

Sengoerina argandi, n. gen., n. sp., and its position in the evolution of Late Permian biserialamminid foraminifers

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ABSTRACT: The name *Sengoerina* is proposed for a new biserialamminid genus characterized by a coiled stage of initially globular to progressively angular, biserial chambers followed by an uncoiled stage of angular, biserial chambers. Unlike *Dagmarita*, it has a distinct coiled stage and lacks spine-like projections at the outer margins of the chambers. *Sengoerina* constitutes the root stock of the angular-chambered, dagmaritin-type biserialamminids which evolved from the globivalvulines in the Late Permian.

INTRODUCTION

In a paper on biserialamminid evolution, Zaninetti and Altiner (1981) proposed that the dagmaritin stock (Subfamily Dagmaritinae Bozorgnia) evolved from the globivalvulines (Subfamily Biserialammininae Chernysheva) in the Late Permian. This trend consists of three fundamental steps according to those authors. The genus *Dagmarita* Reitlinger was derived from the biserially enrolled globivalvulines by the development of an uncoiled test with angular chambers ornamented by spine-like projections. The second step involved the derivation of secondarily enrolled biserialamminids, *Paradagmarita* Lys (in Lys and Marcoux 1978), from *Dagmarita*. The appearance of the genus *Louissetita* Altiner and Bronnimann with internally divided chambers was considered to be another step in the evolution of the dagmaritin stock.

This study presents a taxonomic description of a new Permian genus involved in the early development of dagmaritin-type biserialamminids, and discusses the evolutionary trends and chronostratigraphic value of the group in the Late Permian. The new genus *Sengoerina* occurs in two localities in northwestern Turkey (text-fig. 1) where Permian rocks are found as olistoliths in debris flow deposits of Triassic age. These sediments were deposited during the final deformation of the Karakaya Basin which is considered to be a failed rift in northwestern Anatolia (Sengör and Yilmaz 1981; Kocayigit 1987; Altiner and Kocayigit 1993).

SYSTEMATIC DESCRIPTIONS

Order FORAMINIFERIDA Eichwald 1830
Suborder FUSULININA Wedekind 1937
Superfamily PALAEOTEXTULARIACEA Galloway 1933
Family BISERIAMMINIDAE Chernysheva 1941
Subfamily DAGMARITINAE Bozorgnia 1973

Genus *Sengoerina* Altiner n. gen.

Type species: *Sengoerina argandi*, n. gen., n. sp.

Derivation of name: This new genus is dedicated to Prof. Dr. A. M. C. Sengör for his contributions to our understanding of the Tethyan realm and its tectonics.

Description: Test free, biserially enrolled to uncoiling; chambers globular, progressively becoming angular in the biserially enrolled earliest stage and angular and biserial in the uncoiled stage; wall calcareous generally thickening at the chamber junctions, microgranular and dark and with a transparent light median or outer layer; aperture single and interiomarginal, generally protected by a valvular tooth appearing at the end of ontogeny.

Remarks: The genus differs from *Dagmarita* in having a distinct coiled stage with biserially enrolled globular chambers (globivalvulinid stage) and in the absence of spine-like projections at the outer margins of the angular chambers in the uncoiled stage. It differs from *Paradagmarita* in having globular chambers instead of angular ones in the earliest stage of coiling and distinctly flaring angular chambers in the uncoiled stage.

Sengoerina argandi Altiner n. sp.

