

# A STUDY OF FOSSIL ALGAE FROM SYLHET LIMESTONE FORMATION OF MEGHALAYA AND MIKIR HILLS, ASSAM†

A. K. PAL\* AND S. K. DUTTA\*\*

\*Geological Survey of India, Lucknow

\*\*Dibrugarh University, Dibrugarh

## ABSTRACT

This paper deals with the geology and algal remains of the Sylhet Limestone Formation. The formation comprises three limestone members namely, Lakadong, Umlatodoh and Prang with two intervening sandstone members in ascending order. The Limestones are rich in foraminifera and algae. Sixteen species of red algae belonging to fourteen genera are described. The Lakadong Member is characterised by *Distichoplax-Dissocladella* assemblage, Umlatodoh by *Furcoporella-Griphoporella* assemblage and the Prang by *Lithothamnium-Halimeda* assemblage. The algal assemblages suggest Landenian, Ypresian and Lutetian ages respectively. These results corroborate the ages suggested by foraminiferal evidences. The presence of algae indicates deposition in shallow, marine conditions with minor fluctuations.

## INTRODUCTION

The areas under investigation are located in : (1) around Lumshnong on the south eastern slopes of the Shillong Plateau, in the Jaintia Hills, (2) Mawmluh Hills, Lower Cherrapunjee in the Khasi Hills, both areas belonging to the State of Meghalaya, and (3) the Kailapahar and Slibhetta areas of Mikir Hills in the State of Assam. Of these, the Lumshnong area presents the most complete section (Map 1) of the entire Sylhet Limestone Formation. The Mawmluh Hills show only the Lakadong Member while Silbhetta and Kailapahar show the presence of Prang Member only.

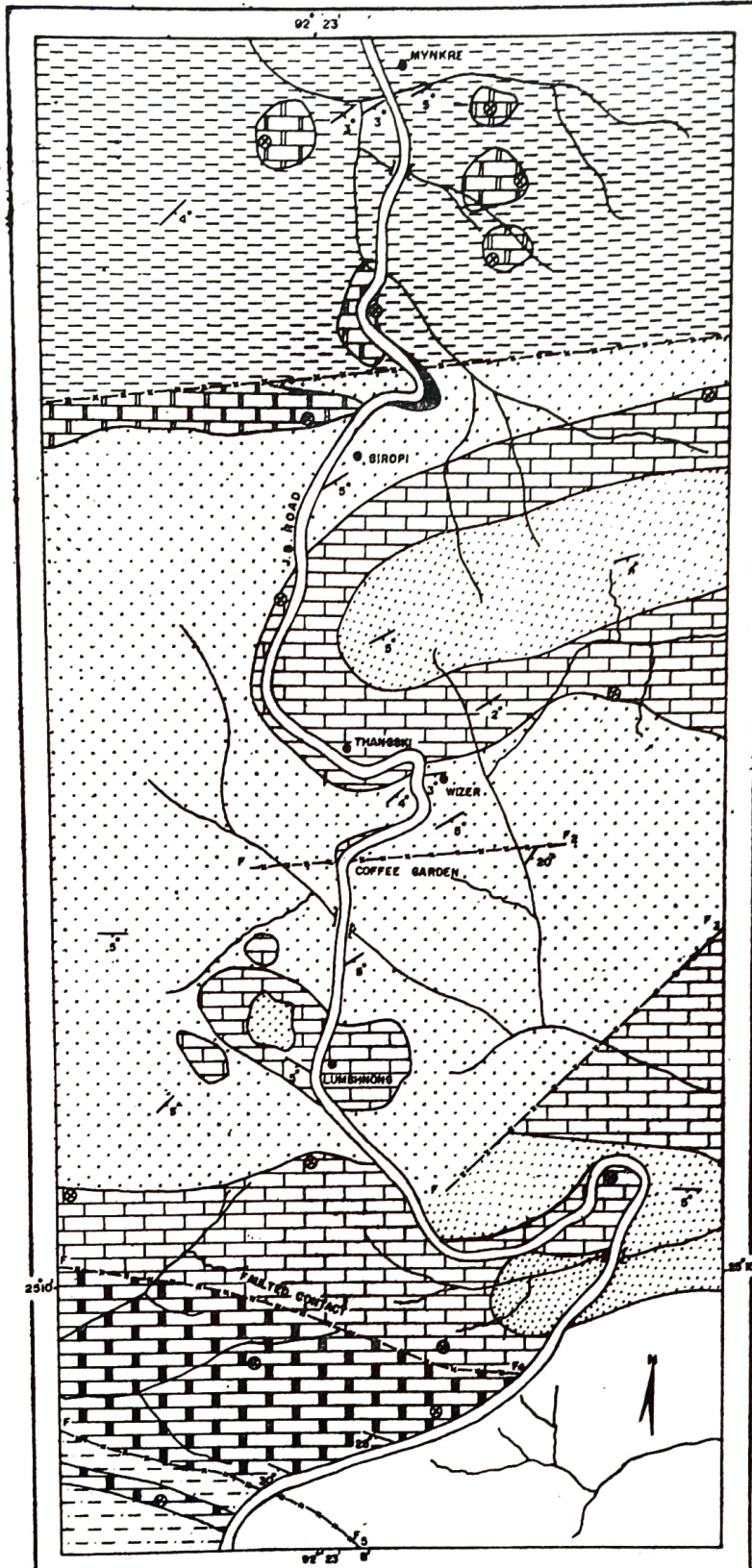
A composite stratigraphy of the various sections observed in the area around Lumshnong presents the following succession :

Formation	Member	Lithology	Age
Kopili Formation		Alternations of shales and sandstones with bands of calcareous sandstone to mainly light to dark grey splintery shales, fine grained sandstones and bands of fossiliferous limestone and marl especially towards bottom.	Priabonian
Sylhet Limestone Formation	Prang Limestone	Fossiliferous limestone, light grey hard and massive with abundant <i>Discocyclusina sowerbi</i> , <i>Pecten</i> , <i>Arca</i> and <i>Assilina</i> .	Lutetian
	Nurpuh Sandstone	Bedded sandstone with subordinate calcareous band and impersisitent coaly layer.	Ypresian
	Umlatodoh Limestone	Hard light grey massive fossiliferous limestone with occasional sand bands.	
	Lakadong Sandstone	Well bedded fine to medium grained sandstone with thin coal seams interstratified with carbonaceous shale and clay.	Landenian
Therria Formation	Lakadong Limestone	Fossiliferous limestones with occasional shale bands.	Palaeocene
		Hard, compact well bedded sandstone, contains coal.	

