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***Clypeina? tekini* sp. nov.**

(Dasycladalean green Algae) from the Early Eocene in the Eskişehir Region (Western Central Turkey)

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■ Abstract

***Clypeina? tekini* sp. nov. (Dasycladalean Green Algae) from the Early Eocene in the Eskişehir Region (Western Central Turkey).** – A new Dasycladalean alga, *Clypeina? tekini* sp. nov. is described from the Lower Eocene sediments of the Seyitgazi Region, southern Eskişehir, central Turkey. The elongated, compact calcareous skeleton of this species consists of regularly spaced horizontal whorls with pores of branches, a smooth inner surface and a networked outer skeleton surface. The laterals are of bowling-pin form with a smaller proximal and a larger sub-spherical distal swelling forming the cortex. The species occurs in a rich algal and larger benthic foraminifera (especially alveolinids) association.

Clypeina? tekini sp. nov. and species showing a similar structure of the branches, form a special category of species within the genus *Clypeina* (Michelin 1845), characteristics of which at least are of infra-specific rank.

Keywords: *Clypeina?*, Dasycladales, Green Algae, Early Eocene, Seyitgazi Region, Central Turkey

■ Introduction

The objective of this work is to provide a systematic description of a new species of dasycladalean alga, *Clypeina? tekini* from the Ilerdian unit located at the southwest of Seyitgazi city (southern Eskişehir, Turkey) (Fig. 1). Early Eocene sequences in this area unconformably overly the Upper Cretaceous-Lower Paleocene ophiolite unit and are overlain by tuffites and lacustrine limestones of Upper Miocene age. The shallow-water successions consist of an abundant and diversified algal flora and accompanying porcellaneous benthic foraminifera of Ilerdian–Middle Cuisian age. Investigations of the foraminifera in the Ilerdian-Cuisian Unit were performed by Dizer (1964) and Özgen-Erdem et al. (2007). Halimedaceae and some Dasycladalean algal assemblages were determined for the first time by Özgen-Erdem and Radoičić (2009), and by Radoičić and Özgen-Erdem (2011). As other described new dasyclad species, which were found in Early-Late Ilerdian limestones, it is stratigraphically important when this part of the Eocene succession is considered.

■ Material

Though *Clypeina? tekini* sp. nov. was found in three stratigraphic sections, namely Sarıbayır, Kışlatepe and Kozyaka, it was mostly observed in the Sarıbayır section. Therefore, the stratigraphic distribution of the new species, and other algal and foraminiferal assemblages are illustrated only from the Sarıbayır section. A total of 135 thin sections were prepared from 64 samples, which had been examined for paleontological studies from the three sections.

The Sarıbayır section was described by Özgen-Erdem et al. (2007). Therefore it is briefly introduced in this study. The section was measured approximately 2 km southwest of the Sarıbayır Village, southwest of Seyitgazi Town (UTM coordinate 4362000-293800, Fig. 1). The sequence is composed of limestone, sandy and clayey limestone with green algae and porcellaneous benthic foraminifera, especially alveolinids (Fig. 2).

