



LATE CRETACEOUS (MAASTRICHTIAN) OSTRACODES FROM THE LAMETA FORMATION, JABALPUR CANTONMENT AREA, MADHYA PRADESH, INDIA

ASHU KHOSLA and ASHOK SAHNI

CENTRE OF ADVANCED STUDY IN GEOLOGY, PANJAB UNIVERSITY, SECTOR-14, CHANDIGARH - 160014, INDIA

ABSTRACT

Here we report the occurrence of an ostracode assemblage from the classic localities of the Lameta Formation (Maastrichtian) of Chui Hill and Bara Simla Hill, Jabalpur Cantonment, Madhya Pradesh, India. The assemblage comprising several thousand specimens includes several gigantic individuals measuring up to 4.1 mm in size. The present assemblage is rich and taxonomically diverse comprising 10 genera and 15 species including one indeterminable form. In terms of diversity, the subfamily Cypridinae (Family Cyprididae) is dominant, represented as it is by 4 genera and 6 species (*Altanicypris bhattai* n. sp., *Eucypris* cf. *E. bajshintsavica*, *Mongolianella palmosa*, *Mongolianella khamariniensis*, *Mongolianella* sp., and *Mongolocypris* cf. *M. gigantea*). The subfamily Cypridopsinae (Family Cyprididae) is represented by ?*Cypridopsis bugintsavicus* and ? *Cypridopsis* sp. The Family Candonidae is represented by 3 species *Candona altanulaensis*, *Candona* (*Candona*) cf. *C. (C.) hubeiensis* and *Paracandona jabalpurensis*. The subfamily Cyclocypridinae (Family Candonidae) is represented by single species *Cyclocypris transitoria*. The Family Cyprideidae is represented by *Cypridea* (*Pseudocypridina*) sp. The Family Darwinulidae is represented by *Darwinula* sp. 1 and 2 *indet.*

This ostracode assemblage exhibits considerable resemblance to other infratrappean assemblages of the Nand, Dhamni-Pavna sections (Maharashtra) and other intertrappean assemblages of Nagpur in central India, Mamoni in Rajasthan, Asifabad in Andhra Pradesh and Gurmatkal in south India. On the whole, the Jabalpur assemblage has distinct Mongolian and Chinese affinities (even down to species level). Important taxa include (*Altanicypris*-*Cypridea*-*Candona*-*Cypridopsis*-*Darwinula*-*Mongolianella*) which are characteristic of the non-marine, uppermost Cretaceous of Mongolia and China.

Key words : Ostracodes, Lameta Formation, Late Cretaceous (Maastrichtian), Jabalpur, India.

INTRODUCTION

Fossils from the Lameta Formation at Jabalpur have been known since 1828 when a British Army Officer Capt. Sleeman (in Matley, 1921) reported the first dinosaurian remains from India and Asia, along with petrified wood fragments. Since then, the Jabalpur sections have provided a classic succession for the study of Late Cretaceous faunas and sedimentary facies in a rift-controlled basin. The present study relates to the finding of a rather large collection of ostracods (over 3000 specimens) recovered from Chui Hill quarry face and the Bara Simla Hill section (fig. 1). The Chui Hill locality is about 1.5 km NE of Jabalpur Railway Station (23° 19' N: 79° 58' E). The ostracod-yielding bed is a grey siltstone (fig. 2) which overlies the 8 m thick trough cross-bedded Green Sandstone marking the base of the Lameta Formation. Bara Simla Hill is 2 km SE of Chui Hill (23° 10' N: 79° 59' E); the ostracod-bearing layers are represented by a green marl and a variegated shale band sandwiched between the

dinosaur egg- and eggshell-rich Lower Limestone (fig. 2).

The material described here is the result of systematic bulk quarrying since 1982. A field trip to the Bara Simla Hill section by Drs D. Gillette, Phil Murrey, K. Kumar, B.N.Tiwari and Ashok Sahni initially located the productive horizons. Subsequently, additional material was collected and referred to briefly by Singh (1985) and Tripathi (1986). Dr. R.S. Rana was also instrumental in augmenting material from Chui Hill.

REPOSITORY OF SPECIMENS AND ABBREVIATIONS

The specimens described in this paper are stored in the Vertebrate Palaeontology Laboratory of Centre of Advanced Study in Geology, Punjab University, Chandigarh, India.

No: Number; VPL/KH/BSH & CH: Vertebrate Palaeontology Laboratory, Khosla, Bara Simla Hill, Chui Hill; mm: millimetres. All dimensions are given in millimetres.

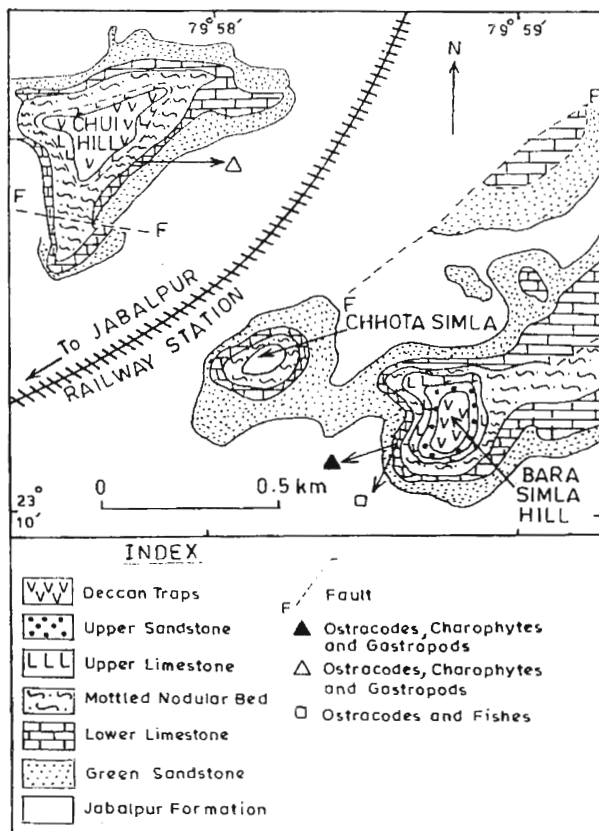


Fig. 1. Geological map of the Jabalpur Cantonment area, Madhya Pradesh, showing the ostracod-bearing localities (map modified after Matley, 1921).

SYSTEMATIC PALAEOLOGY

Subclass Ostracoda Latreille, 1806

Order Podocopida Muller, 1894

Suborder Podocopina Sars, 1866

Family Cyprididae Baird, 1845

Subfamily Cypridinae Baird, 1845

Genus Altanicypris Szczechura, 1978

Altanicypris bhatiai n. sp.

(Pl. I, figs. a-g)

Altanicypris sp. Sahni and Khosla, 1994 a, p. 458, figs. 2 n - p.

Material : 115 well preserved carapaces and several other uncatalogued specimens.

Holotype: VPL/KH/BSH/1803.

Derivation of name: The new species is named after Prof. S.B. Bhatia, Panjab University,

Chandigarh, India, in recognition of his great contributions to Indian Palaeontology.

Diagnosis: Carapace subovate and inflated at the centre; lip-like extension at the anterior end; valve surface showing strongly pitted ornamentation.

Description: Carapace is large and subovate in lateral outline and strongly inflated in the middle. The greatest height is in the middle. The left valve is larger than the right, overlapping it along the entire margin. The dorsal margin is arched and the ventral margin is straight and slightly concave in the middle. Both ends of the carapace are rounded. The anterior margin is broadly rounded while the posterior margin is narrowly rounded in its lower part. The anterior margin has a lip-like extension. The external surface of the carapace has a pitted ornamentation. The internal structures are not known.

Dimensions (mm) :

	Length	Height	Width
(No.VPL/KH/BSH/ 1800)	1.79	1.16	1.13
(No.VPL/KH/BSH/ 1801)	1.67	1.11	1.08
(No.VPL/KH/BSH/ 1802)	1.43	1.08	1.14
(No.VPL/KH/BSH/ 1803)	1.73	1.19	1.03
(No.VPL/KH/BSH/ 1804)	1.90	1.25	Broken carapace
(No.VPL/KH/BSH/ 1805)	1.90	1.25	1.20

Remarks: The present specimens closely resemble *Altanicypris szczechuræ* Stankevitch recorded by Szczechura (1978) from the Upper

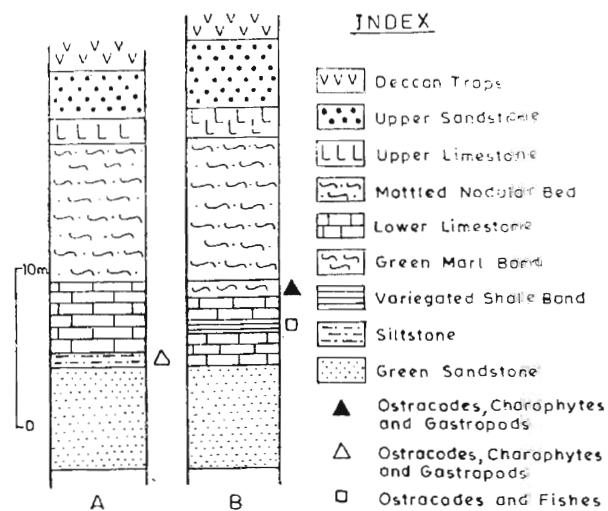


Fig. 2. Stratigraphic successions at Chui Hill (A) and Bara Simla Hill (B), Jabalpur showing the ostracod-bearing localities.

