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FOSSILS BIVALVES FROM THE UPPER BHUBAN FORMATION OF PRAYER POINT, TUIRIAL ROAD, AIZAWL, MIZORAM, INDIA

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ABSTRACT

The grey sandstone bed of the Bhuban Formation of Prayer Point, Tuirial Road Aizawl, India, has yielded 26 forms (13 species) of which all of them are bivalves. They are represented by 6 genera that are grouped into 6 families, 3 superfamilies, and 3 orders belonging to 2 subclasses. Out of these 13 species, 3 species could not be identified at the specific level for want of better-preserved materials and more detailed information. A close study of these fossil assemblages reveals that the Upper Bhuban Formation of Prayer Point, Tuirial road Aizawl has a geological age ranging from Aquitanian to Vindobonian, i.e. Middle to Lower Miocene age (~11 to 23 million years).

Keywords: *Sandstone, Bhuban, Miocene, Aizawl, Bivalves.*

Introduction

The bivalves described and illustrated in this paper come from the Upper Bhuban Formation of Prayer Point, Tuirial road, Aizawl and they are the sole representative group of fossils in the study area. Though the preservation is not very satisfactory and these generally occur as isolated valves, molds and casts, the essential external features are observable enough for the identification up to species level. The classification scheme of the Bivalvia suggested by Newell has been adopted for systematic (see Moore R. C. *et al.*, 1969). The identification of genera and species is mainly based on the external morphological characters and comparison with the type specimens. Measurements of the specimens are given in millimeters. The figured

specimens are housed in the Paleontology Laboratory of the Department of Geology, Mizoram University, Aizawl, India.

Materials and Methodology

Geological settings

Mizoram is a part of the Tripura-Mizoram Accretionary belt of the Cenozoic age consisting of alternate argillaceous and arenaceous succession. It is considered to be the southern extension of the Surma basin. The entire sedimentary succession of Mizoram is about 8000 meters. The main rock types exposed in the area are sandstone, siltstone, shale, mudstone, and their admixture in various proportions and a few pockets of shell limestone, calcareous sandstone, and intra-formational conglomerates. The Tertiary rocks of Mizoram have been grouped sequentially into Barail, Surma, and Tipam Groups in ascending order of their age respectively. The Surma Group is divisible into a lower Bhuban Formation and an upper Boka Bil Formation. Bhuban Formation is further divisible into lower, middle and upper Bhuban Units.

Methodology

Litho-association of the study area has been studied extensively in order to collect field data. Different fossiliferous horizons have been identified properly. Bed-by-bed collections of mega-biota from the study area have been made. The mega-biota thus -

