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ORBITOLINID FORAMINIFERA FROM THE LOWER APTIAN ISHIDO FORMATION OF THE SANCHU CRETACEOUS SYSTEM, KANTO MOUNTAINS, CENTRAL JAPAN

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ABSTRACT

Palorbitolina lenticularis (Blumenbach) is described for the first time from the Lower Aptian *Orbitolina*-bearing sandstone and limestone, Ishido Formation, Sanchu Cretaceous System, Honshu, Japan. *Palorbitolina lenticularis* is associated with *Iraqia simplex* Henson.

Key words: *Palorbitolina lenticularis* (Blumenbach), Sanchu Cretaceous System, Ishido Formation, Honshu, Japan

INTRODUCTION

The genus *Orbitolina* is one of the most important foraminiferal genera known from the carbonate platform sediments of the Barremian to Cenomanian age in the Tethys province. Yabe and Hanzawa (1926) reported five different forms of this genus - *Orbitolina discoidea conoidea* var. *ezoensis* Yabe and Hanzawa, *O. japonica* Yabe and Hanzawa, *O. japonica* var. *miyakoensis* Yabe and Hanzawa, *O. planoconvexa* Yabe and Hanzawa and *O. shikokuensis* Yabe and Hanzawa from the Lower Cretaceous (e.g. Hiraiga Formation of the Miyako Group, the typical Aptian-Albian sediments, Japan) of Japan (Fig. 1, localities 3, 4 and 8). Hofker (1963) referred these five species to *Orbitolina lenticularis* (Blumenbach) in his synonymy list. Ujiie and Kusukawa (1968) examined the Miyako material of *Orbitolina*. Though Ujiie and Kusukawa (1968) failed to reveal the nature of embryonic chambers of the early stage of *Orbitolina*, they considered that the Miyako material may belong neither to *Orbitolina lenticularis* form group I of Hofker (1963) from the Barremian to Middle Aptian nor to the form group III from the sediments younger than the Upper Albian. Further, they found the Miyako material to have a unimodal curve of the ratio of test diameter to test height in the frequency distribution.

Matsumaru (1971, 1973) studied the Hokkaido and the Shikoku material of *Orbitolina* and revealed the presence of *Orbitolina lenticularis* form group II of Hofker (1963) (Fig. 1, localities 3 and 8). Further, *Orbitolina lenticularis* was also recorded by Matsumaru *et al.* (1976) from the calcareous sandstone exposed in the Koma River area, Saitama Prefecture, which probably belongs to the "Ishido" Formation of the Sanchu Cretaceous System, about 33kms east of the Sanchu Graben (Fig. 1, locality 5). It follows from the above that the Japanese *Orbitolina* from the sediments of the Aptian age is referable to *Orbitolina lenticularis* (Blumenbach) form group II.

Recently, Daiichi-Kashima Seamount Research Group (1985) reported the Lower Cretaceous *Orbitolina* and conical foraminifers from the dredged limestone samples of Daiichi-Kashima Seamount, about 150 kms east off Choshi Inubo-Zaki (cape), Chiba Prefecture, east of Japan Trench (Fig. 1, locality 9). They concluded that the Hofker's (1963) *Orbitolina lenticularis* form group II belongs to the form group III and *Orbitolina kiliani* (Prever). However, as one of us (K.M.) examines their illustrations, it appears that the former belongs to *O. lenicularis* form group IV and the latter belongs to *Neoiraqia* sp. The reefal limestone of Daiichi-Kashima Seamount is shown to have yielded an assemblage comprising *Orbitolina concava* (Lamarck) or *Mesorbitolina texana* (Roemer) and *Neoiraqia* sp. which is assigned an Upper Albian or Lower Cenomanian age. Iba *et al.* (2005) found *Orbitolina*-bearing limestone pebbles in the conglomerate of the lowermost Lower Yezo Group in the Nakagawa and Okahonai areas, northern Hokkaido (Fig. 1, localities 1 and 2). Though based on only one axial section, they considered it to belong to *Orbitolina lenticularis* form group II or *Orbitolina (Mesorbitolina) parva* - *O. (M.) texana*, and assigned the Late Aptian age to the *Orbitolina*-bearing limestone pebbles. Matsumaru (2005) described *Praeorbitolinoides japonica*, n. gen., n. sp. from the Lower Aptian *Orbitolina*-bearing limestone, Shimanoshita Mudstone, Lower Yezo Group, Hokkaido, associated with *Palorbitolina lenticularis* (Blumenbach) and others (Fig. 1, locality 3). In the present work, using embryonic chambers as a basis the authors re-examine all the *Orbitolina*-bearing sediments of the Japanese Cretaceous and establish an exact specific affinity of the dominant forms of the Lower Cretaceous orbitolines from the Ishido Formation of the Sanchu Creaceous System in the Sanchu Graben, Kanto Mountains, Central Japan (Fig. 1, localities 6 and 7).

