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Systematic Studies on some Middle Eocene Calcareous Nannofossils / Northern Iraq

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ABCTRACT

Twenty-one surface samples from Avanah Formation dating to Middle Eocene cropping out in Dohuk area, northern Iraq, were studied for their nannofossils with light microscope .The study shows that the formation contains a rich and varied assemblage of nannofossils with a significant development of special forms such as Discoasters and Coccolithes . These forms are useful as stratigraphic indicators in Paleogene sediments and as paleoecological indicators of the studied area. One of these samples had being studied by Scanning Electron Microscope to show some of the diagnostic features of the studied species. The study resulted in the recognition of (12) species belong to (10) genera of calcareous nannofossils.

دراسة تصنيفية لبعض أنواع متحجرات النانو الكلسية للايوسين الأوسط/ شمالي العراق

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الملخص

احدى وعشرون عينة صخرية تم اختيارها من المقطع الصخري لتكوين أفانه في الطرف الجنوبي لطية بيخير المحدبة، في منطقة دهوك، شمال العراق لدراسة محتوياتها من احافير النانو الجيرية المجهرية وعلاقتها بالظروف البيئية التي كانت سائدة أنذاك من حيث تاثيرها في انتشار توزيع تلك الكائنات بواسطة المجهر الضوئي، وقد تمت دراسة احدى العينات الاكثر غزارة بمتحجرات النانو بواسطة المجهر الاليكتروني الماسح لبيان بعض الصفات الاساسية الخاصة والمميزة لتلك الانواع حيث تم تشخيص(12) نوعا تعود الى (10) اجناس من متحجرات النانو الكلسية.

INTRODUCTION

In recent years more attention have been paid to the abundant, widely distributed and rapidly evolved calcareous nannofossils .Since the size of these fossils is less than 63 ***micron*** , its diagnostic featuers can only be seen under Scanning Electron Microscope which has become more widely available and greatly enhanced the study of nannofossils . Much of the work on the fine structure and formation of these fossils has been made possible by scanning electron microscope.

Material and Method

Studying calcareous nannofossils, the samples should be properly prepared, because calcareous nannofossils are minute and fragil strong chemicals can not be used. The isolation method which used is based on specific gravity ,consisting of three steps:

1- Disperse the samples.
2- Concentrate the samples.
3- Prepare the samples for SEM.

After coating the sample with gold nice image of single calcareous nannofossils may be obtaind. SEM technique used for study calcareous nannofossils being a feasible means and is now actively developed. The present study deals with the nannopaleontology of Eocene samples from Avanah Formation outcrops in Dohuk area, northern Iraq, (Fig. 1).The studied section consist of marl, marlylimestone and limestone alternating beds with thicknes of about (58) m.(Fig. 2).

One of the studied samples (no.9) contain well preserved assemblages of nannofossils as shown by light microscope survey, was studied by SEM. The study is mainly restricted to mention the diagnostic features of some Eocene forms, from the area under investigation. A set of positive prints of the SEM photomicrographs and the films are deposited in the archives of the SEM unit, Physical Department, Faculity of Science, Cairo University -Egypt with serial No. (217-296).

Systematic Paleontology

The Classification was based on Perch-Nielsen (1985), Young and Bown (1997):

Kingdom: PROTISTA
Division: Chrysophyta Rothmaler, 1949
Class: Coccolithophyceae Rothmaler, 1949
Family: Discoasteraceae Tan Sin Hok, 1927
Genus: ***Discoaster*** Tan Sin Hok, 1927
Type species: ***Discoaster pentaradiatus*** Tan Sin Hok, 1927

Discoaster barbadiensis Tan Sin Hok, 1927
Pl. 1, Fig . 2
1927 ***Discoaser barbadiensis*** Tan Sin Hok; 30: 415 c.