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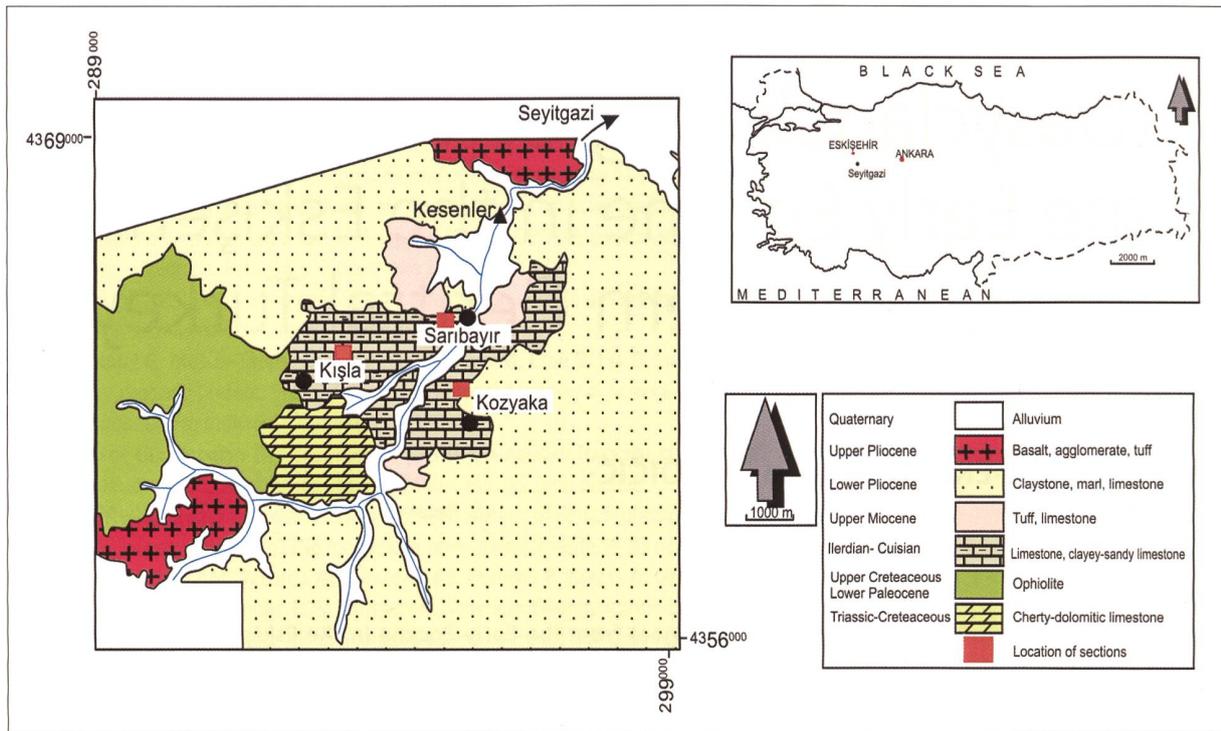


Fig. 1. Geological map of the studied area and location of stratigraphic sections (Geological map modified from Özcan et al., 1989).

