CHAPTER -3

SYSTEMATIC DESCRIPTION
OF
VERTEBRATES
3. SYSTEMATIC DESCRIPTION OF VERTEBRATES

3.1 SYSTEMATIC DESCRIPTION OF BIVALVIA

Bivalves represent the most abundant group of invertebrate fossils in the study area, both in number and kind. Though, the preservation of bivalves is generally poor and mostly in the form of moulds and casts of isolated valves, the essential external features are observable enough to facilitate the identification up to species level. Moreover, a few well-preserved specimens with both the valves intact have also been recovered. The identification of genera and species is mainly based on the external morphological characters and comparison with the type specimens. Internal features have also been considered wherever observable.

The classification adopted for the systematic study of bivalves is after Newell (see Moore R. C. et al., 1969). Dimensions of the specimens are given in millimeters and the figures in the parentheses are in percentages. The figured specimens are housed in the Palaeontological Laboratory, Department of Geology, Mizoram University, Aizawl, Mizoram, India. The following abbreviations have been used:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sp. No.</td>
<td>Specimen number</td>
</tr>
<tr>
<td>RV</td>
<td>Right valve</td>
</tr>
<tr>
<td>LV</td>
<td>Left valve</td>
</tr>
<tr>
<td>BV</td>
<td>Both valves</td>
</tr>
<tr>
<td>s.s.</td>
<td>Sensu stricto</td>
</tr>
<tr>
<td>cf.</td>
<td>Comparable to</td>
</tr>
<tr>
<td>aff.</td>
<td>Affinity to</td>
</tr>
<tr>
<td>G/</td>
<td>Gastropods</td>
</tr>
<tr>
<td>F/</td>
<td>Foraminifera</td>
</tr>
<tr>
<td>R</td>
<td>Ruata quarry</td>
</tr>
<tr>
<td>FZ</td>
<td>Faith Academy</td>
</tr>
<tr>
<td>Zonuam</td>
<td></td>
</tr>
<tr>
<td>LG</td>
<td>Luangmu L Govt. Complex</td>
</tr>
<tr>
<td>SD</td>
<td>Subsequent designation</td>
</tr>
<tr>
<td>OD</td>
<td>Original designation</td>
</tr>
<tr>
<td>M</td>
<td>Monotypy</td>
</tr>
<tr>
<td>T</td>
<td>Tautonomy</td>
</tr>
<tr>
<td>NR</td>
<td>Number of ribs</td>
</tr>
<tr>
<td>(c)</td>
<td>Computed</td>
</tr>
<tr>
<td>B/</td>
<td>Bivalves</td>
</tr>
<tr>
<td>C/</td>
<td>Decapods</td>
</tr>
<tr>
<td>B</td>
<td>Bika quarry</td>
</tr>
<tr>
<td>YL</td>
<td>Youth Hostel, Luangmu L</td>
</tr>
<tr>
<td>GZ</td>
<td>Govt. Complex Road</td>
</tr>
<tr>
<td>Zonuam</td>
<td></td>
</tr>
<tr>
<td>LG</td>
<td>Luangmu L Govt. Complex</td>
</tr>
</tbody>
</table>
The specimens have been photographed mostly in natural light with orientation in the reading position. Magnification of the photographs is given in the explanation to the photoplates. In some cases, however, the measurements may not tally with the actual figures given in the text due to parallax effect during photography.

**Phylum** MOLLUSCA Linne’, 1758  
**Class** BIVALVIA Linne’, 1758  
**Subclass** PALAEOTAXODONTA Korobkov, 1954  
**Order** NUCULOIDEA Dall, 1889  
**Superfamily** NUCULACEA Gray, 1824  
**Family** NUCULIDAE Gray, 1824  
**Genus** *Nucula* Lamarck, 1799  

Type species: *Arca nucleus* Linne’, 1758; M. Recent; France.  

**Subgenus** *Nucula* (s. s.)

*Nucula (Nucula) agrawali* Tiwari, 1992  
(Pl. 3, figs. 1 – 2)  

2004. *Nucula (Nucula) agrawali* Tiwari: Mazumder, p. 32 - 33, Pl. II, fig. 5.  

**Material:** Two complete bivalved specimens.  
**Location:** Locality no. 6 (Govt. Complex Road, Zonuam, Aizawl).  
**Horizon:** Brown silty-sandstone of Upper Bhuban unit, Bhuban Formation.  
**Dimensions (mm):**

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Height</th>
<th>Inflation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>B/GZ - 216</td>
<td>28.00</td>
<td>18.00 (64.24)</td>
<td>10.00 (35.71)</td>
<td>BV</td>
</tr>
<tr>
<td>B/GZ - 217</td>
<td>30.00</td>
<td>22.00 (73.33)</td>
<td>16.00 (53.33)</td>
<td>BV</td>
</tr>
</tbody>
</table>

**Remarks:** The distinguishing characters of the species, viz., sub-trigonal to transversely elongate outline, moderate inflation, small, pointed, opisthogyrous and posterior-fifth umbo are clearly discernable in the specimens at hand. Besides, the specimens closely resemble with the specimens of the same species reported by Tiwari (1992) and
Mazumder (2004) from the Upper Bhuban unit of Bhuban Formation of Mizoram. Hence, identification is confirmed. Higher inflation of specimen B/GZ – 217 may be because the valves are opened along the ventral margin.

Superfamily  NUCULANACEA H. Adams and A. Adams, 1858
Family  NUCULANIDAE Adams and Adams, 1858
Genus  Portlandia Morch, 1857

Type species:  Nucula arctica Gray, 1824; SD ICZN, 1966. Recent; North Atlantic.

Subgenus  Portlandia (s.s.)

Portlandia (Portlandia) ovatoelongata Mazumder, 2004

(Pl - 3, fig. 3)


Material: One right valve.

Location: Locality no. 6 (Govt. Complex road, Zonuam, Aizawl).

Horizon: Brown silty-sandstone of Upper Bhuban unit, Bhuban Formation.

Dimensions: The lone specimen numbering B/GZ - 218 has: Length – 21.00mm; Height – 15.00mm (71.42); Inflation – 11.00mm (52.38).

Remarks: The lone specimen, on direct comparison, matches well with the holotype (K17/B/98) of Portlandia (Portlandia) ovatoelongata of the Mazumder’s collection from Kolasib in all diagnostic characters like elongate-ovate outline, thick and slightly opisthogyrate umbo, triangular umbonal profile, nature and configuration of margins, antero- and postero-ventral furrows and broad undulations with fine concentrics. Thus, it is assigned to this form. Present specimen is however, nearly half the size of the Majumder’s collections.

Subclass  PTERIOMORPHIA Buerlen, 1944
Order  ARCOIDA Stoliczka, 1871
Superfamily  ARCACEA Lamarck, 1809
Family  ARCIDAE Lamarck, 1809
Sub Family  ARCINAE Lamarck, 1809
Genus  Barbatia Gray, 1842
Type species: *Arca barbatia* Linne, 1758; SD Gray, 1857: Recent; Mediterranean.

**Barbatia (Barbatia) bataviana** Martin var. *carinata* Noetling, 1939

(Pl - 3, figs. 4 – 5)

1885. *Arca bataviana* Martin, p. 253, Pl. 13, figs. 256-257

1901. *Arca (Barbatia) bataviana* Martin var. *carinata* Noetling, p. 148, Pl. 7, figs. 7- 8

1939. *Barbatia (Barbatia) bataviana* Martin var. *carinata* Noetling: Mukerjee, p. 25,

Pl. I, figs. 12 and 13.

**Material:** Two isolated right valves.

**Location:** Locality 2 (Ruata Quarry, near Ramrikawn, Tuivamit, Aizawl).

**Horizon:** Upper intraformational conglomeratic band, Upper Bhuban unit, Bhuban Formation.

**Dimensions:**

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Height</th>
<th>Inflation</th>
<th>RV</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/R-59</td>
<td>27.00</td>
<td>28.00 (c.103.70)</td>
<td>9.00 (33.33)</td>
<td>RV</td>
</tr>
<tr>
<td>B/R-60</td>
<td>20.00</td>
<td>25.00 (c.125.00)</td>
<td>7.00 (35.00)</td>
<td>RV</td>
</tr>
</tbody>
</table>

**Remarks:** In general outline, dimensional ratios and external features, the two specimens at hand greatly resemble *Barbatia (Barbatia) bataviana* Martin var. *Carinata* Noetling reported and figured by Mukherjee (1939) from the Baghmara and Dalu localities of the Garo Hills, Meghalaya excepting for the larger size of the former. Hence, these are assigned to this form without any reservation.

**Barbatia sp.**

(Pl - 3, figs. 6)

Type species: *Arca barbatia* Linne, 1758; SD Gray, 1857: Recent; Mediterranean

**Material:** One right valve.

**Location:** Locality 1 (Bika Quarry, Tuivamit, Aizawl).

**Horizon:** Upper intraformational conglomeratic band, Upper Bhuban unit, Bhuban Formation.
Dimensions:

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Height (Inflation)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>B/B-55</td>
<td>31.00</td>
<td>13.00 (41.93)</td>
<td>6.00 (19.35)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>RV</td>
<td></td>
</tr>
</tbody>
</table>

Description and Remarks: Valve transversely elongate, length nearly two and a half times than the height, moderately inflated maximum inflation being behind the umbo. Umbo sub-median, pointed anteriorly with a prominent umbonal profile. Dorsal margin straight and ventral margin with a median sinuosity. Anterior margin narrowly rounded whereas posterior one broadly rounded. Valve surface covered with flat radial ribs separated by the interspaces of equal width. These are crossed over by numerous concentric growth lines producing cancellate ornamentation. Internal features not discernible. Specific identification is not attempted in the absence of other details.

Genus *Trisidos* Röding, 1798

Type species: *Arca tortuosa* Linne’, 1758; OD

*Trisidos semitorta* (Lamarck), 1819

(Pl. 3, figs. 7)

1840. *Arca tortuosa* ?J.de C.Sowerby, Pl. 25, fig. 13
1853. *Arca kurracheensis* d’Archiac and Haime, p. 263, Pl. 22, fig. 4.
1885. *Arca (Trisis) semitorta* Smith, p. 268.
1891. *Arca (Trisis) semitorta* Smith, p. 432.
1901. *Arca (Parallelepipedum) semitorta* Noetling, p. 151.
Material: One broken left valve
Location: Locality 2 (Ruata Quarry, near Ramrikawn, Tuivamit, Aizawl).
Horizon: Upper intraformational conglomeratic band, Upper Bhuban unit, Bhuban Formation.
Dimensions: Specimen no. B/R -57 has the following dimensions: Length – 34.00, Height - 15.00(44.11); Inflation – 6.00 (17.64)
Remarks: Though the specimen at hand is partially broken, it matches well with *Trisidos semitorta* (Lamarck) recorded by Vredenburg (1928) from the Gaj beds of Kachchh and Sind in respect of general proportion, in the cancellate ornamentation produced by prominent raised radial ribs traversed by fine growth lines and in twisted hinge. On these counts, it also matches well with the same species reported by Mukerjee (1939) from Garo Hills. It is a widely distributed form reported from the Oligocene of Baluchistan and Sind, Gaj of Kachchh and Sind and Lower Miocene of Meghalaya. The present specimen is however, larger than its Meghalaya counterpart.

Subfamily ANADARINAE Reinhart, 1935
Genus *Anadara* Gray, 1847

Type species: *Arca antiquata* Linne, 1758; OD. Recent; Medagascar.

*Anadara (Anadara) craticulata* (Nyst), 1847
(Pl - 3, figs. 8 – 9)
1844. *Arca clathrata* Reeve (non Defrance, 1816), p. 44.
1847. *Arca craticulata* Nyst, p. 22.
1853. *Arca burnesi* d’Archiac and Haime, p. 264, Pl. XXII, fig. 5.
1885. *Arca burnesi* d’Archiac and Haime: Martin, p. 245, Pl. XII, fig. 50.
1920. *Arca (Scapharca) burnesi* d’Archiac and Haime: Tesch, p. 97, Pl. XXXVIII, fig. 258.

**Material:** Two broken left and right valves.

**Location:** Locality 1 (Bika Quarry, University road, Tuivamit, Aizawl); Locality 2 (Ruata Quarry, near Ramrikawn, Tuivamit, Aizawl); Locality 6 (Govt. Complex Road, Zonuam, Aizawl)

**Horizons:** Lower intraformational conglomeratic band, Upper Bhuban unit, Bhuban Formation of Locality 1; upper intraformational conglomeratic band, Upper Bhuban unit, Bhuban Formation of Locality 2; Brown silty-sandstone of Upper Bhuban unit, Bhuban Formation of Locality 6.

**Dimensions:**

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Height</th>
<th>Inflation</th>
<th>NR</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/R-71</td>
<td>15.00</td>
<td>19.00 (126.66)</td>
<td>8.00 (53.33)</td>
<td>RV 43</td>
</tr>
<tr>
<td>B/B-72</td>
<td>13.00</td>
<td>17.00 (130.76)</td>
<td>6.00 (46.15)</td>
<td>LV 30</td>
</tr>
<tr>
<td>B/GZ-220</td>
<td>18.00</td>
<td>18.00 (100.00)</td>
<td>9.00 (50.00)</td>
<td>BV 28</td>
</tr>
<tr>
<td>B/GZ-221</td>
<td>18.00</td>
<td>18.00 (100.00)</td>
<td>7.00 (38.88)</td>
<td>LV 26</td>
</tr>
</tbody>
</table>

**Remarks:** Though, the specimens under examination are poorly preserved and not complete, these show all the essential features of the species under reference like broadly elliptical outline, moderate inflation, unequal radial ribs with granulation on the anterior side and umbonal position. Hence, it is referred to as *Anadara (Anadara) craticulata* (Nyst).

