MICRO-ORGANISMS FROM THE BUSHIMAY SYSTEM (LATE PRE-CAMBRIAN) OF KANSHI, ZAIRE

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ABSTRACT

Micro-organisms from the drill core samples recorded from the Bushimay Supergroup (Late Pre-Cambrian) of Kanshi, Zaire are recorded. The micro-organisms consist of remains of algae fungi, acritarcha and indeterminate remains. Among the algae both filamentous and colonial forms are present. The colonial forms are either preserved in the form of globular colony or elongate colony. Many of these colonies are surrounded by a mucilage sheath. The algal remains have been assigned to 9 genera belonging to 14 species. Of these 2 genera *Palaeomicrocysts* and *Chlorogloeaopsis* are new. Only 1 genus and 3 species have been referred to fungi. The acritarch remains belong to the groups Sphaeromorphitae, Megasphaeromorphitae, Acanthomorphitae Netromorphitae and the family Tasmanaceae. The spinate forms are rare in the assemblage. The elements belonging to Sphaeromorphitae and Megasphaeromorphitae are common. The assemblage resembles, on the basis of algal and fungal remains, to the Late Pre-Cambrian flora of Bitter Spring Formation of Australia and on the basis of acritarcha remains, the Late Pre-Cambrian (Upper Riphean) acritarcha assemblage of USSR.

INTRODUCTION

In recent years substantial data on the presence of micro-organisms from the Pre-Cambrian have been published. Micro-organisms from the Early Pre-Cambrian have been described by Barghoorn and Schopf (1966) from the Swaziland Supergroup occurring in the eastern, Transvaal near Barberton, South Africa. Pflug (1966a, 1967) and Schopf and Barghoorn (1967) have reported from the Fig Tree Formation. Cloud and Licari (1963) reported from the Soudan Iron Formation. During recent years, Middle Pre-Cambrian microfossils have been reported from the Witwatersrand Supergroup of South Africa (Pflug *et al.*, 1969), the Transvaal Supergroup of South Africa (Cloud & Licari, 1963), the Vallen Group of Greenland (Bondensen *et al.*, 1967), the Middle (Laberge, 1967) and Lower Belchar Group of Hudson Bay (Hoffmann & Jackson, 1969), the Gunflint Iron-Formation of Southern Canada (Barghoorn & Tyler, 1965; Cloud, 1965). Of these occurrences the most significant in terms of biological diversity and fidelity of preservation are the micro-biota of the Gunflint Iron-Formation and Lower Belchar Group of the Canadian shield.

Perhaps the greatest advances in Pre-Cambrian palaeobiology of the past decade have derived from the investigations of Late Pre-Cambrian sediments. Several well preserved microbiota exhibiting considerable biological diversity have recently been described from the Beck Spring Dolomite of California (Cloud *et al.*, 1969; Gutstadt & Schopf, 1969), the Skillogalee Dolomite of South Australia, (Schopf, 1968; Schopf & Blacie, 1971; Barghoorn & Schopf, 1965), the Paradise Creek Formation of Central Australia (Licari *et al.*, 1969), the Muhos Shale of Finland (Tynni & Sivola, 1969), the Belt Supergroup of Montana (Pflug, 1964, 1965, 1966b), the Nonesuch Shale of Michigan (Meinschen *et al.*, 1964; Barghoorn *et al.*, 1965), Grand Canyon, Arizona (Schopf *et al.*, 1973), Brioverian cherts of Normandy (Roblot, 1963, 1964), Siberia, Russia (Naumova, 1960; Timofeev, 1955, 1959, 1960, 1963, 1970a, 1970b; Pichova, 1967; Andreeva, 1962, Lopukhin, 1966, 1969, 1971a, b, 1963) and India (Salujha *et al.*, 1967, 1971a, 1971b, 1972; Venkatachala & Rawat, 1973). Some of these records have been reviewed by Glaessner (1962, 1966) and Schopf (1970).

In the present paper the micro-remains recovered from the Bushimay Supergroup (Late Pre-Cambrian) of Zaire are described. Up-till now preliminary contribution on the micro-remains of Bushimay has been done by Boulouard and Calandra (1963). They reported the presence of micro-remains from the Bore S13B, Point no. 467 (Raucq, 1957; 384-404) from the Bushimay of Kanshi. In all 189 samples belonging to 5 bore holes were examined by them. Of these samples, no. a, (car. 107/14), b. (car. 113/1), c. (car. 121/1) and d. (car. 158/162/1) yielded micro-remains (For details see Raucq, 1970, p. 149). The micro-fossils were referred to Leiosphaerids.

BUSHIMAY SUPERGROUP

In northwestern Shaba (formerly Katanga) and eastern Kasai a thick sedimentary Supergroup, the Bushimay, crops out and has been studied in some detail in an area extending from about Long. 26°E to Long. 22°E and from Latitude 5°S to Lat. 9°S.

These beds are equivalent to the Lower Katangan of Shaba (Cahen, 1973, 1974).

The first studies on the Bushimay Supergroup were made by Cornet in 1897, Mathieu in 1912, Kostka in 1913 and Richet in 1919. The present state of knowledge is based on the work of Raucq (1957, 1970), Cahen & Mortelmans (1947), Dumont (1971), Bertrand-Sarfati (1972), Cahen (1973, 1974) Lepersonne (1973).

The Supergroup is subdivided into three groups:

The Upper group (B II) is mainly composed of carbonate and pelitic rocks approximately 1000 m thick. It is separated from the middle group (B I) which is composed of arenites, pelites and some dolomitic pelites by a sharp break in sedimentation locality underlined by an important lava flow. An unconformity separates the basal conglomerate of group B (I) from the Lower group B(O) which is restricted to a relatively narrow trough in the vicinity of the Kibaride Belt.

The Bushimay Supergroup rests unconformably on the Kibaran which was folded some 1300 m.y. ago. It is terminated by a Lava flow which has been dated at 938 ± 15 m.y. So that the entire Supergroup is comprised between *c.* 940 m.y. and *c.* 1300 m.y., it belongs thus to the Late Pre-Cambrian. The Upper group is probably younger than *c.* 1050-1100 m.y. (Cahen, 1973, 1974).

Study of the Stromatolites (Bertrand-Sarfati, 1972; Cahen, 1973) has shown that the Upper Group (B II) corresponds to a lower portion of the Upper Riphean of USSR.

TABLE 1 — STRATIGRAPHICAL SUCCESSION OF BUSHIMAY

Lithostratigraphical units		Lithological description	Thickness
Group B2			
Formation	$B2_e$	Mainly calcite limestones, often reef deposits with stromatolites	100 m
Formation	$B2_d$	Mainly dolomitic limestones with various cherts	400 m
Formation	$B2_c$	Dolomitic limestones, usually reef deposits, with shaly intercalations, stromatolites	290 m
Formation	$B2_b$	Dolomitic limestones, calcareous shales, dolomitic shales, conglomerate with calcareous peebles and cement	125 m
Formation	$B2_a$	Reef dolomitic limestones with stromatolites	105 m
		BREAK IN SEDIMENTATION	
Group B1			c. 410 m to 1270 m
Formation	$B1_e$	Micaceous, feldspar bearing, muddy grits, various shales, dolomitic shales, dolomitic limestones, micaceous dolomitic grit	
Formation	$B1_d$	Micaceous sandstones, sometimes dolomitic sandstones and micaceous sandstones	
Formation	$B1_c$	Shales, micaceous shales and sandstones, sandstones and conglomerates	
Formation	$B1_{a/b}$	Basal conglomerate	
		UNCONFORMITY	
Group B0*			c. 260 m
Formation	$B0_b$	Lower Lumafumbo conglomerates, conglomeratic arkoses and quartzites, conglomerates	
Formation	$B0_a$	Mukebo quartzites with one bed of red to pink chert	

*Known only in Western Katanga.

MATERIAL AND METHODS

Drill core samples of Bore hole No. S13B from Kanshi (see Fig. 1) as detailed in Table 2 were subjected to maceration for the isolation of microfossils. The samples were repeatedly washed in distilled water before they were subjected to acid treatment. The samples were first kept for 3 hours in hydrochloric acid. After this period the hydrochloric acid was washed with the help of distilled water and then treated with hydrofluoric acid for 48 hours. The hydrofluoric acid was removed by repeated washing and decantation of distilled water. After this slides were prepared for micro-remains into polyvenyl alcohal and canada balsam.

Samples 7 to 10 belong to Group B2c of the stratigraphical sequence of Table 1.

All the figured slides are preserved at Musée Royal de l' Afrique Centrale, Tervuren, Belgium.

I wish to express my deep gratitude to Mr. L. Cahen, Director, Musée Royal de l' Afrique Centrale, Tervuren and Dr. M. N.

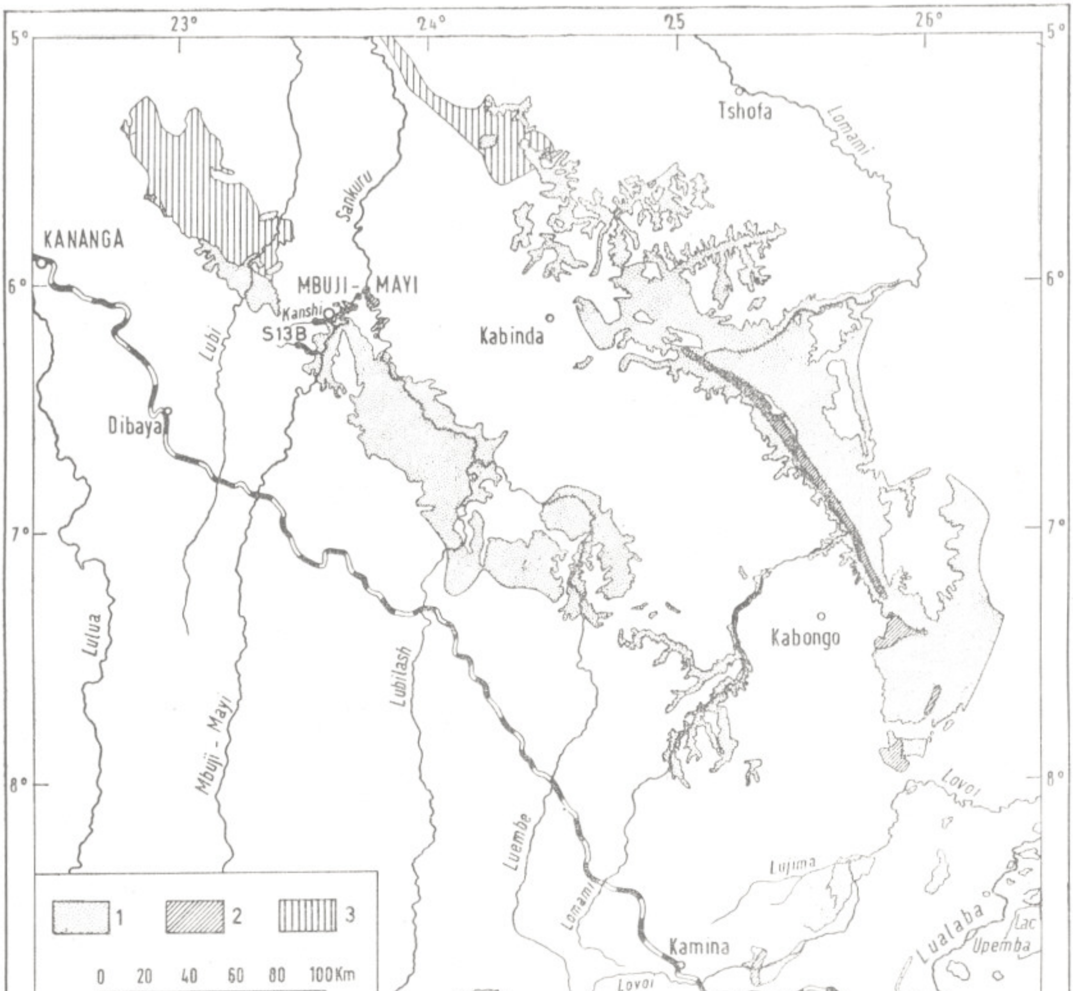

FIG. 1 — Map showing the position of drill core S13B in Bushimay Supergroup near Kanshi. 1. Bushimay Supergroup. 2. Lavas. 3. Bushimay under Planerozoic cover.

