

## INDIAN PRECAMBRIAN MICROBIOTA FROM BEDDED CHERTS: A REVIEW

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### ABSTRACT

There are nine microbial assemblages described from Indian Precambrian sequences from the petrographic thin sections of black bedded chert. The earliest record is from the Iron Ore Supergroup (age ca. 3100 Ma) and the youngest is from the Trans Aravalli Vindhyaans (ca. 700 Ma). The identification of each form has been reviewed. Out of 31 species reported from the Precambrian cherts from India, only 21 species appear to be valid. These microorganisms belong to both coccoids and filamentous forms.

### INTRODUCTION

There is an extensive development of Precambrian sequences in India which are widely distributed over the Peninsular as well as the Himalayan regions (Fig.1). Generally the Archean rocks show medium to high grade metamorphism with extensive tectonic disturbance, while the Proterozoic sequences show low to medium grade metamorphism, in which the sedimentary nature of rocks is still recognisable. The late Proterozoic rocks are often the best preserved, more or less undisturbed and, have the least effect of metamorphism. Records of life in the form of stromatolites and body fossils from these rocks are many, but often invited skepticism and doubts. In recent years, the occurrence of stromatolitic assemblages have been reviewed by a number of workers (Kumar, 1980, 1984; Maithy, 1980; Raha and Sastri, 1982; Tewari, 1984). However, body fossil reports describing microfossils and megafossils are also many but need critical evaluation. Acritarchs; organic walled microfossils of uncertain taxonomic affinities are the subject of most of these papers. Important papers on acritarchs include Sitholey *et al.*, (1953), Salujha (1971), Salujha *et al.*, (1971), Maithy and Shukla (1977), Viswanathaiah and Venkatachalpathy (1980), Nautiyal (1983), Maithy and Gupta (1983) and Maithy (1984). In all these reports, the maceration method has been adopted for the recovery of fossils in which chances of contamination are more and syngeneity is always a matter of doubt (see Schopf and Prasad, 1978; McMenamin *et al.*, 1983). Thus, unless and until great care is taken to establish microfossil's syngeneity and its biogeneity as a bonafide microfossils, it is very difficult to establish the evolutionary

trends in acritarchs (Cloud and Morrison, 1979). But the microbiota described from the petrographic thin section of bedded cherts has been considered more reliable (see Schopf and Prasad, 1978), as chances of contamination are negligible and the microbiota is preserved three dimensionally. In the light of this, the present paper reviews all the Indian records of microfossils described from the petrographic thin sections of the bedded cherts on the basis of their morpholog-

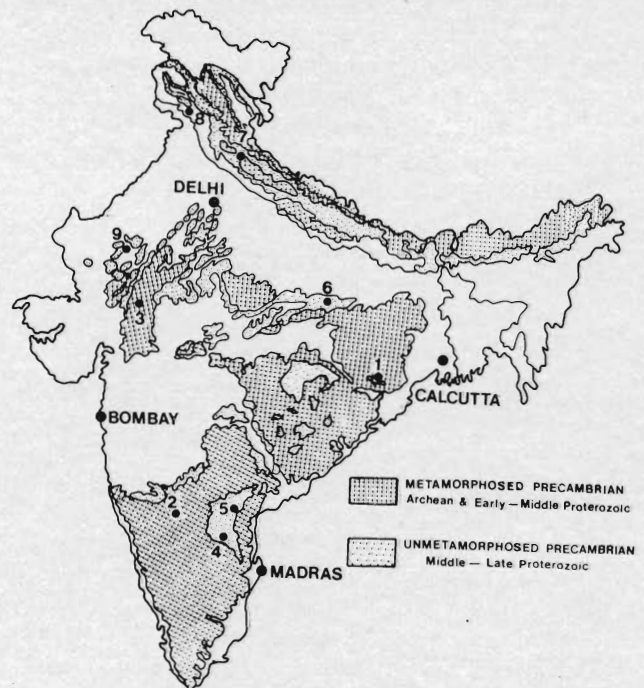


Fig.1. Location map of the different localities from where microbiota has been recorded from the petrographic thin sections of bedded cherts.

ical descriptions, photomicrographs, location of samples in the map and litholog, and repository.

