CHAPTER 5

ALGAL BIOSTRATIGRAPHY

The following biostratigraphic study will, perhaps, appear as lending some support to Praturio's (1966) optimism regarding the possibility of establishing valid algal zonation for geological sections. The study, however, is attempted here with the ultimate aim of facilitating the tracing of ecological history across the stratigraphical sequence in the study area.

All the nine lithostratigraphic sections described in Chapter 2 were systematically sampled. Sample positions along the sections are indicated in the relevant illustrations (Text-fig. 2-10). Variations in the occurrence of the algal taxa (Tables 2-10), at different stratigraphic levels have made possible an attempt at delineation of a few algal assemblage zones and subzones (Text-fig. 2-10, 12-13). The zones have been numbered I, II,... and the subzones a,b,... in ascending orders. The zonal and subsonal boundaries are concordant with the lithostratigraphical boundaries and the inter-zonal or inter-subsonal contacts vary from sharp to transitional or overlapping. Two algae barren zones intervene the algal zones.

The algal zones/subzones contain easily distinguishable assemblages of calcareous algae. In the description of the
zones and subzones dominant lithological and carbonate petrographic characteristics and also foraminiferal and other biotic associations have been incorporated.

**Zone I : Metagoniolithon (?) megahavensis Zone**

Reference Locality : Section G

Description : This lowest zone covers the lowest 27 m of Lekadong Limestone Member as developed and exposed in the study area. Carbonate petrographically it is predominantly a highly recrystallized arenaceous biosparite ('pseudosparite'). Most of this zone shows only *Metagoniolithon (?) meghalavensis*. Towards the top some *Distichocorys biserialis* and *Corallina cf. C. princa* are associated. Some badly preserved crustose corallines are seen both towards bottom and top.

Foraminiferal association in this zone is highly obliterated. But *Miscellanea miscella, Alveolina, Nummulites (?)*, *Remikothalia, Distichocorys, Luckhartia, Sperrulina, Actinosichon*, miliolids and textulariids have been recognized.

This zone could not be observed in other local sections in which the exposed thicknesses below the datum plane (p. 35) fall far short of that in this section. The arenaceous character of the limestone of this zone possibly
indicates that the zone is closely underlain by unexposed sandstones.

**Zone II : Distichoplaez bierialis Zone**

**Reference Localities :** Sections D, E, F, and G.

**Description :**

The badly recrystallized arenaceous carbonates of the lowest zone is succeeded above in Section G by this zone. The zone has also been partially encountered at the exposed lower parts of the Lekadong Limestones in Sections D, E and F. In the study area and is upto 21 m thick in this area. The predominant biofacies of the zone contain the unmistakable *Distichoplaez bierialis* as the most distinctive and common algae throughout the thickness of the zone.

Further subdivision of the zone into subzones has been possible as follows:

**IIIa D. bierialis-Corallina cf. G. priaca Subzone**

The lowest 9 m of the *D. bierialis* zone in section G are biofacies and bicrystals and contain rare quartz and some glauconite at the bottom. *Corallina cf. G. priaca* occurs in this subzone as the other most common algae besides the zonal marker. Also associated with these richer algae
are rare *Metacompionolithon* (?), *neocalavensis*, and rare *Archaeolithothamnium*, *Lithothamnium* and rare to frequent *Lithothamnella melanocystes*, some *Ovulites morallati*, *Q. elongata*, doubtful *Halimeda praemorsa* and very rare *Marinella lucasone*.

Foraminifera are common to abundant in this subzone and include *Miscellanea miscella*, *Ocnoculina aequa* (?), *Q. cf. canalisera*, *Lockhartia cf. Q. haeimi*, *Renitholithia*, *Disocyclyna ranikotensis*, rotolids? (very abundant), textulariids, large and small miliolids, *Alveolina primaevae*, and *Operorbitolites*.

Rare coral specimens are also seen in some slides.