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





GEOLOGICAL MAP OF THE AREA AROUND LUMSHNONG

SCALE - 1 MILE



U.S. GEOLOGICAL SURVEY

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|  | LAKADONG LIMESTONE  |   |                |
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The Sylhet Limestone Formation has been divided into : Lakadong Limestone, upto 150 m of fossiliferous limestone ; Lakadong Sandstone, upto 24 m of sandstone with workable coal seams ; Umlatodoh Limestone, upto 60 m of limestone with sandstone bands; Nurpuh Sandstone, about 20 m of sandstone with calcareous band and coaly layer and Prang Limestone, up to 270 m of fossiliferous limestone.

The Sylhet Limestone has been traced north east of the Mikir Hills and has been found in deep wells in the Brahmaputra Valley, a thickness of about 400 m having been proved (MATHUR & EVANS, 1964). Recent drilling for oil in the Tengakhat well in the Brahmaputra Valley reveals that the Prang Limestone Member of the Sylhet Formation has extended as far as Tengakhat in the Dibrugarh District on the north, if not further beyond. In the Tengakhat well, Lakadong Sandstone has been recognised on palynological basis at a depth of 3540 metres (DUTTA, 1976).

### Lakadong Limestone

The limestone is light bluish grey to dark grey in colour. It is compact, hard, fine grained and contains both mega and microforaminifera. The limestone often grades into calcareous sandstone towards the top. It is also observed to contain sporadic disseminations of pyrite grains and specks near the contact with the overlying Lakadong Sandstone. The dip of the beds is gentle, varying between 4° to 8° towards south and south east and occasionally  $\pm$  horizontal.

So far, Lakadong Limestone is recorded only from the Khasi and Jaintia Hills in the State of Meghalaya. Although quite a good number of deep oil wells have been dug in the Sibsagar and Dibrugarh District, so far no limestone belonging to Lakadong Member has been encountered.

The Lakadong Limestone forms the lowermost member of the Sylhet Limestone Formation. It is very rich in foraminifera. Important forms are : *Miscellanea miscella*, *Discocyclina ranikotensis*, *Lockhartia haimei*, *Operculina* cf. *canalifera*, *Quincoloculina*, *Alveolina* sp. and *Gypsina* sp. with a rich assemblage of calcareous algae. The fossil assemblage suggests Landenian age. This limestone has been equated with the Ranikot Stage (KRISHNAN, 1968).

### Umlatodoh Limestone

Good exposures of Umlatodoh Limestone occur from the South of the village Siropi (milestone 75) to near the 82/6 milestone on the Jowai-Badarpur Road in the Jaintia Hills, Meghalaya. In the northern part the limestone is exposed as detached and irregular patches, while towards south it occurs as a long, continuous band trending east-west.

In the Khasi Hills, these rocks are exposed on the Cherra-Shella Road near Ishamoti and on the bridle path between Buribazar and Komorrah limestone quarry.

So far, apart from the Khasi and Jaintia Hills, Umlatodoh Limestone has not been reported from anywhere in the N. E. region. However, a part of the Tura Sandstone of the Garo Hills may be the time equivalent of this limestone since the Tura Formation spans the time from Therria to Prang.

The Limestone is rich in foraminifera. At places more than 50 per cent of the total assemblage is dominated by *Alveolina elliptica* and *A. oblonga*. Other associated foraminifers are *Nummulites atacicus*, *N. irregularis*, *Discocyclina*, *Miliolidae*, etc. This limestone member has been equated with the Laki Stage (KRISHNAN, l. c.). These fossils suggest Ypresian age for this limestone.

## Prang Limestone

The Prang Limestone forms the uppermost member of the Sylhet Limestone Formation. This limestone member is most widely distributed in the States of Meghalaya and Assam. Good exposures are found at Tong seng near Lumshnong, Jaintia Hills; at Kommorah, Khasi Hills; near Kopili, N. Cachar and at Silbhetta, Kailapahar and Sainalangso in Mikir Hills. In the Brahmaputra Valley this limestone member has been encountered in the deep bore holes at Disangmukh, Dikhowmukh and Teok of the Sibsagar District (METRE, 1969) and Tengakhat of the Dibrugarh District, Assam.

In the Prang Limestone *Assilina spira corrugata* and species of *Nummulites* such as *N. beaumonti*, *N. obtusus*, *N. pangaroensis*, *N. acutus* are quite common. Other important forms are *Discocyclus omphala*, *D. sowerbi*, *Assilina papillata*, etc.

The Prang Limestone is equated with the Kirthar Stage (KRISHNAN, *l.c.*). These fossils suggest the Lutetian age for this limestone.

A check list of the fossil algal species described here follows :

### RHODOPHYCOPHYTA : CORALLINACEAE

#### MELOBESIOIDEAE

*Archaeolithothamnium* aff. *A. keenani* Howe

*Lithothamnium andamanensis* Chatterji & Gururaja

*L.* aff. *L. bofilli* Lemoine

*Mesophyllum meghalayensis* sp. nov.

*Lithoporella melobesioides* (Foslie) Foslie

*Melobesia* sp.

*Distichoplax biserialis* (Diet.) Pia

*D. raoi* Verma

#### CORALLINOIDEAE

*Jania occidentalis* Johnson 1965

### CHLOROPHYCOPHYTA : CODIACEAE

*Halimeda* sp.

#### DASYGLADACEAE

*Griphoporella arabica* Pfender

*Neomeris* sp.

*Furcoporella diplopora* Pia

*Trinocladus umlatodohensis* sp. nov.

*Cymopolia* sp.

*Dissocladella lakadongensis* sp. nov.

Genus—**Archaeolithothamnium** Rothpletz 1891

**Archaeolithothamnium** aff. **A. keenani** Howe 1934

Pl. 1, Figs. 1-2; Pl. 2, Fig. 15.

