STUDIES ON THE LATEST PRECAMBRIAN AND EOCAMBRIAN ROCKS IN NORWAY

No. 5.

MICROFOSSILS FROM LATE PRECAMBRIAN SEDIMENTS AROUND LAKE MJØSA, SOUTHERN NORWAY

By Svein Manum, University of Oslo

Abstract.

Microfossils extracted with ordinary palynological methods from the Biskopås conglomerate (Biri-conglomerate) and the Biri-shale of the late Precambrian age in Southern Norway are described. Two principle categories of spherical bodies occur: 1) spherical masses entirely composed of minute "cells" and 2) spherical shells of simple or composite membranes. They are further divided into six provisional forms (designated A—F) by their micro-structures. Certain forms occur united into clusters suggestive of a reproduction by budding. The natural affinities of the fossils remain problematic.

However, there is some evidence from thin-sections of the source material to suggest that bodies of category 1 may be "spores" produced by unicellular organisms roughly half a millimetre in diameter.

Material and treatment.

The investigated material came from two different stratigraphical units in the Hedmark Group of Southern Norway: 1) Phosphoritic pebbles from the "Biri-conglomerate," collected by Dr. N. Spjeldnæs at Moelv (identical with the material from which *Papillomembrana* Spjeldnæs 1963 has been described) and by Mr. D. Huseby at Roterud (Biri); 2) calcareous shale ("Biri-shale") collected by Mr. D. Huseby at Vismundelva (Biri). The stratigraphy of the Hedmark Group (Sparagmite Group) is described by K. Bjørlykke *et al.* 1967.

The samples were treated according to usual palynological methods, i. e. hydrofluoric acid maceration followed by oxidization with Schulze's mixture for about 24 hours. However, the oxidization had only very little if any effect on the result. Before maceration, the samples were thoroughly cleaned and then heated for a short time over a Bunsen burner. The residues were mounted in glycerin-jelly.

Results.

The maceration residues largely consist of black to brownish (yellowish) grey microscopic particles and fragments apparently of organic origin and ranging in size from less than one micron to a few tens of microns. In addition, organized bodies form a striking, although quantitatively small component. They are more or less irregularly circular in outline with diameters ranging from less than 10 μ to nearly 40 μ. The greater part of them is approximately spherical, others are flattened but appear to have had a roughly spherical shape originally.

These bodies, as well as most of the odd objects, disappear after heating the residue for a few minutes to c. 800° Centigrade, or treating it with chromic-sulphuric acid. This is taken to show that the objects are of organic origin.

For a description in this report, I have selected the forms that look most convincingly organized. I have not attached formal names to them, for I feel that a better understanding of these and similar objects and their significance is wanted before they can be treated taxonomically in a proper way. References to previously published names are almost meaningless since they are in general too briefly characterized.

The most useful character for separating the forms appear to be the micro-structures of the bodies or their walls, although I make no claim to fully understand them. Two principle categories may thus be distinguished: 1) Spherical bodies apparently wholly composed of a large number of small "cells," the whole body with or without a distinct enveloping membrane; 2) spherical shells, interior empty, with or without enveloping membrane.

To the first category belong Forms A and C described herein. The spherical masses are more or less opaque so that their interior is not easily observed, but from the more translucent examples as well as a few more or less squashed ones (cp. Pl. I fig. 1 and Pl. II fig. 5) I infer that they are entirely built up of small, approximately spherical "cells." The second category comprises the rest of the forms described and shows a much wider range of variation. Form B faintly resembles the first category in its shell composition (one layer of "cells"). More finely granular (not "cellular") wall structures are seen in Forms E and F. Form D has an irregularly porous wall structure.

One highly interesting feature is a tendency within certain forms to be united in clusters highly suggestive of a reproduction by budding. This is seen in Forms B and C, distinguishable also by their micro-struc-

variation in their dimensions and the micro-structures in the smallest members are distinctly finer than in the largest ones, suggesting that the former are juvenile. There seem to be two different modes of attachment represented: In Form B a clear tendency to form irregular chains is seen, while in Form C a centrifugal arrangement around a mother-cell seems to prevail.

The natural affinities of these microfossils remain problematic. Perhaps the biologically most interesting feature is the "budding" seen in certain forms, which in itself is suggestive of vegetative phases of organisms not much beyond the unicellular level of organization. The "cellular" composition of some forms and the resistance of the membranes on the other hand suggest a kind of "spore" function. But there is nothing to suggest that they are derived from higher plants.

