

BIOSTRATIGRAPHIC ZONATION OF THE UPPER CRETACEOUS FORMATION'S OF KHASI AND JAINTIA HILLS, MEGHALAYA

ANASUYA BHATTACHARYA AND UTPAL BHATTACHARYA

GEOLOGICAL SURVEY OF INDIA, LUCKNOW

ABSTRACT

The Upper Cretaceous rocks of Khasi and the adjoining Jaintia Hills, Meghalaya, exhibit presence of profuse quantity of the invertebrate fossils.

In view of the poor representation of ammonites, attempts are made to introduce the biostratigraphic zonation of the faunal association on the basis of overwhelming presence of lamellibranchs. *Inoceramus* being the most dominant and widespread amongst the lamellibranchs constitute the Range Zone, which is further classified into six Assemblage Zones on the basis of dominant and characteristic faunal association. These zones range in age from Campanian to Upper Maastrichtian, the lower limit of which extends even up to Turonian.

INTRODUCTION

The Upper Cretaceous shelf sediments exposed all along the entire southern fringes of the Shillong plateau from Jadukata river in the west to Muktapur-Dawki area in the east are well known for quite some time.

Though not much of systematic study has been done on the fossil content of these marine sediments, however, the pioneering work of Oldham (1859) followed by Medlicott (1889) and Spengler (1923) are of worth mentioning. In the recent years, the observations made by Nagappa (1960) and Biswas (1962) also attract attention. The most valuable contribution on the problems related to the palaeontology of these marine incursions has been made by Bhattacharya (Unpublished Progress Report, G.S.I., 1974) from the detailed study undertaken between 1970-74.

Biostratigraphic Zonation forms an important basis on the inter regional correlation of beds. The detailed faunal analysis carried out by the authors on the Upper Cretaceous faunal association of this area has revealed feasibility in introducing biostratigraphic zonation within an otherwise uniform and massive sediments. The biostratigraphic zonation thus attempted by the authors, includes the presence of one *Inoceramus* Range Zone within the faunal association. This Range Zone on the basis of dominant and characteristic faunal association, is further being sub-divided into six Assemblage Zones.

GEOLOGICAL SET UP

The Upper Cretaceous shelf sediments (Khasi Group, Murthy *et al.*, Unpublished data, G.S.I. 1974) overlie unconformably the basement complex consisting of crystallines, metamorphites or amygdaloidal basalt. These sediments in turn conformably are overlain by an alter-

nation of calcereous and argillaceous sediments of Lower Tertiary age (Jaintia Group, Murthy *et al.*, unpublished data, G.S.I., 1974).

The main rock constituents of these formations are thick pile of arkosic to arenaceous often glauconitic sediments with a polymictic conglomerate horizon at the base. The entire sequence shows a variable thickness ranging from 5 m. to 450 m.

The basalmost unit on the plateau is a conglomerate horizon named as Weilo Conglomerate Bed (Bhattacharya, U. Unpublished Report G.S.I., 1974). In the sub-montane tract located to the south of the plateau, the basalmost unit consists of alternate bands of conglomerate and coarse grained arkose, both glauconitic, named as Jadukata Formation (Talukdar, S. G. Unpublished Report, G.S.I. 1966). Several fossil bearing horizons are noted in these formations. The contact between these two basalmost units is faulted. Basement controlled Raibah lineament (Talukdar, S. G., Unpublished Report, G.S.I., 1966) and Rilang lineament (Bhattacharya, U. Unpublished Report, G.S.I., 1974) delimit the contact between these two basalmost sequences of the Khasi Group.

Followed up, overlying both the Weilo Conglomerate Bed or the Jadukata Formation conformably occurs a thick pile of massive bedded glauconitic arkose which is named as Mahadek Formation (after Ghosh 1940). Presence of profuse quantity of unaltered detrital fragments of quartz and feldspars are noted within these sediments. This formation exhibits presence of several fossil horizons.

The topmost rock unit that overlies conformably the Mahadek Formation is Langpar Formation (after Medlicott 1869) which is represented by an association

Table 1. Generalized Stratigraphic Succession.

Western Part (on the plateau)			Northern Part (on the plateau)			Southern Part (in the sub-montane tract)		
Group	Formation	Age	Group	Formation	Age	Group	Formation	Age
Jaintia Group	..	lr. Eocene to Up. Palaeocene	Jaintia Group	..	lr. Eocene to Up. Palaeocene	Jaintia Group	..	lr. Eocene to Up. Palaeocene
Khasi Group	Riangmaw Formation	lr. Maestrich- tian(?) to Campanian (?)	Khasi Group	Langpar Formation	Lower Palaeo- cene to Up. Maestrichtian	Khasi Group	Langpar Formation	lr. Palaeocene to Up. Maes- trichtian
				Mahadek Formation	Up. Maestrich- tian to Campanian		Mahadek Formation	Up. Maestrich- tian to Campanian
				Weiloi Conglomerate Bed	?Turonian		Jadukata Formation	?Turonian
Unconformity Crystallines (Pre-Cambrian).			Unconformity Crystallines and Metamorphites (Pre-Cambrian)			Unconformity Amygdaloidal Basalt (Jurassic)		

of calcareous sandstone, siltstone, sandy limestone, shale and exhibits change in the facies laterally.