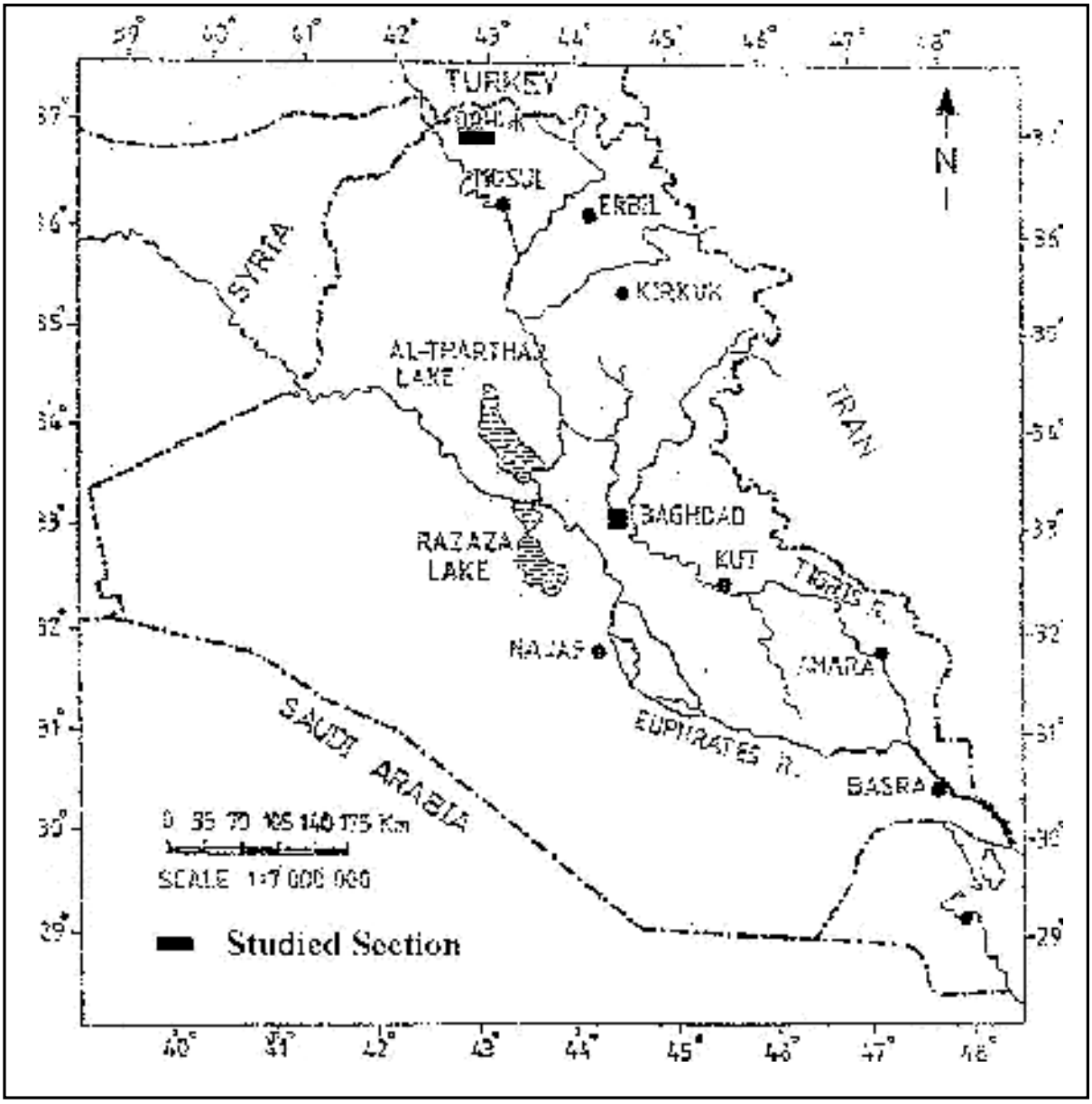

Fig. 1: Location map of the Studied Section.