Apertures and markings of various kinds which have been reported by some authors on microfossils of corresponding age have not been observed in the present material.

In this connection I would like to draw attention to the sporomorphs Type I and Type VII described by Spjeldnæs (1967) from the same source material. They show within a well defined membrane several spherical bodies resembling to varying degrees my Form A. The incomplete specimen designated by Spjeldnæs as Type VI exhibits a fairly similar morphology. In the Types VI and VII of Spjeldnæs the contained bodies appear to be wholly composed of granules or "cells" (as in my Form A), but in Type I there appears to be only a superficial layer of "cells." It seems possible to visualize the entire bodies as roughly spherical, unicellular organisms, perhaps with outgrowths or appendages in some cases (cp. Spjeldnæs' figs. 1 and 2, Pl. 4), and in the size range of a few tenths to half a millimetre. The presence of granular or "cellular" bodies inside them is in the line with a "spore" function as suggested for these bodies above.

In his thin-sections Spjeldnæs (l. c.) has also noted a form (Type V) which corresponds fairly well with my Form B, but it throws no additional light on their morphology.

Microfossils from Precambrian and early Cambrian sediments have attracted an increasing amount of interest in the last decade, particularly in the USSR, where they are being used for correlation of the otherwise nonfossiliferous sediments (cp. f. i. the papers by Chepikova 1966 and Pychova 1966). To draw any stratigraphical conclusions from the present, very limited investigation, however, is hardly permissible.

A comparison with previously, usually very briefly, described forms can only be too superficial to be of any use. Still, I would like to draw attention to one category in the present material, represented by the "cellular" Forms A and C, which seem to have equivalents in material described by Timofeev (1959, p. 26, "*Symplassosphaeridium*") from the Upper Cambrian *Dictyonema*-shale from Vologda, and by Roblot (1963, figs. 27, 28) from the Middle Brioverian in France. The "budding" seen in the present Form C, however, seems to be something quite distinct.

Timofeev (1963) has previously reported some microfossils from the Eocambrian in Finnmark, Northern Norway, but none of the present forms appear to be similar to them.

None of the microfossils obtained can be seen to have any relationship to *Papillomembrana compta* Spjeldnæs (1963) which was described from thin sections of pebbles from the Biskopås conglomerate ("Biri-conglomerate").

I am not prepared to distinguish between the microfossil assemblages of the pebbles of the "Biri-conglomerate" and the stratigraphically somewhat younger "Biri-shale" as known at present. A somewhat greater variety of forms have been seen in the former, which have yielded the more rare forms described herein, but the most frequent forms (A and B) occur in either sediment.

Descriptions

FORM A

Pl. I, figs. 1–5.

Globular bodies, 15 to 24 μ in diameter, apparently composed of densely packed "cells" ranging in diameter from 1.5 to 2.5 μ but in any individual specimen being rather uniform in size. No separate enveloping membrane visible. The component cells are distinct on the surface, their presence inwards towards the centre is not always easily ascertained. However, it is quite clear that more than a single superficial layer of cells exist, and in a few favourable specimens a continuously changing pattern of cells can be seen as one is focussing through them. Most specimens are too opaque or otherwise too obscure in the middle to permit a statement regarding the interior structure. More or less opaque specimens often appear facetted on the surface.

Occurs in both the conglomerate and the shale.

FORM B

Pl. I, figs. 6–22.

Globular bodies of varying dimensions united in an irregularly chain-like manner. The individual bodies are composed of an approximately spherical capsule enveloped in a thin membrane. The internal capsule appears to be a hollow shell whose wall consists of one layer of densely packed "cells" or granules (opaque "cells") with diameters up to 1.5 μ. However, in the smaller members of a cluster these wall elements are noticeably finer and often indistinct. Quite often the capsule is too opaque for its structural details to be shown; however, its hollow nature has been ascertained in a fair number of specimens.

The enclosing membrane is less than 0.5 μ thick and fairly distinct, particularly in the smaller members of a cluster. In the larger members it is very corrugated, but far less so to nearly smooth in the smaller to smallest members. In some specimens the origin of these corrugations is indicated by their replacement in part by small, somewhat less than hemispherical bulges, whose size and form make it probable that they were cast by the underlying component elements of the capsule wall.

Separate bodies comparable to individual members of this form occur frequently; such specimens resembling the smaller cluster members are quite abundant, while larger ones are fairly rare.