*Anadara (Anadara) daviesi* Mukerjee, 1939

(Pl. 3, figs. 10 – 11)

1939. *Anadara daviesi* Mukerjee, p. 28, Pl. I, fig. 14; Pl. II, fig. 1.


**Material:** Three left and right valves.

**Location:** Locality 1 (Bika Quarry, University road, Tuivamit, Aizawl), Locality 2 (Ruata Quarry, near Ramrikawn, Tuivamit, Aizawl), Locality 3 (near Youth Hostel, Luangmual, Aizawl) and Locality 6 (Govt. Complex road, Zonuam, Aizawl).

**Horizon:** Lower intraformational conglomeratic band, Upper Bhuban unit, Bhuban Formation of Locality 1; upper intraformational conglomeratic band, Upper Bhuban unit, Bhuban Formation of Locality 2; Brown silty-sandstone of Upper Bhuban unit, Bhuban Formation of Locality 3 and 6.

**Dimensions:**

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Height</th>
<th>Inflation</th>
<th>NR</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/YL-63</td>
<td>17.00</td>
<td>11.00 (64.70)</td>
<td>7.00 (41.17)</td>
<td>LV</td>
</tr>
<tr>
<td>B/R-64</td>
<td>24.00</td>
<td>18.00 (75.00)</td>
<td>9.00 (37.50)</td>
<td>LV</td>
</tr>
<tr>
<td>B/B-68</td>
<td>14.00</td>
<td>11.00 (78.57)</td>
<td>8.00 (57.14)</td>
<td>LV</td>
</tr>
<tr>
<td>B/GZ-221</td>
<td>16.00</td>
<td>10.00 (62.50)</td>
<td>11.00 (68.75)</td>
<td>RV</td>
</tr>
</tbody>
</table>

**Remarks:** Species diagnostic characters like elongate and sub-ovate outline, height about 60 per cent of the length, moderate inflation, oblique posterior margin, broad and flattened radial ribs and distinct granulations towards anterior to anterior-third of valves are well marked in the present specimens. Hence, the assignment.

*Anadara (Anadara) garoensis* Mukerjee, 1939

(Pl - 3, figs. 12)


**Material:** One left valve.

**Location:** Locality 1 (Bika Quarry, University road, Tuivamit, Aizawl).

**Horizon:** Lower intraformational conglomeratic band, Upper Bhuban unit, Bhuban Formation.
Dimensions:

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Height</th>
<th>Inflation</th>
<th>NR</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/R-58</td>
<td>24.00</td>
<td>18.00 (75.00)</td>
<td>8.00 (33.33)</td>
<td>LV</td>
</tr>
</tbody>
</table>

Remarks: The diagnostic characters of the species christened by Tiwari (2001) are subquadrilateral outline, strongly and evenly convex flanks, steeply inclined posterior area with wing like posterior end and thick and closely spaced radials crossed over by concentrics producing reticulate pattern of ornamentation. These characters are very well marked in the lone specimen at hand therefore it is assigned to this species without any hesitation. The only difference that can be noticed between the two is the taller nature of Tiwari’s specimen in which height is nearly ninety percent of the length and it is much smaller than the present collection. The present specimen is however assigned to this species inspite of these trivial differences.


Material: One left valve.

Location: Locality 2 (Ruata Quarry, near Ramrikawn, Tuivamit, Aizawl).

Horizon: Upper intraformational conglomeratic band, Upper Bhuban unit, Bhuban Formation.
**Anadara (Anadara) trapezoida** Tiwari, 2001

(Pl - 3, figs. 14)


2004. *Anadara (Anadara) trapezoida* Tiwari, Mazumder, p. 49, Pl. III, fig. 3.

**Material:** One left and right valves.

**Location:** Locality 1 (Bika Quarry, University Road, Tuivamit, Aizawl).

**Horizon:** Lower intraformational conglomeratic band, Upper Bhuban unit, Bhuban Formation.

**Dimensions:**

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Height</th>
<th>Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/B-62</td>
<td>16.00</td>
<td>25.00 (156.25)</td>
<td>9.00 (56.25)</td>
</tr>
<tr>
<td>B/B-69</td>
<td>9.00</td>
<td>13.00 (144.44)</td>
<td>5.00 (55.55)</td>
</tr>
</tbody>
</table>

**Remarks:** Tiwari (2001), while erecting a new species under the name *Anadara (Anadara) trapezoida*, stated that the diagnostic characters of the species are sub-terminal umbo, obliquely trapezoidal outline, angular posterior carina, steeply sloping posterior margin and almost parallel postero-dorsal and ventral margins. All these features are well marked in both the specimens at hand. Hence, the assignment.

**Family** NOETIIDAE Stewart, 1930

**Subfamily** STRIARCINAE MacNeil, 1938

**Genus** Arcopsis Koenen, 1885

*Type species:* Arca limopsis Koenen, 18?? ; SD Reinhart, 1935

**Arcopsis sp.**

(Pl - 3, figs. 15)

**Material:** One right valve

**Location:** Locality 2 (Ruata Quarry, near Ramrikawn, Tuivamit, Aizawl).

**Horizon:** Upper intraformational conglomeratic band of Upper Bhuban unit, Bhuban Formation.

**Dimensions (mm):** Specimen no. B/R-56 has: Length – 20.00; Height – 15.00 (75.00); Inflation – 5.00 (25).
Description and Remarks: The lone specimen at hand is rhomboidal in outline, moderately inflated and umbo is situated one-third from the anterior. The umbo is prosogyrate and distinct. Dorsal margin is straight, anterior and posterior margins are rounded and merge smoothly with the dorsal and ventral margins. Ventral margin is flat. It has a postro-ventral carina that is more prominent towards the dorsal margin and becomes feeble towards the ventral margin. Posterior area is small and moderately sloping. There is a feeble median sulcus running from umbo to the ventral margin. Valve surface is covered with thirty-eight fine and nearly equally spaced bifurcating ribs. These are in turn crossed over by concentric growth lines producing nodes at the intersections. The interspaces are narrower than the ribs. Specific identification is not attempted for the want of better-preserved material. This is the first report of the genus from the Miocene sediments of Mizoram.

Order MYTILOIDA Ferussac, 1822
Superfamily PINNACEA Leach, 1819
Family PINNIDAE Leach, 1819
Genus Pinna Linne’, 1758

Type species: Pinna rudis Linne’, 1758: SD. Children, 1823; Recent; Barbados.

Pinna (Pinna) cf. rudis Linné
(Pl - 3, figs. 16)

Synonomy of the typical form Pinna rudis Linné are as follows:
1971. Pinna rudis Linné: Davies, p. 189, fig. 430d.

Material: One complete specimen.
Location: Locality 6 (Govt. Complex Road, Zonuam, Aizawl).
Horizon: Brown silty-sandstone of Upper Bhuban unit, Bhuban Formation.
Dimensions: Specimen no. B/GZ-227 has: Length – 27.00; Height – 28.00 (103.70).

Remarks: General outline and radial ornamentation along with a few commarginal undulations of the present specimen at once reminds the species Pinna (Pinna) rudis
Linné. However, it is referred to as *Pinna (Pinna)* cf. *rudis* for the want of more details and better-preserved specimens.

**Order**

PTERIOIDA Newell, 1965

**Suborder**

PTERIINA Newell, 1965

**Superfamily**

PECTINACEA Rafinesque, 1815

**Family**

PECTINIDAE Rafinesque, 1815

**Genus**

*Chlamys* Röding, 1798

Type species: *Pecten islandicus* Müller, 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), 1791

(Pl - 3, figs. 17 – 19)

1791. *Ostrea senatoria* Gmelin, p. 3327.

1840. *Pecten articulatus* J. de C. Sowerby, Pl. XXV, fig. 15.

1853. *Pecten favrei* d’Archiac and Haime, p. 270, Pl. XXIV, fig. 5.

1927. *Chlamys senatoria* (Gmelin): Cox, p. 45. Pl. VII, figs. 1 - 3; p. 75, Pl. XV, fig. 3; Pl. XXVII, fig. 10.


1936. *Chlamys senatoria* (Gmelin): Cox, p. 54, Pl. V, fig. 18; Pl. IV, fig. 9.

1939. *Chlamys senatoria* (Gmelin): Mukerjee, p. 31, Pl. I, fig. 2; Pl. II, figs. 9-10.


1992. *Chlamys (Chlamys) senatoria* (Gmelin): Tiwari MS, p. 73, Pl. VII, figs. 10, 11; Pl. VIII, figs. 1 - 3.


2004. *Chlamys (Argopecten) senatoria* (Gmelin): Mazumder, p. 69, Pl. VIII, fig. 5.


38
Material: One complete specimen, one left and three right valves.

Location: Locality 1 (Bika Quarry, University road, Tuivamit, Aizawl); Locality 3 (near Youth Hostel, Luangmual, Aizawl); Locality 4 (near Faith Academy, Zonuam, Aizawl).

Horizon: Lower intraformational conglomeratic band of Upper Bhuban unit, Bhuban Formation of Locality 1; Brown silty-sandstone of Upper Bhuban unit, Bhuban Formation of Locality 3 and 4.

Dimensions:

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Height</th>
<th>Inflation</th>
<th>NR</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/B-98</td>
<td>15.00</td>
<td>15.00 (100.00)</td>
<td>4.00 (26.26) RV</td>
<td>25</td>
</tr>
<tr>
<td>B/YL-86</td>
<td>13.00</td>
<td>13.00 (100.00)</td>
<td>3.00 (23.07) RV</td>
<td>24</td>
</tr>
<tr>
<td>B/B-87</td>
<td>17.00</td>
<td>19.00 (111.76)</td>
<td>4.00 (23.52) RV</td>
<td>28</td>
</tr>
<tr>
<td>B/FZ-88</td>
<td>15.00</td>
<td>17.00 (113.33)</td>
<td>6.00 (40.00) LV</td>
<td>24</td>
</tr>
<tr>
<td>B/YL-92</td>
<td>21.00</td>
<td>22.00 (c. 104.00)</td>
<td>6.00 (28.50) BV</td>
<td>30 (C)</td>
</tr>
</tbody>
</table>

Remarks: Cox (1937), while commenting on the species from the Burdigalian of Persia, stated that the species in question is sub-orbicular with the height only slightly in excess of the length, its surface is covered with about 24 wide radial ribs and the interspaces are occupied by the fine, closely spaced undulating sqamae. All these characters are well defined in the present specimens. Hence, the identification. The number of ribs in the present specimens however vary from 22 to 28 depending on the size. This species has also been reported from the Miocene of Garo Hills (Mukerjee, 1939; Lyngdoh, 2004) and Miocene of Mizoram (Tiwari, 1992, Mazumder, 2004 and Lalchawimawii, 2004). It is a widely distributed form reported from Asia and Africa and ranges in age from Miocene to Recent.

Genus

_Pecten_ Müller, 1776

Type species: _Ostrea maxima_ Linne’, 1758; SD Schmidt, 1818; Recent; English Channel.

_Pecten (Pecten) mathuri_ Tiwari MS, 1992

(Pl – 3, figs. 20 a – b, Pl – 4, fig. 1)

1992. _Pecten (Pecten) mathuri_ Tiwari MS, p. 78, Pl. VIII, figs. 5 - 8.
Material: Two bivalved specimens, two left and one right valves.

Location: Locality 1 (Bika Quarry, University road, Tuivamit, Aizawl); Locality 3 (near Youth Hostel, Luangmual, Aizawl); Locality 4 (near Faith Academy, Zonuam, Aizawl).


Dimensions:

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Height</th>
<th>Inflation</th>
<th>Valve</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/YL-90</td>
<td>17.00</td>
<td>16.00 (94.11)</td>
<td>3.00 (17.64)</td>
<td>LV</td>
</tr>
<tr>
<td>B/FZ-91</td>
<td>22.00</td>
<td>19.00 (86.36)</td>
<td>6.00 (27.27)</td>
<td>BV</td>
</tr>
<tr>
<td>B/B-93</td>
<td>18.00</td>
<td>18.00 (100.00)</td>
<td>3.00 (16.66)</td>
<td>RV</td>
</tr>
<tr>
<td>B/B-94</td>
<td>21.00</td>
<td>21.00 (100.00)</td>
<td>3.50 (16.66)</td>
<td>LV</td>
</tr>
<tr>
<td>B/B-97</td>
<td>18.00</td>
<td>16.00 (88.88)</td>
<td>5.00 (27.77)</td>
<td>BV</td>
</tr>
</tbody>
</table>

Remarks: Tiwari (1992), while describing the species for the first time, wrote that it is sub-orbicular in outline having evenly rounded anterior, posterior and ventral margins and its antero-dorsal is slightly more elongate than the postero-dorsal. The right valve of the species is oblique and slenderly more convex than the left one. In all these characters, the specimens at hand approach the species christened by Tiwari. Hence, it is named accordingly.