In the area lying to the west of Jadukata River (Um Kynchiang River), the entire Khasi Group undergoes facies transgression, as such, has been named as Riangmaw Formation (Bhattacharya, U., Unpublished Report, G.S.I., 1972). In this area, the Khasi Group is represented by coarse grained to gritty arkose sediments, very often glauconitic, containing profuse quantity of unaltered matter and irregular lenses of conglomerate.

Generalised stratigraphic succession as suggested by the authors is incorporated in the Table 1.

BIOSTRATIGRAPHY

All the three formations of the Khasi Group are highly fossiliferous. The faunal content includes lamellibranchs, gastropods, ammonoids, nautiloids, belemnites, echinoids, brachiopods, besides good quantity of corals, foraminifera, ostracods, shark teeth, dicotyledenous wood and a few plant impressions, etc. In total 180 species were identified from the invertebrate fossil content of which only 48 were reported earlier. Seven distinct fossil horizons were noted, which could be correlated throughout the area, three in the Jadukata Formation, three in the Mahadek Formation and one in the Langpar Formation. Incidentally, the topmost fossil horizons of the Jadukata and Mahadek Formations transgress into the lower part of the overlying Mahadek and Langpar Formations respectively.

Amongst all the groups, lamellibranch constitutes the bulk of the fauna and is presented in profuse quantity in all the fossil horizons from the base to the top. Within lamellibranchs, the genus *Inoceramus* is the most pre-

dominant one and is distributed uniformly throughout all the fossil hirozons. It is represented by as many as four species. So considering the overwhelming presence of this genus, authors used *Inoceramus* for the purpose of establishing *Inoceramus* Range Zone. The other important genera like *Alectryonia*, *Gryphaea*, *Exogyra*, *Spondylus*, *Pecten*, *Pinna*, *Cardium* etc. though present in good number, display certain amount of limitation both in spatial as well as vertical distribution. As such, utility of such genera has been confined towards identifying Assemblage Zones within the Range Zone only.

As many as six such Assemblage Zones are proposed (Table 2) within the *Inoceramus* Range Zone based on the abundance of individuals. In addition to it the association of other fossils are also taken into consideration as and when required in defining the Assemblage Zones. Stratigraphic disposition of the fossil horizons, vis-a-vis biostratigraphic zones, within the Jadukata, Mahadek and Langpar Formations have been included in Table 2. A brief description of the Assemblage Zones is given below :

Inoceramus-Pinna Assemblage Zone (6 m. thick) : It corresponds with the lower most fossil horizon located at the basal part of Jadukata Formation and consists of coarse to medium grained calcareous sandstone when weathered becomes limonitic. Some of the important fossils constituents are *Inoceramus balticus* (Boehm), *I. balticus* var. *meghalayensis* (nov.), *Pinna complanata* (Stol.), *Pinna laticostata* (Stol.), *Spondylus calcaratus* (Forb.), *S. cf. striatus*, *Modiola flagellifera* (Forb.), *Pecten assamensis* (Spengl.) along with small sized echinoid. *Echinoconus dovillei* (Cotteau & Gauthier), *Hemiaster frontacutus* (Stol.).

Inoceramus-Pecten Assemblage Zone (15 m. thick) :

Table 2. Generalised litholog of Jadukata, Mahadek and Langpar Formations (located in the southern part of Khasi Hills) showing stratigraphical positions of the fossil horizons/biozones.

Formation	Rock Stratigraphy	Thickness	Fossil Horizons	Biostratigraphic Zones
Langpar	Predominantly calcareous sandstone with minor bands of calcareous shale	7 m		
	Predominantly calcareous shale with minor bands of silty sandstone very often fossiliferous	15 m	F7	<i>Nautilus-Turritella</i> assemblage zone
	Alternation of calcareous soft limonitic sandstone with minor shales and impure limestones	7 m		
	Calcareous silty shale	5 m		
	Argillaceous greenish sandstone with minor sandy limestone and sandy shale. Well preserved fossils noted in the lower part	12 m	F6	<i>Gryphaea-Pachydiscus</i> assemblage zone
Mahadek	Hard calcareous often limonitic sandstone upper part of which is well concentrated with fossils	15 m		
	Variegated arkose with calcareous bands at the top depicting two fossil horizons	7 m	F5	<i>Alectryonia-Stigmatopygus</i> assemblage zone
			F4	<i>Inoceramus-Alectryonia</i> assemblage zone
	Medium to coarse grained variegated arkose with unaltered detritals and minor glauconitic clay horizons	68 m		
	Gritty arkose with pebbles and fragments of vein quartz ..	20 m		
Jadukata	Polymictic unsorted coarse grained variegated arkose ..	20 m		
	Glauconitic coarse arkose	30 m		
	Coarse to medium grained glauconitic arkose with angular fragments of feldspar and minor gritty bands with a fossil horizons	43 m	F3	<i>Trigonoarca-Eubaculites</i> assemblage zone
	Alternate bands of coarse grained to gritty glauconitic arkose and conglomerate with a fossil horizon at the base	45 m	F2	<i>Inoceramus-Pecten</i> assemblage zone
	Medium grained arkose	12 m		
Jadukata	Alternation of coarse to gritty arkose with conglomerate bands ..	60 m		
	Massive glauconitic sandstone with occasional pebbles/cobbles with a fossil horizon at the base	45 m	F1	<i>Inoceramus-Pinna</i> assemblage zone

This assemblage zone is located stratigraphically a further higher up and corresponds to the second fossil horizon having similar lithology. The assemblage includes—*Pecten raduloides* (Stol.), *P. assemensis* (Spengl.), *P. aff. subdecemcostatus* (Vog.), *Inoceramus balticus* (Boehm.), *I. balticus* (Boehm.) var. *meghalayensis* (nov.), *I. multiplicatus* (Stol.), *Trigonoarca abrupta* (Stol.), *Panopea ovalis* (Sow.), *P. orientalis* (Forb.), *Solarium vylapaudiense* (Stol.).

