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DIAGNOSTIC STRUCTURAL ELEMENTS OF *RANIKOTHALIA* CAUDRI AND RE-DESCRIPTION OF ITS SIX SPECIES FROM THANETIAN-ILERDIAN OF TURKEY

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ABSTRACT

The diagnostic structural elements, such as the external ornamentations of the test particularly around the central knob, meshes of marginal canal network in the thickened marginal cord, trabecular system with its canals, basal cover V in shape (like cover plate) and septal flap are important generic characteristics of *Ranikothalia* Caudri. The known species of *Ranikothalia* in Turkey, viz *Ranikothalia nuttalli* (Davies, 1927), *Ranikothalia couisensis* (d'Archiac, 1866), *Ranikothalia daviesi* n.sp., *Ranikothalia bunyanensis* Sirel, 2015, *Ranikothalia polatliensis* Sirel, 2013 and *Ranikothalia solimani* Butterlin and Monod, 1969 are re-described and figured by means of the foregoing characteristic structural elements.

Keywords: *Ranikothalia*, larger benthic foraminiferal structural elements, Thanetian-Ilerdian, Turkey.

INTRODUCTION

Caudri (1944) described the new genus *Ranikothalia* based on the figures of type species *Nummulites nuttalli* Davies in Davies (1927, p. 266, pl. XVIII, figs. 3,4; pl. XIX, figs. 7-9) and in Davies and Pinfold (1937, p. 18, pl. III, figs. 1, 2, 9; pl. VI, figs. 19, 20). The purpose of this paper is to illustrate the diagnostic structural elements of *Ranikothalia*, including its ornamentation around the shapeless central knob (Fig. 4A, Fig. 6 A-D, Fig. 7 A,B), marginal canal network in the thickened marginal cord (Fig. 3a A-F, Fig. 4 C-E, Fig. 6 E-G, Fig. 7C, D, Fig. 8 A-E), trabecular system and its canals (Fig. 4A, Fig. 6 A-C, Fig. 7B) and basal cover plate V in shape (Fig. 3b A-F). In this connection, the type species of *Ranikothalia nuttalli* (Davies), *Ranikothalia couisensis* (d'Archiac), *Ranikothalia daviesi* n. sp., *Ranikothalia polatliensis* Sirel, *Ranikothalia bunyanensis* Sirel and *Ranikothalia solimani* Butterlin and Monod have been re-described and figured by the light of foregoing diagnostic structural elements.

All the thin sections and free specimens described and figured in this paper are deposited in the collection of Ankara University, Department of Gelological Engineering, under the labels shown in Pl. I-VII and Figs. 3a,b; 4, 6-8.

MATERIAL AND METHODS

This study is based on the free specimens and orientated equatorial, axial, tangential, and oblique sections of *Ranikothalia* form the stratigraphic sections (Figs 5-9) and from the spot sample (Fig. 1).

Well preserved specimens of *R. nuttalli* (Davies), *R. couisensis* (d' Archiach) and *R. daviesi* n. sp. are obtained from the soft materials of Thanetian-Cuisian Sakarya succession (Figs., 1, 5). The geological map, lithostratigraphic units and larger foraminiferal species of the Sakarya succession have previously been reported by Sirel (1975, 1976*a*, *b*).

Here re-described *Ranikothalia bunyanensis* Sirel is reported from the Thanetian-middle Ilerdian sequece referred to as Bünyan section (Fig. 9) is situated at SW Bünyan town, NE Kayseri, eastern part of central Turkey. This interesting succession was chosen as a reference section for Paleocene/ Eocene boundary of the very shallow water marine environment. *Ranikothalia bunyanensis* Sirel and other species such as *Lacazina blumenthali* Reichel and Sigal, *Glomalveolina* cf. *levis* Hottinger, *Elazigina subsphaerica* (Sirel), *Assilina* cf. *yvettae* Schaub, *Thomasella* sp., *Lockhartia* sp., *Valvulineria* sp., *Valvulina triangularis* d'Orbigny characterize the Paleocene/ Eocene boundary. The lithologic units and the very shallow water foraminiferal species of the Bünyan section have been introduced by Sirel (2015, p. 25, Fig. 12).

The sandy limestone with *R. polatliensis* Sirel and exotic limestone block with *R. solimani* Butterlin and Monod were taken at a spot from the early Ilerdian? of Kuşcu village, SE Polatı town, SW Ankara, central Turkey and from Thanetian exotic limestone block within the ophiolitic melange at 2 km north of Saray town, NE Van, eastern Turkey respectively (Fig. 1).

SYSTEMATIC PALEONTOLOGY

The suprageneric classification follows Loeblich and Tappan (1987). The description of morphological features applied the terms employed Muller-Merz (1980), Loeblich and Tappan (1987) and Hottinger (2006)

Order **Foraminiferida** Eichwald, 1830
Suborder **Rotalina** Delage and Herouard, 1896
Superfamily **Nummulitacea** de Blainville, 1827
Family **Nummulitidae** de Blainville, 1827
Genus ***Ranikothalia*** Caudri, 1944
Type species *Nummulites nuttalli* (Davies, 1927), Eocene, Ranikot beds of Thal, India

Diagnosis: Thin-inflated lenticular large test has characteristic external ornamentation, namely, pustules (Fig. 6, B), thickened septal flament with trabecular canals as a slit (Fig. 7, B) around the amorphous central knob (Fig. 4, A and Fig. 6, A-C). The slightly curved septal flaments become thinner towards the periphery (Fig. 4, A, B; Fig., 6 D; Fig 7, A). The canal system in the thickened marginal cord is the important diagnostic characteristics of *Ranikothalia* Caudri (Fig.4, B-D;

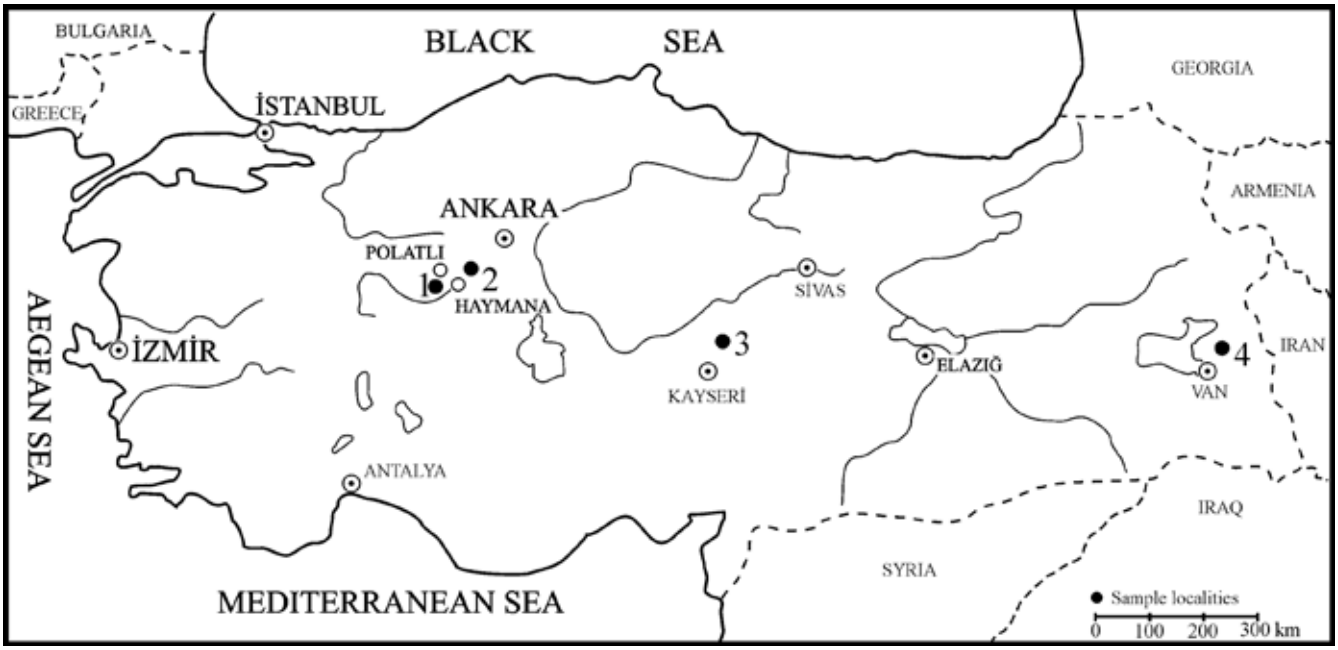

Fig. 1. Location map, showing the localities of the species of ***Ranikothalia*** Caudri: 1: *R.nuttalli* (Davies), *R. couisensis* (d' Archiac) and *R. daviesi* n.sp. in the Sakarya section (Fig. 5), 2: *R. polatliensis* (Sirel) from the Kuşcu village, 3: *R. bunyanensis* SIREL in the Bünyan section (Fig. 9), 4: *R. solimani* Butterlin and Monod from the Van area.

Fig. 6, D-G; Fig.7, D). The horizontal and vertical canals in the marginal cord form the meshes of marginal canal network (Fig. 2; Fig. 3a A-F; Fig. 8 A). The tangential section (Fig.8, A) clearly show that the horizontal and vertical canals of marginal canal network are connected with the intraseptal canals. We belive that the marginal, trabecular and intraseptal canals form a special canal system for *Ranikothalia* Caudri. The intercameral foramina present, located at the base of the septum (Fig. 2 and Fig. 10, 2). All the species in this study have basal cover plate V in shape (Fig. 3b) probably instead of the typical cover plate in rotaliids forms (Muller-Merz, 1980, pl. 11-14). The septal flap is indistinct (Fig. 14, 1; Fig. 15, 1) and dimorphism is distinct (Fig. 10-16). Its staratigraphic range is Thanetian-Ilerdian.

Differential Diagnosis: The genus *Ranikothalia* Caudri was derived from *Nummulites nuttalli* Davies by Caudri (1944) latter author did not illustrate it, while he created the new genus. He made use of the figures of Davies (1927) and Davies and Pinfold (1937) in the establishment of the new genus. The reticulation system in the thickened marginal cord and transvers trabeculae along the septal flaments as described by Davies and Pinfold (1937) are considered distinguishing characteristics by Caudri (1944).

Chordoperculinoides Arni (type species *Operculina bermudezi* Palmer) is identical with *Ranikothalia* Caudri in possessing external ornamentations of the test, especially around the central knob the meshes of marginal canal network in the marginal cord (Arni, 1966, Fig. 1; pl. I, fig. 4 and pl. II, fig. 7). *Ranikothalia* Caudri is distinguished easily from *Nummulites* Lamarck, *Operulina* d' Orbigny, even *Assilina* d' Orbigny by the diagnostic structural elements in (Figs. 2, 3a,b; Fig. 4, 6-8).

Ranikothalia nuttalli (Davies, 1927)
(Fig. 11: 1-10; Fig. 11: 1-7; Figs. 3 b, 4)

Nummulites nuttalli Davies, 1927, p. 266-269, pl. XVIII, figs. 3,4; pl. XIX, figs. 7-9. - Davies and Pinfold, 1937, p. 18, pl. III, figs. 1, 2, 9; pl. VI. figs. 19, 20. - Daci-Dizer, 1953, p. 242, pl. V, figs. 7-8.

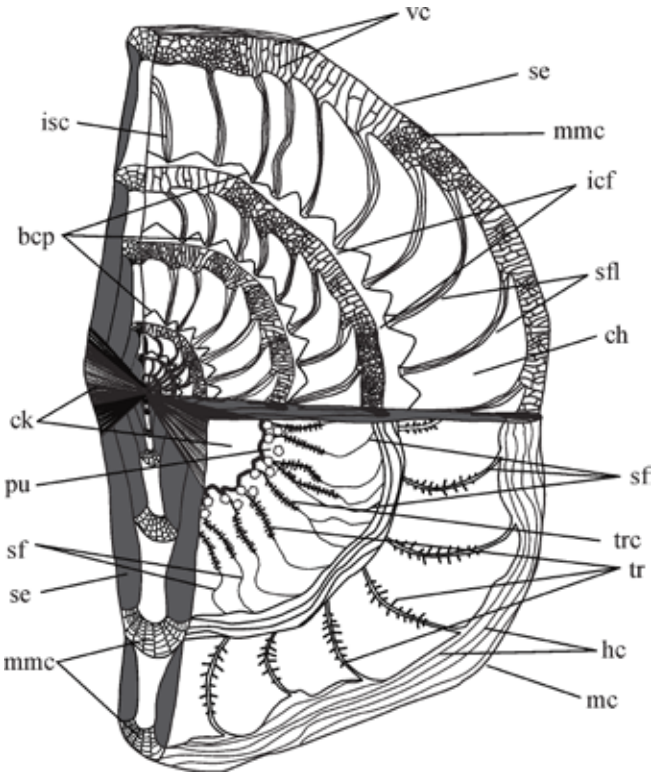

Fig. 2. Structural diagram of ***Ranikothalia*** Caudri, compiled from A and B form of here described species (Fig. 3a,b, 4, 6-8 and Pl. 1-7). **Abbreviation: ch:** Chamber, **icf**: Intercameral foramina, **isc:** Intraseptal canal, **mc:** Marginal cord, **mmc:** Meshes of marginal canal network, **hc:** Horizontal canals, **vc:** Vertical canals, **se:** Septum, **ck:** Central knob, **sf;** Septal flaments, **sfl:** Septal flap, **tr:** Trabeculae, **trc: T**rabecular canals, **pu:** Pustule, **bcp:** Basal cover plate V in shape, (not scale).