Subclass: HETERODONTA Neumayr, 1884
Order: VENEROIDA H. Adams and A. Adams, 1856
Superfamily: LUCINACEA Fleming, 1828
Family: UNGULINIDAE Adams and Adams, 1857
Genus: Diplodonta Bronn, 1831

Type species: Venus lipinis Brochhi, 1814; SD.Hermannsen, 1846; Recent; Mediterranean.
Diplodonta (Diplodonta) incerta d’Archiac, 1850

(Pl – 4, figs. 2 – 3)

1853. Lucina inflata d’Archiac: d’Archiac and Haime, p. 240, Pl. XVI, figs. 15 - 16; Pl. XXXVI, figs. 7 - 8.
1939. Taras (Diplodonta) incerta d’Archiac: Mukerjee, p. 9, Pl. II, fig. 6.

Material: Two bivalves and one right valve.
Locality: Locality 3 (near Youth Hostel, Luangmual, Aizawl) and Locality 6 (Govt. Complex road, Zonum, Aizawl)
Dimensions:

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Height</th>
<th>Inflation</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/YL-20</td>
<td>17.00</td>
<td>17.00 (100.00)</td>
<td>4.00 (25.00)</td>
<td>RV</td>
</tr>
<tr>
<td>B/GZ-231</td>
<td>21.00</td>
<td>21.50 (102.38)</td>
<td>9.00 (42.85)</td>
<td>BV</td>
</tr>
<tr>
<td>B/GZ-233</td>
<td>20.00</td>
<td>22.00 (110.00)</td>
<td>8.00 (40.00)</td>
<td>BV</td>
</tr>
</tbody>
</table>

Remarks: The general proportion and external characters of the ornamentation of the specimen collected from the above two fossil localities are identical with Diplodonta incerta reported by Vredenburg (1928) from the Gaj beds of Sind. Hence the assignment. However, the present collection is almost half the size of the Vredenburg’s specimen.

Diplodonta (Diplodonta) rotundatus (Montagu), 1803

(Pl – 4, fig. 4)

1803. Tellina rotundata Montagu, p. 71, Pl. II, fig. 3.
Diplodonta rotunda (Montagu): Reevem p. 36.
Diplodonta rotunda (Montagu): Lamy, p. 188.
Diplodonta rotunda (Montagu): Lamy, p. 335.
Diplodonta rotundatus (Montagu): Cox, p. 386.
Taras (Diplodonta) rotundatus (Montagu): Mukerjee, p. 9.
Diplodonta rotundatus (Montagu): Tiwari, p. 87, Pl. IX, figs. 8 and 9.
Diplodonta rotundatus (Montagu): Mazumder, p. 80, Pl. IV, fig. 7.
Diplodonta rotundatus (Montagu): Lyngdoh, p. 64, Pl. VIII, figs. 8 and 9.
Diplodonta rotundatus (Montagu): Lalchawimawii, p. 26, Pl. III, figs. 5a and 6.

**Material**: Two left valves and one right valve.

**Locality**: Locality 6 (Govt. Complex road, Zonuam, Aizawl).

**Horizon**: Brown silty-sandstone of Upper Bhuban unit, Bhuban Formation.

**Dimensions**:

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Height</th>
<th>Inflation</th>
<th>Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/GZ-232</td>
<td>19.00</td>
<td>21.00 (110.52)</td>
<td>7.00 (36.84)</td>
<td>RV</td>
</tr>
<tr>
<td>B/GZ-235</td>
<td>14.00</td>
<td>15.00 (107.14)</td>
<td>4.80 (34.28)</td>
<td>LV</td>
</tr>
<tr>
<td>B/GZ-236</td>
<td>27.00</td>
<td>23.00 (85.18)</td>
<td>9.00 (33.33)</td>
<td>LV</td>
</tr>
</tbody>
</table>

**Remarks**: On account of their small size, less prominent umbo, less oblique outline and more expanded posterior area, these specimens are assigned to Diplodonta (Diplodonta) rotundatus (Montagu). The species is a long ranging one (i.e. Oligocene to Recent) and has a wide geographical distribution as it is also recorded from Arabia, Mediterranean region, western Europe, east Atlantic, South Africa, Mekran Coast, Red Sea and India.

**Superfamily**    CARDITACEA Fleming, 1820
**Family**         CARDITIDAE Fleming, 1828
**Subfamily**      CARDITAMERINAE Chavan
**Genus**          Cyclocardia Conrad, 1867

Type species: *Cardita borealis* Conrad, 1831; SD Stoliczka, 1871. Upper Cretaceous to Recent; Cosmopolitan.
Cyclocardia sp.
(Pl – 4, figs. 5 – 7)

Material: Three right valves.
Location: Locality 1 (Bika Quarry, University road, Tuivamit, Aizawl).
Horizon: Lower intraformational conglomeratic band, Upper Bhuban unit, Bhuban Formation.

Dimensions:

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Height</th>
<th>Inflation</th>
<th>NR</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/B-114</td>
<td>19.00</td>
<td>25.00 (131.57)</td>
<td>6.00 (31.57)</td>
<td>RV 16</td>
</tr>
<tr>
<td>B/B-115</td>
<td>20.00</td>
<td>22.00 (110.00)</td>
<td>7.00 (35.00)</td>
<td>RV 16</td>
</tr>
<tr>
<td>B/B-117</td>
<td>16.00</td>
<td>18.00 (112.50)</td>
<td>5.00 (31.25)</td>
<td>RV 16</td>
</tr>
</tbody>
</table>

Description and Remarks: Valves tall, thick, sub-trigonal in shape and strongly inflated. Umbo prosogyrous, prominent and situated anterior - third of the valve length. Dorsal margin curved, anterior margin short and concave and joins the ventral margin at an obtuse angle, posterior margin long and sloping (35°) and joins ventral margin obtusely. Ventral margin obliquely rounded being larger towards antero-ventral than the postero-ventral one. A feeble carina runs from the umbo towards both the antero-ventral and the postero-ventral corners forming moderately sloping anterior and posterior areas. Anterior carina is moderately curved whereas posterior one is fairly straight. Surface ornamented with sixteen strong radial ribs. These ribs are stronger in the middle portion than in the anterior and posterior areas. Interspaces also follow the same pattern. Though the valve surface is worn out in all the specimens at hand, it seems to bear fine concentrics and nodes may be seen towards the ventral margin. Internal characters not observable. The specimens could not be identified upto the species level due to poor preservation.

Lyngdoh (2004) reported a species under the name Cyclocardia mutabilis from the Miocene of the Garo Hills of Meghalaya. My specimens are however, much taller than the Meghalaya counter part, hence cannot be merged. This species was originally described by Cotter (1923) and Noetling (1901) from the Eocene and Miocene of Meghalaya respectively. These are also much less in height than our specimens. This is the first report of the genus from Mizoram.
Suborder  ASTARTEDONTINA
Superfamily  CRASSATELLACEA Ferussac, 1822
Family  ASTARTIDAE  d’ Ordigny, 1844
Subfamily  ASTARTINAE  d’ Orbigny, 1844
Genus  Astarte  J.Sowerby, 1816

Type species:  Venus scotica Maton and Rackettm, 1807 (= Pectunculus sulcatus 1778); OD. Recent; Scotland.

Subgenus  Bythiamena Gardner, 1926
Type species:  Astarte (Bythiamena) isoscleles  Gardner, 1926; OD. Miocene; U.S.A.

Astarte (Bythiamena) striata Tiwari, 1992
(Pl – 4, figs. 8 – 9)

1992.  Astarte (Bythiamena) striata Tiwari, p. 90, Pl. IX, figs. 10 a and b.
2004.  Astarte (Bythiamena) striata Tiwari: Lalchawimawii, p. 28, Pl. III, figs. 10 and 11.

Material:  Two complete Bivalve and one left valves.
Location:  Locality 1 (Bika Quarry, University road, Tuivamit, Aizawl), Locality 3 (near Youth Hostel, Luangmual, Aizawl), Locality 5 (Luangmual Govt. Complex, Aizawl).
Horizon:  Lower intraformational conglomeratic band, Upper Bhuban unit, Bhuban Formation of Locality 1; Brown silty-sandstone of Upper Bhuban unit, Bhuban Formation of Locality 3 and 5.

Dimensions:

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Height</th>
<th>Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/B-10</td>
<td>8.00</td>
<td>9.00 (112.50)</td>
<td>5.00 (62.50)</td>
</tr>
<tr>
<td>B/YL-11</td>
<td>15.00</td>
<td>16.00 (106.66)</td>
<td>8.00 (53.33)</td>
</tr>
<tr>
<td>B/LG-234</td>
<td>25.00</td>
<td>28.00 (112.00)</td>
<td>14.00 (56.00)</td>
</tr>
</tbody>
</table>

Remarks:  The specimens under consideration tally well with the holotype of Astarte (Bythiamena) striata (Tiwari, 1992) in view of their broadly trigonal outline, slightly inequilateral valves, height slightly in excess of length, moderate inflation, curved and
pointed prosogyrous umbo that are placed at anterior-third of the shell length and surface of shell covered with dense sets of fine concentric striations. Hence, their assignment to this species is beyond doubt.

Superfamily       CARDIACEA Lamarck, 1809
Family            CARDIIDAE Lamarck, 1809
Subfamily         LAEVICARDIINAE Keen, 1936
Genus             Clinocardium Keen, 1936

Type species:  Cardium nuttallii Conrad, 1837; OD. Upper Miocene to Recent; North Pacific to North-West Atlantic.

Clinocardium sp.
(Pl – 4, fig. 10)

Material: One poorly preserved left valve.
Location: Locality 1 (Bika Quarry, University road, Tuivamit, Aizawl).
Horizon: Lower intraformational conglomeratic band, Upper Bhuban unit, Bhuban Formation.
Dimensions (mm):

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Height</th>
<th>Inflation</th>
<th>NR</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/B-106</td>
<td>24.00</td>
<td>21.00 (87.50)</td>
<td>7.00 (29.16)</td>
<td>LV 9</td>
</tr>
</tbody>
</table>

Description and Remarks: In slightly oblique and sub-ovate outline, much asymmetrical ventral margin rising rapidly in posterior region, and flat topped radial ribs, the present specimen matches well with Clinocardium andoi Itoigawa and Shibata illustrated by Nagakawa (1998 p. 133, figs. 2-4, 6, 14,17 and 18). It also matches well with the specimens of the same species reported by Lyngdoh (2004, pl. X, figs. 14-15) from the Miocene of Garo Hills, Meghalaya in these respects. However, my specimen bears nine strong radial sculptures as compared to numerous weak radials of the earlier reported specimens. Moreover, further comparison is not possible due to poor preservation. Hence, it is left to the open nomenclature.
**Superfamily** - MACTRACEA Lamarck, 1809

**Family** - MACTRIDAE Lamarck, 1809

**Subfamily** - MACTRINAE Lamarck, 1809

**Genus** - *Mactra* Linne,’ 1767

*Type species:* *Cardium stultorum* Linne,’ 1758; SD. Fleming, 1818. Recent: Mediterranean.

**Mactra (Mactra) protoreevesii** Noetling, 1901

(Pl – 4, fig. 11)


**Material:** One left valve.

**Location:** Locality 1 (Bika Quarry, University Road, Tuivamit, Aizawl).

**Horizon:** Brown silty-sandstone of Upper Bhuban unit, Bhuban Formation.

**Dimensions:**

<table>
<thead>
<tr>
<th>Sp. No.</th>
<th>Length</th>
<th>Height</th>
<th>Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/B-29</td>
<td>23.00</td>
<td>17.00 (73.91)</td>
<td>3.00 (13.04)</td>
</tr>
</tbody>
</table>

**Remarks:** Mukerjee (1939, p.14), while describing *Mactra protoreevesii* Noetling from the Garo Hills of Meghalaya, opined that characteristic features of the species are disproportion between the size of anterior and posterior regions, the presence of a broad, flattened keel running from umbo towards the posterior margin and extremely elongate anterior and the short acuminate posterior regions. All these characters are very well-marked in the specimen at hand. Hence, the assignment. Identification is further confirmed by the direct comparison of the specimen with Tiwari’s collection (*op. cit.*) particularly with Sp. No. – MT/4/8 from the Upper Bhuban Formation of Mizoram.
Subfamily: LUTRATIINAE  Adams and Adams, 1956
Genus: Lutraria  Lamarck, 1759

Type species: Mya lutraria  Linne’, 1758; Tautonomy. Recent; Mediterranean.

Lutraria philippinarum  Reeve, 1854

(Pl – 4, figs. 12 – 14)

1854. Lutraria philippinarum Deshayes; Reeve, conch. Icon, VIII, Lutraria sp. 4.
1932. Lutraria philippinarum, Prashad, Siboga-Exped Monogr. , L III c, p. 211(with Synonymy)
1936. Lutratria philippinarum, Reeve: Cox, p. 65, Pl. VIII, fig. 1.

Material: Three poorly preserved bivalved specimens.

Location: Locality 1 (Bika Quarry, University road, Tuivamit, Aizawl).

Horizon: Lower intraformational conglomeratic band, Upper Bhuban unit, Bhuban Formation.

