MIOCENE FORAMINIFERA FROM THE BARIPADA BEDS-PART I, MAYURBHANJ DISTRICT, ORISSA

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ABSTRACT

The paper records seventeen species of foraminifera from the arenaceous yellowish white fossiliferous limestone and greenish grey shales of the Baripada Beds. Three species and one subspecies are described as new. The present foraminiferal assemblage suggests an Early Miocene age to the arenaceous yellowish white fossiliferous limestone and a middle part of Early Miocene to Late Miocene age to the greenish grey shales. These beds were deposited in the shallower part of the inner neritic environment.

INTRODUCTION

The present study is based on the rock sample collected from the Baripada Beds in the year 1970. The Baripada Beds are exposed in the river section situated at Itamundia (21° 53’ N : 86° 44’ E) village (see Fig. 1) and have a low easterly dip. The following geological sequence of the Baripada Beds has been recorded in this river section:

but it is poor in smaller foraminifera and the conformably overlying greenish grey shales has yielded a rich assemblage of the smaller foraminifera. Frequency distribution of smaller foraminifera has been shown in Fig. 2.

Fig. 1: Showing location of the area studied.

<table>
<thead>
<tr>
<th>Lithological Units</th>
<th>Sample Numbers</th>
<th>Thickness in Metres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laterite</td>
<td></td>
<td>4.5</td>
</tr>
<tr>
<td>Conglomerate</td>
<td></td>
<td>1.5</td>
</tr>
<tr>
<td>Greenish grey shales</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Arenaceous yellowish white fossiliferous limestone containing megafossils—Ostrea sp. etc.</td>
<td>1</td>
<td>1.2</td>
</tr>
<tr>
<td>Greenish white shales</td>
<td></td>
<td>Not determined</td>
</tr>
</tbody>
</table>

Baripada Beds

<table>
<thead>
<tr>
<th>SPECIES</th>
<th>SAMPLE NO.</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMMONIA BECCARI (LINNE) VAR. KOEBOENSIBLE ROY</td>
<td>C</td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>BRIZALINA SINGH SP. NOV.</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BULIMINELLA ?BREVIOR CUSHMAH</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BULIMINELLA AFF. &amp; LONGICAMERATA BANDY</td>
<td>VR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BULIMINELLA MUNZAWAI ASANO</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CIBICIDES HAZZARDI TEWARI SUBSP. NOV.</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CIBRODELPHIUM SUBINCEMENTUM (ASANO)</td>
<td>VR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CRIBRONOMION DATTALI SP. NOV.</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FLORILUS COMMUNIS (D' ORIGNY)</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LAGENA AMPHORA REUSS</td>
<td>VR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LAGENA SP.</td>
<td>VR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TRILOCULINA SP.</td>
<td>VR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TURBORTALIA CONTINUOSA BLOW</td>
<td>VR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TURBORTALIA OBESA (BOLLI)</td>
<td>VR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UVRIGERINA SP.</td>
<td>VR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VALVULINERIA SASTRI SP. NOV.</td>
<td>R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>?VRGULOPSIS SP.</td>
<td>VR</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**LEGEND**

One specimen per sample = Very rare = VR
2-5 speciments per sample = Rare = R
6-10 specimens per sample = Common = C

Fig. 2: Showing frequency distribution of foraminifera in the Baripada Beds, exposed in the Burabang river section at Itamundia.

*Present Address: Institute of Petroleum Exploration, Oil & Natural Gas Commission, Kaulagarh Road, Dehra Dun.
PREVIOUS WORK

The Baripada Beds were first recognised by Bose (1904) and subsequently, the geological and palaeontological studies on these beds were carried out by Pilgrim (1904), Eames (1936), Jea (1942), Hora (1939), Sharma (1936, 1957) and Sahni, Mehrotra and Jauhari (1971).

SYSTEMATIC DESCRIPTION

Order FORAMINIFERIDA Eichwald, 1830
Suborder MILIOLINA Delage & Herouard, 1896
Superfamily MILIOLACEA Ehrenberg, 1839
Family MILIOLIDAE Ehrenberg, 1839
Subfamily QUINQUELOCULININAE Cushman, 1917.
Genus TRILOCULINA d’ Orbigny, 1826

Triloculina sp.