*Description*—Thallus crustose, 0.6 to 0.8 mm, hypothallus of curved layers of rectangular cells, 10-24  $\mu\text{m}$  wide and 8-20  $\mu\text{m}$  high. Perithallus of horizontal rows of squarish cells, 10-20  $\mu\text{m}$  wide and 10-20  $\mu\text{m}$  high. Sporangia elliptical, not collected into conceptacles, 95-120  $\mu\text{m}$  high and 45-60  $\mu\text{m}$  wide.

*Remarks*—The fragments possess the hypothallic and perithallic tissue and arrangements of sporangia characteristic of *A. keenani*. The general appearance and the cell dimensions closely fit HOWE's (1934) descriptions and the specimens described by JOHNSON AND STEWART (1953).

Age—Landenian to Ypresian. It has been reported from the Lower Eocene of California by JOHNSON AND STEWART (*l. c.*) and HOWE (*l. c.*).

Horizon and Locality—Umlatodoh Member, Jaintia Hill.

Type No.—60-61.

Genus—**Lithothamnium** Philippi 1837

**Lithothamnium andamanensis** Chatterji & Gururaja 1972

Pl. 4, Figs. 27-28.

*Description*—Thallus branched, about 5-6 mm long and 1.5-2 mm wide. Hypothallus up to 0.8 mm. wide, shows curved lenticular growth zone. Each growth zone is thick at the centre, tapers laterally, consists of 5-7 layers of cells. The cells measure 15-20  $\mu\text{m} \times 15-18 \mu\text{m}$ . Perithallus thin, conceptacle 400  $\times$  200  $\mu\text{m}$ .

*Remarks*—The present specimens agree closely with *L. andamanensis* described from the Upper Palaeocene of South Andamans. This species has not been recorded earlier from N. E. India.

Age—Landenian.

Horizon and locality—Lakadong Member, Khasi Hills (near Mawmluh) and Jaintia Hills (near Lumshnong).

Type No.—5 and 40.

**Lithothamnium** aff. **bofilli** Lemoine 1939

Pl. 3, Fig. 20.

*Description*—Thallus crustose, thin (0.4-0.5 mm) mammilose; hypothallus well developed, made up of rectangular to slightly irregular cells (12-18  $\mu\text{m} \times 7-15 \mu\text{m}$ ) arranged in fountain like files. The perithallial cells rectangular (10-15  $\mu\text{m} \times 8-10 \mu\text{m}$ ). Conceptacles hemispherical (350  $\mu\text{m} \times 130 \mu\text{m}$ ).

*Remarks*—*L. bofilli* Lemoine is known from the Lutetian (Middle Eocene) of Spain and Middle to Upper Eocene of Algeria (Lemoine, 1939). Rao (1943) reported this species from Nongstein Road section from the basal band of Cherra Limestone. The present study shows that this alga is confined to Prang limestone.

Age—Lutetian.

Horizon and Locality—Prang Member, Jaintia Hills.

Type No.—109.

Genus—**Mesophyllum** Lemoine 1928

**Mesophyllum meghalayensis** sp. nov.

Pl. 1, Figs. 3-4.

*Holotype*—Pl. 1, Fig. 3.

*Diagnosis*—Thallus nodular with protuberances, coaxial hypothallus of rectangular cells, perithallus of squarish cells, showing strong growth zones. Conceptacle with several pores.

*Remarks*—This species is fairly common in the samples from Lakadong Limestone. It differs distinctly from *Mesophyllum daviesi* Rao (1943) and *Mesophyllum* sp. Shripad Rao (1943) in having a nodular shape with protuberances. *M. californicum* Johnson & Stewart resembles the present specimens in having similar hypothallial and perithelial tissue but differs in having larger sporangial conceptacles.

Age—Landenian.

Horizon and locality—Lakadong Member, Jaintia Hills.

Type No.—45.

Genus—**Lithoporella** Foslie 1909

**Lithoporella melobesioides** (Foslie) Foslie 1943

Pl. 1, Fig. 6

*Description*—Monostromatic, with the cells, rectangular in shape,  $48 \times 16 \mu\text{m}$ — $60 \times 20 \mu\text{m}$ .

*Remarks*—This is a cosmopolitan Lower Tertiary alga. In India, this is known from the Palaeocene to Nerinea beds of Pondicherry, Bagh beds of Narmada Valley and Andamans (SASTRY, RAO & IQBALUDDIN, 1963; PAL, 1969; CHATTERJI & GURURAJA, 1972).

*Age*—Landenian.

*Horizon and locality*—Lakadong Member, Jaintia Hills.

*Type No.*—68.

Genus—**Melobesia** Lamouroux 1812

**Melobesia** sp.

Pl. 1, Fig. 5.

*Description*—Thalli monostromatic, the cells squarish or a little wider than high.

*Remarks*—The present specimen differs from *M. (Lithoporella) assamica*, the only other species reported from Assam by being monostromatic in habit. We feel that the latter species which is crustose and upto 4 layers thick, may be referred to *Peyssonnelia* Decaisne 1841. Because of the fragmentary nature of the present specimen, no attempt has been made to place it in any species of *Melobesia* described so far.

*Age*—Landenian.

*Horizon and locality*—Lakadong Member, Jaintia Hills.

*Type No.*—4.

Genus—**Jania** Lamouroux 1812

**Jania occidentalis** Johnson 1965

Pl. 2, Fig. 16.

*Description*—Segments and fragments of segments showing tiers of axial cells, surrounded by a narrow layer of marginal cells. The axial cells  $60\text{--}70 \mu\text{m}$  long and  $12\text{--}15 \mu\text{m}$  wide. The marginal cells almost squarish,  $15 \mu\text{m} \times 15 \mu\text{m}$ .

*Remarks*—This species had been reported from mid-Palaeocene of Guatemala by JOHNSON (1965). It has not been reported earlier from N. E. India.

*Age*—Landenian.

*Horizon and locality*—Lakadong Member, Khasi Hills (near Mawmluh).

*Type No.*—5A.

Genus—**Distichoplax** Pia 1934

**Distichoplax biserialis** (Diet.) Pia 1934

Pl. 2, Fig. 13.