**IIIb. P. biseriata-Pseudolithothamnium album-Solenomorpha o'gormanii Subzone**

The 9 m of predominant bioncrites and biolithites, and some bioncrosperites overlying Subzone IIIa in Section G contain the distinctive looking squamariacean *Pseudolithothamnium album* and the solenoporeaceous *Solenomorpha o'gormanii*, besides *Districhophax biseriata*, as the characterizing fossils. The common to abundant crustose corallines in this subzone include *Archaeolithothamnium tawarii*, *Lithothamnium* cf. *Q. hoffi*, and *Lithothamnella melanocystes*. *Lithothamnium carianae* is rare. Rare *Amphirana* sp., *Corallina* cf. *Q. priera*.
and *Metaconiolithon* (?) *mehalevensis* have also been seen. Foraminifera recognized in this subzone are abundant *Discorculina* and *Oncorculina salza* besides frequent *Ranikothalia, Miscellanea miscella* and miliolids. Abundant corals and occasional bryozoans are also present.

**Ilo D. biserialis-Clypeina elliotii-Acroporella encaea Subzone**

This is a thin (upto 3 m) algally very distinctive subzone encountered in Sections D, E, F and G, comprising biosparites and biomicrosparites with a vertically restricted occurrence of the beautiful dasyclade *Clypeina elliotii, Hamuluvella* (?) cf. *K. mcdonaldensis* and *Acroporella encaea* besides the zonal marker. Other algae are rare *Metaconiolithon* (?) *mehalevensis, Triplocoralla* sp., *Trinoclada* sp., *Anglocoralla* (?) sp., *Keeneria* cf. *K. plecmensis, Halimeda preascomilla, doubtful Crulites* and very rare *Lithothamnium* fragments.

Foraminifera of this subzone constitute a rich fauna and include *Miscellanea miscella, Oncorculina* cf. *O. canalisera, O. sp., Ranikothalia, Lachkhetia* cf. *L. hatmai, Alveolina, miliolids* and *textulariids*.

Echinoid spines and bryozoans are occasionally seen.

**Remarks:**

The *Distichoplax* biserialis Zone as a whole can be
established as marking the upper part of the Lakadong Limestone Member below its topmost 9 to 10 metres. And because of the fairly restricted vertical range (Palaeocene-Lower Eocene) of this marker fossil in the Tethyan areas the zone can form a suitable biostratigraphical entity for the purposes of stratigraphical correlation and age determination.

Zone III: *Marinella luneoni* Zone:

Reference Localities: Sections B, C, D, E, F and G.

Description:

In the study area this zone covers the topmost part of the Lakadong Limestone Member. Maximum exposed thickness known is about 18 m. While the zone overlies the distinctive *D. bimarialis* zone with a sharp contact, its top coincides with the junction between the Lakadong Limestone and the Lakadong Sandstone Members. Carbonate petrographically it is a biomicrite or biomicrosparite or sometimes bio-intrapelsmicrite, with varying proportions of pellets, intraclasts (mainly at top) and oolithes. Most common and distinctive alga in this zone is *Marinella luneoni*. It occurs alone or is associated with *Ovalites margaritula*, *Furcospirallia diplora*, *Terebrarrella* sp. A*, *Acicularia* sp. A, *Ovalites morleti*, *Q. elongata*, and *Q. maillolensis*, their frequencies varying from zero to common in different samples. *Distichoplane*
biseriales is conspicuously missing in all the slides studied from this zone.

Foraminifera present here are mostly obliterated by diagenesis. Frequent rotalids and miliolids together with Operculina asea have been recognized.

Spines and plates of echinoids, and pelecypods are also present.

Remarks:

This is a very well delimited zone in the study area and marks the topmost part of the Lakadong Limestone Member. Marinella lugonii is almost wholly restricted to this local zone belonging to the Upper Palaeocene. Although Marinella aff. lugonii was earlier described from the Palaeocene-Middle Eocene of Cuba (Beckmann and Beckmann, 1966), definite specimens of this species was not known so far from rocks younger than the Cretaceous.