The records of microbiota from the petrographic thin sections of cherts can be subdivided into two:

1. Archean microbial assemblages
2. Proterozoic microbial assemblages

#### ARCHEAN MICROBIAL ASSEMBLAGES

There are only two records of microfossils reported from Archean sequences of India (Fig. 1, locality 1 & 2) and both are from non-stromatolitic cherts of peninsular India.

*Iron Ore Supergroup:* The Iron Ore Supergroup occupies a vast area in Bihar, Madhya Pradesh and Orissa, and constitutes most important iron ore deposits in India. The main lithology is represented by phyllite, tuff, conglomerate, banded hematite, quartzite and mafic igneous rocks. No radiometric age is available for these rocks. However, the Singhbhum Granite which has intruded the Supergroup has been dated as ca.  $2950 \pm 20$  Ma by Rb/Sr method (Sarkar and Saha, 1977). The gneisses which unconformably underlie the Iron Ore Supergroup give a Rb/Sr age of  $3200 \pm 85$  Ma (Sarkar and Saha, 1977). Thus the tentative age of the Iron Ore Supergroup can be taken as ca. 3100 Ma.

Avasthy (1977) first discovered the microbiota from the black cherts of Keonjhar district, Orissa (Fig. 1, locality 1) which was described by Maithy and Avasthy (1982) who reported a filamentous form *Gunflintia* and coccoid forms *Sphaerophycus*, *Aphanocapsiosis* and *Nannococcus*.

Comparison of small spheroids with *Sphaerophycus* appears to be valid.

Forms compared with *Nannococcus* and *Aphanocapsiosis* are differentiated here on the basis of globular and rectangular shape of colony. This aspect is not convincingly depicted in the given photomicrographs. In absence of other morphological characters they may simply be interpreted as coccoid colonies.

The photomicrograph given for the reference specimen of *Gunflintia* shows the linearly arranged elongated small spheroids or cell like units. Arrangement of cells in chain like manner is more likely to be *Eosynechococcus mooreii* than the *Gunflintia* sp.

Thus, the comparison of the small coccoid with *Sphaerophycus* can be accepted but comparison of other forms with *Nannococcus*, *Aphanocapsiosis* and *Gunflintia* appears not to be valid, however organic nature and size range can be accepted.

The diameter of the coccoids ranges between  $2-15 \mu\text{m}$ .

*Sandur Schist Belt:* Below the Banded Iron Formation in Karnataka region, the Sandur Schist Belt consists of metamorphosed rocks which show stromatolites in manganiferous dolomitic limestone (Murthy and Krishna Reddy, 1984). In the Bellary district of Karnataka, a 15-22 cm. thick fossiliferous chert band occurs in the Donimalai Formation within argillaceous schist, underlying the Banded Iron Formation (Fig. 1, locality 2). Direct radiometric data are not available for Sandur rocks but these rocks have been correlated with the other schist belts of the Dharwar craton, whose age has been suggested as 3000 Ma, i.e., the time of its cratonisation (Naqvi and Rogers, 1986).

Naqvi *et al.*, (1987) reported two filamentous forms interpreted as silicified cyanobacteria which they compared to modern *Lyngbya* and *Scytonema*. The width ranges between  $5-10 \mu\text{m}$  and a maximum length of  $250 \mu\text{m}$  is recorded. No coccoid form has been reported from this microbial assemblage. However, Kumar (1988) pointed out that the forms mentioned by Naqvi *et al.* (1987) show very high optical relief with respect to the surrounding silica and thus questioned the silicified cyanobacterial interpretation. Surprisingly Naqvi *et al.* (1987) have reported cells with  $15 \mu\text{m}$  width within a filament of uniform width of  $10 \mu\text{m}$ . Naqvi *et al.* (1988) have tried to justify the siliceous nature of these filaments by using microprobe analysis. According to them the silica varies from 2-96% along the length of the filaments which appears to be ridiculous. It may be pointed out that microprobe analysis is not the appropriate technique to decide the nature of three dimensionally preserved microfossils embedded within 1 30-40  $\mu\text{m}$  thick chert. Since no organic matter has been reported from the slides, there is a possibility that these forms may represent nonbiotic mineralic threads.