REGIONAL GEOLOGY

Takei (1963) and Takei *et al.* (1977) described the geology and stratigraphy of Kanto Mountains. According to them, the Cretaceous System of the Sanchu Graben of Kanto Mountains, with a breadth of 2 to 4 km in the north-south and a length of about 40 km in the east-west, is divided into three formations, in

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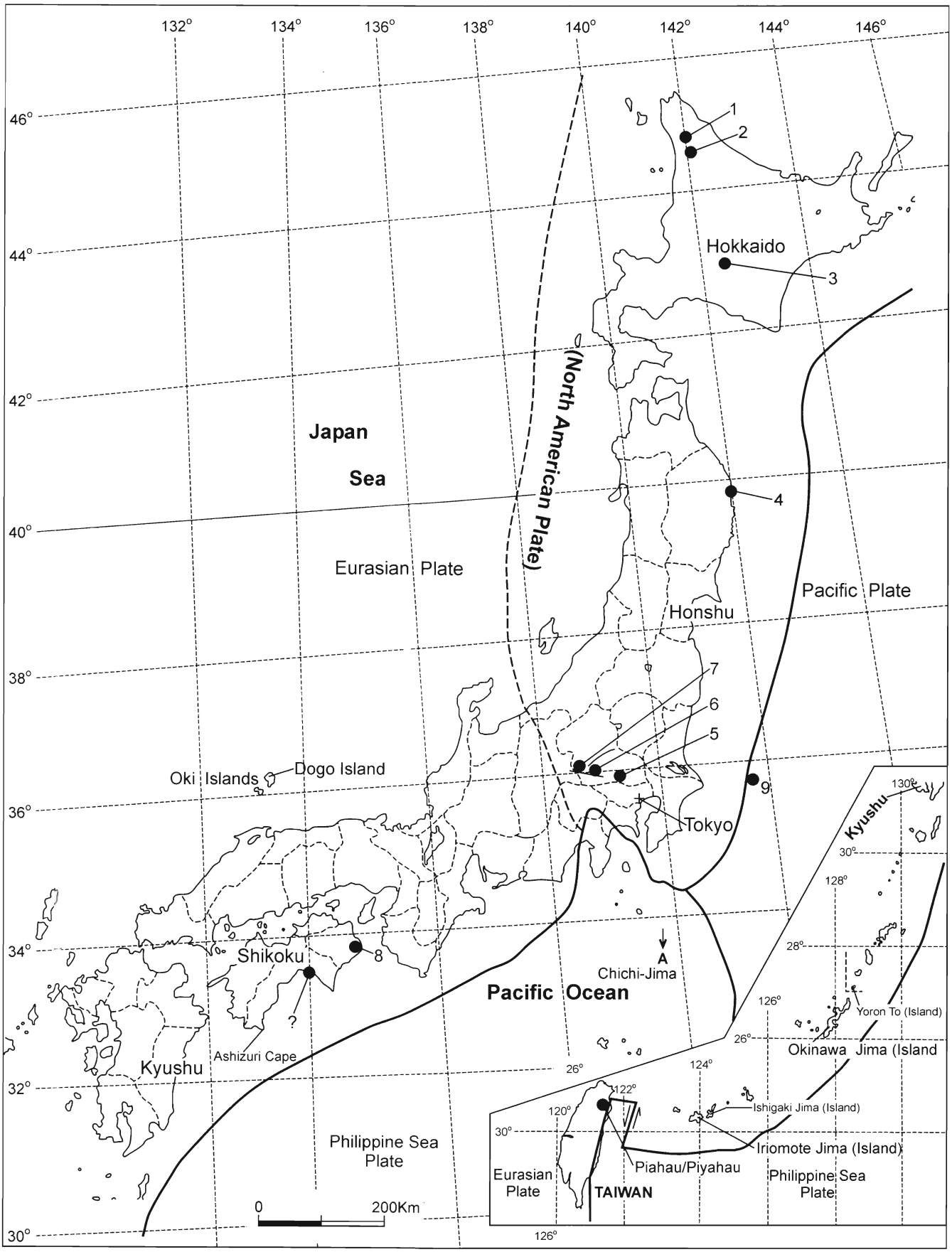