Period	Epoch	Formation	Thick(m.)	Sample Number	Lithology	Remark
Paleogene	Middle Eocene	Avanah	1	1		Pale fossiliferous limestone bed
			3	2		Pale greenish shale bed
			2	3		Pale brownish massive limestone bed
			1	4		Grayish shaly limestone bed
			1	5		Yellowish massive limestone bed
			1	6		Pale limestone fossiliferous bed
			1	7		Marly limestone bed
			2	8		Pale gray massive limestone bed
			1	9		Pale gray marl bed
			1	10		Fossiliferous limestone bed
			1	11		Pale brown marly shale bed
			9	12		Thick fossiliferous limestone bed
			3	13		Sandy shale bed
			3	14		Pale yellow massive limestone bed
			3	15		Yellowish gray marl bed
			5	16		Pale recrystallized limestone bed
			3	17		Pale gray marly limestone bed
			5	18		White gray massive limestone bed
			7	19		Marly limestone bed
			3	20		Fossiliferous limestone bed
			2	21		Coarse sandstone bed
						Weathered sandstone bed with evaporates and mud

Fig.2: Lithological Section of the Avanah Formation, Dohouk Area.

1984 ***Discoaster barbadiensis*** Tan Sin Hok-El-Dawoody and Elewi; 2 No. 4, 365 - 382, pl. 2 , Fig. 3
1992 ***Discoaster barbadiensis*** Tan Sin Hok-El-Dawoody; 407- 432, pl. 3 Fig. 9.

2011 ***Discoaster barbadiensis*** Tan Sin Hok-Al-Badrani; 11, (1), pp. 71 - 84, pl. 1, Fig. 4.

Description:

A robust asteroliths with (11) pointed rays which are connected for most of their length along straight radial sutures, its diagnostic features show specimens of basket - shaped with a selender stem on one side of the center.

Occurrences:

This species was recorded throughout middle Eocene of USA Bukry (1975)**,** Egypt Eldawoody (1992), Iraq Al-Badrani (2011).

Discoaster distinctus Martini , 1958
Pl.1, Fig. 3
1958 ***Discoaster distinctus*** Martini; 39: 363, pl. 4, Fig. 17
1976 ***Discoaster distinctus*** Martini-Haq and Lohmnn; 1: 154, pl. 6, Fig. 6.
1985 ***Discoaster distinctus*** Martini – Perch-Nielsen; p. 468, Fig. 27.

Description:

Asterolith having usually six rays terminating with deep notch, its diagnostic features show the distinct central knob and the well developed node on each side of the ray at terminal ends which give the
appearance of bifurcations to the ray.

Occurrences:

This species was described from the Middle- Late Eoceneof Iraq, Elewi (1982), Eocene of NW Germany, Martini, (1958)**,** Lower and Middle Eocene of USA, Haq and Lohmann, (1976).

Discoaster elegans Bramlette and Sullivan, 1961
Pl. 1, Fig .1
1961 ***Discoaster elegans*** Bramlette and Sullivan; 7: 159, pl. 11, Fig. 16
1976 ***Discoaster elegans*** Bramlette and Sullivan -Haq and Lohmann; 1: 154, pl. 5, Fig. 3.
1985 ***Discoaster elegans*** Bramlette and Sullivan - Perch - Nielsen; p. 468, Fig. 27.

Description:

Asterolith rosette-like, consisting of (11) pointed rays or segments of equal size, seems to be very similar to ***Discoaster barbadiensis*** ,its diagnostic features show specimens with delicate concentric lines or depressions parallel to the periphery.

Occurrences:

This species was recorded throughout Lower - middle Eocene of Iraq, Elewi (1982), Al-Badrani (2011), Eocene of Egypt,El-Dawoody, (1992).

Family: Prinsiaceae Hay and Mohler, 1967
Genus: ***Reticulofenestra*** Hay and Wade (emed.Stradner),1968
Type species: ***Tremalithus placomorphus*** Kamptner, 1948
Reticulofenestra umbilica (Levin, 1965) Martini and Ritzkowski, 1968
Pl. 1, Fig. 4
1965 ***Coccolithus umbilicus*** Levin; 39: 265, pl. 41, Fig .2
1968 ***Reticulofenestra umbilica*** (Levin)- Martini and Ritzkowski; 69: 233 - 7.
1976 ***Reticulofenestra umbilica*** (Levin) - Haq and Lohmann; 1: 154, pl. 7, Figs. 7
1985 ***Reticulofenestra umbilica*** (Levin)- Perch-Nielsen; p. 506, Figs. 59, 60
1998 ***Reticulofenestra umbilica*** (Levin) -El-Dawoody; 42/2, 365 - 392.