Plate 1, figures 1-10

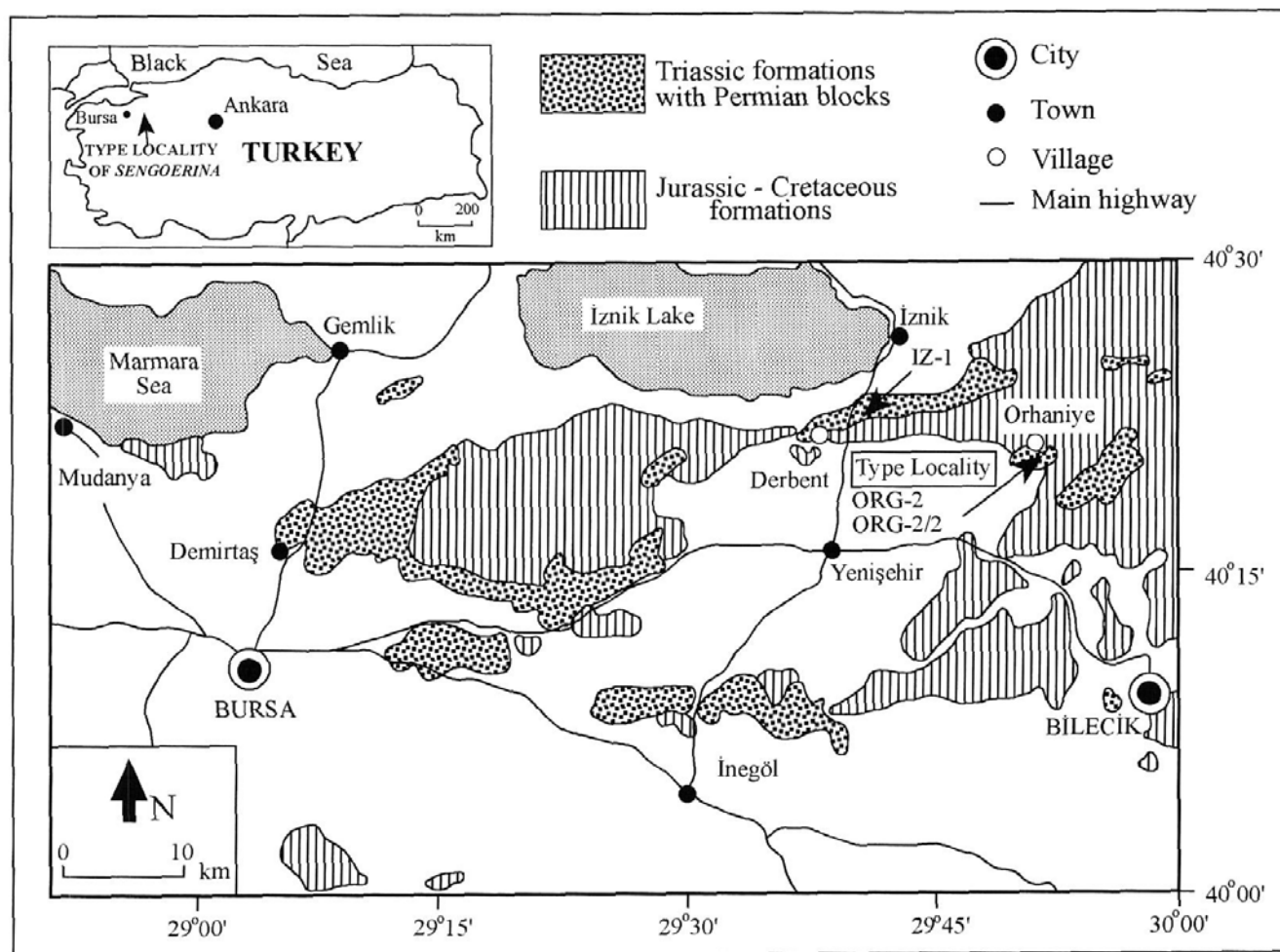
Holotype: The specimen in slightly oblique longitudinal section is here illustrated in plate 1, fig. 6. It is from sample ORG-2, thin section number 15. The holotype is housed in the thin section laboratory of the Marine Micropaleontology Research Unit, Middle East Technical University, Ankara, Turkey.

Derivation of name: The new species is dedicated to Emile Argand, one of the pioneers of Tethyan geology who documented the evolution of Tethys between the supercontinents of Laurasia and Gondwana (Sengör 1984).

Type locality: Twenty-five kilometers northwest of Yenisehir (Bursa). The type material comes from a large olistolith outcropping 0.5km south of the village of Orhaniye (text-fig. 1).

Type level: Sample ORG-2, Midian. Stratigraphically in the upper part of the olistolith containing abundant foraminifers and algae.

Material: Fifty specimens have been examined in three samples collected from Orhaniye (samples ORG-2 and ORG-2/2) and Derbent (sample IZ-1) areas in northwestern Anatolia, Turkey.



TEXT-FIGURE 1

Type locality of *Sengoerina*, n. gen. in northwestern Anatolia, Turkey. ORG - 2, ORG - 2/2 and IZ - I are the sample collections.