Fig. 1. Map showing the fossil localities of orbitolinid foraminifers in Japan. Localities 6 and 7 are treated in this study. Others are described in the text. Localities with question mark and Piahau/Piyahau, Taiwan are obscure until present, although these are reported.

ascending order: Ishido Formation (Aritan Stage of the Japanese Cretaceous Stages) consisting of 200 to 600 m thick sandy shale with sandstone and conglomerate, rarely with limestone lens; Sebayashi Formation (Miyakoan Stage) consisting of 200 to 500 m thick sandstone with shale; and Sanyama Formation (Gyliakian Satge) consisting of 700 to 1400 m thick shale with sandstone and conglomerate. These formations are distributed in three belts, the northern belt being recognized as a monoclinal structure, while the middle and southern belts regarded as the synclinal belts. Though *Orbitolina* sp. is known from the Ishido Formation, its detailed study could not be carried out until Matsumaru *et al.*' s (1976) work from the Koma River area in the eastern part of the Sanchu Graben.

AGE OF THE *ORBITOLINA* ASSEMBLAGE

Matsukawa (1983) found ammonites from the Ishido Formation, which include *Barremites* (*B.*) *difficilis* (d' Orbigny), *B.* (*B.*) aff. *strettostoma* (Ulig), *Pulchellina ishidoensis* Yabe and Shimizu, *Simbirskites* (*Milanowskia*) sp., *Shasticrioceras* aff. *patricki* Murphy, *Pseudohaploceras japonicum* Obata and Matsukawa, and *Heteroceras* (*H.*) aff. *astieri* d' Orbigny. These ammonites are correlated with the Late Hauterivian to Barremian fauna of the Tethys, Boreal and Circum-Pacific provinces. Sashida *et al.*, (1992) reported planktic and benthic foraminifers from SH 1 and SH 2 samples of the Shinzaburo Valley, near the type locality of the Ishido Formation. These include *Hedbergella planispira* (Tappan), *Globurigerina hoterivica* (Subbotina), *Globigerinelloides* aff. *blowi* (Bolli), *Haplophragmoides* sp. A, *H.* sp. B, *H.* sp. C, *Paratrochamminoides* sp., *Gyroidina* sp., *Pullenia* sp., and *Gavelinella* sp. (Fig. 2). These are referable to the planktic foraminiferal assemblage zone, *Globigerinelloides blowi* Zone, demarcated in the Ishido Formation. Following Caron's (1985) planktic foraminiferal zonation, an Early Aptian age is assigned to this zone. According to Sliter (1999), the *Globigerinelloides blowi* Zone is an equivalent of his KS 6 Zone, correlatable with the Late Barremian to Early Aptian on a global scale.

