

THE LARGER FORAMINIFERA FROM THE YINKIONG FORMATION (EARLY EOCENE) OF EAST SIANG DISTRICT, ARUNACHAL PRADESH

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ABSTRACT

The paper describes and illustrates the larger foraminifera from the Yinkiong Formation (Early Eocene) of East Siang district, Arunachal Pradesh. The assemblage comprises of *Nummulites* sp. A, *Nummulites* sp. B, *Nummulites* cf. *N. globulus* Leymerie, *Assilina dandotica* Davies, *Assilina* sp. A, *Assilina* sp. B, *Orbitolites* cf. *O. complanata* Lamarck and? *Discocyclina* sp., which has been attributed to Early Eocene age.

This assemblage, together with the earlier record from Arunachal Pradesh, is comparable with the faunal assemblages known from the Subathu Group of Western Himalaya, and is distinct from the larger foraminiferal assemblages known from Burma and Shillong Plateau (Meghalaya). Further, in view of the occurrence of Subathu outcrops of western Himalaya and those of Arunachal Pradesh in identical structural/tectonic setting along the frontal zone of the Himalaya and their faunal affinities, the continuity of Subathu sea all along the Himalayan frontal zone upto Arunachal Pradesh, has been postulated.

INTRODUCTION

When *Nummulitic* Lower Tertiary strata were discovered in the Dihang valley, Arunachal Pradesh (Tripathi et al. 1979, 1981), subsurface data were thought to suggest that a positive area had existed east of Kathmandu (Nepal) during the Eocene (Karunakaran and Ranga Rao 1976). Strata of Eocene age were therefore believed to be absent from this area (Talukdar and Ranga Rao, 1978), although Ray and Acharyya (1976) and Acharyya and Ray (1978) considered that they might be preserved below the Himalayan nappe sheets. Later Tripathi et al. (1981a) located new exposures of *Nummulitic* rocks in the Yinkiong-Mariang area, East Siang district, Arunachal Pradesh. *Nummulites* were first discovered in strata formerly assigned to the Gondwana Supergroup, and found later in rocks previously believed to be of Precambrian to Early Palaeozoic age. There is therefore a possibility that further outcrops of nummulitic strata will be found along the strike/tectonic continuity/contact of the Gondwana Supergroup or older sediments.

GEOLOGY OF THE AREA

Limited data on the geology of the area was available till the systematic geological traverses and mapping were initiated by the Geological Survey of India in 1962. The first preliminary account of the geology of the area was presented by Dhoundial and Santra (In Balasundaram, 1971) and based on a couple of traverses some additional data was provided by Jain et al. (1975). Detailed geological investigations by the officers of the Arunachal Pradesh Circle, of the Geological Survey of India in parts of Yamne valley, coupled with the earlier works led to the establishment of the following geological succession in the Yinkiong-Mariang area of East Siang district Arun-

achal Pradesh (Tripathi et al., 1981).

Younger Volcanics	Light to dark green, greyish, purple basic intrusives and effusives	Tertiary
	Nummulitic limestone, shaly limestone Alternations of red, purple, pale green and grey green shale and siltstone	
Yinkiong Formation	Reddish brown to black slaty shale and black slate Light to dark grey, medium to coarse grained sandstone with conglomerate lenses.	Early Eocene
Older Ahor Volcanics	Thrust Basic intrusives and effusives	Palaeozoic
	Thrust	
Miri Formation	Megacyclothem of dominantly quartzite (White, pink, light blue and grey colour) with limestone, phyllite and oligomictic conglomerate.	Lower Palaeozoic.