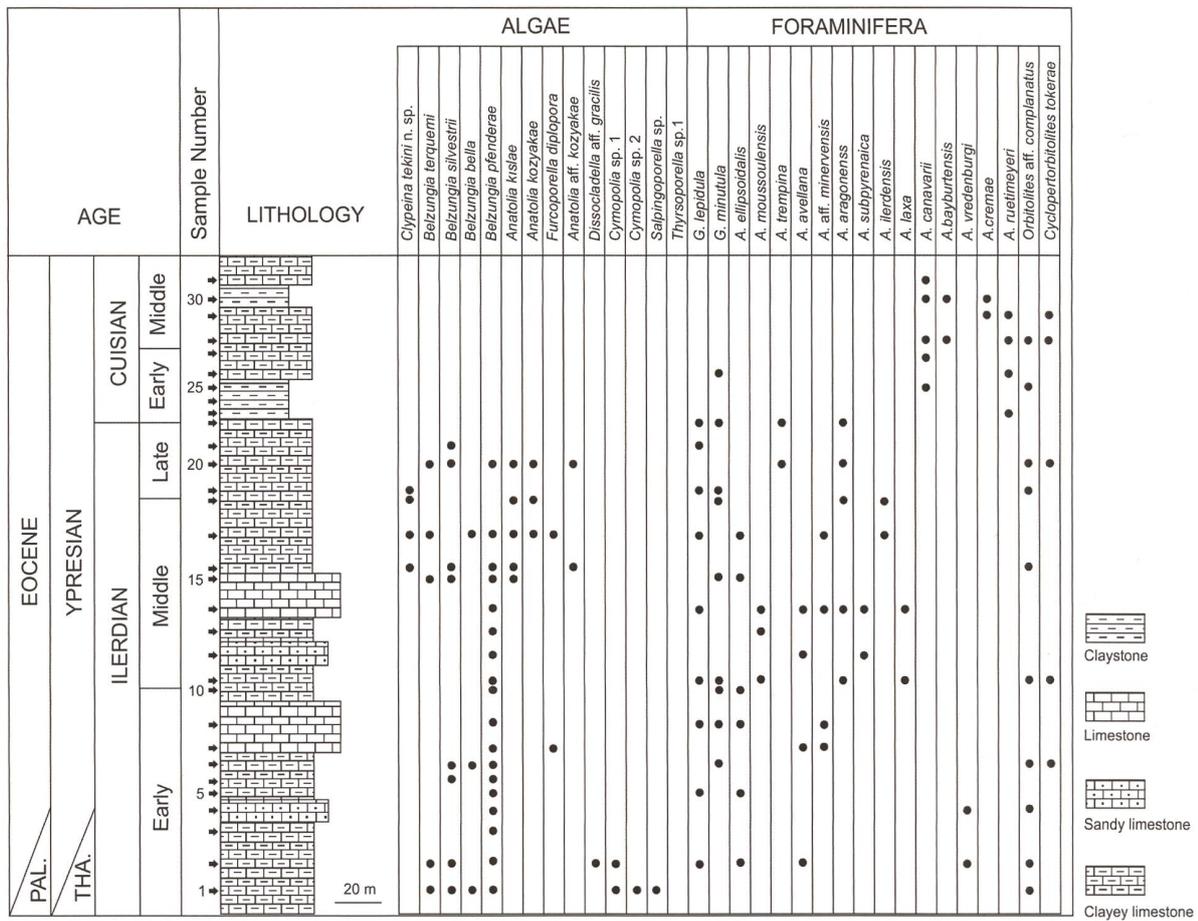


Fig. 2. Stratigraphic distribution of dasycladalean algae and benthic foraminifera in the Sarıbayır section.

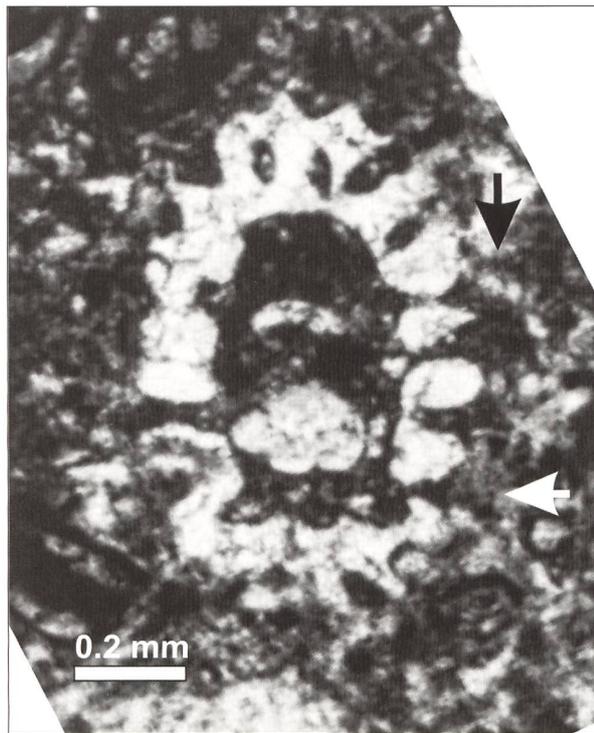


Fig. 3. *Clypeina? tekini* sp. nov., oblique section, upper arrow: weakly espiad uncalcified part of a distal swelling; lower arrow: tangential section of the whorl (three transverse sections of pores in the middle part).

Systematic paleontology

Order Dasycladales Pascher 1931. Genus *Clypeina* (Michelin, 1845) Bassoullet et al., 1979

Clypeina? tekini sp. nov.

Fig. 3, Pl. 1, figs 1-6, Pl. 2, figs 1-7

Origin of the name: The species is dedicated to Prof. Dr. U. Kağan Tekin (Hacettepe University, Ankara) for his contribution to the study of radiolarians from Turkey.

Holotype: The specimen in the longitudinal subaxial section, 1.80 mm long with 14 whorls, is illustrated in Pl. 1, fig. 1. The thin section is labeled NESAS. 16c.

