MICROBIOTA AND CATAGRAPHS FROM THE VARIKUNTA AREA OF CUDDAPAH SUPERGROUP

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ABSTRACT

Cryptarchs namely *Granomarginata*, *Lophosphaeridium* and *Protoleiosphaeridium* belonging to Sphaeromorphitae and catagraphs — *Vesicularites* and *Conferta* — are recorded from the subsurface samples of the Cuddapah Supergroup. The catagraphs are supposed to be formed by the exobiogenic activities of Cyanophyceae and bacteria. No comment on the age could be made on the basis of poor occurrence of biota, as they show wide geological distribution from Late Proterozoic to Devonian.

Key-words — Cryptarchs, Catagraphs, Cuddapah Supergroup, Proterozoic, Devonian, India.

सारांश

कडापाह महासमूह के वेरिकुन्त क्षेत्र से सूक्ष्मजीविता एवं कैटाग्राफ़ – जगन्नाथ प्रसाद मंडल, प्रभात कुमार माइती एवं ऍस० ऍच० मेहदी

कडापाह महासमूह के उपस्तरी नमूनों से स्फ़ेयरोमोर्फिटी से सम्बद्ध क्रिप्टार्क – ग्रेनोमार्जिनेटा, लोफ़ोस्फ़ेयरीडियम् – तथा कैटाग्राफ़ – वैसिकुलाराइटिस एवं कॉनफर्टा, अभिलिखित किये गये हैं। कैटाग्राफ़ अनुमानत : स्यैनोफ़ाइसी एवं जीवाणुओं की बाह्य-जीवजनित क्रियाशीलता के फलस्वरूप बने हैं। जीविता की कम प्राप्ति के आधार पर इस समुच्चय की आयु पर कोई टिप्पणी नहीं की जा सकी क्योंकि जीविता अन्तिम प्राग्जीवी से लेकर डिवोनी युग तक व्यापक वितरण प्रदर्शित करती है।

INTRODUCTION

ORGANOSEDIMENTARY structures and palynomorphs were previously known from the Cuddapah Supergroup. Rao in 1943 first reported the algal structures from the Lower Cuddapah near Royalcheruvu. These structures appeared to be oolitic, but the author confirmed their biogenecity after critical examination. He opined them to be resembling to a cross section of a thallus of Dasycladaceae. In 1944, he reported the organic structure similar to *Cryptozoon*. Further in 1949, he recorded algae in the thin sections of rocks. They were described as: (i) encrusting type, (ii) annular type, (iii) filamentous type, and (iv) branching type together with *Cryptozoon*-like structure. The structures reported by Rao (1943) as cross section of the thallus of Dasycladaceae have been postulated to be similar to Archaeocyatha by Balakrishnan (1974) and Maithy and Gupta (1981). However, from the photograph published by Rao (1943, fig. 1) appears to be a Catagraphia particularly *Vesicularites* type.

Sahni and Srivastava (1962) claimed the recovery of monolete and trilete spores from the Jonk River Section of Cuddapah Supergroup, Madhya Pradesh. These spores in all probability seem to be contaminants because such evolved forms are not expected in this older rock. Schopf and Prasad (1978) reported an assemblage comprising single cells, filaments and