Dimensions:

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Height</th>
<th>Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/B-6</td>
<td>29.00</td>
<td>20.00 (68.96)</td>
<td>10.00 (34.48)</td>
</tr>
<tr>
<td>B/B-7</td>
<td>32.00</td>
<td>26.00 (81.25)</td>
<td>12.00 (37.50)</td>
</tr>
<tr>
<td>B/B-9</td>
<td>28.00</td>
<td>21.00 (75.00)</td>
<td>8.50 (30.35)</td>
</tr>
</tbody>
</table>

Remarks: The diagnostic character of the species Lutraria philippinarum Reeve as stated by Cox (1936, p. 65), is compressed, elongate-ovate and somewhat arcuate outline with anterior one-sixth umbo. These characters can be clearly seen in the specimens under study inspite of their poor preservation. In addition to above, the ornamentation also seems to be similar i.e. coarse and undulating growth lines. Therefore, the identification is confirmed.
*Lutraria (Lutraria) saigengai* Tiwari MS, 1992  
(Pl – 4, fig. 15)


**Material:** One fairly well preserved bivalved specimen.

**Location:** Locality 2 (Ruata Quarry, Tuivamit, Aizawl).

**Horizon:** Lower intraformational conglomeratic band, Upper Bhuban unit, Bhuban Formation.

**Dimensions:**

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Height</th>
<th>Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/R-1</td>
<td>43.00</td>
<td>22.00 (51.16)</td>
<td>11.00 (25.58)</td>
</tr>
</tbody>
</table>

**Remarks:** Compressed nature with gapping at both the ends, transeversely-elliptically outline, height nearly half of the length, anterior-third to anterior-fourth umbo, broad rounded margins and commarginal bands becoming wider towards ventral margin remind at ones the species newly designated by Tiwari (1992) as *Lutraria (Lutraria) saigengai*. However, the present specimen is larger in size and more inflated. Since these differences are of trivial nature, it is identified as *Lutraria (Lutraria) saigengai*.

**Superfamily**  
SOLENACEA Lamarck, 1809

**Family**  
CULTELLIDAE Davies, 1935

**Genus**  
*Cultellus* Schumacher, 1817

Type species: *Cultellus magmus* (=*Solen lacteus* Spengler, 1794); by monotype. Recent; East Indies.

**Subgenus**  
*Cultellus* s. str.

*Cultellus (Cultellus) zulloi* Tiwari MS, 1992  
(Pl – 4, fig. 16)

2004. *Cultellus (Cultellus) zulloi* Tiwari: Lalchawimawii, p. 31, Pl. IV, fig. 4.
Material: One left and right valves.
Location: Locality 6 (Govt. Complex Road, Zonuam, Aizawl).
Horizon: Brown silty-sandstone of Upper Bhuban unit, Bhuban Formation.

Dimensions:

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Height</th>
<th>Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/GZ-238</td>
<td>36.00</td>
<td>16.00 (44.44)</td>
<td>3.00 (8.33)</td>
</tr>
<tr>
<td>B/GZ-239</td>
<td>39.00</td>
<td>14.00 (35.89)</td>
<td>4.00 (10.25)</td>
</tr>
</tbody>
</table>

Remarks: These specimens have perfectly elliptical outline excepting near umbonal region, their length is about 2.3 to 2.8 times than the height, and they have a shallow groove on either side of the umbo all along the dorsal margin. These have small and low umbones placed anterior-forth of the shell-length. In all the above characters, these specimens approach very closely to *Cultellus (Cultellus) zulloi* Tiwari (1992). Hence, their assignment is justified.

*Cultellus* sp.

(Pl – 4, fig. 17, Pl – 5, fig. 1)

Material: Two complete juvenile specimens.
Location: Locality 2 (Ruata Quarry, near Ramrikawn, Tuivamit, Aizawl)
Horizon: Upper intraformational conglomeratic band, Upper Bhuban unit, Bhuban Formation.

Dimensions:

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Height</th>
<th>Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/R-200</td>
<td>30.00</td>
<td>11.00 (36.66)</td>
<td>3.00 (10.00)</td>
</tr>
<tr>
<td>B/R-201</td>
<td>24.00</td>
<td>10.00 (41.66)</td>
<td>4.00 (16.66)</td>
</tr>
</tbody>
</table>

Description and Remarks: The shell is thin, highly compressed and narrowly elongated and seems to be gaping at both the ends. Umbo is small, indistinct and situated about anterior - third to one - fourth of the shell-length. Antero-dorsal is short and gently sloping whereas postero-dorsal is long and straight. Anterior and posterior margins are narrowly rounded and ventral margin is flat. Surface appears to be smooth. Poor preservation of the
specimen does not warrant specific identification and comparison with other known forms of the species.

**Superfamily**
TELLINACEA de Blainville, 1814

**Family**
TELLINIDAE de Blainville, 1814

**Subfamily**
TELLININAE de Blainville, 1814

**Genus**
*Tellina* Linne’, 1758

Type species: *Tellina radiata* Linne’, 1758; SD Children, 1823. Recent; West Indies.

**Subgenus**
-*Angulus* Megerle Von Muehlfeld, 1811.

Type species: *Tellina lanceolata* Gmelin, 1791; SD. Gray, 1847. Recent; East Indies.

*Tellina (Angulus) sp.*
(Pl – 5, figs. 2 – 3)


**Material:** Five bivalved specimens and one left and right valves each.

**Locality:** Locality 5 (Luangmual Government Complex, Aizawl) and 6 (Govt. Complex road, Zonuam, Aizawl).

**Horizon:** Brown silty-sandstone of Upper Bhuban unit, Bhuban Formation of Locality 5 and 6.

**Dimensions:**

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Height</th>
<th>Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/GZ-241</td>
<td>27.00</td>
<td>16.00 (59.25)</td>
<td>7.00 (25.92)</td>
</tr>
<tr>
<td>B/GZ-242</td>
<td>27.00</td>
<td>16.00 (59.25)</td>
<td>8.00 (29.62)</td>
</tr>
<tr>
<td>B/LG-243</td>
<td>28.00</td>
<td>17.00 (60.71)</td>
<td>8.00 (28.57)</td>
</tr>
<tr>
<td>B/LG-244</td>
<td>34.00</td>
<td>20.00 (58.82)</td>
<td>9.00 (26.47)</td>
</tr>
<tr>
<td>B/LG-245</td>
<td>28.00</td>
<td>18.00 (64.28)</td>
<td>4.00 (14.28)</td>
</tr>
<tr>
<td>B/LG-246</td>
<td>22.00</td>
<td>15.00 (68.18)</td>
<td>3.00 (13.63)</td>
</tr>
<tr>
<td>B/GZ-247</td>
<td>20.00</td>
<td>14.00 (70.00)</td>
<td>9.00 (45.00)</td>
</tr>
</tbody>
</table>
Remarks: All these specimens show essential characters of the subgenus *Tellina* (*Angulus*) described by Tiwari (1992) viz., compressed, inequilateral, subelliptical nature of the shell and sub-median and low umbo. Further, there is a strong similarity between the two in the nature of the margins and the nature and numbers of furrows and flexures. Hence, these are identified as *Tellina* (*Angulus*) sp. Their assignment under a new species is however deferred for the want of better-preserved materials.

**Subgenus** - *Eurytellina* Fischer, 1887

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

*Tellina* (*Eurytellina*) *cf.* *pilgrimi* Cox, 1936

(Pl – 5, fig. 4)

The synonymy for the typical form is as follows:

1936. *Tellina pilgrimi* Cox, p. 37, Pl. IV, figs.11, 12 a - b.

1992. *Tellina* (*Eurytellina*) *pilgrimi* Cox: Tiwari, p.108. Pl. XI, figs. 4, 5, 7, 8, 9, 10, 11; Pl. XIII, figs. 8 a - b.


**Material:** Three bivalves and one right valve.

**Locality:** Locality 5 (Luangmual Government Complex, Aizawl) and 6 (Govt. Complex road, Zonuam, Aizawl).

**Horizon:** Brown silty-sandstone of Upper Bhuban unit, Bhuban Formation of Locality 5 and 6.

**Dimensions:**

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Height</th>
<th>Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/LG-248</td>
<td>27.00</td>
<td>20.00 (74.07)</td>
<td>14.00 (51.85)</td>
</tr>
<tr>
<td>B/LG-249</td>
<td>26.00</td>
<td>19.00 (73.07)</td>
<td>10.00 (38.46)</td>
</tr>
<tr>
<td>B/GZ-250</td>
<td>31.00</td>
<td>24.00 (77.41)</td>
<td>9.00 (29.03)</td>
</tr>
<tr>
<td>B/GZ-251</td>
<td>25.00</td>
<td>17.00 (68.00)</td>
<td>6.00 (24.00)</td>
</tr>
</tbody>
</table>

Remarks: In dimensional ratios and general outline, the specimens at hand resemble paratype of *Tellina pilgrimi* originally described by Cox (1936) from Persia. Further
comparison is not possible due to poor preservation. Hence, these are referred to as *Tellina (Eurytellina)* cf. *pilgrimi* Cox.

**Tellina (Moerella) indifferens** Noetling, 1901

(Pl – 5, figs. 5 – 6)

1901. *Tellina indifferens* Noetling, p. 221, Pl. XV, figs. 3 a - b.


**Material:** Three bivalved specimens.

**Locality:** Locality 5 (Luangmual Government Complex, Aizawl) and 6 (Govt. Complex road, Zonuam, Aizawl).

**Horizon:** Brown silty-sandstone of Upper Bhuban unit, Bhuban Formation of Locality 5 and 6.

**Dimensions:**

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Height</th>
<th>Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/LG-252</td>
<td>35.00</td>
<td>25.00 (71.42)</td>
<td>12.00 (24.28)</td>
</tr>
<tr>
<td>B/LG-253</td>
<td>34.00</td>
<td>25.00 (73.52)</td>
<td>12.00 (35.29)</td>
</tr>
<tr>
<td>B/G2-254</td>
<td>34.00</td>
<td>25.00 (73.52)</td>
<td>12.00 (35.29)</td>
</tr>
</tbody>
</table>

**Remarks:** The diagnostic characters of this species are smooth and rather flat surface, elongate triangular outline, sub-terminal to sub-median umbo, narrow elongate anterior, and short and rounded posterior. All these characters are well marked in the three specimens available for study. Hence, specific assignment of these specimens is confirmed.

**Tellina (Tellinella) loknathi** Tiwari, 1992

(Pl – 5, fig. 7)


**Material:** Three right valves embedded in matrix and one left valve.
**Location:** Locality 1 (Bika Quarry, University road, Tuivamit, Aizawl), Locality 2 (Ruata Quarry, near Ramrikawn, Tuivamit, Aizawl) and Locality 5 (Luangmual Government Complex, Aizawl) and 6 (Govt. Complex Road, Zonuam Aizawl).

**Horizon:** Grey silty-sandstone of Upper Bhuban unit, Bhuban Formation of Locality 1; Upper intraformational conglomerate band of Upper Bhuban unit, Bhuban Formation of Locality 2; Brown silty-sandstone of Upper Bhuban unit, Bhuban Formation of Locality 5 and 6.

**Dimensions:**

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Height</th>
<th>Inflation</th>
<th>Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/R-13</td>
<td>35.00</td>
<td>20.00 (57.14)</td>
<td>3.00 (8.57)</td>
<td>RV</td>
</tr>
<tr>
<td>B/B-15</td>
<td>46.00</td>
<td>26.00 (56.52)</td>
<td>3.00 (6.52)</td>
<td>RV</td>
</tr>
<tr>
<td>B/LG-255</td>
<td>23.00</td>
<td>11.00 (47.82)</td>
<td>3.00 (13.04)</td>
<td>LV</td>
</tr>
<tr>
<td>B/GZ-257</td>
<td>19.00</td>
<td>13.00 (68.42)</td>
<td>2.50 (13.15)</td>
<td>RV</td>
</tr>
</tbody>
</table>

**Remarks:** The specimens at hand match well with *Tellina loknathi* reported by Tiwari (1992) from Lunglei of Mizoram in dimensional ratios, nature and position of umbo, configuration of margins and nature and number of flexures and furrows. Though the surface is worn out and surface sculpture could not be clearly seen, the worn out surfaces give the feeling of growth lines that become wider towards the ventral surface like in Tiwari’s collections. Thus these have been assigned to *Tellina (Tellinella) loknathi* Tiwari.

**Subfamily** MACOMINAE Olsson, 1961

**Genus** *Apolymetis* Salisbury, 1929

Type species: *Tellina meyeri* Phillipi, 1846, ex Dunker, MS; by Monotypy. Recent; East Indies.

**Subgenus** *Apolymetis* s.str.

*Apolymetis (Apolymetis) aizawlensis* Tiwari and Kachhara, 2000

(Pl – 5, figs. 8 – 9)

2000. *Apolymetis (Apolymetis) aizawlensis* Tiwari and Kachhara, p. 84, Pl. 1, figs. 4 - 8; Pl. 2, figs. 1-7.

Material: One complete specimen, one broken bivalve and one right valve

Location: Locality 6 (Govt. Complex road, Zonuam, Aizawl).

Horizon: Brown silty-sandstone of Upper Bhuban unit, Bhuban Formation.