#### PROTEROZOIC MICROBIAL ASSEMBLAGES

There are seven units from which the microbiotas have been reported.

*Aravalli Supergroup:* The Aravalli Supergroup occurs in the Aravalli Range in Rajasthan and Madhya Pradesh. It unconformably overlies the Banded Gneiss Complex and is overlain unconformably by the rocks of Delhi Supergroup. On the basis of radiometric dating based on Pb/U, Rb/Sr and Sm/Nd, Naqvi and Rogers (1986) have suggested an age



between 2500-1200 Ma. However, on the basis of stromatolites, Banerjee (1971) suggested Middle to Upper Riphean age (1400-680 Ma.) Thus, there is no general agreement on the age of Aravalli Supergroup and on the basis of available data, it can be assigned an age somewhere between 2500-1500 Ma, as it is overlain by the rocks of Delhi Supergroup which is pre-Vindhyan and the maximum age for Vindhyan is considered to be 1400 Ma (Naqvi & Rogers, 1986). The Aravalli stromatolites need restudy.

Banerjee (1973) first reported only filamentous form *Eomycetopsis robusta* from the middle part of the Matoon Formation of the Aravalli Supergroup, Udaipur district, Rajasthan (Fig. 1, locality 3, Table 1). The width of the form ranges between 20-25  $\mu\text{m}$ . Width of filaments compared with *Eomycetopsis robusta* does not fall within the range given by Schopf (1968). Photomicrograph shows much resemblance to the species *Siphonophycus kestron*. From the same horizon Maithy (1978) reported only coccoid forms and compared them with *Huroniospora microreticulata* with a diameter ranging between 8-12  $\mu\text{m}$ . Reticulate structure in these forms is not very clear, however, comparison upto generic level can be accepted. According to Maithy (1978) different stages of cell division in coccoids with a diameter range of 3-6  $\mu\text{m}$ . have also been noticed, but it is not clearly seen in the photomicrographs.

Table 1. Lithostratigraphic succession of the Aravalli Supergroup, Rajasthan (after Banerjee, 1971)

Delhi Supergroup	
-----Unconformity-----	
Aravalli	Udaipur Formation
Supergroup	Matoon Formation
	Dabri Formation
-----Unconformity-----	
Banded Gneissic Complex/Bhilwara Group	

**Cuddapah Supergroup:** This Supergroup is well developed in south central India especially in Andhra Pradesh. It covers an area of about 42,000 sq. kms. and its thickness varies between 3,000-4,000 meters. The lithostratigraphic sequence of the Cuddapah

Supergroup is given in Table 2. Sr/Sr dating for amygdoloidal basalt in lower part of Cuddapah sequence is given by Crawford and Compston (1973) which gives lower age for the Supergroup as ca. 1583  $\pm$  147 Ma. Silicified microfossils from chert have been recorded from the Vempalle and the Cumbum Formations (Table 2).

**Vempalle Formation:** This is the youngest formation of the Papaghani Group. The upper part of the formation contains black and grey fossiliferous chert in association with stromatolitic and dolomitic limestone. Lavas of this formation yielded the whole rock age for this unit as 1370  $\pm$  60 Ma (Crawford, 1969) on the basis of Rb/Sr method.

Table 2. The lithostratigraphic sequence of Cuddapah Supergroup (Modified by Narayanswami, 1966 after King, 1872).

Thickness in metres	Group	Lithologic Unit
600	Kistna Group	Srisalem Quartzite Kolamnala Slates Irlakonda Quartzite
		-----Unconformity-----
1000	Nallamalai Group	Cumbum Slates Bairenkonda Quartzite
		-----Unconformity-----
3300	Cheyair Group	Tadpatri Shales/Pullampet Slates Pulivendla Quartzite/Nagri Quartzites
1400	Papaghani Group	Vempalle Slates and Limestone Gulcheru Quartzite
		-----Unconformity-----
	Archean	Gneisses and granites

Schopf and Prasad (1978) reported abundant filamentous and coccoid microfossils from a 20 cms thick chert band (Fig. 1, locality 4). The assemblage is made up of spheroidal unicells, tubular sheaths and cellular filaments. However, cells within filaments are not clearly seen in the photomicrograph. No identification was attempted on generic and specific level. Filaments' width is between 2-17  $\mu\text{m}$  and diameter of coccoids ranges between 4-40  $\mu\text{m}$ . Polyhedral organic packets of large size have also been noted and interpreted as mucilaginous sheaths enclosing group of unicells, similar to that found as in modern coccoid cyanobacteria (Schopf and Prasad, 1978).