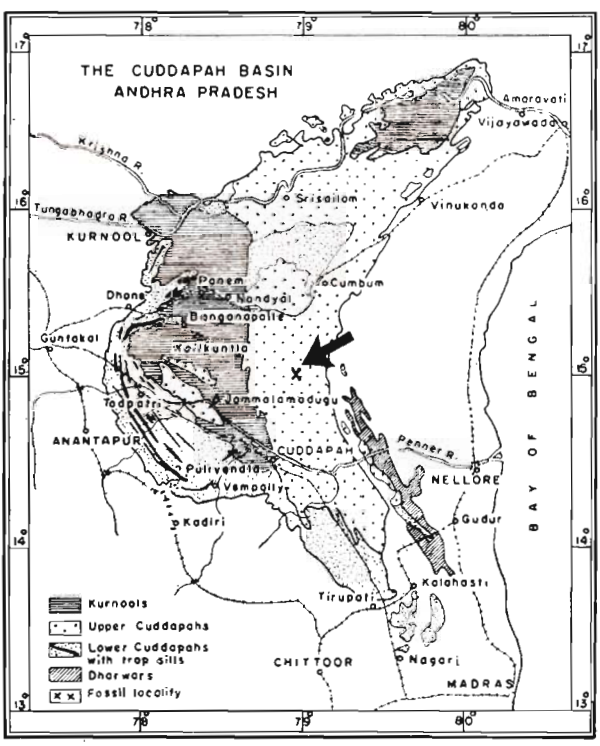
other micro-organisms. All were found in *Collenia*-like stromatolites from the Vemapalle Formation (Papaghni Group) of South-Central India. The unique finding in this report was the presence of large single cells above 20 μm which according to authors may be eukaryotic.

The present paper deals with the organosedimentary structures, cryptarchs and few curious microfossils recovered in the drill core samples from Varikunta area, Nallamalai Group, Cuddapah Supergroup.

GEOLOGY

The Cuddapah Supergroup is deposited in various parts of the peninsular India and rests over the Dharwar sediments. The reasons for the development of the ensialic, shallow water Cuddapah Basin are not understood. It is possible that the deposition of the sediments by erosion of existing uplifted areas resulted in the formation of basin (Naqvi *et al.*, 1978). The rocks of Cuddapah have been subjected to intense folding and metamorphism. The Cuddapah Basin forms a crescent-shaped compact area occupying about 35,000 sq km. The vast pile of sediments is exposed in two major groups — one in Andhra Pradesh and the other in Orissa and Madhya Pradesh. The Cuddapah Supergroup is subdivided into four groups, viz., (i) Papaghni, (ii) Cheyair, (iii) Nallamalai, and (iv) Kistna in ascending order. All the groups are well demarcated from each other by unconformity.

The Varikunta area is situated towards the northern end of the Zangamrajupalle-Varikunta mineralized belt about 5 km north-west of Varikunta (15°03′: 78°52′, 57 1/16) (Text-fig. 1), Cuddapah District, Andhra Pradesh. The Dolomite Member of the local Varikunta Formation constitutes the host rocks for Zn-Pb-Cu mineralization.



TEXT-FIG. 1 — Map of Cuddapah basin in which the arrow indicates the 'drilling site'.

The formation exposed throughout the belt is considered by previous workers, belonging to the Cumbum Formation (Nallamalai Group) of the Cuddapah Supergroup. A variety of shales associated with two main horizons of dolomite or dolomitic rocks are also present in this formation. A detailed study of drill core of the dolomite member helps in distinguishing four main lithologies or subfacies of the dolomite. The distribution pattern of individual subfacies within the main carbonate facies and the variation in the thickness of submembers give rise to a possibility that the dolomite belongs to a reef complex. The lithologies seem to be controlled by certain features of contiguation of the basin floor. Such variations in the topography of the basin floor within a relatively small area of deposition of mainly chemogenic sediments and generally shallow environments seem to be possible in a lagoonal environment.

The stratigraphic succession of different lithofacies constituting the local members in the Varikunta Formation in ascending order is as follows:

Rock types	Thickness
Banded green-pink shale	40 m
Siliceous dolomite and quartzite	30-40 m
Green banded shale	30-40 m
Carbonaceous shale	20-40 m
Dolomite	30-70 m
Green shale	20-30 m
Pink shale	400 m