Isotypes: Different skeleton sections in the thin sections from the sample NESAS. 16 are shown in Pl. 1, figs 1-4; Pl. 2, figs 1, 5.

Repository: Thin sections of the Nazire Özgen-Erdem collection are housed at the Department of Geological Engineering, Cumhuriyet University, Sivas (Turkey).

Type locality and level: The Sarıbayır Section is approximately 2 km southwest of the Sarıbayır Village, which is southwest of Seyitgazi city (UTM coordinate: 4362000, 293800, Fig. 1). The type bed SAS.16 consists of a foraminiferal bioclastic limestone of middle Ilerdian age containing a rich algal flora (*Belzungia silvestrii*, *B. pfenderae*, *Anatolia kışlae*, *A. aff. kozyakae*) and benthic foraminifera (*Glo-*

malveolina lepidula, *G. minutula*, *Alveolina ellipsoidalis*, *A. minervensis*, *A. aragonensis*, *A. ilerdensis*).

Diagnosis Elongated cylindrical thallus with large main stem bearing regularly spaced whorls (0.8-0.12 mm) of 8-12 horizontal primary lateral. The bowling-pin shaped laterals bear a small proximal smaller swelling, followed by a constriction in the middle part of the length, from which they gradually enlarge into sub-spherical distal swellings forming the cortex. Reproductive organs located in the distal swellings. In successive whorls, the branches are arranged in vertical files. Calcareous skeleton made of colorless sparry calcite, homogenous, with a smooth inner part and networked external surface.

Dimensions: The longest observed skeleton is 2.22 mm, the external skeleton diameter ranges from 0.46 to over 0.80 mm (eroded surface), the inner diameter 0.17-0.45 mm (= main stem diameter with mucilage layer). The lowermost part of the proximal swelling was covered by a mucilage layer. The calcareous sleeve encloses a portion of the laterals, from mucilage to the lower-middle part of the outer sub-spherical swelling (network surface). The wall thickness is 0.14-0.22 mm (= the length of the calcified part of the branches); the distance between two whorls (h) is 0.10-0.12 mm. Diameter of the pores on the skeleton surface ranges from 0.09 to 0.11 mm, with 0.077-0.083 mm in subsurface sections and 0.050-0.058 mm in the middle part of the laterals (Pl. 1, fig. 3).

Preservation: Preservation of the skeleton varies and the pores of the laterals are secondary enlarged, especially in the inner area of the skeleton starting on the mucilage layer. Therefore, the dimensions of the proximal swelling are unknown. The skeleton surface is more or less eroded. The elements of the thallus structure are recognized on sections in Fig. 3 and in Pl. 1, figs 1-4.

Relationships: *Clypeina? tekini* sp. nov. having a bowling-pin form of laterals, may be compared to the Paleogene *Clypeina occidentalis* (Johnson and Kaska) Radoičić and the Maastrichtian *Clypeina croatica* Gušić, both with lateral high inclined on the main stem, forming funnel-like whorls. *Clypeina? tekini* sp. nov. differs from these two species in having horizontal laterals, and from *C. croatica* in having an un-segmented thallus. The bowling-pin shaped laterals of *Clypeina occidentalis* clearly differ in outline and dimensions from those of *C. tekini* sp. nov., – they are thinner, slightly narrower in the proximal part close to a very small swelling, without a differentiated, larger distal swelling that is not corticated on the surface. The basal swelling of *C. tekini* sp. nov. is larger than in *C. occidentalis*. In one other *Clypeina*, the Paleogene *C. socaensis* Deloffre and Radoičić, the bowling-pin shape of the laterals is found only in some sections of the funnel-like whorls, and quite different, feather-like in longitudinal sections.

Why «Clypeina?» – *Clypeina? tekini* sp. nov. along with the herein mentioned, comparable species of genus, belongs to a group of forms made of whorls of bowling-pin shaped, inclined or horizontal laterals. Are these characters sufficient to discriminate the taxa of specific or sub-specific ranks?, remains an open question. Presently, a sufficiently clear-cut definition of *Clypeina* is still looked-for.

