



The first appearance of the Bartonian benthic foraminifera at the Çayraz Section (north of Haymana, south Ankara, central Turkey)

Çayraz kesitinde Bartoniyen bentik foraminiferlerinin ilk görünüşü (kuzey Haymana, güney Ankara, orta Türkiye).

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ABSTRACT

Up to now, the existence of the Bartonian larger benthic foraminifera was not reported from the Haymana-Polatlı Basin. In this study, the argillaceous limestone collected from the top of the Çayraz section (near Çayraz village, 5 km north of Haymana) yielded indicator foraminiferal species, namely *Nummulites perforatus* (De Montfort), *Alveolina stercusmuris* Mayer-Eymar and *Alveolina nuttalli* Davies for Bartonian. These species are described and their stratigraphic ranges are discussed in detail.

Keywords: Bartonian, benthic foraminifera, central Turkey, Çayraz formation.

ÖZ

Bugüne değin, Haymana-Polatlı Havzası'nda Bartoniyen iri bentik foraminiferlerinin varlığı rapor edilmemiştir. Bu çalışmada, Çayraz kesitinin (Çayraz köyü yakını, Haymana'nın 5 km kuzeyi) üstünden toplanan killi kireçtaşından *Nummulites perforatus* (De Montfort), *Alveolina stercusmuris* Mayer-Eymar ve *Alveolina nuttalli* Davies karakteristik foraminiferleri elde edilmiştir. Bu foraminifer türleri şekilleriyle ayrıntılı olarak tanımlanmış ve stratigrafik yayılımları tartışılmıştır.

Anahtar Kelimeler: Bartoniyen, bentik foraminiferler, orta Türkiye, Çayraz formasyonu

INTRODUCTION

The main objective of this study is to introduce Bartonian with the shallow water benthic foraminifera (mainly nummulitid and alveolinid species) from the Çayraz section (near Çayraz village, 5 km north of Haymana, south of Ankara, Central Turkey; Figures 1 and 2). The argillaceous limestone, which forms the basis of this study and is found at the top of the Çayraz section (Figure 2), yielded *N. perforatus*, *A. stercusmuris*, *A. nuttalli* of Bartonian age. Numerous geological and paleontological studies at the relevant locality have been previously realized by the following authors: Hottinger (1960 a, b), Schaub (1962), Dizer (1964), Yüksel (1970), Gökçen (1976), Sirel and Gündüz (1976), Ünalın et al. (1976), Toker (1979, 1980), Sirel et al. (1986), Koçyiğit (1991), Çiner et al. (1996), Özcan (2002), Özcan et al. (2007), Sirel (2010). So far, the occurrences of the Bartonian benthic foraminiferal species has not been reported by these studies.

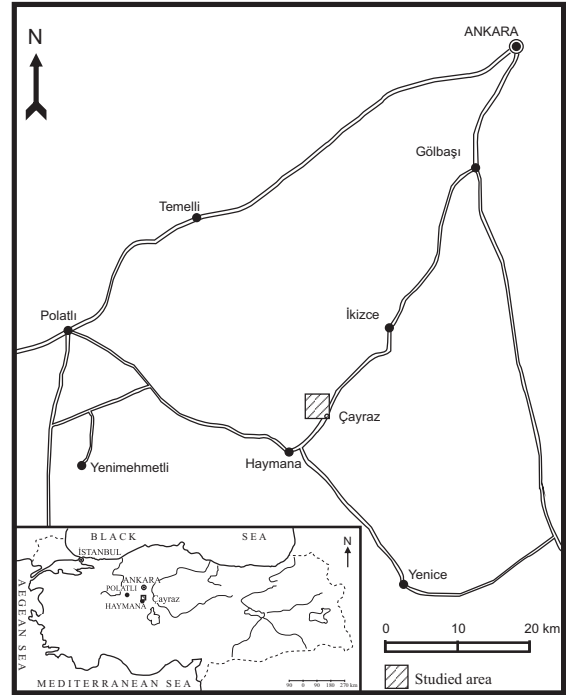


Figure 1. Map showing the sampling location.
Şekil 1. Örnek yerini gösteren yerbuldurular haritası.