Microfossil association: The new species is associated with several foraminiferal and algal taxa in the studied material. These are *Rauserella erratica*, *Dunbarula* sp., *Lantschichites* sp., *Kahlerina* sp., *Nankinella* sp., *Chusenella* ? sp., *Pseudodoliolina* sp., *Neoschwagerina ventricosa*, n. sp., *Yabeina* sp., *Diplosphaerina inaequalis*, *Tuberitina* sp., *Rectostipulina quadrata*, *Pseudovidalinidae*, *Lasiolus* sp., *Globivalvulina cyprica*, *G. vonderschmitti*, G. sp., *Paraglobivalvulina* sp., *Dagmarita chanakchiensis*, *Palaeotextularia* sp., *Deckerella* sp., *Climacammina* sp., *Spireitlina* sp., *Neoendothyra* sp., *Bradyina* sp., *Lunucammina postcarbonica*, L. sp., *Pachyphloia ovata*, *P. iranica*, *P. pedicula*, *Fronidina permica*, *Protonodosaria* sp., *Langella cukurkoyi*, *Pseudolangella fragilis*, *Pseudotristix solida*, *Partisania* sp., *Robuloides lens*, ribbed "Nodosaria" sp., *Meandrospira* sp., *Agathammina* sp., *Hemigordius* spp., *Hemigordopsis renzi*, *Baisalina pulchra*, *Mizzia velebitana*, *Gymnocodium bellerophontis*, *Pseudovermiporella nipponica*, *Tubiphytes obscurus*.

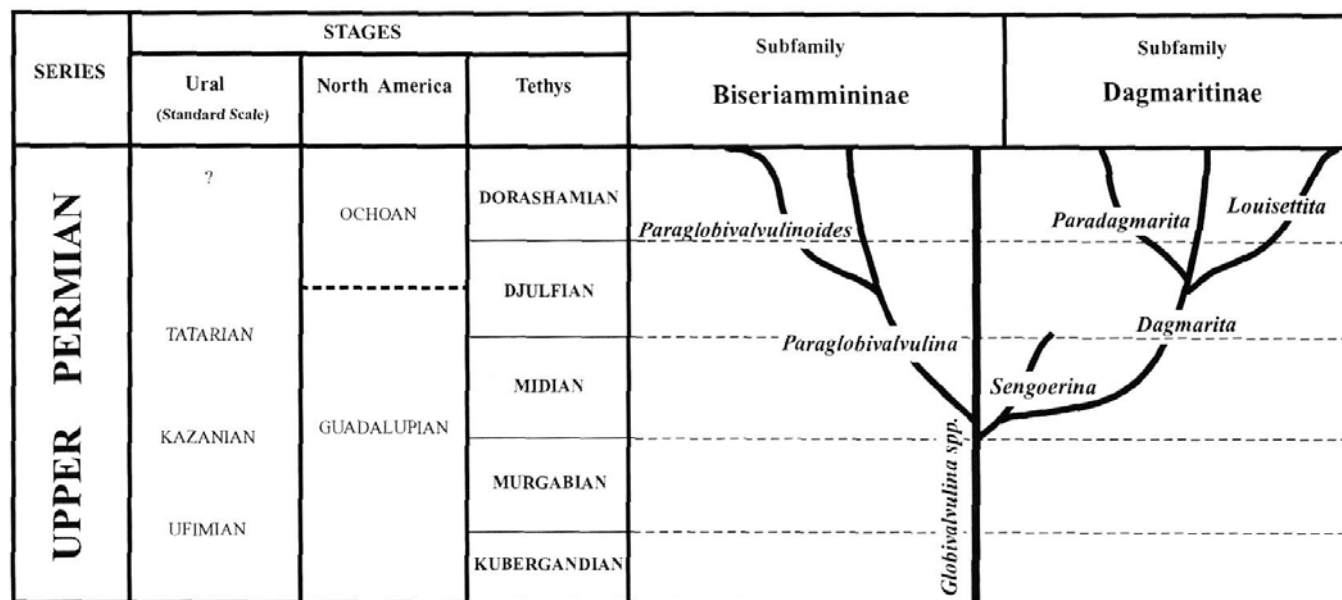
Description: The coiled portion of the test is composed of an initial chamber (pl. 1, figs. 1-3, 5) and 8 to 9 pairs of chambers coiled in 1 to 1 1/2 whorls. Chambers gradually increase in size and volume in the coiled stage except the last two or three pairs (pl. 1, figs. 1-3, 5-6, 8) which are at least twice as voluminous as

the previous chambers. Chambers also become gradually angular at this stage (pl. 1, figs. 2-3, 5-6, 8) showing the passage from a globivalvuline to a dagmaritin stage.