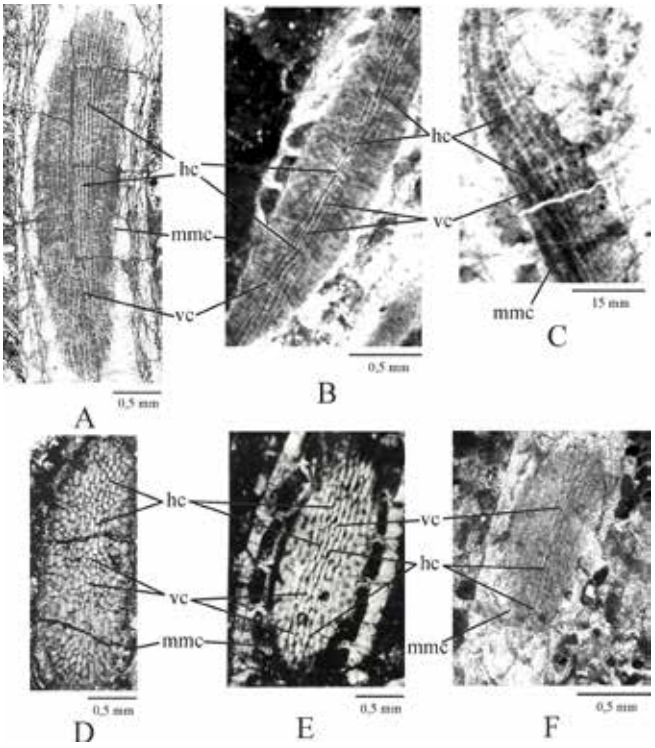

Fig. 3a. The meshes of marginal canals network in the species of ***Ranikothalia*** Caudri, compiled by the tangential sections of the B form**. A:** *R. couisensis* (d' Archiac), (S. 11). **B**: *R. nuttalli* (Davies), from Fig. 4 C, **C:** *R. daviesi* n.sp., (R. 13). **D:** *R. polatliensis* Sirel, enlarged from Fig. 6D, **E:** *R. solimani* Butterlin and Monod, enlarged from Pl. VII, fig.6, **F:** *R. bunyanensis* Sirel, enlarged from Pl. VI, fig. 7, **Abbreviation: mmc:** Meshes of marginal canal network, **hc:** Horizotal canals, **vc:** Vertical canals.

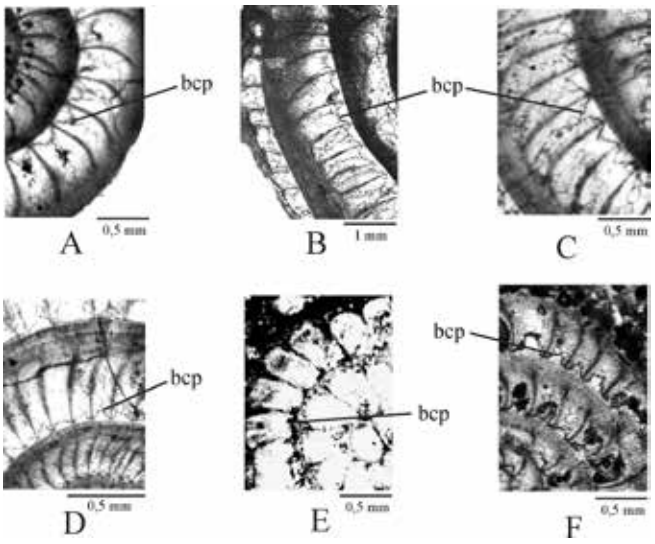

Fig. 3b. Showing cover plate V in shape in the equatorial sections of the species of *Ranikothalia* Caudri. **A:** *R. nuttalli* (Davies), A form, enlarged from Pl. I, fig. 6, (S. 8a). **B:** *R.nuttalli* (Davies) B form, enlarged from Pl. II, fig. 2, **C:** *R. couisensi* (d' Archıac), B form, enlarged from Pl. IV, fig. 7, **D:** *R. daviesi* n. sp. , B form, enlarged from Pl. IV, fig. 7, **E:** *R. polatliensis* Sirel, A form, enlarged from Pl. V, fig. 4, **F:** *R. bunyanensis* Sirel, A form, enlarged from Pl. VI, fig. 2, **Abbreviation : bcp:** Basal cover plates V in shape.

Ranikothalia nuttalli (Davies) Caudri, 1944 p. 351-404. - Sirel, 1976a, pl. X, figs. 10-13; pl. XI, figs. 1-7, 10. – Hottinger, 1977 non, pl. 17, fig. 1; pl. 18, 1-17.

Re-description: The microspheric generation has a large thin lenticular test with slightly swollen central part and rounded periphery (Fig. 10: 1, 5; Fig. 11: 1, 3). The external surface of the test is ornamented by the comparatively small central knob, thickened marginal cord, curved septal flaments with trabeculae (Fig. 10: 1; Fig. 11: 1; Fig. 4: A, B, D). The diameter of the test ranges from 10-14.4 mm and thickness from 1.1-1.7 mm. The thickness of marginal cord reaches to 0.130 mm at the first and 0.400 mm at the last whorls. The chambers are subrectangular growing gradualy towards the periphery and regularly in height, about twice the width in the all whorls of test (Fig. 10: 2, 6, 8; Fig: 11, 2, 7). There are 7 whorls in an equatorial section measuring 14.4 mm in diameter (Fig. 11: 2). Number of septa in the whorl: 1st, 10-14; 2nd, 18-19; 3rd, 28-30; 4th, 38-41.

The megalospheric generation has a small, thin lenticular test with rounded periphery (Fig. 10: 7, 9). The test ornamentation of this generation is similar to that of the microspheric form (Fig. 10: 10). The diameter of the test ranges from 2.7 mm to 4.3 mm and the thickness from 0.6 mm to 0.9 mm. Number of septa in the whorls: 1st, 13-15; 2nd, 20-24; 3rd, 26-34.

The diagnostic structural elements of the type species *Ranikothalia nuttalli* (Davies) are given in (Figs. 2, 3a,b, 4; Pl. I, II).

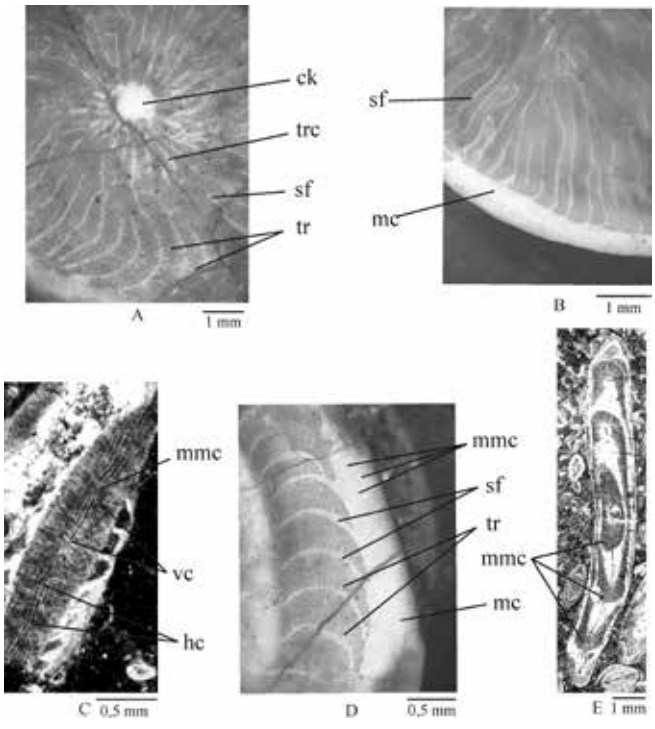

Fig. 4. Structural elements of ***Ranikothalia nuttalli*** (Davies)**,** all figs. compiled from Sirel (1976 a, lev. X and XI). **A**: Polar region on the lateral view, B form, enlarged from (Pl. I, fig 1). **B**: Marginal cord at the last whorl of lateral view of B form, enlarged from (P. 48). **C**: Tangential section of B form, (C. 11), **D**: Trabecular system between last two whorls, B form, enlarged from (Pl. I fig. 6). **E**: Subaxial section of B form, (R. 13). **Abbreviation: ck:** Central knob (or umbo, boss):, **sf**: Septal filaments, **tr**: Trabeculae, **trc**: Trabecular canals, **mc**: Marginal cord, **mmc**: Meshes of marginal canal network, **hc:** Horizontal canals, **vc:** Vertical canals, **ch**: Chamber.

Remarks: The type species was first described as *Nummuites nuttalli* Davies, 1927 from the Ranikot beds of Thal, India by Davies (1927, p. 266, pl. XVIII, figs. 3,4; pl. XIX, figs. 7-9). This species has been described and figured again as *N. nuttalli* Davies from the Punjab Salt range, although it has meshes of marginal canal network in the thickened marginal cord (Davies and Pinfold, 1937, p. 19, pl. VI, figs. 19-20). Caudri (1944) was transferred it to the new genus *Ranikothalia* Caudri by the reticulation of the marginal cord and the trabecular system.

R. nuttalli (Davies) has previously been described and figured from the Ilerdian of Sakarya section (Fig.5), south of Polatlı, central Turkey by Sirel (1976, p. 100, lev. X, şek. 10-13; lev. XI, şek. 1-7,10). This species is here re-described detail by means of the new diagnostic structural elements provided from the new additional material.

R.nuttalli (Davies) differs from the co-occurring species *R. couisensis* (d' Archiac) in its larger, thin lenticular test with loosely coiled whorls. There are 6-7 whorls in an equatorial section measured 14.1 mm in diameter (Fig. 10: 2), whereas, latter species has 7 whorls in an equatorial section measured 8.1 mm in diameter (Fig. 12: 2). Furthermore, *R. couisensis* (d'Archiac) has different characteristic external ornamentations (Fig. 12: 1) when compared with *R.nuttalli* (Davies) (Fig. 10: 1 and Fig. 11: 1). The second co-occrring species *R. daviesi* n.sp. differs from the type species in having smaller test, loosely coiled whorls, (Fig. 13: 1, 2, 4-8).

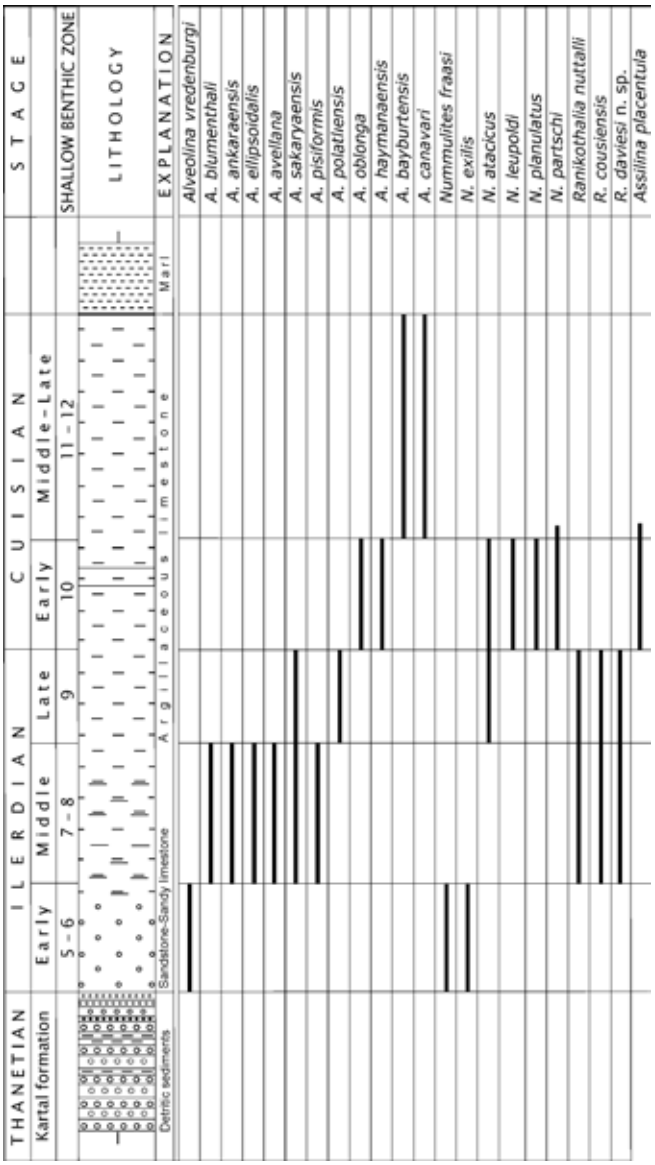

Fig. 5. Stratigraphic distribution of *Ranikothalia nuttalli* (Davies), *Ranikothalia couisensis* (d' Archıac), and *Ranikothalia daviesi* n.sp. in the Sakarya section, little modified from Sirel (2015, Fig. 13) (not scale).