Description:

Large elliptical coccoliths with large central opening spanned on the proximal side by a reticulate membrane consisting of anastomosing rods which are derivatives of the proximal shield , the central part has numerous small circular pores which elongate into slits near the margin.

Occurrences:

This species was recorded throughout middle Eocene of Egypt (El- Dawoody 1998), U.S.A (Levin 1965) and Iraq (Elewi 1982).

Family: Calyptrosphaeraceae Boudreaux and Hay, 1969
Genus: ***Daktylethra*** Gartner, 1969
Type species: ***Daktylethra punctulata*** Gartner, 1969
Daktylethra punctulata Gartner, 1969
Pl. 1, Fig. 5
1969 ***Daktylethra punctulata*** Gartner (in Gartner and Bukry); 43, pp. 1213-1221, pls. 139 - 142.
1971b ***Daktylethra punctulata*** Gartner -Perch-Neilsen; 18, No. 3, pp. 1-76, pls. 1 - 61, Figs. 1 - 2.
1972 ***Daktylethra punctulata*** Gartner - Loker; 3, No. 5, pp.735 – 823, 1985
Daktylethra punctulata Gartner-Perch-Nielsen; p. 453, Fig. 13.

Description:

This species has adistinctive helmet-shaped holococcolith with a concave base and an elliptical cross section, the upper half of the helmet has umerous, large, circular pits and spike-like projections.

Occurrences:

This species was recorded throughout the middle Eocene of Alabama (Blow 1969).

Genus: *Zygrhablithus* Deflandre ,1959

Type species: *Zygolithus bijugatus* Deflandre, 1954

Zygrhablithus bijugatus (Deflandre) 1954, Deflandre, 1959

Pl. 2, Fig. 1

1954 ***Zygolithus bijugatus*** Deflandre (in Deflandre and Fert); 40, pp. 115-176, pls. 1 - 15, Figs. 1 - 127.

1959 ***Zygrhablithus bijugatus*** (Deflandre)- Deflandre; 2, 135.

1961 ***Zygrhablithus bijugatus*** (Deflandre) - Bramlette and Sullivan; 7, pp. 129 - 174, pls. 1 - 14.

1975 ***Zygrhablithus bijugatus*** (Deflandre)- Bybell ; 11, No. 4, p.177 - 250, pls.1-24.

1985 ***Zygrhablithus bijugatus*** (Deflandre) - Perch-Nielsen; p. 453, Fig. 13.

Description :

This holococcolith has an upward flaring elliptical base which is surmounted by a complex stem – like feature , this stem is x- shaped where it joins the basal disc, there is a depression in the base between each of the cross bar of the x, the crossbar rise upward as blade like vanes to form the stem.

Occurrences:

This species occurs throughout the middle Eocene of Alabama (Blow 1969).

Family: Pontosphaeraceae Lemmermann, 1908

Genus: *Pontosphaera* Lohmann, 1902

Type species : *Pontosphaera syracusana* Lohmann, 1902

Pontosphaera multipora (Kamptner , 1948), Roth 1970

Pl. 2, Fig. 2

1948 ***Discolithus multiporus*** Kamptner; 157, pp. 1 - 16, 2 pls.

1968 ***Discolithina multipora*** (Kamptner) - Haq; 18, pp. 13 - 74, pls. 1- 11, Figs. 3

1970 ***Pontosphaera multipora*** (Kamptner)-Roth; 63, p. 860 .

1985 ***Pontosphaera multipora*** (Kamptner)- Perch-Nielsen; p. 499, Figs. 51, 53.

Description:

This discolith has numerous circular pores of approximately uniform size on its surface arranged in arrows parallel to the periphery, the ridges between the pores give the distal side an irregular, bumpy surface.