(Plate 1 figs. 1-2)

Description: Test oval in side view, about 1/5 times as long as broad, periphery rounded, basal end more or less rounded, apertural end without neck; chambers distinct, inflated, three chambers making up the exterior region, middle one highly inflated and large in size; sutures distinct, depressed, concave in shape; wall smooth; aperture rounded, with indistinct lip and a long tooth tapering in width towards outer end.

Dimensions:
Specimen No. Length Breadth Thickness
I/B/1 0.49 mm. 0.40 mm. 0.35 mm.

Remarks: Only a single fairly preserved specimen is obtained from the sample.

Horizon and locality: Greenish grey shales, exposed in the Burubalong river section at Itamundia, Baripada Beds.

Repository: Geological Museum, Lucknow University.

Dimensions:
Specimen No. Length Breadth Thickness
Hypotype No. I/B/2 0.35 mm. 0.15 mm.

Remarks: The type species has been recorded from the Oligocene Formation of Germany.

Horizon and locality: Greenish grey shales, exposed in the Burubalong river section at Itamundia, Baripada Beds.

Repository: Geological Museum, Lucknow University.

Lagena sp.

(Plate 1, fig. 4)

Description: Test flask-shaped, inflated, broadest below the middle, basal end rounded, apical end with small neck; wall hispid; aperture rounded at the end of neck.

Dimensions:
Specimen No. Length Breadth Thickness
I/B/3 0.35 mm. 0.15 mm.

Remarks: Only a solitary specimen of the present form has been found.

Horizon and locality: Greenish grey shales, exposed in the Burubalong river section at Itamundia, Baripada Beds.

Repository: Geological Museum, Lucknow University.

Superfamily Buliminacea Jones, 1875
Family Turritiidae Cushman, 1927
Subfamily Turritiidae Cushman, 1911
Genus Buliminella Cushman, 1925

Buliminella brevior Cushman, 1925

(Plate 1, figs. 5-6)

Buliminella brevior Cushman, 1925, pl. 5, fig. 14.

Dimensions:
Specimen No. Length Breadth
Hypotype No. I/B/4 0.35 mm. 0.18 mm.
Hypotype No. I/B/5 0.35 mm. 0.28 mm.

Remarks: The present form has smaller dimensions in comparison to the type form, reported from the Monterey shales (Miocene) of San Luis Obispo County, California, U.S.A.

Horizon and locality: Greenish grey shales, exposed in the Burubalong river section at Itamundia, Baripada Beds.

Repository: Geological Museum, Lucknow University.

Lagena amphora Reuss, 1863

(Plate 1, fig. 3)

Lagena amphora Reuss, 1863, pl. 4, fig. 57.

Dimensions:
Specimen No. Length Breadth
Hypotype No. I/B/4 0.35 mm. 0.18 mm.
Hypotype No. I/B/5 0.35 mm. 0.28 mm.

Remarks: The present form has smaller dimensions in comparison to the type form, reported from the Monterey shales (Miocene) of San Luis Obispo County, California, U.S.A.

Horizon and locality: Greenish grey shales, exposed in the Burubalong river section at Itamundia, Baripada Beds.

Repository: Geological Museum, Lucknow University.
MIOCENE FORAMINIFERA FROM THE BARIPADA BEDS—PART I

Bulimina hanzawai Asano, 1949

(Plate 1, fig. 7)

Bulimina hanzawai Asano, 1949, tf. 1 (54-55).

Dimensions:
Specimen No. Length Breadth
Hypotype No. 1/B 6 0.34 m. 0.18 m.

Remarks: The reported form is identical to the type species reported from the Kokozura Formation (Miocene), Japan. However, it has smaller dimensions in comparison to the type species.

Horizon and locality: Greenish grey shales, exposed in the Burabalg river section at Itamundia, Baripada Beds.

Repository: Geological Museum, Lucknow University.

Genus Buliminella Bandy 1949

Buliminella aff. Buliminella longicamerata Bandy 1949

(Plate 1, figs. 8-9)

Buliminella longicamerata Bandy, 1949, pl. 26, fig. 8.

Dimensions:
Specimen No. Length Breadth
1/B/7 0.33 mm. 0.18 mm.

Remarks: It seems very close in shape to Buliminella longicamerata Bandy recorded from upper part of the Jackson Formation, Zone B (Upper Eocene) of Clarke Country, Alabama, U.S.A. but differs from the latter in having smaller dimensions and a tooth in the middle of the aperture.