The orbitolinid foraminifers treated in this study are located at Otchi Valley, Ueno-Mura (Village), Tano-Gun, Gunma Prefecture (Figs. 1-2, locality 6) and Yaegoya, Ueno-Mura, Tano-Gun (Figs. 1-2, locality 7). Judging from the geological map of Takei (1963) and Takei *et al.* (1977), the *Orbitolina*-bearing calcareous sandstone at Otchi is regarded as belonging to the upper part of the Ishido Formation, while the *Orbitolina*-bearing gray coloured, spongiomorphoid coral and algal limestone at Yaegoya is considered to belong to the lower part of this formation. The sandstone at Locality 6 (Otchi) yields *Palorbitolina lenticularis* (Blumenbach), *Spiroloculina* sp. and

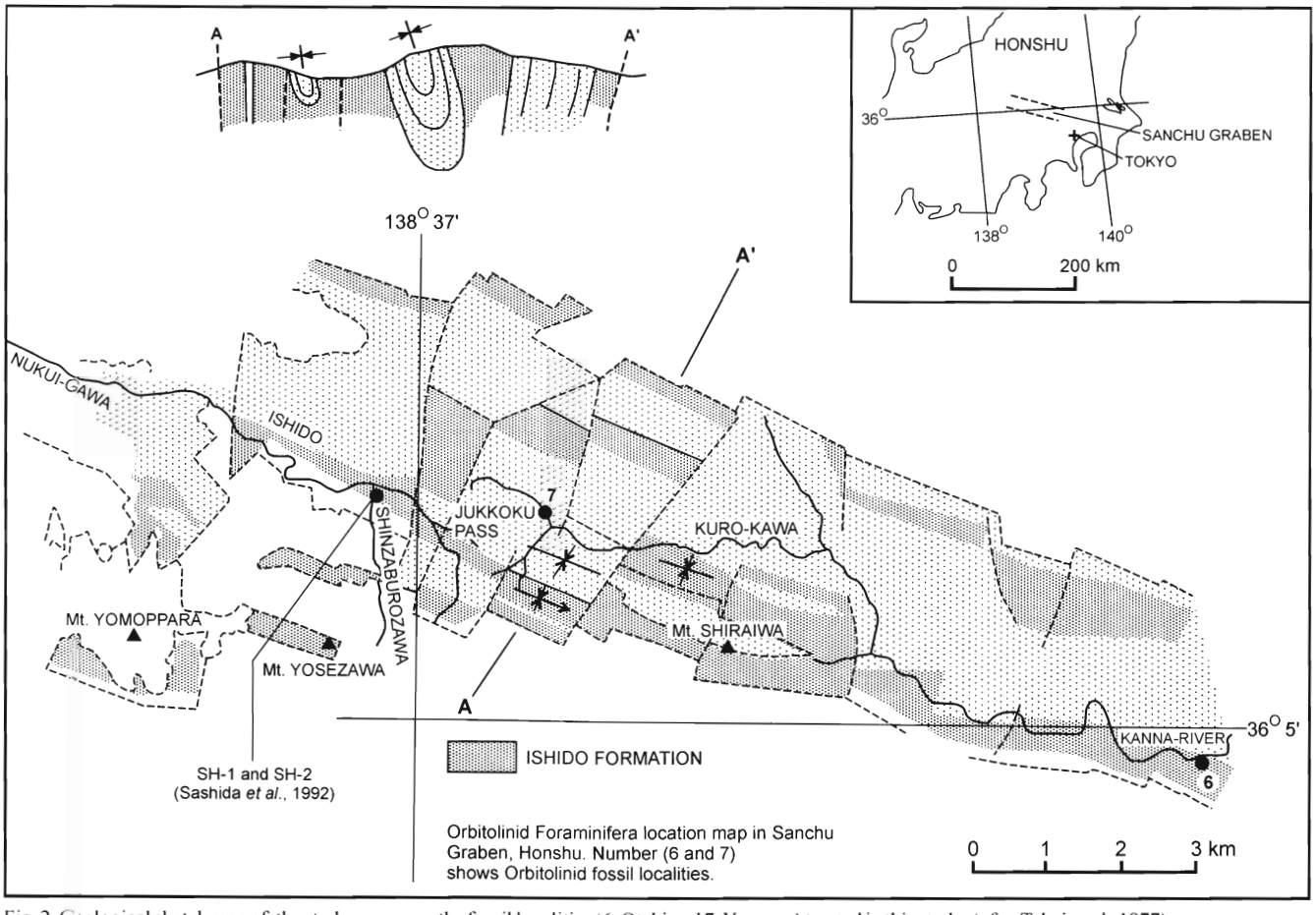


Fig. 2. Geological sketch map of the study area, esp. the fossil localities (6. Otchi and 7. Yaegoya) treated in this study (after Takei *et al.*, 1977).

Pseudolituonella sp., whereas the limestone at Locality 7 (Yaegoya) contains *Palorbitolina lenticularis* (Blumenbach), *Iraqia simplex* Henson, *Orbitolinopsis* sp., *Haplophragmoides* cf. *globosus* Lozo, *Spiroloculina* sp., and keramospherids. The *Palorbitolina lenticularis-Iraqia simplex* Assemblage recognized in the Ishido Formation is assigned an Early Aptian age. A total of 144 thin sections from the sample collections of two localities have been examined in this study.

SYSTEMATIC DESCRIPTION

The authors describe herein *Palorbitolina lenticularis* in detail. The associated fauna will be described later when more material has been studied. The description of the genus is based on a classification of Loeblich and Tappan (1988).