*Remarks*—Our specimens appear to be identical with *Distichoplax biserialis* (Diet.) Pia 1934. It is quite abundant in the Lakadong Limestone and was earlier recorded from Langrin area of Khasi Hills by SRIPADA RAO (1943, pp. 285-286). This is an index fossil for Palaeocene with a world-wide distribution.

*Age*—Landenian.

*Horizon and locality*—Lakadong Member, Jaintia Hills.

*Type No.*—98.

**Distichoplax raoi** Verma 1960

Pl. 2, Figs. 9, 14.

*Description*—Thallus very thin. Biserial to multilayered arrangement of cells inclined or perpendicular to central axis. Cells opposite or alternate, rhombic in shape with arms 42.8 u.

*Remarks*—The specimens essentially correspond to *D. raoi* originally reported from the Samana Range. *D. raoi* has also been recorded from the Palaeocene of Bagh beds in association with *D. biserialis* (PAL, 1968). In the present area it is recorded from the Lakadong Limestone of Khasi Hills again in association with *D. biserialis*.

*Age*—Landenian.

*Horizon and locality*—Lakadong Member, Khasi Hills.

*Type No.*—99-100.

Genus—**Halimeda** Lamouroux 1812

**Halimeda** sp.

Pl. 4, Fig. 29.

*Description*—Branches 8 mm. long or more and 0.6 mm. wide, with a medullary zone 200  $\mu\text{m}$  wide, composed of tubular filaments of 50  $\mu\text{m}$  diameter, surrounded by a peripheral zone about 200  $\mu\text{m}$  thick. The coarse tubes of central area are more or less parallel to centre but curve outward branching repeatedly ending in fine short tubes perpendicular to surface.

*Remarks*—Present species is quite common in Prang Limestone of Mikir Hills. Though the preservation is fairly good, the random sections do not show sufficient detail. Hence, no specific identification could be made.

*Age*—Lutetian.

*Horizon and locality*—Prang Member, Mikir Hills around Kailapahar.

*Type No.*—33.

Genus—**Griphoporella** Pia 1915

**Griphoporella arabica** Pfender 1938

Pl. 3, Figs. 17, 24.

*Description*—Broadly club-shaped or elongate-ovoid, thin walled, hollow calcifications, external diameter 740  $\mu\text{m}$ —800  $\mu\text{m}$ . Wall thickness up to 80  $\mu\text{m}$ , perforated by close-set straight sides pores of 15-20  $\mu\text{m}$  diameter, widening very slightly at the external surface.

*Remarks*—Our material compares closely with *G. arabica* known from Palaeocene and Eocene of France, N. Africa and Middle East (PFENDER, 1938, 1940; ELLIOTT, 1955—1968). So far, *G. arabica* has not been recorded from India.

*Age*—Landenian-Ypresian.

*Horizon and locality*—Umlatodoh Member of Jaintia Hills.

*Type No.*—2 and 95.

Genus—**Neomeris** Lamouroux 1816

**Neomeris** sp.

Pl. 3, Fig. 17.

*Description*—A slightly oblique, longitudinal section of a fragment showing pear shaped sporangia. Calcification restricted to the outermost layer containing sporangia. Seven sporangial cavities observed within the fragment.

Width of fragment (calcified)	..	..	..	235	$\mu\text{m}$
Length of fragment	..	..	..	1.07	$\mu\text{m}$
Length of sporangial cavity	..	..	..	160	$\mu\text{m}$
Width of sporangial cavity	..	..	..	107	$\mu\text{m}$
Space between adjoining sporangial cavities	..	..	..	53	$\mu\text{m}$

*Remarks*—The present specimen has not been assigned to any described species because of its fragmentary nature.

*Age*—Landenian to Ypresian.

*Horizon and locality*—Umlatodoh Member, Jaintia Hills.

*Type No.*—2C.

Genus—**Furcoporella** Pia 1918

**Furcoporella diplopora** Pia 1918

Pl. 3, Fig. 18; Pl. 4, Fig. 26.

*Description*—Hollow cylindrical calcareous tubes upto 1.2 mm long with external diameter upto 40  $\mu\text{m}$  internal diameter 300  $\mu\text{m}$ ; wall thickness 100-130  $\mu\text{m}$ . Numerous regular whorls of paired branches, about 8 pairs in each whorl, each commencing from the inside of the tube as a single large pore. In transverse section, the very short primary canal seen to divide into two secondaries which diverge at about 60° widening slightly in a straight course to the periphery where they widen sharply.

*Remarks*—The present specimens compare closely with *F. diplopora* known from the Palaeocene and Eocene of Central and Southern Europe and Middle East (PIA, 1918; PFENDER, 1940; ELLIOTT, 1956, 1960, 1968; MASSIEUX, 1966). It is recorded for the first time in India.

*Age*—?Landenian to Ypresian.

*Horizon and locality*—Umlatodoh Member, Jaintia Hills.

*Type No.*—3A and 21.

Genus—**Trinocladus** Raineri 1922

**Trinocladus umlatodohensis** sp. nov.

Pl. 3, Fig. 19.

*Holotype*—Pl. 3, fig. 19.

*Diagnosis*—Small, thick walled, tubular dasyclad, up to 1 mm. long and 0.55 mm. in diameter, successively widening branches up to the third degree.

*Description*—Fragments of a calcified tubular dasyclad showing successive verticils of radial branches, each branch showing outwardly widening primaries giving rise to several similar-shaped secondaries and these in turn giving rise to tertiaries. Outer diameter 440  $\mu\text{m}$ —550  $\mu\text{m}$ , internal diameter 230  $\mu\text{m}$ , length of fragments up to 0.9 mm; thickness of wall 160  $\mu\text{m}$ ; primary branches 60  $\mu\text{m}$ , when they leave the stem, widening up to 100  $\mu\text{m}$  when they branch out into secondaries; secondaries 40-45  $\mu\text{m}$ , and branching out to tertiaries 20-25  $\mu\text{m}$  in diameter.

*Remarks*—This species comes close to *T. tripolitanus* Raineri but differs in having a much smaller thallus and larger internal diameter. *T. perplexus* Elliot has a much larger thallus (2.5 mm) than our species.

*Age*—Ypresian.

*Horizon and locality*—Umlatodoh, Khasi Hills.

*Type No.*—2A (Holotype).