YINKIONG FORMATION

The Yinkiong Formation was defined by Jain et al. (1975), with its type section between the Dihang bridge (km 65/0) and Yinkiong, as consisting of thick, dark grey, micaceous sandstone grading upwards into siltstone and shale, interbedded with green and red shales, the basal sandstones being non-bedded to current bedded with clasts of grey shale. Individual grey, green and red beds attaining a thickness of 100 metre

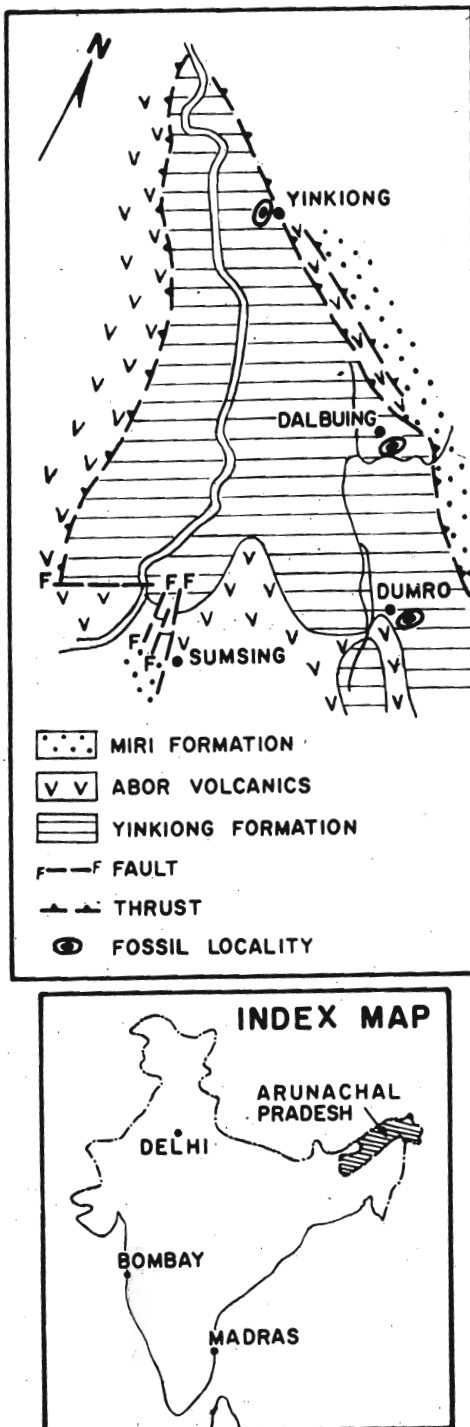


Fig. 1. Locality map

characterize the formation. They tentatively assigned it a Precambrian to Middle Palaeozoic age and grouped it as part of the Miri Group.

Gaur and Singh (quoted in Tripathi *et al.* 1981a) of the Arunachal Pradesh Circle, Geological Survey of India, observed for the first time nummulitic limestone in its

upper part which yielded the nummulitic fauna described in this paper.

The Yinkiong Formation is well exposed near Dalbuing along the southern slopes of the Dumro hill and along the Sipung Korong and its tributaries (Fig. 1). The nummulitic limestone interbedded with shale is prominently exposed near Dalbuing.

In the eastern part, the Yinkiong Formation has a thrust contact with the white and pink quartzite of the Miri Formation, along a North-South to NNW-SSE trending thrust plane, accompanied by intense shearing.

The limestone samples collected from Dalbuing contain the nummulitic fauna; however the limestones are partially recrystallised and isolated individuals could not be obtained from the samples, as a result the study is based on random thin sections alone. All the material described here comes from the sample collected from Dalbuing, East Siang district, Arunachal Pradesh.

REPOSITORY

The illustrated specimens (Slides) are deposited with the type collections of the Geological Survey of India at Calcutta.

SYSTEMATIC DESCRIPTION

- Order Foraminiferida EICHWALD, 1830
 Suborder Rotaliina DELAGE & HEROUARD, 1896
 Superfamily Rotaliacea EHRENBERG, 1839
 Family Nummulitidae DE BLAINVILLE, 1825
 Subfamily Nummulitinae DE BLAINVILLE, 1825
 Genus *Nummulites* LAMARCK, 1801
 Type species: *Camerina laevigata* BRUGUIERE, 1792

Nummulites sp.A

(Pl. I-1-3, 5-6)

Description: A Form-In thin section, test diameter varies from 1.00 mm to 1.33 mm, and thickness from 0.66 mm to 0.67 mm. Single protoconch of 0.08 mm diameter is visible in axial section. In basal section nucleococonch appears double, but not clearly seen, however, the deuteroconch appears much smaller than the protoconch. Spire consists of 3 to 4 evenly spaced, gradually opening whorls. Spiral lamina relatively thick septa straight, with slight curvature near the distal end chambers higher than long. BForm not found.