Stratigraphic and Geographic Distribution: The last occurrence of *Nummulites exilis* Douvillé, *Alveolina vredenburgi* Davies of early Ilerdian age and the first occurrence of *Nummulites planulatus* (Lamarck), *Nummulites leupoldi* Schaub and *Assilina placentula* (Deshayes) of early Cuisian age in the Sakarya section (Fig. 5) defined the biostratigraphic range of *R. nuttalli* (Davies), *R. couisensis* (d' Archiac) and *R. daviesi* n. sp., that the interval indicates to SBZ 7-9 (middle-late Ilerdian) of Serra-Kiel *et al*. (1998).

R. nuttalli (Davies) occurs in the argillaceous limestone of the Sakarya section (Fig. 5), with *R. couisensis* (d' Archiac), *R. daviesi* n. sp., *Alveolina polatliensis* Sirel, *Alveolina sakaryaensis* Sirel, *Alveolina decipiens* Schwager and *Alveolina rotundata* Hottinger of middle-late Ilerdian age.

Ranikothalia couisensis (d'Archiac, 1866)
(Fig. 12: 1-16; Fig. 6, A-G)

Nummulites couisensis d'Archiac: in Tchihatcheff, 1866, p. 222. - Schaub, 1960 p. 443-451, pl.1,figs. 1a-b,2-11;pl. 2, figs. 1a-b,2a-b, 3a-b, 4a-b, 5a-b,6-8. - Blondeau, 1972 p, 123, pl. II, figs. 17,19, 20.

Ranikothalia couisensis (d'Archiac) Sirel, 1976a, p. 100, pl. XI,, figs. 8, 9, 11, 12; pl. XII, figs. 1-12; pl. XIII, figs. 1-2.

Re-description: The microspheric form has a large, inflated lenticular test with rounded perihery (Fig. 12: 3-5, 16). The external surface of the test is ornamented by the pustules, thickened septal flaments with trabeculae, trabecular canals are occured around the huge, shapeless central knob (Fig. 12: 1, 6, 8 14, 15; Fig. 6, A-C). The marginal cord is well seen in the last whorl (Fig. 12: 1, 8, 14). The septal flaments except the central area, become slightly curved towards the perihery (Fig. 12: 1, 14, 15). The diameter of the test ranges from 7 mm to 12 mm and the thickness from 2 mm to 2.4 mm. There are 7 whorls in an equatorial section measuring 8.1 mm in diameter (Fig. 12: 2). The chambers are subrectangular growing gradualy towards the periphery and regularly in height, about twice the width in the all whorls of test. *R. couisensis* consist of all diagnostic structural elements of *Ranikothalia*. Number of septa in the whorls: 2nd, 16; 3rd, 20; 4th, 28; 5th, 36; 6th, 44.

Macrospheric form has a inflated test with rounded perihery (Fig. 12: 16). The external ornamentation of this generation is similar to that of microspheric form (Fig. 12: 1, 6, 8, 12, 14, 15). The diameter of megalospheric form ranges from 3 mm to 4 mm and thicknes from 1 mm to 1.4 mm. The subspheric protochonch and second chamber (protochonch 0,130 mm- 0,285 mm in diameter; second chamber 0,230 mm- 0,345 mm in diameter) are followed by subrectangular chambers line up in 3-4 whorls (Fig. 12: 11, 13). All the structural elements of the species are given in (Fig. 6 and Fig. 12). Number of septa in the whorls: 1st, 14; 2nd, 19; 3rd, 22.

Remarks: Unfortunately, *Nummulites couisensis* d' Archiac was first described and figured inadequately from the early Tertiary of Asie Mineure by d' Archiac (1866). This species has

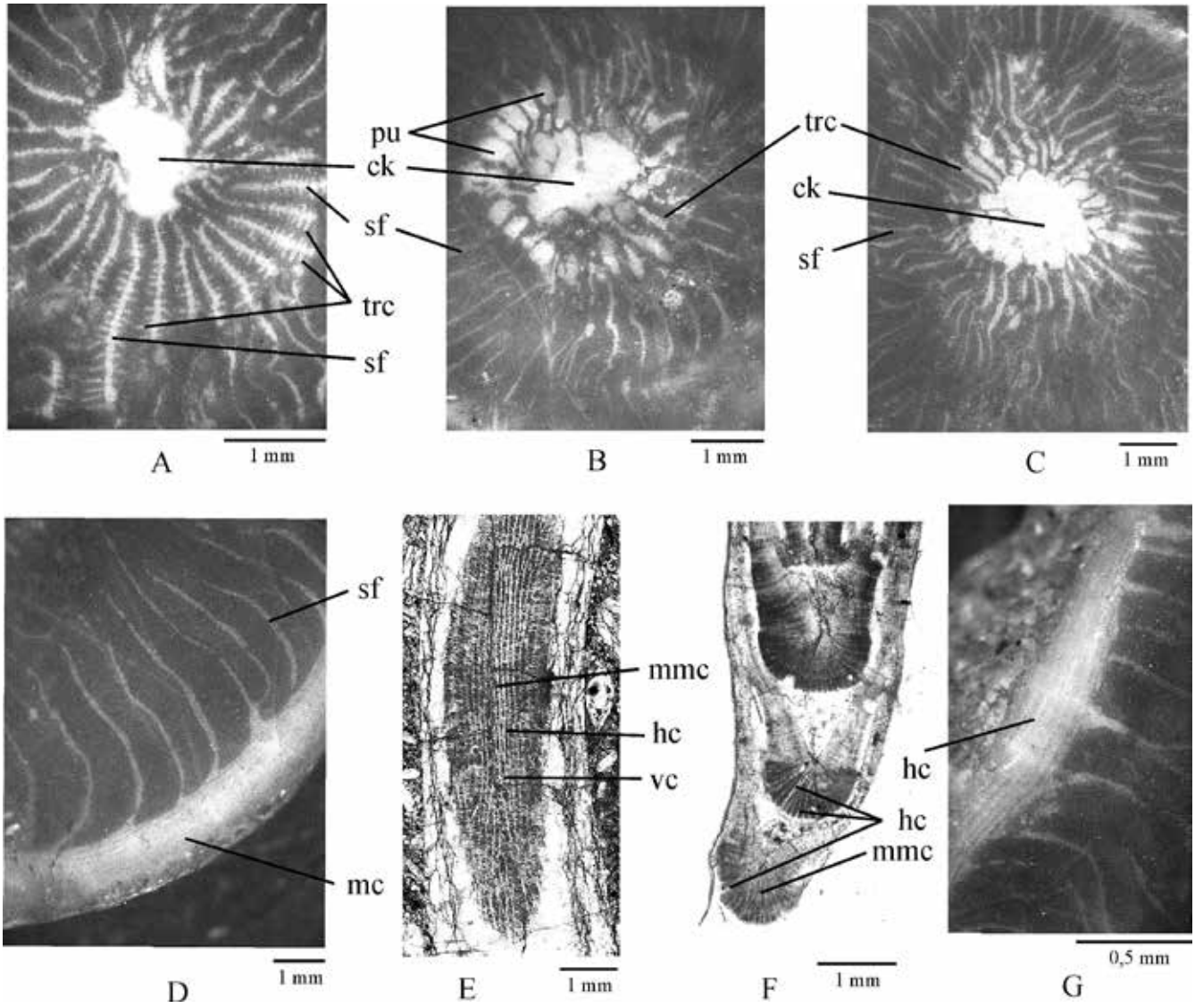

Fig. 6. Structural elements of ***Ranikothalia couisensis*** (d' Archıac). All figs. compiled from Sirel (1976; lev. X and XI). **A:** Central part of lateral view of B form (C. 12). **B:** Central part of lateral view, B form, enlarged from Pl. III, fig. 2. **C:** Central part of lateral view, B form, enlarged from Pl. III, fig. 3. **D:** Marginal cord in the last whorl, enlarged from Pl. III, fig. 2. **E:** The meshes of marginal canal network in the tangential srction, B form, enlarged from Pl. III, fig. 6, **F:** Last three whorls of the incomplete axial section, B form, from Pl. III, fig. 7. **G:** Marginal canals in the marginal cord of the last whorl, B form, (C.12). **Abbreviation: ck**: Amarphous, large central knob, **sf**: Septal filaments, **trc**: Trabecular canals, **mc**: Marginal cord, **mmc**: Meshes of marginal canal network, **pu:** Pustules, **hc:** Horizontal canals, **vc:** Vertical canals.

been described and figured as *N. couisensis* (d' Archiac) from Ilerdian of Coiza (aude), Montazels, Antugnac, Tremp basin by Schaub (1960); Schaub made use of the collection of d'Archiac, while he re-described *N. couisensis* d' Archiac Later, this species was transferred to *Ranikothalia* Caudri by the meshes of marginal cord network in the marginal cord of the axial sections and external ornamentation on the lateral views by Sirel (1976a, pl. XII, figs. 1, 3, 5, 8, 11, 12; pl. XIII, figs. 1,2). This species is here re-described detail by means of the new diagnostic structural elements provided from the new additional material of Sakarya section (Fig. 5).

Stratigraphic and Geographic Distribution: It is given in the chapter of co-occurring species *R. nuttalli* (Davies).

Ranikothalia daviesi Sirel and Deveciler sp. nov.
(Fig. 13: 1-13; Figs. 3, C; Fig. 7)

Operculina aff. *canalifera* (d' Archiac and Haime) Davies and Pinfold, 1937, p. 36, pl. V, fig. 20.

Nummulites murchisoni (Rutimeyer) Sirel, 1976a, p. 99, lev. X, şek. 5,7-9.

Origin of name: This species is dedicated to L.M. Davies

Holotype: Lateral view, B form, illustrated in Pl. IV, fig. 1 (label P. 41).

Paratype: *Illustrated* in Fig. 13: 2-13; labels are given in Fig. 13.