One specimen reminiscent of an enveloping membrane devoid of its capsule is shown in Pl. I figs. 15 and 16; its pattern of hemispherical bulges is somewhat coarser than usual for Form B.

The objects thus referred to in Form B compose an assemblage of rather heterogeneous aspect. A further differentiation attempted at an earlier stage, particularly for the separate bodies, could not be maintained because the characters were found to intergrade too much. A good reason for lumping is provided by the fairly wide range of variation often seen in the members of one single cluster.

Occurs in the conglomerate and the shale.

FORM C

Pl. II, figs. 1–5.

Globular body, diameter c. 30 μ, with smaller bodies, usually 5–10 μ in diameter, attached to it. The individual bodies, whether large or

small, are composed of more or less spherical "cells" whose diameter is 2.4—3.0 μ in the larger ones and down to less than 0.5 μ in the smaller ones. An enveloping membrane is fairly distinct in the smaller members, less distinct or possibly missing in the larger ones.

Found in the conglomerate.

FORM D

Pl. II, figs. 6—9.

Spherical shells, the two specimens seen have diameters 25 and 30 μ respectively. The wall appears porous in optical section, with cavities of circular to rather elongate oval outlines and greatly varying dimensions; in surface view they appear as a net-work with greatly varying mesh form and size (from less than 0.5 μ to c. 10 μ). Wall thickness varies between approximately 2 μ and 4 μ.

Found in the conglomerate.

FORM E

Pl. II, fig. 10.

Almost flattened objects of irregularly rounded outline (original shape probably ovoid to spherical), diameter about 20—30 μ. The wall itself is probably very thin, the most conspicuous character being irregularly distributed opaque granules from less than 0.5 to somewhat over 1.0 μ in diameter, sometimes fused, and giving the surface an unevenly spotted appearance.

Found in the conglomerate.

FORM F

Pl. II, fig. 11.

Flattened objects of subcircular outline (original shape probably approximately spherical), diameter of the two specimens observed 33 x 36 μ and 27 x 30 μ respectively. Membrane less than 0.5 μ thick, of a finely granular composition showing in surface view as fine (less than 0.5 μ), evenly distributed dots.

Found in the conglomerate.

Acknowledgements.

I wish to thank Dr. Nils Spjeldnæs, University of Aarhus, and Mr. Dag Huseby, University of Oslo, for the samples used. Much pains-

taking laboratory and microscopy work was done by Mr. D. Huseby. A grant towards technical assistance from the Norwegian Research Council for Science and the Humanities is gratefully acknowledged.

Literature.

Bjørlykke, K., Englund, J. O. and *Kirkhusmo, L.*, 1967. Latest Precambrian and Eocambrian Stratigraphy of Norway. - N.G.U. This volume.

Chepikova, J. K., 1966: Paleophytological characteristic of the Upper Pre-Cambrian deposits of eastern regions of Russian platform (Engl. summary). - In: The importance of palynological analysis for the stratigraphic and paleofloristic investigations, pp. 42—44. Acad. Nauk USSR, Moskva.

Pychova, N. G., 1966: Microfossils in Lower Cambrian and Pre-Cambrian of the south of eastern Siberia. - Ibid. pp. 45—50.

Roblot, M.-M., 1963: Découverte de sporomorphes dans des sédiments antérieurs a 550 M. A. (Briovérien). - C. R. Acad. Sci. 256: 1557—1559, 1 pl.

Spjeldnæs, N., 1963: A new fossil (Papillomembrana sp.) from the Upper Precambrian of Norway. - Nature 200 (4901): 63—64.

Spjeldnæs, N., 1967: Fossils from pebbles in the Biskopåsen Formation in Southern Norway. - N.G.U. This volume.

Timofeev, B. V., 1959: Drevnejshaja flora Pribaltiki i ejo stratigrafitsjeskoe znatsjenie.—Trudy VINGRI 129, 320 pp., Leningrad.

Timofeev, B. V., 1963: On organic remains in the Eocambrian of Norway. - N. Geol. Tidsskr. 43: 473—476, 1 pl.

Explanation of plates.

All figures are from untouched negatives, photographed through an oil immersion lens with n.a. 1.14. Magnification is x 1000 throughout. The slides are preserved in the Palaeontological Museum of the University of Oslo under the common designation PAP 6. The exact position of the fossils in each slide is indicated by coordinates on the labels. Slides No. 13 and 14 are from the shale, the rest from the conglomerate.