Remarks: The species is characterized by the small size of test, few herls and small protoconch, and appears distinct from the known species of *Nummulites*, although its characters are not well preserved; nevertheless its nearest comparable species is *Nummulites variolaris* Lamarck.

G.S.I. Type Number: 19943 to 19947.

Nummulites sp.B

(Pl. II-4-7)

Description: A Form—The axial section shows 3 to 5 evenly spaced whorls of nearly uniform thickness. The nucleoconch is double, dominated by a large protoconch whose diameter varies from 0.2 mm to 0.35 mm B form not found.

G.S.I. Type Numbers: 19948 to 19949.

Nummulites cf. N. globulus LEYMERIE

(Pl. II—9)

Remarks: The illustrated axial section shows five closely coiled gradually opening whorls of the megalospheric form, whose protoconch diameter is 0.33 mm; diameter of the test appears to be 2.00 mm and thickness 1.5 mm; the overall characters are comparable with *N. cf. globulus* Leymerie.

G.S.I. Type Number: 19950

Genus *Assilina* D'ORBIGNY, 1826

Type species *Nummulites spira* DE ROISSY, 1805

Assilina dandotica DAVIES, 1937

(Pl II—1, 2)

1937 *Assilina dandotica* Davies; Davies and Pinfold, pp. 28-29, pl. 4, figs. 1-3, 6-8.

Remarks: The megalospheric form has four to five whorls with a double nucleoconch, the protoconch being larger. The chambers are nearly rectangular in shape and nearly twice as high as long. The axial section is typically hexagonal.

G.S.I. Type Number 19951-19952.

Assilina sp. A

(Pl. I—7; Pl. II—3-8; Pl. III—1 -4)

Description: Test diameter is 4 mm and thickness 1.35 mm. Protoconch not clear, chambers higher than long. The T/D ratio is comparable with that of *Assilina subspinosa* Davies, but on account of its coarse nature of test and few whorls it has been tentatively recognised as a distinct species.

G.S.I. Type Number 19953 to 19959.

Assilina sp. B

(Pl. II—5 -6, Pl. III—5 -7)

Description: Septal filaments are fused. In thin section, diameter of the test 3.66 mm and thickness 1.5 mm. Nucleoconch double, protoconch has a diameter of 0.06 mm. The spire consists of 4 to 5 overlapping whorls. The species is comparable with *Assilina sp. A* described above, but differs from it in the convexity of the test and number of whorls.

G.S.I. Type Number: 19960 to 19964.

Suborder Miliolina DELAGE & HEROUARD, 1896

Superfamily Miliolacea EHRENBERG, 1835

Family Sortitidae EHRENBERG, 1839

Subfamily Soritinae EHRENBERG, 1839

Type species: *Orbitolites complanata*
LAMARCK, SD DOUVILLE, 1902

Orbitolites of O. complanata LAMARCK

(Pl. I—4)

Remarks: The species is represented by two sub-axial sections which show a large nucleoconch, which is