MATERIAL

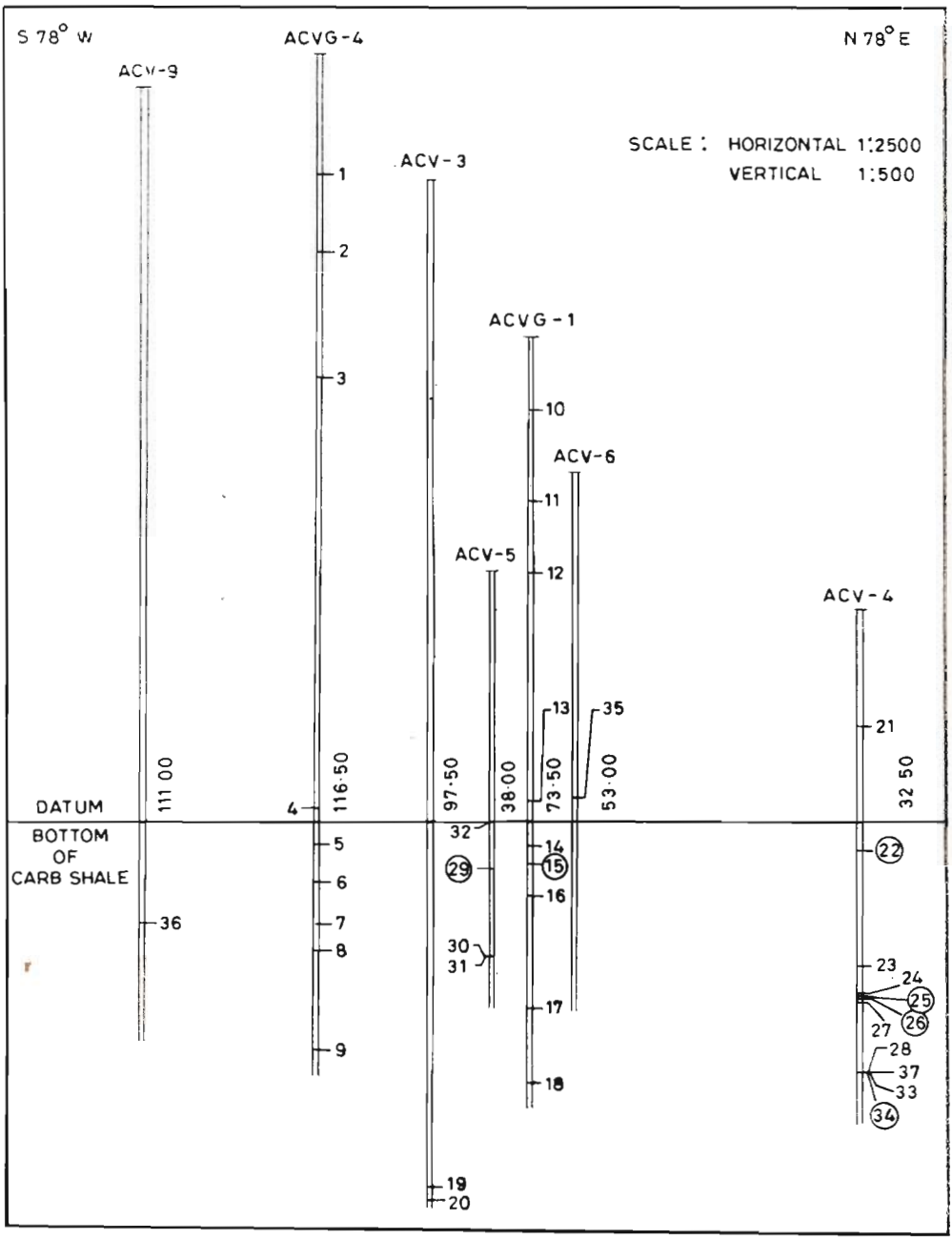
In the present paper 37 samples from seven drill cores have been studied which were supplied by G.S.I. (S. H. Mehdi). The samples consists of chert, dolomite and shale. The position of the samples in the drill cores is shown in Text-fig. 2 and the detail of samples is given in Table 1. Microfossils have been studied both in thin sections and from the acid resistant residues. In all, 85 thin section slides and 60 slides of acid resistant residues were studied. Organic remains were preserved in most of the slides, but only five samples were found to be suitable for the study of biota. Most of the observations have been made from the macerated residues, as the morphology of biota was not clearly visible in thin sections.