Occurrences:

This species was recorded through middle Eocene of Alabama (Blow 1969).

Family: Rhabdosphaeraceae Lemmermann, 1908

Genus: ***Blackites*** Hay and Towe, 1962

Type species: *Discolithus spinosus* Deflandre and Fert, 1954

Blackites creber (Deflandre), 1954, Bybell, 1975

Pl. 2, Fig. 3

1954 ***Rhabdolithus creber*** Deflandre (in Deflandre and Fert); 40, pp. 115-176, pls. 1 - 15, Figs. 1 - 127.

1961 ***Rhabdosphaera crebra*** (Deflandre) -Bramlette and Sulivan; 7, pp. 129 - 174, pls. 1 - 14.

1975 ***Blackites creber*** (Deflandre) - Bybell; 11, No. 4, pp. 177 - 250, pls. 1-24. 1985.

Description:

This rhabdolith posses an arched basal plate with four cycles of crystal elements surmounted by a narrow tapering circular stem attached to a basal plate with a more pronounced collar which is distinct and flares out from the stem. Its diagnostic features shows that the collar of ***B. creber*** has tow aligned layer of crystallites which are all vertically arranged.

Occurrences:

This species was recorded throughout the middle Eocene of Alabama (Blow 1969).

Family: Sphenolithaceae Deflandre, 1952

Genus: ***Sphenolithus*** Deflandre, 1952

Type species: *Sphenolithus radians* Deflandre**,** 1952

Sphenolithus radians Deflandre, 1952

Pl. 2, Fig. 5

1952 ***Sphenolithus radians*** Deflandre (in Grasse); 1: 1466, Figs. 343, 363.

1976 ***Sphenolithus radians*** Deflandre - Haq and Lohman; 1: 158, pl. 10 Figs. 11, 12 .

1985 ***Sphenolithus radians*** Deflandre-Perch-Nielsen**;** p. 517, Fig. 70.

Description:

The individuals of this species appear to show the basal disc is concave and the stem consists of wedge – shaped of several radialy arranged plates ,the base is

constructed of (4)radiating wedge-shaped elements and is surmounted by several (3) blade-like segments that rise to form a non-bifurcating apical spine.

Occurrences:

This species was recorded throughout middle Eocene of France (Deflandre 1952), USA (Haq and Lohman 1976), Germany (Perch-Nielsen 1985).

Family: Coccolithaceae Poche, 1913
Genus: ***Ericsonia*** Black, 1964
Type species: ***Ericsonia occidentalis*** Black, 1964
Ericsonia formosa Black, 1964,Haq, 1971
Pl. 2, Fig. 6
1963 ***Cyclococcolithus formosus*** Kamptner; 66, 163, pl. 2, Fig. 8, text Fig. 20 .
1964 ***Ericsonia formosa*** (Kamptner)- Black; 7, 306, pls. 50 - 53.
1971 ***Ericsonia formosa*** (Kamptner)-Haq; 25: 17, pl. 4, Figs. 7, 8.
1985 ***Ericsonia formosa*** (Kamptner)-Perch-Nielsen; p. 465, Figs. 23, 24.
1994 ***Ericsonia formosa*** (Kamptner) - El-Dawoody and Elewi; 8, pp. 249-258. Fig. 5.

Description:

This species has a circular form with a wide collar and a small central opening. The collar and shield elements are joined distally along a serrate line. In cross- polarized light only the proximal shield is bright, afeature which distingwishs this species from other circular placoliths.

Occurrences:

This species was originally recorded from the Eocene sediments of Iraq (El-Dawoody and Elewi 1994) and throughout the middle Eocene of Alabama, (Blow 1969).