Horizon and locality: Greenish grey shales, exposed in the Burabalg river section at Itamundia, Baripada Beds.

Repository: Geological Museum, Lucknow University.

Family Buliminidae Jones, 1875

Genus Brizalina Costa, 1856

Brizalina singhi sp. nov.

(Plate 1, figs. 11-15)

Description: Test elongate in side view, length slightly more than double of the width, apical end broad and rounded basal end pointed; chambers more or less distinct initial part of the test probably triserial and the rest being biserial; chambers gradually increase in size from basal end to apical end, slightly inflated; sutures indistinct towards the basal region, oblique and curved; aperture loop shaped, small in size.

Dimensions:
Specimen No. Length Breadth
1/B/10 0.33 mm. 0.20 mm.

Remarks: This form has characters similar to the genus Virgulopsis reported from the Middle Miocene. However, due to the scarcity of the specimens, no detail work on this disputed genus could be done.

Repository: Geological Museum, Lucknow University.

Family Uvigerinidae Haeckel, 1894

Genus Uvigerina d' Orbigny, 1826

Uvigerina sp.

(Plate 3, figs. 7-8, 10)

Description: Test elongate, somewhat cylindrical, length about triple of the breadth, widest at below the middle, apical end terminates into a very small neck,
basal end more or less pointed; chambers distinct, bigger towards the apical end and smaller towards the basal end, slightly inflated, triserial; sutures distinct, slightly depressed; wall smooth, perforated; aperture terminal, rounded with small non-perforate neck with narrow lip.

**Dimensions:**

<table>
<thead>
<tr>
<th>Specimen No.</th>
<th>Length</th>
<th>Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>I/B/11</td>
<td>0.36 mm.</td>
<td>0.15 mm.</td>
</tr>
</tbody>
</table>

**Remarks:** Only a single specimen of the present form has been found.

**Horizon and locality:** Greenish grey shales, exposed in the Burabalang river section at Itamundia, Baripada Beds.

**Repository:** Geological Museum, Lucknow University.

**Superfamily** Discorbacea Ehrenberg, 1838

**Family** Discorbidae Ehrenberg, 1838

**Subfamily** Baggininae Cushman, 1927

**Genus** Valulineria Cushman, 1926

*Valulineria sastri* sp. nov.

(Plate 2, figs. 1-6)

**Description:** Test medium, rounded, trochospiral, periphery broadly rounded, dorsal side having more than two whors, ventral side umbilicate, moderately convex, showing the chambers of last whorl only; chambers distinct, slightly inflated, twelve chambers in the dorsal side, peripheral chambers somewhat subrectangular in shape while inner ones triangular in shape, six chambers in the ventral side, triangular in shape; sutures distinct, raised, curved in the dorsal side and radial limbate in the ventral side; wall smooth, perforated; aperture extra-umbilical with distinct lip.

**Dimensions:**

<table>
<thead>
<tr>
<th>Specimen No.</th>
<th>Length</th>
<th>Breadth</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holotype No. I/B/12 ...</td>
<td>0.30 mm.</td>
<td>0.25 mm.</td>
<td>0.18 mm.</td>
</tr>
<tr>
<td>Paratype No. I/B/13 ...</td>
<td>0.42 mm.</td>
<td>0.35 mm.</td>
<td>0.22 mm.</td>
</tr>
<tr>
<td>Paratype No. I/B/14 ...</td>
<td>0.40 mm.</td>
<td>0.35 mm.</td>
<td>0.21 mm.</td>
</tr>
<tr>
<td>Paratype No. I/B/15 ...</td>
<td>0.38 mm.</td>
<td>0.31 mm.</td>
<td>0.25 mm.</td>
</tr>
<tr>
<td>Paratype No. I/B/16 ...</td>
<td>0.43 mm.</td>
<td>0.35 mm.</td>
<td>0.28 mm.</td>
</tr>
</tbody>
</table>

**Remarks:** The present new species differs from *Valulineria californica* Cushman recorded from the Upper Monterey Formation (Miocene) of California in possessing less number of chambers in the last whorl, and smaller dimensions.

**Etymology:** The species is named after Mr. V. V. Sastri, Additional Director, Institute of Petroleum Exploration, Oil and Natural Gas Commission, Dehra Dun.