TABLE 2 — SAMPLES EXAMINED FROM THE BORE HOLE NO. S. 13, KANSHI

No.	Sample	No. of Bore core	Depth in metres	Microfosssils present or absent
1.	RG. 32.211	422/1	421,75-422	—
2.	RG. 32.212	422/1	421,75-422	—
3.	RG. 32.330	373/5	372,45	—
4.	RG. 32.356	309/5	306-315	—
5.	RG. 32.356	309/3	306-35	—
6.	RG. 32.367	277/5	276,26	—
7.	RG. 32.422	158/1-162/1	157-162	+
8.	RG. 32.440	121/1	118,40-122,90	+ (Rich)
9.	RG. 32.453	113/2	112-113,86	+
10.	RG. 32.464	107/14	106	+ (Rich)

Bose, Assistant Director, Birbal Sahni Institute of Palaeobotany, Lucknow for passing on the bore core samples from the Bushimay Supergroup of Kanshi for the study of micro-organisms.

DESCRIPTION

The micro-organisms obtained from the Bushimay Supergroup consist of a variety of algae (both filamentous and colonial forms), fungi and microplanktons classed under acritarcha. For the classification of algal and fungal forms the system proposed by Barghoorn and Tyler (1965) and Schopf (1968) has been followed and for acritarcha the system proposed by Downie *et al.* (1963) has been followed.

ALGAE

Phylum — CYANOPHYTA
Class — CYANOPHYCEAE
Order — NOSTOCALES
Family OSCILLATORIACEAE (S. F. Gray) Durmortier ex Kirchner

Genus — *Gunflintia* Barghoorn, 1965

Type species — *Gunflintia minuta* Barghoorn, 1965.

Gunflintia magna sp. nov.

Pl. 1, figs. 1, 2

Holotype — Pl. 1, fig. 1; slide no. 32.440/3.
Locality — As noted above.

Diagnosis — Multicellular filaments, straight or curved, unbranched; septa, distinct, uniformly spaced, constricted at the ends septae, thick folds present; individual filaments of generally uniform diameter; each septa rectangular in outline; margin straight, septa uniform in size, three times longer than wide; measuring 25-30 μ in length and 9-10 μ in width; surface thick and punctate.

Comparison — Barghoorn and Tyler (1965) reported two species of *Gunflintia*, viz., *G. minuta* and *G. grandis* from the Pre-Cambrian of Gunflint Chert, Ontario. *G. minuta* Barghoorn and Tyler (1965) differs by extremely narrow filament (1μ-5μ) and small size. *G. grandis* Barghoorn and Tyler (1965) differs by the varying size of cells in a filament whereas in *G. magna* sp. nov. the cells are of equal size. Moreover, *G. magna* is much larger in size.

Occurrence — Frequent.

Gunflintia barghoornii sp. nov.

Pl. 1, figs. 3, 4

Holotype — Pl. 1, fig. 3; slide no. 32.440/2.
Locality — As noted above.

Diagnosis — Multicellular filaments, straight or curved, unbranched, septa distinct, uniformly spaced; constricted at the ends of septa, folds absent; individual filament of uniform diameter; each septa rectangular in outline with rounded corners; septa ± uniform size, two to three times longer than wide; 40-60 μ in length and 16-20 μ in width, surface thin and smooth.

Comparison — *Gunflintia magna* sp. nov. differs from *G. barghoornii* sp. nov. by thick filament, punctate surface and the rectangular outline of cells without any curvature *G. minuta* Barghoorn and Tyler (1965) has narrow filament. *G. grandis* Barghoorn and Tyler (1965) has irregular size of cells.

Occurrence — Common.

Genus — *Siphonophycus* Schopf, 1968

Type species — Siphonophycus kestron Schopf, 1968.

Siphonophycus punctatus sp. nov.

Pl. 1, fig. 5

Holotype — Pl. 1, fig. 5; slide no. 32453/2.

Locality — As noted above.

Diagnosis — Thallus broad, tubular nonseptate, unbranched commonly quite long, smooth in surface texture, thallus cylindrical, solitary straight up to 150 μ (incomplete specimen) occasionally folded, thallus cylindrical, 40-50 μ in diameter, intrapunctate ornamented, reproductive structures unknown.

Comparison — Siphonophycus kestron Schopt (1968) known from the Late Pre-Cambrian of Bitter Spring Formation of Central Australia differs from *S. punctatus* sp. nov. in the presence of sheath encompasing individual cells.

Occurrence — Rare.

Order — CHOROOCOCCALES

Family — CHOROOCOCCACEAE Naget, 1849

Genus — *Sphaeropycus* Schopf, 1968

Type species — Sphaerophycus parvum Schopf, 1968.

Sphaerophycus densus sp. nov.

Pl. 1, figs. 6-7

Holotype — Pl. 1, fig. 7; slide no. 32·440/3/10.

Locality — As noted above.

Diagnosis — Cells circular in outline, commonly solitary or in pairs, less frequently arranged in loosely associated irregular groups of a few to many cells or uniseriate aggregates of few cells long; surface texture smooth and thick in appearance; cell diameter vary from 2-6 μ; sheaths encompasing individual cells absent.

Comparison — Sphaerophycus parvum Schopf (1968) reported from the Late Pre-Cambrian of Bitter Spring Formation of Central Australia differs from *S. densus* sp. nov. in the presence of sheath encompassing individual cells.

Occurrence — Common.

Genus — *Palaeoanacystis* Schopf, 1968

Type species — Palaeoanacystis vulgaris Schopf, 1968.

Palaeoanacystis psilata sp. nov.

Pl. 1, figs. 8

Holotype — Pl. 1, fig. 8; slide no. 32·440/3.

Locality — As noted above.

Diagnosis — Cells circular or circular-oval, occasionally slightly irregular due to mutual compression, irregular folds present, clumped together in more or less oval-circular colony of 15-50 cells; surface texture smooth; cell diameter vary from 15-20 μ, cell wall thin and not encompased by individual sheath.

Comparison — Palaeoanacystis vulgaris Schopf (1968) reported from the Bitter, Spring Formation of Australia differs from *Palaeoanacystis psilata* sp. nov. by thick cell walls and the colonies composed of much higher number of cells i.e. 300.

Occurrence — Frequent.

Genus — *Myxococcoides* Schopf, 1968

Type species — Myxococcoides minor Schopf, 1968.

Myxococcoides verrucosa sp. nov.

Pl. 1, fig. 9

Holotype — Pl. 1, fig. 9, slide no. 32·440/1.

Locality — As noted above.

Diagnosis — Cells commonly spherical to sub-spherical, occasionally ellipsoidal, somewhat flattened by compression against adjacent cells, clumped in more or less circular colony composed of 40 cells, surface texture micro-verrucose, cell dimension varies from 8-10 μ, cell wall thin, cells not enclosed by organic sheaths.

Comparison — Myxococcoides minor Schopf (1968), *M. inornata* Schopf (1968) and *M.*

reticulata Schopf (1968) are known from the Bitter Spring Formation of Australia. *M. minor* and *M. reticulata* differ from *M. verrucosa* sp. nov. due to psilate, psilate to punctate and reticulate exine. *M. inornata* has psilate exine and the cells are commonly embedded in a non-lamellated somewhat granular amorphous matrix.

Occurrence — Frequent.

Myxococcoides congoensis sp. nov.

Pl. 2, fig. 10

Holotype — Pl. 2, fig. 10; slide no. 32·440/2.

Locality — As noted above.

Diagnosis — Cells nearly spherical, little or not at all distorted by mutual compression, grouped in colonies of few cells, surface texture reticulate, lumina 3-4 μ; cell diameter vary 30-35 μ, cell walls thick; cells commonly embedded in a non-lamellated somewhat granular amorphous organic matrix.

Comparison — Due to reticulate surface texture of cells, *Myxococcoides congoensis* sp. nov. compares to *M. minor* Schopf (1968) and *M. reticulata* Schopf (1968). But both the Australian species show surface texture from psilate to reticulate whereas in *M. congoensis* it is always reticulate.

Occurrence — Frequent.

Genus – *Palaeomicrocystis* gen. nov.

Type species — *Palaeomicrocystis schopfii* gen. nov.

Generic Diagnosis — Cylindrical, long and narrow filaments, composed of colony of cells, irregularly overlapped, 4-5 cells broad; colony arranged into distinct partial colonies to give septate appearance to filament, partial colonies sometimes 15 times as long as broad, partial colonies 100 μ in length and 30-40 μ in width, cells spherical or elongated, 10-12 μ in diameter, granulate exine, partial colonies encircled by distinct mucilage, reproductive structures unknown.

Etymology — With reference to morphological similarity to modern algae of the genus *Microcystis* Kutzing.

Palaeomicrocystis schopfii sp. nov.

Pl. 2, figs. 11, 12

Holotype — Pl. 2, fig. 11; slide no. 32·440/1.

Locality — As noted above.

Diagnosis — As for genus.

Discussion — *Palaeomicrocystis schopfii* is of relatively rare occurrence in Bushimay of Kanshi. It is comparable in general morphology to modern Chroococcacean blue-green algae and among these appears closely similar to members of the genus *Microcystis* Kutzing (e.g. *Microcystis pseudofilamentosa* Crow).