Remarks: Because of the existence of external ornamentation particularly around the amorphous central knob, trabecular canals (Fig. 7, B) and meshes of marginal canal network (Fig. 2; Fig. 3a, C), basal cover plate V in shape (Fig. 3b, D), *Nummulites murchisoni* (Rutimeyer) has been placed in the genus *Ranikothalia* Davies as a new species. *R. daviesi* n. sp. is identical with the isolated specimens *Operculina* aff. *canalifera* (d' Archiach) in Davies and Pinfold (1937, p. 36, pl. V, fig. 20) by the operculinoid test and the external ornamentation. The

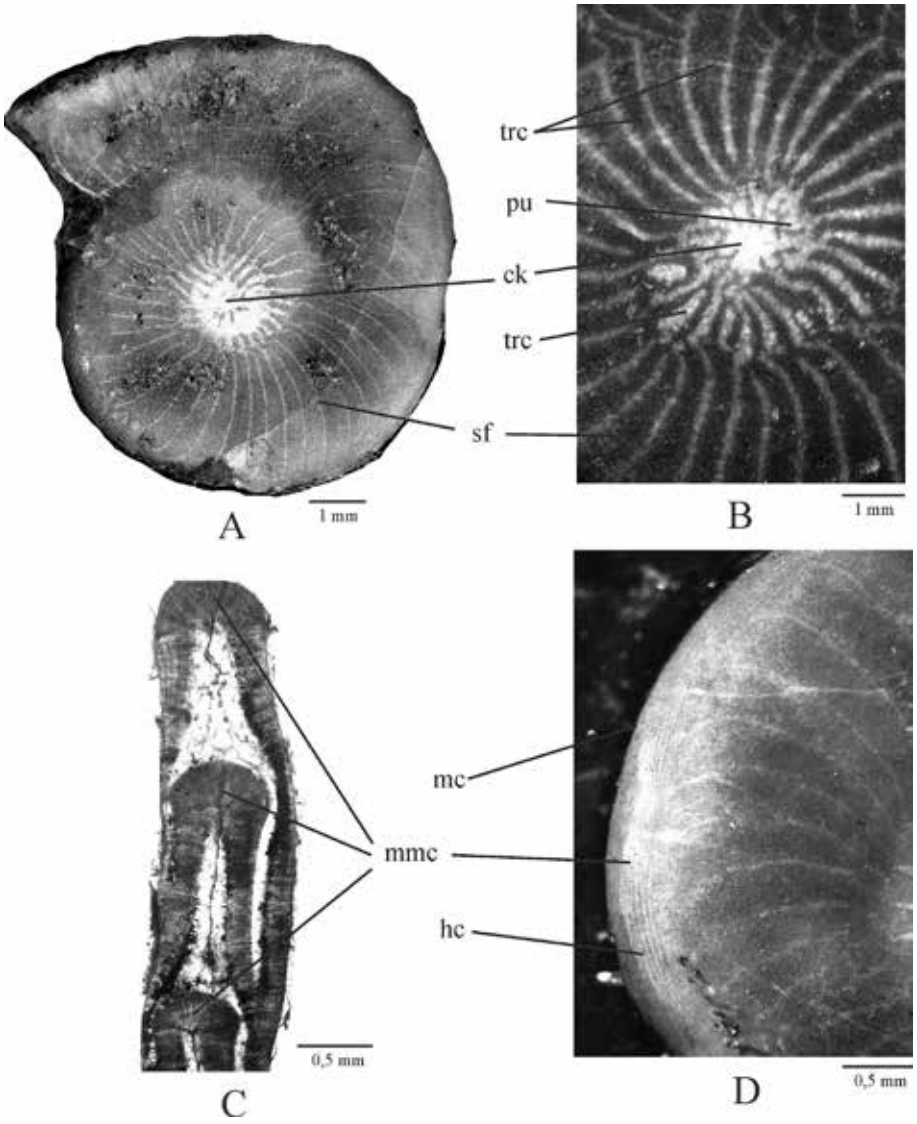

Fig. 7. Structural elements of ***Ranikothalia daviesi*** Sirel and Deveciler sp**.** nov. All figs. compiled from (Sirel, 1976, lev. X, şek. 5-9) and topotypes. **A:** Lateral view, B form, (P. 43), **B:** Central part of the lateral view, enlarged from the central part of Pl. VII, fig. 1, **C:** Three whorls of the axial section, enlarged from Pl. VII, fig. 3, **D:** Lateral view, enlarged from the margial cord of last whorl (P. 43c). **Abbreviation: mc**: Marginal cord, **mmc**: Meshes of marginal canal network, **hc**: Horizontal canals, **trc**: Trabecular canals, **pu**: Pustule, **ck**: Amarphous central knob, **sf**: Septal flaments.

new species differs from the type species *R. nuttalli* (d' Archiac) in possessing smaller operculinid test with loosely coiled last two whorls. It is distinguished from *R. couisensis* (d' Archiac) in its thin lenticular test, weakly developed external ornamentation around the shapeless small central knob and loosely coiled whorls (Fig. 12 and Fig. 13).

Material: 32 specimens, free, random and oriented sections from Sakarya section (Fig. 5).

Depository: Holotype and paratypes are deposited in the collection of Ankara University, Department of Gelological Engineering, under the labels shown in Fig. 13.

Type locality: Sakarya section (Fig. 5) S of Sakarya village, S of Polatlı town, SW Ankara, central Turkey. (map reference J28-a1, coordinate: 19 925-72 800; 19 825-72 374).

Type level: Early Eocene **(**middle-late Ilerdian (SBZ 8-9).

Description: The microspheric generation has a operculinid thin lenticular test with rounded periphery (Fig. 13: 1, 3, 5, 13). The external surface of the test is ornamented by relatively small central knob, developed marginal cord particularly at the last whorl and slightly curved septal filaments (Fig. 13: 1, 5, 10). The septal filaments pass over the marginal cord Fig. 13: 1, 5). The trabecular canals are well seen around the amorphous central oknob (Fig. 7, B). The diameter of the test ranges from 7.1 mm to 10 mm and the thickness from 1 mm to 1.6 mm. The chambers are subrectangular growing gradualy towards the periphery, the height of the chambers is two fold the width in the all whorls of test (Fig. 13: 1, 4, 6, 7-9, 11, 12). All the structural elements of the species are shown in (Fig. 2; Fig. 3a-b; Fig. 7). Number of septa in the whorls: 1st, 12-15; 2nd, 15-18; 3rd, 21-22; 4th, 22-25; 5th, 33-49

The megalospheric generation has a operculinid thin lenticular test with rounded periphery (Fig. 13: 11-13). The external test ornamentation is similar to that of the microspheric form. The diameter of the test ranges from 3.1 mm to 3.8 mm.

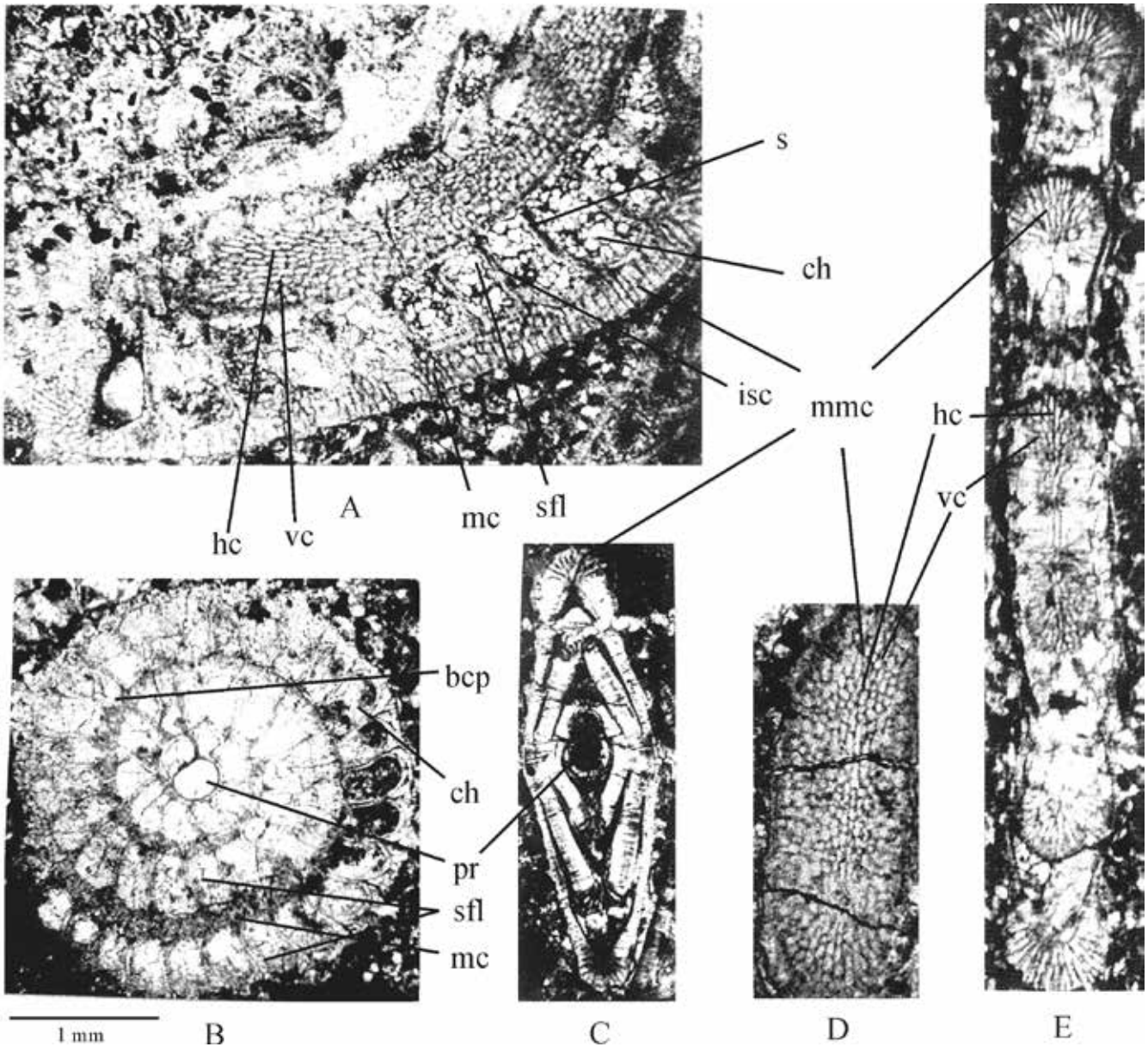

Fig. 8. Structural elements of ***Ranikothalia. polatliensis*** Sirel**,** all figs. compiled from (Sirel, 1998, pl. 64-65 and Sirel (2013, pl. V-VI). **A:** Tangential section of last two incomplete whorls, B form, showing connection between marginal canals and intraseptal canals, (30/5/59), **B:** Equatorial section, A form, (30/5/8), **C.** Axial section, A form, showing marginal canals in the marginal cord of upper ultimate whorl, (30/5/4), **D:** Tangential section, showing meshes of marginal canal network, (30/5/7), **E:** Subaxial section, B form, showing marginal canals in the marginal cords, (30/12/3). **Abbreviation: mc**: Marginal cord, **mmc**: Meshes of marginal canal network. **hc:** Horizontal canals, **vc:** Vertical canals**, s**: Septa, **ch**: Chamber, **pr**: Protochonch, **isc:** Intraseptal canal, **sfl:** Indistinct septal flap.

The thickness of the test is about 0.8 mm. The new species contains all the diagnostic structural elements of *Ranikothalia* Caudri (Fig. 2; Fig. 3a-b; Fig. 7 and Fig. 13: 1-13). Number of septa in the whorls: 1st, 11; 2nd, 18-22.

Stratigraphic and Geographic Distribution: *R. daviesi* n.sp. is associated with *R. couisensis* (d' Archiac), *R. nuttalli* (Davies), *A. polatliensis* Sirel, *A. sakaryaensis* Sirel, *A. decipiens* Schwager and *A. rotundata* Hottinger of middle-late Ilerdian age in the Sakarya section (Fig. 5).

Ranikothalia polatliensis Sirel, 2013
(Fig. 14: 1-12; Figs. 3a, D; Figs. 3b, E; Fig. 8)

Ranikothalia sindensis (Davies) Sirel, 1998, p. 105, pl. 64, figs. 1-13; pl. 65, figs. 1-7; pl. 66, fig. 13.

Ranikothalia polatliensis Sireli, 2013, p. 34-35, pl. V, figs. 6-9; pl. VI, figs. 1-13.