Cell division in a few forms is also noted, and according to Schopf and Prasad (1978), it may be the first evidence of eukaryotic organisms. In our

opinion, however, the evidence they present is not conclusive.

**Cumbum Formation:** This formation belongs to the Nallamalai Group of the Upper Cuddapah sequence (Table 2). 1400 Ma age has been assigned on the basis of radiometric data obtained from a galena sample collected from a quartz vein cutting across the shales of this formation near Zangamrajupalle (Aswathanarayana, 1962a & b). On the basis of stromatolitic assemblage a Middle Riphean age (1400-950 Ma) has been assigned to this formation (Vaidyanathan, 1961). Gururaja *et al.* (1979) first reported microfossils from the stromatolitic black chert (Fig. 1, locality 5).

Nonseptate filamentous forms which have been compared with *Archaeoestis* with width range 2-6  $\mu\text{m}$ , dominate the microbiota. Specimen comparable to *Archaeoestis* is not clear in photomicrograph, however the reticulate texture is more or less visible. Branching at angle of about  $85^\circ$  is also one of the characteristic feature of this species. Branched ends are supposed to be closed and unbranched portion of the tube remains open, which are not convincingly depicted in the photomicrograph. Coccoid forms similar to *Corymbococcus* are also present, where size ranges between 7-10  $\mu\text{m}$ . Colony of thick walled spheroids enclosed within an encompassing sheath is one of the most distinguishing feature of species *Corymbococcus* which is neither mentioned in description nor seen in photomicrograph. Thus identification is not supposed to be valid. *Eoastrion* is a rare form of this assemblage but the photograph does not show its characteristic features. Thus identification on a generic or specific level is not at all convincing.

**Vindhyan Supergroup:** The Vindhyan Supergroup shows a wide geographical distribution in Central India, in part of eastern Rajasthan, Haryana, Madhya Pradesh, Uttar Pradesh and Bihar. It covers an area of about 104,000 sq. kms. in Central India and has a thickness of about 4,000 meters. Rocks of this supergroup are mainly unmetamorphosed and show well preserved sedimentary structures. On the basis of its stromatolitic assemblage, the age of Vindhyan Supergroup is suggested as lower to upper Riphean (Kumar, 1976a, & b, 1980; Rao *et al.* 1977). The lithostratigraphic succession of the Vindhyan Supergroup is given in Table 3.

**Kheinjua Formation (Lower Vindhyan), Semri Group:** In the Son Valley area of Mirzapur district, Uttar Pradesh, the Fawn Limestone member of the Kheinjua Formation (Table 3) is ca. 30 meters thick

Table 3. Lithostratigraphic subdivision of the Vindhyan Supergroup (modified after Auden, 1933).

Supergroup	Group	Formation	Member
V		Bhander	
I		Formation	
N	Upper	Rewa	
D	Vindhyan	Formation	
H		Kaimur	
Y		Formation	
A			
N			
----- Unconformity -----			
		Rohtas	
		Formation	Limestone & Shales
S			
U			
P		Kheinjua	Glauconitic Sandstone
E		Formation	Fawn Limestone
R	Semri		Olive Shales
G	Group	Porcellanite	
R		Formation	Porcellanites
O	(Lower		
U	Vindhyan)		
P		Basal	Kajrahat Limestone
		Formation	Basal Conglomerate
----- Unconformity -----			
		Bijawar	Schists & Phyllites
		Group	

carbonate horizon, represented by fawn to greyish black dolomitic and siliceous limestone with white to black bedded chert. K/Ar dating of the Glauconitic Sandstone which conformably overlies the Fawn Limestone has given  $1080 \pm 40$  Ma. age (Kreuzer *et al.* 1977). On the basis of stromatolites, age is estimated as Middle Riphean (1100 Ma) (Kumar, 1976).