Superfamily **Orbitolinacea** Martin, 1890
Family **Orbitolinidae** Martin, 1890
Subfamily **Orbitolininae** Martin, 1890
Genus ***Palorbitolina*** Schroeder, 1963
Palorbitolina lenticularis (Blumenbach, 1805)

Madreporites lenticularis Blumenbach, 1805, . 1-2, pl. 0, figs.1-6.

Orbulites lenticulata Lamarck, 1816, p. 197.

Orbitolina lenticulata (Lamarck), d'Orbigny, 1850, p. 143, no. 342.

Orbitolina concave (Lamarck), Martin, 1890, p. 209-231, pl. 24, figs. 1-13; pl. 25, figs. 14-20.

Orbitolina discoidea-conoidea var. *ezoensis* Yabe and Hanzawa, 1926, p. 17-18, pl. 3, figs. 18-20; pl. 5, figs. 4-17.

Orbitolina japonica Yabe and Hanzawa, 1926, p. 18, pl. 4, fig. 17.

Orbitolina shikokuensis Yabe and Hanzawa, 1926, p. 19-20, pl. 6, figs. 8-16.

Orbitolina cf. *lenticularis* (Blumenbach), Henson, 1948, p. 57-60, pl. 3, figs. 6-11.

Orbitolina lenticularis (Blumenbach), Douglass, 1960, p. 30-32, pl. 1, figs. 1-26.- Hofker, 1963, p. 220.228, pl. 1, figs. 1-17; pl. 2, figs. 1-15; pl. 3, figs. 1-15; pl. 4, figs. 1-13; pl. 5, figs. 1-8; pl. 6, figs. 1-17; pl. 7, figs. 1-6; pl. 21, figs. 10, 20-21, text-fig. 17. -Hofker, 1966, p. 10.11, pl. 1, figs. 2-4, 7, 9-10, text-figs.1-2, 4.-Matsumaru, 1971, p. 152-153, pl. 59, figs. 1-4. - Hashimoto and Matsumaru, 1974, p. 97-98, pl. 11, figs. 10-28; pl. 12, figs. 26-32, 35; pl. 13, fig. 8.-Hashimoto and Matsumaru, 1977, p. 54-56, pl. 6, figs. 1-15; pl. 7, figs. 1-21.