Dimensions:

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Height</th>
<th>Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/GZ-258</td>
<td>34.00</td>
<td>24.00 (70.58)</td>
<td>13.00 (38.23)</td>
</tr>
<tr>
<td>B/GZ-259</td>
<td>31.00</td>
<td>19.00 (61.29)</td>
<td>10.00 (32.25)</td>
</tr>
<tr>
<td>B/GZ-260</td>
<td>30.00</td>
<td>21.00 (70.00)</td>
<td>12.00 (40.00)</td>
</tr>
</tbody>
</table>

Remarks: In trigonally-ovate outline, slightly inequivalved and strongly inequilateral character, in nature and position of umbones, in the nature and number of furrows and flexures and in ornamentation, these specimens, particularly specimen no. B/GZ-258, are identical to the holotype of *Apolymetis (Apolymetis) aizawlensis* described and figured by Tiwari and Kachhara (2000). Author could not make any distinction between the two sets of specimens. Hence, the assignment.

*Apolymentis (Apolymetis) grimesi* Noetling, 1901

(Pl – 5, figs. 10 – 12)

1901. *Tellina (Metis) grimesi* Noetling, p. 216, Pl. 14, figs. 4 - 6.


2004. *Apolymetis grimesi* (Noetling): Lalchawimawii, p. 35, Pl. IV, fig. 10; Pl. V, fig. 1.

Material: Three bivalves, one left valve embedded in the matrix and one broken right valve.

Location: Locality 2 (Ruata Quarry, near Ramrikawn, Tuivamit, Aizawl) and Locality 6 (Govt. Complex road, Zonuam Aizawl).

Dimensions:

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Height</th>
<th>Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/R-12</td>
<td>20.00</td>
<td>22.00 (110.00)</td>
<td>4.00 (20.00)</td>
</tr>
<tr>
<td>B/GZ-262</td>
<td>33.00</td>
<td>31.00 (93.93)</td>
<td>15.00 (45.45)</td>
</tr>
<tr>
<td>B/GZ-263</td>
<td>26.00</td>
<td>25.00 (96.15)</td>
<td>14.00 (53.84)</td>
</tr>
</tbody>
</table>

**Remarks:** The specimens available for the study resemble very closely with *Apolymetis grimesi* (Noetling) reported by Mukerjee (1939) from the Miocene of Garo Hills, Meghalaya in respect of general configuration, dimensional ratios and in the nature, number and disposition of flexures and furrows. This species has also been reported by Lyngdoh (2004) from the Miocene of the Garo Hills, Meghalaya and on comparison is found to match well with the present specimens in above characters. The present specimens however, are more or less sub-orbicular and have more pronounced concentric growth lines on both the valves than the Garo counterparts.

**Family**  
PSAMMOBIIDAE Fleming, 1828

**Subfamily**  
PSAMMOBIINAE Fleming, 1828

**Genus**  
*Gari* Schumacher, 1817

Type species: *Gari vulgaris* (= *Solen amethystus* Wood, 1815); Eocene to Recent; Cosmopolitan.

*Gari* (*Gari*) *natensis* Noetling, 1901

(PI – 5, fig. 13)

1901. *Gari natensis* Noetling, p. 228, Pl. XV, figs. 6, a - e.


**Material:** One right valve.

**Location:** Locality 4 (near Faith Academy, Zonuam, Aizawl).

**Horizon:** Brown-silty sandstone of Upper Bhuban unit, Bhuban Formation.

**Dimensions:** The lone specimen (Sp. no. B/FZ-23) has the following dimensions; Length – 15.00; Height – 8.00 (53.33); Inflation – 2.00 (13.33)
Remarks: The present specimen, though small and poorly preserved, matches well with *Gari* (*Gari*) *natensis* Noetling (1901) with respect to outline, posterior region and ornamentation. Nodes produced by the concentric lines crossing over the carina are also faintly preserved in the present specimen. Moreover, it also matches very well with the specimens of the same species reported by Lyngdoh (2004) from the Miocene of Garo Hills, Meghalaya. Hence, the assignment seems to be correct.

**Gari (Psammobia) kingi** (Noetling), 1901

(Pl – 5, fig. 14)

1901. *Gari kingi* Noetling, p. 232, Pl. XV, figs. 11, 11a, 12, 12a, 13, and 13a.

**Material**: One right valve.

**Location**: Locality 5 (Luangmual Govt. Complex, Aizawl).

**Horizon**: Brown silty-sandstone of Upper Bhuban unit, Bhuban Formation.

**Dimensions (mm)**:

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Height</th>
<th>Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/LG-264</td>
<td>30.00</td>
<td>16.00 (48.00)</td>
<td>6.00 (20.00)</td>
</tr>
</tbody>
</table>

**Remarks**: In general proportions, external characters of ornamentation and dimensional ratios and nature and number of posterior keels and furrows, lone specimen from Mizoram resemble very closely with the holotype of *Gari kingi* Noetling (1901). Further, it has been compared with the Mukerji’s collection of the same species from the Miocene of Baghmara, Meghalaya (Sp. No. K22/876) and found to match well expecting the smaller size of the latter. Therefore, its identification is beyond doubt.

**Superfamily** GLOSSACEA Gray, 1847

**Family** GLOSSIDAE Gray, 1847

**Genus** Glossus Poli, 1795

Type species: *Glossus rubicundus* Poli, 1795 (= *Cardium humanum* Linne’, 1758); M; Palaeocene to Recent; Europe, N.Atlantic, West Asia to Indo Pacific.

**Subgenus** Cytherocardia Sacco, 1900

Type species: *Isocardia cytheroides* Mayer, 1868; OD; Eocene to Miocene; Europe.
Glossus (Cytherocardia) cytheroides (Mayer), 1969
(Pl – 5, figs. 15 a – b)


**Material:** Two complete bivalves and one broken right valve.

**Location:** Locality 1 (Bika Quarry, University road, Tuivamit, Aizawl) and Locality 2 (Ruata Quarry, near Ramrikawn, Tuivamit, Aizawl).

**Horizon:** Lower intraformational conglomeratic band, Upper Bhuban unit, Bhuban Formation of locality 1 and Upper intraformational conglomeratic band, Upper Bhuban unit, Bhuban Formation of locality 2.

**Dimensions:**

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Height</th>
<th>Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/R-48</td>
<td>23.00</td>
<td>25.00 (108.69)</td>
<td>11.00 (47.82)</td>
</tr>
<tr>
<td>B/R-50</td>
<td>14.00</td>
<td>14.00 (100.00)</td>
<td>9.00 (64.28)</td>
</tr>
<tr>
<td>B/B-52</td>
<td>14.00</td>
<td>14.00 (100.00)</td>
<td>6.00 (42.85)</td>
</tr>
</tbody>
</table>

**Remarks:** The specimens in hand, remind at once, *Glossus (Cytherocardia) cytheroides* (Mayer) reported by Mazumder (2004) from the Bhuban rocks of Kolasib, Mizoram in respect of elongate-ovate outline, prominent prosogyrous umbo placed anterior-fifth, nature of margins, a postero-ventral ridge and in ornamentation. Hence, the assignment. However, the example from Ruata Quarry, Ramrikawn, Aizawl is a taller form as compared to Kolasib. Further, comparison with the same species illustrated by Keen and Casey (1969) from the Miocene of France does not distinguish the two. Hence, the assignment is justifiable.

**Superfamily** VENERACEA Rafinesque, 1815
**Family** VENERIDAE Rafinesque, 1815
**Subfamily** PITARINAE Stewart, 1930
**Genus** Callista Poli, 1791

Type species: *Venus chione* Linne’, 1758; SD Meek, 1876. Palaeocene to Recent; Mediterranean.
**Callista (Callista) pseudoumbonella** Vredenburg

(Pl – 6, fig. 1)

1928. *Cytherea (Callista) pseudoumbonella* Vredenburg, p. 450, Pl. XXIX, figs. 10 -13, Pl. XXX, figs. 1 - 3 and 5 and 6.


**Material:** One fairly preserved and two ill preserved right valves.

**Location:** Locality 1 (Bika Quarry, University road, Tuivamit, Aizawl) and Locality 2 (Ruata Quarry, near Ramrikawn, Tuivamit, Aizawl).

**Horizon:** Lower intraformational conglomeratic band, Upper Bhuban unit, Bhuban Formation of Locality 1 and Upper intraformational conglomeratic band, Upper Bhuban unit, Bhuban Formation of Locality 2.

**Dimensions:**

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Height</th>
<th>Inflation</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/R-5</td>
<td>25.00</td>
<td>20.00 (80.00)</td>
<td>12.00 (48.00) RV</td>
<td></td>
</tr>
<tr>
<td>B/B-51</td>
<td>22.00</td>
<td>16.00 (72.72)</td>
<td>9.00 (40.90) RV</td>
<td></td>
</tr>
<tr>
<td>B/B-53</td>
<td>25.00</td>
<td>18.00 (72.00)</td>
<td>5.00 (20.00) RV</td>
<td></td>
</tr>
</tbody>
</table>

**Remarks:** Tiwari (1992), while reporting *Callista (Callista) pseudoumbonella* Vredenburg from the Miocene of Hlimen, Mizoram, commented that the diagnostic characters of the species are ovate outline, strong inflation, thick umbo, produced anterior and its ornamentation. All these characters are well marked in the present specimens, particularly in Sp. No. B/R-5. Hence, the identification is beyond doubt.

**Subgenus**

*Costacallista* Palmer, 1927

Type species: *Venus erycina* Linne,’ 1758; OD. Palaeocene – Recent; America, Asia, Europe, N.Z.
**Callista (Costacallista) erycina** (Linne’), 1758

(Pl – 6, fig. 2)


1901. *Cytherea erycina* Favanne: Noetling, p. 198, Pl. XII, figs. 9 – 12.


1927. *Macrocallista erycina* (Linne’): Cox, p. 58, Pl. IX, figs. 7 – 8.


2004. *Callista (Costacallista) erycina* (Linne’): Lyngdoh, p. 98, Pl. XIII, figs. 1 and 2.


**Material:** Two incomplete right valves.

**Location:** Locality 2 (Ruata Quarry, near Ramrikawn, Tuivamit, Aizawl)

**Horizon:** Upper intraformational conglomeratic band, Upper Bhuban unit, Bhuban Formation of Locality 2.

**Dimensions:**

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Height</th>
<th>Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/R- 42</td>
<td>30.00</td>
<td>23.00 (76.66)</td>
<td>6.00 (20.00)</td>
</tr>
<tr>
<td>B/R- 42(a)</td>
<td>32.00</td>
<td>23.00 (71.87)</td>
<td>6.00 (18.75)</td>
</tr>
</tbody>
</table>

**Remarks:** The species *Callista (Costacallista) erycina* (Linne’) is known to have extremely variable form ranging from normal type to the more elongate and lanceolate types (Mukerjee, 1939; Tiwari, 1992). The present specimens are lanceolate type and match well with the general outline and external characters of ornamentation of the species under consideration. As such, these have been assigned to *Callista (Costacallista) erycina* (Linne’) without any reservation.
**Subfamily**  
**DOSINIINAE**  
**Genus**  
**Dosinia** Scopoli, 1777

Type species: *Chama dosin* Adanson, 1757 (= *Venus concentrica* Born, 1778);  
M. Recent; U.S.A.

**Subgenus**  
**Dosinia s.str.**

**Dosinia (Dosinia) peralta** Vredenburg  
(Pl – 6, figs. 3 – 4)


**Material:** One left and two right valves.  
**Location:** Locality 1 (Bika Quarry, University road, Tuivamit, Aizawl) and Locality 5 (Govt. Complex road, Zonuam, Aizawl)  
**Horizon:** Lower intraformational conglomeratic band, Upper Bhuban unit, Bhuban Formation of Locality 1, and brown silty-sandstone of Upper Bhuban unit, Bhuban Formation of Locality 5.

**Dimensions:**

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Height</th>
<th>Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/B-26</td>
<td>33.00</td>
<td>35.00 (106.06)</td>
<td>5.00 (15.15)</td>
</tr>
<tr>
<td>B/B-3</td>
<td>21.00</td>
<td>23.00 (109.52)</td>
<td>4.00 (19.04)</td>
</tr>
<tr>
<td>B/LG-4</td>
<td>19.00</td>
<td>21.00 (110.52)</td>
<td>3.20 (16.84)</td>
</tr>
</tbody>
</table>

**Remarks:** The diagnostic characters of the species are sub-orbicular outline, height slightly more than the length, moderate inflation, symmetrical ventral margin, long and straight postero-dorsal margin, concavity at the anterior end and fine concentric growth lines. All these characters can be clearly seen in the isolated valves at hand. These also match well with the *Dosinia (Dosinia) peralta* Vredenburg (p. 449, Pl. XXIX, figs. 1 – 6). Hence the assignment.
**Dosinia (Dosinia) subpenicillata** Vredenburg, 1928

(Pl – 6, figs. 5–6)

1928. *Dosinia subpenicillata* Vredenburg, p. 448, Pl. XXIX, figs. 7-9


**Material:** Three isolated left valves.

**Location:** Locality 1 (Bika Quarry, University road, Tuivamit, Aizawl).

**Horizon:** Lower intraformational conglomeratic band, Upper Bhuban unit, Bhuban Formation.

**Dimensions:**

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Height</th>
<th>Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/B-19</td>
<td>29.00</td>
<td>27.00 (93.10)</td>
<td>5.00 (17.24)</td>
</tr>
<tr>
<td>B/B-25</td>
<td>39.00</td>
<td>36.00 (92.30)</td>
<td>5.00 (12.82)</td>
</tr>
<tr>
<td>B/B-34</td>
<td>25.00</td>
<td>23.00 (92.00)</td>
<td>4.00 (16.00)</td>
</tr>
</tbody>
</table>

**Remarks:** Vredenburg, while describing a new species under the name *Dosinia subpenicillata* (1928, p. 448, Pl. XXIX, figs. 7-9), remarked that this is an orbicular form expanded in an antero-posterior direction with feeble convexity, has almost horizontal ligamental margin and its surface sculpture consists of fine and numerous concentric ridges. All these characters are clearly marked in all the specimens at hand. Therefore, these can be assigned to the Vredenburg’s species without any reservation.