Occurrence — Rare.

Genus – *Entosphaeroides* Barghoorn, 1965

Type species — *Entoshphaeroides amplus* Barghoorn, 1965.

Entosphaeroides bilinearis sp. nov.

Pl. 2, figs. 13-14

Holotype — Pl. 3, fig. 13; slide no. 32·440/1.

Locality — As noted above.

Diagnosis — Nonseptate, thin, smooth, unbranched filaments, straight or curved, 300-340 μ long and 16-20 μ broad in diameter, spore-like bodies arranged in two irregular rows, circular in outline, 10-12 μ in diameter, exine punctate with irregular folds due to compression; sheath enclosing filaments are not well marked.

Comparison — *Entosphaeroides amplus* Barghoorn (1965) recorded from Gunflint Formation, Animikie Series, Ontario, Canada is distinguished from *E. bilinearis* sp. nov. by irregular distribution of spore-like bodies and narrow dimension of filament.

Occurrence — Rare.

Entosphaeroides irregularis sp. nov.

Pls. 2, 3, figs. 15, 16

Holotype — Pl. 2, fig. 15; slide no. 32.440/2.

Locality — As noted above.

Diagnosis — Nonseptate thin, smooth, unbranched filaments; straight or curved 300 μ long and 40-50 μ in diameter; spore-like bodies arranged together in 4-5 in a row, irregularly overlapped. occasionally randomly distributed in the lumina of filaments; spore-like bodies oval in outline, 9-18 μ in diameter, exine thick, smooth with irregular folds; sheath enclosing filament not marked.

Comparison — *Entosphaeroides amplus* Barghoorn (1965) shows irregular distribution of spore-like bodies, whereas in *E. irregularis* sp. nov. the spore-like bodies are arranged in a linear row, grouped together 4-5 in a row. Moreover, in *E. amplus* the dimension of filament is narrow. In *E. bilinearis* sp. nov. the spore-like bodies are arranged in two rows. Moreover, the exine of spore-like bodies in *E. bilinearis* is punctate whereas in *E. irregularis* the exine is smooth.

Occurrence — Frequent.

Family — ENTOPHYSALIDACEAE

Genus – *Cholorogloeaopsis* gen. nov.

Genotype — *Cholorogloeaopsis zairensis* sp. nov.

Generic diagnosis — Elongated colony, composed of spherical or ellipsoidal cells, 8-10 μ in diameter, arranged in form of long cylindrical colony, 2-4 cells in a row, exine granulate, mucilage envelope absent.

Etymology — With reference to morphological similarity to modern algae of the genus *Chlorogloea* Wille.

Cholorogloeaopsis zairensis sp. nov.

Pl. 3, figs. 21-23

Holotype — Pl. 3, fig. 21; slide no. 32.440/3.

Locality — As noted above.

Diagnosis — As for genus.

Discussion — *Chlorogloeaopsis zairensis* occurs commonly in Bushimay of Kanshi and is comparable in general morphology to modern family Entophysalidaceae of blue-green algae and among these appears closely similar to members of the genus *Chlorogloea* Wille (e.g. *Chlorogloea fritschii* Mittra).

Occurrence — Common.

Phylum — CHLOROPHYTA
Class — CHLOROPHYCEAE
Order — CHLOROCOCCALES(?)

Genus – *Glenobotrydion* Schopf, 1968

Type species — *Glenobotrydion aenigmatis* Schopf, 1968.

Glenobotrydion tetragonalum sp. nov.

Pl. 3, figs. 17, 18

Holotype — Pl. 3, fig. 17; slide no. 32.440/2.

Locality — As noted above.

Diagnosis — Cells tetragonal with rounded corners; commonly with prominent, oval, small organic structure on inner surface of cell wall; cells arranged end to end in a single row of about 10-12 cells with little or no distortion due to mutual compressions; surface texture smooth; cell size measures 30-50 μ in length and 20-30 μ in width; aggregated cells not embedded in amorphous, unlamellated organic matrix; single oval shaped pyrenoid-like structure, measuring 9-15 μ in length and 4-8 μ in width commonly present on the inner surface of cell walls.

Comparison — Up-till now only two species of *Glenobotrydion* are known. *Glenobotrydion aenigmatis* was recorded by Schopf (1968) from the Late Pre-Cambrian of the Bitter Spring Formation of the Central, Australia and *G. majorinum* Schopf and Blacic (1971) from North-Central Amadens Basin, Australia. Both the above named species differ by the circular shape of cells, circular pyrenoid-like structure and smooth cell walls.

Occurrence — Rare.

Glenobotrydion kanshiensis sp. nov.

Pl. 3, figs. 19-20

Holotype — Pl. 3, fig. 19; slide no. 32·44/3.

Locality — As noted above.

Diagnosis — Cells circular; commonly with prominent, circular, small organic structure on inner surface of walls; cells commonly in loosely associated groups, pseudo-filamentous in organization, one or two rows of cells placed in a linear row; sheath absent; surface texture finely punctate; cell diameter 18-24 μ and circular disc shaped pyrenoid-like structure, 4-5 μ in diameter.

Comparison — *Glenobotrydion aenigmatis* Schopf (1968) and *Glenobotrydion majorinum* Schopf and Blacic (1971) agree to *Glenbotrydion kanshiensis* sp. nov. due to circular pyrenoid-like structure but differs in having cells more or less spherical in outline. Moreover, the Australian species differ by the presence of sheath which is absent in *G. kanshiensis*.

Occurrence — Rare.

FUNGI (?)

Phylum — EUMYCOPHYTA (?)

Genus – *Eomycetopsis* Schopf, 1968

Type species — *Eomycetopsis robusta* Schopf, 1968.

Eomycetopsis septata sp. nov.

Pl. 3, fig. 24

Holotype — Pl. 3, fig. 24; slide no. 32.440/2.

Locality — As noted above.

Diagnosis — Filaments commonly solitary; commonly gregarious, sinuously interlaced in a loosely woven parenchyma like mass, smooth to granular surface texture of walls; filaments 170 μ long, more or less regularly cylindrical, 4-8 μ in diameter, septate portion of filaments common, septate portion of filaments vary in length, commonly less than 10 μ, filaments attenuated at the septa.

Comparison — Up-till now only two species of *Eomycetopsis* are known, *E. robusta* Schopf (1968) and *E. filiformis* Schopf (1968) from the Late Pre-Cambrian of the Bitter Spring Formation of Australia. Filaments of *Eomycetopsis robusta* are commonly solitary and they are occasionally in groups of few entangled filaments, whereas in *E. septata* the filaments are gregarious in nature. Filaments of *E. filiformis* are coriaceous in nature, whereas in *E. septata* the filaments are smooth to granular.

Occurrence — Common.

Eomycetopsis rugosa sp. nov.

Pl. 4, figs. 25-26

Holotype — Pl. 4, fig. 26; slide no. 32.422/1.

Locality — As noted above.

Diagnosis — Filaments commonly solitary, occasionally in groups of few entangled filaments, sinuously interlaced in a loosely woven prosenchyma-like mass; surface of filaments finely punctate with rugose structure, filaments up to 200 μ large, regularly cyclindrical, 5-12 μ in diameter, septate portion of filaments extremely rare.

Comparison — *Eomycetopsis robusta* Schopf (1968) differs from *E. rugosa* sp. nov. by coriaceous, coarsely and irregularly granular surface texture of filaments. *E. filiformis* Schopf (1968) differs by rare occurrence of solitary filaments and finely to coarsely granular surface texture. *E. septata* sp. nov. has smooth surface texture of filaments, moreover, the filaments are frequently septate and commonly gregarious in nature.

Occurrence — Common.

Eomycetopsis cylindrica sp. nov.

Pl. 4, figs. 27-28

Holotype — Pl. 4, fig. 27; slide no. 32.440/3/7.

Locality — As noted above.

Diagnosis — Filaments rarely solitary, commonly gregarious, sinuously interlaced in a close cylindrical mass; surface texture of filament smooth to finely granulose, filaments up to 250 μ in length, more or less regularly cylindrical with a variance in diameter, 4-5 μ in diameter, sepatate portion of filaments rare, reproductive structure unknown.

Comparison — In *Eomycetopsis robusta* Schopf (1968), *E. filiformis* Schopf (1968), *E. septata* sp. nov. and *E. rugosa* sp. nov., the filaments are interlaced in a loosely woven prosenchyma-like mass while in *E. cylindrica* the filaments are closely interlaced into a cylindrical structure. Moreover, the septate filaments are rare in *E. cylindrica* in comparison to *E. robusta* and *E. septata*. *E. rugosa* differs by the rugose surface texture of filaments.

Occurrence — Frequent.

ACRITARCHS

Group — ACRITARCHA Evitt, 1963.
Sub-group — SPHAEROMORPHITAE Downie, Evitt and Sarjeant, 1963

Genus – *Protoleiosphaeridium* Timofeev, 1956

Type species — *Protoleiosphaeridium conglutianum* Timofeev, 1958.

Protoleiosphaeridium densum sp. nov.

Pl. 4, fig. 29, 30

Holotype — Pl. 4. fig. 29; slide no. 32.440/3.

Locality — As noted above.

Diagnosis — Thick dark brown, circular-oval, 10-20 μ, exine laevigate.

Comparison — *Protoleiosphaeridium diatretus* Salujha, Rehman and Rawat (1971) compares to *P. densum* due to laevigate exine but differs in the presence of lighter areas. *P. pristinum* Salujha, Rehman and Arora (1971) has pitted exine. *P. conglutianum* Timofeev (1959) is much bigger in size from *P. densum*. *P. cambriense* Timofeev (1959) is larger in diameter and the wall is structured. *P. cryptogranulosum* Staplin (1961) is distinguished by pitted exine.

Protoleiosphaeridium laevigatum sp. nov.

Pl. 4, fig. 31

Holotype — Pl. 4, fig. 31; slide no. 32.440/3.

Locality — As noted above.

Diagnosis — Thick dark-brown circular, 20-30 μ, exine laevigate with minute lighter areas, folds absent.

Comparison — *Protoleiosphaeridium diatretus* Salujha, Rehman and Rawat (1971) compares due to laevigate exine but differs by its small size. *Protoleiosphaeridium* sp. by Venkatachala and Rawat (1972) from Bhimas compares by laevigate exine but differs due to small size and thin exine.

Occurrence — Common.

Genus — *Symplassosphaeridium* Timofeev, 1959

Type species — *Symplassosphaeridium incrustatum* Timofeev, 1959.

Symplassosphaeridium bushimayensis sp. nov.

Pl. 4, fig. 32

Holotype — Pl. 4, fig. 32; slide no. 32.440/3.

Locality — As noted above.

Diagnosis — Dark brown, almsot spherical, 15-30 μ, exine over 1 μ thick; body divided into several rounded areas, ± 1 μ in diameter.