Trigonoarca-Eubaculites Assemblage Zone (15 m. thick): It corresponds to the topmost fossil horizon of Jadukata Formation and transgresses into the overlying Mahadek Formation. The prevailing rock type is hard grey calcareous sandstone, where ammonite attain prominence along with lamellibranchs. Characteristic fossils being *Inoceramus tuberculatus* (Woods), *I. balticus* (Boehm.), *Trigonoarca brahminica* (Forb.), *T. abrupta* (Forb.), *T. gemana*, *Protocardium hillana* (Sow.), *Grammatodon japheticum*

(Forb.), *Turritella pondicheriensis* (Forb.), *Eubaculites vagina* (Forb.), *E. vagina* var. *simplex* (Koss.), *Anisoceras indicum* (Forb.), *A. largesulcatus* (Forb.), *Pachydiscus gollevillensis* (D'orb.), *Placentoceras tamulicum* (Blen.), *Epigonoceras epigonum* (Koss.), and *Cymatoceras kayeanus* (Stol.).

Inoceramus-Alectryonia Assemblage Zone (14 m. thick): It overlies the earlier mentioned Assemblage Zone corresponds with the fourth fossil horizon. This zone is noted within the topmost part of Mahadek Formation of this area. Almost all the fossils encountered in the underlying Assemblage Zone are found to be totally missing. This zone exhibits mainly broken fragments of giant *Inoceramus* (*I. multiplicatus* (Stol.), *I. balticus* (Boehm.) and *Alectryonia* (*Alectryonia unguata* (Stol.). Other constituents are *Gryphaea vesicularis* and *G. arriualurensis* (Stol.).

Anisoceras-Stigmatopygus Assemblage Zone (3 m.

Table 3. Distribution of fossils in the Biozones of the Upper Cretaceous Formations of Meghalaya.