Genus: ***Campylosphaera*** Kamptner, 1963
Type species: ***Campylosphaera bramletti*** Kamptner, 1963
Campelosphaera dela (Bramlette and Sullivan), 1961
Pl. 1 , Fig. 6
1961 ***Coccolithites delus*** Bramlette and Sullivan; 7: 151, pl. 7, Figs. 1, 2
1967 ***Campelosphaera dela*** (Bramlette and Sullivan) - Hay and Mohler; 41: 1531, pl. 198, Fig. 14.
1976 ***Campelosphaera dela*** (Bramlette and Sullivan) - Haq and Lohmann; 1: 158, pl. 9, Fig. 3.
1985 ***Campelosphaera dela*** (Bramlette and Sullivan)- Perch-Nielsen;p. 457, Fig. 20.

Description:

This species is characterized by its subrectangular rim outline and a large central area spand by two crossbars, one aligned with long axis and the other aligned with short axis of the shields .The specimen show clearly the strongly inward curved ends of the rim.

Occurrences:

This species was recorded throughout the middle Eocene of U.S.A (Bramlette and Sullivan 1961) , and Iraq (El-Dawoody and Elewi 1994).

Incertae sedis:

Genus*: Nannotetrina* Achuthan and Stradner, 1969

Type species : *Nannotetrina fulgens* Stradner, 1960

Nannotetrina fulgens (Stradner), 1960, Achuthan and Stradner, 1969

Pl. 2, Fig. 4

1960 ***Nannotetraster fulgens*** Stradner (in Martini and Stradner); Vol. 76, 268, Figs. 10 - 16 .

1969 ***Nannotetrina fulgens*** (Stradner) - Achuthan and Stradner ; 1, (1967) :7,pl. 5, Figs. 4 - 6

1971 ***Nannotetrina fulgens*** (Stradner) - Perch-Nielsen; 18: 66, pl. 55, Figs. 1 - 7 .

1985 ***Nannotetrina fulgens*** (Stradner) - Perch-Nielsen ; p. 534, Fig. 89.

1994 ***Nannotetrina fulgens*** (Stradner) - El-Dawoody and Elewi; 8:253, Fig.6.

Description:

This species is characterized by having (4) straight arms slightly offset at the center with no marginal rim ,the arms seems to be very thick deu to the overgrowth, so there are no ultrastructural features could be seen at the inter-arm space.

Occurrences:

This species was recorded from the middle Eocene of Germany (Stradner, 1960) and Iraq, (El-Dawoody and Elewi, 1994).

Conclusion:

Calcareous nannofossils can be used to help determine the paleotemperature and current patterns of ancient oceans, following Perch –Nielsen (1985) *Sphenolithus* species are characteristic of low latitude, open sea and warm waters, where as *Pontosphaera* species are frequent in hemipelagic sediments, both genera as well as *Discoasters* are well represented in the studied section.

The presence of shallow water benthonic foraminifera indicates that these sediments were probably deposited in the neritic zone under fluctuating water conditions (Al-Banna and Al-Mutwal 2002 and 2005). The distribution of

nannofossils along the studied section is not homogenous, in some strata the microfossils are exceedingly diverse with abundant nannofossils, but other levels may show scarce or sparse species of nannofossils. The exact nature of these fluctuations is unknown. The erratic distribution of these species in the studied area seems to be correspond to the change in lithologic constitute which may reveal changes in physical parameters of the environment.