The uncoiled portion is composed of two or three pairs of angular chambers in the adult test (pl. 1, figs. 3-4, 6-8). The height of the chambers in the second and third pairs is more or less constant (pl. 1, figs. 4, 6) and chambers are distinctly flaring in the last pairs (pl. 1, figs. 6-8).

The wall of *Sengoerina argandi* is basically microgranular and measures 14-18µm in thickness. A thin translucent layer forms along the outer edge of the wall but appears as a middle layer within the septum (pl. 1, figs. 1-10) where an overlying microgranular layer is deposited by the next growing chamber. The valvular tooth protecting the single interiomarginal aperture appears in the second or third pairs of chambers in the uncoiled stage and attains a length half the width of the chamber (pl. 1, figs. 6, 10).

Measurements: Diameter of the proloculus: 35-40µm; diameter of the coiled portion: 160-240µm; height of the adult test: 275-355µm (with two pairs of uncoiled chambers), 370-425µm (with three pairs of uncoiled chambers); maximum width of the



TEXT-FIGURE 2

The position of *Sengoerina*, n. gen. in the evolution of the Late Permian biseriamminid genera. Correlation of the Upper Permian stages of Urals, North America and Tethys is after Leven (1992).

adult test: 255-300µm; height of the chambers in the uncoiled stage: 55-75µm (first pair), 85-100µm (second pair), 90-100µm (third pair); thickness of the wall: 14-18µm, thickness of the translucent layer: 3-5µm.

Remarks: Although this population is completely different from any other biseriamminid in the Carboniferous and Permian, some tangential sections (pl. 1, fig. 10) may be confused with *Dagmarita chanakchiensis* Reitlinger. However, the absence of spine-like extensions at the chamber corners helps to distinguish such sections of *Sengoerina argandi* from *D. chanakchiensis*.

EVOLUTIONARY TRENDS IN LATE PERMIAN BISERIAMMINIDS

After appearing in the Late Visean (Conil et al. 1976), globivalvulines, including the problematic genus *Biseriella* Mamet (in Armstrong and Mamet 1974) (see Altiner and Savini 1995) and the genus *Tenebrosella* Villa and Sanchez de Posada became the most abundant representatives of the Family Biseriamminidae. Species diversity increased both in the Middle Carboniferous (or Early - Middle Pennsylvanian) Eurasian-Arctic Realm (Reitlinger 1950; Brazhnikova et al. 1967; Armstrong and Mamet 1974, 1979; Lys et al. 1978; Massa and Vachard 1979; Wagner et al. 1979; Altiner 1981; Lin 1984; Villa and Sanchez de Posada 1986; Groves 1988; Perret 1993; Groves et al. 1994) and the Early - Middle Pennsylvanian Midcontinent-Andean Realm (Mamet 1975, 1996; Brenckle et al. 1982; Groves 1984, 1992; Skipp et al. 1985; Altiner and Savini 1995). However, this foraminiferal group waned in the Late Carboniferous (or in the Late Pennsylvanian)-Early Permian, becoming less diversified and less abundant in the foraminiferal associations. It was in the Late Permian that the globivalvulines again became truly diversified at the specific level (Reichel 1945; Zaninetti and Altiner 1981; Jenny-Deshusses 1983; Altiner 1984) at the same time that new

genera evolved from the main globivalvuline stock (text-fig.2). Thus, biseriamminid evolution in the Late Permian split into two distinct morphologic trends: one with forms consisting of globular chambers (Subfamily Biseriammininae) and the other with forms basically characterized by angular chambers (Subfamily Dagmaritinae) (Zaninetti and Altiner 1981). It should be noted that the Subfamily Louisettitinae, established by Loeblich and Tappan (1984) for specialized forms with angular chambers, is tentatively synonymized with Dagmaritinae in this paper.