Genus—**Cymopolia** Lamouroux 1816

**Cymopolia** sp.

Pl. 3, Fig. 21.

*Description*—Club-shaped fragments of a horizontally set, whorled dasyclad. Each whorl consisting of several branch systems of the following pattern : an inner primary branch divided into several secondaries and one sporangial cavity, usually spherical. The secondaries reach the outer surface to give a dense pore pattern. Outer diameter 780  $\mu\text{m}$ . Primary branches 40  $\mu\text{m}$ , secondary 20  $\mu\text{m}$  and tertiaries 10-15  $\mu\text{m}$  in diameter. Sporangial cavities 60  $\mu\text{m}$  in diameter.

*Horizon and locality*—Umlatodoh Member, Jaintia Hills.

*Type No.*—36.

Genus—**Dissocladella** Pia 1936.

**Dissocladella lakadongensis** sp. nov.

Pl. 3, Figs. 22-23.

*Holotype*—Pl. 1, fig. 11.

*Diagnosis*—Thallus cylindrical or slightly widening upward, with a hollow central axis from which whorled primary branches emerge perpendicularly to the centre. Sporangia at the distal end of primary branch ; clusters of paired secondary branches arising from thin cuticle layer.

Species Characters	<i>D. undulata</i> (Raineri) Pia	<i>D. savitriae</i> Pia	<i>D. deserta</i> Elliott	<i>D. lakadongensis</i> sp. nov.
Length	1.4 + mm	3.5 mm	0.75	2.5 mm
Outer diam.	0.24—0.32 mm	1.5—2 mm	0.39—0.47	0.54 mm
Inner diam.	0.08—0.10 mm	1.1—1.6 mm		
Primary branches diam.	0.04—0.056 mm	0.026 mm		0.04 mm
No. in one whorl	8	40	12	18—20
Secondary branches	6 to a branch 0.024—0.056 mm	4—6 0.013 mm	..	4—6 0.020 mm
Locality	Albian-Cenoma- nian of Libya and U. Cretace- ous of Iraq	Danian of S. India	Palaeocene & L. Eocene of Iraq; L. Eocene of Egypt	Landenian of Meghalaya

Comparative measurement chart.

*Age*—Landenian

*Horizon and Locality*—Lakadong Member, Jaintia Hills (around Lumshnong).

*Type No.*—11 & 14.

*Description*—The cylindrical thallus has a maximum outer diameter of 0.54 mm and length upto 2.5 mm; diameter of primary branches 40  $\mu\text{m}$ , secondary branches 20  $\mu\text{m}$ ; sporangial cavities ellipsoidal, 60  $\mu\text{m} \times 40 \mu\text{m}$ .

*Remarks*—*D. lakadongensis* has a thin walled hollow calcareous cylinder with primaries arranged perpendicularly to the central axis. The sporangia differ from the other

three described species, viz., *D. undulata* (Raineri) Pia, *D. savitriae* Pia and *D. deserta* Elliott. The present species differs from *D. undulata* and *D. deserta* in having a longer thallus and a larger number of primary branches in a whorl. *D. savitriae* has a larger thallus and a much larger number of branches in a whorl.

#### DISCUSSION

The present study is based on systematic collection of samples from Lakadong, Umlatodoh and Prang members of the Sylhet Limestone Formation from the area around Lumshnong, Jaintia Hills. The samples from the Mikir and Khasi Hills were collected from well differentiated outcrops and subcrops. It is interesting to note that these members are marked by distinct assemblages of fossil calcareous algae. RAO (1943) has described four species of *Archaeolithothamnium*, five species of *Lithothamnium* and one species each of *Mesophyllum*, *Melobesia*, *Distichoplax* and *Corallina* from Sylhet Limestone Formation. But the precise horizons of the samples have not been ascertained. He has observed all these species in the Lakadong Member except one, i.e. *Lithothamnium* aff. *bofilli* which occurs only in the Prang Member. The present paper deals with species other than those which have been described earlier by RAO.

The Lakadong Member is rich in algal remains. Eight species, mostly of Corallinaceae are described here. Of these, *Lithothamnium andamanensis*, *Lithoporella melobesoides* and *Distichoplax biserialis* are quite common. The Umlatodoh Member shows an abundance of dasyclads over corallines. Amongst the six species, five are dasyclads, of which *Griphoporella arabica* and *Furcoporella diplopora* are quite common. The fossiliferous limestone beds are prolific in forams and occasionally fragmentary remains of algae are encountered. This comprises mostly coralline algae though certain thin bands show abundance of *Halimeda*. As the dasyclads grow mostly within a depth of 10 m, their abundance in Umlatodoh Member suggests a shallow and open sea environment. The Prang Member shows a comparatively smaller number of algal remains. However, *Halimeda* is common in the Silbhetta and Kailapahar area of Mikir Hills and *Lithothamnium* aff. *bofilli* is common in Lumshnong, Jaintia Hill.

The three algal assemblages from Lakadong, Umlatodoh and Prang Members suggest Landenian, Ypresian and Lutetian ages respectively. The result of these investigations corroborate the conclusion referred from the foraminiferal assemblages.

During the Palaeocene-Eocene times, the sedimentation continued uninterrupted on the shelf resulting in the deposition of the Sylhet Limestone Formation. This deposition took place under warm conditions in a shallow, open sea. This is evident by the presence of high quantities of forams and algae. The oscillatory movements during Eocene resulted in the deposition of interbedded shale and sandstone within the Sylhet Limestone Formation.