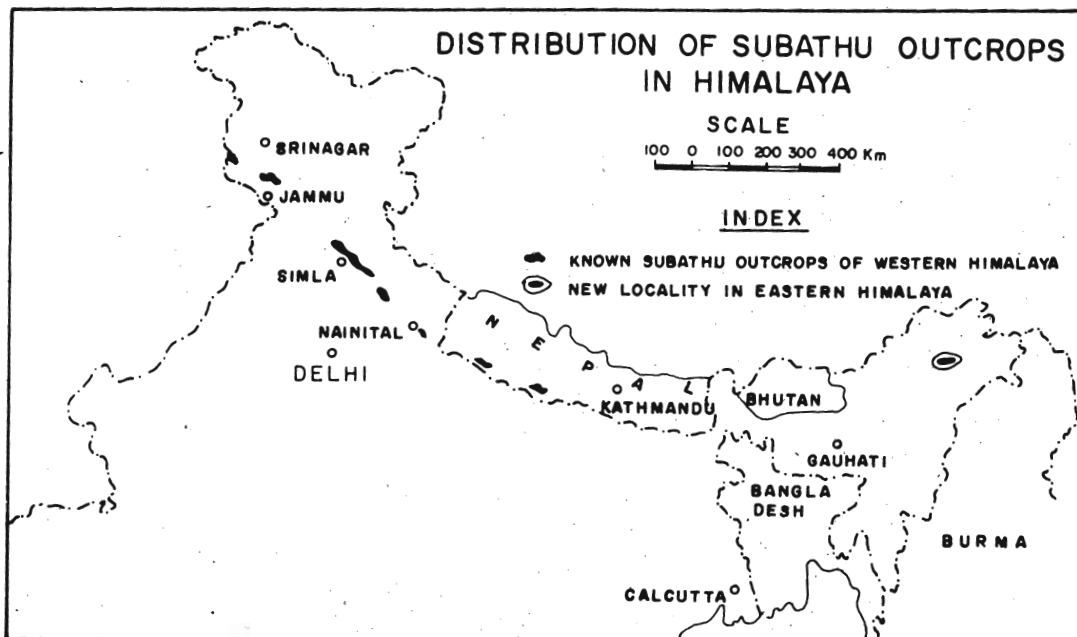


Fig. 2

multilocular, the chambers are in annular series. Chambers are arranged in successive alternate series, each chamber connecting the preceding annulae by pores. The figured specimens are comparable with *Orbitolites complanata* Lamarck.

G.S.I. Type Number: 199665

Family Discocyclinidae GALLOWAY, 1928

Genus *Discocyclina* GUMBEL, 1870

Type species: *Orbitolites pratti* MICHELIN, 1846

Discocyclina sp.

(PII—8)

Remarks: One oblique section of the orbitoidal foraminifera has been illustrated which shows the characters of chambers attributable to *Discocyclina* sp.

G.S.I. Type Number: 19666.

FAUNAL ANALYSIS

The following assemblage has been illustrated from the Yinkiong Formation.

Nummulites sp. A, *Nummulites* sp. B, *Nummulites* sp. cf. *N. globulus* Leymerie, *Assilina dandotica* Davies, *Assilina* sp. A, *Assilina* sp. B, *Orbitolites* cf. *complanata* Lamarck and ?*Discocyclina* sp.

The above assemblage has been attributed to Early Eocene.

The above assemblage has been compared with the Subathu assemblage of western Himalaya on account of the presence of *Assilina dandotica* Davies, and the earlier record of the following assemblage from the Rengging Formation (Tripathi et al. 1981) of Arunachal Pradesh: *Nummulites atacicus*, *N. globulus*, *N. lahirii*, *N. nuttalli*, *N. thalicus*, *N. wadiai*, *Assilina dandotica*, *A. granulosa*, *Lockhartia* cf. *conditi*, *L. hamiei*, *L. cf. conica*, *Miscellanea miscella*, *Miscellanea* sp. and *Lepidocyclus* (*Polylepidina*) sp.

SUBATHU SEA

Nagappa (1959) had earlier analysed the larger foraminiferal assemblages recorded from Sind-Baluchistan (now in Pakistan) in the west to Assam, Burma, Andaman and Nicobar islands in the east. He had broadly concluded that the tethyan nummulitic fauna (represented by the faunal assemblage occurring in the Subathu Group of rocks and their equivalents) was distinct from the Indo-Pacific fauna of the Burmese region, and the assemblage recorded from Shillong Plateau in Assam (now Meghalaya) is intermediate between the two. These conclusions, in spite of additional records of larger foraminifera from western Himalaya and Assam still hold good today (see table 1).

The significant record of larger foraminiferal assemblage akin to Subathu fauna from the Eastern Himalaya

(Tripathi et al. 1981; and present record), in similar stratigraphic/tectonic setup is considered suggestive of the continuity of Subathu sea, a successor of Tethys, upto Arunachal Pradesh (Fig. 2). The easternmost record of Subathu and equivalent strata from the western Himalaya comes from Tansen area of Nepal (Sakai, 1983); a strike length of nearly 900 km separates the East Siang district outcrop from that of Tansen area. Nevertheless the possibilities of finding additional outcrops in the intervening area can not be ruled out. Thus the extent of the Subathu sea all along the northeastern shore of the Indian Plate (shield) must have resulted in the deposition of Palaeocene-Eocene strata in brackish, littoral and neritic environments. The subsequent Himalayan tectonism and nappe systems, resulting from the northeastward drift of the Indian Plate might have contributed to the present scanty nature of the Subathu outcrops and the partial concealment below the Himalaya nappe systems as envisaged by Acharyya and Ray (1978) earlier.