Group	Litho stratigraphic levels	Range Zone	Assemblage Zone	Dominant and Characteristic fossils	Age			
K H A S I G R O U P	Lowermost part of Langpar Formation	↑	Gryphaea-Pachydiscus Zone	<i>Alectryonia ungulata</i> , <i>A. pectinata</i> , <i>Cardium pullatum</i> , <i>C. exulans</i> , <i>Cytherea discoidalis</i> , <i>Crassatella zitelliana</i> , <i>Gryphaea vesicularis</i> , <i>G. arriyalurensis</i> , <i>Inoceramus balticus</i> , <i>I. balticus</i> var. <i>meghalayensis</i> , <i>Lucina divaricata</i> , <i>Opis repleta</i> , <i>Panopea orientalis</i> , <i>Neithea faujasi</i> , <i>Pholadomya caudata</i> , <i>Spondylus sulcatellus</i> , <i>Tellina petrosa</i> , <i>Trinonoarca jamana</i> , <i>Actaeon ovum</i> , <i>Aporrhais tegulata</i> , <i>Bullinula obtusiuscula</i> , <i>Campanile</i> sp., <i>Cerithium arkoense</i> , <i>C. intermixtum</i> , <i>Chrysodomus</i> sp., <i>Cyprea ficulina</i> , <i>Fasciolaria assamensis</i> , <i>Fusus gracilis</i> , <i>Leptomaria indica</i> , <i>Mitreola citharina</i> , <i>Natica lyrata</i> , <i>Nerinea</i> sp., <i>Nerita D' Archiaci</i> , <i>Pseudoliva ambigua</i> , <i>Pugnellus uncutus</i> , <i>Rapa nodifera</i> , <i>Solariaella radiatula</i> , <i>Trochus striatulus</i> , <i>Turritella dispassa</i> , <i>T. sexlineata</i> , <i>Volutilithes muricata</i> , <i>Cardiaster orientalis</i> , <i>Hemiaster vicinus</i> , <i>Nucleolites</i> sp., <i>Ophiaster</i> sp., <i>Pyrina ataxensis</i> , <i>P. ataxensis</i> var. <i>rotunda</i> , <i>Anisoceras indicum</i> , <i>A. large-sulcatum</i> , <i>Eubaculites vagina</i> , <i>Gaudryceras subtililineatum</i> , <i>Pachydiscus denisonianus</i> , <i>P. egertonianus</i> , <i>P. gollevillensis</i> , <i>P. gollevillensis</i> var. <i>meghalayensis</i> , <i>P. ootacodensis</i> , <i>P. tweenianus</i> , <i>Pseudophyllites indra</i> , <i>Epigoniceras cala</i> , <i>Cymatoceras kayeanus</i> , <i>Nautilus baluchitanensis</i> , <i>Belemnites fibula</i> , <i>Concinthyris acutiplicata</i> , <i>Gibbithyris indica</i> , <i>Rectithyris subdepressa</i> , <i>Rhynchonella assamensis</i> .	U P P E R M A E S R I C H T I A N			
	Mahadek Formation (Upper part)			Anisoceras-Stigmatophygus Zone	<i>Alectryonia ungulata</i> , <i>A. pectinata</i> , <i>Axinea sub-planata</i> , <i>Gryphaea vesicularis</i> , <i>Inoceramus balticus</i> , <i>I. multiplicatus</i> , <i>I. tuberculatus</i> , <i>Lima divercata</i> , <i>Pecten assamensis</i> , <i>P. aff. dujardini</i> , <i>Tellina petrosa</i> , <i>Campanile</i> sp., <i>Cerithium crispicans</i> , <i>C. vagans</i> , <i>Turritella pondicherriensis</i> , <i>T. multi-striata</i> , <i>Cassidulus oldhamica</i> , <i>Echinoconus dowillei</i> , <i>Hemiaster pullus</i> , <i>H. vicinus</i> , <i>Stigmatophygus elatus</i> , <i>S. elatus</i> var. <i>meghalayensis</i> , <i>Anisoceras large-sulcatum</i> , <i>Eubaculites vagina</i> E. <i>vagina</i> var. <i>simplex</i> , <i>Pachydiscus gollevillensis</i> , <i>P. ootacodensis</i> , <i>Eutrephoceras sublaevigatus</i> .	L M O A W E E S R T R I C H I A N		
	Mahadek Formation (Upper part)			Inoceramus-Alectryonia Zone	<i>Alectryonia ungulata</i> , <i>A. pectinata</i> , <i>Gryphaea arriyalurensis</i> , <i>Inoceramus balticus</i> , <i>I. multiplicatus</i> , <i>Inoceramus</i> sp., <i>Pecten assamensis</i> , <i>Echinoconus dowillei</i> , <i>Hemiaster frontacutus</i> , <i>Ophiaster</i> sp., <i>Eubaculites vagina</i> .	T I A N		
	Lowermost part of Mahadek Formation			I N O C E R A M U S	Trigonoarca-Eubaculites Zone	<i>Trigonoarca brahminica</i> , <i>T. gamana</i> , <i>T. abrupta</i> , <i>Trigonia indica</i> , <i>Tellina adpressa</i> , <i>Protocardium hillanum</i> , <i>P. pondicherriensis</i> , <i>Pholadomya martini</i> , <i>P. radiatula</i> , <i>P. tigris</i> , <i>P. coenoceras</i> , <i>Panopea orientalis</i> var. <i>gurgites</i> , <i>P. ovalis</i> , <i>Axinea subplanata</i> , <i>Grammatodon japatium</i> , <i>Inoceramus balticus</i> , <i>I. multiplicatus</i> , <i>I. japatium</i> , <i>I. tuberculatus</i> , <i>Opis repleta</i> , <i>Turritella pondicherriensis</i> , <i>T. dispassa</i> , <i>Natica larteti</i> , <i>Nerita D' archiaci</i> , <i>Euspira pagoda</i> , <i>Hemiaster vicinus</i> , <i>H. pullus</i> , <i>Eubaculites vagina</i> , <i>Eubaculites vagina</i> var. <i>simplex</i> , <i>Pachydiscus gollevillensis</i> , <i>Anisoceras indica</i> , <i>Placentoceras tamulicum</i> , <i>Epigoniceras</i> , <i>Cymatoceras kayeanus</i> , <i>Belemnites fibula</i> , <i>Eutrephoceras sublaevigatus</i> .	C A M P A N I A N	
	Jadukata Formation					Inoceramus-Pinna Zone	<i>Hemiaster front acutus</i> , <i>Echinoconus dowillei</i> , <i>E. dowillei</i> cf. <i>hemisphericus</i> , <i>Solarium karapardiensis</i> , <i>Spondylus calcareatus</i> , <i>Inoceramus balticus</i> , <i>I. balticus</i> var. <i>meghalayensis</i> , <i>I. tuberculatus</i> , <i>Modiola flogellifera</i> , <i>Neithea faujasi</i> , <i>Pecten assamensis</i> , <i>Pinna complanata</i> , <i>P. laticostata</i> , <i>Poromya globulosa</i> .	N I A N
	Jadukata Formation (Lower part)					Inoceramus-Pecten Zone	<i>Cardiaster orientalis</i> , <i>Hemiaster indicus</i> , <i>H. vicinus</i> , <i>Solarium vylapardiensis</i> , <i>Spondylus striatus</i> , <i>Trigonoarca gamana</i> , <i>Poromya lata</i> , <i>P. laticostata</i> , <i>Pecten</i> aff. <i>dujardini</i> , <i>Pecten reduloides</i> , <i>P. assamensis</i> , <i>P. aff. subdecemcostatus</i> , <i>Exogyra suborbiculata</i> , <i>Inoceramus balticus</i> , <i>I. multiplicatus</i> , <i>Meithea faujasi</i> .	T U R O N I A N
	Jadukata Formation (Lowermost part)							

thick) : It corresponds with the fifth fossil horizon. This zone is noted in the upper part of Mahadek Formation. It is very much well developed in the central and western part of the terrain. In this horizon large number of fossils make their first appearance. Most significant of them are spatangoid echinoid *Stigmatopygus elatus* (Forb.), *Cassidulus oldhaminica* (Stol.) which appear in large number but kept themselves restricted to this Assemblage Zone only. Other associated important constituents are *Gryphaea vesicularis* (Lam.), *Inoceramus balticus* (Boehm.), *Anisoceras indica* (Forb.), *Anisoceras large-sulcutus*, *Eubeculites vagina* (Forb.) and *Belemnites fibula* (Forb.). The rock types are hard grey coarse to medium calcareous sandstone.