Orbitolina (*Palorbitolina*) *lenticularis* (Blumenbach), Schroeder, 1963, p. 349-357, pl. 23, figs. 1-9; pl. 24, figs. 1-10.

Palobitolina lenticularis (Blumenbach), Zhang, 1991. p. 73-74, pl. 1, figs. 1-10.

Palorbitolina nannembryona Zhang, 1991, p. 74, pl. 1, figs. 11-17.

Palorbitolina complanata Zhang, 1991, p. 74, pl. 1, figs. 18.21.

Description: Test large, conical through concavo-convex to reflexed concavo-convex; embryonic chambers consisting of protoconch (Hofker's (1963) proloculus and epi-embryonic chambers; Schroeder's (1963) proloculus; or Arnaud-Vanneau's (1969) zone peri-proloculaire, deuteroconch; (Hofker's (1963) deuteroconch, Schroeder's (1963) supra-embryonale zone; or Arnaud-Vanneau's (1969) zone apicale and peri-embryonic chambers; Hofker's (1963) epi-embryonic chambers; Schroeder's (1963) peri-embryonaler ring; or Arnaud-Vanneau's (1969) tour peri-embryonnaire), followed by uniserially and rectilinearly arranged discoidal chambers; chambers characterised by a thin marginal zone of primary and secondary subepidermal vertical plates (beams) between radial partitions, and horizontal exoskeletal rafters between roofs and floors or horizontal intercameral partitions of chambers; poorly developed radial zone of reticulate partitions and/or their zigzag pattern of thick radial partitions; and a central complex of labyrinthic layer, with central pillars and pores between adjacent chambers; wall, with imperforate epidermis, of granular calcite and fine-grained agglutinated material in marginal zone, and coarse-grained agglutinated particles in the radial and central zones.

Dimensions: Diameter of test = 2.24 to 2.50 mm in the Otchi specimens and 1.59 to 3.00 mm in the Yaegoya specimens, Height of test = 0.88 to 1.50 in the Otchi specimen and 0.95 to 1.36 mm in the Yaegoya specimens, Form ratio of diameter to height = 1.67 to 2.55 in the Otchi specimens and 1.54 to 3.16 in the Yaegoya specimens; Diameter of protoconch = 104, 112 and 120 micron in the Otchi specimens and 104, 120, 120 and 156 micron in the Yaegoya specimens; Diameter of peri-embryonic chambers = 176, 208 and 240 micron in the Otchi specimens and 240, 168, 184 and 280 micron in the Yaegoya specimens.

Remarks: The present form is characterised by simple features of embryonic chambers, and has a diameter of protoconch varying from 104 to 156 micron and its mean value of 119.4 micron in 7 specimens. Although the sample size is limited (number of measurements), the data presented above is safely comparable with the data observed in *Palorbitolina lenticularis* (Blumenbach) from the Upper Barremian to Lower Aptian of east Bosnia, Inner Dinarides, Yugoslavia (Gusic, 1981). Moreover, the Bedoulian species *Iraqia simplex* Henson (Moullade *et al.*, 1985) has also been recorded at Yaegoya (Figs. 1-2, locality 7). Based on above observations, the studied material is assigned to *Palorbitolina lenticularis* (Blumenbach) which indicates an Early Aptian (Bedoulian) age to *Palorbitolina lenticularis-Iraqia simplex* Assemblage of the Ishido Formation.