Table 1 Distribution of larger foraminifera recorded from the Subathu Group in Western Himalaya and their equivalents from Arunachal Pradesh, Meghalaya (Shillong Plateau) and Burma

Name of species	Subathu Group	Arunachal Pradesh	Meghalaya	Burma
<i>Nummulites acutus</i> (Sowerby)	x		x	
<i>N. atacicus</i> Leymerie	x	x		x
<i>N. barroni</i> Chapman	x			
<i>N. beaumonti</i> d'Archaic & Haime	x		x	x
<i>N. discorbinus</i> (Schloth.)	x			
<i>N. discorbinus</i> (Schloth.) minor	x			
<i>N. djokjokartae</i> (Martin)	x			
<i>N. gizehensis</i> Forks.			x	
<i>N. globulus</i> Leymerie	x	x		
<i>N. cf. ketalensis</i> Carter	x			
<i>N. irregularis</i> Deshayes	x			
<i>N. lahiri</i> Davies	x	x		
<i>N. laevigatus</i> (Brung.)			x	
<i>N. cf. mamilla</i> (Fichtel & Moll)	x	x		
<i>N. nuttalli</i> Davies	x	x		
<i>N. obesus</i> d'Arch.				x
<i>N. obtusus</i> (Sowerby)	x		x	
<i>N. pengaroensis</i> Verbeek			x	
<i>N. perforatus</i> (Montfort)	x		x	
<i>N. planulatus</i> Lamarck	x			
<i>N. ramondi</i> DeFr.			x	
<i>N. scaber</i> Lamarck	x		x	
<i>N. stamineus</i> Nuttall	x			
<i>N. striata</i> (Bruguiere)	x			
<i>N. subatacicus</i> Douville	x	x		
<i>N. thalicus</i> Davies	x	x		
<i>N. uranensis</i> de la Harpe	x			
<i>N. variolarius</i> (Lamarck)	x			
<i>N. wadiai</i> Davies	x	x		
<i>N. yauensis</i> Cott.				x
<i>Assilina dandotica</i> Davies	x	x		
<i>A. daviesi</i> de Cizancourt	x			
<i>A. daviesi</i> var. <i>nammalensis</i> Gill	x			
<i>A. exponents</i> (Sowerby)	x			