Stratigraphic distribution :

In the Sarıbayır section (type locality), *Clypeina? tekini* sp. nov. appears in the middle Ilerdian, occurring through 35 meters in the upper Ilerdian (samples no. NESAS. 16-19). The accompanying dasycladalean species are *Belzungia terquemi*, *B. silvestri*, *B. bella*, *B. pfenderae*, *Anatolia kislai*, *A. kozyakae*, *Furcoporella diplopora*, *Dissocladella* aff. *gracilis*, *Dissocladella* sp., *Thyrsoporella* sp.1 (see below), some undetermined Dasycladales and foraminifera (*Glomalveolina lepidula*, *G. minutula*, *Alveolina ellipsoidalis*, *A. trempina*, *A. aragonensis*, *A. ilerdensis*).

Rare sections of *Clypeina? tekini* sp. nov. occur in the early and middle Ilerdian part of the Kışlatepe section (samples NEK.5, 12 and 14) and in the early Ilerdian of the Kozyaka section (samples NES.18 and 19), with similar fossil assemblages. Consequently, in the type area, *Clypeina? tekini* sp. nov. is distributed through the Ilerdian (Fig. 2).

Note on Thyrsoporella sp1.

Thyrsoporella sp1 is present in the Kışlatepe (Pl. 2, Fig. 8) and Kozyaka sections (Pl. 2, Fig. 9). The large,

poorly preserved skeleton of this species (Pl. 2, Fig. 9), with smooth inner surface, has an inner diameter of 0.73 mm (close to the main stem diameter). In the fairly destroyed skeleton, thick stocky branches of the first two orders are preserved in places. External diameter 1.01 mm. The species is considerably larger than Lutetian *Thyrsoporella cancelata* Gumbel (d - 0.250, D - 0.45), and also *Thyrsoporella silvestrii* Pfender in Massieux (non 1966a), lectotype designated here: transverse section on the Pl. 1, fig 2, in Massieux 1966a (d-0.375, D-0.625, in Massieux 1966b, p.138).

Conclusions

Clypeina? tekini sp. nov., described from the early-middle Ilerdian limestones of Seyitgazi (southern Eskişehir) is associated with other dasycladalean algae (*Belzungia terquemi*, *B. silvestri*, *B. bella*, *B. pfenderae*, *Anatolia kislai*, *A. kozyakae*, *Furcoporella diplopora*, *Dissocladella* aff. *gracilis*, *Dissocladella* sp., *Cymopolia* sp.1, *C. sp.2*, *Thyrsoporella* sp1.) and an association of alveolinids denoting the Ilerdian-middle Cuisian. This new species is characterized by regularly spaced horizontal whorls of pores of laterals, a smooth inner and networked outer skeleton surface. The laterals are bowling-pin shaped, with a smaller proximal and a larger sub-spherical distal swelling forming a cortex.

