A NOTE ON SOME EARLY EOCENE OSTRACODES FROM THE SUBATHU FORMATION, MORNI, SHIMLA HILLS, LESSER HIMALAYAS

S.B. BHATIA AND H. BAGI
CENTRE OF ADVANCED STUDY IN GEOLOGY, PANJAB UNIVERSITY, CHANDIGARH - 160 014

ABSTRACT

Twenty-three ostracode taxa were collected from the Subathu Formation exposed in the Morni area of the Shimla Hills in the Lesser Himalayas. Eleven of these are recorded for the first time from the Subathu Formation. These are Cytheridea sp., Cushmartidea cf. C. tewarii, Eucytherura vimali, Semicytherura rameshi, Schizocythere rakhensis, S. prolata, Alocopocythere abstracta, Gyrocythere mitigata, Occultocythereis cf. O. peristica, C. subspinelliosa, Cytherella palanaensis. The assemblages is indicative of Early Eocene age.

INTRODUCTION AND PREVIOUS WORK

The ostracodes of the Subathu Formation, Lesser Himalayas are less well known than other groups of fossils. The only two works dealing at length with the ostracodes are by Tewari and Singh (1967) from the Kalakot area of Jammu and Kashmir and by Mathur (1977) from the Shimla Hills. In the former paper, the authors have identified sixteen species of Early Eocene ostracodes from the Nummulitic beds of Kalakot area of Jammu & Kashmir, viz., Bairdia kalakotensis, B. jammuensis, B. beraguaensis, Bairdoppilata kalakotensis, Bythocypris kashmirensis, B. westi, Paracypris jhingrani, Krithe indica, Aurila kohl, Caudites indica, Cytherella rajnathi, Echinocythereis cheropodiensis, Hermanites wadiai, H. puri, Quadracythere sahnii, Cytherella tawaica. Mathur (1977) has described and illustrated twenty-six taxa of ostracoda viz., Leguminocythereis lunejensis, Leguminocythereis sp., Schizocythere cf. S. appendiculata, Schizocythere sp. indet., Xestoleberis subglobosa, Cytherella protuberantlis, Cytherella sp. indet., Cytherellidea cf. C. barkhanensis, C. sp. insolensa, Paracypris contracta, P. jhingrani, Ilyocypris khoslai, Ilyocypris sp., indet., Krithe bartonensis, K. rutoti, Krithe sp., Cytherurus sp. indet., Semicytherura sp. I, Semicytherura sp. II and Paijenborchella (Eupaijenborchella) cf. P. eocaenica.

GEOLOGY AND BIOSTRATIGRAPHY

The geology and biostratigraphy of the Subathu Formation in the Lesser Himalayas has been described in detail by Medlicott (1879), Datta et al. (1965), Raiverman and Raman (1971), Mathur (1978), Singh (1980), Sahni (1981) and Bhatia (1982) among others. Batra (1987) has subdivided the upper part of the Subathu Formation of the Shimla Hills area into three distinct faunal zones viz., faunal Zone I (Early-Middle Ypresian), faunal Zone II (Late Ypresian) and faunal Zone III (Early Lutetian). This classification has been followed in this paper.

PRESENT WORK

The authors examined the ostracodes of the Subathu Formation exposed in the Morni area (Fig. 1).
The material for the present work was collected in the month of July, 1984. The locality lies on the left bank of the Ghaggar river at village Kharog, and falls in the Bilaspur tectonic unit (Bhandari and Agarwal, 1967; Raiverman et al. 1983). The base of the Subathu Formation is exposed in the Morni area. It shows an unconformable contact with the Pre-Tertiary Tundapathar Limestone. Lithologically, the Subathu Formation in this locality consists of black carbonaceous shales at the base, green or grey shales intercalated with lenticular limestone in the middle, and variegated shales intercalated with sandstones capped by white quartzitic sandstone towards the top.