UPPER CRETACEOUS	PALEOCENE		E O C E N E																OLIGOCENE	SERIES	
MAASTRIHTIAN	DANIAN-THANETIAN		ILERDIAN	CUISIAN (SBZ 10-12)						LUTETIAN-BARTONIAN (SBZ 13-18)						Oligo-Mio	STAGE - SBZ				
LITHOLOGY																	NUMBER OF SAMPLES	EXPLANATION			
Sand stone, marl, lime stone succession	Marl limestone succession		Sandy limestone, sandstone, conglomerate	Clayey limestone, marl, sand stone succession																19	
<i>Orbitoides medius</i> , <i>Siderolites calcitrapoides</i> , <i>Cidena cf. soezerli</i> , <i>Lepidorboides</i> sp., <i>Globotruncanid</i> species	<i>Haymanella</i> sp.	<i>Glomalveolina primaeva</i> , <i>Pseudocuvillierina sireli</i> , <i>Lafiteina mengaudi</i> ,	<i>Nummulites frassi</i> , <i>N. exilis</i> , <i>Assilina pustulosa</i> , <i>Alveolina vredenburghi minutus</i> , <i>Glomalveolina</i> sp.	6	7	8	9	10	11	12	13	14	15	16	17	18	19	<i>Nummulites planulatus</i>			
																				<i>Nummulites irregularis</i>	
																					<i>Nummulites cf. atacicus</i>
																					<i>Nummulites cf. archiaci</i>
																					<i>Nummulites cayrazensis</i>
																					<i>Nummulites partschi</i>
																					<i>Nummulites cf. millecaput</i>
																					<i>Nummulites lehneri</i>
																					<i>Nummulites laevigatus</i>
																					<i>Nummulites pinfoldi</i>
																					<i>Nummulites aff. pinfoldi</i>
																					<i>Nummulites perforatus</i>
																					<i>Assilina placentula</i>
																					<i>Assilina exponens</i>
																					<i>Assilina spira</i>
																					<i>Assilina</i> sp.
																					<i>Alveolina bayburtensis</i>
																	<i>Alveolina canavarii</i>				
																	<i>Alveolina cayrazensis</i>				
																	<i>Alveolina stercusmuris</i>				
																	<i>Alveolina nuttalli</i>				

Figure 2. Stratigraphic distribution of nummulitid, assilinid and alveolinid species in Çayraz section (not-to-scaled) (Sirel, 2010).

Şekil 2. Çayraz kesitindeki nummulitid, assilinid ve alveolinidlerin stratigrafik dağılımı (ölçeksiz) (Sirel, 2010).

The Çayraz succession is the best locality for early and middle Eocene (Cuisian-Lutetian), so that Cuisian and Lutetian sequences of Çayraz were chosen as the reference sections of above chronostratigraphic units by its accessibility, completeness and benthic foraminiferal content (Sirel, 2010).

Detailed paleontological study concerning nummulitid and alveolinid species have been introduced from the Çayraz section by Sirel and Gündüz (1976; Figs. 2, 3). In this study the Bartonian stage was not reported by the authors, in spite of the fact that the Bartonian species *Asilina exponens* (Sowerby) occurred at the top of the section.

The oriented equatorial and axial sections were made from the isolated foraminiferal specimens in the soft-argillaceous limestone. All the specimens in the plate 1-3 are deposited in the collection of Ankara University, Faculty of Engineering, Department of Geological Engineering.

SYSTEMATIC PALEONTOLOGY

Order Foraminiferida Eichwald, 1830

Family Nummulitidae Blainville, 1825

Genus: *Nummulites* Lamarck, 1801

Type species: *Camerina laevigata* Brugiere, 1792

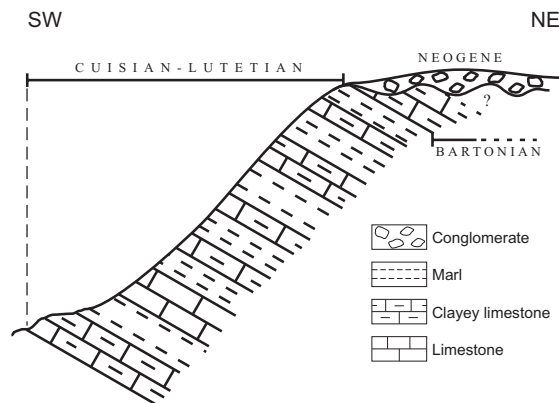


Figure 3. Schematic cross-section of the Çayraz sequence (not-to-scaled).