Barren Zone: Lakadong Sandstone Member

The whole thickness of the Lakadong Sandstone Member overlying the Marinella lugonii Zone in the study area is devoid of algae and fauna. (However, palynofossil assemblage believed to be of Lower Eocene age have been reported earlier by Sah and Dutta, 1974 in Sah and Singh, 1977 and Dutta, 1976 from the Lakadong Sandstone Member of Meghalaya and Assam).
Zone IV: **Ovalites- Furcoporalla-Dissocladella Zone**

**Reference Localities:** Sections A, C, D, E, F, G, H and I.

**Description:**

The entire exposed thickness (up to ca 36 m) of the Umlatdoh Limestone Member is covered by this zone. The zone mostly consists of bionicsparites and biosparites. Ooliths and intraclasts occur both towards bottom and top. Near the top an abundance of very well-sorted, well-formed ooliths and **Ovalites moreletti** segments constitute the biosparites. Glaucunitic filling of fossils are also seen near the top and the bottom of the zone. The carbonate rocks of the middle part of the zone are followed both at the lower and the upper ends by alternations of thin current-beded sandstones, calcareous sandstones, siltstones, arenaceous limestones, limestones and shales.

The zone as a whole is characterized by the frequent to very abundant occurrence of the udoteacean green algae **Ovalites** including *O. margarita*, *O. moreleti*, *O. elongata* and **Hallimeda praemorsa**. But towards the lower and the upper ends they generally become rarer. The arenaceous and/or argillaceous parts which contain dominant *O. moreleti* may be taken as locally indicating the upper and the lower limits of the zone. **Furcoporalla diplomera** and **Dissocladella sp. A** and
E. sp. B are frequent to common associates. The other important fossils recorded from this zone are as follows:

**Algae:**

- *Solenospermia o'gormanii*, *Solenospermia (?)* sp.,
- A *conisporancia*, *Lithocorella minor*, *Lithopelia (?)* sp.,
- *Listichopora biserialia*, *Janiabeatnics*, *Acicularia* sp. B.

**Foraminifera:**

- *Alveolina oblonga*, B *elliptica*, *Emsulites stericus*.
- *Discocyclina rombikotensis*, *Lachertia* including B cf. B *conditi*, *Oecurculina* sp., 2 cf. 2 *canalisera*, *Cortorbitolites* cf. 2 *pouillai*, *Heterocystina*?, *Hinnemalculina*, *Triloculina*, *Pyrco* and *textulariida*.

**Other fauna:**

- Gastropods, pelecypods and echinoid spines and plates.

**Remarks:**

This zone can be lithologically demarcated as being both underlain and overlain by algally barren zones represented by the whole thickness of the Lakefong Sandstone Member and the greater part of the Narpuk Sandstone Member respectively. Also, in the study area, the zone is generally
marked by an *Alveolina*-dominated foraminiferal community.

**Barren Zone : Narpuh Sandstone Member**

Sandstone samples from the lower part of the member overlying Zone IV have not yielded calcareous algae or Foraminifera. The calcareous upper part of the member, underlying the Prang Limestone Member, have, however, shown some fragments of crustose coralline algae along with some doubtful foraminiferal fragments in the matrix. This part has, therefore, been included in the succeeding algal zone which is characterized by the crustose corallines (Bhattacharya, A and Chatterjee, B.P., 1977, have reported *Alveolina elliptica*, *Dissacyclina* sp., *Hymenocystis* sp., *Oropela* sp., *Texitularia* sp. and miliolids in the Narpuh beds from the Thrianghat - Shella areas in the Khasi Hills).

**Zone V : Archaeolithothamnum-Lithothamnum-Lithoporella Zone**

**Reference Locality : Section I**

**Description :**

The top of the zone coincides with the junction between the Prang Limestone Member and the overlying Popili Formation and, as indicated above, the bottom lies at the calcareous upper part of the underlying Narpuh Sandstone Member which contains small fragments of *Lithoporella* and
other unrecognizable crustose corallines along with doubtful foraminiferal fragments. This zone, therefore, mainly covers the entire thickness (ca. 81 m) of the Prong Limestone Member as exposed in the study area. The dominant bio-
micrites and biomicrudes of the limestone member are slightly arenaceous towards the bottom and markedly argillaceous towards the top. In intimate association with its non-
arenaceous parts biolithites are also present. Carbonate grains such as intraclasts and oolites are absent in this zone.