The present collection of ostracodes comes from the middle part of the Subathu Formation. The stratigraphic placement of the samples yielding ostracods is shown in Fig. 1. In all, four rock samples (M1-M4) have yielded ostracodes. They occur in the green and/or grey shales of two faunal zones equivalent to faunal Zone I and faunal Zone II (Batra, 1987). Their distribution is shown in Table 1.

In all, twenty-three taxa were found. Fifteen of these have been identified to the specific level while three have been compared with previously known taxa; the rest are either indeterminate or left under open nomenclature because the material was insufficient or badly preserved. These ostracodes occur mostly as moulds and casts of carapaces. A few of the indeterminate taxa are likely to be new species but more material is required before they can be described. The classification followed is that of Moore (1961). For the genera Alocopocythere and Gyrocycythe which are not given in the Treatise, Siddiqui (1971), the original author has been followed. Only the systematics of those ostracode taxa which are being recorded for the first time from the Subathu Formation is dealt with in the present paper.

All the illustrated specimens have been deposited in the museum of the Centre of Advanced Study in Geology, Panjab University, Chandigarh under the numbers CASGMF 1484-1494.

Table 1: Stratigraphic distribution of ostracodes in the Subathu Formation exposed in the Morni area.

<table>
<thead>
<tr>
<th>TAXA</th>
<th>NOS.</th>
<th>BARIA SP</th>
<th>BYTHOCYPRIIS WESTI SINGH AND Tewari</th>
<th>PARACYPRIS CONTRACTA (Jones)</th>
<th>CYTHERIDEA SP</th>
<th>DENTOKRITEH BARTONENSI (Jones)</th>
<th>DENTOKRITEH [?] RUTOTI [Kei]</th>
<th>CYTHERIDEA PRODOS SIDDUQI</th>
<th>SCHR OJCYTHERE RAKHIS SIDDUQI</th>
<th>SCHR OJCYTHERE PRODOS SIDDUQI</th>
<th>CYTHERELLOIDEA CF. C. BARKHANENSIS Tewari and Tandon</th>
<th>CYTHERELLOIDEA CF. C. BARKHANENSIS Tewari and Tandon</th>
</tr>
</thead>
<tbody>
<tr>
<td>FAUNAL ZONE II</td>
<td></td>
<td>R</td>
<td>C</td>
<td>A</td>
<td>A</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>SAMPLE</td>
<td></td>
<td>M4</td>
<td>M3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FAUNAL ZONE I</td>
<td></td>
<td>R</td>
<td>R</td>
<td>A</td>
<td>A</td>
<td>R</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>A</td>
<td>C</td>
</tr>
<tr>
<td>SAMPLE</td>
<td></td>
<td>M2</td>
<td>M1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Frequency: A = Abundant (>10 specimens); C = Common (5-10 specimens); R = Rare (<5 specimens)
4. Phlyctenophora jhingrani (Singh and Tewari)
5. Cytheridea sp.
6. Dentokrithe bartonensis (Jones)
7. Dentokrithe (?) ruoti (Khosla)
8. Cushmanidea cf. C. tevarii Khosla
9. Eucytherura vimali (Singh and Misra)
10. Semicytherura rameshi (Singh and Misra)
11. Schizocythere rakhiensis Siddiqui
12. Schizocythere prolata Siddiqui
13. Schizocythere sp.
14. Pajenborchella ecoenica Triebel
15. Pajenborchella sp. I
16. Pajenborchella sp. II
17. Allocythera abstracta Siddiqui
18. Gyrocysthera mirgata Siddiqui
19. Occultocythereis cf. O. peristicta Siddiqui
20. Occultocythereis subspinellosa Khosla
21. Xestoleberis subglobosa (Bosquet)
22. Cytherella palamae Siddiqui
23. Cytherellinae cf. C. barkhanensis Tewari and Tandon

**SYSTEMATIC DESCRIPTION**

**Subclass** Ostracoda LATREILLE, 1806
**Order** Podocopida MILLER, 1894
**Superfamily** Cytheracea BARD, 1850
**Family** Cytherideidae SARS, 1894
**Subfamily** Cytherideinae SARS, 1894
**Genus** Cytheridea BOSQUET, 1852

**Cytheridea sp.** (Plate I — 9)

**Material:** Five specimens; hypotype CASGMF 1484

**Dimensions:** Length 0.66 mm, height 0.33 mm, thickness 0.33 mm.

**Remarks:** The specimens in our collection are typical of the genus *Cytheridea*. It appears to be a new species but more specimens are required to determine exact placement. This, however, forms the first record of this genus from the Subathu Formation.