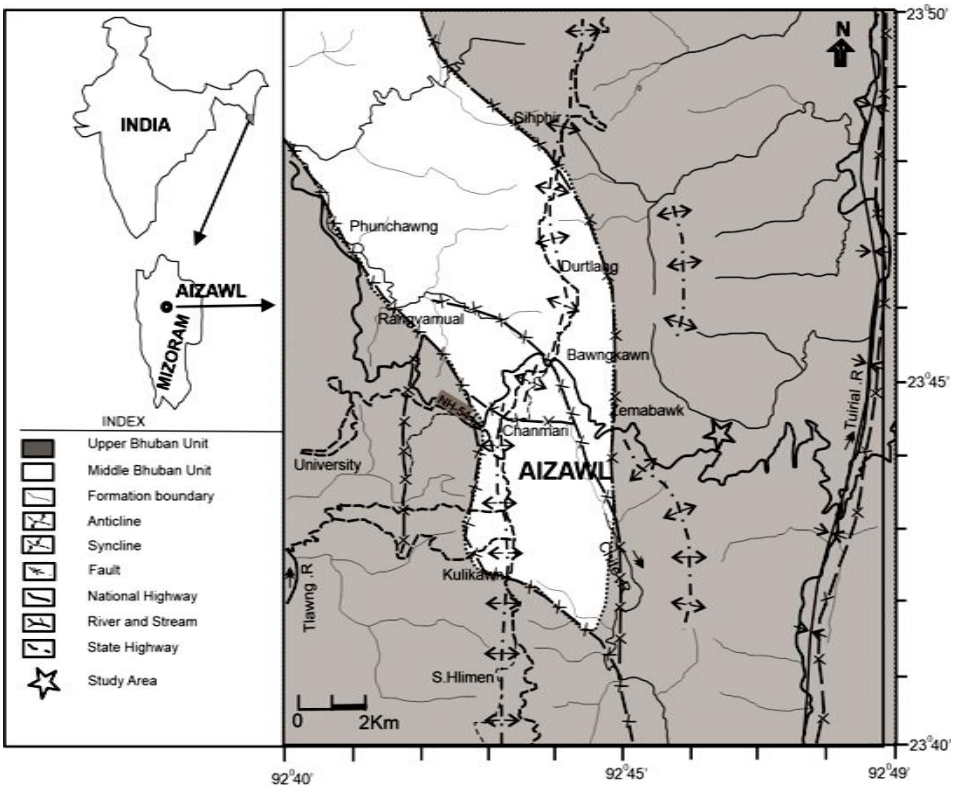

Figure 1: Location map of the study area

collected have been thoroughly studied group-wise up to species level for their systematic palaeontological descriptions with the help of type material and available literature in the laboratory. The age of the fossiliferous horizons has been deciphered based on the common occurrence of fossils species in the rock successions of equivalent age. The Bhuban succession of the study area has been correlated with the Miocene succession of the other areas based on the extent to which fossil fauna are common. The data regarding the distribution pattern of fossils in the rocks (*viz*. orientation, density, sorting, and state of preservation), their association, mode of occurrence, relationship with the enclosing sediments, and forms have helped to decipher the palaeoecology of the fossil species. This data along with the bathymetry of the studied taxa has been used to work out the depositional history of the associated rocks and paleogeography of the study area. The following abbreviations are used in the description of the specimen:

Sp. No. – Specimen number, L – Length, H- Height, I- Inflation, BV- Both valve, LV- Left valve, RV- Right valve.

Fossil locality description

The locality is Prayer Point, Tuirial Road (N 23^0 44' 09'' – E 92^0 45' 93'') which is located about 11 km from Aizawl, eastern side. The exposed rock unit is about 24 meters, medium to fine grey sandstone bed, with joints present at almost every 3 meters. Fossils are dispersed in the top 7 meters range. This section is well bedded, moderately hard, and compact.

Results and Descriptions:

Phylum MOLLUSCA Linné, 1758

Class BIVALVIA Linné, 1758

Subclass PTERIOMORPHIA Buerlen, 1944

Order PTERIOIDA Newell, 1965

Suborder PTERIINA Newell, 1965

Superfamily PECTINACEA Rafinesque, 1815

Family PECTINIDAE Rafinesque, 1815

Genus *Chlamys* Roeding, 1798.

Type species: *Pectenislandicus* Mueller, 1776; SD. Herrmannsen, 1847; Recent; North-Atlantic.

Subgenus *Argopecten* Monterosato, 1899

Type species: *Pecten solidulus* Reeve, 1853; OD. Recent; Unknown locality.

***Chlamys* (*Argopecten*) *senatoria* (Gmelin)**

(Figure A)

Material: One left valve and one right valve.

Dimensions:

Sp. No.	L	H	I	
B2	22.2	21	2	RV
B2	36.6	31.3	6.6	LV

Description and Remarks: The species in question is highly variable in dimensional ratios and intervening spaces. Besides, it is a long-ranging one from Miocene to Recent having wide geographical distribution in Asia and Africa.

The specimens at hand agree with all the essential characteristics of the species *Chlamys* (*Argopecten*) *senatoria* (Gmelin) and are referred to it. Both specimens resemble very well with Tiwari's collection (Specimen No. HPQ/8/17) and Lalchawimawii`s collection (B/CH/380) from Mizoram under the same name. Hence, the reference.

***Chlamys* (*Chlamys*) *quilonensis*Dey**

(Figure B)

Material: One right valve.