Kumar (1978a) first reported the microbiota from the Fawn Limestone (Fig. 1, locality 6) which was subsequently described by McMenamin *et al.* (1983) in detail. Species identified and described from the Kheinjua Formation comprising both filamentous and coccoid forms named: *Myxococcoides minor*, *Eosynechococcus isolatus*, *Tetraphycus congregatus*, *Eoentophysalis belcherensis*, *Eoentophysalis magna*, *Melasmatosphaera media*, cf. *Gunflintia minuta*, *Eomycetopsis ? siberiensis*, *Cephalophytarion*, *Siphonophycus*, *Sphaerophycus*, *Globophycus* (?), *Kheinjua-sphaera vulgaris* and *Glenobotrydion aenigmatis* have been reported. Size of coccoid forms vary in diameter from 2.6-33.6  $\mu\text{m}$ , and width of the filaments ranges between 0.57-7.50  $\mu\text{m}$ . Kumar



(1978) has mentioned the occurrence of *Cephalophytarion*, *Sphaerophycus* and *Globophycus*, but in absence of detailed description these forms are considered as invalid. Average size of the microbiota from the Kheinjua Formation slightly deviates from the tendency noted by Schopf (1977). These forms show comparatively narrow size range and indicate an age somewhat younger than 1400 Ma when compared with the Table given by Schopf (1977).

*Trans Aravalli Vindhyan*: In the west of Aravalli Mountain chain, a thick sedimentary sequence known as the Trans-Aravalli Vindhyan covers an area of about 50,000 sq. km. in Rajasthan. The age of this group is suggested to be younger than  $745 \pm 10$  Ma, which is based on radiometric data given by Crawford and Compston (1970) for the Malani Rhyolite over which the Trans-Aravalli Vindhyan have been unconformably deposited. Tentatively it can be assigned ca. 700 Ma age. The stratigraphic succession is given in Table 4.

Table 4. Stratigraphic succession of Trans-Aravalli Vindhyan (after Khan, 1971).

Nagaur Group	
Bilara Group	Pondlo Formation Gotan Formation Dhanapa Formation
Jodhpur Group	
----- Unconformity -----	
Malani Rhyolite	

Maithy (1984) described microbiota from the stromatolitic chert of the Dhanapa Formation (Bilara Group) in which only three coccoid species have been compared with *Nannococcus vulgaris*, *Huroniospora psilata* and *Kakabekia umbellata*, but subsequently Maithy (1988, personal communication) questioned the comparison with *Nannococcus vulgaris* which has a diameter of 180  $\mu\text{m}$ . Moreover small spheroids enclosed within a mucilagenous sheath is also one of the diagnostic feature of this species which is not clearly visible in given photomicrographs.

Psilate structure in forms compared with *Huroniospora psilata* is not clearly seen in the photograph, hence comparison only upto generic level can be accepted.

Fig. 7 in given plate shows the morphology similar to *Kakabekia umbellata* but author has mentioned Fig. 8 as reference photomicrograph for above spe-

cies. This may be a printing mistake or wrong numbering of figures. The diameter range of *Huroniospora* and *Kakabekia* is between 8-20  $\mu\text{m}$ .

#### MICROBIOTA FROM THE HIMALAYAN REGION

From the Himalayan region, the microbial assemblages have been reported only from the Deoban Limestone of Chakrata area, Garhwal Himalaya (Fig. 1, locality 7) and the Jammu Limestone of Udhampur area, Jammu & Kashmir (Fig. 1, locality 8).

*Deoban Limestone Formation*: The Deoban Limestone Formation is well exposed in Garhwal Himalaya which unconformably overlies the rocks of Simla slates. Rupke (1974) used the term Deoban Group and further divided it into three lithostratigraphic formations which are, Lower, Middle and Upper Deoban Formations.

Valdiya (1969), Prashra (1977), Kumar and Singh (1979) and Sinha and Raaben (1981) have reported different types of stromatolites from the Deoban Limestone and on this basis, it has been assigned Lower Riphean to Vendian age (1700-580 Ma.) (for discussion, see Tewari, 1984). No radiometric dates are available for these rocks.