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PLATE 1

Fig.1: *Discoaster elegans* Bramlette and Sullivan , sample No. 9, X= 10000

Fig. 2: *Discoaster barbadiensis* Tan Sin Hok, sample No. 9, X=15000

Fig. 3: *Discoaster distinctus* Martini , sample No. 9, X=10000

Fig. 4 :*Reticulofenestra umbilica* (Levin),sample No. 9, X=5000

Fig. 5 :*Daktylethera punctulata* Gartner , sample No.9, X= 8500

Fig. 6: *Campylosphaera dela* (Bramlette and Sullivan), sample No. 9, X=10000

PLATE 2

Fig. 1: *Zygrhablithus bijugatus* (Deflandre), sample No. 9, X= 8500

Fig.2 : *Pontosphaera multipora* (Kamptner) , sample No. 9, X= 5000

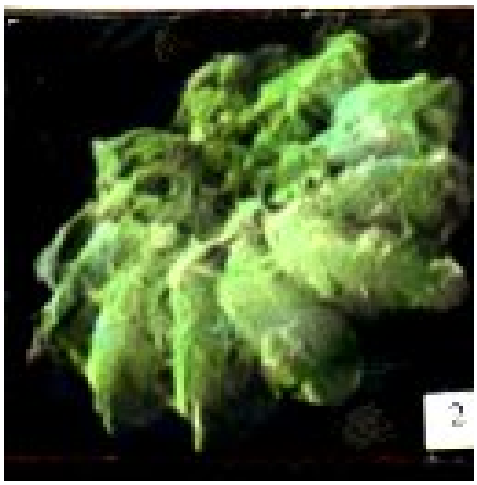
Fig. 3: *Blackites creber* (Deflandre) , sample No. 9, X=15500

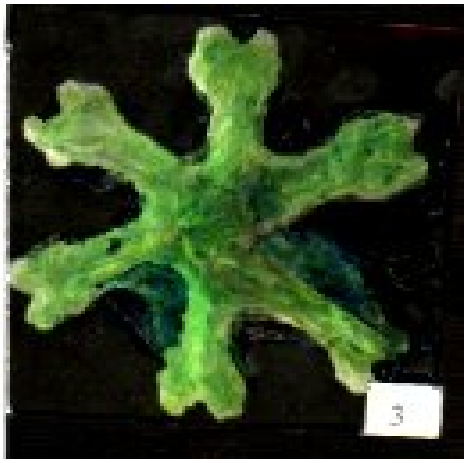
Fig.4: *Nannotetrina fulgens* (Stradner) , sample No. 9, X=25000

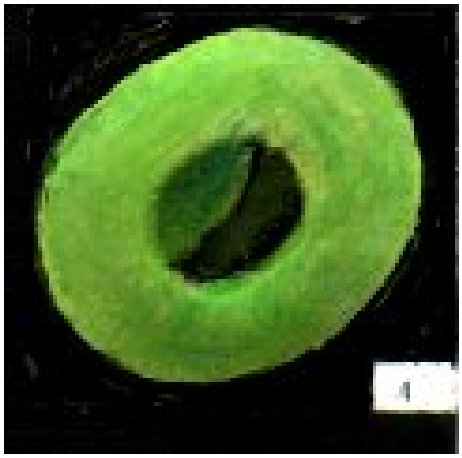
Fig. 5: *Sphenolithus radians* Deflandre , sample No. 9, X= 10000

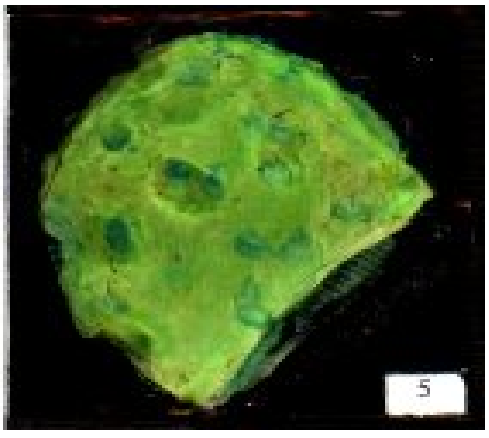
Fig 6 : *Ericsonia formosa* (Kamptner) , sample No. 9, X=8500

PLATE 1









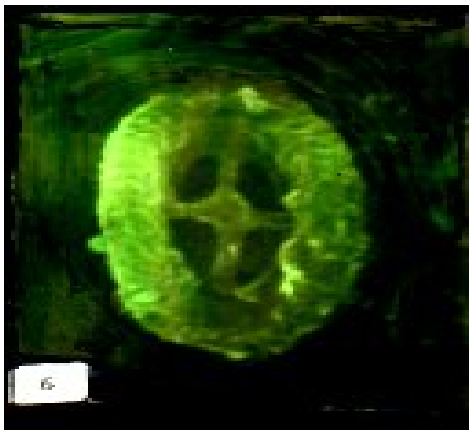


PLATE 2