Dimensions:

Sp. No.	L	H	I	
L2	11.4	10.9	1.2	RV

Description and Remarks: The valves are thin, feebly convex, and oblique, more in length than height, and covered with around 16 rounded ribs, which are squamose near the margin. The interspaces have the same width as the ribs. The above description tallies well with the *Chlamys* (*Chlamys*) *quilonensis* Dey (1962, op. cit.), Hence, the assignment.

***Chlamys* sp.**

(Figure C)

Material: One left valve and One right valve

Dimensions:

Sp. No.	L	H	I	
L3	16.7	18.7	3.9	LV
L4	9.7	11.2	1.9	RV

Description and Remarks: The specimen differs in size and inflation. The valves seem to be trigonal to trapezoidal and the auricles are not well preserved. The number of radial ribs cannot be counted because of poor preservation.

Since the specimens are incomplete and poorly preserved, their specific identification and comparison with other known forms are not possible.

Subclass HETERODONTA Neumayr, 1884

Order VENEROIDA H. Adams and A. Adams, 1856

Family UNGULINIDAE Adams and Adams, 1857

Genus *Diplodonta* Bronn, 1831.

Type species: *Venus lipinis* Brochhi, 1814; SD. Hermannsen, 1846; Recent; Mediterranean.

Subgenus *Diplodonta* (*s. s.*)

***Diplodonta (Diplodonta) incerta* d'Archiac**

(Figure D)

Material: Two left valves.

Dimensions:

Sp. No.	L	H	I	
L9	14.4	14.4	3.1	LV
L11	17.3	16.4	1.7	LV

Description and Remarks: The specimens are compared with the *Diplodonta incerta d'Archiac* figured by Mukerjee (1939, p. 9, Pl. II, fig. 6) to which they are found to match well in respects outline, nature and positions of umbones,

angulations from the umbo to a posterior marginal band. Hence, they are designated accordingly.

Suborder ASTARTEDONTINA

Superfamily TELLINACEA de Blainville, 1814

Family TELLINIDAE de Blainville, 1814

Subfamily TELLINIDAE de Blainville, 1814

Genus *Tellina* Linné, 1758.

Type species: *Tellina radiate* Linné, 1758; SD. Children, 1823. Recent; West Indies.

***Tellina maubawka* Tiwari**

(Figure E)

Material: One left valve.

Dimensions:

Sp. No.	L	H	I	
PP1	26.3	16.2	2.6	LV

Description and Remarks: The specimen is characterized by an ovate-truncate outline, obliquely rounded anterior margin, sinuous ventral margin, and height is about two-thirds of the length. There is a prominent furrow from the umbo towards the postero-ventral. The specimen has fine but sharp concentric growth lines but the total surface sculpture could not be ascertained because of worn-out surfaces. These characters are very well matched with the description done by Tiwari on *Tellina maubawka*. Hence merged with the Tiwari's specimens (2006, op. cit.) (Figure E).

Subgenus *Eurytellina* Fischer, 1887

Type species: *Tellina punicea* Born, 1790; M. Recent; West Indies.

***Tellina* (*Eurytellina*) *pilgrimi* Cox**

Material: One right valve.

Dimensions:

Sp. No.	L	H	I	
PP4	29.7	18.7	3.2	RV

Description and Remarks: These species have variable dimensions (Cox, 1936). For example, the paratypes, have almost median umbones and a slightly more height-to-length ratio (75%), while holotype (G.S.I. No. 17375) is more elongated (the height-length ratio is 69%) with umbones little posterior to the median. Likewise, the specimen has similarities and resemblance with a 62.9% ratio, though it is a bit low compared to the holotypes and paratypes, it is acceptable and hence assigned to *Tellina* (*Eurytellina*) *pilgrimi* (Cox, 1936).

***Tellina* (*Eurytellina*) *pilgrimi* Cox**

(Figure F)

Material: One complete bivalve, two right valves, and one left valve.