**Family** Neocytherideidae PURI, 1957
**Genus** Cushmanidea BLAKE, 1933

**Cushmanidea cf. C. tevarii Khosla, 1972** (Plate I — 3)

**Material:** Two specimens, hypotype CASGMF 1485

**Dimensions:** Length 0.85 mm, height 0.41 mm, thickness 0.36 mm.

**Remarks:** The Subathu specimens may be compared with *C. tevarii*, the types of which were described by Khosla (1972) from the Early Eocene rocks of the Khuiala Formation of Rajasthan. The specimens were compared with the topotype material. Our specimens are, however, larger in size.

**Family** Cytheruridae MILLER, 1894

**Genus** Eucytherura MILLER, 1894

**Eucytherura vimali (SINGH & MISRA)** (Plate I — 2)

**Schizocythere vimali** Singh and Misra, 1968, pp. 29-30, pl. 7, figs. 8-10.
**Eucytherura vimali** (Singh and Misra), Khosla, 1972, p. 494, pl. 3, fig. 12, pl. 4, fig. 16.

**Material:** Three specimens; hypotype CASGMF 1486

**Dimensions:** Length 0.38 mm, height 0.23 mm, thickness 0.23 mm

**Remarks:** The specimens in our collection come within the range of variation of *E. vimali* as described by Khosla (1972). Our specimens show faint reticulation and appear to be slightly worn out.

**Genus** Semicytherura WAGNER, 1957

**Semicytherura rameshi (SINGH & MISRA)** (Plate I — 6)

**Cytherura rameshi** Singh and Misra, 1968, pp. 31-32, pl. 8, figs. 4-6
**Semicytherura rameshi** (Singh and Misra), Khosla 1972, p. 495, pl. 3, fig. 11.

**Material:** Five specimens; hypotype CASGMF 1487

**Dimensions:** Length 0.40 mm, height 0.26 mm, thickness 0.21 mm

**Remarks:** The specimens recorded herein resemble *S. rameshi* (Singh and Misra), the types of which were from the Eocene beds of Rajasthan. The specimens were compared with the topotype material.

**Family** Schizocytheridae HOWE
**Genus** Schizocythere TRIEBEL, 1950

**Schizocythere rakhiensis SIDDIQUI** (Plate I — 5)


**Material:** Four specimens; hypotype CASGMF 1488

**Dimensions:** Length 0.47 mm, height 0.28 mm, thickness 0.26 mm

**Remarks:** The present specimens are similar to the one described by Siddiqui (1981) as *S. rakhiensis* from the Early Eocene rocks of Pakiasan. Specimens recorded as *S. appendiculata* by Khosla (1972) from
Rajasthan and by Mathur (1977) from the Simla Hills appear to be synonymous with Siddiqui's specimens.

**Schizocythere prolata** *Siddiqui* (Plate I — 4)


**Material:** Two specimens; hypotype CASGMF 1489

**Dimensions:** Length 0.43 mm, height 0.28 mm, thickness 0.26 mm

**Remarks:** The specimens from the Morni area come within the range of variation of *S. prolata*, the types of which were described by Siddiqui (1981) from the Late Paleocene rocks of Pakistan. This is the first record of this species from the Subathu Formation.

**Family** Trachyleberididae *Sylvester-Bradley*, 1948

**Genus** Alocopocythere *Siddiqui*, 1971

*Alocopocythere abstracta* *Siddiqui* (Plate I — 11)

*Alocopocythere abstracta* Siddiqui, 1971, p. 17, pi. 3, figs. 5-11, pi. 4, fig. 1; Siddiqui, 1983, pi. 11, fig. 2.