**Horizon and locality:** Greenish grey shales, exposed in the Burabalang river section at Itamundia, Baripada Beds.

**Repository:** Geological Museum, Lucknow University.

**Superfamily** Rotaliacea Ehrenberg, 1839

**Family** Rotaliidae Ehrenberg, 1839

**Subfamily** Rotalliinae Ehrenberg, 1839

**Genus** Ammonia Brunnich, 1772

*Ammonia becari* (Linne) var. *koestoensis* (Le Roy), 1939

(Plate 2, figs. 7-9)

*Rotalia becari* (Linne) var. *koestoensis* (Le Roy), 1939, pl. 6, figs. 13-15.

**Dimensions:**

<table>
<thead>
<tr>
<th>Hypotype No. I/B/17</th>
<th>Length</th>
<th>Breadth</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.55 mm.</td>
<td>0.49 mm.</td>
<td>0.35 mm.</td>
</tr>
<tr>
<td>Hypotype No. I/B/18</td>
<td>0.57 mm.</td>
<td>0.50 mm.</td>
<td>0.38 mm.</td>
</tr>
<tr>
<td>Hypotype No. I/B/19</td>
<td>0.68 mm.</td>
<td>0.58 mm.</td>
<td>0.40 mm.</td>
</tr>
<tr>
<td>Hypotype No. I/B/20</td>
<td>0.55 mm.</td>
<td>0.49 mm.</td>
<td>0.35 mm.</td>
</tr>
</tbody>
</table>

**Remarks:** The present form is smaller in dimensions than the type variety described from the Miocene transitional zone, Sand Clay Series of the Central Sumatra, Netherlands, Indies.

**Horizon and locality:** Arenaceous yellowish white fissile limestone and greenish grey shales, exposed in the Burabalang river section at Itamundia, Baripada Beds.

**Repository:** Geological Museum, Lucknow University.

**Family** Elphidiiidae Galloway, 1933

**Subfamily** Elphidiinae Galloway, 1933

**Genus** Cribroelphidium Cushman and Bronnimann,

*Cribroelphidium subincertum* (Asano), 1950

(Plate 3, figs. 1-2)

*Elphidium subincertum* Asano. 1950. text figs. 56-57.

**Dimensions:**

<table>
<thead>
<tr>
<th>Specimen Nos.</th>
<th>Length</th>
<th>Breadth</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypotype No. I/B/21</td>
<td>0.28 mm.</td>
<td>0.20 mm.</td>
<td>0.10 mm.</td>
</tr>
<tr>
<td>Hypotype No. I/B/22</td>
<td>0.28 mm.</td>
<td>0.24 mm.</td>
<td>0.12 mm.</td>
</tr>
</tbody>
</table>

**Remarks:** This species was originally described by Asano (op. cit.) from the Upper Pliocene, Sendai Formation of Hokkaido Island, Japan.
Horizon and locality: Greenish grey shales, exposed in the Burabalong river section at Itamundia, Baripada Beds.

Repository: Geological Museum, Lucknow University.

Genus Cribrorionion Thalman, 1947

Cribrorionion dattii sp. nov.

(Plate 3, figs. 3-6)

Description: Test medium in size, rounded, planispiral, involute, bilaterally symmetrical, inflated, periphery rounded umbilical region raised and perforated, lumenate in edge view, length slightly larger than breadth; chambers distinct, slightly inflated and number, elongate triangular in shape, postulated chamber just below the apertural face, gradually increasing in size; sutures distinct, depressed, curved, radial, retrans process absent, every suture contains a row of pores; wall smooth, perforated; aperture slightly indistinct, a row of pores at the base of apertural face.

Dimensions:

Specimen No. Length Breadth Thickness
Holotype No. 1/B/23 0.48 mm. 0.42 mm. 0.25 mm.
Paratype No. 1/B/24 0.40 mm. 0.35 mm. 0.17 mm.
Paratype No. 1/B/25 0.52 mm. 0.45 mm. 0.25 mm.
Paratype No. 1/B/26 0.45 mm. 0.40 mm. 0.22 mm.

Remarks: The present new species resembles Cribrorionion clarum (Krasheninnikov) reported from the Miocene (Upper Tortonian) Formation of Podolia, U.S.S.R. in outline but differs from it in the presence of pustulose chamber just below the apertural face and aperture in the form of a row of pores at the base of apertural face.