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## EXPLANATION OF PLATES

### PLATE 1

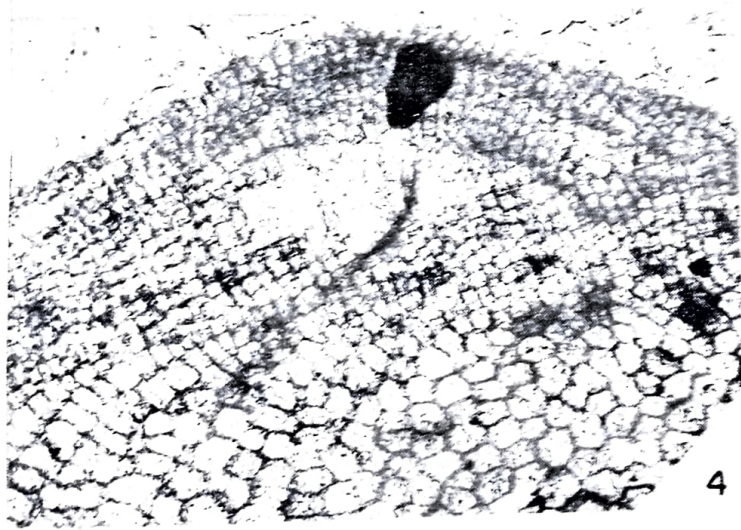
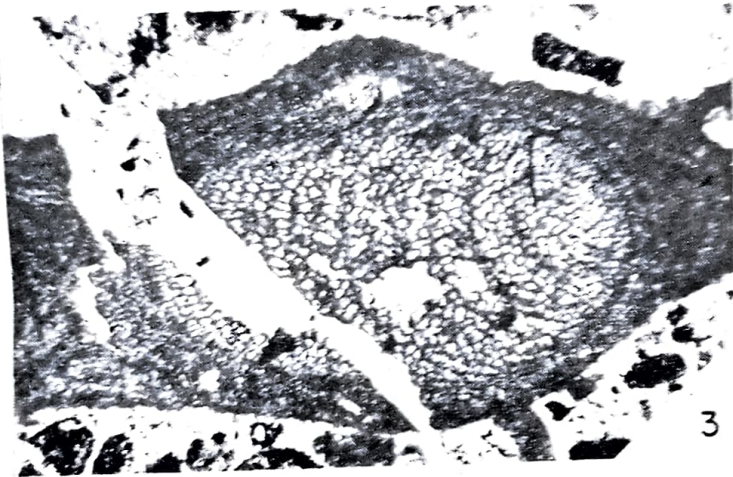
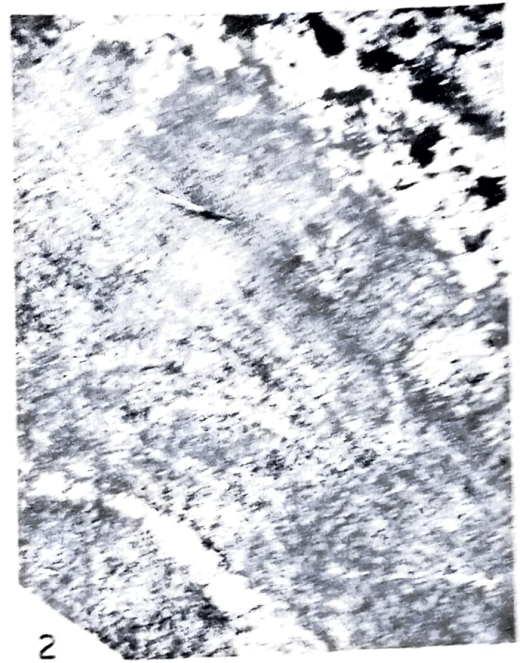
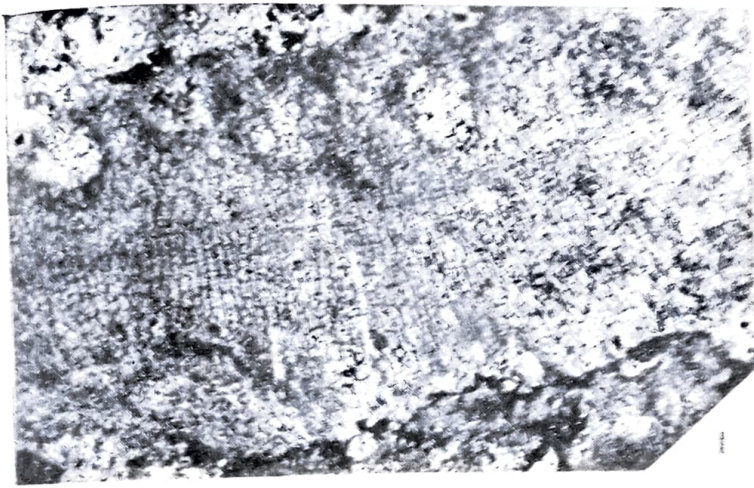
- Fig. 1. *Archaeolithothamnium* aff. *A. keenani* Howe showing perithallic tissue and sporangia ( $\times 90$ )
- Fig. 2. *Archaeolithothamnium* aff. *A. keenani* Howe, showing hypothallic and perithallic tissue ( $\times 90$ )
- Fig. 3. *Mesophyllum meghalayensis* sp. nov., showing hypothallus, perithallus and nature of sporangia ( $\times 35$ )
- Fig. 4. *Mesophyllum meghalayensis* ( $\times 90$ )
- Fig. 5. *Melobesia* sp. ( $\times 90$ )
- Fig. 6. *Lithoporella melobesioides* (Foslie) Foslie ( $\times 75$ )
- Fig. 7. *Corallina grandis* (Dasgupta) Rao  $\times 35$  (not described)

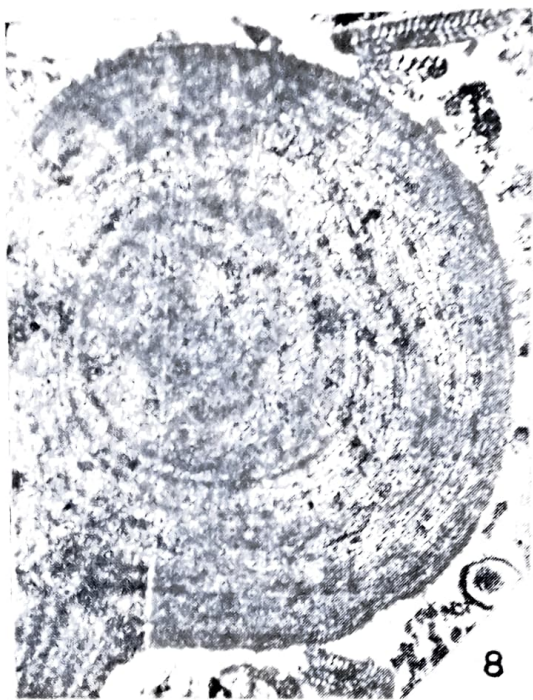
### PLATE 2

- Fig. 8. *Lithothamnium* sp. ( $\times 35$ , not described)
- Fig. 9. *Distichoplax raoi* Varma ( $\times 100$ )
- Fig. 10. *Amphiroa irazuensis* Johnson ( $\times 35$ , not described)
- Fig. 11. *Amphiroa* sp. ( $\times 30$ , not described)
- Fig. 12. *Amphiroa* sp. ( $\times 70$ )
- Fig. 13. *Distichoplax biserialis* (Diet) Pia
- Fig. 14. *D. rasi* Varma, showing multilayered thallus ( $\times 35$ )
- Fig. 15. *Archaeolithothamnium* aff. *A. keenani* Howe ( $\times 30$ )
- Fig. 16. *Jania occidentalis* Johnson ( $\times 40$ )