**Material:** Two hundred specimens; hypotype CASGMF 1490

**Dimensions:** Length 0.68 mm, height 0.41 mm, thickness 0.40 mm

**Remarks:** The specimens in our collection come within the range of variation of *A. abstracta*, the types of which were from the Upper Rakhi Gaj Shales (Early Eocene) of the Rakhi Nala section of Pakistan. Siddiqui (1983) has also recorded the same species from the Subathu Formation. Specimens identified as *Leguminocythereis lunaejensis* by Mathur (1977) probably belong to the present taxon.

**Genus** Gyrocythere *Siddiqui*, 1971

**Gyrocythere mitigata** *Siddiqui* (Plate I — 10)

*Gyrocythere mitigata* Siddiqui, 1971, pp. 42-43, pl. 21, figs. 5-11; Siddiqui, 1983, pl. 1, fig. 11.

**Material:** Ten specimens; hypotype CASGMF 1491

**Dimensions:** Length 0.85 mm, height 0.48 mm, thickness 0.48 mm

**Remarks:** The Subathu specimens are identical to *G. mitigata*, the types of which were described by Siddiqui (1971) from the Early Eocene rocks of Pakistan. According to Siddiqui (1983), this genus is so far known only from the Eocene to Miocene rocks of the Indian Subcontinent. This forms the first record of the present taxon from the Subathu formation.

**Genus** Occultocythereis *Howe*, 1951

**Occultocythereis subspinellosa** *Khosla* (Plate I — 7)

*Occultocythereis subspinellosa* Khosla, 1972, p. 491, pi. 2, figs. 21-22, pl. 4, fig. 11, pi. 5, fig. 8.

**Material:** Ten specimens; hypotype CASGMF 1493

**Dimensions:** Length 0.58 mm, height 0.33 mm, thickness, 0.23 mm

**Remarks:** The specimens recorded herein closely resemble *O. subspinellosa*, the types of which were described by Khosla (1972) from the Early Eocene rocks of Rajasthan. However, our specimens have greater width and fewer spines. The specimens were compared with the topotype material.

**Suborder** Platyopina *Sars*, 1866

**Family** Cytherellidae *Sars*, 1866

**Genus** Cytherella *Jones*, 1849

*Cytherella palanaensis* Khosla, 1972, p. 482, pl. 1, figs. 1-2; pl. 5, fig. 1.

**Material:** Five specimens; hypotype CASGMF 1494

**Dimensions:** Length 0.55 mm, height 0.30 mm, thickness 0.20 mm

**Remarks:** The specimens in our collection closely resemble *C. palanaensis*, the types of which were described by Khosla (1972) from the Early Eocene
rocks of the Khuiala Formation of Rajasthan. The specimens were compared with the toptotype material.

AGE AND AFFINITY OF THE OSTRACODE FAUNA

Faunal Zone I contains nine of the twenty-three ostracode taxa listed here; seven of these have been identified up to the specific level. Two species, Paracypris contracta and Cushmanidea cf. C. teuari, are restricted to this Zone. P. contracta is common here and is widely distributed in the Eocene rocks of India (Mathur, 1977) and Europe (Keij, 1957; Haskins, 1968-71; Monostori, 1985). Cushmanidea cf. C. teuari described by Khosla (1972) from the Early Eocene of Rajasthan, is rare in the present material; this is the first record of the taxon in the Subathu Formation. According to Neale and Singh (1985), Cushmanidea is not often encountered in the Tertiary rocks of the Indian Subcontinent.

