviradiata.* – Eisenack: Neotypen . . ., p. 202, Pl. 17, fig. 7.
1964 *Baltisphaeridium trifurcatum* f. *breviradiata.* – Downie & Sarjeant: Bibliography . . ., p. 97.

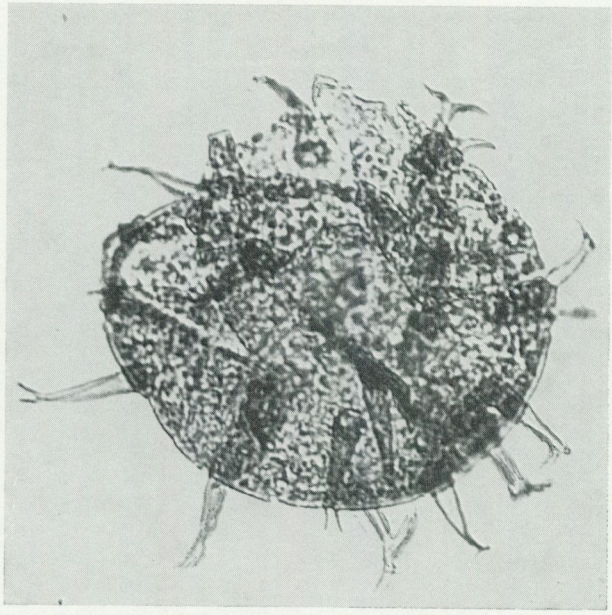


Fig. 21. *Peteinosphaeridium asperum* n. sp., holotype, 750 X.

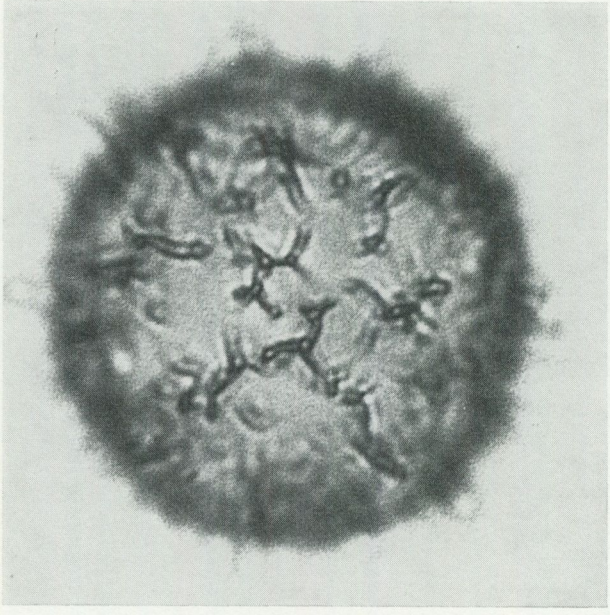


Fig. 22 *Peteinosphaeridium breviradiatum* (EISENACK, 1959) EISENACK, 1969, 1650 X.

1965 *Baltisphaeridium trifurcatum* subsp. *breviradiata*. – Eisenack: Die Mikrofauna . . ., p. 138, Pl. 11, fig. 8; Pl. 12, fig. 15.
1968 *Baltisphaeridium trifurcatum* subsp. *breviradiata*. – Eisenack: Über die Fortpflanzung . . ., p. 7, Pl. 1, fig. 9; Pl. 2, fig. 3.
1969 *Peteinosphaeridium breviradiatum*. – Eisenack: Zur Systematik . . ., p. 255.

DESCRIPTION. – *Peteinosphaeridium* sp. with moderately thick, single walled, spherical, shagrinate vesicle. No excystment structure recorded. Angular proximal process junction with the vesicle. Separation of the interior of the process from the vesicle cavity. Numerous short processes, psilate, cylindrical, homomorphic, furcate (trifurcate) with acuminate tips.

DIMENSIONS. – Vesicle diameter: 40–44 μ; process length: 2–3 μ; process breadth: < 1 μ; furca length (each furca-tip): 3 μ; process separation: 4–10 μ.

REMARKS. – *Peteinosphaeridium breviradiatum* exhibits general similarities with *P. nanofurcatum* KJELLSTRÖM, 1971. It differs, however, by lacking the characteristic lambda-shaped bifurcate processes with their bulbous tips of *P. nanofurcatum*.

MATERIAL. – Grötlingbo Borehole No. 1, Gotland; SGU slide no. 456:2.

OCCURRENCE. – Grötlingbo Borehole No. 1, Gotland; Middle Ordovician (Lower Viruan), Folkeslunda – Lower Uhaku beds, 456.10 m. – Baltic erratics; Ordovician.

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