Acknowledgment

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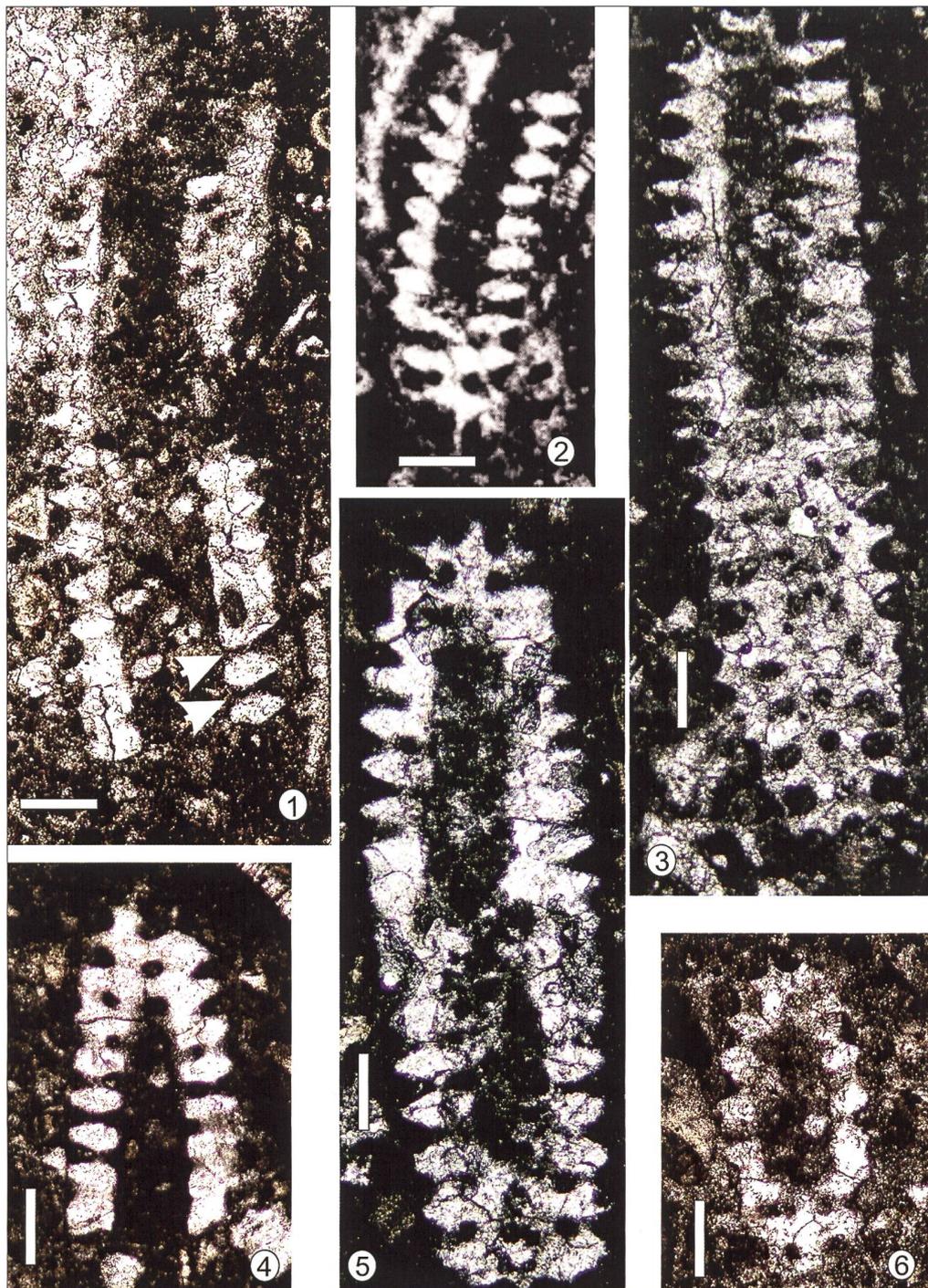


Plate 1: *Clypeina? tekini sp. nov.*

All scale bars: 0.2 mm

Fig. 1: Holotype, longitudinal subaxial section of a partly altered skeleton, arrows: pores of branches with distal swellings; thin section NESAS. 16b.

Fig. 2: Longitudinal oblique in lower part the tangential section, in the lower part: pores arranged in vertical files, thin section NESAS. 17a.

Fig. 3: Longitudinal partly tangential section of the largest observed skeleton, in the lower part, transverse section of pores arranged in vertical file, the smaller ones in the middle file correspond to narrowed portion of the laterals, thin section NASAS. 16x19.

Fig. 4: Slightly oblique section of a skeleton fragment with differently preserved pores, those in the left wall with well visible narrowing of the branches, thin section NESAS. 16d.

Fig. 5: Elongated oblique section, thin section NESAS. 16x9.

Fig. 6: Oblique section, thin section NEK. 14c.