TABLE 1

Sample No.	Bore core No.	Depth in meter	Nature of sample
1	ACVG-4	(17.80)	Green banded shale
2	do	(29.90)	Carbonaceous shale
3	do	(49.00)	Carbonaceous shale
4	do	(114.70)	Cherty carbonaceous shale
5	do	(119.70)	Chert
6	do	(125.55)	Dolomite
7	do	(131.95)	Cherty dolomite
8	do	(136.10)	Cherty dolomite
9	do	(151.20)	Green shale
10	ACVG-1	(11.22)	Green banded shale
11	do	(24.75)	Green banded shale
12	do	(35.60)	Carbonaceous shale
13	do	(69.80)	Carbonaceous shale
14	do	(77.02)	Chert
15	do	(79.97)	Dolomite
16	do	(84.65)	Cherty dolomite
17	do	(102.03)	Dolomite
18	do	(113.00)	Green shale
19	ACG-3	(153.20)	Cherty dolomite
20	do	(154.80)	Cherty dolomite
21	ACV-4	(18.00)	Carbonaceous shale
22	do	(36.50)	Cherty dolomite
23	do	(54.25)	Cherty dolomite
24	do	(58.60)	Cherty dolomite
25	do	(59.20)	Cherty dolomite
26	do	(59.20)	Cherty dolomite
27	do	(59.50)	Cherty dolomite
28	do	(70.50)	Cherty dolomite
29	ACV-5	(44.80)	Chert
30	do	(58.30)	Chert
31	do	(58.30)	Chert
32	do	(38.10)	Carbonaceous chert
33	ACV-4	(70.70)	Cherty dolomite
34	do	(70.80)	Cherty dolomite
35	ACV-6	(49.10)	Carbonaceous shale
36	ACV-9	(126.50)	Cherty dolomite
37	ACV-4	(70.50)	Cherty dolomite

DESCRIPTION

Recently, Diver and Peat (1979) have introduced a new group 'Cryptarch', partly parallel to 'Acritarch' of Evitt (1963) and transferred all the 'Sphaeromorphitae' of Downie, Evitt and Sarjeant (1963) to accommodate simple and organic walled microfossils of uncertain affinities. The two other new subgroups are — 'Synaplomorphitae' and 'Nematomorphitae' within the group Cryptarch which include filaments and the simple colonial or intimately aggre-



TEXT-FIG. 2 — Location of core samples studied for microbiota and organosedimentary structures (number within the circle denote productive sample).

gated forms. Sphaeromorphitae has been emended as spherical or ellipsoidal forms that occur singly or in loose association. No doubt, this new classification helps better in describing the organic walled microfossils of uncertain affinities. In the

present work the classification of Diver and Peat (1979) has been followed.

Group — Cryptarch Diver & Peat, 1979
Subgroup — Sphaeromorphitae (Downie *et al.*) Diver & Peat, 1979

Genus — *Granomarginata* Naumova, 1960

Type Species — *G. prima* Naumova, 1960.

Granomarginata prima Naumova, 1960

Pl. 1, figs 1, 2

Description — Vesicles 5.5 to 10.2 μm (8.5 μm in average), subspherical with occasional folds on the surface; grana more or less uniformly distributed and reduced in number on one surface.

Remarks — The present form is smaller in size than the type specimen and the size of grana is also robust.

Figured Specimen — Slide no. 6608 from macerated residues of sample no. 15.

Genus — *Protoleiosphaeridium* Timofeev ex Timofeev, 1960

Type Species — *P. conglutinatum* Timofeev ex Timofeev, 1960.

Protoleiosphaeridium sp.

Pl. 1, figs 3-6, 14

Description — Vesicles 4.5 to 22 μm in diameter (9.5 μm in average), spherical, exine thin, smooth, sometimes with reticulate structure.