Şekil 3. Çayraz istifinin yatay şematik kesiti (ölçeksiz).

Nummulites perforatus (de Montfort, 1808)

(Plate 1, Figs 1-6; Plate 2, Figs 1-8)

1808 *Egeon perforatus* de Montfort, p. 166, figs. 2.

1929 *Nummulites perforatus* (de Montfort), Lluca, p. 190-195, pl. 9, figs 30-38; pl. 11, figs. 1-7; pl. 12, figs. 1-7.

1972 *Nummulites perforatus* (de Montfort), Blondeau, p. 161, pl. 36, figs. 6-11.

1981 *Nummulites perforatus* (de Montfort), Samanta, p. 818-823, pl. 113, figs 1-2; pl. 116, figs. 1-2.

1981 *Nummulites perforatus* (de Montfort), Schaub, p. 88-90, pl. 17; pl. 18; pl 19, figs 1-8.

1995 *Nummulites perforatus* (de Montfort), Racey, p. 56-58, pl. 3, figs 1-7.

1995 *Nummulites perforatus* (de Montfort), Pappazoni and Sirotti, pl. 2, figs 7-8.

1991 *Nummulites perforatus* (de Montfort), Avşar, p. 21-22, pl. 1, figs 1-11.

1992 *Nummulites perforatus* (de Montfort), Avşar, p. 156-158, pl. 2, figs 1-11.

2007 *Nummulites perforatus* (de Montfort), Varone and Decrouez, pl. 1, figs. 7-12.

Description: Form B: The test is inflated lenticular with rounded periphery. This form has meandriform septal filaments on the surface. The rounded small granules are distributed all over the surface of the shell. The diameter of the test ranges from 12 to 26.3 mm and the thickness varied from 5 to 15.3 mm. The test of the microspheric generation is composed of three growth stages. Very small microsphere is followed by tightly and regularly coiled 5-7 whorls of juvenile stage. The following 14-15 whorls of the adult period are arranged slightly irregular. The last numerous whorls called senile stage, which are coiled tightly and irregular. The isometric chambers of the earlier whorls gradually become larger than higher toward the last whorls. The septa are slightly inclined and faintly arch shaped. There are 37 whorls in an equatorial section measuring 24.4 mm in diameter and 34 whorls in an equatorial section measuring 19 mm in diameter.

Form A: The test is inflated lenticular with rounded periphery. On the pole of the test, the septal filaments are hardly observed due to the granulation. They are irregularly radial through the periphery. The granules are rounded and coarse as opposite to the microspheric form. The diameter of the test ranges from 4.3 to 5.5 mm and the thickness from 2.5 to 3.2 mm. The shape of proloculus is changed between globular to ovoid and the diameter of proloculus ranges between 0.59 to 0.86 mm. The spire is regular. Isometric chambers of the first 1-2 whorls become larger than higher at the last whorls. The septa are inclined and slightly curved. There are 6 whorls in an equatorial section measuring 5.5 mm in diameter.

Distribution: The inflated lenticular species *Nummulites perforatus* (De Montford) was found together with *A. stercusmuris* and *A. nuttalli* at the top of the Çayraz section (Fig. 2). According to Serra-Kiel et al. (1998, p. 286, Fig. 3), *N. perforatus* indicates the Bartonian age. Like wise, *A. stercusmuris* was reported from the Bartonian of the Darende area, western Malatya Sirel and Acar (2008, p. 83, pl. 76, Fig. 1).

Family Alveolinidae Ehrenberg, 1829

Genus: *Alveolina* d'Orbigny, 1826

Type species: *Oryzaria boscii* DeFrance, in Bronn, 1825

Alveolina stercusmuris Mayer-Eymar, 1886

(Plate 3, Fig. 1)

1886 *Alveolina stercusmuris* Mayer-Eymar, (in Hottinger, 1960a, p. 147; in Drobne, 1977, p. 50).