Comparison — *Symplassosphaeridium tumidulum* Timofeev (1960) and *S. incrustatum* Timofeev (1959) are larger in overall size.

Occurrence — Frequent.

Genus — *Trematosphaeridium* Timofeev, 1956

Type species — *Trematosphaeridium decoratum* Timofeev, 1956.

Trematosphaeridium zairiensis sp. nov.

Pl. 4, fig. 33

Holotype — Pl. 4, fig. 33; slide no. 32.440/1

Locality — As noted above.

Diagnosis — Spherical to subspherical; 20-25 μ, exine laevigate with small circular perforations, ± 1 μ; body bearing irregular folds.

Comparison — *Trematosphaeridium decoratum* Timofeev (1959) is larger in size with many large perforations. *Trematosphaeridium* sp. Timofeev (1963) is larger in size with a thick and smooth exine. *T. inspissatum* Salujha, Rehman and Arora (1971) differs in having a thicker exine with coarsely granualate ornamentation. *T. bhimaii* Salujha, Rehman and Arora (1972) has finely granulose exine with few perforations.

Occurrence — Rare.

Genus — *Granomarginata* Naumova, 1961

Type species — *Granomarginata prima* Naumova, 1961.

Granomarginata minuta sp. nov.

Pl. 4, fig. 34

Holotype — Pl. 4, fig. 34; slide no. 32.440/2

Locality — As noted above.

Diagnosis — Brown spherical, 12-15 μ, exine thick, granulose; grana closely set, peripheral thickening absent.

Comparison — *Granomarginata prima* Naumova (1960) differs due to finely granulose structure. *G. primitiva* Salujha, Rehman and Arora (1971) differs by sparsely arranged grana and a peripheral thickening.

Occurrence — Rare.

Genus — *Vavosphaeridium* Timofeev, 1956

Type species — *Vavosphaeridium michailovskyi* Timofeev, 1960.

Vavosphaeridium bharadwajii Salujha, Rehman & Rawat, 1971.

Pl. 4, fig. 35

Description — Dark brown, spherical 20-30 μ, exine about 1 μ thick, reticulate, reticulations incomplete, muri protruding at the margin.

Comparison — The present specimen compares in its organisation to *Vavosphaeridium bharadwajii* Salujha, Rehman and Rawat (1971, Pl. 1, figs. 1, 2) recorded from the Vindhyan Formation of Rajasthan.

Occurrence — Frequent.

Vavosphaeridium densum sp. nov.

Pls. 4, 5, figs. 36, 39

Holotype — Pl. 5, fig. 39, slide no. 32.422/1.

Locality — As noted above.

Diagnosis — Blackish-brown, spherical, 60-130 μ; exine thick; reticulate, reticulum distinct; lumina of irregular shape, 2-6 μ; muri thick, 2 μ broad.

Comparison — *Vavosphaeridium michailovskyi* Timofeev (1959) has incomplete reticulum, whereas in *V. densum* the reticulum is complete. *V. bharadwajii* Salujha, Rehman and Rawat (1971) is comparatively small in size.

Occurrence — Common.

Genus – *Archaeofavosina* Naumova, 1960

Type species — *Archaeofavosina simplex* Naumova, 1960.

Archaeofavosina naumovae sp. nov.

Pl. 5, fig. 40

Holotype — Pl. 5, fig. 40, slide no. 32.440/2.

Locality — As noted above.

Diagnosis — Dark brown, spherical to sub-spherical, 70-90 μ; exine ±1 μ thick with large polygonal reticuloid areas, 12-20 μ wide; muri raised, 2-4 μ broad; small circular pitted structure present in between reticulum, pits closely arranged, margin of pits raised.

Comparison — *Archaeofavosina simplex* Naumova (1960) is smaller in size. *A. venusta*Salujha, Rehman an d Arora (1971a) is smaller in size and has granulate exine. In *A. compta* Salujha, Rehman and Arora (1971b) the pits are sparsely arranged. *A. pellucida* Salujha, Rehman and Arora (1972) differs in small size and irregular shape of pits.

Occurrence — Rare.

Archaeofavosina sinuta sp. nov.

Pl. 5, figs. 41, 42

Holotype — Pl. 5, fig. 41, slide no. 32·340/1.

Locality — As noted above.

Diagnosis — Brown, spherical, 110-130 μ, exine thin with small polygonal reticulate areas, 8-10 μ wide, muri raised, 1 μ broad; small, irregular-shaped pitted structure in between reticulum; pits closely arranged.

Comparison — *Archaeofavosina compta* Salujha, Rehman and Arora (1971b) has sparsely arranged pits whereas in *A. sinuta* the pits are closely arranged. In *A. pellucida* Salujha, Rehman and Rawat (1972) the reticulum is more pronounced than *A. sinuta* sp. nov. *A. naumovae* sp. nov. differs from *A. sinuta* by big broad reticulum and circular shaped pits which are bordered.

Occurrence — Rare.

Genus – *Leiosphaeridia* (Eisenack, 1958) Downie & Sarjeant 1963

Type species — *Leiosphaeridia baltica* Eisenack, 1958.

Leiosphaeridia kanshiensis sp. nov.

Pl. 6, fig. 44

Holotype — Pl. 6, fig. 44; slide no. 32.440/3.

Locality — As noted above.

Diagnosis — Vesicle oval in outline, 60-80 μ, wall thick, smooth to punctate, sometimes folded due to thin wall.

Comparison — Due to smooth to punctate exine it compares to *L. pellucida* Salujha, Rehman and Arora (1971) reported from the Vindhyans of Son Valley, but *L. pellucida* is spherical in outline and also much smaller in size. *L. deflandrei* Stockmans & Williere, (1963) differs from *L. kanshiensis* by finer and closely set perforations.

Occurrence — Frequent.

Genus — *Lophosphaeridium* Timofeev, 1959

Type species — *Lophosphaeridium rarum* Timofeev, 1959.

Lophosphaeridium granulatum sp. nov.

Pl. 4, fig. 38

Holotype — Pl. 4, fig. 38, slide no. 32.440/3.

Locality — As noted above.

Diagnosis — Dark brown, spherical, sometimes appearing subspherical due to folds, 70-80 μ, exine covered with closely arranged coni 2 μ long and 1 μ broad, giving granulate surface appearance.

Comparison — *Lophosphaeridium triangulatum* Downie (1963) is subtriangular in outline and has long sparsely set spines. *L. psilotum* Downie (1963) has long spines. *L. citrinum* Downie (1963) has capitate spines. *L. parvum* Stockmans and Williere (1963) differs due to sparsely arranged processes. In *L. rarum* Timofeev (1959) and in *L. plicatum* Timofeev (1959) the coni are sparesly arranged.

Occurrence — Rare.

Genus — *Orygmatosphaeridium* Timofeev, 1959

Type species — *Orygmatosphaeridium ruminatum* Timofeev, 1959.

Orygmatosphaeridium vulgarum sp. nov.

Pl. 6, fig. 45

Holotype — Pl. 6, fig. 45; slide no. 32.440/3.

Locality — As noted above.

Diagnosis — Vesicle thick, 90-150 μ, circular or circular oval, with prominent irregular folds, surface pitted, pits closely arranged, 1-2 μ in diameter, circular oval and rectangular in outline, pit margins with raised thickenings.

Comparison — *Orygmatosphaeridium ruminatum* Timofeev (1959) is comparatively bigger in size than *O. vulgarum* sp. nov. Moreover, in *O. ruminatum* the pit pores are also bigger in size. *O. kibartaium* Bagdaysergan from the Lower Palaeozoic of Pre-baltic is smaller in size than *O. vulgarum*.

Occurrence — Common.

Orygmatosphaeridium trizonatum sp. nov.

Pl. 4, fig. 46

Holotype — Pl. 4, fig. 46; slide no. 32.440/3.

Locality — As noted above.

Diagnosis — Vesicle 60-80 μ; circular, surface divided by folds into three distinct triangular zones, surface pitted, pits closely arranged, 1 μ in diameter, circular in outline.

Comparison — *Orygmatosphaeridium ruminatum* Timofeev (1959) and *O. vulgarum* sp. nov. are bigger in size. Moreover, distinct zones are absent in both the species.

Occurrence — Rare.

Sub-group — MEGASPHAEROMORPHYTAE Timofeev, 1970

Genus — *Kildinella* Sepheleva & Timofeev, 1953

Type species — *Kildinella hyperboreica* Sepheleva and Timofeev, 1963.

Kildinella timofeevii sp. nov.

Pl. 6, fig. 47

Holotype — Pl. 6, fig. 47; slide no. 32·440/3.

Locality — As noted above.

Diagnosis — Light brown, spherical to sub-spherical, size 60-100 μ, exine thin, smooth, structureless, with several irregular folds of varying dimensions.

Comparison — *Kildinella giperboreica* Sepheleva and Timofeev (1963) is coparatively much smaller in size. *K. magna* Timofeev (1969) agrees in shape, but is much larger in size.

Occurrence — Common.

Genus — *Nucellosphaeridium* Timofeev, 1969

Type species — *Nucellosphaeridium deunffii* Timofeev, 1969.

Nucellosphaeridium triangulatum sp. nov.

Pls. 6, 7, figs. 50, 54

Holotype — pl. 6, fig. 50; slide no. 32.440/3.

Locality — As noted above.

Diagnosis — Vesicle circular, 80-100 μ, distinct thick, dark-brown triangular central body, 70×50 μ with rounded corners, placed in the centre of vesicle, occupying 2/3 area; vesicle enveloping the central body from all sides, vesicle exine reticulate, muri and lumina well defined, ± 1 μ wide.

Comparison — *Nucellosphaeridium deminatum* Timofeev (1970) and *N. bellum* Timofeev (1970) differs from *N. triangulatum* sp. nov. in its circular central body and small size of central body in comparison to the overall size of the vesicle.

Occurrence — Rare.

Nucellosphaeridium magnum sp. nov.

Pl. 7, fig. 55

Holotype — Pl. 7, fig. 55; slide no. 32.440/2.

Locality — As noted above.

Diagnosis — Vesicle transversly oval, 200-300 μ, a distinct thick dark-brown circular central-body, 70-80 μ, placed in the centre of vesicle, occupying 1/3 area; vesicle enveloping the central body from all sides, vesicle exine reticulate, muri and lumina well defined, ± 1 μ wide.

Comparison — *Nucellosphaeridium deminatum* Timofeev (1970), *N. bellum* Timofeev (1970) and *N. triangulatum* sp. nov. differs from *N. magnum* due to circular outline of vesicles.

Occurrence — Rare.

Nucellosphaeridium zonatum sp. nov.

Pl. 6, fig. 48

Holotype — Pl. 6, fig. 48; slide no. 32.440/2.