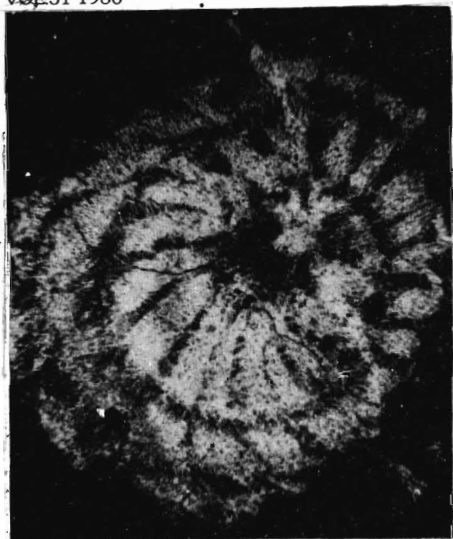
<i>A. granulosa</i> (d'Archaic)	x	x		
<i>A. granulosa</i> var. <i>chumbiensis</i> Gill	x			
<i>A. laminosa</i> Gill	x			
<i>A. laeymeriei</i> (d'Archaic & Haime)	x			
<i>A. cf. mamillata</i> (d'Archaic)	x			
<i>A. orientalis</i> Rutten	x			
<i>A. papillata</i> Nuttall			x	x
<i>A. regularia</i> (Ghose)			x	
<i>A. regularia sijuensis</i> Samanta			x	
<i>A. spinosa</i> Davies	x			
<i>A. spira</i> (de Roissy)	x		x	
<i>A. spira corrugata</i> de la Harpe			x	
<i>A. spira taikhimensis</i> Samanta			x	
<i>A. subdaviesi</i> Gill	x			
<i>A. sublaminosa</i> Gill	x			
<i>A. subspinosa</i> Davies	x			
<i>A. subspira corrugata</i> Samanta			x	
<i>A. subspira rongmukensis</i> Samanta			x	
<i>A. simsongi</i> Samanta			x	
<i>A. subsimsongi</i> Samanta			x	
<i>A. subassamica</i> Samanta			x	
<i>A. subassamica sijuensis</i> Samanta			x	
<i>A. subumblicate</i> de Cizancourt	x			
<i>A. cf. umbilicate</i> (Rutten)			x	
<i>Lockhartia cf. conditi</i> (Nuttall)	x	x		
<i>L. conica</i> Smout	x	x		
<i>L. haime</i> (Davies)	x	x		
<i>L. hunti</i> (Davies)	x			
<i>L. hunti</i> var. <i>pustulosa</i> Smout	x			
<i>L. tipperi</i> Davies	x			
<i>Pellatispira</i> sp.			x	x
<i>Biplanispira</i> sp.				x
<i>Asterigerina</i> sp.				x
<i>Gypsina globula</i> (Reuss)				x
<i>Ranikothalia</i> sp.	x		x	
<i>Miscellanea</i> sp.	x		x	
<i>M. miscella</i> (d'Archaic & Haime)		x		
<i>Operculina</i> sp.	x			x
<i>O. canalifera</i> d'Archaic	x		x	x
<i>O. patalensis</i> Davies	x			
<i>O. sp. cf. O. paronai</i> Checcia-Risp.	x			
<i>Operculinoides</i> sp.	x			
<i>Discocyclina</i> sp.		x		
<i>Discocyclina dispersa</i> (Sowerby)		x		
<i>D. flemengi</i> Davies	x			
<i>D. omphalius</i> Fritsch				x
<i>D. radianus</i> d'Archaic		x		
<i>D. sowerbui</i> Nuttall		x		
<i>D. cf. trionalis</i> Cresp.				x
<i>D. undulata</i> Nuttall		x		
<i>Alveolina</i> sp.			x	
<i>A. oblonga</i> d'Orbigny	x			
<i>A. ovidea</i> d'Orbigny	x			
<i>A. primaeva</i> Reichel			x	
<i>Orbitolites complanata</i> Lamarck			x	
<i>O. cf. complanata</i> Lamarck			x	
<i>Opertoorbitolites</i> sp.			x	
<i>Lepidocyclina</i> (Polylepidina) sp.		x		

After: Archaic, J.A. d' and Haime 1853-54, Singh, S. 1952, Mandwal, N.K. 1959, Nagappa, Y. 1959, Tewari, B.S. 1961, Pant, S.C. 1962, Pant, S.C. and Iqbaluddin, 1962, Samanta, B.K. 1962,