The definition of Late Permian Tethyan stages based fundamentally on the fusuline zonation, has recently been revised by Leven (1993) who in particular modified the Murgabian-Midian boundary by shifting the former Late Murgabian *Neoschwagerina margaritae* Zone into the Midian. This repositioning has modified the interpretation of the chronostratigraphic position of several smaller foraminiferal taxa calibrated to the fusuline zonation. Thus, genera such as *Dagmarita*, *Paraglobivalvulina* Reitlinger, *Neoendothyra* Reitlinger, *Abadehella* Okimura and Ishii, *Hemigordiopsis* Reichel were considered to have appeared in the Midian (Leven 1993).

The first of the globular-chambered and completely involute biseriamminids to evolve from globivalvulinid stock in the Late Permian (text-fig. 2) was *Paraglobivalvulina* (Zaninetti and Altiner 1981). The genus has previously reported from the late Midian in Turkey (Altiner 1984; Köyliüoglu and Altiner 1989) and we recently discovered it in Midian *Yabeina* beds in north-western Anatolia. It is also known from Midian beds or equivalents in Iran (Lys et al. 1978; Jenny-Deshusses 1983) and in Transcaucasia (Reitlinger 1965; Pronina 1988).

The genus *Paraglobivalvulinoides* Zaninetti and Jenny-Deshusses, which probably represents the final stage in the evolution of biseriamminids with globular chambers, is a direct de-

scendant of *Paraglobivalvulina* (text-fig. 2). This form with a completely involute test and a secondary septal system joining the internal spirals to the final chambers was discovered in the *Colaniella parva* beds in the Himalaya (Lys et al. 1980) indicating Changxingian stage which has been previously correlated to the uppermost Djulfian and Dorashamian stages of the Transcaucasian Permian (Altiner et al. 1980).

The new genus *Sengoerina* consisting morphologically of both globivalvuline and dagmaritin stages constitutes the root of biserialminids with angular chambers (Subfamily Dagmaritinae) (text-fig. 2). The evolution is possibly related to a Midian transgression that was one of the most extensive in the Late Permian of the Tethyan Realm (Leven 1993) and that led to the development of several new smaller foraminiferal genera around the Murgabian-Midian boundary. In Turkey *Sengoerina* occurs in Midian samples in association with its direct descendant, *Dagmarita*, characterized by a totally uncoiled test and biserially arranged angular chambers with spine-like extensions at the chamber corners. The presence of a small coiled portion in some individuals of *Dagmarita*, as indicated by Zaninetti and Altiner (1981), also supports a direct evolutionary link between *Sengoerina* and *Dagmarita*.

The genus *Dagmarita* gave rise to the appearances of two distinct biserialminid genera with angular chambers in the Late Permian (text-fig. 2; the problematic genus *Crescentia* Ciarapica, Cirilli, Martini and Zaninetti has not been included in this evolutionary study). The genus *Louissetita* with internally divided tests and the secondarily enrolled form, *Paradagmarita*, both appeared in the latest levels of the Tethyan Permian (Altiner and Bronnimann 1980; Altiner 1984; Lys and Marcoux 1978; Zaninetti and Altiner 1981). In Turkey, these forms were recorded in association with several *Reichelina* species and very rarely occurring *Paleofusulina* species (*P. laxa* Sheng, *P. mutabilis* Sheng) known from the Changxingian stage of eastern Asia (Sheng 1963).

It is thus evident that the accelerated evolution of Late Permian biserialminid foraminifers yielded several new forms whose appearances define important horizons in the Midian-Dorashamian interval. The newly established genus *Sengoerina* is one of them and represents the link between the ancestral globivalvulines and the dagmaritin foraminifers.