Dimensions:

Sp. No.	L	H	I	
C4	30	26.4	3.6	BV
C27A	22.7	20	3.1	LV
C27B	26.1	17.5	4.2	RV
PP4	29.7	18.7	3.2	RV

Description and Remarks: This species has variable dimensions (Cox,

1936). For example, the paratypes have almost median umbones and slightly more height-to-length ratio (75%), while holotype (G.S.I. No. 17375) is more elongated (the height-length ratio is 69%) with umbones little posterior to the median. Likewise, the specimen has similarities and resemblance with a 62.9% ratio, though it is a bit low compared to the holotypes and paratypes, it is acceptable and hence assigned to *Tellina* (*Eurytellina*) *pilgrimi* (Cox, 1936).

Subgenus *Perodinia* Dall, 1900

Type species: *Tellina albicans* Gmelin, 1826; OD.

***Tellina* (*Perodina*) sp.**

(Figure G)

Material: One left valve.

Dimensions:

Sp. No.	L	H	I	
PP01	37.8	20.3	4.6	LV

Description and Remarks: The shelliselongated, solid, and compressed. sub equivalve, without lunule, escutcheon long, narrow; shell with fine concentric grooves, stronger anteriorly; lateral teeth weak. This form is distinct from other species of *Tellina* but the identification is left to open nomenclature for more and better-preserved material.

Family PSAMMOBIIDAE Fleming, 1828

Subfamily PSAMMOBIINAE Fleming, 1828

Genus *Gari* Schumacher, 1817

Type Species: *Gari vulgaris* (= *Solenamethystus* Wood, 1815); SD Children, 1823. Recent; East Indies.

Subgenus *Gari* (*s. s*.)

***Gari* (*Gari*) *natensis*Noetling**

(Figure H)

Material: One right valve.

Dimensions:

Sp. No.	L	H	I	
PP3	29.3	11.9	3.3	RV

Description and Remarks: The overall outline, ornamentation and posterior region of the present specimen resemble *Gari natensis* Noetling (1901), particularly the holotype no. 7629 and hence the assignment.

Superfamily VENERACEA Rafinesque, 1815

Family VENERIDAE Rafinesque, 1815

Subfamily TAPETINAE Adams and Adams.

Genus *Paphia* Roeding, 1798

Type species: *Paphiaalapapilionis* (=*Venus rotundata* Linné, 1758); SD. Dall, 1902; Recent; Western Pacific.

Subgenus *Paphia*(*s. s*.)

***Paphia* (*Paphia*) *persica* Cox**

(Figure I)

Material: One right valve.

Dimensions:

Sp. No.	L	H	I	
B5	19.2	11.4	2.1	RV

Description and Remarks: The specimen has a sub-median umbone, elongated valve, and fine concentric sculpture. It has been compared with the specimens assigned to the same species by Tiwari (1992) from the Upper Bhuban Formation of Mizoram to which these exhibit close similarity. The specimen approach *Paphia*(*Paphia) persica* Cox in its characteristics. Hence, the identification.

***Paphia* (*Paphia*) *rotundata* (Linné)**

(Figure J)

Material: One left valve.

Dimensions:

Sp. No.	L	H	I	
B4	19.6	12.9	4.2	LV

Description and Remarks: The specimens have been assigned to *Paphia* (*Paphia*) *rotundata* (Linne') owing to the similarity in respect of general outline, nature, and positions of umbo, dimensional ratios, and surface ornamentation. Hence, these are assigned to the Linne' species. The identification has further been confirmed by the direct comparison with Tiwari's collection (1992).

Subgenus *Callistotapes* Sacco, 1900

Type species: *Venus ventula* Basterot, 1825; OD. Oligocene to Recent; Europe, Asia and New Zealand.

***Paphia* (*Callistotapes*) *pseudoliratus* Vredenburg**

(Figure K)

Material: One left valve and one right valve.