Gryphaea-Pachydiscus Assemblage Zone (15 m. thick) : It represents the topmost Assemblage Zone within the *Inoceramus* Range Zone. It occupies the uppermost part of Mahadek and lower most part of its overlying Langpar Formations. This Assemblage Zone, incidentally displays highest concentration of fauna amongst all such zones. Brachiopods made their first appearance. Ammonoids predominates over other groups and appear for the last time along with *Inoceramus*. Important constituent are *Pachydiscus gollevillensis* (D'orb.), *P. gollevillensis* var. *meghalayensis* (Nov.), *P. twenianus* (Stol.), *P. ootacodensis* (D'orb.), *P. denisonianus* (Stol.), *Gaudryceras subtilineatum* (Koss.), *Pseudophyllites indra* (Forb.), *Epiconiceras cala* (Forb.), *Nautilus pondicherriensis* (Koss.), *N. baluckisthanensis* (Spengl.). The rock types are mostly calcareous coarse to medium grained sandstone with minor dark grey clayey intercalations.

However, within the Langpar Formation, towards the upper part profuse quantity of invertebrate fossils are also noted. This faunal association has been grouped under *Nautilus-Turritella* Assemblage Zone. This faunal assemblage is devoid of ammonoids, *Inoceramus* and echinoids (*Stigmatopygus elatus*) the index fossils of Maestrichtian and content fossils of apparent younger age (Lr. Palaeocene). As such, the horizon has not been taken into account while describing the biostratigraphy of the Upper Cretaceous faunistic association. Assemblage-wise distribution of dominant and characteristic fossils are incorporated in Table-2.

CONCLUSION

Systematic studies on the faunistic association of this part of the Indian subcontinent reveals the presence

of significant amount of invertebrates. Within the Upper Cretaceous sequences, as lamellibranch constitutes the major bulk, biostratigraphic zonation attempted, has been based primarily on the lamellibranch only.

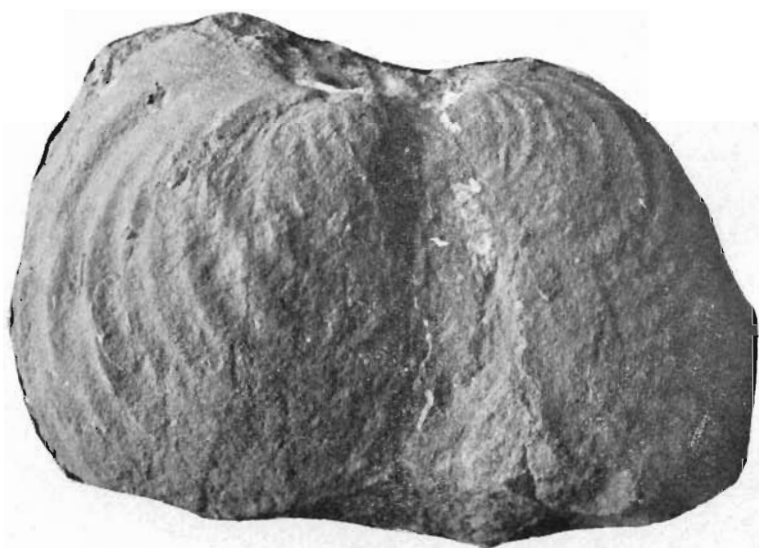
The uppermost limit of the Cretaceous is restricted within the stratigraphical limit of the basalmost of Langpar Formation is also being exhibited from the faunal distribution.

ACKNOWLEDGEMENT

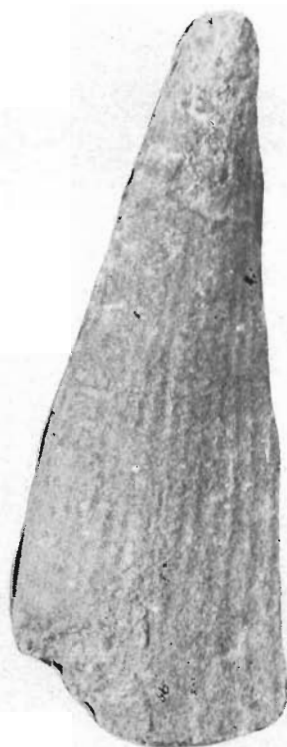
The authors thankfully acknowledge the guidance and assistance received from Sri M. V. A. Sastry, Director, Central Palaeontology Laboratory, Geological Survey of India during the course of Laboratory work.