Remarks — This is the most abundant form with wide size range. A statistical approach on 49 vesicles did not indicate any break in the series of size range. The form is morphologically comparable with *Huronispora* Barghoorn (1965). However, *Huronispora* is known from thin section and *Protoleiosphaeridium* is known from the macerated acid resistant preparation.

Figured Specimen — Slide nos. 6606, 6610, 6609, 6602 from macerated residues of sample nos. 22, 25 and 26.

Genus — *Lophosphaeridium* Timofeev, 1959

Type Species — *Lophosphaeridium rarum* Timofeev, 1959.

Lophosphaeridium kurnooleii Salujha, Rehman & Arora, 1972

Pl. 1, fig. 7

Description — Vesicle spherical, dark colour, disc-like 35.5 μm in diameter; exine granulate; grana irregular, often few grana touch each other and form pseudoreticulate structure, grana ±1 μm broad.

Remarks — Morphologically similar to *L. kurnooleii* but bigger in size than the type specimen of *L. kurnooleii*. The form is rare.

Figured Specimen — Slide no. 6603 from macerated residue of sample no. 25.

INCERTAE SEDIS

1. A number of irregular forms have apiculate structures (Pl. 1, figs 9-12) or spines (Pl. 1, fig. 8). These forms are very dark with variable shape and size. The size ranges from 3 to 16 μm (±10 μm common). Surface is covered with apiculi of varying shape and size. Spines are rare, 2.3 μm long and 1 μm in diameter at base.

   Figured Specimens — Slide nos. 6605, 6606 and 6607 from the macerated residues of sample nos. 13 and 26.

2. A few irregular shaped colonies are observed which have been formed by irregularly arranged cells embedded within a gelatinous mass (Pl. 1, fig. 13). Cells are uniform in size, 5 to 7.3 μm in diameter. The number of cells in a colony could not be counted due to overlapping.

   Figured Specimen — Slide no. 6604 from the macerated resudue of sample no. 25.

ORGANOSEDIMENTARY STRUCTURES

The rocks are predominantly made up of sparry calcite, well sorted with stretched, elliptical, ovoid or bean-shaped, subrounded to rounded siliceous, carbonaceous and oolitic structures. The oolite forms are about 2% to 30% of the total volume of the

detrittal clasts. Mostly the typical rounded shape of the structures is not present as it is fragmented, stretched and in few cases shows preferred orientation along bedding due to turbulent current action. The core of the structures is mainly made up of carbonates surrounded by rims of carbonaceous matter and is being later replaced by cryptocrystalline silica which is also occurring as concentric rims. The cryptocrystalline silica (chert) is seen replacing the sparry calcite and carbonaceous matter as matrix-possibly formed during the diagenesis and leaving behind relic minerals. The possibility of the cryptocrystalline chert in the interior part of the structures representing the silica secreted by algae is not ruled out. Such cherty structures are not infrequently impregnated with carbon dust. The same is absent in the overall cherty matrix in which these cherty structures are embedded. This feature also suggests the biogenic origin of such structures. Moreover, petrographic study has revealed that the carbonaceous matter are organic in nature and not opaque ore minerals.

These problematic carbonate structures have been identified as 'Catagraphia', which are regarded as a result of the activity of Cyanophycean algae and bac'eria. The organic nature of the oncolites and catagraphs becomes apparent, if the fossil carbonate nodules are compared with the calcareous concretions and tufa formed by recent algae (Zhuravleva, 1964; Bertrand-Sarfati, 1976). The present form of catagraphs appears similar to *Vesicularites* Reitlinger and *Conferta* Klinger but detail comparison up to form level is not possible due to distortion of rocks.

Catagraphia Maslov, 1953

Vesicularites Reitlinger, 1959

Type Form — *V. flexuosus* Reitlinger, 1959

Vesicularites sp.

Pl. 1, fig. 15

Description — Circular, oval or irregular shaped in cross section; a circular small lumen at centre. Lamellation absent, outer wall thick and dark.

Remarks — Morphologically the present form is comparable with *V. parvus* Zabrodin, 1968 but *V. parvus* is larger in size.