Locality — As noted above.

Diagnosis — Vesicle circular, 65-90 μ, a distinct thick dark-brown central body, 50-60 μ, placed in the centre, enclosed by vesicle from all sides, the central body occupies 3/4 area of vesicle; exine reticulate, muri and lumina well defined, ± 1 μ wide.

Comparison — *Nucellosphaeridium deminatum* Timofeev (1970), *N. bellum* Timofeev (1970) and *N. magnum* sp. nov. has comparatively smaller central body in comparison to vesicle size. *N. triangulatum* sp. nov. has triangular central body.

Occurrence — Rare.

Sub-group- — ACANTHOMORPHITAE Downie, Evitt & Sarjeant, 1963

Genus — *Baltisphaeridium* (Eisenack) Downie & Sarjeant, 1963

Type species — *Baltisphaeridium longispinosum* Eisenack, 1951.

Baltisphaeridium sp.

Pl. 4, fig. 37

Description — Brown, spherical, 22 μ, exine ornamented with 2-3 μ long and 1 μ broad, sharp tipped and closely arranged processes.

Only few specimens were recorded in the assemblage, therefore, a detailed comparison is not possible.

Occurrence — Rare.

Subgroup — NETROMORPHITAE Downie, Evitt & Sarjeant, 1963

Genus — *Leiofusa* Eisenack, 1938

Type species — *Leiofusa fusiformis* Eisenack, 1934.

Leiofusa actinomorpha sp. nov.

Pl. 5, fig. 43

Holotype — Pl. 5, fig. 43; slide no. 32.440/3.

Locality — As noted above.

Diagnosis — Elongate-oval in outline, 100-120 μ, both the ends rounded. However, one of the end more broader than other end, exine smooth.

Comparison — A number of species of *Leiofusa* are known from the Ordovician (Eisenack, 1934; 1951, Deunff, 1961) and Silurian (Eisenack, 1938, Downie, 1959). The present species differs from all of them by its assymetrical outline.

Occurrence — Rare.

Family — TASMANACEAE Sommer, 1956

Genus — *Zonosphaeridium* Timofeev, 1959

Type species — *Zonosphaeridium actinomorphum* Timofeev, 1959.

Zonosphaeridium foveolatum sp. nov.
Pl. 6, fig. 52

Holotype — Pl. 6, fig. 52; slide no. 32.440/2.
Locality — As noted above.
Diagnosis — Circular to subcircular, 80-90 μ, exine thin, micro-foveolate; closely arranged foveolae; circular to oval in outline, ± 4 μ wide peripheral marginal zone.
Comparison — *Zonosphaeridium actinomorphum* Timofeev (1959) and *Z. limpatum* Timofeev (1959) differs by smooth exine. *Z. absolutum* Timofeev (1959) has reticulate exine. *Z. speciosum* Timofeev (1959) and *Z. obscurum* Timofeev (1959) have spines.
Occurrence — Rare.

Zonosphaeridium densum sp. nov.
Pl. 6, fig. 51

Holotype — Pl. 6, fig. 51; slide no. 32.440/3.
Locality — As noted above.
Diagnosis — Circular to sub-circular, thick, 100-200 μ; exine finely reticulate; muri thick, 2 μ; lumina polygonal in outline, 2-4 μ, peripheral marginal zone 8-10 μ wide.
Comparison — *Zonosphaeridium absolutum* Timofeev (1959) compares due to reticulate exine, but differs due to the large size of reticulation. Moreover, *Z. densum* sp. nov. is a thick grain.
Occurrence — Rare.

Genus – *Tasmanites* Newton, 1875

Tasmanites sp.
Pl. 6, fig. 53

Description — Dark brown in colour, spherical, appearing sub-spherical due to folds, 200-400 μ in diameter, wall thick, distinct pores closely arranged, ± 2 μ in size.
Comparison — *Tasmanites* sp. compares closely to *Tasmanites* sp. described by Maithy (1968, Pl. 1, figs. 1, 2) from the Suket Shales of the Vindhyan Formation of India.

INCERTAE SEDIS

Genus – *Kakabekia* Barghoorn, 1965

Type species — *Kakabekia umbellata* Barghoorn, 1965.

Kakabekia flabelliformis sp. nov.
Pl. 7, fig. 57

Holotype — Pl. 7, fig. 57, slide no. 32.440/3.
Locality — As noted above.
Diagnosis — Structure showing tripartite organization, consisting of dark bulb, cordate at central portion at the posterior side, slender stipe and a crown or mantle of funnel-like shape; overall length from distal end of bulb to apex of mantle 90 μ.
Comparison — *Kakabekia umbellata* Barghoorn (1965) has spherical bulb and umbrella-like mantle, whereas in *K. flabelliformis* sp. nov. the bulb has a constriction near the base and the mantle is funnel shaped.
Occurrence — Rare.

Kakabekia rarea sp. nov.
Pl. 7, fig. 58

Holotype — Pl. 7, fig. 58, slide no. 32.442
Locality — As noted above.
Diagnosis — Structure showing tripartite organization, consisting of circular bulb, slender stipe and a crown of funnel shape, overall length 110-120 μ, bulb exine granulate.
Comparison — *Kakabekia umbellata* Barghoorn (1965) has umbrella-shaped mantle whereas in *K. rarea* sp. nov. the mantle is funnel shaped. In *K. flabelliformis* sp. nov. the bulb has constriction at the posterior end, whereas in *K. rarea* the bulb is circular in outline.
Occurrence — Rare.

Unbranched Filament.
Pl. 7, fig. 59

Associated with the micro-organisms a large number of thick dark brown unbranched filaments with perforations on surface. The affinities of these forms are uncertain.

DISCUSSION AND CONCLUSION

The micro-organisms recorded from the Bushimay of Kanshi (Late Pre-Cambrian) contains remains of algae, fungi, acritarchs and doubtful remains. These remains consist of 25 genera belonging to 40 species. Of these 9 genera and 14 species have been ascribed to algae, 1 genus and 3 species to fungi, 14 genera and 21 species to acritarchs and 1 genus and 2 species to incertae sedis. In the assemblage the colonial forms of algae are more common than the filamentous forms. Among acritarchs the forms with spines are extremely rare. Commonly the forms of acritarchs show smooth to different types of sculpture.

In recent years a number of assemblages of micro-organisms have been reported from the Pre-Cambrians. In all the assemblages, either remains of algae and fungi (Schopf, 1968; Schopf *et al.*, 1971) have been recorded or the remains of acritarchs only (Timofeev, 1959). But, in the Bushimay assemblage all the elements are present, which may be due to the prevailing ecological conditions.

The oldest known microfossils are known from the Swaziland Supergroup occurring in the eastern Transvaal near Barberton, South Africa (Pflug, 1966a; Schopf & Barghoorn, 1967). The records of microorganisms from the Fig-tree group is extremely rare. Only bacterium-like rods and alga-like spheroids have been recorded.

From the Middle Pre-Cambrian sediments microfossils have been reported from the Witwatesrand Supergroup of South Africa (Pflug, *et al.* , 1969), the Transvaal Supergroup of South Africa (Cloud & Licari, 1968) the Vallen Group of Greenland (Bondensen *et al.*, 1967), the Middle (Laberge, 1967) and Lower Belchar Group of Hudson Bay (Hofmann & Jackson, 1969) and the Gunflint Iron Formation of Southern Canada (Barghoorn & Tyler, 1965; Cloud, 1965). Of these occurrences, the most significant in terms of biological diversity and fidelity of preservations are the micro-biota of the Gunflint Iron Formation and the Lower Belchar Group of the Canadian Shield.

Twelve species of microscopic plants have been identified in the Gunflint Iron Formation. The Gunflint assemblage is composed predominately of procaryotic microorganisms including representatives of several extinct cyanophycean families, (Chrococcaceae, Oscillatoriaceae, Nostocaceae) and a variety of Chemosynthetic bacteria. The elements from the Gunflint Formation, viz., *Gunflintia*, *Entosphaeroides* and *Kakabekia* are recorded in the assemblage of the Bushimay, but the Bushimay assemblage is highly diversified. The micro-biota of Bushimay, Kanshi and of the Lower Belchar Group described by Hofmann and Jackson (1969) has only one common form, i.e. *Eomycetopsis*. Except this the other elements recorded in Lower Belchar Group are different. Moreover, the assemblage of lower Belchar Group is poor in records.

In recent years a rich micro-biota has been described from the Late Pre-Cambrian, Bitter Spring Formation of Australia by Schopf (1958) and Schopf and Blacic (1971), which shows a dominance of filamentous and coccoid blue-green algae. The micro-biota of Bushimay agrees with that of Bitter Spring by the presence of *Sphaerophycus*, *Palaeoanacystis*, *Myxococcoides*, *Siphonophycus*, *Glenobotrydion* and the fungi *Eomycetopsis*. But the septate filamentous algal forms viz., *Oscillatoriopsis*, *Palaeolyngbya*, *Calyptothrix*, *Cephalophytarion*, *Cyanonema* and other filamentous forms like *Archaeonema* and *Tenuofolium* are absent in the Bushimay. Moreover, the Bushimay micro-biota has acritarchs which are totally absent in the Bitter Spring Formation.

Rich assemblages of micro-biota containing the remains of acritarchs have been reported from the Late Pre-Cambrian and Cambrian of the USSR by Naumova (1960) and Timofeev (1959). Several of the acritarcha, viz., *Protoleiosphaeridium*, *Vavosphaeridium*, *Symplassosphaeridium*, *Trematosphaeridium*, *Lophosphaeridium*, *Orygmatosphaeridium*, *Zonosphaeridium*, *Kildinella*, *Nucellosphaeridium and Baltisphaeridium* are known in the Bushimay assemblage. But several other acritarchs both smooth and spinate forms recorded from the Cambrian of the USSR are absent. Moreover, in the USSR assemblages the remains of filamentous and colonial algae and fungi are unknown. Similarly, the flora known from the Vindhyans of India (Maithy, 1968; Salujha, 1973; Salujha *et al.*, 1971) resembles that of the Bushimay by the presence of acritarch remains, but differs by the absence of algal and fungal remains.

The micro-biota of the Bushimay on the basis of the above discussion compares closely to the Late Pre-Cambrian flora of the Bitter-Spring Formation of Australia by the presence of algal and fungal remains and to the lower part of Upper Riphean assemblage of USSR on the basis of acritarchs. Therefore, a Late Pre-Cambrian age can be assigned to the Bushimay Supergroup on the basis of microbiota. This is in keeping with what is known of the age of this supergroup.