Re-description: The microspheric generation has a slightly inflated lenticular test with rounded periphery (Fig. 14: 11, 12). The diameter of the test ranges from 3.7 mm to more than 6.5 mm and the thickness from 0.7 mm to 1.1 mm. The subrectangular large chambers are lined up in 4-5 whorls (Fig. 14: 1, 11, 12). The height of the chambers are always greater than width (Fig. 14: 1). The interval of the whorl increases toward the last whorl (Fig. 14: 1). The marginal cord is strongly thickened, in which,

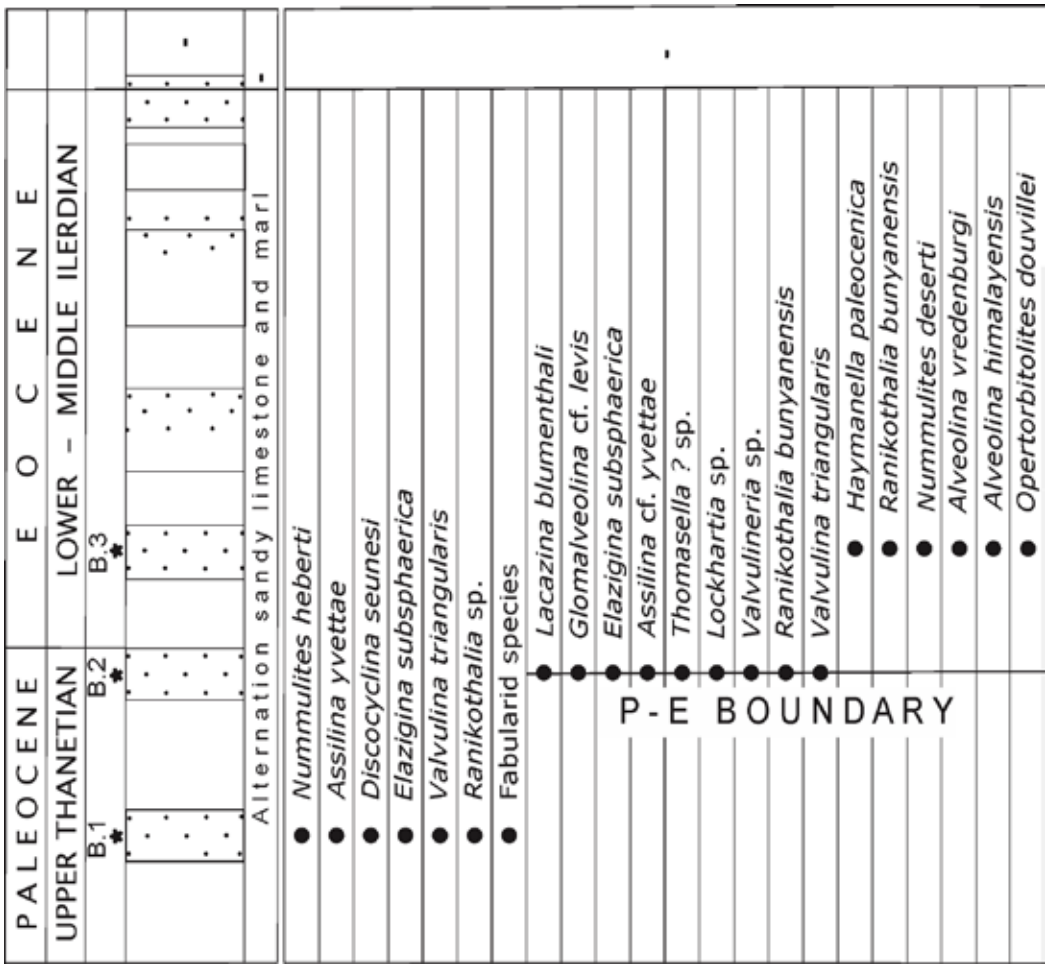

Fig. 9. Stratigraphic distribution of ***Ranikothalia bunyanensis*** Sirel in Bünyan section; compiled from Sirel (2015, Fig. 12), not scale.

numerous horizontal and vertical canals form the meshes of marginal canal network (Fig. 14: 1, Fig. 3a, D; Fig. 8, A, D, E;); the intraseptal canals are connected with the marginal canals (Fig. 8, A).

The megalospheric test is middle sized, inflated lenticular with rounded periphery (Fig. 14: 5, 6, 9, 10). The diameter of the test ranges from 2 mm to 3.1 mm and the thickness from 1 mm to 1,2 mm. The ovoid megalosphere (0.350-0,450 mm in diameter) is followed by semilunar second chamber (Fig. 14: 7, 8) and subrectangular chambers. The height of the chambers are greater than width (Fig. 14: 2-4, 7). The interval of the whorls increase gradually from the first to the last whorl. Number of septa in the whorls: 1st, 10-11; 2nd, 19-20; 3rd, 29.

Remark: The microspheric form of *R. polatliensis* Sirel differs from *Ranikothalia. sindensis* (Davies) in its smaller, thinner test, thightly coiled whorls with large chambers and well developed marginal cord with marginal sutural canals (Fig. 14: 1). The microspheric form differs from the type species *R. nuttalli* (Davies) and *N. couisensis* (d' Archiac) in possessing smaller test, thicker marginal cord with developed meshes of marginal canals network (Fig. 8, A, E).

Stratigraphic and Geographic Distribution: The locality of *Ranikothalia polatliensis* Sirel is located in the Kuşçu village, SE of Polatlı, SW Ankara, central Turkey, in which the spot sample sandy limestone contains aboundingly *Ranikothalia polatliensis* Sirel but it is completely devoid of foraminiferal species, so that its age can not be safely fixed. However the sandy limestone with *R. polatliensis* Sirel comformably ovelies the fluviatile sediments o f the Paleocene Kartal formation near the type locality. Considering the stratigraphic position of this sandy limestone, an Early Eocene age (Ilerdian) has been thought for *R. polatliensis* Sirel.

Ranikothalia bunyanensis Sirel, 2015
(Fig. 15: 1-8; Fig. 3a, F: Fig. 3b, F)

Ranikothalia bunyanensis Sirel, 2015 p. 29, pl. 23, figs. 13-20; pl.31, figs.11,12.

Re-description: The microspheric generation has a slightly biumbilicate, lenticular test with rounded periphery (Fig. 15: 4, 6). The diameter of the test ranges from 3.5 mm to 4.4 mm. and the thickness from 0.7 mm to 0.9 mm. The chambers arranged involute in the early stage but they become evolute in the last two whorl (Fig. 15: 4). The marginal cord is thickened and developed, in which, the meshes of marginal canals network recognized best, in the tangential sections (Fig. 15: 6, 7).

The diameter of the biumbilicate megalospheric test ranges from 3.2 mm to 3.55 mm and thickness from 0.9 mm to 1 mm. The spheric megalosphere (0. 240 - 0.260 mm in diameter) is followed by second chamber (0.300-0.350 mm in diameter) and subrectangular numerous chambers Fig. 15: 1, 2). The interval of the whorls increase gradually towards the last whorl. The

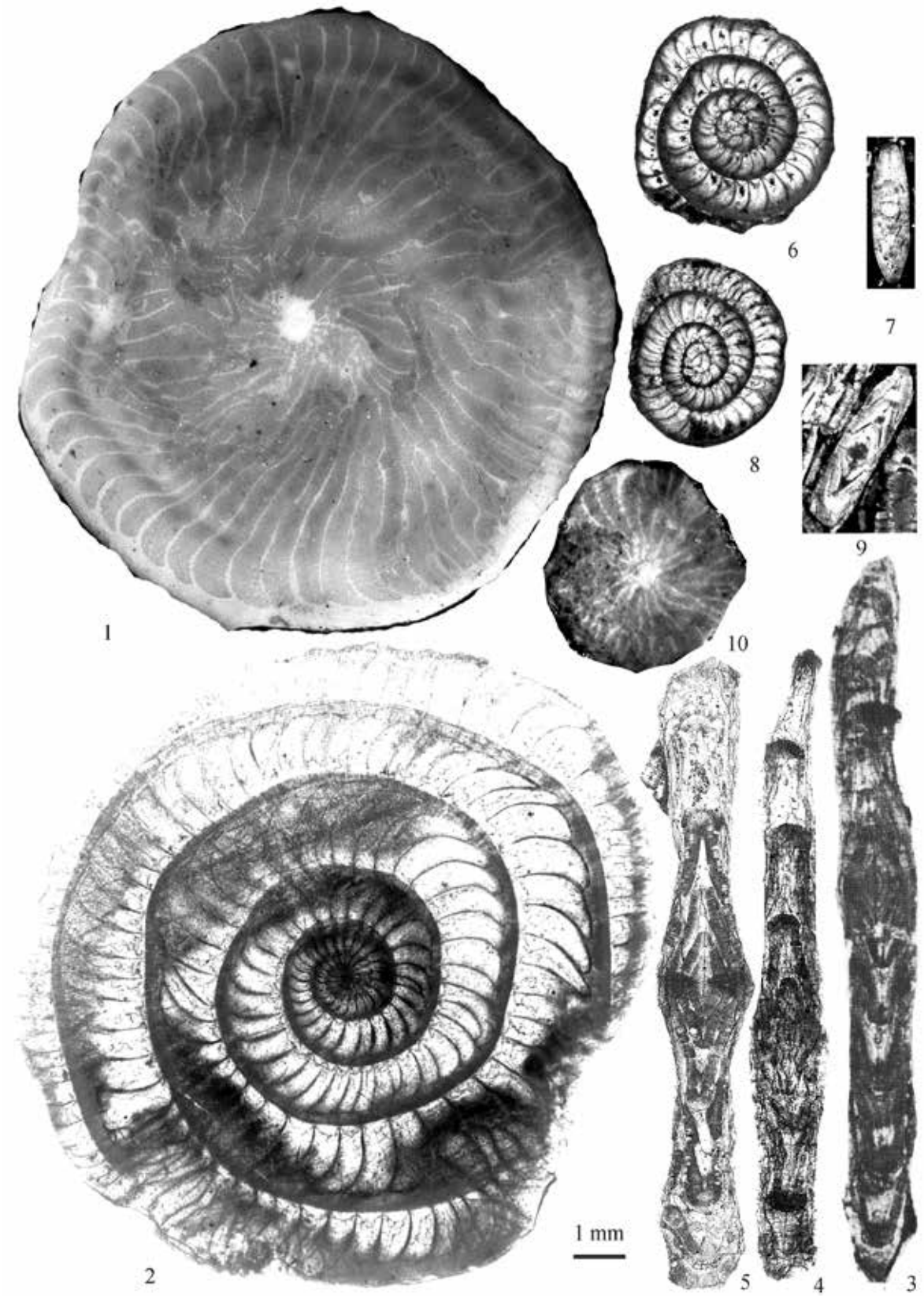

Fig. 10. ***Ranikothalia nuttalli*** (Davies, 1927): Middle-Late Ilerdian, all figs. from the Sakarya section (Fig. 5), compiled by Sirel (1976, pl. X, XI), and figs. 2,4 from Deveciler 2014; figs. 1-5 B form, figs. 6-10 A form**. 1**- Lateral view, showing thick marginal cord and slightly curved septal flaments, (P. 51), **2**- Incomplete equatorial section, showing basal cover plates V in shape, (Sk. 11/4/14), fig. **3**- Axial section, (P. 47), **4**- Incomplete axial section, (Sk. 11/1/6), **5**- Almost axial section, (P. 57), **6**- Equatorial section, showing basal cover plates V in shape , (S.8a), **7**- Axial section, (D-4)**, 8**- Equatorial section, (S.12a), **9**- Axial section, (A-1)**, 10**- Lateral view, showing trabecular canals as fissure on the slightly curved septal flaments, (S.19).