Kumar and Singh (1979) first reported microfossils from the Chakrata area (Fig. 1, locality 7). Fossiliferous black, bedded chert, yielding microorganisms has a maximum thickness of 10 cms. and occurs as lenses and thin layers within the limestone. Only three species of microfossils were reported by Kumar and Singh (1979). Recently Shukla *et al.* (1987) have studied the chert and described 16 species which is the largest number of species from black chert so far described from any Indian Precambrian sequence. The forms present are : *Archeotrichion contortum*, *Biocatenoidea*, *Myxococcoidea minor*, *Siphonophycus kestron*, *Sphaerophycus parvum*, *Melasmotophaera media*, *Glenobotrydion aenigmatis*, *G. majorinum*, *Globophycus*, *Oscillatoriopsis*, *Cyanonema*, *Eomycetopsis robusta*, *E. filiformis*, *Huroniospora*, *Gunflintia minuta*, *Kildinosphaera* and *Animikea septata*. Out of sixteen species five are common with the assemblage described from the Kheinjua Formation of the peninsular India.

Morphological features are clearly visible in the photo-micrographs except for *Animikea septata*. Closely spaced septae in form identified as *Animikea septata* are mentioned in description but not visible in reference photomicrograph, which looks like non-septate empty sheath resembling *Siphonophycus kestron*.

Forms identified as *Archaeotrichion contortum* are more likely *Eomycetopsis filiformis*. Authors themselves doubted the identification and mentioned in detail of plate as *Archaeotrichion contortum* or *Eomycetopsis filiformis*.

*Kildinosphaera* is the only species in this assemblage, which shows unusual size of 260  $\mu\text{m}$ . Size of coccoid forms ranges between 2-260  $\mu\text{m}$  and width of filaments varies between 0.5-18  $\mu\text{m}$ . Unusually large size of coccoid form *Kildinosphaera* is a peculiar feature of this assemblage.

**Jammu Limestone:** An approximately 2500 meters thick carbonate horizon of limestone and dolomites in Jammu & Kashmir occurring as the chain of inliers within Tertiary rocks of the Himalayan foothills, has variously been referred to as Jammu Limestone, Riasi and Sirban Limestone (Raha, 1980).

A Lower to Middle Riphean age (1700-950 Ma) has been suggested on the basis of stromatolites (Raha and Sastri, 1973) and radiometric age of chert has been suggested as 967 Ma which is based on a lead isotopic mean model age of galena occurring in the top most orthoquartzite member (Raha *et al.* 1978).

Raha (1980) reported two filamentous forms comparable to *Gunflintia minuta* and *G. grandis*, with width range 2-6  $\mu\text{m}$  and one coccoid form, comparable to *Huroniospora* with diameter range of 5-40  $\mu\text{m}$ . Heterocyst like structure is not clearly visible in given photomicrograph. Comparison of these filaments with *Gunflintia* sp. is appropriate, but differentiation on specific level is not possible on the basis of the reference photomicrographs. Comparison of coccoid forms with *Huroniospora* appears to be valid upto the diameter range of 16  $\mu\text{m}$ .

#### CONCLUSIONS

1. There is an excellent development of Precambrian rocks in India which shows a wide and extensive geographic distribution, but from only nine horizons the microbial assemblages from the petrographic thin sections of black bedded cherts have been reported. However, there is a controversy about the biogenicity of one assemblage and filamentous forms, described from the Sandur Schist Belt (ca. 3000 Ma) appear to be of non-biotic origin.

2. In all the 31 species of 26 genera have been reported from these chert horizons of sedimentary Precambrian sequences, among which 18 species belong to 16 genera of coccoid forms and 13 species belonging to 10 genera of filamentous forms.

After considering the factors based on description of identified forms, location of sample in map as well as in lithology, photomicrographs and repository, 14 genera and 21 species are found to be valid (Table 5).