Cretaceous Nemegt Formation of Mongolia. The only difference is that the present specimens have a marked pitted ornamentation as compared to the smooth external surface of *Altanicypris szzechurae*. The present forms are also comparable with *Altanicypris bispinifera* described by Szczechura (1978) from Mongolia, which also has a pitted ornamentation. However, the Mongolian species is almost half the thickness of the Jabalpur species and is characterised by irregularly arranged spiny tubercles on the external surface, a feature not yet noticed in the Jabalpur material.

In India, Bhatia *et al.* (1990 a, 1990 b, 1996) and Srinivasan (1991) have reported *Altanicypris szzechurae* from the Upper Cretaceous Asifabad (Andhra Pradesh), Takli (Nagpur) and Mamoni intertrappean beds of Rajasthan and Upper Cretaceous intertrappean beds of Gurmatkal, Karnataka. The present forms are somewhat similar to those described previously from these intertrappeans in lateral outline and the lip-like extension at the anterior end. The strongly pitted ornamentation of the new species, however, distinguishes it readily from other records.

Due to lack of specimens, *Altanicypris* sp. was not assigned a specific name when recorded previously by Sahni and Khosla (1994 a) from the Lameta Formation of Jabalpur.

Type locality and horizon: Green marl band within the Lower Limestone horizon of the Lameta Formation at Bara Simla Hill, Jabalpur, Madhya Pradesh.

Genus Eucypris Vavra, 1891

Eucypris cf. *E. bajshintsavica* Khand and Stankevitch, 1975
(Pl. I, figs. h- j)

Eucypris bajshintsavica Khand and Stankevitch, 1975, p. 179, pl. 1, figs. 1 a-b.- Shuvalov and Stankevitch, 1977, p. 122, pl. 1, figs. 3 a- b. *Eucypris* sp. Sahni and Khosla, 1994 a, p. 458, fig. 2 m.

Material: 10 well preserved carapaces.

Dimensions (mm):

	Length	Height	Width
(No. VPL/KH/BSH/1008)	1.26	0.93	0.64
(No. VPL/KH/BSH/1009)	1.07	0.65	Broken carapace

Description: Carapace large, subovate in lateral outline. The maximum height is in the middle. In dorsal view, maximum width a little posterior to the middle, narrowing towards the anterior. Carapace pointed at both the ends when viewed dorsally. The left valve overlaps the right valve. Both the ends are rounded. The dorsal margin is strongly arched while the ventral margin is gently convex to nearly straight. The valve surface is smooth; and internal details are not known.

Remarks: The present material seems closest in lateral outline to *Eucypris bajshintsavica* described by Shuvalov and Stankevitch (1977) from the late Senonian beds of the Bayshingtoav region, south-eastern Mongolia. They resemble *Eucypris* cf. *paratriangulata* and *Eucypris* cf. *anluensis* described from the Mesozoic and Cainozoic of Yunnan, China (Ye *et al.*, 1977). The Chinese species, however, is smaller than the Jabalpur taxon. This species has previously been recorded by Sahni and Khosla (1994 a) from the Lameta Formation of Jabalpur as *Eucypris* sp. However, identification to species level was not then possible because of insufficient material. Prior to the present record of *Eucypris* cf. *E. bajshintsavica*, the species was not known from any infra- and intertrappean localities.

Horizon and locality: Green marl band within the Lower Limestone horizon of the Lameta Formation at Bara Simla Hill, Jabalpur, Madhya Pradesh.

Genus Mongolianella Mandelstam, 1955

Mongolianella palmosa Mandelstam, 1955
(Pl. I, figs. k, l; Pl. II, figs. a-e)

Mongolianella palmosa (Mandelstam) - Galeeva, 1955, p. 46, pl. 11, fig. 2.- Ljubimova, 1956, p. 86, pl. 18, figs. 2-3.

Mongolianella ? palmosa (Mandelstam)- Szczechura, 1978, pp. 103-104, pl. 32, figs. 3- 4.

Mongolianella palmosa (Mandelstam)- Bhatia *et al.*, 1990 a, pp. 47-48, pl. 2, fig. 8.- Bhatia *et al.*, 1990 b, pp. 118-119, pl. 1, fig. 8.- Bhatia *et al.*, 1996, p. 306, pl. 2, fig. 8.- Sahni and Khosla, 1994 a, p. 458, figs. 2 q- r.

Material: 53 well preserved carapaces.

Dimensions (mm):

	Length	Height	Width
(No. VPL/KH/ BSH/ 1010)	1.12	0.44	0.41
(No. VPL/KH/ BSH/1013)	1.26	0.52	0.41

(No.VPL/KH/ BSH/1014)	1.21	0.46	0.42
(No.VPL/KH/ BSH/1015)	1.15	0.54	0.31

Description: The carapace is large, elongate, moderately and equally inflated. Its length is twice its height. The maximum height is in the centre and maximum width towards the posterodorsal side. Both ends are somewhat rounded; the anterior is broadly rounded, the posterior is narrowly rounded. The dorsal margin is slightly arched; the ventral margin slightly concave and more or less straight. Left valve larger than the right valve, overlapping it along the entire margin except posterodorsally. In dorsal view, the carapace appears pointed at both the ends. The external surface is smooth. Internal details unknown.

Remarks: The species is abundantly represented in the present collection and is comparable with *Mongolianella ? palmosa*, described from the Upper Cretaceous Nemegt Basin of Mongolia (Szczechura, 1978). It shows considerable variation in length as well as in length-height ratio. The Jabalpur specimens are longer than the Nemegt ones (Szczechura, 1978). The species *Mongolianella palmosa* has also been reported by Ljubimova (1956) from Cretaceous deposits of eastern Mongolia. These specimens have their posterior ends more narrowly rounded, a feature also noted in the Jabalpur material. The species is also known from the Lower Cretaceous of Mongolia (Galeeva, 1955).

In India, our forms are comparable with *Mongolianella palmosa* described from the Mamoni, Asifabad and Takli intertrappean beds (Bhatia *et al.*, 1990 a, 1990 b, 1996). Srinivasan (1991) has described *Mongolianella* cf. *M. palmosa* from the intertrappean beds of Gurmatkal, Karnataka. *M. palmosa* has already been reported by Sahni and Khosla (1994 a) from the Maastrichtian Lameta Formation of Jabalpur.

Horizon and locality: Green marl band within the Lower Limestone horizon of the Lameta Formation at Bara Simla Hill and siltstone band at the base of the Lower Limestone at Chui Hill, Jabalpur, Madhya Pradesh.

Mongolianella khamariniensis Galeeva, 1956
(Pl. II, figs. f-g)

Mongolianella khamariniensis Ljubimova, 1956, p. 89, pl. 19, figs. 1a-b.- Hao Yichun *et al.*, 1983, p. 30, pl. 20, figs. 1a-b.- Bhatia *et al.*, 1996, pp.301- 306, pl. 2, fig. 5.

Material: 4 well-preserved carapaces.

Dimensions:(mm)

	Length	Height	Width
(No.VPL/KH/ BSH/1850)	1.27	0.72	Broken carapace
(No.VPL/KH/ BSH/1851)	1.08	0.62	0.48

Description: Carapace large and elongate; moderately inflated, with maximum height at the centre. Both extremities with rounded margins; dorsal margin highly arched while the ventral margin is slightly convex. Left valve larger than the right valve; valve surface smooth. Internal details not known.

Remarks: The material described herein is comparable with that described by Hao Yichun *et al.* (1983) from the Cretaceous Yining and Minhe and southern Sangliao basins of China. The Jabalpur specimens are also very similar to *Mongolianella khamariniensis* described by Bhatia *et al.* (1996) from the Upper Cretaceous intertrappean beds of peninsular India. This is a rare species in our material.

Horizon and locality: Green marl band within the Lower Limestone horizon of the Lameta Formation at Bara Simla Hill, Jabalpur, Madhya Pradesh.

Mongolianella sp.
(Pl. II, figs. h- i)

Material: 5 moderately preserved carapaces.

Dimensions (mm):

	Length	Height	Width
(No.VPL/KH/ BSH/1016)	0.88	0.44	0.36

Description: Carapace elongate, length twice the height. The maximum height and width is median. The carapace is almost uniformly and moderately inflated laterally. Both anterior and posterior ends are broadly rounded and the dorsal margin is slightly arched; but the ventral margin is rather straight. The valve surface is smooth. Internal morphological features not known.