Dimensions:

Sp. No.	L	H	I	
PP5	18	10.8	3.9	LV
B3	16.9	9.1	2.6	RV

Description and Remarks: The specimen are compressed and elongated in nature medium size, ovate outline narrowly rounded anterior and posterior margins fine concentric sculpture which is separated by narrow interstices. These characters well match the species *Tapes* (*Callistotapes*) *pseudovirus*, described by Vredenburg (1928). Hence the specimens at hand are assigned to this species. Tiwari (1992) has included *Callistotapes* under the genus *Paphia* following Myra Keen (in Moore *et al.*, 1969, p. N 685). In accordance, the author also prefers to assign this species as *Paphia* (*Callistotapes*) *pseudoliratus* Vredenburg.

***Paphia* sp.**

(Figure L)

Material: Two left valves and four right valves.

Dimensions:

Sp. No.	L	H	I	
PP8	23.4	17.1	5.1	RV
PP9	21.2	17.2	4.3	RV
B6	23.5	16.1	2.8	RV
B7	18.8	14.7	2.8	LV
B8	20.7	16.3	3.7	RV
B9	28.5	2.6	4.6	LV

Description and Remarks: The specimens are small, elongate-ovate, and moderately inflated. Umbo is prosogyrous and at about one-third of the shell. Concentric ribs are prominent with narrow interstices. Since the preservation of the specimen is poor, most of the defined characteristics cannot be observed and its specific identifications and comparisons with other known forms are not possible.

Order MYOIDA Stoliczka, 1870

Suborder MYINA Stoliczka, 1870

Superfamily MYACEA Lamarck, 1809

Family CORBULIDAE Lamarck, 1818

Subfamily CORBULINAE Gray, 1823

Genus *Corbula* Bruguiere, 1797

Type species: Corbulasulcata Lamarck, 1801; SD. Schmidt, 1818. Recent; Senegal (West Africa).

***Corbula* (*Corbula*) *tunicosulcata* Vredenburg**

(Figure M)

Material: One right valve.

Dimensions:

Sp. No.	L	H	I	
PP10	25.5	20.8	13.5	RV

Remarks: Vredenburg (1928) christened a new species by the name *Corbula* (*Corbula*) *tunicosulcata* considering the diagnostic characteristics like broadly triangular, flattened, and moderately incurved umbo, high inflation, elongated and contracted posterior portion with a prominent curvilinear ridge and surface with broadly spaced angular costae. All these characters are clearly marked in all the specimens at hand. Hence, the assignment. Vredenburg (1928) considered this form as an intermediate form of *Corbulatunicata* (Hinds) and *Corbulasulcata* Lamarck because his collections showed the characters of both these species.

Conclusion

The study area has yielded 13 taxa of bivalves. However, identification at the specific level could not be attempted for 3 species for want of better-preserved materials and more information. Out of the known geological age of 10 bivalves species in the study area, 4 species (40%) have an age range of Aquitanian to Burdigalian, namely *Diplodonta (Diplodonta) incerta* d'Archiac, *Tellina maubawka* Tiwari, *Gari (Gari) natensis* Noetling and *Paphia (Paphia) rotundata* (Linné). *Tellina* (*Eurytellina) pilgrimi* Cox has an age range of Rupelian to Helvetian. The rest of them are long-ranging, viz. two species which have Aquitanian to Upper Miocene (Vindobonian) age range: (*Chlamys (Chlamys) quilonensis* Dey and *Paphia (Paphia) persica* Cox), *Chlamys* (*Argopecten*) *senatoria* (Gmelin) and *Paphia* (*Callistotapes*) *pseudoliratus* Vredenburg with Aquitanian to Recent and *Corbula* (*Corbula*) *tunicosulcata Vredenburg* with Aquitanian to Helvetian age. A close study of these fossil assemblages reveals that the Upper Bhuban Formation of Prayer Point, Tuirial road

Aizawl has a geological age ranging from Aquitanian to Vindobonian, i.e. Middle to Lower Miocene age (~11 to 23 million years).

By studying the nature and occurrence of the fossils, it can be inferred that during depositions of these sediments, an open shallow, warm sea with fluctuations from inner neritic to littoral water with a depth certainly less than 50m existed. The substrate was soft but firm to support epifaunal byssate as well as cemented forms.