1977 *Alveolina stercusmuris* Mayer-Eymar, Drobne, p. 50, pl. 10, figs. 12-14.

2008 *Alveolina stercusmuris* Mayer-Eymar, Sirel and Acar, p. 83-84, pl. 76, fig. 1.

Description: Only one well preserved megalospheric form has a medium sized, subcylindric test with an axial diameter of 5.6 mm and equatorial diameter of 3.1 mm. The index of elongation is 1,81 at the 15 th whorl. 4-5 ovoid to subspheric whorls which follow the proloculus (with a diameter of 0.255 mm) are coiled tightly. In following 3-4 whorls, the axial

thickening is rather thick in comparison with the thickening of the equatorial sector. The last 7 whorls of the senile stage, thickening of the basal layer becomes narrower and becomes constant till the last whorl in both polar and equatorial regions. The size of chamberlets gradually increases from the first to the last whorl. Their cross sections vary from the subspheric to the upright oval.

Distribution: The distribution of this species was described in the *N. perforatus* chapter.

Alveolina nuttalli (Davies, 1940)

(Plate 3, Figs 2-5)

1940 *Alveolina elliptica nuttalli* Davies, p. 219-220, pl. 12, figs. 1-4.

1954 *Alveolina elliptica flosculina* Silvestri, Smout, p. 82-83, pl. 14, figs. 8-12.

1993 *Alveolina nuttalli* (Davies), Samanta, p. 65-72, pl. 10, figs. 1-5; pl. 11, figs. 2-3.

Description: The shape of the test is ovoid with rounded poles. Axial diameter ranges from 4 mm to 5.5 mm, equatorial diameter from 2.6 to 3.8 mm and index of elongation from 1.44 to 1.54. All the sections and incomplete specimens examined were megalospheric. The shell of the species composed of three growth periods. The spheric megalosphere (its diameter ranges from 0.167 to 0.185 mm) is followed by tight coiled ovoid 5-7 whorls of the nepionic stage. The number of the flosculinized whorls ranges from 2 to 3. The ovoid 7-8 whorls of the senile period are coiled tightly in the axial as well as the equatorial spire. The size of the chamberlets increase gradually from the proloculus to the last whorl; their cross section are generally subspheric.

Remarks: Four specimens collected from the upper Kirthar beds (middle Eocene) of north-west India were described and figured as *Alveolina elliptica* (Sowerby) *nuttalli* Davies by Davies (1940), in spite of the fact that the alveolinid association consists of different two species. The first alveolinid species illustrated in Davies (1940, pl. 40, figs. 3,4) resembles *A. elliptica* Sowerby by large test with tightly coiled numerous whorls Hottinger (1960a, pl. 1-3) and

Samanta (1993, pl. 4, figs. 1-5; pl. 5, figs. 1-3; pl. 6, figs. 1-2; pl. 7, figs. 1-2; pl. 8, figs. 1-3). The second species *A. elliptica nuttalli* figured in Davies (1940, pl. 12, figs. 1-2) have a ovoid test including the ovoid nepionic, flosculinized and senile periods growth stages. Later on, these two species were described and figured as *Alveolina elliptica* (Sowerby) and *Alveolina nuttalli* (Davies) from the uppermost middle Eocene of Lakhat, Babia and Cutch areas, western India by Samanta (1993). The specimens collected from the top of the Çayraz section, figured in (pl. III, figs. 2-5) resemble *A. nuttalli* in possessing ovoid test with three growth stages; therefore, they were here described as *A. nuttalli* (Davies).

Distribution: The distribution of this species was described in the *N. perforatus* chapter.

DISCUSSIONS AND CONCLUSIONS

The benthic foraminiferal zones (SBZ 1-20) were established for the Tethyan Paleocene-Eocene by Serra-Kiel et al. (1998). According to these authors, the inflated lenticular species *N. perforatus* indicates to the SBZ 17 (Bartonian). The subcylindrical alveolinid species in Pl. 3, fig. 1 called as *A. stercusmuris* apperantly similar to that of the Darende species (Sirel and Acar, 2008, p. 83, pl. 76, fig. 1). The later species is associated there with *Alveolina fusiformis* Sowerby and *Alveolina elongata* D'Orbigny of Bartonian age Sirel and Acar (2008).