Horizon and locality: Greenish grey shales, exposed in the Burabalong river section at Itamundia, Baripada Beds.

Etymology: The species is named after Dr. A. K. Datta, Senior Scientific Officer, Institute of the Petroleum Exploration, Oil and Natural Gas Commission, Dehra Dun.

Repository: Geological Museum, Lucknow University.

Superfamily Glorigerinae Carpenter, Parker & Jones, 1862
Family Globorotaliidae Cushman, 1927
Subfamily Globorotaliinae Cushman, 1927
Genus Globorotalia Cushman & Bermudez, 1949

Turborotalia obesa (Bolli) 1957

(Plate 3, figs. 9, 11-12)

Globorotalia obesa Bolli, 1957, pl. 29, fig. 2 a—c, 3.

Geoboloralia (Turborotalia) obesa Bolli, Blow, 1959, pl. 19 fig. 124 a, fig. 124 a—c.

Dimensions:

Specimen No. Length Breadth Thickness
Hypotype No. 1/B/27 0.20 mm. 0.17 mm. 0.10 mm.

Remarks: Bolli (1957) has recorded the type species from the uppermost part of the Cipero Formation (Miocene, Globorotalia foshii robusta Zone) and Globorotalia foshii foshii Zone). Blow (1967) re-studied the present species and gave its new range from Zone N2 to Zone N23 (Late Oligocene to Pleistocene).

Horizon and locality: Greenish grey shales, exposed in the Burabalong river section at Itamundia, Baripada Beds.

Repository: Geological Museum, Lucknow University.

Turborotalia continua Blow, 1959

(Plate 4, figs. 1-5)

Globorotalia opima Bolli subsp. continua Blow, 1959, pl. 19, figs. 125 a—c.

Globorotalia (Turborotalia) continua Blow, 1967, pl. 3, figs. 4-6.

Dimensions:

Specimen No. Length Breadth Thickness
Hypotype No. 1/B/28 0.20 mm. 0.15 mm. 0.10 mm.
Hypotype No. 1/B/29 0.20 mm. 0.15 mm. 0.10 mm.

Remarks: It is similar to the type species Turborotalia continua Blow described from the Pozon Formation (Miocene, Vindobonian, Husito marly clay member). Blow (1967) re-studied the type species and recorded its range from Zone N6 to ?Zone N17 (Middle part of Early Miocene to Late Miocene).

Horizon and locality: Greenish grey shales, exposed in the Burabalong river section at Itamundia, Baripada Beds.

Repository: Geological Museum, Lucknow University.

Superfamily Orbuloidacea Schwager, 1876
Family Cibicides Cushman, 1927
Subfamily Cibicides Cushman, 1927
Genus Cibicides de Montfort, 1908
Cibicides hawaiiensis Ellis, 1939
Cibicides hazzardi tevarii subsp. nov.
(Plate 4, figs. 7-9)

Description: Test medium, more or less plano-convex, periphery rounded, with prominent keel, dorsal side nearly flat, ventral side convex, with prominent umbo, showing the chambers of last whorl only; chambers distinct, gradually increasing in size, slightly inflated, twelve chambers in the dorsal side, chambers triangular to subrectangular in shape, ten chambers in ventral side, triangular in shape; suture distinct, raised, curved and limbate; wall smooth; aperture an arched slit at the base of the last formed chamber, with a distinct lip.

Dimensions:
Specimen No. 3
Holotype No. I/B/31 0.31 mm. 0.25 mm. 0.10 mm.

Remarks: The present form resembles Cibicides hazzardi Ellis in certain morphological characters but differs from it in having a well developed keel.

Horizon and locality: Greenish grey shales, exposed in the Burabalang river section at Itamundia, Baripada Beds.

Etymology: The subspecies is named after Dr. B. S. Tewari, Professor, Geology Department, Panjab University, Chandigarh.

Repository: Geological Museum, Lucknow University.

Superfamily  Cassidulinacea d’Orbigny, 1839
Family  Nonionidae Schultze, 1854
Subfamily  Nonioninae Schultze, 1854
Genus  Florilus de Montfort, 1808

Florilus communis (d’ Orbigny), 1846

(Plate 4, figs. 6, 10)

Nonionina communis d’ Orbigny, 1846, pl. 5, figs. 7, 8.
Nonion commun (d’ Orbigny), Cushman, 1939, pl. 3, fig. 2.