EXPLANATION OF PLATE I

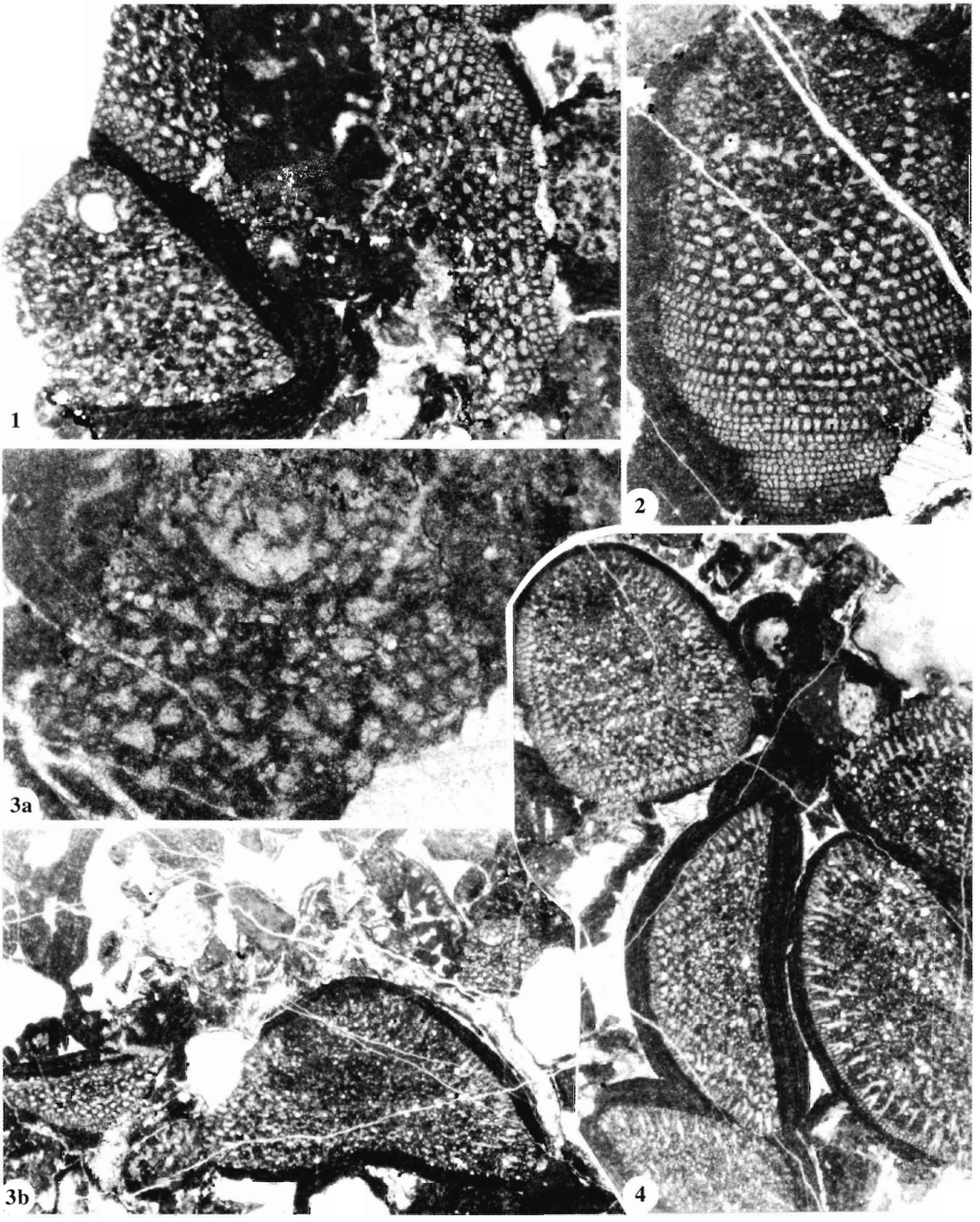
(All Yaegoya specimens. figs. 1,2. x 44; fig. 3a. x 114; figs. 3b, 4. x 23)

Palorbitolina lenticularis (Blumenbach)

1. Sub-axial to slightly oblique section showing embryonic chambers.

2-3. Oblique sections.

4. Transverse sections showing embryonic and peri-embryonic chambers, and chambers with marginal zone, radial zone and central complex.



MATSUMARU, YOSIDA AND HAYASHI

Material: Thin sections Otchi 1-83 and Yaegoya 1-61.
Stratigraphic Horizon : Ishido Formation.
Geological Age: Early Aptian (Bedoulian).

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