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Plate: Fossil Specimens

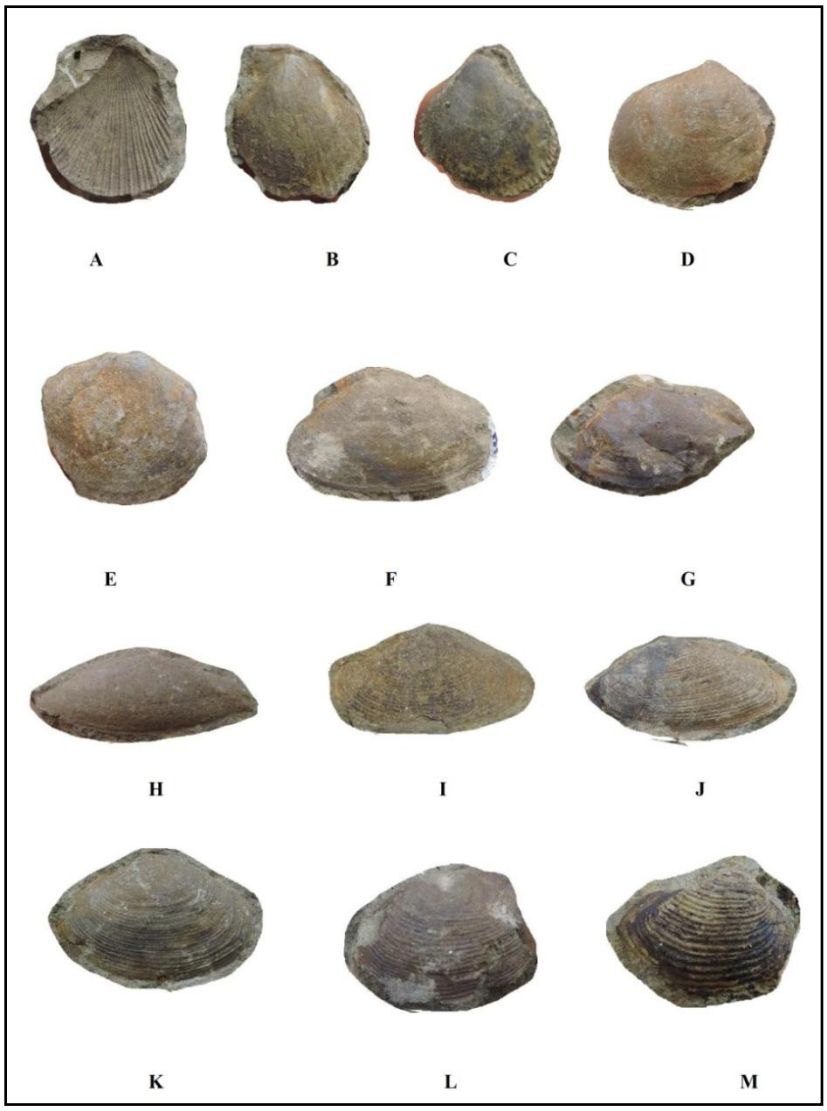

Figure Descriptions:

A: *Chlamys* (*Argopecten*) *senatoria* (Gmelin) – External of right valve
B: *Chlamys* (*Chlamys*) *quilonensis* Dey – External of left valve
C: *Chlamys* sp. – External of right valve
D: *Diplodonta (Diplodonta) incerta* d'Archiac – External of right valve
E: *Tellina* (*Eurytellina) pilgrimi* Cox – External of left valve
F: *Tellina maubawka* Tiwari – External of left valve
G: *Tellina Perodina*sp. – External of left valve
H: *Gari* (*Gari*) *natensis* Noetling – External of right valve
I: *Paphia* (*Paphia*) *persica* Cox – External of left valve
J: *Paphia* (*Paphia*) *rotundata* (Linné) – External of left valve
K: *Paphia* (*Callistotapes*) *pseudoliratus* Vredenburg – External of left valve
L: *Paphia* sp. – External of right valve
M: *Corbula* (*Corbula*) *tunicosulcata* Vredenburg – External of right valve

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