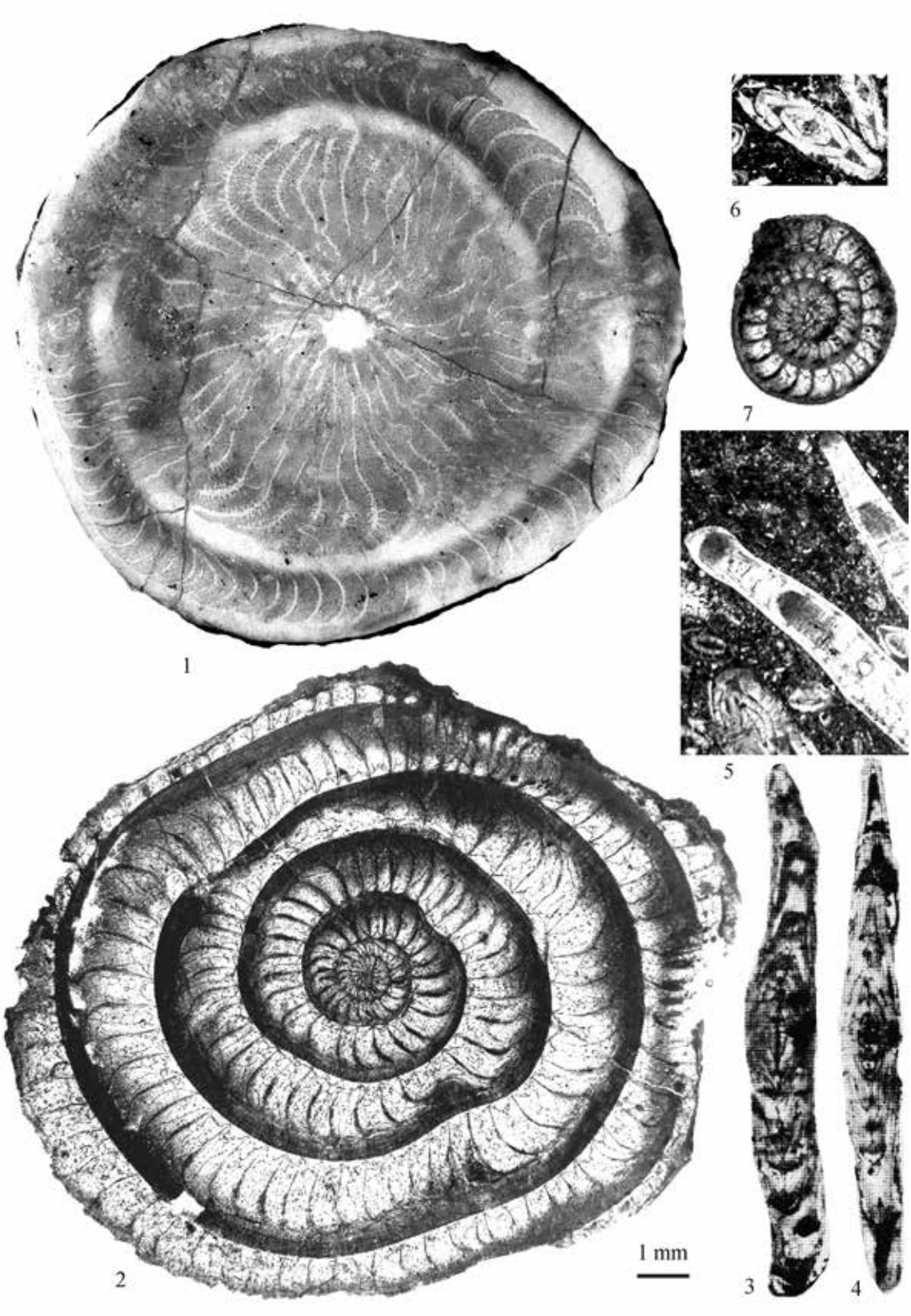

Fig. 11. ***Rankothalia nuttalli*** (Davies, 1927): Middle-Late Ilerdian, all the figs. from the Sakarya section (Fig. 5); figs. 1, 3, 4 from Sirel (1976, pl. X. XI), figs. 5-7 from the additional material and fig. 2 from Deveciler 2014; figs. 1-5 B form; 6-8 A form. **1-** Lateral view, showing slightly curved septal flaments with trabeculae and trabecular canals around the shapeless small central knob and thickened marginal cord, (P. 50), **2-** Equatorial section, showing cover plates V in shape, (Sk 11/4/30), **3-** Axial section, (P. 54), **4-** Axial section, (P. 53), **5-** Tangencial sections of two specimens, showing reticulation of the marginal canals, (B-3), **6-** Axial section, (G.2), **7-** Equatorial section, showing basal cover plates V in shape, (S. 9a).

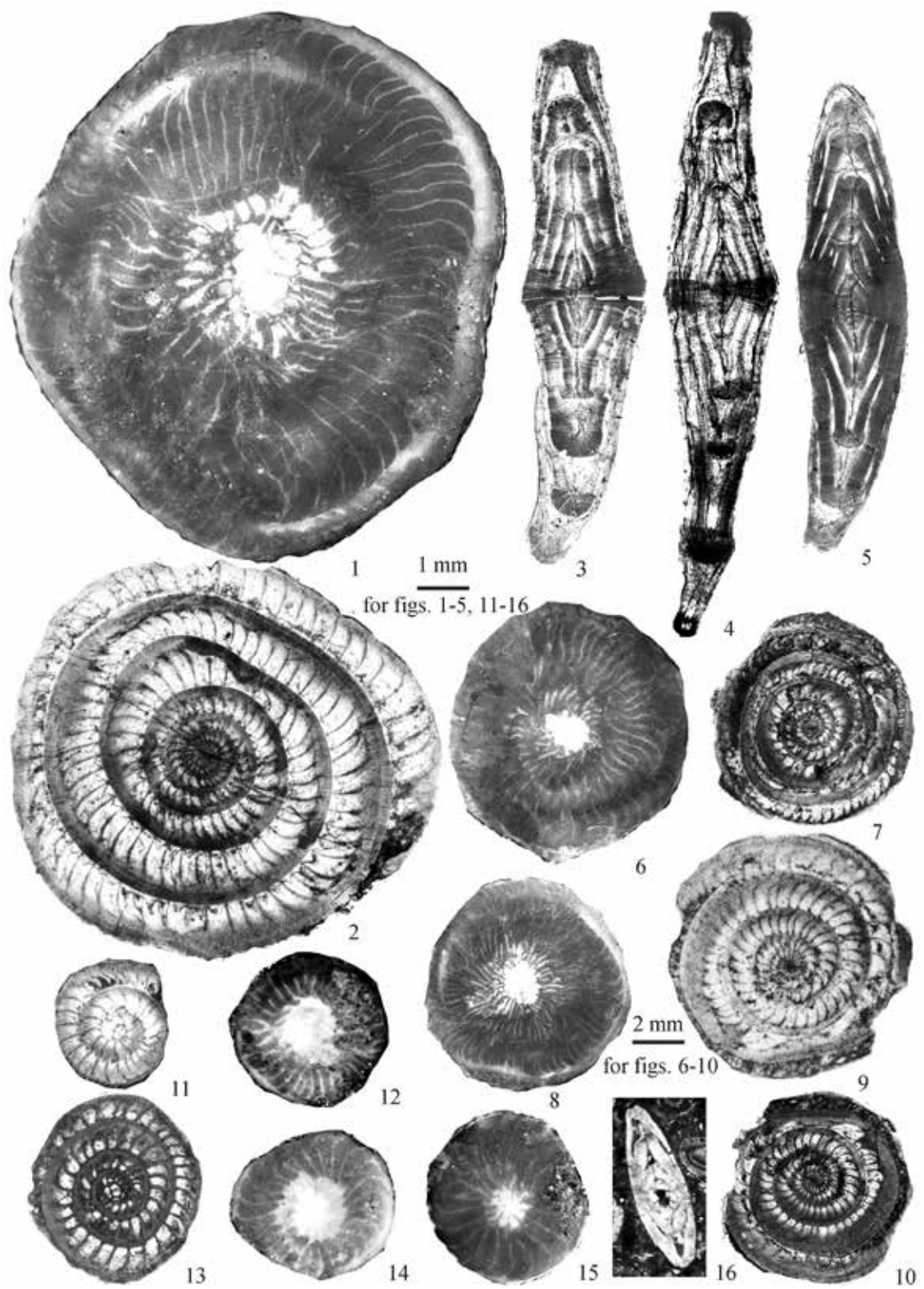

Fig. 12. ***Ranikothalia couisensis*** (d' Archiac, 1866): Middle-late Ilerdian, all figs. from the Sakarya section (Fig. 5), figs. 1, 3, 5-9 compiled by Sirel (1976), pl. X, XI; figs. 2,4 from Deveciler (2014) and figs. 10-16 from the additional materials colleted from same locality; figs. 1-10 B form; figs. 11-16 A form. **1-** Lateral view, showing large pustules and trabecular canals around the large amorphous central knob, slightly curved septal flaments and thick marginal cord, (P. 67), **2-** Equatorial section with thightly coiled whorls in accordance with *R. nuttalli* (DAVIES) and *R. daviesi* n.sp., showing cover plate V in shaped , (Sk. 11/4/19), **3-** Axial section with inflated test (P. 70), **4-** Axial section with inflated test, (Sk. 11/4/28), **5-** Inflated axial section, (P. 65), **6-** Lateral view, (P. 60), **7-** Equatorial section, (P. 68), **8-** Lateral view, (P. 64), **9-** Equatorial section, (P. 66), **10-** Equatorial section, (C. 6), **11-** Equatorial section, (S. 11 b), **12-** Lateral view with large amorphous central knob (S. 17), 13- Equatorial section, (S. 8c), **14-** Lateral view with large amorphous central knob , (S. 18), **15.** Lateral view, (C. 9), **16-** Axial section, (D.2). (Scale bar 1 mm and 2 mm)

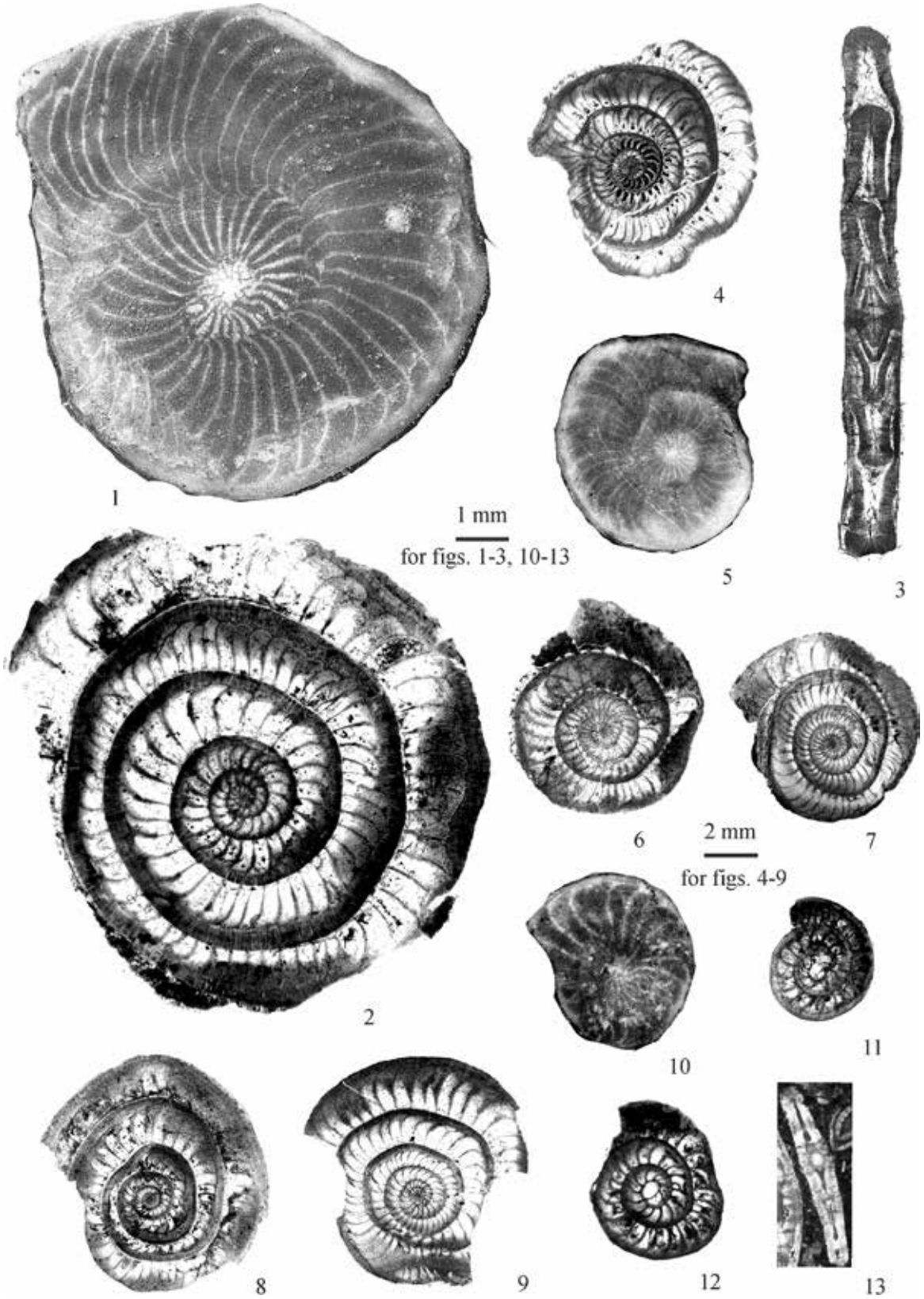

Fig. 13. ***Ranikothalia daviesi*** **Sirel and Deveciler** sp. nov.: Middle-Late Ilerdian, all figs. from the Sakarya section (Fig. 5), figs. 1,3,5 compiled by Sirel (1976, pl. X); the others topotypes, figs. 1-9 B form, 10-13 A form. **1-** Lateral view of Operculinid test, showing trabecular canal system as fissure, around the shapeless small central knob and slightly curved septal flaments, (P. 41), **2-** Equatorial section, showing basal cover plate V in shape, (S. 2), **3-** Axial section of thin lenticular test with operculinid whorls, (P. 39), **4-** Incomplete equatorial section, (S. 3), **5-** Lateral view, showing operculinid test, (P. 42), **6-** Equatorial section, (S. 7), **7-** Equatorial section, showing thin cover plates V in shaped, enlarged in Fig. 3, (S. 6), **8-** Incomplete equatorial section of small specimen, (S. 5), **9-** Incomplete equatorial section, (S. 1), **10-** Lateral view, (S. 15), **11-** Equatorial section, (S. 14c), **12-** Equatorial section, (S. 13a), **13-** Axial section, (A. 2).