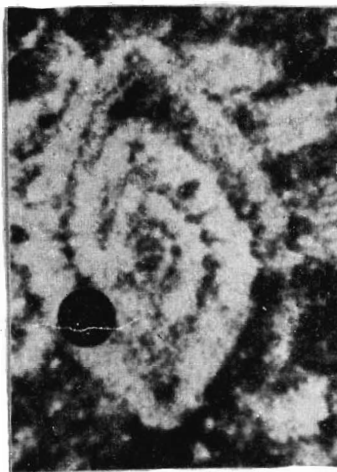
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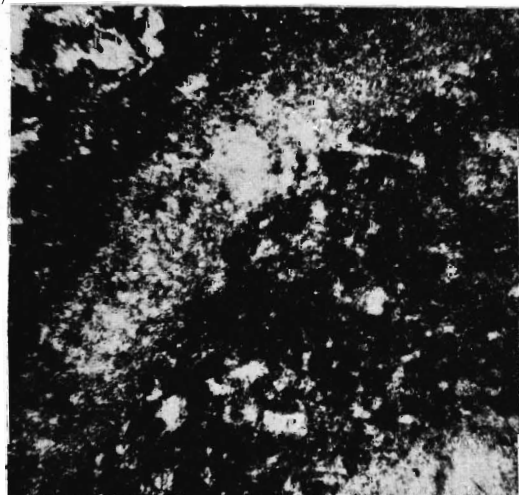
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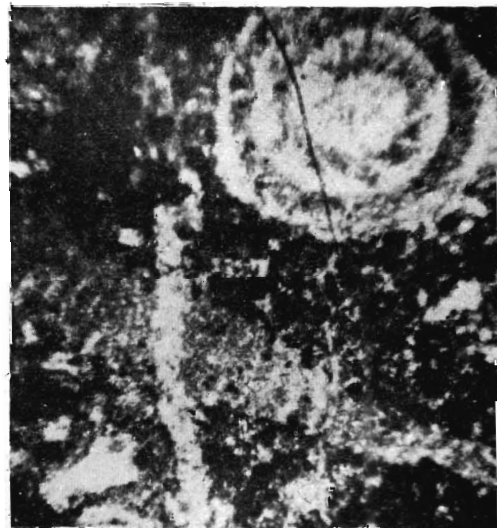
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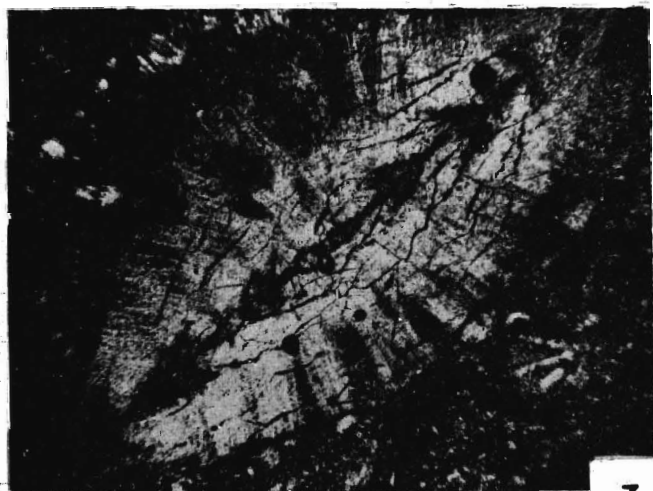
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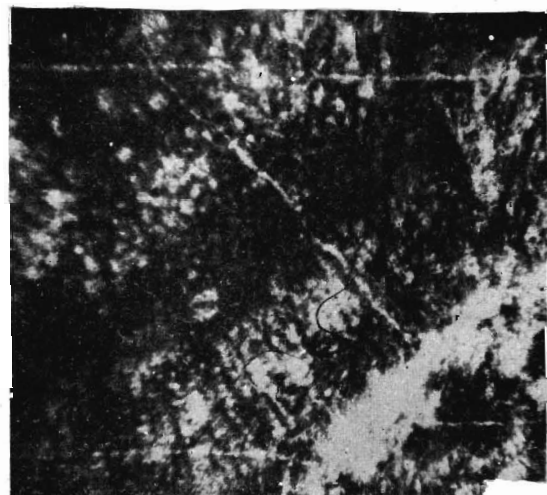
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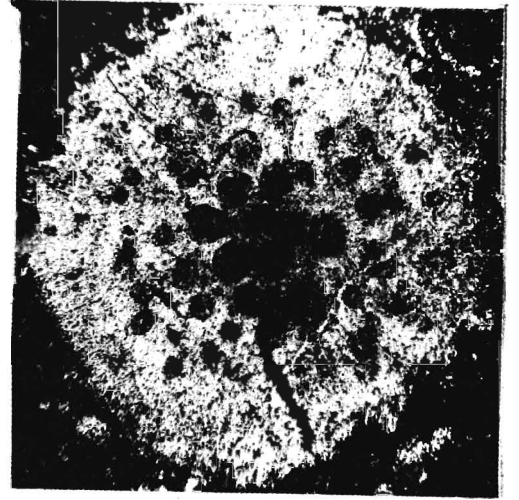
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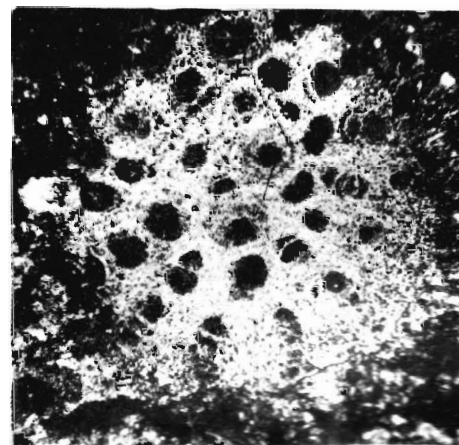
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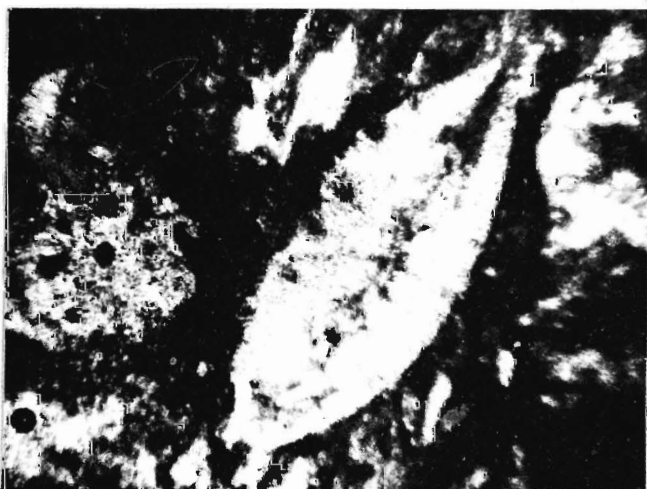
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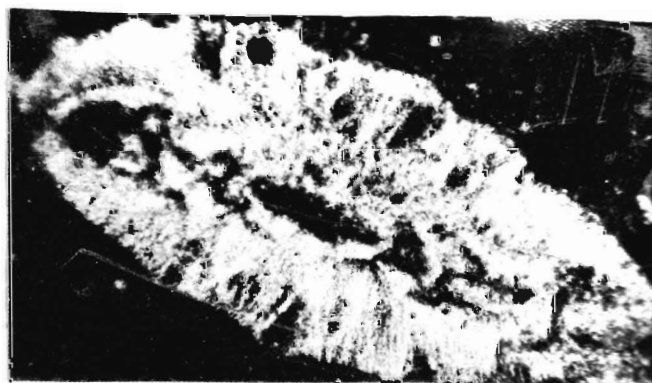
4