REFERENCES

- BHATTACHARYA, ANASUYA, 1973. Note on the Lamellibranch fauna of the Marine Cretaceous of Meghalaya. *Ind. Min.* **27**(1) : 83-109.
- BHATTACHARYA, ANASUYA AND CHATTERJEE, B. P. 1975. Note on the age of Limestone underlying Therria Sandstone at Therriaghat, United Khasi and Jaintia Hills Distt., Meghalaya. *Ind. Min.* **29** : 1-4.
- CHATTERJEE, B. P. AND BHATTACHARYA ANASUYA. 1976. Stratigraphy and Micropalaeontology of Bore Hole Cores, Garampani area, North Cachar Hills, Assam. *Proceedings of the VI. India Colloquium and Micropalaeontology.* : 22-25.
- CHATTERJEE, B. P. AND BHATTACHARYA ANASUYA. 1977. Comparative study of the Lower Tertiary formations of Therriaghat and Shella Sections, United Khasi and Jaintia Hills District, Meghalaya. *Rec. Geol. Surv. India.* **109** (2) : 136-140.
- BISWAS, B. 1967. Stratigraphy of Mahadek, Langpar, Cherra and Tura Formation, Assam, India. *Bull. Geol. Min. Met. Soc. India.* **II** : 1-48.
- GHOSH, A. M. N. 1960. Stratigraphical position of the Cherra Sandstone Assam. *Record Geol. Surv. India.* **V** (4) : 1-19.
- KOSSMAT, F. 1897. On the stratigraphy and faunistic relation of Pondicherry. *Rec. Geol. Surv. India.* **30**(2) : 51-95.
- MEDLICOTT, H. B. 1839. Geological sketch of the Shillong Plateau. *Mem. Geol. Surv. India.* **12**(1) : 151-207.
- MOORE, R. C. 1963. 'Treatise on Invertebrate Palaeontology' Part. H. Brachiopoda ; Part-I. Gastropoda ; Part. K, Nautiloidea ; Part L. Ammonoidea ; Part N. Bivalvia.
- NAGAPPA, Y. 1960. The Cretaceous—Tertiary boundary in India—Pakistan subcontinent. 21st session, *I.G.C.* : 41-49.
- OLDHAM, I. 1859. On the geological structure of a portion of Khasi Hills. *Beng. Mem. Geol. Surv. India.* **1** : 99-210.
- SPENGLER, E. 1923. Contribution to the Cretaceous Palaeontology of the Pacific Coast. *Pal. Ind.* (N. S.) **8**, Mem. 1.
- STOLICZKA, F. 1861-68. Cretaceous Fauna of S. India. *Pal. Ind.* Ser. 7, **1** : Ser. 5, **2** : Ser. 6, **8** : Ser. 7, **4**.