**Subfamily** CLEMENTIINAE Frizzel, 1936

**Genus** - *Clementia* Gray, 1842

Type species: *Venus papyracea* Gray, 1825; SD Gray, 1847. Recent; Pacific.

**Subgenus** - *Clementia (s. s.)*

**Clementia (Clementia) papyracea** (Gray), 1825

(Pl – 6, figs. 7–9)


1840. *Venus nonscripta* J.de C.Sowerby, Pl.XXV, fig.8.

1927. *Clementia papyracea* (Gray): Cox, p.54, Pl.IV, figs. 3 and 4
1928. *Venus* (*Clementia*) *papyracea* (Gray): Vredenburg, p.455, pl. XXXII, fig. 3.
1930. *Clementia papyracea* (Gray): Cox, p.130, Pl.XV, fig.4.
1932. *Clementia papyracea* (Gray): Prashad, p. 262
1936. *Clementia papyracea* (Gray): Cox, p.62, Pl. VIII, figs. 7 - 8
1970. *Clementia papyracea* (Gray): Iwasaki, p.213, Pl.XXIII, fig. 5.
1982. *Clementia papyracea* (Gray): Kanno et.al., p.89, Pl.XV, fig. 15.
1994. *Clementia* (*Clementia*) *papyracea* (Gray): Noda et al., P.95, fig. 6.9.
1997. *Clementia* (*Clementia*) *papyracea* (Gray): Jain MS, p.146, Pl.XXV, figs. 18-22; Pl.XXVI, fig.1.

**Material:** One complete and one broken bivalves and one fragmentary right valve.

**Location:** Locality 1 (Bika Quarry, University road, Tuivamit, Aizawl), Locality 4 (near Faith Academy, Zonuam) and Locality 6 (Govt. Complex road, Zonuam, Aizawl)

**Horizon:** Lower intraformational conglomeratic band, Upper Bhuban unit, Bhuban Formation of Locality 1; brown silty-sandstone of Upper Bhuban unit, Bhuban Formation of Locality 4 and 6.

**Dimensions (mm):**

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Height</th>
<th>Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/FZ-2</td>
<td>32.00</td>
<td>20.00 (62.5)</td>
<td>13.00 (40.62)</td>
</tr>
<tr>
<td>B/B-8</td>
<td>15.00</td>
<td>15.00 (100.00)</td>
<td>7.00 (46.66)</td>
</tr>
<tr>
<td>B/GZ-266</td>
<td>27.00</td>
<td>17.00 (62.96)</td>
<td>8.00 (29.62)</td>
</tr>
</tbody>
</table>

**Remarks:** Though the species *Clementia* (*Clementia*) *papyracea* (Gray) is a variable form, it has a characteristic ornamentation i.e. coarse concentric undulations that are
in turn finely striated. This typical surface sculpture can be clearly seen in all the specimens at hand. Therefore, these have been assigned to the species under consideration. This is a widely distributed species and has been reported from Japan, Phillipines, East Indies, Eastern Australia, Persian Gulf and Arabia. It has also been reported from the Gaj of Kachchh and Sind, Miocene of Garo Hills and Mizoram.

**Subfamily** TAPETINAE  Adams and Adams, 1857

**Genus**  *Paphia*  Roeding, 1798

Type species:  *Pahia alapapilionis* (=  *Venus rotundata*  Linne’, 1758); SD. Dall, 1902; Recent; Western Pacific.

**Subgenus**  *Paphia s.str.*

**Paphia (Paphia) rotundata**  (Linne’), 1969

(Pl – 6, figs. 10 – 13)


Pl. XVI, figs. 1a, b, c.

2005.  *Paphia (Paphia) rotundata*  (Linne’): Lalchawimawii, p.43, Pl. VI, fig. 3.

**Material:** Two bivalves, two left and right valves each.

**Location:** Locality 4 (near Faith Academy, Zonuam, Aizawl), Locality 5 (Luangmual Govt. Complex, Aizawl), and Locality 6 (Govt. Complex Road, Zonuam, Aizawl)

**Horizon:** Brown silty-sandstone of Upper Bhuban unit, Bhuban Formation of Locality 4, 5 and 6.

**Dimensions:**

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Height</th>
<th>Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/FZ-21</td>
<td>25.00</td>
<td>16.00 (64.00)</td>
<td>9.00 (36.00)</td>
</tr>
<tr>
<td>B/FZ-30</td>
<td>30.00</td>
<td>17.00(56.66)</td>
<td>5.00 (16.66)</td>
</tr>
<tr>
<td>B/LG-265</td>
<td>24.00</td>
<td>17.00 (70.83)</td>
<td>5.00 (20.83)</td>
</tr>
<tr>
<td>B/LG-267</td>
<td>25.00</td>
<td>17.00 (68.00)</td>
<td>3.00 (12.00)</td>
</tr>
<tr>
<td>B/GZ-268</td>
<td>21.00</td>
<td>12.00 (62.50)</td>
<td>4.00 (19.04)</td>
</tr>
<tr>
<td>B/GZ-269</td>
<td>32.00</td>
<td>20.00 (62.50)</td>
<td>12.00 (37.50)</td>
</tr>
</tbody>
</table>
**Remarks:** The specimens at hand have been assigned to *Paphia (Paphia) rotundata* (Linne’) owing to almost total similarity with this species in respect of general outline, dimensional ratios, nature and positions of umbo and in surface ornamentation. Hence, these are assignment to the Linne’ species. The identification has been further confirmed by the direct comparison of the present specimens with the Tiwari’s collection (1992).

*Paphia (Paphia) jhai* Tiwari MS  
(Pl – 6, figs. 14 – 15)


**Material:** Two bivalved specimens.  
**Location:** Locality 5 (Luangmual Govt. Complex, Aizawl).  
**Horizon:** Brown silty-sandstone of Upper Bhuban unit, Bhuban Formation.

**Dimensions (mm):**

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Height</th>
<th>Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/LG-22</td>
<td>32.00</td>
<td>19.00 (59.37)</td>
<td>13.00 (40.62) BV</td>
</tr>
<tr>
<td>B/LG-215</td>
<td>16.00</td>
<td>10.00 (62.50)</td>
<td>6.00 (37.50) BV</td>
</tr>
</tbody>
</table>

**Remarks:** The two specimens at hand exhibits all the diagnostic characters like overall shape, dimensional ratios, position of umbo and external sculpture of the species *Paphia (Paphia) jhai* Tiwari (1992). On direct comparision, these are also found to match very closely with the holotype of Tiwari’s collection. Hence the identification.

**Subgenus** *Callistotapes* Sacco, 1900  
Type species: *Venus ventula* Basterot, 1825; OD. Oligocene to Recent; Europe, Asia and New Zealand.

*Paphia (Callistotapes) pseudoliratus* Vredenburg, 1928  
(Pl – 6, fig. 16 – 17)

1928. *Tapes (Callistotapes) pseudoliratus* Vredenburg, p. 457, Pl. XXXI, figs. 2 - 5.  

**Material:** One bivalved specimen and two broken right valves.

**Location:** Locality 4 (near Faith Academy, Zonuam, Aizawl) and Locality 5 (Luangmual Govt. Complex, Aizawl)

**Horizon:** Brown silty-sandstone of Upper Bhuban unit, Bhuban Formation of Locality 4 and 5.

**Dimensions:**

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Height</th>
<th>Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/FZ-40</td>
<td>16.00</td>
<td>11.00</td>
<td>3.00 (18.75)</td>
</tr>
<tr>
<td>B/LG-271</td>
<td>25.00</td>
<td>17.00</td>
<td>10.00 (40.00)</td>
</tr>
<tr>
<td>B/LG-272</td>
<td>17.00</td>
<td>15.00</td>
<td>3.00 (17.64)</td>
</tr>
</tbody>
</table>

**Remarks:** Diagnostically compressed outline, elongate-ovate shape, narrowly rounded anterior and posterior margins; elongate ill defined lunule and prominent concentric sculpture separated by narrow interstices are satisfactorily marked in all the specimens of the present collection. On the account of the above characters, these match very well with the *Paphia (Callistotapes) pseudoliratus* Vredenburg and are accordingly assigned.

**Subfamily** CHIONINAE Frizzel, 1936

**Genus** *Timoclea* Brown, 1827

Type species: *Venus ovata* Pennat, 1777; M.Late Miocene – Recent; Europe, Mediterranean, India, Central America, Western Pacific.

**Subgenus** *Timoclea s.str.*

*Timoclea (Timoclea) scabra* (Hanley), 1844

(Pl – 6, fig. 18, Pl – 7, fig. 1)


**Material**: Two fragmentary left valves.

**Location**: Locality 3 (near Youth Hostel, Luangmual, Aizawl) and Locality 5 (Luangmual Govt. Complex, Aizawl)

**Horizon**: Brown silty-sandstone of Upper Bhuban unit, Bhuban Formation of Locality 3 and 5.

**Dimensions**: Dimensions could not be measured due to fragmentary nature of the specimens.

**Remarks**: Mazumder (2004) reported this species from the Miocene of Kolasib area, Mizoram and commented that the diagnostic characters of the species in question are ovate-trigonal outline, moderate inflation, rounded posterior and ventral margins and concentric growth lines crossed over by fine radials. The radials become more prominent just anterior to the posterior slope. Though the specimens under study are fragmentary and other characters could not be ascertained, the characteristic surface sculpture i.e. concentric growth lines crossed over by the fine radials and the radial intern turning becoming prominent just anterior to posterior slope, can be clearly seen in all the specimens available for the study. Thus, these can be safely merged with *Timoclea (Timoclea) scabra* (Hanley) on account of the above characters.

**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: *Corbula sulcata* Lamarck, 1801; SD.Schmidt, 1818. Recent; Senegal (West Africa).

*Corbula (Corbula) mekranica* Vredenburg, 1928
2004. *Corbula mekranica* Vredenburg: Mazumder, p.130, Pl.XIII, fig.11.

**Material:** Two right valves and one left valve embedded in the matrix.

**Location:** Locality 1 (Bika Quarry, University Road, Tuivamit, Aizawl) and Locality 2 (Ruata Quarry, near Ramrikawn, Tuivamit, Aizawl).

**Horizon:** Lower intraformational conglomeratic band, Upper Bhuban unit, Bhuban Foramtion of Locality 1; Upper intraformational conglomeratic band, Upper Bhuban unit, Bhuban Formation of Locality 2.

**Dimensions:**

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Height</th>
<th>Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/B-203</td>
<td>13.00</td>
<td>12.00 (92.30)</td>
<td>3.00 (23.07)</td>
</tr>
<tr>
<td>B/B-208</td>
<td>7.00</td>
<td>7.00 (100.00)</td>
<td>2.00 (28.57)</td>
</tr>
<tr>
<td>B/R-209</td>
<td>6.00</td>
<td>6.00 (100.00)</td>
<td>2.00 (33.33)</td>
</tr>
</tbody>
</table>

**Remarks:** Vredenburg (1928), while comparing *Corbula* (*Corbula*) *tunicosulcata* with *Corbula* (*Corbula*) *mekranica*, stated that there is no difference between the two species excepting that the former is more inequivalved and less elongate. Mizoram examples are also more inequivalved and less elongate, hence these are clubbed with *Corbula* (*Corbula*) *mekranica* (Vredenburg). These, on comparison with the Tiwari’s and Mazumder’s collection, are also found to match well. Hence, assignment is confirmed.

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

(Pl – 7, figs. 3 – 4)


**Material:** Two left valves and three right valves embedded in the matrix.
Location: Locality 1 (Bika Quarry, University road, Tuivamit, Aizawl), Locality 3 (near Youth Hostel, Luangmual, Aizawl) and Locality 4 (Faith Academy, Zonuam, Aizawl).

Horizon: Lower intraformational conglomeratic band, Upper Bhuban unit, Bhuban Formation of Locality 1; Brown silty-sandstone, Upper Bhuban unit, Bhuban Formation of Locality 3 and 4.

Dimensions:

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Height</th>
<th>Inflation</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>B/B-54</td>
<td>15.00</td>
<td>10.00 (66.66)</td>
<td>4.00 (26.66)</td>
<td>LV</td>
</tr>
<tr>
<td>B/B-204</td>
<td>15.00</td>
<td>9.00 (60.00)</td>
<td>5.00 (33.33)</td>
<td>RV</td>
</tr>
<tr>
<td>B/B-210</td>
<td>16.00</td>
<td>11.00 (68.75)</td>
<td>4.00 (25.00)</td>
<td>RV</td>
</tr>
<tr>
<td>B/FZ-212</td>
<td>10.00</td>
<td>6.00 (60.00)</td>
<td>2.50 (25.00)</td>
<td>LV</td>
</tr>
<tr>
<td>B/YL-205</td>
<td>12.00</td>
<td>8.00 (66.66)</td>
<td>4.00 (33.33)</td>
<td>RV</td>
</tr>
</tbody>
</table>

Remarks: Vredenburg (1928) christened a new species by the name Corbula (Corbula) tunicosulcata considering the diagnostic characters 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 Corbula tunicata (Hinds) and Corbula sulcata Lamarck because his collections showed the characters of both these species.
3.2 SYSTEMATIC DESCRIPTION OF GASTROPODA

The Bhuban sediments of the study area have yielded only a few gastropods. Overall, preservation of gastropods is poor and apertures so crucial for identification are rarely preserved. Classification given by Davies (1971, pp.280 - 444) has been followed in this work. Dimensions are given in millimeters.