Remarks: The present genus is comparable with

Mongolianella sp. indet. described by Srinivasan (1991) from Upper Cretaceous intertrappean beds at Gurmatkal, Karnataka. However, the Gurmatkal specimens have narrow rounded anterior and posterior ends while this species has broad rounded ends. In general appearance and other characters, the two forms are more or less similar. The genus has also been reported from the intertrappean beds of Nagpur and Asifabad (Rana, 1984; Prasad, 1985). Recently, *Mongolianella* sp. has been recorded, but without any illustration or description, from the Lameta Formation of Nand-Dongargaon and Dhamni-Pavna sections in Maharashtra (Mohabey, 1996; Mohabey and Udhoji, 1990, 1996 a; Mohabey *et al.*, 1993; Udhoji *et al.*, 1990).

This is likely to be a new species of *Mongolianella* but the limited number of specimens oblige us to leave it in open nomenclature. Rare in our material.

Horizon and locality: Green marl band within the Lower Limestone horizon of the Lameta Formation at Bara Simla Hill, Jabalpur, Madhya Pradesh.

Genus Mongolocypsis Szczechura, 1978

Mongolocypsis cf. *M. gigantea* Ye *et al.*, 1977
(Pl. II, figs. j- l; Pl. III, figs. a- h)

Mongolocypsis gigantea Ye *et al.*, 1977, pp. 246-247, pl. 11, fig. 21, pl. 12, fig. 2.- Gou and Cao, 1983, p. 392, pl. 4, fig. 3.

Mongolocypsis cf. *M. gigantea* (Ye *et al.*), Sahni and Khosla, 1994 a, p. 456 - 458, figs. 2a-d.

Material: About 110 complete carapaces and several other uncatalogued specimens.

Dimensions (mm):

	Length	Height	Width
(No. VPL/KH/ BSH/1001)	4.12	2.85	1.92
(No. VPL/KH/BSH/ 1002)	3.93	2.66	1.75
(No. VPL/KH/ BSH/1026)	2.85	1.78	1.61
(No. VPL/KH/ BSH/1027)	3.93	2.53	1.73
(No. VPL/KH/ BSH/1028)	3.86	2.59	Broken carapace
(No. VPL/KH/ BSH/1029)	2.20	1.45	1.00

Description: The carapace is very large and thick-shelled, ovate to subovate in lateral outline. The carapace is markedly and moderately tumid and slopes downwards when viewed postero-dorsally. The maximum height is slightly posterior to the mid-

length and the greatest width occurs posteriorly. Left valve larger than the right valve. The species shows a prominent left-over-right overlap along the entire margin. Both the anterior and posterior ends are broadly rounded. The dorsal margin is gently arched while the ventral margin is nearly convex to straight. This species is represented by several moult stages. Sexual dimorphism is confirmed in only one specimen (VPL/KH/BSH/1026). The female is shorter than the male and has a pronounced well-preserved beak at the anteroventral end. The external surface is smooth. Internal details are not known.

Remarks: This large species is recorded for the first time from the Lameta Formation of Jabalpur. It is represented by both sexes and is comparable to *Mongolocypsis gigantea* reported from the Maastrichtian of Yunnan, China (Ye *et al.*, 1977; Gou and Cao, 1983). The species also appears to be close to *Mongolocypsis distributa* described from the Upper Cretaceous of the Nemegt Basin, Mongolia (Szczechura, 1978). It also shows some similarity in general shape to *Mongolocypsis tera* (Su) as described from the Albian of the Hekou Formation, Fujian province, southern China (Ye, 1994).

The lone female specimen with an anteroventral beak described herein is close to *Cypridea distributa* Stankevitch, known from Upper Cretaceous deposits in the Nemegt Ula, Tsagan Khushu and Bugeen Tsav regions of the southern Gobi Desert, Mongolia (Stankevitch and Sochava, 1974). This specimen is also close to *Cypridea* (*C.*) *gigantea* and *Mongolocypsis porrecta* (Ye, 1994). The former has been recorded from the Campanian-Maastrichtian of the Shifangtai Formation, Songliao Basin of northern China, and the latter from the Albian of the Hekou Formation, Fujian province, southern China (Ye, 1994).

A considerable variation of size and shape has been found within the studied material. The length of the Jabalpur specimens varies from 2 to 4.1 mm. The specimens described by Stankevitch and Sochava (1974) are longer than 2 mm, which size is generally similar with the female and some juvenile forms from Jabalpur. Because of the occurrence of several moult stages, the authors are inclined to

compare the present species with *Mongolocypris gigantea*. This species has already been reported by Sahni and Khosla (1994 a) from the Lameta Formation of Jabalpur.

Horizon and locality: Green marl band within the Lower Limestone horizon of the Lameta Formation at Bara Simla Hill and siltstone band at the base of the Lower Limestone at Chui Hill, Jabalpur, Madhya Pradesh.

Subfamily **Cypridopsinae** Bronstein, 1947

Genus **Cypridopsis** Brady, 1868

? *Cypridopsis bugintsavicus* Stankevitch, 1974
(Pl. IV, figs. a- c)

Lycopteroocypris ? bugintsavicus Stankevitch- (in Stankevitch and Sochava, 1974), p. 281, pl. 2, fig. 9.

? *Cypridopsis bugintsavicus* Stankevitch- Szczechura, 1978, p. 99, pl. 31, figs. 2- 3.- Sahni and Khosla, 1994 a, pp. 458- 459, figs. 2 k- l.

Material: 100 well-preserved carapaces and numerous other uncatalogued specimens.

Dimensions (mm):

	Length	Height	Width
(No.VPL/KH/ BSH/1007)	0.88	0.64	0.69

Description : The carapace is medium-sized, sub-triangular and ovate in lateral outline. Valves are subequal, left valve larger than the right one. Both the anterior and posterior ends are rounded. The dorsal margin is strongly arched and the ventral margin is straight. The carapace is highly inflated posterodorsally and posteroventrally. The greatest height is medial and the greatest width is postero-medial. The external surface is smooth. Internal features not seen.

Remarks: In size and general appearance, the present specimens are comparable to *Lycopteroocypris (?) bugintsavicus* Stankevitch, from the Upper Cretaceous deposits of the Nemegt Ala, Tsagan Khushu and Bugeen Tsav regions in the southern Gobi Desert, Mongolia (Stankevitch and Sochava, 1974). The species has also been recorded from the late Senonian deposits in the Bayshingtoav region, southeastern Mongolia (Shuvalov and Stankevitch, 1977).

The Jabalpur individuals are also rather similar in shape, size and lateral outline to specimens described from the Nemegt Basin (Upper

Cretaceous) of Mongolia and questionably identified as *Cypridopsis bugintsavicus* (Szczechura, 1978). However, a few of these Mongolian specimens show a faintly punctate ornamentation on the external surface in contrast to the smooth-surfaced Jabalpur specimens. The species has already been reported by Sahni and Khosla (1994 a) from the Maastrichtian Lameta Formation of Jabalpur, Madhya Pradesh.

Horizon and locality: Green marl band within the Lower Limestone horizon of the Lameta Formation at Bara Simla Hill, Jabalpur, Madhya Pradesh.

? *Cypridopsis* sp. Szczechura, 1978
(Pl. IV, figs. d- g)

? *Cypridopsis* sp. Szczechura, 1978, pp. 99-100, pl. 30, figs 1-3.

Material : 9 well preserved carapaces.

Dimensions (mm):

	Length	Height	Width
(No.VPL/KH/ CH/1017)	1.04	0.70	0.56

Description: The carapace is more or less kidney-shaped in lateral outline. The left valve is larger than the right valve and overlaps it both dorsally and ventrally. Both ends of the carapace are rounded. The anterior end is broadly rounded while the posterior one is narrowly rounded. The dorsal margin is arched and the ventral margin is slightly convex or straight. The greatest height is median and the greatest width is postero-medial. The maximum width is nearly equal to half the length. The valve surface is smooth. Internal details not known.

Remarks : This species is similar in shape, size and general outline to ? *Cypridopsis* sp. from the Upper Cretaceous Nemegt Formation, Nemegt, Nemegt Basin and Gobi Desert of Mongolia (Szczechura, 1978). A few Mongolian specimens display a faint punctuation in contrast to the smooth Jabalpur specimens.

In India, the genus *Cypridopsis* has also been recorded without illustration or description from the Lameta Formation of Nand-Dongargaon and Dhamni-Pavna sections, Maharashtra (Mohabey, 1996; Mohabey and Udhoji, 1996 a; Mohabey *et al.*, 1993).

Horizon and locality: Green marl band within the Lower Limestone horizon of the Lameta Formation at Bara Simla Hill and siltstone band at the base of the Lower Limestone at Chui Hill, Jabalpur, Madhya Pradesh.

Family **Candonidae** Kaufmann, 1900

Subfamily **Candoninae** Kaufmann, 1900

Genus **Candona** Baird, 1845

Candona altanulaensis Szczechura and Blaszyk, 1970

(Pl. IV, figs. h- l)

Candona altanulaensis Szczechura and Blaszyk, 1970, p. 114, pl. 29, figs. 2-4.- Stankevitch and Sochava, 1974, p. 283, pl. 2, fig. 6.- Szczechura, 1978, pp. 85-86, pl. 19, figs 1-6.- Bhatia *et al.*, 1990 a, p.47, pl. 3, fig. 3.- Sahni and Khosla, 1994 a, p. 458, fig. 2 s.

Material: 23 well preserved carapaces.