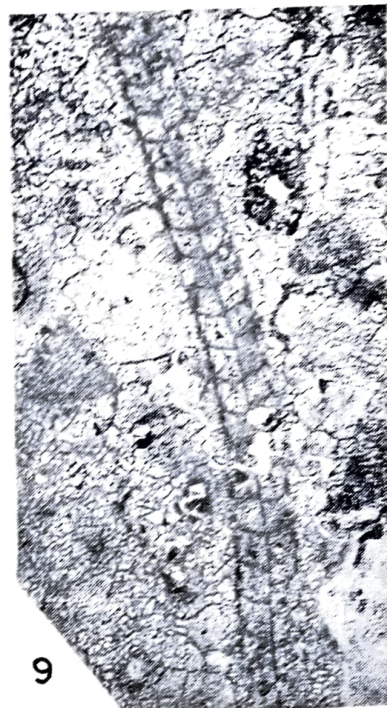
### PLATE 3

- Fig. 17. *Neomaris* sp., longitudinal section of a fragment ( $\times 40$ ). *Griphoporella arabica* Pfender on lower left.
- Fig. 13. *Furcosporella diplopora* Pia; slightly oblique longitudinal section ( $\times 40$ )
- Fig. 19. *Trinocladus unlatodohensis* sp. nov. ( $\times 40$ )
- Fig. 20. *Lithothamnium* aff. *bofilli* Lemoine ( $\times 40$ )
- Fig. 21. *Cympolia* sp; slightly oblique transverse section ( $\times 50$ )





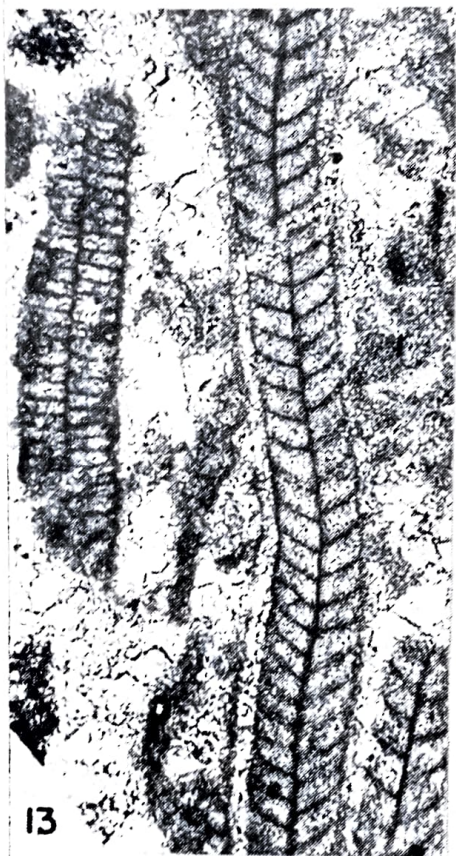
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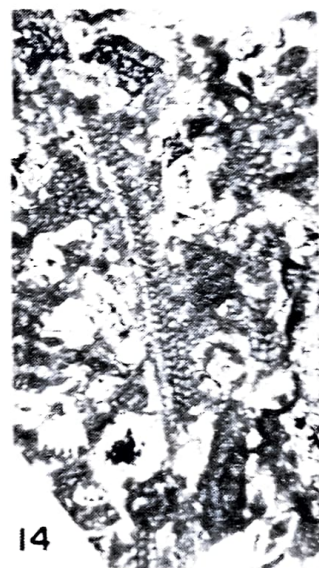
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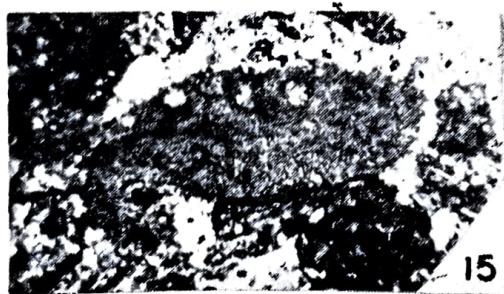
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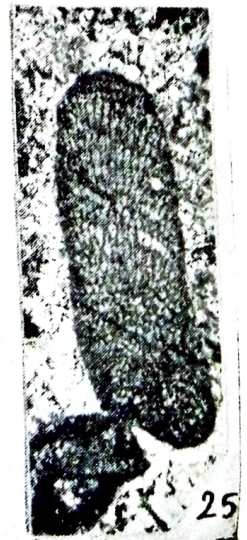
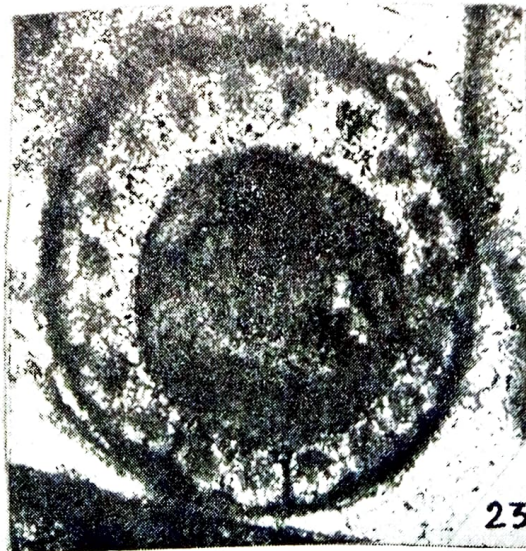
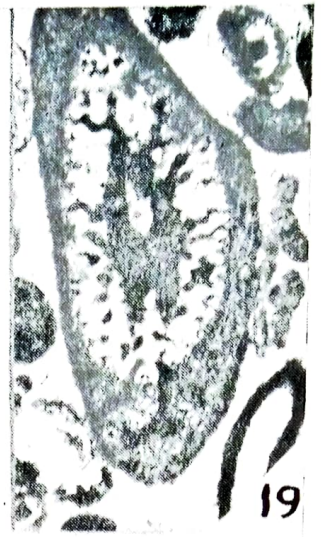
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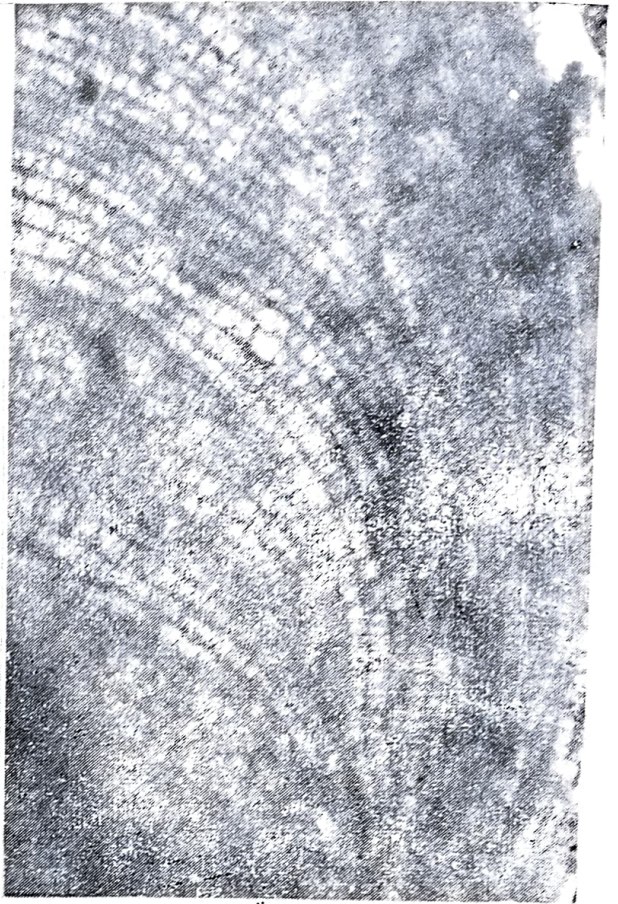