Because of the foregoing paleontological datum, the argillaceous limestone with *N. perforatus*, *A. stercusmuris*, *A. nuttalli* located at the top of the Çayraz section is attributed Bartonian.

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PLATE 1

Bartonian, all figures from Çayraz section, figs 1,6 x5; figs 2-5 x10.

Nummulites perforatus (De Montfort);

Fig. 1- Equatorial section of B form, showing three growth stages, C-1/04/6.

Fig. 2- External view of A form, showing rounded and coarse granules, C-2 /02/1.

Fig. 3- Equatorial section of A form, C-2 /02/8.

Fig. 4- External view of A form, showing granules and radial septal filaments close to periphery, C-2/02/2.

Fig. 5- Axial section of A form, showing the proloculus and pillars, C-3/3/3.

Fig. 6- Equatorial section of B form, C-1/01/5.

LEVHA 1

Bartonian, tüm şekiller Çayraz kesitindedir, şek. 1,6 x5; şek. 2-5 x10.

Nummulites perforatus (De Montfort);

Şek. 1- B formunun üçlü gelişim evresini gösteren ekvatoryal kesiti, C-1/04/6.

Şek. 2- A formunun yuvarlak ve iri granüllerini gösteren dış görünümü, C-2/02/1.

Şek. 3- A formunun ekvatoryal eksiti, C-2/02/8.

Şek. 4- A formunun granülleri ve kenara yakın ışınal bölme izlerini gösteren dış görünümü, C-2/02/2.

Şek. 5- A formunun ilk loca ve sütunlarını gösteren aksel kesiti, C-3/3/3.

Şek. 6- B formunun ekvatoryal kesiti, C-1/01/5.

PLATE-I/LEVHA-1



PLATE 2

Bartonian, all figures from Çayraz section, figs. 1-3, 5, 7, 8 x 5; figs. 4, 6 x10.

Nummulites perforatus (De Montfort);

Fig. 1- External view of B form, showing small rounded granules, C-1/05/1.

Fig. 2- Equatorial section, young specimen of B form, contains first 13 whorls, C-1/10/3.

Fig. 3- Equatorial section, young specimen of B form, contains first 12 whorls, C- 1/10/2.

Fig. 4- Equatorial section of A form showing first 6 whorls, C-2/02/2.

Fig. 5- External view of a young B form, C-1/10/3.

Fig. 6- Axial section of A form showing the proloculus and pillars, C-2/02/10.

Fig. 7- Axial section of B form showing pillars, C-1/01/eks.

Fig. 8- Axial section of B form, showing thin pillars, C-1/05/eks.

LEVHA 2

Bartonian, bütün şekiller Çayraz kesitindedir, şek. 1-3, 5, 7, 8 x 5; şek. 4, 6 x10.

Nummulites perforatus (De Montfort);

Şek. 1- B formunun küçük yuvarlak granüllerini gösteren dıştan görünümü, Cay/B/05/1.

Şek. 2- Genç B formunun ilk 13 turunu gösteren ekvatoryal kesiti, Cay/A/3.

Şek. 3- Genç B formunun ilk 12 turunu gösteren ekvatoryal kesiti, Cay/A/2.

Şek. 4- A formunun ilk 6 turunu gösteren ekvatoryal kesiti, Cay/A/02/2.

Şek. 5- Genç B formunun dıştan görünümü, Cay/A/3.

Şek. 6- A formunun ilk loca ve sütunlarını gösteren aksenal kesiti, Cay/A/02/10.

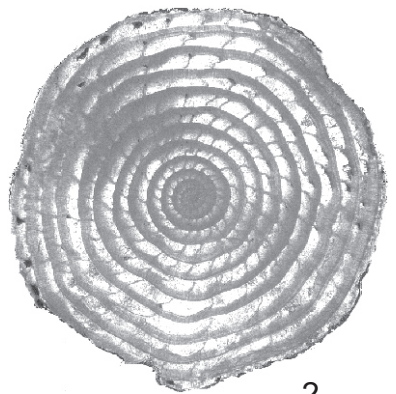
Şek. 7- B formunun sütunlarını gösteren aksenal kesiti, Cay/B/01/eks.