1



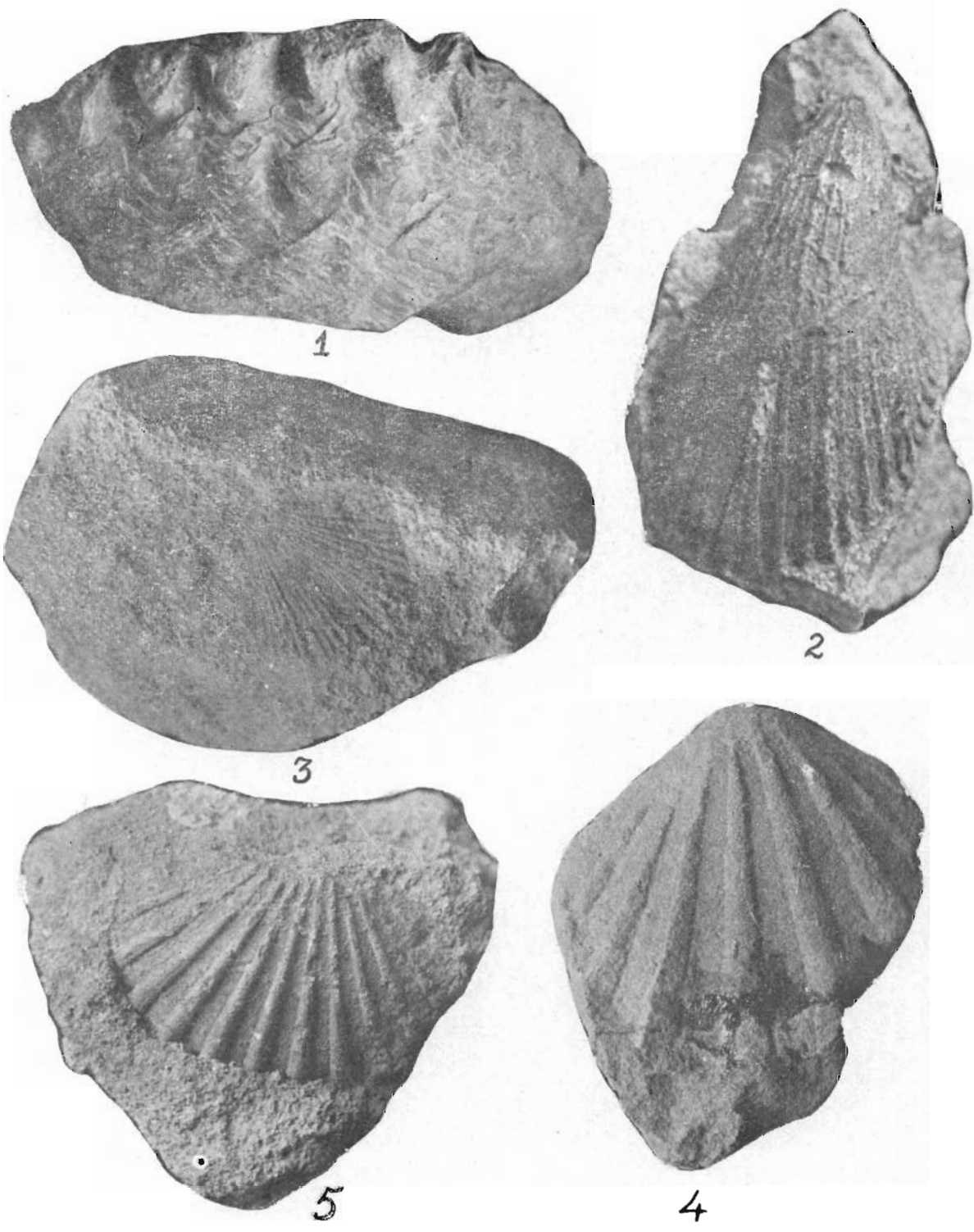
2



3



4

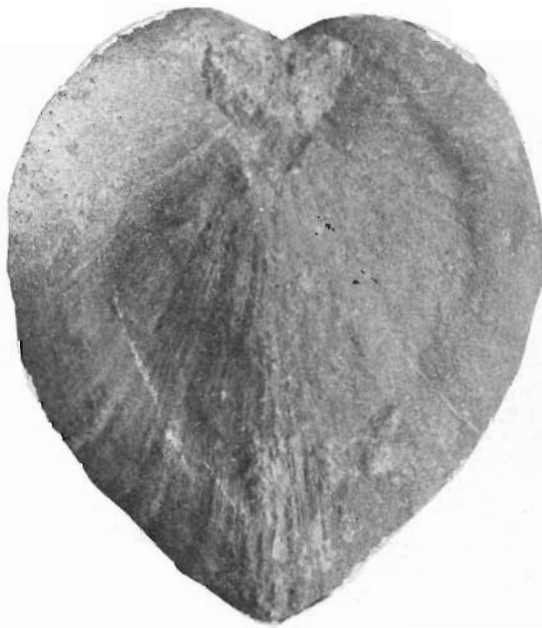




1



2



4



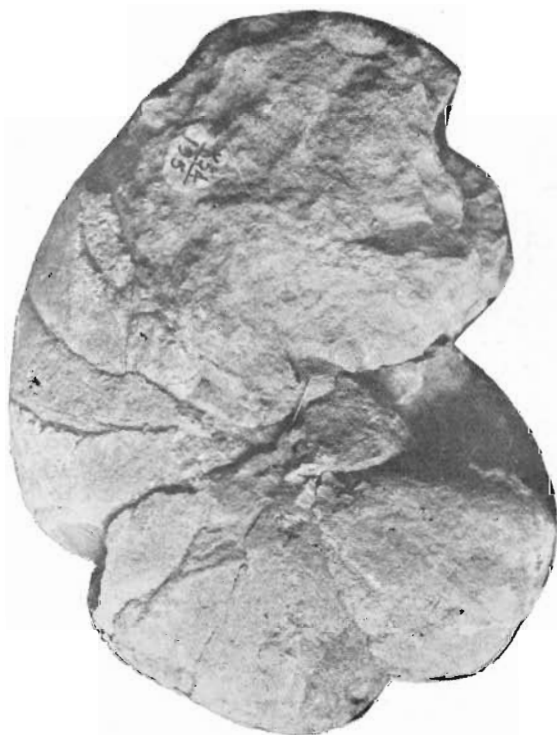
3



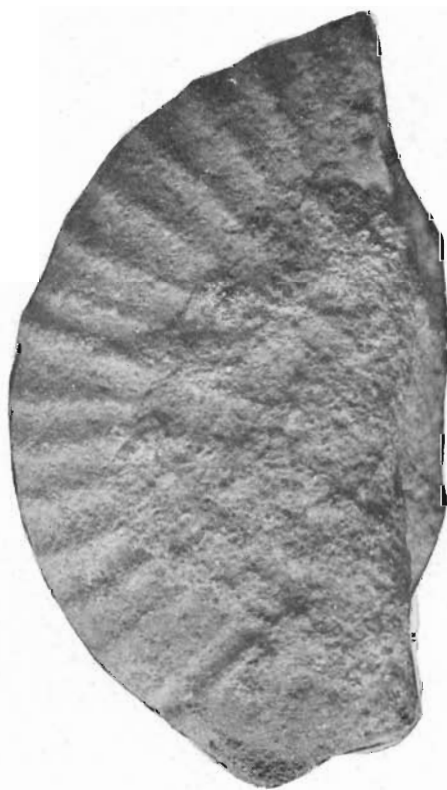
1



2



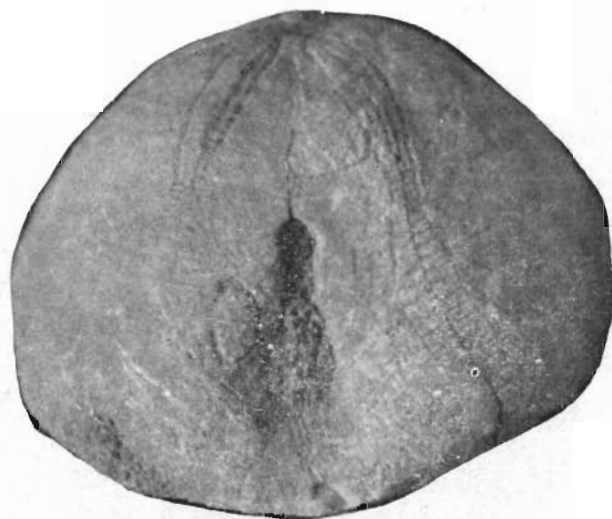
3



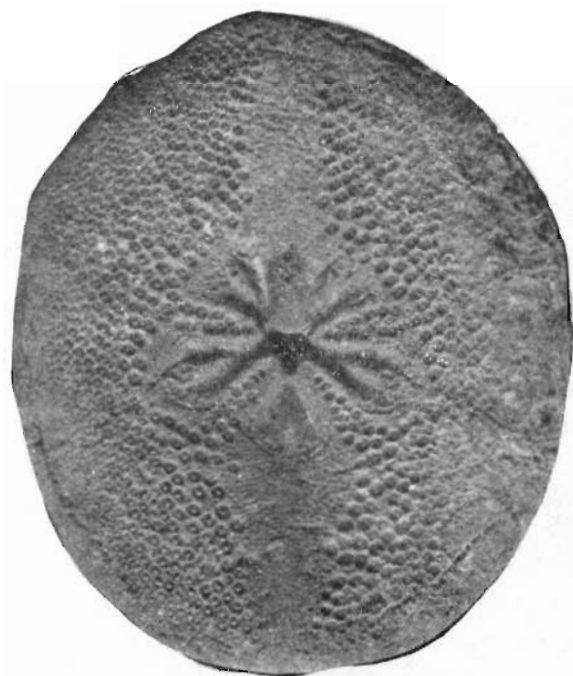
4



1



2



3



4





1



2



4



3



1



2



3



4

EXPLANATION OF PLATES

(All the figures are natural size except otherwise mentioned)

PLATE I

- 1 & 4 *Inoceramus haliicus*, Boehm. Mahadek Formation, Jadukata Area, Khasi Hill.
 2 *Pinna laticostata*, Stol. Jadukata Formation, Howsyaram plateau, Khasi Hill.
 3 *Pinna conplanata* Stol. Jadukata Formation, Laitkyusew plateau, Khasi Hill.

PLATE II

- 1 *Alectryonia unguolata*, Lam. Mahadek Formation, Pynursla plateau, Khasi Hill.
 2 & 3 *Neithea fanjasi*, Pict. & Camp. Jadukata Formation, Cherrapunji plateau, Khasi Hill.
 4 *Pecten assamensis* Spengl. Jadukata Formation, Cherrapunji plateau, Khasi Hill.
 5 *Pecten aff. decemcostatus*, Vog. Mahadek Formation, Cherrapunji plateau, Khasi Hill.

PLATE III

- 1 *Trigonoarca abrupta*, Forb. Mahadek Formation, Jadukata area, Khasi Hill.
 2 *Eubaculites vagina*, Forb. Mahadek Formation, Dawki area, Jaintia Hill.