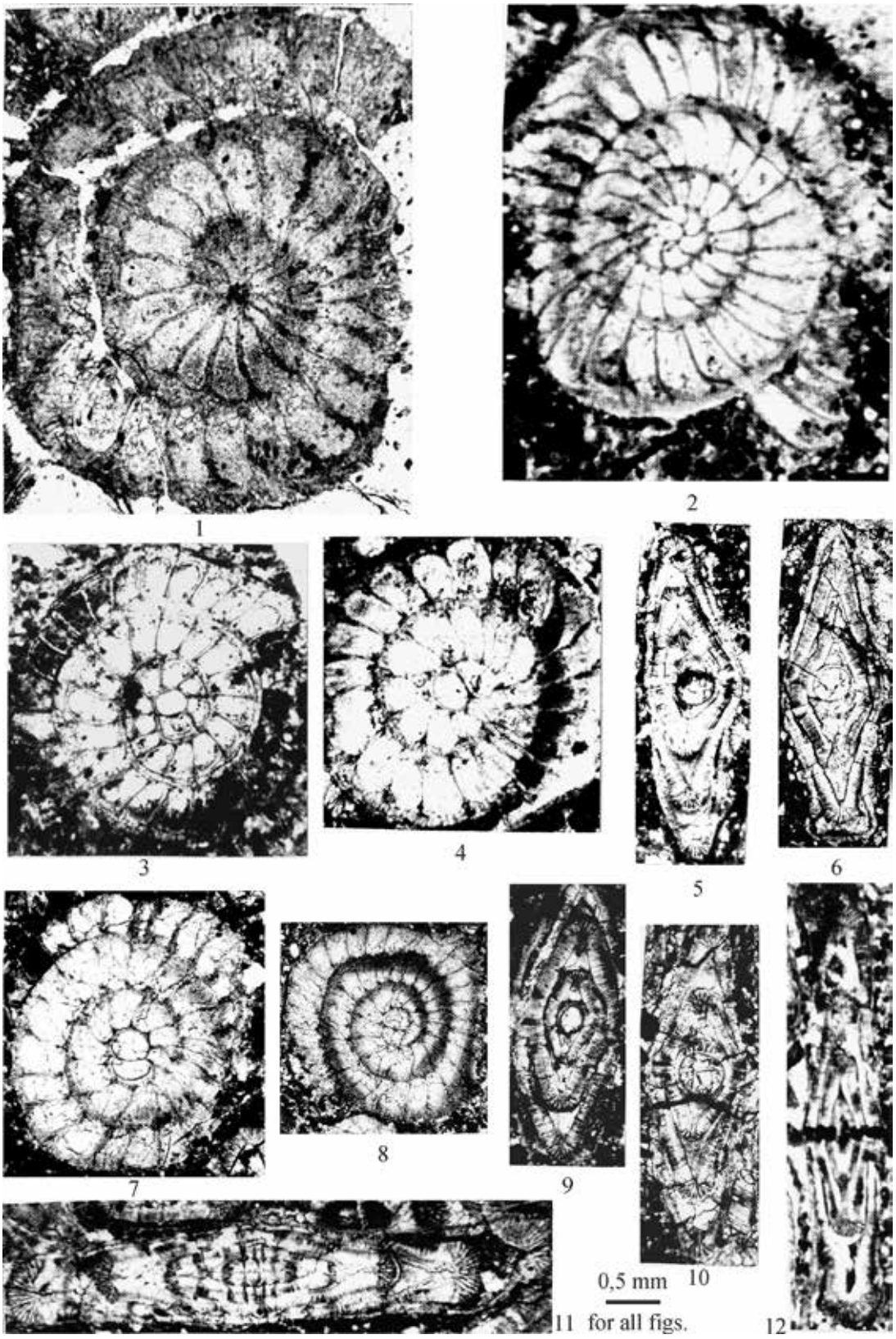

Fig. 14. ***Ranikothalia polatliensis*** Sirel, 2013: Ilerdian, all figs. compiled from Sirel (1998, pl. 64-65), spot sample, collected from the Kuşçu village, S of Polatlı, SW of Ankara, central Turkey (Fig. 1), all figs. megalospheric form except figs. 1, 11,12 microspheric form. **1-** Almost equatorial section, showing meshes of marginal canal network and septal flap, (30/5/1), **2-** Almost equatorial section, (30/7/2), **3-** Equatorial section , (30/5/2)**, 4-** Equatorial section, showing basal cover plate V in shape, (30/5/4)**., 5-** Axial section, (30/5/10), **6-** Axial section, (30/5/9), **7-** Incomplete equatorial section, (30/5/5), **8-** Equatorial section, (30/5/12), **9-** Axial section, (30/5/4), **10-** Axial section, (30/5/11), **11-** Subaxial section, showing marginal canals, (30/5/13), **12-** Almost axial section, (30/7/2).

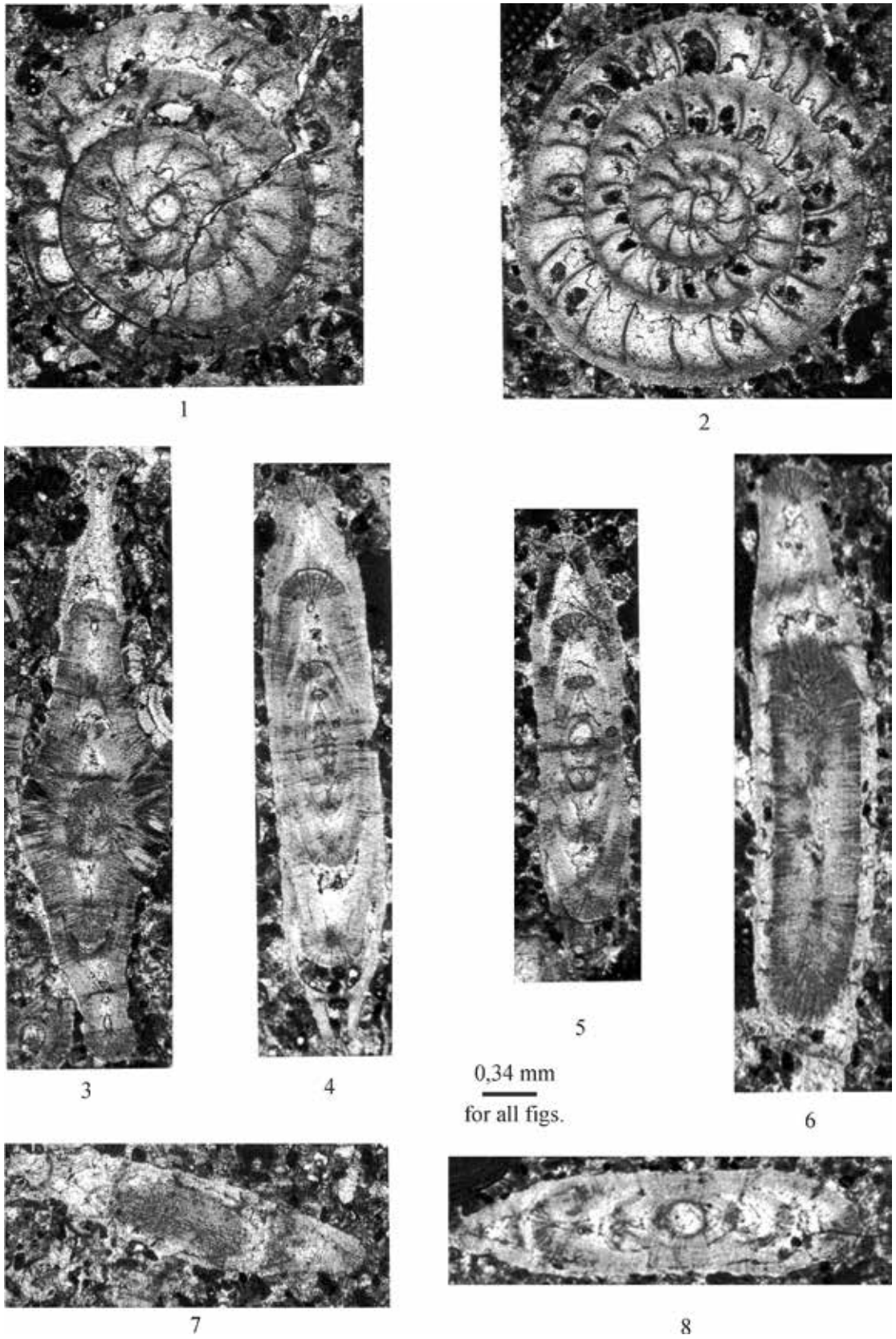

Fig. 15. ***Ranikothalia bunyanensis*** Sirel, 2015:, Thanetian-Ilerdian boundary, all figs. from Bünyan section (Fig. 9), compiled from Sirel (2015, Fig. 12, pl. 23 and 31, figs 1, 2, 5, 7, 8 A form; figs. 3, 4, 6 B form. **1-** Equatorial section, with the marginal canals in the thickened septum, (B. 3/6/6), **2-** Equatorial section, showing basal cover plate V in shape, (B. 3/6/4), **3-**Subaxial section of *Ranikothalia* sp., (B. 2/7/2), **4-** Subaxial section, (B. 3/1/7), **5-** Axial section, (B. 3/1/6), **6-** Tangential section, showing the meshes of marginal canal network inner whorl of the section, (B. 2/1/2), **7-** Tangential section, showing the meshes of margianal canal network inner whorl, (B.2/1/2), **8-** Centered axial section, (B. 3/2/1).