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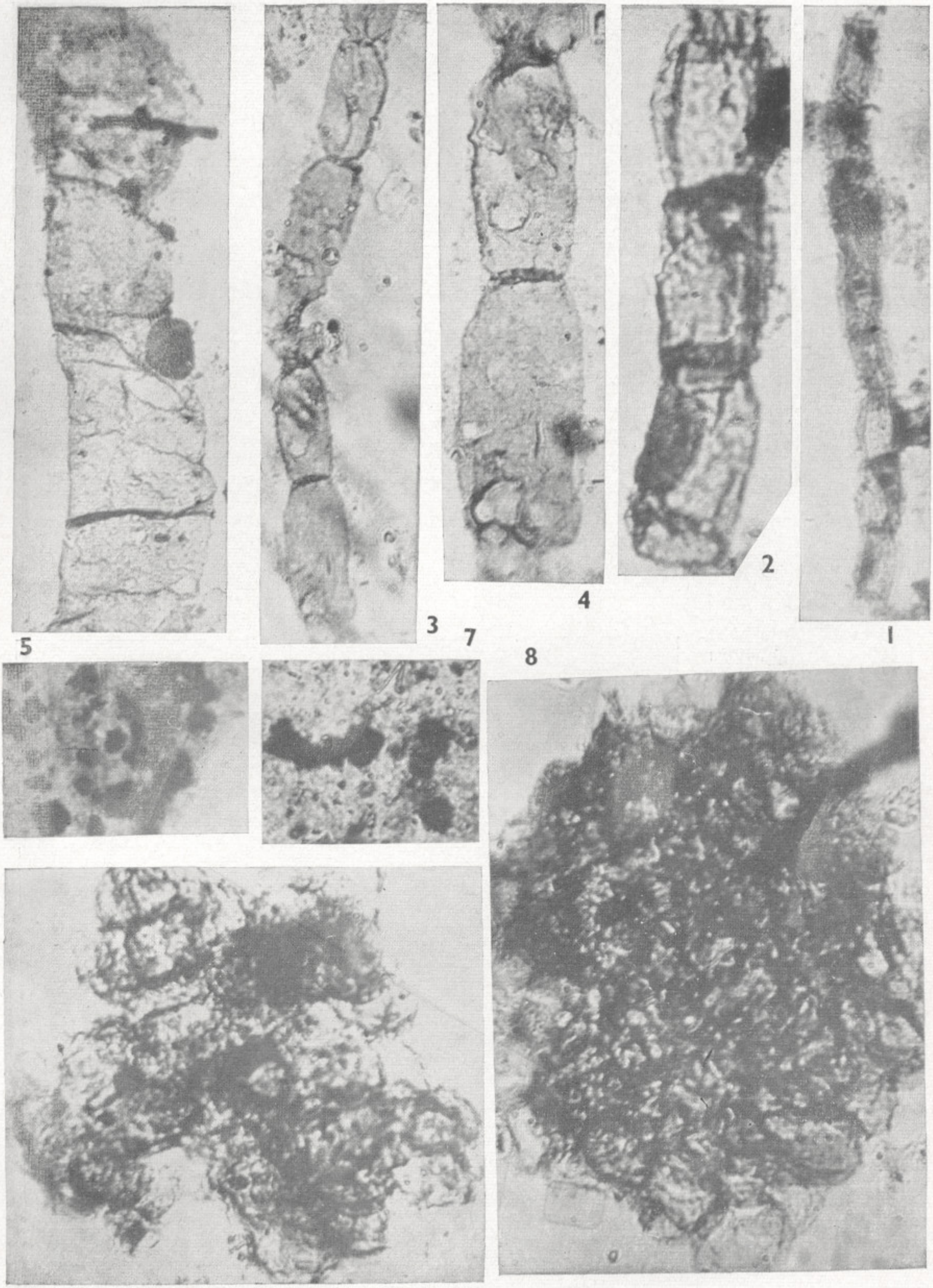
EXPLANATION OF PLATES

Plate 1

1. *Gunflintia magna* sp. nov., Slide no. 32.440/3/18, × 500.
2. *Gunflintia magna* sp. nov., Slide no. 32.440/3/18, × 1000.
3. *Gunflintia barghoornii* sp. nov., Slide no. 32.440/2/3, × 500.
4. *Gunflintia barghoornii* sp. nov., Slide no. 32.440/2/3, × 1000.
5. *Siphonophycus punctatus* sp. nov., Slide no. 32.43/2/1, × 500.
6. *Sphaerophycus densus* sp. nov., Slide no. 32.440/3/4, × 1000.
7. *Sphaerophycus densus* sp. nov., Slide no. 32.440/3/10, × 1000.
8. *Palaeoanacystis psilata* sp. nov., Slide no. 32.440/3/15, × 1000.
9. *Myxococcoides verrucosa* sp. nov., Slide no. 32.440/1/2, × 1000.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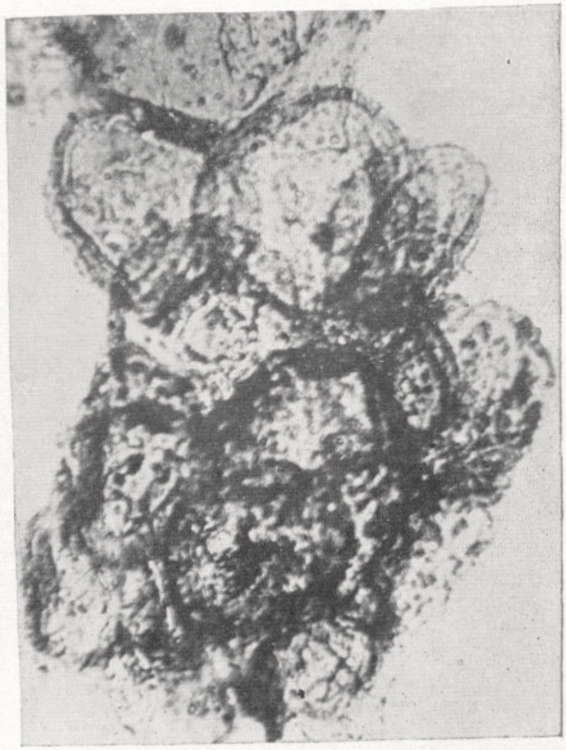

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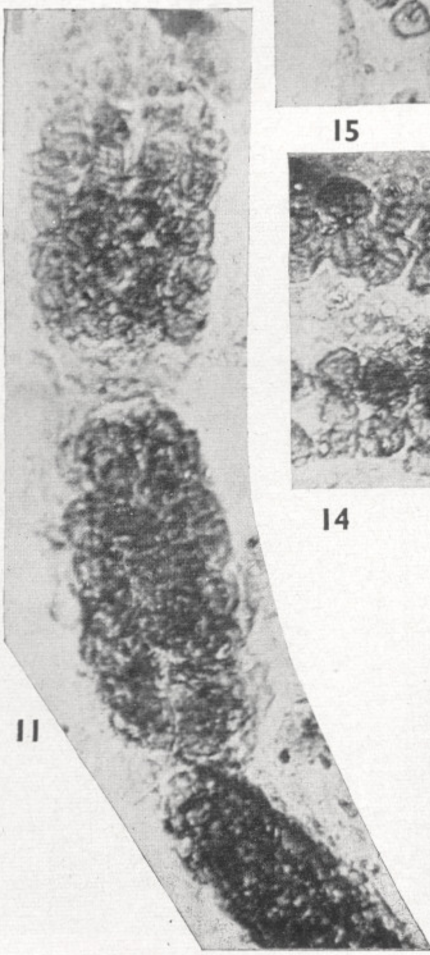

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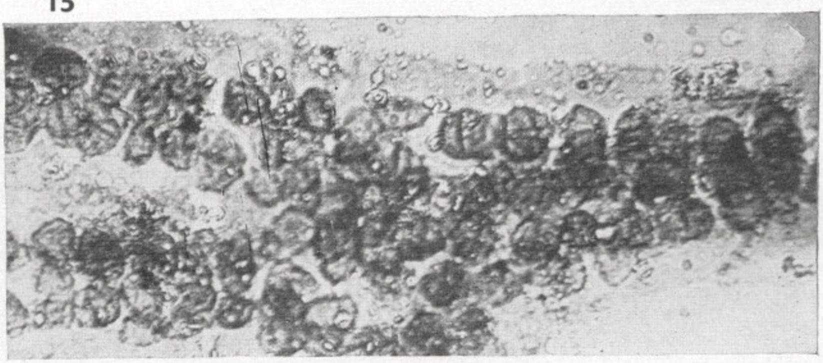

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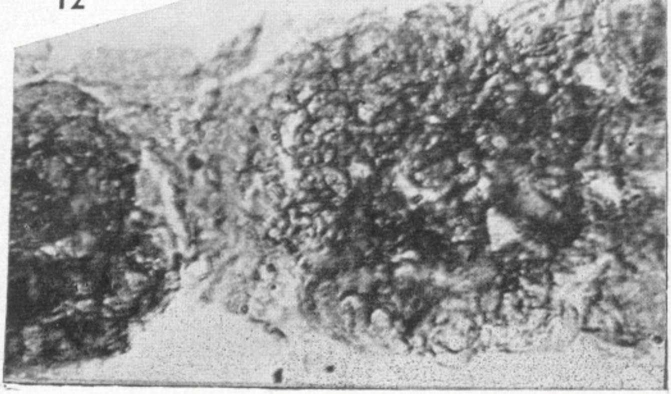

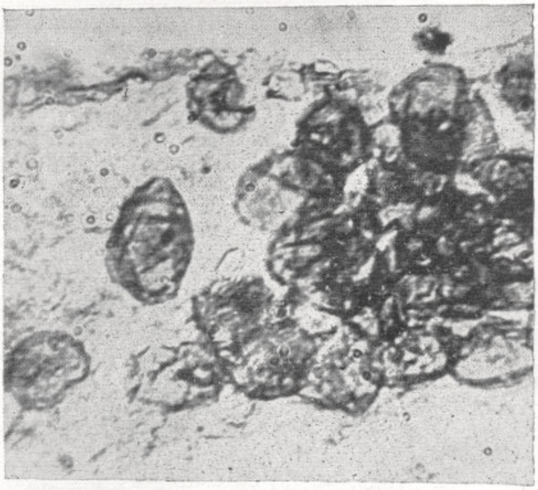

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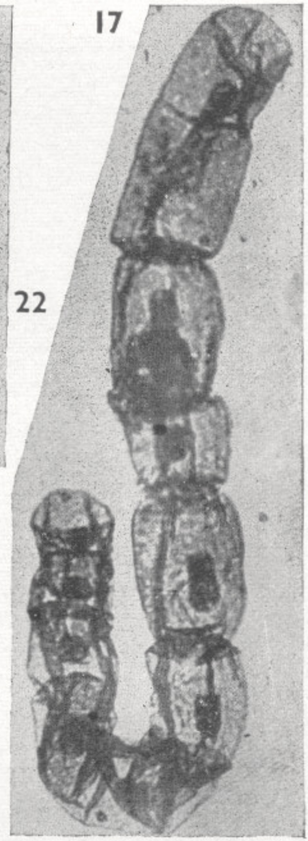