- **Class**: GASTROPODA Cuvier, 1797
- **Subclass**: PROSOBRANCHIA Milne Edwards, 1848
- **Order**: MESOGASTROPODA Cox, 1959
- **Superfamily**: CERITHIACEA Fleming, 1822
- **Family**: TURRITELLIDAE Woodward, 1851
- **Subfamily**: TURRITELLINAE Woodward, 1851
- **Genus**: Archimediella Lamarck, 1799

Type species: *Turbo terebra* Linne’, 1758; by monotypy. Recent; Western Pacific.

**Subgenus**: Torculoidella Sacco, 1895

Type species: *Turbo varicosus* Brochhi. Pliocene; Italy.

*Archimediella (Torculoidella) angulata* (Sowerby), 1840

(Pl – 7, figs. 5 – 6)

1840. *Turritella angulata* Sowerby, Pl. XXVI, figs. 7 and 8.
1853. *Turritella acuticarinata* Dunker, p. 132, Pl. XVIII, fig. 10.
1879. *? Turritella angulata* Sowerby: Martin, p. 68, Pl. XII, fig. 2.
2004. *Archimediella (Torculoidella) angulata* (Sowerby): Lalchawimawii, p. 47, Pl.VI, fig. 7.

**Material:** Two incomplete specimens.

**Location:** Locality 1 (Bika Quarry, University Road, Tuivamit, Aizawl), Locality 3 (near Youth Hostel, Luangmual, Aizawl) and Locality 4 (Faith Academy, Zonuam, Aizawl).

**Horizon:** Lower intraformational conglomeratic band, Upper Bhuban unit, Bhuban Formation of Locality 1, and brown silty-sandstone of Upper Bhuban unit, Bhuban Formation of Locality 3 and 4.

**Dimensions:**

<table>
<thead>
<tr>
<th>Sp.no.</th>
<th>Height</th>
<th>Diameter of spire</th>
</tr>
</thead>
<tbody>
<tr>
<td>G/B-26</td>
<td>19.00</td>
<td>-</td>
</tr>
<tr>
<td>G/B-27</td>
<td>45.00</td>
<td>-</td>
</tr>
</tbody>
</table>

**Remarks:** Mukerjee (1939), while reporting the species from the Miocene of the Garo Hills, Meghalaya remarked that this species shows wide variations. He discussed four main variation of this species from A - D. My specimen belongs to A which has angular whorls marked by strong sharp spiral carina in which numerous secondary threads on the posterior part of the whorls are of nearly the same strength as the two primary ones and in which the third primary spiral forms a well defined angle.
Superfamily: CYPRAEACEA
Family: CYPRAEIDAE
Subfamily: CYPRAEINAE
Genus: Cypraea

Cypraea sp.
(Pl – 7, figs. 7 – 8)

Material: Two specimens.
Location: Locality 1 (Bika Quarry, University Road, Tuivamit, Aizawl).
Horizon: Lower and upper intraformational conglomeratic bands, Upper Bhuban unit, Bhuban Formation.

Dimensions:

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Height</th>
<th>Diameter at the base</th>
</tr>
</thead>
<tbody>
<tr>
<td>G/B-7</td>
<td>25.00</td>
<td>17.50</td>
</tr>
<tr>
<td>G/B-8</td>
<td>25.00</td>
<td>16.50</td>
</tr>
</tbody>
</table>

Remarks: Oval shape, more or less globose nature, curved, denticulate and slightly projecting and moderately wide spire, deep notch at both the ends of the two specimens remind at once the genus Cypraea. These specimens are thus assigned to this genus. Further description is not possible due to poor preservation. It is to be noted however, that this genus ranges from Middle Miocene to Recent and is an Indo-Pacific form found also in Indonesia and Africa (Davies, 1975). This is the first record of the genus from the Northeastern region.

Superfamily: TONNACEA Suter, 1913
Family: FICIDAE
Genus: Ficus (Bolten) Roeding, 1798

Type species: Bulla ficus Gmelin; SD. Dall, 1909. Recent; Indo - Pacific.

Ficus (Ficus) ficus (Linne’), 1767
(Pl – 7, fig. 9)

1799. Pyrula ficus (Linne’): Lamarck, p. 73.
1971. *Ficus ficus* (Linne’): Davies, p. 348, fig. 749.
1974. *Ficus ficus* (Linne’): Dance, p. 120.

**Material:** One specimen is examined.

**Location:** Locality 2 (Ruata Quarry, near Ramrikawn, Tuivamit, Aizawl)

**Horizon:** Upper intraformational conglomeratic band, Upper Bhuban unit, Bhuban Formation.

**Dimensions:**

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Height</th>
<th>Diameter at the base</th>
</tr>
</thead>
<tbody>
<tr>
<td>G/R-3</td>
<td>35.00</td>
<td>18.00</td>
</tr>
</tbody>
</table>

**Remarks:** The diagnostic characters of this species are posteriorly expanded body whorl, almost flat spire, finely reticulated ornamentation and crowded spiral threads that are broader than the intervals. All these characters are well marked in the present collection. It has also been compared with the Mazumder’s collection to which it is found to match well. Hence the assignment.

*Ficus* (*Ficus*) *kachhensis* (Vredenburg), 1925

(Pl – 7, fig. 10)


**Material:** One specimen.

**Location:** Locality 1 (Bika Quarry, University Road, Tuivamit, Aizawl).

**Horizon:** Lower intraformational conglomeratic band and silty-sandstone of Upper Bhuban unit, Bhuban Formation.

**Dimensions:**

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Height</th>
<th>Diameter at the base</th>
</tr>
</thead>
<tbody>
<tr>
<td>G/B-9</td>
<td>30.00</td>
<td>-</td>
</tr>
</tbody>
</table>
Remarks: The essential characters of the species *Ficus (Ficus) kachhensis* (Vredenburg) like slender elongate ovoid, conoidal and slightly stepped spire and large body whorl can be easily discernable in the present specimen. Hence, the specimen is merged with this species.

*Ficus (Ficus) conditus* (Brongniart), 1823

(Pl – 7, fig. 11)

1823. *Pirula condita* Brongniart, p. 75, fig. 4.

1853. *Ficula condita* Brongniart: Hoernes, p. 270, Pl. XXVII, figs. 4 - 6.


1895. *Ficula theobaldi* Noetling, p. 28, Pl. VI, fig. 5.

1901. *Ficula theobaldi* Noetling, p. 298, Pl. XIX, fig. 21.


1939. *Ficus condita* Brongniart: Mukerjee, p. 52, pl. III, fig. 5.


2004. *Ficus (Ficus) conditus* Brongniart: Mazumder p. 146, Pl. XVI, fig. 2.

2004. *Ficus (Ficus) conditus* Brongniart: Lalchawimawii, p. 49, Pl. VI, figs. 8 - 9.

Material: One specimen.

Location: Locality 1 (Bika Quarry, University Road, Tuivamit, Aizawl).

Horizon: Lower intraformational conglomeratic band, Upper Bhuban unit, Bhuban Formation.
Dimensions:

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Height</th>
<th>Diameter at the base</th>
</tr>
</thead>
<tbody>
<tr>
<td>G/B-4</td>
<td>41.00</td>
<td>16.00</td>
</tr>
</tbody>
</table>

**Remarks:** The pyriform shape and patterns of spiral ornamentation of the species *Ficus conditus* (Brongniart) are well marked in present specimen. Hence, the identification. The identification is further confirmed by direct comparison of the specimen at hand with the one housed in the Palaeontological Laboratory, Department of Geology, Mizoram University (Tiwari, 1992) to which these are found to tally well.

- **Superfamily** MURICACEA
- **Family** MURICIDAE
- **Subfamily** MURICINAE
- **Genus** *Murex* Linne’, 1758

Type species: *Murex tribulus* Linne’; SD Montfort, 1810. Recent; Indo - Pacific.

*Murex maegillivrayi* Dohrn

(Pl – 7, figs. 12)


**Material:** One nearly complete and one fragmentary conch.

**Location:** Locality 2 (Ruata Quarry, near Ramrikawn, Tuivamit, Aizawl)

**Horizon:** Upper intraformational conglomeratic band of Upper Bhuban unit, Bhuban Formation.

**Dimensions:**

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Height</th>
<th>Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>G/R-2</td>
<td>24.00</td>
<td>21.00</td>
</tr>
</tbody>
</table>

**Remarks:** The present specimen has been compared with *Murex maegillivrayi* Dohrn reported by Tiwari (1992) from the Miocene of Mizoram to which it has been found to match well particularly on account of long anterior canal and blunt spines. Hence the assignment.
Superfamily: CONACEA Rafinesque, 1815
Family: CONIDAE Rafinesque, 1815
Genus: Conus Linne’, 1758

Type species: Conus marmoreus Linne’; SD Children, 1823. Recent; Indo-Pacific.

Subgenus: Leptoconus Swainson, 1840

Type species: Conus amadis Martini; SD Herrmannsen, 1847. Recent; Indo-Pacific.

Conus (Leptoconus) bonneti Cossmann, 1900

(Pl – 7, figs. 13 – 14)

1900. Conus (Leptoconus) bonneti Cossmann, p. 59, Pl. IV, figs. 15 - 16.

Material: Five poorly preserved specimens.

Location: Locality 1 (Bika Quarry, University Road, Tuivamit, Aizawl) and Locality 2 (Ruata Quarry, near Ramrikawn, Tuivamit, Aizawl)

Horizon: Lower intraformational conglomeratic band, Upper Bhuban unit, Bhuban Formation of Locality 1; Upper intraformational conglomeratic band, Upper Bhuban unit, Bhuban Formation of Locality 2.

Dimensions:

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Height of conch</th>
<th>Diameter of conch</th>
</tr>
</thead>
<tbody>
<tr>
<td>G/R-13</td>
<td>15.00</td>
<td>15.00</td>
</tr>
<tr>
<td>G/R-14</td>
<td>15.00</td>
<td>12.00</td>
</tr>
<tr>
<td>G/B-16</td>
<td>15.00</td>
<td>16.00</td>
</tr>
<tr>
<td>G/B-18</td>
<td>18.00</td>
<td>18.00</td>
</tr>
<tr>
<td>G/B-21</td>
<td>18.00</td>
<td>15.00</td>
</tr>
</tbody>
</table>
Remarks: The present specimens show all the essential characters of the species *Conus (Leptoconus) bonneti* Cossmann figured by Tiwari (1992). As such, these are assigned to it with least reservation.

*Conus (Dendroconus) loroisii* Kiener

(Pl – 7, figs. 15 – 17)

1847. *Conus loroisii* Kiener, p. 91, Pl. LXV, fig. 1.

1894. *Conus striatellus* Jenkins, p. 54, Pl. VII, fig. 3.

1879. *Conus striatellus* Jenkins: Martin, p. 9, Pl.I, figs. 2, 3 and 5.


1893. *Conus (Dendroconus) exloroisii* Sacco, p. 8.

1895. *Conus loroisii* Kiener: Martin, p. 21, Pl. III, fig. 52.


2003. *Conus (Dendroconus) loroisii* Kiener: Tiwari and Kachhara, p. 76, Pl. VI, fig. 56.


Material: Six poorly preserved specimens.

Location: Locality 1 (Bika Quarry, University Road, Tuivamit, Aizawl) and Locality 2 (Ruata Quarry, near Ramrikawn, Tuivamit, Aizawl)


Dimensions:

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Height of conch</th>
<th>Diameter of conch</th>
</tr>
</thead>
<tbody>
<tr>
<td>G/R-10</td>
<td>20.00</td>
<td>9.00</td>
</tr>
<tr>
<td>G/R-12</td>
<td>33.00</td>
<td>21.00</td>
</tr>
<tr>
<td>G/B-17</td>
<td>38.00</td>
<td>23.00</td>
</tr>
<tr>
<td>G/B-19</td>
<td>17.00</td>
<td>11.00</td>
</tr>
</tbody>
</table>
G/B-20   19.00   11.00
G/B-22   12.00   8.00
G/B-25   25.00   14.00

Remarks: I have noted the following prominent features in these specimens: Low extra-conic spire and large body whorl, protoconch followed by five to six feebly sloping spiral whorls, sulcate suture, body whorl shows numerous growth lines parallel to the outer lip. The above description of the present specimens reminds me at once *Conus (Dendroconus) lorioissii* Kiener. Besides, it has also been compared with the specimens of this species reported by Mazumder (2004) from the Miocene of Kolasib area. As such, assignment is beyond question.
3.3 SYSTEMATIC DESCRIPTION OF ECHINOIDEA

Echinoids are represented by ill preserved tests of regular and irregular forms. Irregular forms have been quite often encountered in all the fossiliferous beds whereas regular one is represented by only one specimen. Though, Tiwari (1992) and Mazumder have identified these tests as belonging to the genus *Schizaster*, the preservation of the tests is so poor that I do not venture to identify it even upto the generic level.