The zone is distinguished by the predominant occurrence of the crustose coralline community represented largely by species of Archaeolithothamnium, Lithothamnium and Lithoporella along most of its thickness.

Robust larger Foraminifera associated with the above algae are the distinctive faunal elements here. Frequently they are encrusted all around by the crustose algae.

Important fossils recorded from this zone are the following:

Algae:

Foraminifera:

Discocyclina including *D. wetherbyi*, *D. undulata*,
*D. dispansa*, Palliatioire including, *P. orbitoides*, *Pumulites*
including *P. acutus*, *P. obtusus*, *P. basmanyti*, *Asolina*
including *A. papilata*, *Alveolina elliptica*, *A. oblonga*,
*Orbitolites* cf. *O. complanata*.

Other fauna:

Echinoid spines and plates.

Remarks:

Further zonal division of the thick Prang Limestone Member was not attempted because of the difficulty of precise identification of infertile crustose corallines and because of the difficulties of elaborate sampling of certain portions of the limestone member in this section. The zone as proposed here can broadly be characterized as showing the predominance of reeffoi1 algae and Foraminifera in such carbonate rocks as constitute the fore-reef and reef-core sediments.

General Remarks on the Algal Assemblages in the Sylhet Limestone Formation

Most groups of algae are known to have evolved rather slowly and hence their vertical ranges are not much restricted
in time. However, a reference to the known stratigraphical
distribution of the algal taxa described in this thesis shows
that they are mostly restricted to the Palaeocene-Eocene
strata. Thus the total algal composition of the Sylhet
Limestone Formation bears out the known age assignments to
it from foraminiferal studies.

Further,

1) In the study area, the Lakadong Limestone Member
which, to all appearances, is entirely covered by the Upper
Palaeocene *Miscellanea miscella* Range Zone is primarily
referred to three local assemblage zones. Of these,
the *Metacombolithon (?) mechalevansis* Zone(I) locally marks
the lower part, the *Distichoplex biserialis* Zone(II) the
middle part, and the *Marinella luconii* Zone(III) the upper
part of the Upper Palaeocene in a general way. Amongst the
three local Upper Palaeocene algal zones, the middle
*Distichoplex biserialis* Zone is the most important biostrati-
 graphical entity. (*D. biserialis* is also known to mark
certain Lakadong Limestone beds in the Khosi Hills areas;
vide Ghose, 1967, Bhattacharya, A and Chatterjee, B.P., 1977
and Bhattacharya, U and Chatterjee, B.P. (1977)). Besides the
zonal marker which is a largely Palaeocene (also Lower Eocene)
alga in the Tethyan belt, *Clypeina elliottii*, *Acronoralla ameana,*
*Nemuliumella* cf. *N. sedalenensis* and *Archaeolitothamnium
perplexum* are also so far known almost only from the Palaeocene
strata.

ii) The Unatdoh Limestone Member which has been assigned to the Lower Eocene age from its foraminiferal composition is entirely covered by the Cylindrea-Furconoralla-Dissorophilla assemblage. An abundant occurrence of the constituents of this assemblage in the Sylvat Limestone Formation locally marks this member only. Individually, Q. morallati is not known above the transition between Lower and Middle Eocene (Beckmann and Beckmann, 1966) and Dissorophilla, as a genus, is known only up to the Lower Eocene. These facts coupled with the scarce occurrence of Distichoplas biserialis at the bottom of this member (e.g., in Section II) appear to support the assignment of the Lower Eocene age to this member by earlier foraminiferal workers.

iii) The Prang Limestone Member which is characterized by foraminiferal assemblages belonging to the Middle-Middle-Upper Eocene age does not contain individually diagnostic vertically restricted algal elements. However, collectively most of the already known crustose coralline species indicated in this member are also largely Middle-Upper Eocene forms. Of further stratigraphical interest is the fact that the rich and varied community of the Melobesioidea in the Middle-Upper Eocene Prang Limestone Member scarcely contains survivors from the Upper Palaeocene-Lower Eocene limestones below.