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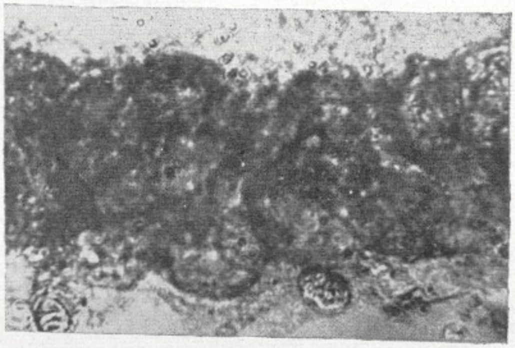

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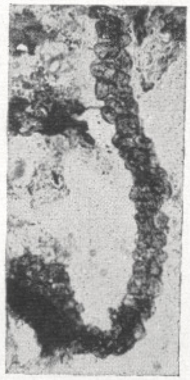

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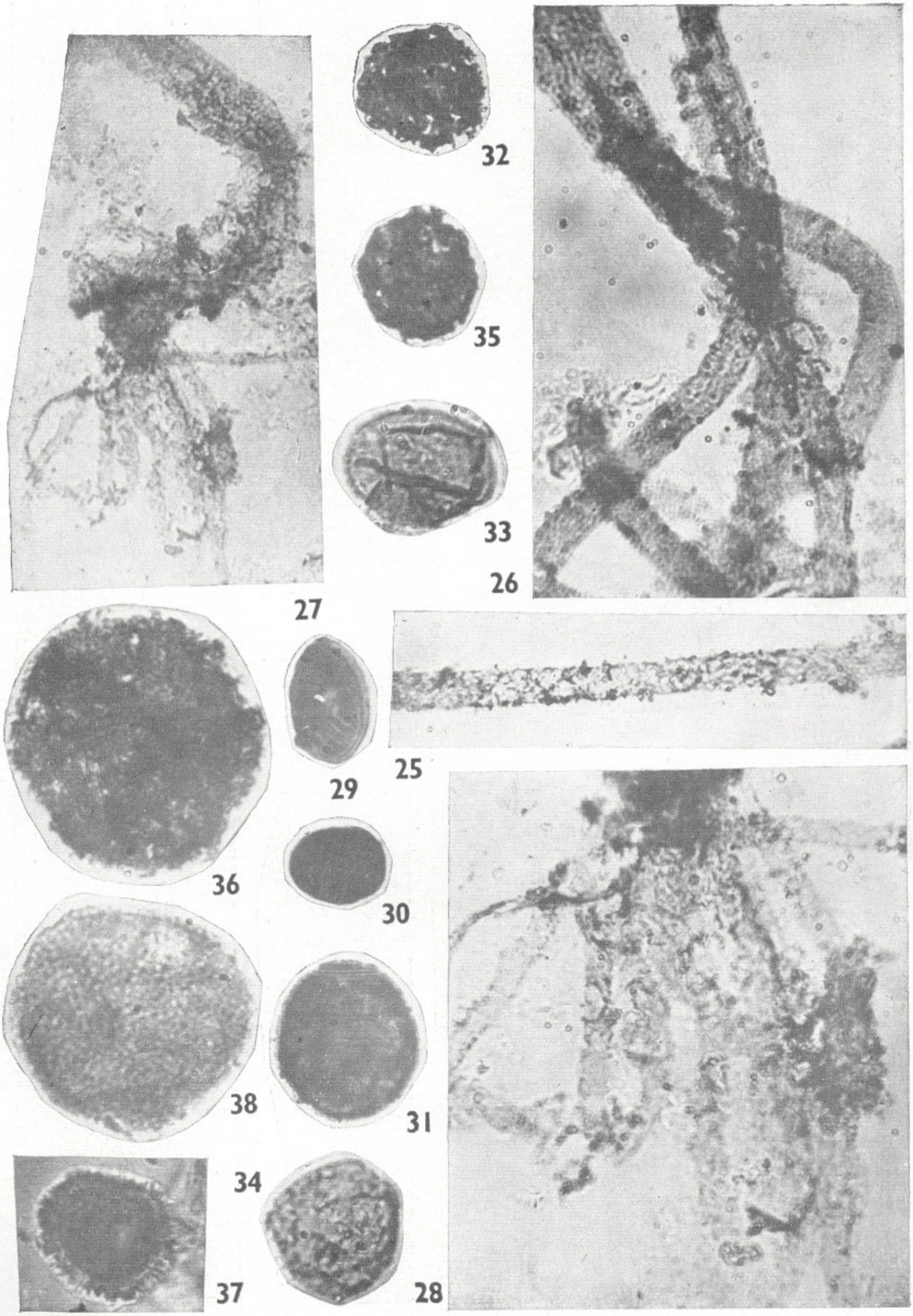
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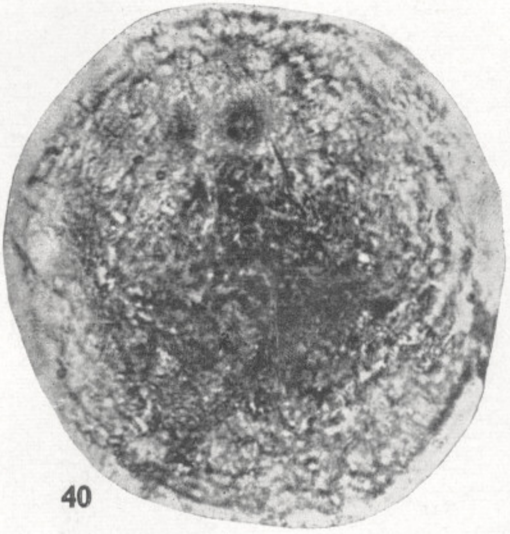

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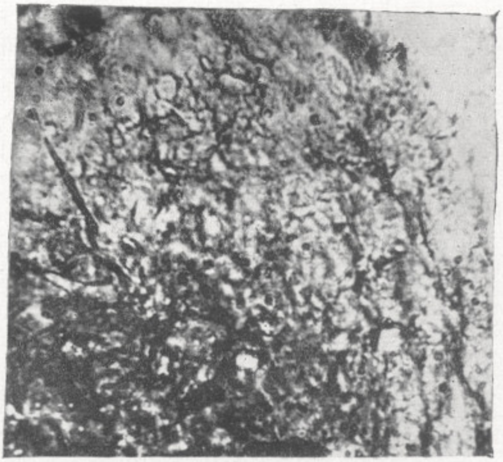

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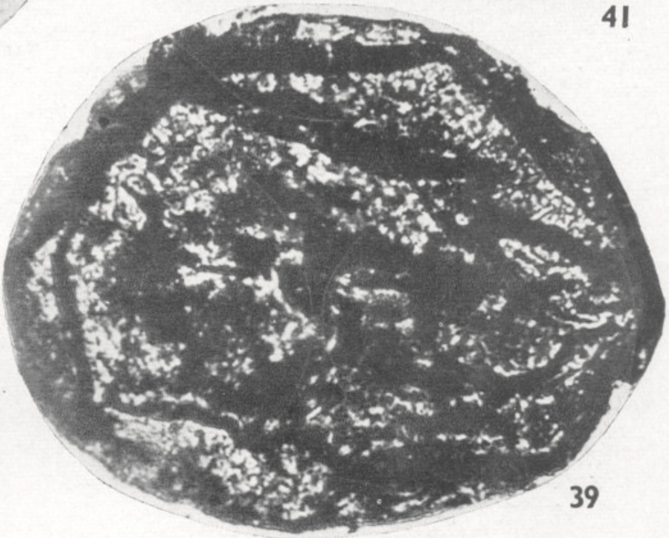

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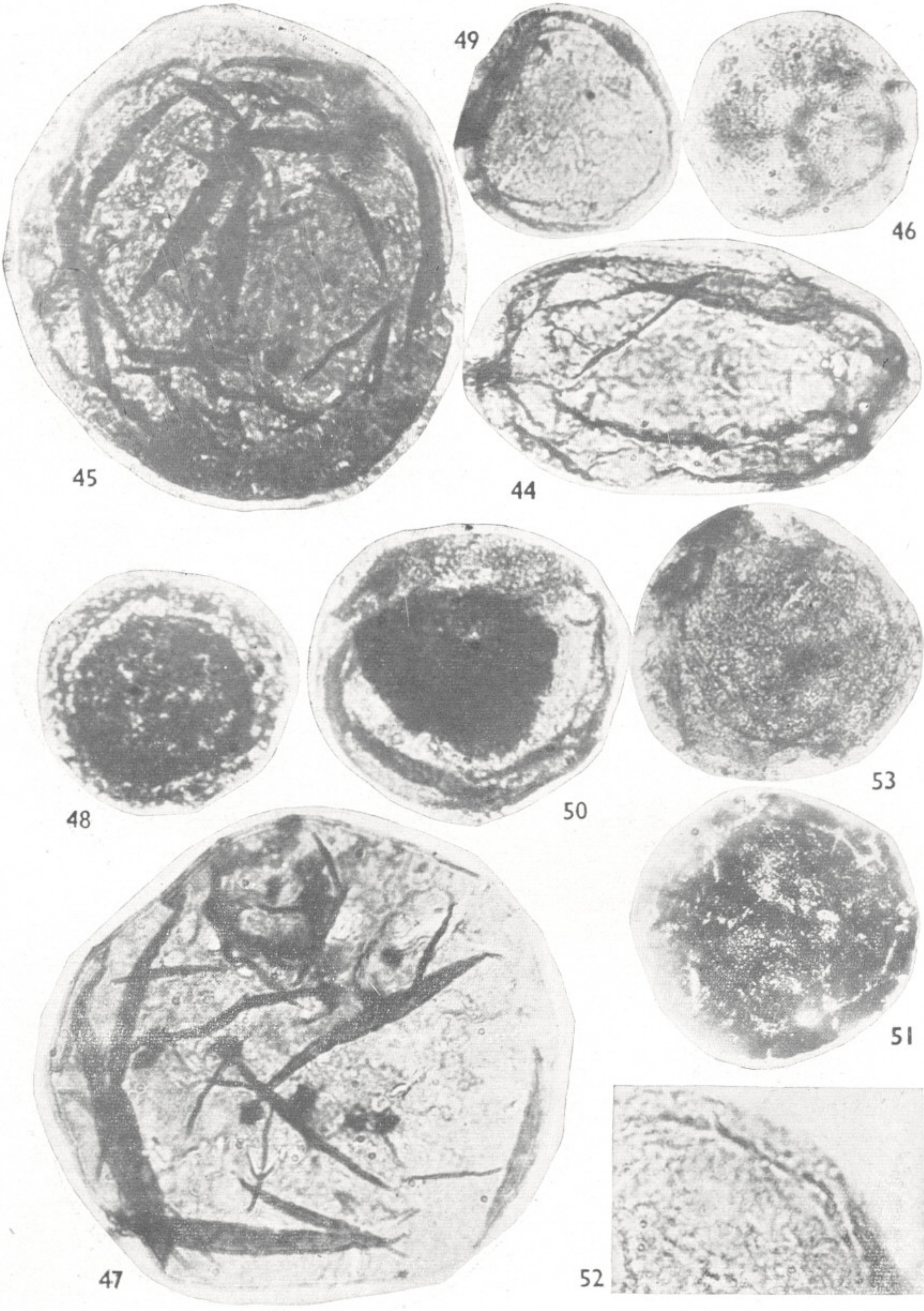
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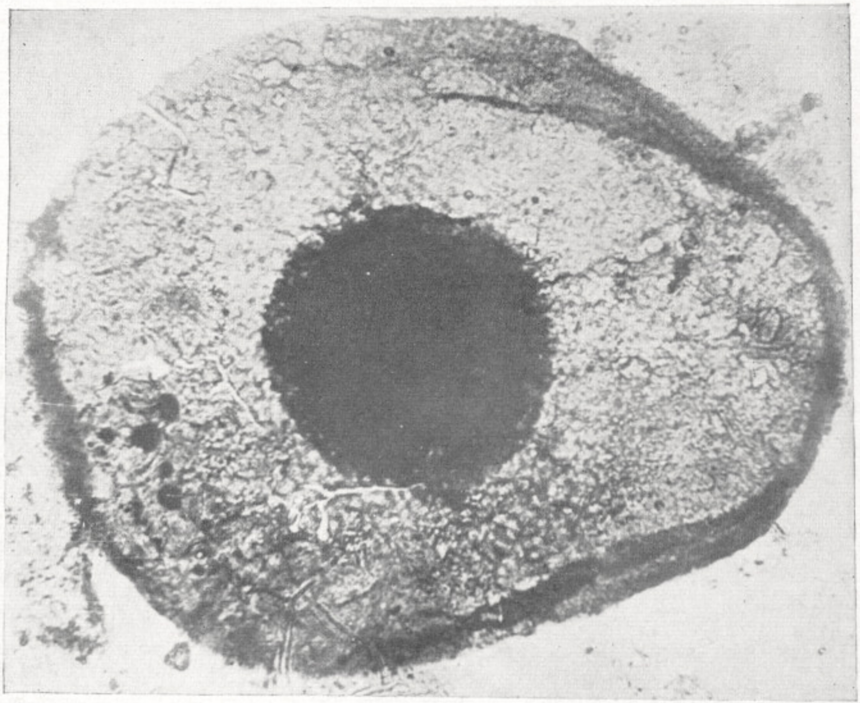