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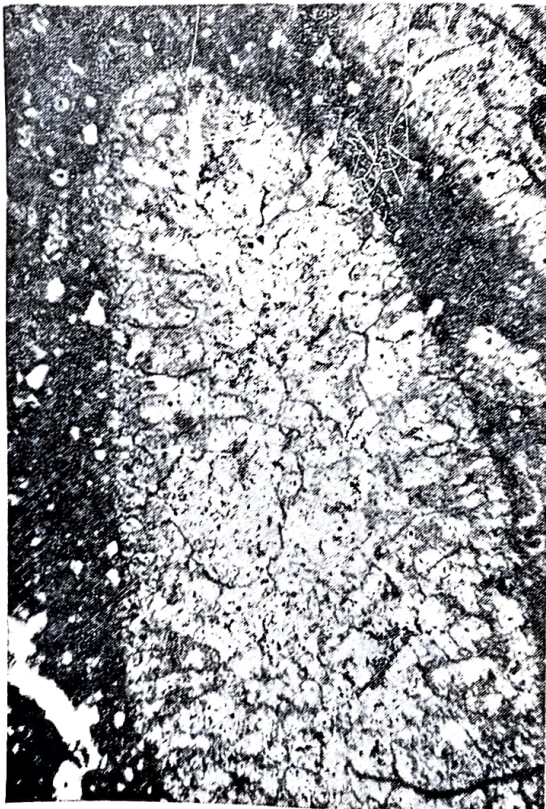




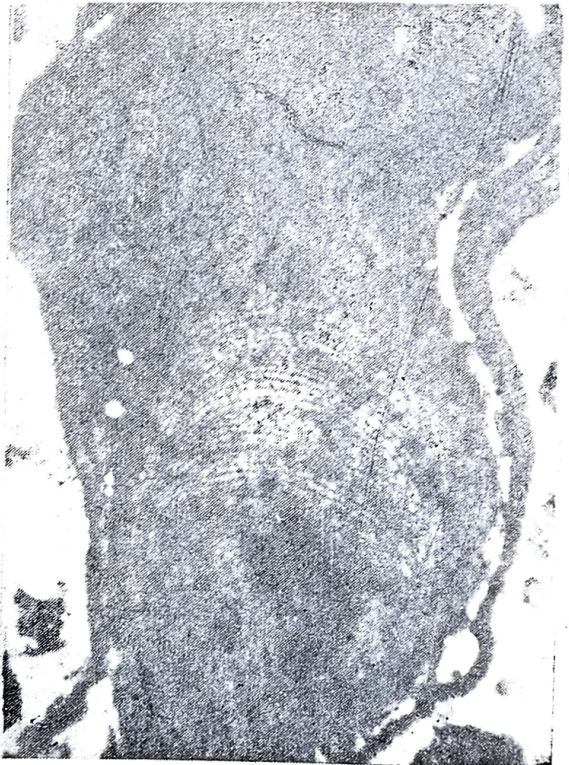
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- Fig. 22. *Dissocladella lakadongensis* sp. nov. Transverse section.  
Fig. 23. *Dissocladella lakadongensis* sp. nov. Slightly oblique transverse section ( $\times 70$ )  
Fig. 24. *Griphoporella arabica* Pfender ( $\times 40$ )  
Fig. 25. *Jania* sp. ( $\times 30$ , not described)

PLATE 4

- Fig. 26. *Fuscoporella diplopora* Pia ( $\times 100$ )  
Fig. 27. *Lithothamnium andamanensis* Chatterji & Gururaja ( $\times 100$ )  
Fig. 28. *Lithothamnium andamanensis* Chatterji & Gururaja ( $\times 100$ )  
Fig. 29. *Halimeda* sp. ( $\times 30$ )