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EXPLANATION OF PLATES

PLATE I (All figures x 30)

1. *Nummulites*: sp. A, GSI Type No. 19943.
2. *Nummulites*: sp. A, GSI Type No. 19944.
3. *Nummulites*: sp. A, GSI Type No. 19945.
4. *Orbitolites* cf. *O. complanata* Lamarck, GSI Type No. 19965.
5. *Nummulites*: sp. A, GSI Type No. 19946
6. *Nummulites* sp. A, GSI Type No. 19947
7. *Assilina* sp. A, GSI Type No. 19953
8. ? *Discocyclina* sp., GSI Type No. 19966

PLATE II (All figs. x 30, except fig. 8 x 10)

1. *Assilina dandotica* Davies, GSI Type No. 19951
2. *A. dandotica* Davies, GSI Type No. 19952
3. *Assilina* sp. A, GSI Type No. 19954
4. *Nummulites* sp. B, GSI Type No. 19948
5. *Assilina* sp. B, GSI Type No. 19960
6. *Assilina* sp. B, GSI Type No. 19961
7. *Nummulites* sp. B, GSI Type No. 19949
8. *Assilina* sp. B, GSI Type No. 19955
9. *Nummulites* cf. *N. globulus* Leymerie, GSI Type No. 19950

PLATE III (All figs x 30)

1. *Assilina* sp. A, GSI Type No. 19956
2. *Assilina* sp. A, GSI Type No. 19957
3. *Assilina* sp. A, GSI Type No. 19958
4. *Assilina* sp. A, GSI Type No. 19959
5. *Assilina* sp. B, GSI Type No. 19962
6. *Assilina* sp. B, GSI Type No. 19963
7. *Assilina* sp. B, GSI Type No. 19964