Şek. 8- İnce pillarları gösteren B formunun aksenal kesiti, Cay/B/05/eks.

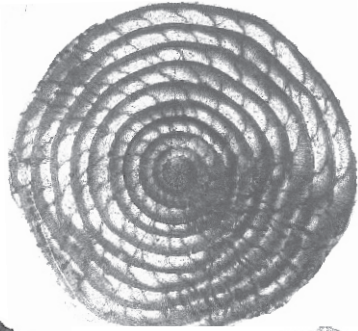
PLATE-II/LEVHA-II



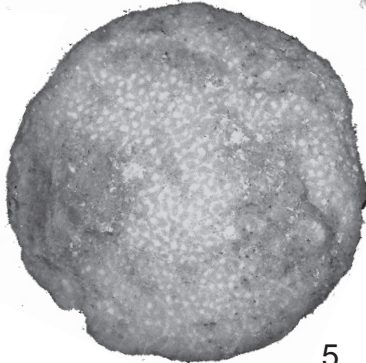
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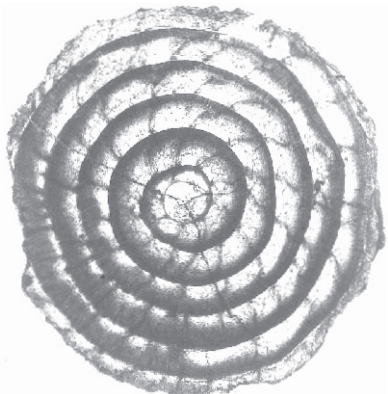
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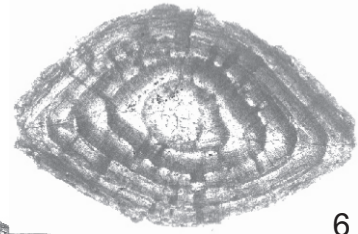
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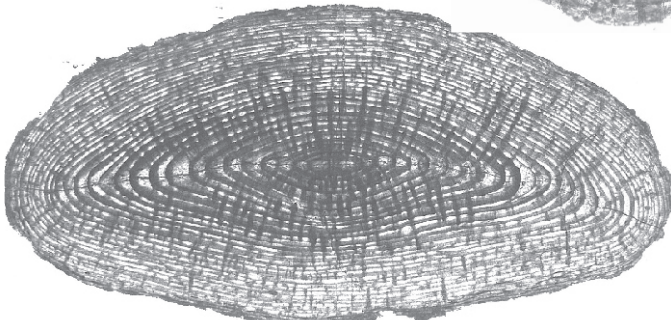
5



4



6



7



8

PLATE 3

Bartonian, all figures from Çayraz section, x20.

Alveolina stercusmuris Mayer-Eymar;

Fig. 1- Axial section A form, C-Alv/1

Alveolina nuttalli Davies;

Fig. 2- Axial section of A form?, showing three growth stages, C-Alv/2.

Fig. 3- Almost axial section of A form, showing reduced senile whorls, C-Alv/11.

Fig. 4- Incomplete axial section of A form, C-Alv/9.

Fig. 5- Incomplete axial section of A form, C-Alv/8.

LEVHA 3

Bartonian, bütün şekiller Çayraz kesitindedir, şek. 1-5 x20.

Alveolina stercusmuris Mayer-Eymar;

Şek. 1- A formunun aksenal kesiti, Cay/Alv/1

Alveolina nuttalli Davies;