Figured Specimen — Slide no. 6612. In thin section from sample no. 34.

Conferta Klinger, 1968

Type Form — *Conferta rara* Klinger, 1968

Conferta sp.

Pl. 1, fig. 16

Description—Elongated canal-like appearance in cross section; ends mostly tapering and lateral walls straight or bumpy. Lamellation absent, outer wall thick and dark.

Remarks — The present form is comparable with *Conferta rara* but differs due to larger in size.

Figured Specimen — Slide no. 6611. In thin section from sample no. 29.

DISCUSSION

A poor assemblage of biota comprising three genera of cryptarch, namely *Granomarginata*, *Lophosphaeridium* and *Protoleiosphaeridium* belonging to 'Sphaeromorphitae', a few unidentifiable isolated apiculate forms, colonies and organosedimentary structures are recorded. The synsedimentary nature of the recovered microfossils is demonstrable by the facts: (i) colour of microfossils is same as in the surrounding matrix, (ii) acid treatment microfossils are easily separable from rocks and the rock matrix remain stuck to the wall of biota even after maceration (Pflug & Maithy, 1977), and (iii) comparable taxa are known to occur from other places.

The problematic sedimentary structures i.e. catagraphia are simple in nature. They are recorded in almost all the drill core samples at different depths. The position of samples has been shown in Text-fig. 2. Their significance in stratigraphical correlation in different drill cores remains still open.

A number of radiometric age data of the Cuddapah Supergroup rocks are known. A model age of 1400 Ma has been suggested for the Lower Cuddapah sequence by Crawford, 1969; Vingradov *et al.*, 1964; Aswathanarayana, 1962b; Compston, 1973; and Rusell and Slawson, 1962. Schopf and Prasad (1978) have also made remarks on the age of the Cuddapah rocks. Aswathanarayana (1962a) ascertained the model age of Zangamrajupalle (14°45′, 78°51′), Galena by lead isotopic study as 780-840 Ma. The present studied rocks belonging to the Varikunta Formation most likely may have the same age. An attempt to date these rocks on basis of the poorly recorded biota and catagraphs is not feasible. Moreover, the recorded biota shows a wide range of distribution, i.e. from Proterozoic to Devonian. Much stress also cannot be laid upon the records of few forms with apiculate structures or spines. Occurrence of typical acanthomorphs is known from the Cambrian onwards (Downie, 1967). However, the stray occurrence may be due to local basinal factor. Therefore, a critical comment on the age can only be given on the basis of well-preserved biota in near future.

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EXPLANATION OF PLATE

(All the photographs are × 1000 unless otherwise stated. All the slides are preserved at the Museum of Birbal Sahni Institute of Palaeobotany, Lucknow).

1, 2. *Granomarginata prima* in two focuses showing grana and folds. Grana appears to be reduced on one surface as in fig. 2, slide no. 6608, stage reading (Leitz) 46 × 102.5.

3-6, 14. *Protoleiosphaeridium* sp. showing a range of size variation; fig. 3, slide no. 6609, stage reading 54 × 99.5; fig. 4, slide no. 6610, stage reading 42.5 × 111.5; fig. 5, slide no. 6609, stage reading 60.5 × 101; fig. 6, slide no. 6606, stage reading 50 × 105.3; fig. 14 showing grana-like structure on the surface, slide no. 6602, stage reading 53.4 × 102.

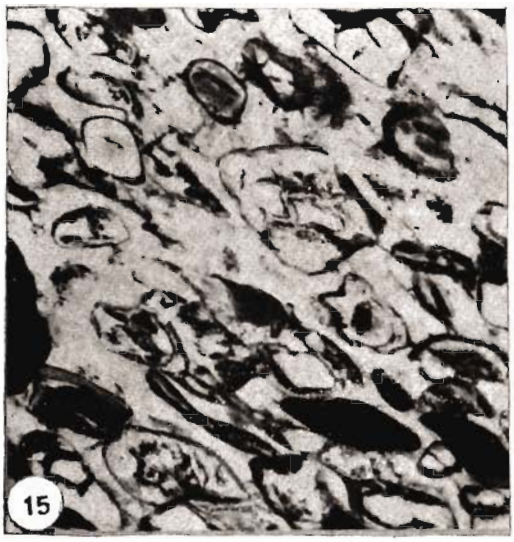
7. *Lophosphaeridium kurnooleii* showing grana on the surface, slide no. 6603, stage reading 36.3 × 98.7.