Dimensions (mm):

	Length	Height	Width
(No.VPL/KH/ BSH/ 998)	0.62	0.38	0.36
(No.VPL/KH/ BSH/999)	0.75	0.44	0.42
(No.VPL/KH/ BSH/1011)	0.63	0.41	0.40
(No.VPL/KH/ BSH/1019)	0.71	0.43	0.40

Description: The carapace is small and subreniform in lateral outline. The left valve is slightly larger than the right valve, overlapping it ventrally. Both anterior and posterior margins are rounded, but the posterior margin is more broadly rounded and also more angulate postero-dorsally. The carapace is moderately inflated in the middle and both the ends are pointed in dorsal view. The dorsal margin is convex and slopes downwards towards the anterior end; the ventral margin is concave. The greatest height is at the posterior end and greatest width at the centre. The valve surface is smooth. Internal details not known.

Remarks: The type of this species was originally described by Szczechura and Blaszyk (1970) from the Upper Cretaceous Nemegt Basin, Gobi Desert of Mongolia. However, the Jabalpur material is closest in size, shape and all other features to *Candona altanulaensis* as reported from Upper Cretaceous (Nemegt Formation) Nemegt and Altan Ula IV, Nemegt Basin and beds of Bugeen Tsav and Tsagan Khushu, Gobi Desert (Szczechura, 1978;

Stankevitch and Sochava, 1974).

In India, the species has already been described by Bhatia *et al.* (1990 a) and Srinivasan (1991) from the Upper Cretaceous intertrappean beds of Asifabad (Andhra Pradesh), Takli (Nagpur) and Gurmatkal (Karnataka).

Earlier, specimens of this species from Jabalpur had been illustrated and identified as *Eucandona* sp. (Sahni and Tripathi, 1990). More recently, Sahni and Khosla (1994 a) determined the synonymy with this species.

Horizon and locality: Green marl band within the Lower Limestone horizon of the Lameta Formation at Bara Simla Hill, Jabalpur, Madhya Pradesh.

Candona (Candona) cf. C. (C). hubeiensis Hou *et al.*, 1978

(Pl. V, figs. a- b)

Candona (Candona) hubeiensis Hou *et al.*, 1978, p. 161, pl. 8, figs. 9-14.

Material: 3 well preserved carapaces.

Dimensions (mm):

	Length	Height	Width
(No. VPL/KH/ BSH/1045)	0.56	0.38	0.33
(No. VPL/KH/ BSH/1046)	0.54	0.36	0.32

Description: The carapace is subovate and inflated in lateral outline. The greatest height lies a little posterior to the middle. The left valve is somewhat larger than the right. Both ends of the carapace are rounded. The anterior is more broadly rounded than the posterior. The dorsal margin is arched and the ventral margin is straight. In dorsal view, the maximum width is a little posterior to the middle, and the carapace narrows towards the anterior. The external surface is smooth. Internal morphological features are not known.

Remarks: The specimens from the Lameta Formation of Jabalpur are quite similar in size and general outline to *Candona (Candona) hubeiensis* described by Hou *et al.* (1978) from Cretaceous deposits of the Yangtze - Han river plain in central Hubei, China. This species has also been reported from Middle Jurassic-Tertiary deposits of Xining and Minhe Basins of China (Hou *et al.*, 1978). In India,

Srinivasan (1991) has recorded the species *Candona* (*Candona*) cf. *C. (C.) hubeiensis* from Upper Cretaceous intertrappean beds of Gurmatkal, Karnataka. This species is rare in our material. More and better preserved specimens are needed to confirm the specific placement.

Horizon and locality: Green marl band within the Lower Limestone horizon of the Lameta Formation at Bara Simla Hill, Jabalpur, Madhya Pradesh.

Genus *Paracandona* Hartwig, 1899

Paracandona jabalpurensis Sahni and Khosla,
1994 a
(Pl. V, figs. c- f)

Paracandona jabalpurensis Sahni and Khosla, 1994 a, pp. 457- 458, figs. 2 e- f.

Material: 50 specimens; 25 complete well preserved, 15 broken and 10 poorly preserved specimens.

Dimensions (mm):

	Length	Height	Width
(No.VPL/KH/ BSH/1003)	1.07	0.62	0.69
(No.VPL/KH/ BSH/1960)	0.89	0.58	Broken carapace
(No.VPL/KH/ BSH/1961)	0.90	0.52	0.54

Description: The carapace is elliptical and bean-shaped in lateral outline; its greatest height is medial. The left valve is larger and overlaps the right valve along the entire margin. Both anterior and posterior ends are broadly rounded. The dorsal margin is arched and the ventral margin is straight. In dorsal view, maximum width and inflation occur medially. The external surface shows a strongly-punctate ornamentation. The internal morphological features are not known.

Remarks: The species does not resemble any other known Chinese-Mongolian Late Cretaceous taxon. It has already been recorded by Sahni and Khosla (1994 a) from the Maastrichtian of Jabalpur. Outside India, Tambareau (1984) has reported *Paracandona belgica* from the Upper Cretaceous of the continental Montian of Belgium.

Horizon and locality: Green marl and variegated shale band within the Lower Limestone horizon of the Lameta Formation at Bara Simla Hill, Jabalpur, Madhya Pradesh.

Subfamily *Cyclocypridinae* Kaufmann, 1900

Genus *Cyclocypris* Brady and Normann,
1889

Cyclocypris transitoria Stankevitch, 1974
(Pl. V, figs. g- i)

Timiriasevia ? transitoria (Stankevitch), Stankevitch and Sochava, 1974, p. 284, pl. 2, figs. 1-2.

Cyclocypris transitoria (Stankevitch) - Shuvalov and Stankevitch, 1977, pp.120-121, pl. 2, figs. 1-3.-Szczechura, 1978, pp. 87-88, pl. 31, fig. 1.- Sahni and Khosla, 1994 a, pp. 458- 459, fig. 2 j.

Material: 44 well-preserved carapaces and several other uncatalogued specimens.

Dimensions (mm):

	Length	Height	Width
(No.VPL/KH/ BSH/1006)	0.60	0.44	0.51
(No.VPL/KH/ BSH/1035)	0.73	0.49	0.58

Description: The carapace is small, subtriangular in lateral outline and compressed ventrally; it is inflated dorsally with maximum height in the middle and greatest width posteriorly. The left valve is larger than the right valve, overlapping it distinctly along the ventral margin. Both ends of the carapace are somewhat rounded. The dorsal margin is strongly arched while the ventral margin is straight or concave. The external surface is smooth. Internal details unknown.

Remarks: The species is recorded herein for the first time from the Maastrichtian Lameta Formation of Jabalpur. Our specimens may be comparable with *Timiriasevia (?) transitoria*, a species, which was originally described by Stankevitch and Sochava (1974) from the Upper Cretaceous Nemegt-Ala. Tsagan Khushu and Bugeen Tsav regions, and localities of the southern Gobi Desert. The species *Cyclocypris transitoria* has also been recorded by Shuvalov and Stankevitch (1977) from the Late Senonian deposits of the Bayshingtoav region in southeastern Mongolia. The present material is almost identical in shape to *Cyclocypris transitoria* described from the Upper Cretaceous Nemegt Formation of Mongolia by Szczechura (1978). In India, the species has already been recorded by Sahni and Khosla (1994 a) from Jabalpur. Recently, it was also recorded but without either illustration or description from the Lameta Formation of Nand-

Dongargaon in Maharashtra (Mohabey, 1996; Mohabey and Udhoji, 1996 a).

Horizon and locality: Green marl band within the Lower Limestone horizon of the Lameta Formation at Bara Simla Hill and siltstone band at the base of the Lower Limestone at Chui Hill, Jabalpur, Madhya Pradesh.

Family **Cyprideidae** Martin, 1940

Subfamily **Cyprideinae** Martin, 1940

Genus **Cypridea** Bosquet, 1852

Subgenus (**Pseudocypridina**) Roth, 1933

Cypridea (*Pseudocypridina*) sp.
(Pl. V, figs. j- k; Pl. VI, figs. a- b)

Cypridea (*Pseudocypridina*) sp. Sahni and Khosla, 1994 a, pp. 458-459, figs. 2 g-i.

Material: 2 well preserved carapaces and few other poorly preserved specimens.

Dimensions (mm):

	Length	Height	Width
(No.VPL/KH/ BSH/ 1004)	0.60	0.38	0.30
(No.VPL/KH/ BSH/1005)	0.56	0.34	0.32

Description: The carapace is elongate-ovate in lateral outline. The left valve overlaps the right valve at all margins. A distinct beak is visible anteroventrally. In lateral view, the anterior is more rounded and higher than the less rounded posterior. The posterior margin meets the dorsal margin in a distinct angulation at about one- third the length. The maximum inflation is median. The dorsal margin is arched and the ventral margin is nearly straight. The external surface exhibits faintly developed small tubercles. Internal details are not known.