3.4 SYSTEMATIC DESCRIPTION OF DECAPODA

The preservation of decapod crustaceans in the Surma succession is fairly good. These are mostly in the form of dorsal sides of well-preserved carapaces, though ventral sides and appendages are also preserved in some specimens. The systematic description of the decapods from the present collection is as follows:

<table>
<thead>
<tr>
<th>Suborder</th>
<th>PLEOCYMETA Burkenroad, 1963</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infraorder</td>
<td>BRACHYURA Latreille, 1803</td>
</tr>
<tr>
<td>Superfamily</td>
<td>CALAPPOIDEA de Haan, 1833</td>
</tr>
<tr>
<td>Family</td>
<td>CALAPPIDAE de Haan, 1833</td>
</tr>
<tr>
<td>Subfamily</td>
<td>CALAPPINAE de Haan, 1833</td>
</tr>
<tr>
<td>Genus</td>
<td><em>Calappa</em> Weber, 1795</td>
</tr>
</tbody>
</table>

Type species: *Cancer granulatus* Linné, 1758; SD. Latreille, 1810. Recent; Mediterranean.

*Calappa protopustulosa* Noetling 1901

(Pl – 8, figs. 1 – 2)

1901. *Calappa protopustulosa* Noetling, p. 369, Pl. XXIV, figs. 6 a - b.

**Material:** Two carapaces, one weathered anteriorly.

**Locality:** Locality 1 (Bika Quarry, University Road, Tuivamit, Aizawl).

**Horizon:** Lower intraformational conglomeratic band, Upper Bhuban unit, Bhuban Foramtion
Dimensions (mm):

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>C/B - 7</td>
<td>18.00</td>
<td>21.00</td>
</tr>
<tr>
<td>C/B - 9</td>
<td>21.00</td>
<td>26.00</td>
</tr>
</tbody>
</table>

Remarks: The carapace is subcircular in shape, length slightly less than the width, carapace more curved anterior-posteriorly than laterally, antero-lateral and postero-lateral margins form almost a semicircle, antero-lateral margin with fine compressed and a series of tubercles. Carapace covered with the longitudinal ridges separated by furrows; ridges near the gastric region are more prominent than others; all the ridges are set with probably seven tubercles. The gastro-cardiac region can be delineated by the presence of the two most prominent longitudinal furrows in which the depth and width increases posteriorly. In above characters, the specimens at hand are undoubtedly identical to *Calappa protopustulosa* Noetling (1901, *op. cit.*) from Miocene sediments of Myanmar (GSI type no. 7768). However, the carapace of the specimen no. C/B - 9 is slightly elongated laterally which may be due post-depositional deformation.

Genus *Typilobus* Stocliczka, 1871

Type species: *Typilobus granulosus*; OD. Upper Ecocene; Hungary

*Typilobus granulosus* Stocliczka, 1871

(Pl – 8, fig. 3)

1871. *Typilobus granulosus* Stocliczka, p. 15, Pl. III, figs. 3 - 5
1997. *Typilobus granulosus* Stocliczka: Tiwari *et al*., p. 130, Pl. 1, fig. 2d.

Material: Two well-preserved carapaces.

Location: Locality 2 (Ruata Quarry, Ramrikawn, Tuivamit) and Locality 6 (Govt. Complex Road, Zonuam, Aizawl).

Horizon: Upper Intraformational conglomerate of Upper Bhuban unit, Bhuban Formation of locality 2; brown silty-sandstone of Upper Bhuban unit, Bhuban Formation of Locality 6
Dimensions (mm):

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>C/R - 8</td>
<td>9.00</td>
<td>11.00</td>
</tr>
<tr>
<td>C/GZ - 10</td>
<td>10.00</td>
<td>10.00</td>
</tr>
</tbody>
</table>

Remarks: The carapace is transversely ovate in shape and its entire surface is covered with fine and dense granules; the anterior is nearly semicircular and flattened, the posterior is small, gradually narrowed with a small tubercle at each end; all the regions are well defined. Cardio-gastric region delineated by a prominent furrow on either side that run upto the frontal margin. Cardiac lobe is most prominent and bears a tubercle at the middle. These specimens match very well with *Typilobus granulosus* Stoclizka (GSI type no. 2280-2281) excepting smaller size of the latter. Hence, the assignment.

**Genus** *Ebalia* Leach, 1816

Type species: *Cancer tuberosus* Pennant, 1777; SD Rathbun, 1922. Recent.

*Ebalia tuberculata* Noetling

(Pl – 8, fig. 4)


**Material:** One carapace.

**Location:** Locality 6 (Govt. Complex Road, Zonuam, Aizawl).

**Horizon:** Brown sandstone of Upper Bhuban unit, Bhuban Formation.

**Dimensions (mm):** Specimen no. C/GZ - 17 measures 9.00mm in length and 11.00mm in width.

Remarks: In general outline, surface sculpture, nature of the margins and lobes, the lone specimen matches well with the *Ebalia tuberculata* Noetling (1901). Besides it has also been compared with the specimen of this species reported by Tiwari (1997) from Miocene of Mizoram. Hence, identification is confirmed.
Superfamily PORTUNOIDEA Rafinesque, 1815
Family PORTUNIDAE Rafinesque, 1815
Genus *Neptunus* de Haan, 1839

*Neptunus sindensis* Stoliczka, 1871

(Pl – 8, figs. 5 – 8)

1901. *Neptunus sindensis* Stoliczka: Noetling p. 51, Pl. X, figs. 2, 2a,b; Pl. XI, figs 1, 1a; Pl. XIII, figs. 1, 1a.

**Material:** Four incomplete carapaces.

**Location:** Locality 1 (Bika Quarry, University Road, Tuivamit, Aizawl) and Locality 5 (Luangmual Govt. Complex, Aizawl)

**Horizon:** Lower intraformational conglomeratic band, Upper Bhuban unit, Bhuban Formation of Locality 1; Brown silty-sandstone of Upper Bhuban unit, Bhuban Formation of Locality 5.

**Dimensions:**

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>C/B - 2</td>
<td>23.00</td>
<td>36.00</td>
</tr>
<tr>
<td>C/B - 3</td>
<td>15.00</td>
<td>24.00</td>
</tr>
<tr>
<td>C/LG - 4</td>
<td>17.00</td>
<td>22.00</td>
</tr>
<tr>
<td>C/B - 6</td>
<td>18.00</td>
<td>27.00</td>
</tr>
</tbody>
</table>

**Remarks:** All the prominent characters of the species *Neptunus sindensis* Stoliczka, 1871, viz., carapace one-third broader than long, well defined regions including horse-shoe shaped groove defining the meta- and urogastric lobes, six orbito-frontal spines and nine antero-lateral spines are well marked in the present specimens. Sternum is preserved in one of the specimens (C/B-2) which is squarish in shape and length is little less than the width. Individual sternites tally in shape and size with the type species. On account of the above, the specimens are clubbed with the *Neptunus sindensis* Stoliczka, 1871.
Superfamily: XANTHOIDEA Dana, 1815
Family: XANTHIDAE Rafinesque, 1815
Genus: Xantho Leach, 1804

Type species: *Cancer incisus*; OD. Recent.

**Xantho sp.**

((Pl – 8, figs. 9 a – b)

**Material:** One carapace

**Location:** Locality 1 (Bika Quarry, University Road, Tuivamit, Aizawl)

**Horizon:** Lower intraformational conglomeratic band, Upper Bhuban unit, Bhuban Formation

**Dimensions (mm):**

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Length</th>
<th>Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>C/B - 5</td>
<td>10.00</td>
<td>15.00</td>
</tr>
</tbody>
</table>

**Remarks:** The carapace is broader than long and hexagonal in shape, nearly flat longitudinally and transversely with wide frontal margin. Orbits are small and well separated. Regions are well defined. The specimen described and figured by Mazumder (2004) is also incomplete and matches well with our specimens in respect of the above characters. Specific identification is not attempted due to lack of well preserved specimens.

**Family** HANTHIDAE Alcock, 1898

**Genus** Palaeocapilius Milne-Edwards, 1862

*Palaeocapilius rugifer* Stoliczka, 1871

(Pl – 9, fig. 10)

1901. *Palaeocapilius rugifer* Stoliczka: Noetling p. 55, Pl. XII, fig. 3; Pl. XIV, figs. 1, 1a; Pl. XV, figs. 1, 2, 3 and 4; Pl. XVI, fig. 1.

**Material:** Two incomplete carapace with worn out surfaces.

**Location:** Locality 1 (Bika Quarry, University Road, Tuivamit, Aizawl) and Locality 6 (Govt. Complex Road, Zonuam, Aizawl)
**Horizon:** Lower intraformational conglomeratic band, Upper Bhuban unit, Bhuban Formation of Locality 1; Brown silty-sandstone of Upper Bhuban unit, Bhuban Formation of Locality 6.

**Dimensions:** Specimen no. C/B - 11 measures 35.00mm in length and 42.00mm in width.

**Remarks:** The two specimens at hand, though poorly preserved, are characterized by circular and deeply indented orbits, rugosities and pits on the fresh surface of the carapace that has indistinct lobes, eight tubercles in the antero-lateral margins and long and narrow sternum. In above characters, these match well with the *Palaeocarpilius rugifer* Stoliczka. Though other characters could not be deciphered due to poor preservation, I feel that the above similarities are enough to merge my specimens with that of Noetling’s (1901). Hence, the specimens are assigned to *Palaeocarpilius rugifer* Stoliczka.
3.5 SYSTEMATIC DESCRIPTION OF FORAMINIFERA

Large numbers of foraminiferal tests have been recovered from the lower intraformational conglomeratic band of Locality 1. These however belong to monogenic form of the genus *Ammonia*. Preservation of the tests is very poor and mostly these appear to be rolled out and deformed. The systematic description of the foraminifera from the present collection is as follows:

**Phylum**  PROTOZOA  
**Subphylum**  SARCODINA  
**Superclass**  RHIZOPODA  
**Class**  GRANULORETICULOSEA  
**Order**  FORAMINIFERIDA Eichwald, 1830  
**Suborder**  ROTALIINA Delage and Herouard, 1896  
**Superfamily**  ROTALIACEA Ehrenberg, 1839  
**Family**  Rotaliidae Ehrenberg, 1839  
**Subfamily**  Ammoniinae Saidova, 1981  
**Genus**  *Ammonia* BRUNNICH, 1972

*Ammonia annectens concinna* Millet, 1904  
(Pl - 9, figs. 1 a – b)


**Material:** Several specimens with weathered out tests.

**Location:** Locality 1 (Bika Quarry, University Road, Tuivamit, Aizawl)

**Horizon:** Lower intraformational conglomeratic band, Upper Bhuban unit, Bhuban Formation.

**Dimensions** (mm):

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Diameter</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>F/B - 1</td>
<td>0.27</td>
<td>0.12</td>
</tr>
<tr>
<td>F/B - 2</td>
<td>0.25</td>
<td>0.15</td>
</tr>
</tbody>
</table>

**Description:** Periphery of the test acute, carinate with 10 to 11 chambers in the last whorl; somewhat smooth surface, elevated, straight or slightly curved sutures on spiral side, and
open fissures in the umbilicus. Sutures on umbilical side are deeply excavated, each having two rows of beads.

**Remarks:** The specimens at hand can be well compared with the species *Ammonia annectens concinna* described by Jauhri (1981) from the Miocene sediments of Vinjhan-Miani area of Kachchh. These specimens also have very close affinity to the species *Ammonia annectens* (Parker and Jones) reported by Lambert (2003) from the modern Mahakam delta of East Kalimantan, Indonesia. Therefore, these can be assigned to the species *Ammonia annectens concinna* without any reservation.

*Ammonia sp.*

(Pl – 9, figs. 2 – 3)

**Material:** Several specimens with weathered out tests.

**Location:** Locality 1 (Bika Quarry, University Road, Tuivamit, Aizawl)

**Horizon:** Lower intraformational conglomeratic horizon, Upper Bhuban unit, Bhuban Formation

**Dimensions (mm):**

<table>
<thead>
<tr>
<th>Sp. no.</th>
<th>Diameter</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>F/B - 3</td>
<td>0.3</td>
<td>0.15</td>
</tr>
<tr>
<td>F/B - 4</td>
<td>0.32</td>
<td>0.15</td>
</tr>
</tbody>
</table>

**Description:** Test free, small, and carinate with 10 to 12 chambers in the last whorl; periphery rounded, slightly lobulate, smooth surface, elevated; sutures on dorsal side distinct, slightly oblique and slightly depressed, sutures on umbilical side are deeply excavated; umbilical portion of test worn out but seems to have depression or excavated.

**Remarks:** The specimens described above can be distinguished from the earlier one on account of the higher elevated tests at the dorsal sides and flattened ones at the ventral sides. They are somewhat similar with the species *Ammonia beccarii* Linne’ reported from the upper Cenozoic sequence of Taiwan (Huang, 1964). However, detail comparison could not be made due to poor preservation of the specimen at hand. Hence, identification at a specific level has not been attempted for want of better preserved materials.