3. Except for reports of microbial assemblages described from the Kheinjua Formation (McMenamin *et al.* 1983) and Deoban Limestone (Shukla *et al.* 1987), all other reports lack the basic information concerning taxonomic identification, and good quality photographs. Generally no information is available about taphonomy, depositional environment and facies. Thus no meaningful discussion can be attempted concerning evolutionary trends in the microbial assemblages, through time.
4. The earliest record of microfossils from India is approximately 3100 Ma old from the Iron Ore Supergroup, Keonjhar district, Orissa (Maithy and Avasthy, 1982). Only coccoid forms are present.
5. In Proterozoic both coccoid as well as filamentous forms are recorded.

Table 5. Microfossils described from the petrographic thin sections of bedded cherts from Indian Precambrian sequences, their stratigraphic positions and remarks.

Locality number	Approximate age in million years	Geologic Unit	Locality	Location of samples	Repository	Identified forms on Generic and specific level	Identification valid/invalid	Author & Year of publication
9.	> 745	Dhanapa Fm. Trans-Aravalli Vindhyan (Marwar Supergroup)	Jodhpur & Nagaur district W.Rajasthan	not given	given	<i>cf. Nannococcus vulgaris</i>	Invalid	Maithy (1984)
						<i>cf. Huroniospora, Kakabekia</i>	Valid upto generic level	Maithy (1984)
8.	> 967	Jammu Limestone Fm.	Udhampur district J & K	given	not given	<i>cf. Huroniospora sp., cf. Gunflintia grandis cf. Gunflintia minuta.</i>	Valid upto generic level	Raha (1980)
7.	Ca.1100.	Deoban Limestone Fm.	Chakrata area, Dehra Dun, U.P.			<i>Oscillatorioopsis, Cyanonema, Eomycetopsis robusta, Siphonophycus kestron, Gunflintia minuta, Biocatenoides sp., Myxococcoides minor, Sphaerophycus parvum, Melasmatosphaera media, Glenobotrydion aenigmatis, Archaeotrichion contortum, Animikea septata</i>	Invalid	Shukla et al.(1987)
						<i>Huroniospora sp., Eomycetopsis filiformis, Glenobotrydion majorinum</i>	Valid	Kumar & Singh (1979)
6.	Ca.1140	Kheinjua Fm. (Vindhyan Supergroup)	Son Valley Mirzapur, U.P.	given	given	<i>Tetraphycus congregatus, Eoentophysalis belcherensis, E. magna, Melasmatosphaera media, Kheinjuasphaera vulgaris, cf. Gunflintia minuta, Eomycetopsis siberiensis, Siphonophycus kestron, Glenobotrydion aenigmatis, Myxococcoides minor, Eosynechococcus mooreii</i>	Valid	McMenamin et al.(1983)
				not given	given	<i>Cephalophytarion, Globophycus, Sphaerophycus</i>	Invalid	Kumar (1978)
5.	Ca1200	Cumbum Fm. (Cuddapah Supergroup)	Zangamarajupalli, Andhra Pradesh.	not given	not given	<i>cf. Corymbococcus, cf. Eoastrion, cf. Archaeorestis</i>	Invalid	Gururaja et al. (1979).
4.	Ca.1400	Vempalle Fm (Cuddapah Supergroup)	Bramanpalli, Andhra Pradesh	given	not given	Filamentous forms broadly placed within family Oscillatoriaceae and coccooids belong to family Chroococcaceae	Valid	Schopf & Prasad (1978)
3.	Ca.2500-1500	Matoon Fm. (Aravalli Supergroup)	Jhamar Kotra Udaipur, Rajasthan	not given	not given	<i>cf. Eomycetopsis robusta cf. Huroniospora microreticulata</i>	Invalid Valid	Banerjee (1973) Maithy (1978)
2.	Ca.3000	Donimalai Fm. Sandur Schist Belt	Bellary dist. Karnataka	given	given	Two filamentous forms compared with <i>Scytonema</i> and <i>Lyn gbya</i>	Invalid	Naqvi et al. (1987)
1.	Ca.3100	Iron Ore Supergroup	Keonjhar district, Orissa.	given	given	<i>cf. Sphaerophycus, cf. Aphanocapsiosis, cf. Nannococcus, cf. Gunflintia</i>	Valid Invalid Invalid	Maithy & Avasthy (1982)



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