Remarks: *Cypridea* is a widely distributed Jurassic-Cretaceous genus. Apart from many records from Europe, Brazil, Argentina, Alaska, Canada, etc., it occurs in the Jurassic Morrison Formation of South Dakota (Roth, 1933; Harper and Sutton, 1935) and in the Cretaceous deposits of Mongolia and Siberia (Galeeva, 1955). The specimen (VPL/KH/ 1004) which was lost subsequent to being photographed is well comparable with *Cypridea* (*Pseudocypridina*) *piedmonti* described from the Morrison Formation of the Black Hills, South Dakota, of Lower Cretaceous age (Roth, 1933). The

Morrison Formation is now known to be largely Upper Jurassic (Kimmeridgian-Portlandian) in age (Harper and Sutton, 1935; Sohn, 1957, 1979; Hinte, 1976). Further, *Cypridea piedmonti* as recorded by Harper and Sutton (1935) from the Morrison Formation is also characterised by a distinct antero-ventral beak. Sohn (1979) recorded three species, namely *Cypridea* (*Pseudocypridina*) *piedmonti*, *Cypridea* (*Pseudocypridina*) *laeli* and *Cypridea* (*Pseudocypridina*) *henrybelli* from the Lower Cretaceous Lakota Formation which also resemble the presently described specimens in having a strong beak-like extension in the antero-ventral region. Three more species, *Cypridea* (*Pseudocypridina*) *acutituberculata* Galeeva, *C. (P.) consulta* Mandelstam, and *C. (P.) vitimensis* Mandelstam, described from the Cretaceous of Siberia and Mongolia are comparable with our species in having small tubercles on the external surface.

Srinivasan (1991) described the new species *Cypridea* (*Pseudocypridina*) *indica* from the Upper Cretaceous Yanagundi intertrappean beds of Gurmatkal, Karnataka, India. The Gurmatkal species is much thicker (Length 1.23 mm, Width 0.54 mm, Height 0.99 mm) and lacks a beak in comparison to the Jabalpur specimens. Due to the rarity of the material no specific name can yet be assigned to the present specimens. More and better preserved material is needed to determine this species. Recently, *Cypridea* has been recorded without illustration or description from the Nand-Dongargaon and Dhamni-Pavna sections in Maharashtra (Mohabey, 1996; Mohabey and Udhoji 1996a; Mohabey *et al.*, 1993).

Horizon and locality: Green marl band within the Lower Limestone horizon of the Lameta Formation at Bara Simla Hill, Jabalpur, Madhya Pradesh.

Superfamily **Darwinulacea** Brady and Norman, 1889

Family **Darwinulidae** Brady and Norman, 1889

Genus **Darwinula** Brady and Robertson, 1885

Darwinula sp. 1
(Pl. VI, fig. c)

Darwinula sp. Sahni and Tripathi, 1990, p. 36, pl. 2,
fig. 6.

Material: 6 well preserved carapaces.

Dimensions (mm):

	Length	Height	Width
(No. VPL/ KH/ BSH/ 2000)	0.76	0.33	0.29

Description: The carapace elongate or ovate in lateral outline. The left valve overlaps the right valve. The posterior end is more broadly rounded than the anterior. The dorsal margin is slightly convex while the ventral margin is straight. The external surface is smooth. Internal details are unknown.

Remarks: In lateral outline, the present specimen is comparable with *Darwinula contracta* reported from the Cretaceous of Eastern Mongolia (Ljubimova, 1956). Another morphologically similar species has been reported from Cenomanian-Santonian deposits of the Jiadian Formation, Hubei Province, southern China (Ye, 1994).

In India, the genus *Darwinula* has already been recorded from the Lameta Formation of Jabalpur, Madhya Pradesh (Tripathi, 1986; Sahni and Tripathi, 1990); as well as from the Nand-Dongargaon and Dhamni-Pavna sections in Maharashtra (Mohabey, 1996; Mohabey and Udhoji, 1996 a; Mohabey *et al.*, 1993).

Horizon and locality: Green marl band within the Lower Limestone horizon of the Lameta Formation at Bara Simla Hill, Jabalpur, Madhya Pradesh.

Darwinula sp. 2
(Pl. VI, figs. d- f)

Material: 2 well preserved carapaces.

Dimensions (mm):

	Length	Height	Width
(No. VPL/KH/ BSH/1050)	0.64	0.30	0.33
(No. VPL/KH/ BSH/1051)	0.62	0.29	0.34

Description: Carapace of medium size and elongate inflated in the middle with length more than twice the height. The maximum height and width is

medial. Both ends are broadly rounded; the dorsal margin is slightly arched and the ventral margin is convex. The valve surface shows a strongly pitted ornamentation. Internal morphological features not known.

Remarks: The present genus differs from *Darwinula* sp. 1 in having a strongly pitted ornamentation on the external surface. In general shape, the described specimens appear to belong in *Darwinula*. This is probably a new species of *Darwinula* because, prior to this record, a pitted ornamentation has never been noticed in the Late Cretaceous Mongolian and Indian specimens. The scarcity of material does not allow the authors to describe a new species. *Darwinula* occurs worldwide during the Mesozoic, notably in the Jurassic (Tithonian) to Cretaceous (Hauterivian) of China (Ye, 1994).

Horizon and locality: Green marl band within the Lower Limestone horizon of the Lameta Formation at Bara Simla Hill, Jabalpur, Madhya Pradesh.

Gen. et sp. A
(Pl. VI, figs. g- h)

Material: 4 well- preserved carapaces.

Dimensions (mm):

	Length	Height	Width
(No. VPL/KH/ BSH/2007)	0.59	0.36	0.43
(No. VPL/KH/ BSH/ 2008)	0.78	0.44	0.48

Description: Carapace ovate-triangular in lateral view. The dorsal margin is fairly arched while the ventral margin is compressed. The greatest height is a little anterior to the middle; the greatest width is medial. The anterior margin is broadly and slightly obliquely rounded. The posterior margin is also broadly rounded. The left valve is bigger overlapping the right one anteriorly. The surface of the carapace is smooth. Internal features are not known.

Remarks: The limited number of specimens makes a precise taxonomic assignment difficult.

Horizon and locality: Green marl band within the Lower Limestone horizon of the Lameta Formation at Bara Simla Hill, Jabalpur, Madhya Pradesh.

DISCUSSION

The ostracod-bearing siltstone, green marl and variegated shale band are associated (figs. 1 and 2) within the dinosaur egg- and eggshell-bearing Lameta Limestone (=Lower Limestone, Sahni *et al.*, 1994). The ostracod-yielding siltstone at the base of the Lower Limestone at Chui Hill is a flood plain deposit. The ostracod-bearing green marl band at Bara Simla Hill indicates a palustrine plain environment incorporating a lake or marsh (Sahni *et al.*, 1994; Tandon *et al.*, 1995, 1998). The biota rich Lameta horizon is a well preserved palaeogeomorphological surface with “high” relief represented by sandy, nodular, brecciated and conglomeratic carbonate (= Lower Limestone) rich in dinosaur nests and eggshell fragments (Tandon *et al.*, 1990, 1995; Khosla and Sahni, 1995; Loyal *et al.*, 1996; Sahni *et al.*, 1994; Sahni and Khosla, 1994 a,b; Khosla, 1994, 1996). The “low” relief is considered as a ‘ramp’ (= green marl, variegated shale and siltstone band) and contains ostracods, charophytes, gastropods, fishes and dinosaurian bones (Tandon *et al.*, 1990, 1995; Sahni and Khosla, 1994 a, b; Sahni *et al.*, 1994; Khosla, 1996). The ostracod assemblage is associated with a charophyte assemblage which includes *Microchara sausari* and *Platychara* cf. *P. sahnii*; also with pulmonate gastropods, namely *Physa prinseppi*, *Paludina normalis* and *Lymnaea subulata*; and fishes are represented by *Apateodus striatus*, *Pycnodus* sp., *Phareodus* sp. and *Stephanodus* sp (Khosla, 1996).

The ostracods in the Jabalpur assemblage are represented by 10 genera and 15 species in the 4 families Cyprididae, Candonidae, Cyprideidae and Darwinulidae plus one indeterminate form. In abundance, *Altanicypris bhatiai* n. sp. dominates the ostracod assemblage, followed by *Mongolocypis* cf. *M. gigantea*, ? *Cypridopsis bugintsavicus*, *Mongolianella palmosa*, *Paracandona jabalpurensis*, *Cyclocypis transitoria*, *Candona altanulaensis*, *Eucypris* cf. *E. bajshintsavica*, ? *Cypridopsis* sp., *Mongolianella* sp. *indet.*, *Mongolianella khamariniensis*, Gen et sp. *indet.* A, *Darwinula* sp. 1 and 2 *indet.*, *Candona* (*Candona*) cf. *C. (C). hubeiensis* and *Cypridea*

pseudocypridinea sp. Overall, the assemblage has distinct affinities with Mongolian-Chinese forms as well as with other infratrappean and intertrappean assemblages.