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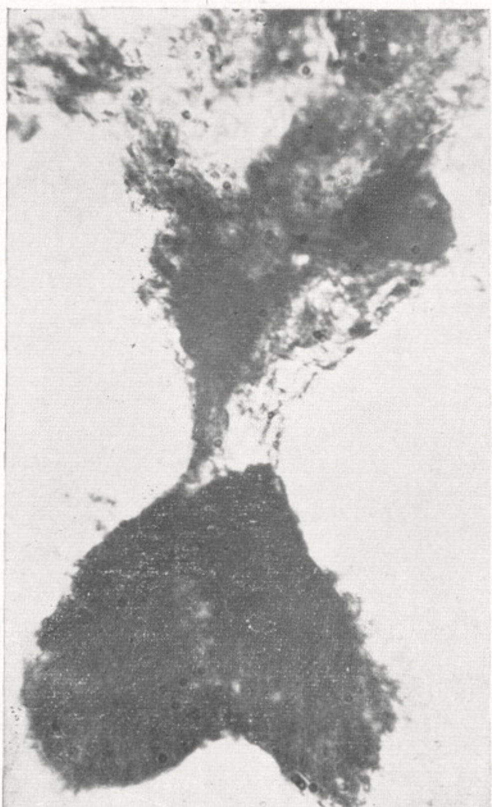

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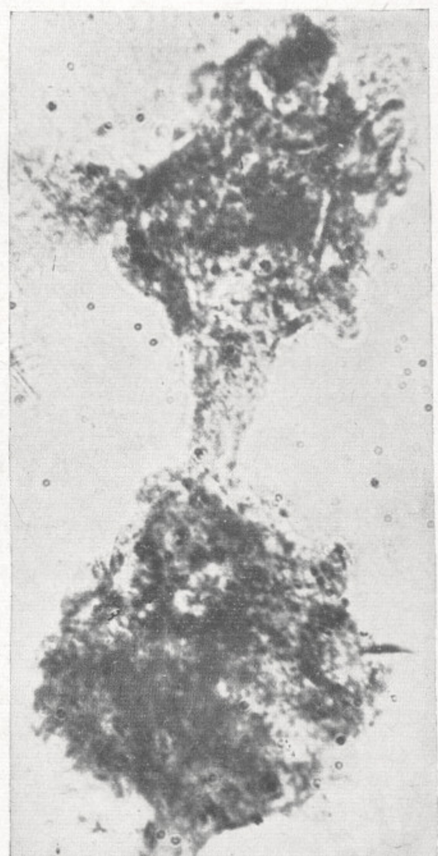

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PLATE 2

10. *Myxococcoides congoensis* sp. nov., Slide no. 32.440/2/4, × 1000.
11. *Palaeomicrocystis schopfii* gen. et sp. nov., Slide no. 32.440/1/7, × 500.
12. *Palaeomicrocystis schopfii* gen. et sp. nov. Slide no. 32.440/1/7, × 1000.
13. *Entosphaeroides bilinearis* sp. nov., Slide no. 32.440/1/11, × 200.
14. *Entosphaeroides bilinearis* sp. nov., Slide no. 32.440/1/11, × 500.
15. *Entosphaeroides irregularis* sp. nov., Slide no. 32,440/2/10, × 500.

PLATE 3

16. *Entosphaeroides irregularis* sp. nov., Slide no. 32.440/2/10, × 1000.
17. *Glenobotrydion tetragonalum* sp. nov., Slide no. 32.440/2/5, × 500.
18. *Glenobotrydion tetragonalum* sp. nov., Slide no. 32.440/2/5, × 1000.
19. *Glenobotrydion kanshiensis* sp. nov., Slide no. 32.440/3/10, × 500.
20. *Glenobotrydion kanshiensis* sp. nov., Slide no. 32.440/3/10, × 1000.
21. *Cholorogloeaopsis congoensis* gen. et sp. nov., Slide no. 32.440/2/11, × 200.
22. *Cholorogloeaopsis congoensis* gen. et sp. nov., Slide no. 32.440/2/11, × 500.
23. *Cholorogloeaopsis congoensis* gen. et sp. nov., Slide no. 32.440/2/11, × 1000.
24. *Eomycetopsis septata* sp. nov., Slide no. 32.440/1/10, × 1000.

PLATE 4

25. *Eomycetopsis rugosa* sp. nov., Slide no. 32.422/2, × 1000.
26. *Eomycetopsis rugosa* sp. nov., Slide no. 32.422/3, × 1000.
27. *Eomycetopsis cylindrica* sp. nov., Slide no. 32.440/3/7, × 500.
28. *Eomycetopsis cylindrica* sp. nov., Slide no. 32.440/3/7, × 1000.
29. *Protoleiosphaeridium densum* sp. nov., Slide no. 32.440/2/9, × 1000.
30. *Protoleiosphaeridium densum* sp. nov., Slide no. 32.453/2/4, × 1000.
31. *Protoleiosphaeridium laevigatum* sp. nov., Slide no. 32.440/1/5, × 1000.
32. *Symplassosphaeridium bushimayensis* sp. nov., Slide no. 32.440/2/44, × 1000.
33. *Trematosphaeridium zaireinsis* sp. nov., Slide no. 32.440/2/9, × 1000.
34. *Granomarginata minuta* sp. nov., Slide no. 32.440/2/10, × 1000.
35. *Vavosphaeridium bharadwajii* Salujha et al. Slide no. 32.440/3/2, × 100.
36. *Vavosphaeridium densum* sp. nov., Slide no. 32.440/3/21, × 500.
37. *Baltisphaeridium* sp. Slide no. 32.440/1/4, × 1000.
38. *Lophosphaeridium granulatum* sp. nov., Slide no. 32.440/3, × 500.

PLATE 5

39. *Vavosphaeridium densum* sp. nov., Slide no. 32.422/4, × 1000.
40. *Archaeofavosina naumovae* sp. nov., Slide no. 32.440/2/12, × 1000.
41. *Archaeofavosina sinuta* sp. nov., Slide no. 32.440/1/1, × 1000.
42. *Archaeofavosina sinuta* sp. nov., Slide no. 32.440/1/1, × 500.
43. *Leiofusa actinomorpha* sp. nov., Slide no. 32.440/3/19, × 1000.

PLATE 6

44. *Leiosphaeridia kanshiensis* sp. nov , Slide no. 32 440/3/12, × 1000.
45. *Orygmatosphaeridium vulgarum* sp. nov., Slide no. 32.440/2/1, × 1000.
46. *Orygmatosphaeridium trizonatum* sp. nov., Slide no. 32.440/3/20, × 500.
47. *Kildinella timofeevii* sp. nov., Slide no. 32.440/3/5, × 1000.
48. *Nucellosphaeridium zonatum* sp. nov., Slide no. 32.440/2/2, × 500.
49. *Zonosphaeridium foveolatum* sp. nov., Slide no. 32.440/2/6, × 500.
50. *Nucellosphaeridium triangulatum* sp. nov., Slide no. 32.440/3/9, × 500.
51. *Zonosphaeridium densum* sp. nov., Slide no. 32.440/3/13, × 500.
52. *Zonosphaeridium foveolatum* sp. nov., Slide no. 32.440/2/6, × 1000.
53. *Tasmanites* sp., Slide no. 32.440/1/9, × 200.

PLATE 7

54. *Nucellosphaeridium triangulatum* sp. nov., Slide no. 32.440/3/9, × 1000.
55. *Nucellosphaeridium magnum* sp. nov., Slide no. 32.440/2/7, × 1000.
56. *Orygmatosphaeridium vulgarum* sp. nov. Slide no. 32.440/2/1, ×1000.
57. *Kakabekia flabelliformis* sp. nov., Slide no. 32.440/3/14, × 1000.
58. *Kakabekia rarea* sp. nov., Slide no. 32.422/4, × 1000.
59. Unbranched filament, Slide no. 32.453/2/3, × 1000.