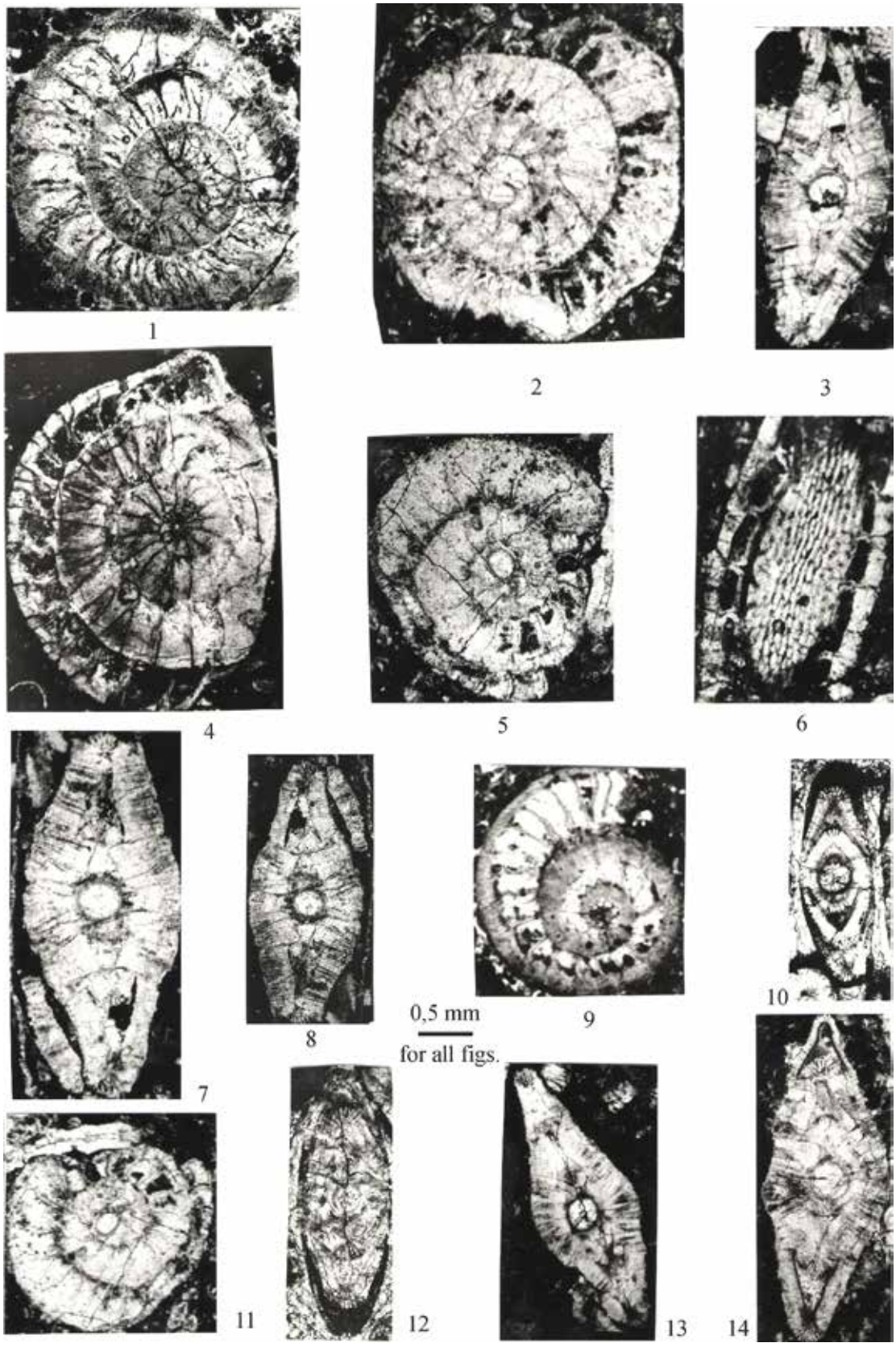

Fig. 16. ***Ranikothalia solimani*** Butterlin and Monod, 1969: Late Thanetian, all figs. from spot samples, Saray village, NE of Van (Fig. 1); megalospheric form, compiled from Sirel (1998, pl. 66). **1-** Equatorial section, showing cover plate and septal flap, (95/1a), **2-** Equatorial section, slightly oblique, (28/1), **3-** Axial section, (15/9), **4-** Incomplete equatorial section, (42/1), **5-** Incomplete equatorial section, (60/3), **6-** Tangential section, showing meshes of marginal canals network inner whorl, (30/1), **7-** Axial section, (10/1), **8-** Axial section, (30/1), **9-** Equatorial section with thick marginal cord, (13/3), **10-** Axial section of *Ranikothalia* sp., (92/2), **11-** Badly preserved equatorial section, (18/2), **12-** Axial section, (97/3), **13-** Axial section, (66/1), **14-** Axial section, (94/1).

height of the chambers are greater than the width. There are 28 chambers in the last whorl of the equatorial section measured 3.55 mm in diameter (Fig. 15: 2). Number of septa in the whorls: 1st, 10-12; 2nd, 18-20; 3rd, 29.

Remark: The megalospheric form of *R. bunyanensis* SIREL differs from the *R. polatliensis* Sirel in its smaller and flattened biumbilical test. In the same way, the microspheric *R. polatliensis* Sirel is distinguished from the species of B form in possessing larger test and loosely coiled whorls. Megalospheric *R. bunyanensis* Sirel differs from *Ranikothalia solimani* Butterlın and Monod, in that *R. bunyanensis* Sirel has a biumbilicate flat test instead of inflated test (compare with Fig. 15: 4 with Fig. 16: 7, 8).

Stratigraphic and Geographic Distribution: *Ranikothalia bunyanensis* Sirel is associated with *Lacazina blumenthali* Reichel and Sigal, *Glomalveolina* cf. *levis* Hottınger, *Elazigina subsphaerica* (Sirel), *Assilina* cf. *yvettae* Schaub, *Thomasella* sp., *Lockhartia* sp., *Valvulina triangularis* d' Orbigny, *Valvulineria* sp. This foraminiferal fauna occurs in the transitional sandy limestone beds (Fig. 9, B.2). It underlies sandy limestone beds (Fig. 5, B. 3) with, *Alveolina vredenburgi* Davies, *Alveolina himalayensis* Sheng and Zhang, *Nummulites deserti* De La Harpe and *Opertorbitolites douvilléi* (Nuttall) *Elazigina subsphaerica* (Sirel), *Haymanella paleocenica* Sirel of early Ilerdian age; and it overlies sandy limestone beds (Fig. 5, B. 1) with *Nummulites heberti* (Munier-Chalmas), *Assilina yvettae* Schaub, *Discocyclina seunesi* Douvillé, *Elazigina subsphaerica* (Sirel), *Valvulina triangularis* D' ORBIGNY, *Ranikothalia* sp. and fabularid species of Thanetian age

Ranikothalia solimani Butterlin and Monod, 1969
(Fig. 16: 1-14; Fig. 3, E)

Ranikothalia solimani Butterlin and Monod, 1969, p. 598, pl. I, figs. 1-4; pl. II, figs. 3-6.

Ranikothalia sp. 1, Sirel, 1998, p. 107, Pl. 66, figs. 1-12.

Ranikothalia cf. *sindensis* (Davies) Sirel, 1998 pl. 66, figs. 14, 15.

Description: The megalospheric test is small inflated lenticular with rounded perperiphery (Fig. 16: 3, 7, 8, 13, 14). The diameter of the test ranges from 2.5 to 3.5 mm and the thickness from 1 to 1.5 mm. The spheric megalosphere (0.275-0.400 mm in diameter) is followed by numerous subrectangular chambers increasing gradually toward the penultimate whorl, but, they increase suddenly in the last whorl (Fig. 16: 1, 2). The interseptal foramen, intraseptal canals, septal flap and cover plate are present (Fig. 16: 1). The one tangential section (Fig. 16: 6) shows that the network of the marginal canals are observed in the septum (Fig. 16: 6) The chamber height is greater than the width, There are 30 subrectangular chambers in the last whorl measured 3.1 mm in diameter (Fig. 16: 1). Number of septa in the whorls: 1st, 14; 2nd, 26-28; 3rd, 28.

Remarks: The test form, course of the whorls, proportion of the test: rates of diameter/thickness and chamber height/width of here described specimens (Fig. 16: 3, 7, 8) are similar to that of *R. solimani* Butterlin and Monod (1969, pl. I, figs. 1,4).

Stratigraphic and Geographic Distribution: It occurs in the Thanetian limestone blocks within the ophiolitic melange, near the Saray village, N of Van (Fig. 1). It is associated in these blocks with *Karsella hottingeri* SIREL, *Miscellanea juliettae* Leppig, *Miscellanea yvettae* Leppig and orthophragminid species.

This species occurs in the other exotic limestone block located at the Kızıltepe, 2 km north of the Saray village, Van, eastern Turkey with *Glomalveolina primaeva* (Reichel), *Vania anatolica* Sirel and Gündüz, *Sakesaria cotteri* Davies, *Sakesaria dukhani* Smout, *Postbrockinella sarayensis* (Sırel, Gündüz, Acar) and *Fallotela* sp. of Thanetian age.

On the contrary, *R. solimani* Butterlin and Monod has been reported from the Late Paleocene-Early Eocene (Ilerdian) limestone of the, Sülemaniye village, Beyşehir town, N Antalya, S Turkey (type locality) with the *Lacazina. blumenthali* Reichel and Sigal, *Saudia labyrintica* (Grimsdale), *Lockhartia* sp., *Discocylina* sp., *Miscellanea* sp. and *Alveolina* sp. (Butterlin and Monod, 1969, Fig. 2).

CONCLUSIONS

Caudri (1944) did not use any photograph to illustrate the structural elements of *Ranikothalia* Caudri while he created the new genus, and, as a result, the diagnostic structural elements of the genus could not be reliably described in the later paleontological studies. This created misunderstanding in the descriptive paleontological research concerning the species of *Ranikothalia* Caudri. and the other species of Nummulitidae De Blainville. This study was aimed to describe the structural elements of *Ranikothalia* Caudri. The diagnostic structural elements of the genus such as external ornamentation, especially around the amorphous central knob the meshes of marginal canal network (Fig. 3a), trabecular canal system and basal cover plate V in shape are described and illustrated from the free specimens, orientiated equatorial, axial sections and random oblique, tangential sections. *Ranikothalia nuttalli* (Davies), *Ranikothalia couisensis* (d' Archiac), *Ranikothalia daviesi* n.sp., *Ranikothalia polatliensis* Sirel, *Ranikothalia bunyanensis* Sirel and *Ranikothalia solimani* Butterlin and Monod have been re-described and re-figured in the light of the above mentioned structural elements.

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REFERENCES

Archiac, A. d' 1866. Faune tertiaire infèrieure. *In*: de Tchihatcheff. *Asie Mineure, Paléontologie*.

Arni, P. 1966. Contribution to the history of growth of the Chordoperculinoides shell. *Eclogae Geologicae Helvetiae*, **59**(1): 338-346.

Blondeaue, A. 1972. *Les Nummulites*: Science de la Terra, Librairie Vuibert, Paris, 254.

Butterlin, J. and Monod, O. 1969. Biostratigraphie (Paléocene a Eocéne moyen) d'une coupe dans le Taurus de Beyşehir (Turquie), Etude des "*Nummulites* cordelées" et révision de ce group. *Eclogae Geologicae Helvetiae*, **62**(2): 583-604.

Caudri, C. M. B. 1944. The larger foraminifera from San Juan de los Morros, State of Guarico, Venezuela. *Bulletins of American Paleontology*, **28**: 351-404.

Dacı-Dizer, A. 1953. Contribution à l'Etude Paleontologique du Kastamonu. *İstanbul Üniversitesi Fen Fakültesi Mecmuası*, serie B, volume 18, no. 3-4, 207-299.

Davies, L. M. 1927. The Ranikot beds of Thal. *Quarterly Journal of the Geological Society*, **83**: 260-290.

Davies, L. M. and Pinfold, E. S. 1937. Eocene beds of the Punjab, Salt range. *Paleontologia Indica*, **24**(2): 1-79.

Deveciler, A. 2014. Haymana-polatlı havzası Nummulites Lamarck ve Assilina d'Orbigny (Nummulitidae familyası) türlerinin tanımlanması

ve bunların biyostratigrafisi. *Unpublished Ph. D Thesis, Ankara Üniversitesi, Ankara.*

Hottinger, L. 1977. *Foraminiféres operculiniformes*. Memoire du Muséum National d'Histoire Naturelle, Serie C, **40**: 159.

Hottinger, L. 2006. Illustrated glossary of terms used in foraminiferal research. *Carnets de Géologie – Notebooks on Geology*.

Loeblich, A. and Tappan, H. 1987. *Foraminiferal Genera and their Classification*. New York (Von Nostrant Reinhold), New York.

Muller-Merz, E. 1980. Strukturananalyse ausgewahiter rotaloider Foraminiferen. *Schweiz Palaontologie Abhanlungen*, **101**: 5-70.

Nagappa, Y. 1959. Foraminiferal biostratigraphy of the Cretaceous-Eocene succession in the India-Pakistan-Burma region. *Micropaleontology*, **5**(2): 145-192.

Schaub, H. 1960. Über einige nummuliten und Assilinen er Monographie und der Sammlung d' Archiac. *Eclogae Geologicae Helvetiae*, **53**(1): 443-45.

Serra-Kiel, J., Hottinger, L., Caus, E., Drobne, K., Ferrandez, C., Jauhri, A.K., Less, G., Pavlovec, R., Pignatti, J., Samso, J. M., Schaub, H., Sirel, E., Strougo, A., Tambareau, Y., Tosquella, J. and Zakrevskaya, E. 1998. Larger foraminiferal biostratigraphy of the Tethyan Paleocene and Eocene*. Bulletin de la Société Géologique de France*, **169**: 281-299.

Sirel, E. 1975. Polatlı (GB Ankara) Güneyinin Stratigrafisi. *Bulletin of the Geological Society of Turkey*, **18**: 181-192.

Sirel, E. 1976*a*. Polatlı (GB Ankara) güneyinde bulunan *Alveolina, Nummulites, Ranikothalia* and *Assilina* cinslerinin bazı türlerinin sistematik incelemeleri. *Bulletin of the Geological Society of Turkey*, **19**: 89-102.

Sirel, E. 1976b. Description of six new species of *Alveolina* found in the south of Polatlı (SW Ankara) region. *Bulletin of the Geological Society of Turkey*, **19**: 19-22.

Sirel, E. 1998. *Foraminiferal description and biostratigraphy of the Paleocene-Lower Eocene shallow-water limestones and discussion on the Cretaceous-Tertiary boundary in Turkey*. General Directorate of Mineral Research and Exploration Monography, serie 2, **117**.

Sirel, E. 2013. Descriptions of two new families, three new speciies and re-descriptıon of four known genera and one subfamily from the larger benthic foraminifera of Paleocene in Turkey. *Bulletin of the Mineral Research and Exploration*, **146**: 27-53.

Sirel, E. 2015. *Reference section and Key localities of the Paleogene stags and discussion on C-T, P-E and E-O Boundaries by the very shallow-shallow water Foraminifera in Turkey*. Ankara Üniversitesi Basmevi, **461**.

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