In Faunal Zone II twenty ostracode taxa have been found; fourteen have been identified up to the specific level and two have been compared with previously known taxa. Ten species are restricted to this zone Cytherella palanaensis, Cytherelloidea cf. C. barkhanensis, Bythocypris westi, Phlyctenophora jhin­grani, Schizocythere rakhiiensis, S. prolata, Occultocythereis cf. O. peristicta, Eucytherura vimali, Gyrocysthree mitigata and Pajienborchella eocaenica. Five of these species, C. palanaensis, B. westi, P. jhin­grani, S. rakhiiensis and E. vimali are so far known only from Early Eocene rocks. S. prolata has hitherto been known only from the Palaeocene, thus extending its range to Late Ypresian. Pajienborchella eocaenica is a typical Eocene species and has been recorded from India (Mathur, 1977), Europe (Monostori, 1985) and other places. Cytherelloidea cf. C. barkhanensis and G. mitigata are long-ranging and have been recorded from the Eocene to Miocene in the Indian Subcontinent (Tewari and Tandon, 1960; Guha, 1965; Lubimova and Guha, 1968; Mathur, 1977; Siddiqui, 1971, 1983; Bhatia, 1984).

Six species are common to both faunal zones and these include Dentokrithe bartonensis, D.? rutoti, Alocopocythere abstracta, Occultocythereis subspin­nella, Semicytherura rameshi and Xestoleberis subglobosa. Of these, D. bartonensis and D.? rutoti are well known cosmopolitan species (Keij, 1957; Haskins, 1968-71; Khosla, 1972; Mathur, 1977; Khosla and Haskins, 1980; Monostori, 1985), while Alocopocyth­ere abstracta and X. subglobosa are typical Tethyan species (Keij, 1957; Guha, 1968; Khosla, 1972; Mathur, 1977; Siddiqui, 1971; 1983; Khosla and Pant, 1981). X. subglobosa is characteristic of the Eocene (Khosla, 1972). The genus Alocopocythere evolved rapidly in the Early Tertiary; as a consequence its species have a relatively short range in time making them invaluable for biostratigraphic zonation (Neale and Singh, 1985) O. subspinelllosa and S. rameshi, previously known only from the Eocene of Rajasthan are being recorded for the first time from the Lesser Himalayas.

The ostracode fauna from faunal Zone I and II show striking similarity with those recorded elsewhere from the Subathu Formation (Tewari and Singh, 1967; Mathur, 1977), Rajasthan and Kutch in India (Tewari and Tandon, 1960; Lubimova and Guha, 1960; Guha, 1968; Singh and Misra, 1968; Khosla, 1972; Khosla and Pant 1981) and from Pakistan (Siddiqui, 1971, 1981, 1983). The beds of faunal zones I and II have also yielded typical Early Eocene larger foraminifera such as Assilina granulosa, A. laminosa, A. daviesi namralmensis and Nummulites praediscorbius among others (Batra, 1987). The age of these zones as indicated by the ostracode assemblage is consistent with the evidence of the foraminiferal assemblage.

ACKNOWLEDGEMENTS

The authors are thankful to Dr. S.C. Khosla (Udaipur) for loan of toptotype material of the species described by him, to Dr. N.S. Mathur (Dehradun) and to Dr. R.S. Batra (Chandigarh) for fruitful discussions in the field. We are also grateful to Dr. (Mrs) Neera Sahni (Chandigarh) for S.E.M. photography. One of us (HB) is grateful to the Council of Scientific & Industrial Research, New Delhi for grant of Research Fellowship.

REFERENCES


EXPLANATION OF PLATE

PLATE I

1. Cytherilla palmaeensis Right valve view (X74)
2. Eucytherura viens Right valve view (X102)
3. Cushmanidea c. C. teuani Right valve view (X53)
4. Schizocycthere prolata Right valve view (X120)
5. Schizocycthere rakhmenni Left valve view (X119)
6. Semicycthere rameshi Right valve view (X127)
7. Occulocycthere subspinellosa Left valve view (X106)
8. Occulocycthere cf. O. persistica Left valve view (X94)
9. Cytheridea sp. Right valve view (X83)
10. Gyrocycthere mitigata Right valve view (X71)
11. Alocopocythere abstracta Left valve view (X74)