Florilus communis (d’ Orbigny) Todd and Low, 1970, pl. 9, fig. 2.

Dimensions:
Specimen No. 3
Hypotype No. O/B 31 0.31 mm. 0.25 mm. 0.10 mm.

Remarks: The type species has been described by d’ Orbigny (1846) from the Miocene of Nusstorf in the Vienna Basin of Austria. Todt and Low (1970) also reported it from the Miocene Formation of Midway drill holes, U.S.A.

Horizon and locality: Greenish grey shales, exposed in the Burabalang river section at Itamundia, Baripada Beds.

Repository: Geological museum, Lucknow University.

Conclusions
1. On the basis of the present foraminiferal assemblage, the greenish grey shales of the Baripada Beds may be referred to a Middle part of Early Miocene to Late Miocene age and an Early Miocene age may be assigned to the conformably underlying arenaceous yellowish white fossiliferous limestone.
2. There is a high percentage of benthonic forms, which are of calcareous nature.
3. Only two planktonic species of the foraminifera are present.
4. The foraminiferal assemblage suggests that the arenaceous yellowish white fossiliferous limestone and greenish grey shales of the Baripada Beds were deposited in the shallower part of the inner neritic environment.

Acknowledgement
The authors express their indebtedness to Drs. R. C. Misra, F. N. A., Professor of Geology, Lucknow University, S. N. Singh, Reader, Geology Department, Lucknow University, and Don. L. Eicher, Editor, Journal of Foraminiferal Research, U. S. A. for their valuable suggestions. The authors are thankful to Sri B. D. Shukla for extending his kind help during the field work. The financial assistance, which was granted by the Ministry of Education, Government of Uttar Pradesh, is gratefully acknowledged.

References
SINGH, JAUHARI and VIMAL


d’Orbigny, A. D., 1846. Foraminifères fossiles due basan tertiare de Vienne. 106.


EXPLANATION OF PLATES

PLATE 1

1-2 Triloculina sp., 1, side view; 2, apertural view; ×100.
3 Lagena anguabra Reuss, side view; ×140
4 Lagena sp., side view; ×154
5-6 Buliminina depressa Cushman, 5, apertural view; ×137; 6, apertural view; ×146.
7 Buliminina hanzawa Asano, apertural view; ×176.
8-9 Buliminina aff. Buliminella tanggourina Bandy, 8, side view; 9, apertural view; ×153.
10 ?Virguleptus sp., apertural view; ×143.
11-15 Brizalina singhii sp. nov., 11, apertural view of the holotype; ×137; 12, side view of the paratype; 13, apertural view of the paratype; ×137; 14, side view of the holotype; 15, apertural view of the holotype; ×157.

PLATE 2

1-6 Valvulinia satria sp. nov., 1, dorsal view of the holotype; 2, ventral view of the holotype; 3, apertural view of the holotype; ×173; 4, dorsal view of the paratype; 5, ventral view of the paratype; 6, apertural view of the paratype; ×136.
7-9 Ammonia beccari (Linne) var. kowecoensis (Le Roy), 7, ventral view; 8, ventral view; 9, apertural view;

PLATE 3

1-2 Criobuliminidae subincertum (Asano), 1, side view; 2, apertural view; ×182.
3-6 Criovenusia dattii sp. nov., 3, side view of the holotype; 4, apertural view of the holotype; ×142.5; 5, side view of the paratype; 6, apertural view of the Paratype; ×112.
7-10 Uvigerina sp., 7, 10, side views; 8, apertural view; ×153.
9, 11-12 Turborotalia obesa (Bolli), 9, apertural view; 11, umbilical view; 12, spiral view; ×275.

PLATE 4

1-5 Turborotalia continens Blow, 1, umbilical view; 2, spiral view; 3, apertural view; X290; 4, umbilical view; 5, spiral view; ×290.
6-10 Plorites communis (d’Orbigny), 6, apertural view; 10, side view; ×161.
7, 8-9 Olivaidea hazzardii (browii) subs. nov., 7, ventral view of the holotype; 8, dorsal view of the holotype; 9, apertural view of the holotype; ×167.