Age implications

The palaeontological data from the Jabalpur area suggest a Maastrichtian age for the Lameta Formation and its rich dinosaur fauna (Buffetaut, 1987). The ostracod assemblage includes important forms like *Altanicypris bhatiai* sp. nov., *Candona altanulaensis*, ? *Cypridopsis bugintsavicus*, *Cyclocypis transitoria*, *Darwinula* sp., *Mongolianella palmosa* and *Mongolocypis* cf. *M. gigantea* (Sahni and Khosla, 1994 a). It is determined as Maastrichtian in age, with many species identical or very close to Mongolian and Chinese forms. Similar assemblages, although less diverse, occur in the Lameta Formation of Nand-Dongargaon and Dhamni-Pavna sections in Chandrapur District, Maharashtra. These Maharashtra taxa have merely been listed without description and illustration by various authors (Mohabey, 1996; Mohabey and Udhoji, 1996 a; Mohabey *et al.*, 1993).

Palaeoecological implications

The entire biota, i.e. ostracods, charophytes, gastropods and fishes (tables 1 and 2) clearly point to a predominantly freshwater, lacustrine, palustrine (swamp) depositional setting for the green marl, variegated shale and siltstone band at the Lameta Formation of Jabalpur.

Table 1: List of the biotic assemblage recovered from green marl, variegated shale band at Bara Simla Hill, Jabalpur.

Ostracodes: *Altanicypris bhatiai* n. sp., *Candona altanulaensis*, *Candona* (*Candona*) cf. *C. (C). hubeiensis*, ? *Cypridopsis bugintsavicus*, ? *Cypridopsis* sp., *Cypridea* (*Pseudocypridina*) sp., *Cyclocypis transitoria*, *Darwinula* sp. 1 and 2 *indet.*, *Eucypris* cf. *E. bajshintsavica*, *Mongolocypis* cf. *M. gigantea*, *Mongolianella palmosa*, *Mongolianella khamariniensis*, *Mongolianella* sp. 1 *indet.*, *Paracandona jabalpurensis* and Gen et sp. *indet.* A.

Charophytes: *Microchara sausari* and *Platychara* cf. *P. sahnii*

Gastropods : *Physa prinseppi*, *Lymnaea subulata* and *Paludina normalis*

Fishes: *Apateodus striatus*, *Pycnodus* sp., *Phareodus* sp. and *Stephanodus* sp.

Table 2 : List of the biotic assemblage recovered from siltstone horizon at Chui Hill, Jabalpur.

Ostracodes: *Altanicypris bhatiai* n. sp., ? *Cypridopsis* sp., *Cyclocypris transitoria*, *Mongolianella palmosa* and *Mongolocypis* cf. *M. gigantea*

Charophyte: *Microchara sausari*

In the intertrappean beds of Nagpur, Gurmatkal, Naskal, Kachchh and infratrappeans of Nand, Dongargaon, Dhamni-Pavna sections (Gayet *et al.*, 1984; Bajpai *et al.*, 1990; Prasad and Khajuria, 1990; Srinivasan, 1991; Mohabey and Udhoji, 1990; Mohabey and Udhoji, 1996 a, 1996 b; Mohabey *et al.*, 1993), a similar freshwater fish fauna has been recovered. The occurrence of fresh water fish, such as *Phareodus* sp., within the variegated shale band suggests lake environment remote from the sea. At present, marine fishes are known only from the Asifabad intertrappeans (Prasad and Sahni, 1987).

The ostracod assemblage includes characteristic freshwater forms such as *Eucypris* and *Darwinula* and other taxa, such as *Candona*, *Cyclocypris* and *Cypridopsis* which are highly sensitive to changes in environmental salinity. All the above listed genera thrive in swamps, ponds or freshwater lakes and are typical of shallow lacustrine environments. Forms such as *Candona* are considered to be benthic creepers and burrowers, while others, e.g. *Cypridopsis*, swim among plants. The collection consists mostly of complete and closed ostracode carapaces, which indicate a low-energy environment.

Based on the work of Szczechura (1978) in the Late Cretaceous Nemegt Basin of Mongolia, a marked increase in the alkalinity of the Jabalpur environment is indicated by greater calcification of the thick-shelled (*Mongolocypis* cf. *M. gigantea*) and by the presence of heavily ornamented (*Altanicypris bhatiai* n. sp. and *Paracandona jabalpurensis*, *Darwinula* sp. 2 *indet.* and *Cypridea* (*Pseudocypridina*) sp.) carapaces. This increase in the precipitation of calcium carbonate was probably favoured by the presence of algae and tropical to sub-tropical climatic conditions. On the whole, the ostracod-bearing marl and siltstone bands were deposited in low-energy environments (backswamps or lake). Similar palaeoenvironments for the ostracod-bearing horizons has also been recorded

from the Late Cretaceous intertrappean beds of Gurmatkal, South India (Srinivasan, 1991). The recovered charophytes and gastropods also clearly support the prevalence of alkaline, shallow, freshwater conditions of deposition.

CONCLUSIONS

A major result of our study is that an uppermost Cretaceous (Maastrichtian) age can be assigned to the investigated infratrappean sections based mainly on the occurrence of a characteristic Late Cretaceous ostracod assemblage (*Altanicypris*-*Cypridea*-*Candona*-*Cypridopsis*-*Darwinula*-*Mongolianella* and *Mongolocypis*). Similar ostracod assemblages have recently been recognized in the dinosaur-bearing Lameta Formation of Nand-Dongargaon and Dhamni-Pavna sections in Maharashtra and Nagpur, and in the Asifabad and Gurmatkal intertrappeans. A Maastrichtian dating is also supported by the presence of the fish *Apateodus striatus*.

ACKNOWLEDGEMENTS

One of us (Ashu Khosla) thanks the following institutes for financial support: Department of Science and Technology, New Delhi (Young Scientist Project for years 1998-2000); Centre Internationale Des Etudiants Et Staggers (CIES) Paris, France (in the form of postdoctoral fellowship during the years 1997-1998) and the Council of Scientific and Industrial Research, New Delhi (in the form of Senior Research Fellowship during years 1995-1997). Both the authors are grateful to Dr. (Mrs.) Neera Sahni (Panjab University, India) and Mr. David Maurin (Montpellier University, France) for taking the SEM photographs and Mr. Pons for printing the photographs. We further extend our sincere gratitude to Profs. Ken McKenzie (Australia) and S.B. Bhatia (Panjab University, Chandigarh) for the loan of literature, identifying the material, and critical comments on the manuscript. We also thank Prof. Monique Vianey-Liaud and Ms. Geraldine Garcia (Montpellier University, France) for their encouragement and assistance during the stay of Ashu Khosla in Montpellier. Lastly, we are grateful to the referee, Prof. R. Whatley (England) for his valuable comments and suggestions in improving the text.