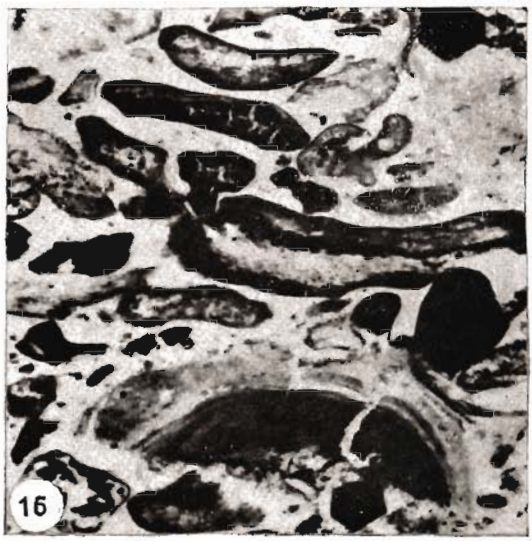
8-12. Showing spinose and apiculate forms and the size variation of the biota, fig. 8, slide no. 6607, stage reading 38.7 × 106; fig. 9, slide no. 6606, stage reading 66.4 × 103.5; fig. 10, slide no. 6605, stage reading 32.8 × 102.7; fig. 11, slide no. 6606, stage reading 35 × 94.9; fig. 12, slide no. 6606, stage reading 30.5 × 96.

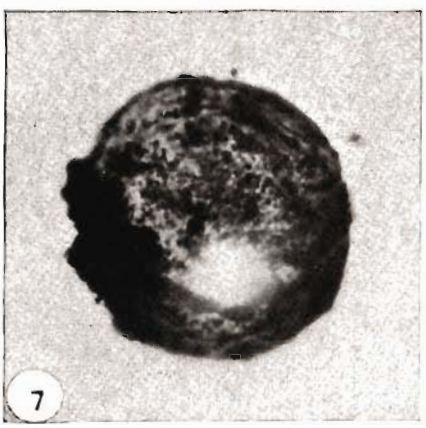
13. A distorted colony of irregularly arranged cells within the gelatinous mass, slide no. 6604, stage reading 38.4 × 114.6.

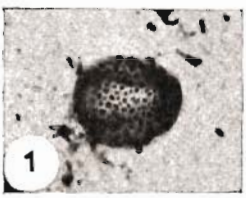
15. *Vesicularites* sp., slide no. 6612. × 14.

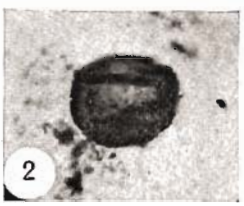
16. *Conferta* sp., slide no. 6611. × 14.

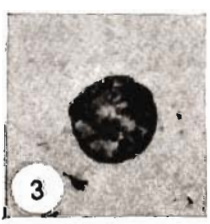


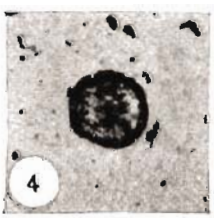


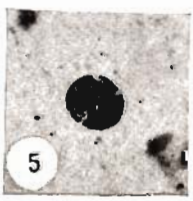


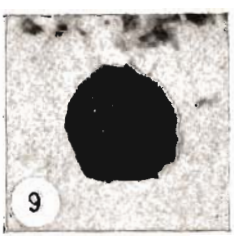












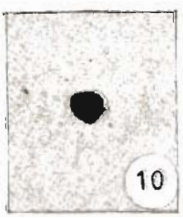


PLATE 1