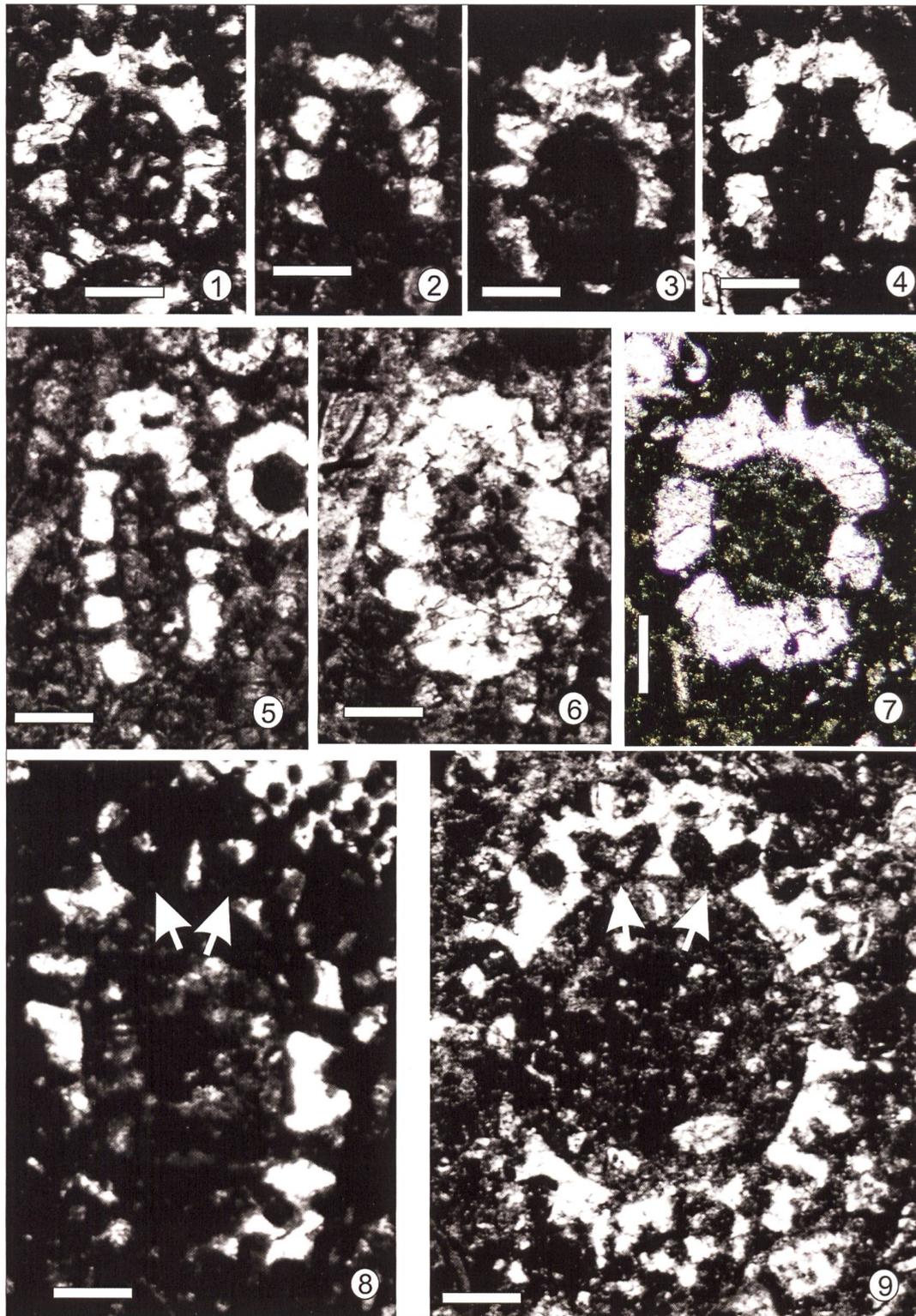


Plate 2: *Clypeina? tekini sp. nov.*

All scale bars: 0.2 mm

Fig. 1: Transverse-oblique section, thin section NESAS. 19e.

Fig. 2-4: Transverse-oblique sections, fragments, thin sections NES19a, NES 18b, NEK 12b.

*Fig. 5: Oblique section, at the right transverse section of small? *Belzungia*, thin section NESAS. 16b.*

Fig. 6: Oblique section of prevailingly recrystallized skeleton, thin section NEK. 5b.

Fig. 7: Transverse oblique section, thin section NEK. 12x1.

Thyrsoporella sp.1

Fig. 8, 9: Oblique sections, arrows: thick short stocky primary and secondary laterals, thin sections NESAS. 19e and NES. 17c.