 3 & 4 *Trigonoarca brahminica*, Forb. Mahadek Formation, Jadukata area, Khasi Hill.

PLATE IV

- 1 & 2 *Cassidulus oldhamica*, Stol. Mahadek Formation Pynursla Plateau, Khasi Hill.
 2 *Entreploceras sub-losrigatus* D'orb. var. *inidea* Spengl. Mahadek Formation, Laitkyusew plateau, Khasi Hill.
 4 *Anisoceras large-sulcatum*, Forb. Mahadek Formation, Jadukata area, Khasi Hill.

PLATE V

- 1, 2 & 3 *Stigmatopygus elatus*, Forb. Mahadek Formation, Laitkyusew plateau, Khasi Hill.
 4 *Anisoceras indicum*, Forb. Mahadek Formation, Therriaghat area, Khasi Hill.

PLATE VI

- & 2 *Pachydiscus gollsvillensis*, Forb. Mahadek Formation, Laitkyusew plateau, Khasi Hill.
 3 & 4 *Pachydiscus ootacodensis*, Stol. Mahadek Formation, Jadukata area, Khasi Hill.

PLATE VII

- 1 & 2 *Epigonoceras epigonum*, Koss. Mahadek Formation, Cherrapunji plateau, Khasi Hill.
 3 *Alectryonia pectinata*, Schloth. Mahadek Formation, Pynursla plateau, Khasi Hill.
 4 *Eubaculites vagina*, Forb. Mahadek Formation, Dawki area, Khasi Hill.

PLATE VIII

- 1 & 2 *Cymatoceras kayeanus*, Stol. Mahadek Formation, Dawki area, Jaintia Hill.
 3 *Gryphaea vesicularis*, Lam. Mahadek Formation, Sokha, Jaintia Hill.
 4 *Pachydiscus denisonianus*. Stol. Mahadek Formation Laitkyusew area, Khasi Hill.