REFERENCES

- Bajpai, S., Sahni, A., Jolly, A. and Srinivasan, S. 1990. Kachchh intertrappean biotas; Affinities and correlation, p.101-105. In: *Cretaceous event stratigraphy and the correlation of the Indian nonmarine strata*. (Eds. Sahni, A. and Jolly, A.), A Seminar cum Workshop IGCP 216 and 245, Chandigarh.
- Bhatia, S.B., Prasad, G.V.R. and Rana, R.S. 1990 a. Deccan volcanism, A Late Cretaceous event : Conclusive evidence of the ostracodes. p. 47-49. In: *Cretaceous event stratigraphy and the correlation of the Indian nonmarine strata*. (Eds. Sahni, A. and Jolly, A.), A Seminar cum Workshop IGCP 216 and 245, Chandigarh.
- Bhatia, S.B., Srinivasan, S., Bajpai, S. and Jolly, A. 1990 b. Microfossils from the Deccan Intertrappean bed at Mamoni, District Kota, Rajasthan: Additional taxa and age implication, p.118-119. In: *Cretaceous event stratigraphy and the correlation of the Indian nonmarine strata*. (Eds. Sahni, A. and Jolly, A.), A Seminar cum Workshop IGCP 216 and 245, Chandigarh.
- Bhatia, S.B., Prasad, G.V.R. and Rana, R. S. 1996. Maastrichtian nonmarine ostracodes from peninsular India : palaeobiogeographic and age implications. p 297-311. In : *Cretaceous Stratigraphy and Palaeoenvironments*. (Ed. Sahni, A.), *Mem. Geol. Soc. India*, 37.
- Buffetaut, E. 1987. On the age of the dinosaur fauna from the Lameta Formation (Upper Cretaceous) of Central India. *News. Stratigr.* 18: 1- 6.
- Courtillot, V., Besse, J., Vandamme, D., Jaeger, J.J. and Cappetta, H. 1986. Deccan flood basalts at the Cretaceous/ Tertiary boundary. *Earth Planet. Sci. Lett.* 80 : 361-374.
- Galeeva, L.I. 1955. Ostrakody melovykh otlozhenii Mongol'skp Narodnoi Respubliki. *Geol. Razved. Neft. Inst. Moscow* : 94 (in Russian).
- Gayet, M., Rage, J.C. and Rana, R.S. 1984. Nouvelles ichthyofaune et herpetofaune de Gitti Khadan, plus ancien gisement connu du Deccan (Cretace/Palaeocene)a microvertebres. Implications palaeogeographiques. *Mem. Geol. Soc. France*, 147 : 55-66.
- Gou, Y.S. and Cao, M.Z. 1983. Stratigraphic and biogeographic distribution of the *Cypridea*-bearing faunas in China, p.381-393. In: *Application of Ostracoda* (Ed. Maddocks R.F.), University of Houston, Geoscience.
- Harper, F. and Sutton, A. K. 1935. Ostracodes of Morrison Formation from the Black Hills, South Dakota. *Jour. Paleont.* 8: 623-628.
- Hao, Y. C., Ruan, P.H., Zhao, X.G., Song, Q.S., Yang, G.D., Cheng, S.W. and Wei, Z.K. 1983. Middle Jurassic-Tertiary deposits and ostracode-charophyte fossil assemblage of Xining and Minhe basins. *Ear. Sci. Wuh. College. Geol.* 23 (2): 1-31.
- Hinte, J. E. van. 1976. A Cretaceous time scale. *Am. Assoc. Pet. Geol. Bull.* 60 (4): 498-516.
- Hou, Y., Ho, J. D. and Ye, C. H. 1978. The Cretaceous-Tertiary ostracodes from the Marginal Region of the Yangtze-Han river plain in Central Hubei. *Mem. Nanjing. Inst. Geol. Pal. Acad. Sin.* 9 : 121-206 (in Chinese).
- Khand, E. and Stankevitch, E.S. 1975. New ostracode species in Bain-Shiren suite from south-eastern Gobi (Upper Cretaceous). In: *Fossil Fauna and Flora of Mongolia* (Eds. Kramarenko, N.N., Luwsandansan, B. and Rozhdestvensky, A.K.), *Joint Soviet-Mongolian Palaeont. Exped. "NAUK MOSCOW"*. 2 : 178- 180.
- Khosla, A. 1994. Petrographical studies of Late Cretaceous pedogenic calcretes of the Lameta Formation at Jabalpur and Bagh. *Bull. Ind. Geol. Assoc.* 27 (2): 117-128.
- Khosla, A. 1996. Dinosaur eggshells from the Late Cretaceous Lameta Formation along the east-central Narbada River Region: Biomineralization and Morphotaxonomical Studies. *Unpublished Ph.D. Thesis, Panjab University, Chandigarh, India.*
- Khosla, A. and Sahni, A. 1995. Parataxonomic classification of Late Cretaceous dinosaur eggshells from India. *Jour. Pal. Soc. India.* 40 : 87-102.
- Ljubimova, P. S. 1956. Ostracodes from the Cretaceous deposits of the eastern part of the Mongolian National Republic and their significance for stratigraphy. *Trudy. Vses. Neft. Nauchno-issled. Geolog. Razv. Inst.* 93: 1-174 (in Russian).
- Loyal, R.S., Khosla, A. and Sahni, A. 1996. Gondwanan dinosaurs of India: affinities and palaeobiogeography. *Mem. Queens. Mus.* 39 (3): 627-638.
- Matley, C.A. 1921. On the stratigraphy, fossils and geological relationships of the Lameta beds of Jubbulpore. *Rec. Geol. Surv. India*, 53: 142-164.
- Mohabey, D.M. 1996. Depositional environments of Lameta Formation (Late Cretaceous) of Nand-Dongargaon Inland Basin, Maharashtra : the fossil and lithological evidences. In *Cretaceous Stratigraphy and Palaeoenvironments - Rama Rao Volume* (Ed. Sahni, A.), *Mem. Geol. Soc. India*, 37 : 363-386.
- Mohabey, D.M. and Udhoji, S.G. 1990. Fossil occurrences and sedimentation of Lameta Formation of Nand area, Maharashtra : palaeonevironmental, palaeoecological and taphonomical implications, p. 75-77. In : *Cretaceous event stratigraphy and the correlation of the Indian nonmarine strata* (Eds. Sahni, A. and Jolly, A.), A Seminar cum Workshop IGCP 217 and 245, Chandigarh.
- Mohabey, D.M. and Udhoji, S.G. 1996 a. Fauna and flora from Late Cretaceous (Maestrichtian) non-marine Lameta sediments associated with Deccan volcanic episode, Maharashtra : its relevance to the K-T boundary problem, palaeonevironment and palaeogeography. In : *Int. Symp. Deccan Flood Basalts, India, Gond. Geol. Mag. Spl.* 2 : 349-364.
- Mohabey, D.M. and Udhoji, S.G. 1996 b. *Pycondus lametae* (Pycondontidae), A Holostean fish from Freshwater Upper Cretaceous Lameta Formation of Maharashtra. *Jour. Geol. Soc. India.* 47 : 593-598.
- Mohabey, D.M., Udhoji, S.G. and Verma, K.K. 1993. Palaeontological and sedimentological observations on non-marine Lameta Formation (Upper Cretaceous) of Maharashtra. India : their palaeontological and palaeoenvironmental significance *Palaeogeog, Palaeoclimatol, Palaeoeco.* 105 : 83-94.
- Prasad, G.V.R. 1985. Microvertebrates and associated microfossils from the sedimentaries associated with Deccan Traps of the Asifabad region, Adilabad District, Andhra Pradesh. *Unpublished Ph. D. Thesis, Panjab University, Chandigarh, India.*
- Prasad, G.V.R. and Khajuria, C. K. 1990. A record of microvertebrate fauna from the intertrappean beds of Naskal, Andhra Pradesh. *Jour. Pal. Soc. India*, 35: 151-161.
- Prasad, G.V.R. and Sahni, A. 1987. Coastal-plain microvertebrate assemblage from the terminal Cretaceous of Asifabad. Peninsular India. *Jour. Pal. Soc. India*, 32: 5-19.
- Rana, R.S. 1984. Microvertebrate palaeontology and biostratigraphy of the infra- and intertrappean beds of Nagpur, Maharashtra. *Unpublished Ph.D. Thesis, Panjab University, Chandigarh, India.*
- Roth, R. 1933. Some Morrison Ostracodes. *Jour. Pal.* 7 (4): 398-405.
- Sahni, A. and Khosla, A. 1994 a. A Maastrichtian ostracode assemblage (Lameta Formation) from Jabalpur Cantonment,

- Madhya Pradesh, India. *Curr. Sci.* **67** (6): 456- 460.
- Sahni, A. and Khosla, A.** 1994 b. Palaeobiological, taphonomical and palaeoenvironmental aspects of Indian Cretaceous sauropod nesting sites. In: *Aspects of Sauropod Palaeobiology* (Eds. Lockley, M.G., Santos, V.F., Meyer, C.A. and Hunt, A.P.), *GAIA (Geoscience Journal) Portugal*. **10** : 215- 223.
- Sahni, A., Tandon, S.K., Jolly, A., Bajpai, S., Sood, A. and Srinivasan, S.** 1994. Upper Cretaceous dinosaur eggs and nesting sites from the Deccan-volcano sedimentary province of peninsular India. p.204-226. In: *Dinosaur Eggs and Babies* (Eds. Carpenter, K., Hirsch, K.F. and Horner, J.R.), Cambridge University Press, Cambridge.
- Sahni A. and Tripathi, A.** 1990. Age implications of the Jabalpur Lameta Formation and intertrappean biotas, p. 35-37. In : *Cretaceous event stratigraphy and the correlation of the Indian nonmarine strata* (Eds. Sahni, A. and Jolly, A.), A Seminar cum Workshop IGCP 216 and 245, Chandigarh.
- Shuvalov, V.F. and Stankevitch, E.S.** 1977. Late Cretaceous Ostracoda and stratigraphy of Bayshingtoav region in south-eastern Mongolia. In: *Mesozoic and Cenozoic Faunas, Floras and Biostratigraphy of Mongolia* (Ed. Tatarinov, L.P), *Soviet- Mongolian Exped.* **4** : 112-124 (in Russian).
- Singh, S.** 1985. Micropalaeontology and biostratigraphy of the infra and intertrappean beds of parts of peninsular India. *Unpublished M. Phil. Thesis, Panjab University, India.*
- Sohn, I. G.** 1957. Upper Jurassic-Lower Cretaceous Cyprideinae (Ostracoda) in the Black Hills (Abstract). *Geol. Soc. Amer. Bull.* **68** (12): 1798.
- Sohn, I.G.** 1979. Nonmarine ostracodes in the Lakota Formation (Lower Cretaceous) in South Dakota and Wyoming. *Geol. Surv. Prof. Paper, Washington* : 1-22.
- Srinivasan, S.** 1991. Geology and Micropalaeontology of Deccan Trap associated sediments of Northern Karnataka, Peninsular India. *Unpublished Ph.D. Thesis, Panjab University, India.*
- Stankevitch, E.S.** 1974. Ostracoda from Upper Cretaceous deposits of continental water-basins in the northern Gobi (Mongolia), p. 57-70. In: *Problemy issledovaniya drevnikh ozer evrazii, Leningard* : 57-70.
- Stankevitch, E.S. and Sochava, A.V.** 1974. Mongolian Senonian Ostracodes. *Soviet- Mongolian Exped.* **1**: 268-286 (in Russian).
- Szczechura, J.** 1978. Fresh-water ostracodes from the Nemegt Formation (Upper Cretaceous) of Mongolia, p. 65-121. In : *Results Pol. Mong. Pal. Expeds., Part VIII* (Ed. Jaworowska, Z. K.). *Pal. Polonica.* **38**.
- Szczechura, J. and Blaszyk, J.** 1970. Fresh-water Ostracoda from the Upper Cretaceous of the Nemegt Basin, Gobi Desert, p. 107-118. In: *Results Pol. Mong. Pal. Expeds., Part-II* (Ed. Jaworowska, Z.K.) *Pal. Polonica.* **21**.
- Tandon, S.K., Sood, A., Andrews, J.E. and Dennis, P.F.** 1995. Palaeoenvironment of the dinosaur-bearing Lameta Beds (Maastrichtian), Narmada Valley, Central India. *Palaeogeogr. Palaeoclimatol., Palaeoecol.* **117**: 153-184.
- Tandon, S.K., Andrews, J.E., Sood, A. and Mittal, S.** 1998. Shrinkage and sediment supply control on multiple calccrete profile development: a case study from the Maastrichtian of Central India. *Sediment. Geol.* **119**: 25-45.
- Tandon, S.K., Verma, V.K., Jhingran, V., Sood, A., Kumar, S., Kohli, R.P. and Mittal, S.** 1990. The Lameta Beds of Jabalpur, Central India: deposits of fluvial and pedogenically modified semi- arid fan- palustrine flat systems. p. 27-30. In : *Cretaceous event stratigraphy and the correlation of the Indian nonmarine strata* (Eds. Sahni, A. and Jolly, A.), A Seminar cum Workshop IGCP 216 and 245, Chandigarh.
- Tambarcau, Y. P.** 1984. Freshwater ostracoda of "Continental Montian" from Hainin, Hainaut, Belgium. *Revue De Micropalaeont.* **27** (2) : 144-156.
- Tripathi, A.** 1986. Biostratigraphy, palaeoecology and dinosaur eggshell ultrastructure of the Lameta Formation at Jabalpur, Madhya Pradesh. *Unpublished M. Phil. Thesis, Panjab University, India.*
- Udhoji, S.G., Mohabey, D.M. and Verma, K.K.** 1990. Palaeontological studies of Lameta Formation of Nand area and their bearing on K-T Boundary problem, p. 73-74. In : *Cretaceous event stratigraphy and the correlation of the Indian nonmarine strata.* (Eds. Sahni, A. and Jolly, A.), A Seminar cum Workshop IGCP 216 and 245, Chandigarh.
- Ye, C.H.** 1994. Succession of Cypridacea (Ostracoda) and nonmarine Cretaceous stratigraphy of China. *Cret. Res.* **15** : 285-303.
- Ye, C.H., Gou, Y.S., Hou, Y.T. and Cao, M.Z.** 1977. Mesozoic and Cenozoic ostracoda fauna from Yunnan. p. 153-330. In : *Mesozoic Fossils of Yunnan, China, part II*, (Ed. Nanjing Institute of Geology and Palaeontology), Science Press Beijing (in Chinese).