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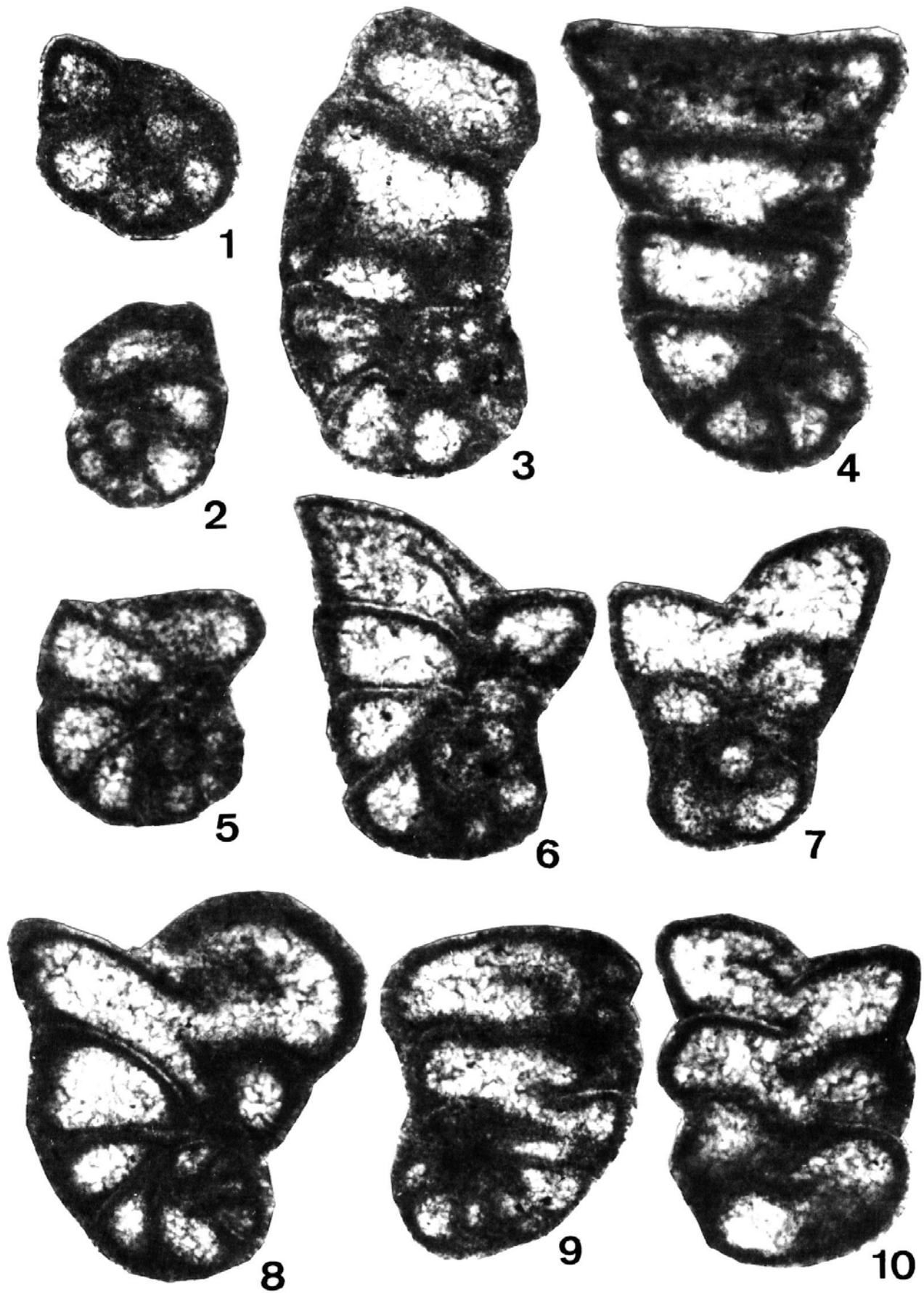
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PLATE 1

All specimens (X196) are *Sengoerina argandi*, n. gen., n. sp. from the Orhanlye and Iznik areas (Bursa-Turkey).

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| 1-2 Equatorial and nearly equatorial sections of juvenile specimens. Sample number ORG-2. | 6 Oblique frontal section. Holotype. Sample number ORG-2. |
| 3 Lateral section. Sample number IZ-1. | 7 Frontal section. Sample number IZ-1. |
| 4 Oblique lateral section. Sample number ORG-2/2. | 8-9 Oblique lateral sections. Sample number IZ-1. |
| 5 Slightly oblique equatorial section of a juvenile specimen. Sample number ORG-2. | 10 Tangential section. Sample number IZ-1. |



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