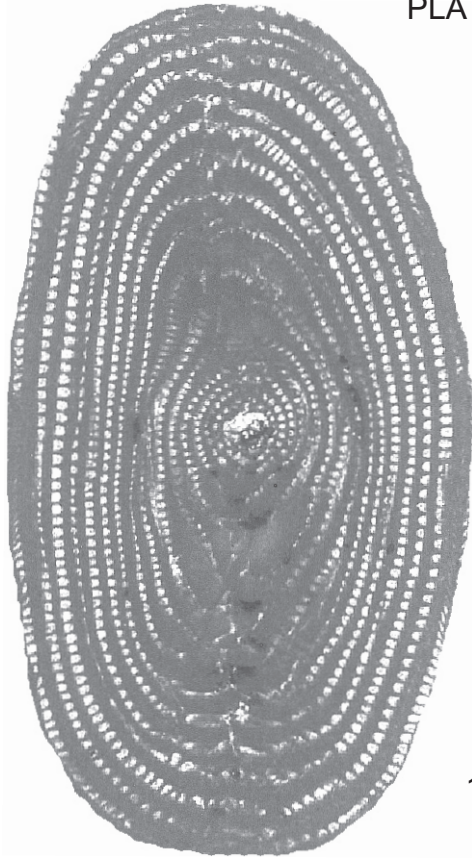
Şek. 2- Üç büyüme evresini gösteren A formunun aksenal kesiti, Cay/Alv/2.

Şek. 3- Azalan buna devresini gösteren A formunun eksene yakın kesiti, Cay/Alv/11.

Şek. 4- A formunun tam olmayan aksenal kesiti, Cay/Alv/9.

Şek. 5- A formunun tam olmayan aksenal kesiti, Cay/Alv/8.

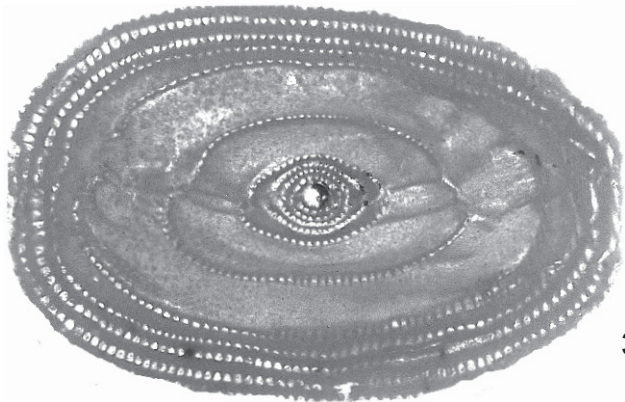
PLATE-III/LEVHA-III



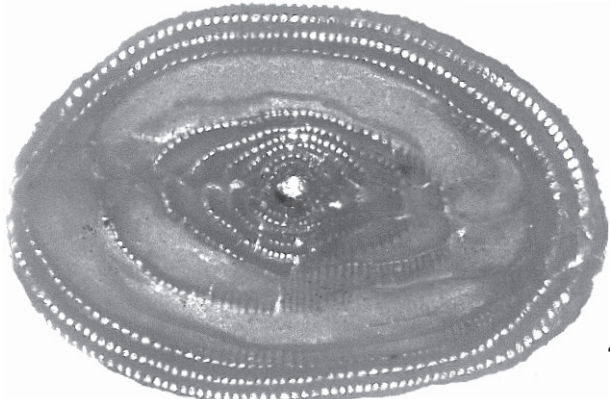
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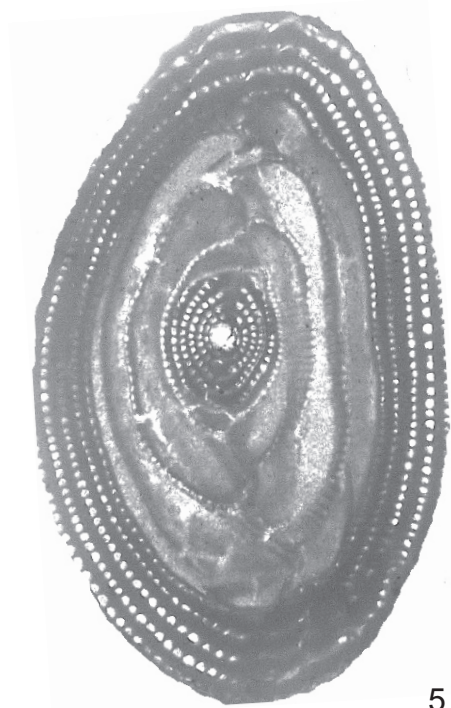
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3



4



5