Plate I

Figs. 1—5. Form A. - Fig. 1: sl. 3, the specimen is slightly squashed and some "cells" coming loose are seen in the lower right hand corner of the figure; fig. 2: sl. 1; fig. 3: sl. 5; fig. 4: sl. 14; fig. 5: sl. 6.

Figs. 6—22. Form B. - Fig. 6: sl. 14; figs. 7, 8, 9: sl. 13; fig. 10: sl. 11, the specimen has small "buds" resembling those in fig. 17 but not clearly showing in this focus; fig. 11: sl. 11; fig. 12: sl. 13; fig. 13: sl. 14; fig. 14: sl. 10, a specimen composed of four bodies of almost equal size; figs. 15, 16: sl. 9, two foci of a membrane resembling that in Form B, but lacking the internal capsule; fig. 17: sl. 11; figs. 18, 19: sl. 9; fig. 20: sl. 13; fig. 21: sl. 12; fig. 22: sl. 9.

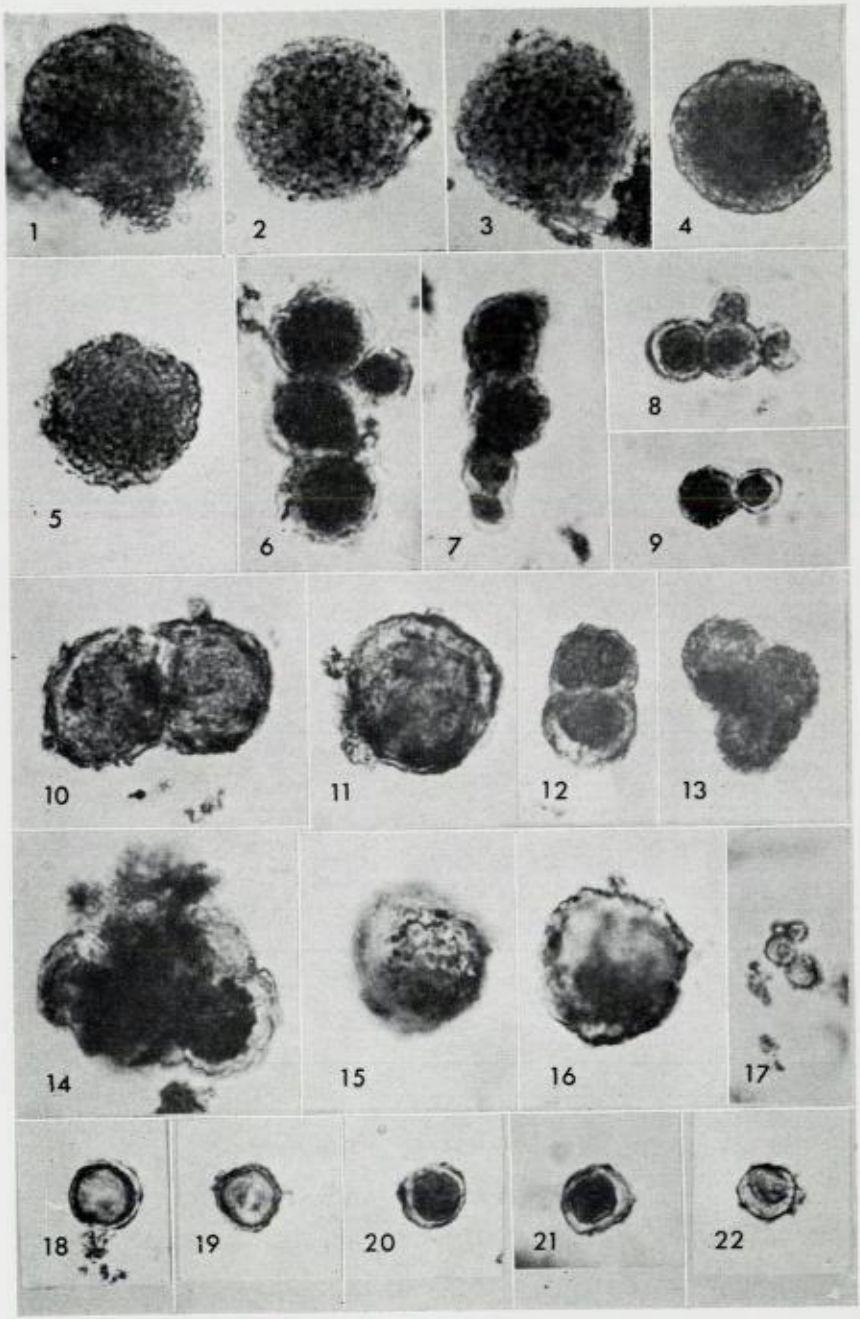
Plate II

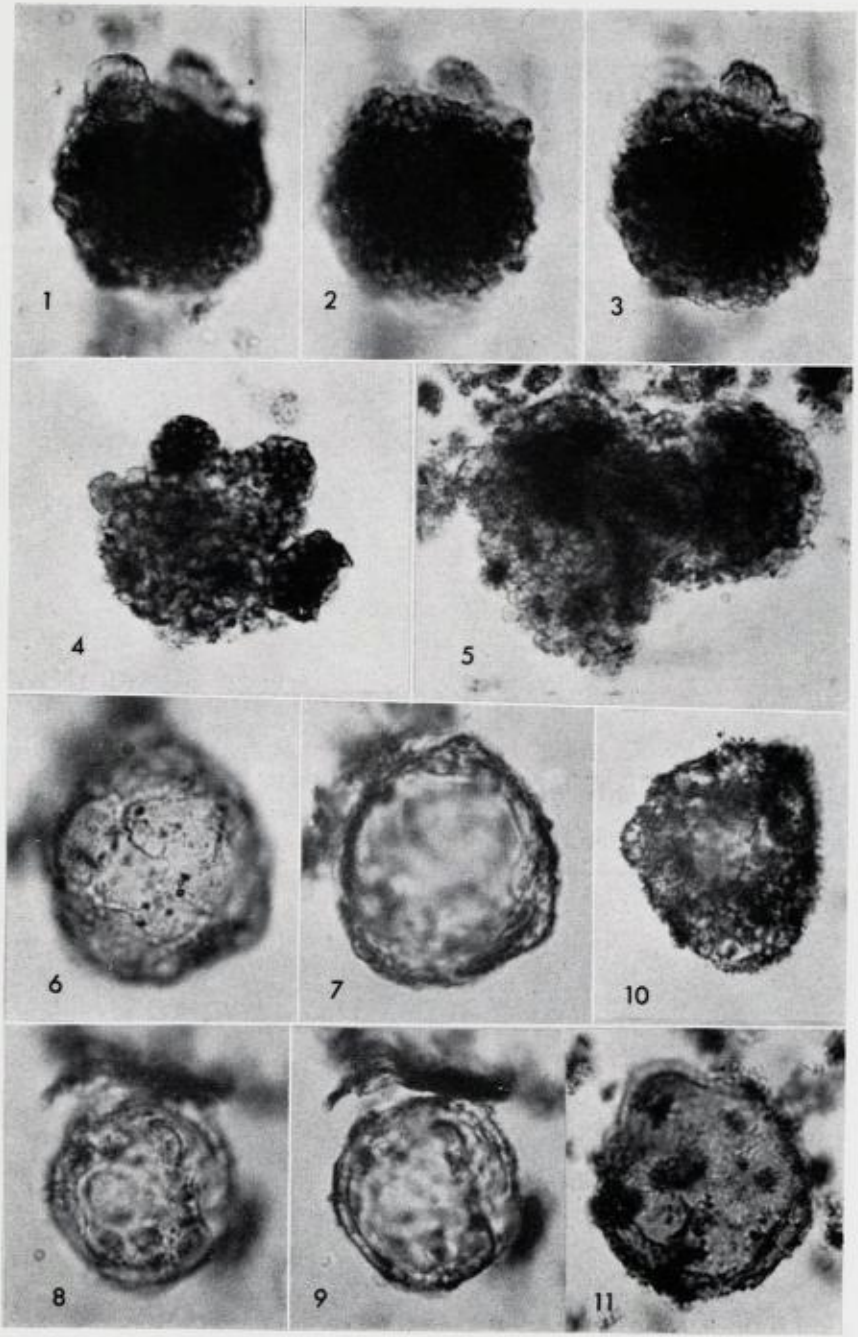
Figs. 1—5. Form C.—Figs. 1—3: sl. 5, three successive foci of one specimen; fig. 4: sl. 2; fig. 5: sl. 12, specimen composed of two bodies, one of which is squashed and the "cells" dispersed.

Figs. 6—9. Form D.—Fig. 6, 7: sl. 6, two foci of one specimen; figs. 8, 9: sl. 4, two foci of one specimen.

Fig. 10. Form E, sl. 7.

Fig. 11. Form F, sl. 8.


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22


1
2
3
4
5
6
7
10
8
9
11