EXPLANATION OF PLATES

Plate I

(Scale bar for figures a-c = 100 mm; d = 1 mm; e-j = 100 mm; k, l = 200 mm)

a-g. *Altanicypriis bhatiai* n. sp.

a, left valve, lateral view; b, enlarged part of figure a showing pitted ornamentation (Holotype VPL/ KH/ BSH/ 1803); c, left valve, lateral view (VPL/ KH/ BSH/ 1800); d, left valve, lateral view (VPL/ KH/ BSH/ 1804); e, dorsal view (VPL/ KH/ BSH/ 1805); f, dorsal view (VPL/ KH/ BSH/ 1801); g, ventral view (VPL/ KH/ BSH/ 1802).

h-j. *Eucypris* cf. *E. bajshintsavica* Khand and Stankevitch, 1975

h, left valve, lateral view (VPL/ KH/ BSH/ 1008); i, dorsal view (VPL/ KH/ BSH/ 1008); j, left valve, lateral view (VPL/ KH/ BSH/ 1009).

k-l. *Mongolianella palmosa* Mandelstam, 1955

k, right valve, lateral view (VPL/ KH/ BSH/ 1013); l, left valve, lateral view (VPL/ KH/ BSH/ 1015).

Plate II

(Scale bar for figures a-e = 200 mm; f- i = 100 mm; j- l = 1 mm)

a-e. *Mongolianella palmosa* Mandelstam, 1955

a, right valve, lateral view (VPL/ KH/ BSH/ 1010); b, dorsal view (VPL/ KH/ BSH/ 1010); c, left valve, lateral view (VPL/ KH/ BSH/ 1014); d, dorsal view (VPL/ KH/ BSH/ 1014); e, ventral view (VPL/ KH/ BSH/ 1014).

f-g. *Mongolianella khamariniensis* Galeeva, 1956

f, right valve, lateral view (VPL/ KH/ BSH/ 1850); g, left valve, lateral view (VPL/ KH/ BSH/ 1851).

h- i. *Mongolianella* sp.

h, left valve, lateral view (VPL/ KH/ BSH/ 1016); i, dorsal view (VPL/ KH/ BSH/ 1016).

j- l. *Mongolocypriis* cf. *M. gigantea* Ye *et al.*, 1977

j, left valve, lateral view (VPL/ KH/ BSH/ 1001); k, dorsal view (VPL/ KH/ BSH/ 1001); l, ventral view (VPL/ KH/ BSH/ 1001).

Plate III

(Scale bar for figures a-c, e-h = 1 mm; d = 100 mm)

a-h. *Mongolocypriis* cf. *M. gigantea* Ye *et al.*, 1977

a, right valve, lateral view (VPL/ KH/ BSH/1001); b, right valve, lateral view (VPL/ KH/ BSH/1002); c, left valve, lateral view (VPL/ KH/ BSH/ 1026); d, enlarged part of figure c showing a well developed beak (VPL/ KH/ BSH/ 1026); e, left valve, lateral view (VPL/ KH/ BSH/1027); f, dorsal view (VPL/ KH/ BSH/1027); g, right valve, lateral view (VPL/ KH/ BSH/ 1028); h, right valve, lateral view (VPL/ KH/ BSH/1029).

Plate IV

(Scale bar for figures a- g = 100 mm)

a- c. *?Cypridopsis bugintsavicus* Stankevitch, 1974

a, left valve, lateral view (VPL/ KH/ BSH/1007); b, dorsal view (VPL/ KH/ BSH/1007); c, ventral view (VPL/ KH/ BSH/1007).

d-g. *?Cypridopsis* sp. Szczechura, 1978

d, left valve, lateral view (VPL/ KH/ BSH/1017); e, right valve, lateral view (VPL/ KH/ BSH/ 1017); f, dorsal view (VPL/ KH/ BSH/1017); g, ventral view (VPL/ KH/ BSH/1017).

h-l. *Candona altanulaensis* Szczechura and Blaszyk, 1970

h, left valve, lateral view (VPL/ KH/ BSH/999); i, left valve, lateral view (VPL/ KH/ BSH/ 998); j, right valve, lateral view (VPL/ KH/ BSH/1011); k, right valve, lateral view (VPL/ KH/ BSH/1019); l, dorsal view (VPL/ KH/ BSH/ 1011).

Plate V

(Scale bar for figures a- k = 100 mm)

- a-b. *Candona (Candona)* cf. *C. (C.) hubeiensis* Hou *et al.*, 1978
 a, left valve, lateral view (VPL/ KH/ BSH/1045); b, dorsal view (VPL/ KH/ BSH/1046).
- c-f. *Paracandona jabalpurensis* Sahni and Khosla, 1994 a
 c, right valve, lateral view (VPL/ KH/ BSH/ 1960); d, left valve, lateral view (VPL/ KH/ BSH/ 1961); e, right valve, lateral view (VPL/ KH/ BSH/1003); f, dorsal view (VPL/ KH/ BSH/1003).
- g-i. *Cyclocypris transitoria* Shuvalov and Stankevitch, 1977
 g, left valve, lateral view (VPL/ KH/ BSH/1006); h, left valve, lateral view (VPL/ KH/ BSH/1035); i, dorsal view (VPL/ KH/ BSH/1035).
- j-k. *Cypridea (Pseudocypridina)* sp.
 j, left valve, lateral view (VPL/ KH/ BSH/ 1004); k, left valve, lateral view (VPL/ KH/ BSH/1005).

Plate VI

(Scale bar for figures a- h = 100 mm)

- a-b. *Cypridea (Pseudocypridina)* sp.
 a, enlarged lower part of Plate V figure k showing well developed beak and faint tubercles (VPL/ KH/ BSH/1005); b, latero-ventral view (VPL/ KH/ BSH/1005).
- c. *Darwinula* sp. 1 *indet.*
 c, right valve, lateral view (VPL/ KH/ BSH/2000).
- d-f. *Darwinula* sp. 2 *indet.*
 d, right valve, lateral view (VPL/ KH/ BSH/1050); e, left valve, lateral view (VPL/ KH/ BSH/1051); f, dorsal view (VPL/ KH/ BSH/1051).
- g-h. Gen et sp. *indet A.*
 h-g, right valve, lateral view (VPL/ KH/ BSH/2007); h, dorsal view (VPL/ KH/ BSH/ 2008).

