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Supplemental skeleton revision of Pseudorbitoididae M.G. Rutten, 1935 from mainly Tethyan and partly American provinces

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ABSTRACT

The nine genera here described from the Tethyan and four genera from the American and Caribbean provinces have previously been placed within different families of Foraminifera by various authors, namely, *Arnaudiella* DOUVILLÉ, *Sirtina* BRÖNNIMANN and WIRZ, *Vanderbeekia* BRÖNNIMANN and WIRZ, *Helicorbitoides* MacGILLAVRY, *Dizerina* MERİÇ, *Sirelella* ÖZGEN-ERDEM and *Cideina* SİREL were shown in Lepidorbitoitidae VAUGHAN; *Postorbitokathina* SİREL and *Orbitokathina* HOTTINGER in Rotaliidae EHRENBERG; *Helicolepidina* TOBLER, *Helicosteginopsis* CAUDRI, *Eulinderina* BARKER and GRIMSDALE and *Helicostegina* BARKER and GRIMSDALE in Lepidocyclinidae SCHEFFEN, in spite of the fact that all of them have characteristics of both rotaliid early and orbitoidal adult stages. Thus the growth stages such as rotaloid early and orbitoidal adult stages of the aforementioned general correspond with the known family Pseudorbitoididae RUTTEN and its type genus *Pseudorbitoides* DOUVILLÉ. Therefore the thirteen genera found in great abundance in the Tethyan, American and Caribbean provinces have been transferred to Pseudorbitoididae RUTTEN.

1. Introduction

The main purpose of this study is to revise the family Pseudorbitoididae RUTTEN and some of the genera from the Tethyan and American provinces (Figure 1).

The Maastrichtian foraminiferal genus *Cideina* SİREL has been placed originally within the family Lepidorbitoididae VAUGHAN; however, due to the both rotaliid and orbitoidal stages, Sirel (1991, Plates I, II) proposed it has typical trochospiral early chambers with pillars and radial canals (funnels).

Sirel (1991) proposed a new family for the new genus *Cideina* SİREL, as well as the known genera *Sirtina* BRÖNNIMANN and WIRZ, *Vanderbeekia* BRÖNNIMANN and WIRZ, and *Orbitokathina* HOTTINGER. This insight gives us an opportunity to find, in particular, a suitable family for the genera (Plates I-VI). As a result of this investigation, the family Pseudorbitoididae RUTTEN (type species *Pseudorbitoides trechmanni* DOUVILLÉ in Plate I) was choosen as the proper family for the here described and figured genera (Plate I-VI) through the common characters such as rotaloid early and orbitoidal adult stage.

So, the following nine genera *Arnaudiella* DOUVILLÉ (Plate I, Figures 1, 3), *Sirtina* BRÖNNIMANN and WIRZ (Plate II, Figures 4, 8),

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1 *Postorbitokathina* SIREL, 2012 Type species: *Orbitokathina saravi* SIREL, GÜNDÜZ & ACAR, 1983 - Turkey (Than.)	9 *Sirelella* ÖZGEN-ERDEM, 2002 Type species: *Sirelella safranboluensis* ÖZGEN-ERDEM, 2002 - Turkey (Lut.)
2 *Arnaudiella* DOUVILLÉ, 1907 Type species: *Arnaudiella grossouvrei* DOUVILLÉ, 1907 - France (Camp.)	10 *Pseudorbitoides* DOUVILLÉ, 1922 Type species: *Pseudorbitoides trechmanni* DOUVILLÉ,1922 - Jamaica (Camp.-Maast.)
3 *Sirtina* BRÖNNIMANN & WIRZ, 1962 Type species: *Sirtina orbitoidiformis* BRÖNNIMANN & WIRZ, 1962 - Iran, Libya, Turkey (Maast.)	11 *Helicolepidina* (TOBLER, 1922) Type species: *Lepidocyclina (Helicolepidina) spiralis* TOBLER (1922) - Trinidad, Venezuella (Eocene)
4 *Vanderbeeckia* BRÖNNIMANN & WIRZ, 1962 Type speces: *Vanderbeeckia trochoidea* BRÖNNIMANN & WIRZ, 1962 - Iran (Maast.)	12 *Orbitocyclina* VAUGHAN, 1929 Type species: *Lepidorbitoides minima* DOUVILLÉ, 1927 - Mexico (Camp.-Maast.)
5 *Cideina* SIREL, 1991 Type species: *Cuvillierina soezerii* SIREL, 1973 - Turkey (Late Maast.)	13 *Eulinderina* BARKER & GRIMSDALE, 1936 Type species: *Planorbulina (Planorbulinella) guayabalensis* NUTTALL, 1930 - Mexico (mid.-late Eoc.)
6 *Helicorbitoides* MACGILLAVRY, 1963 Type species: *Pseudorbitoides longispiralis* PAPP & KÜPPER, 1953 - Sweden, Austria, Turkey (Camp.)	14 *Helicostegina* BARKER & GRIMSDALE, 1936 Type species: *Helicostegina dimorpha* BARKER & GRIMSDALE, 1936 - Cuba, Trinidad, Mexico (mid.-late Eoc.)
7 *Orbitokathina* HOTTINGER, 1966 Type species: *Orbitokathina vonderschimiti* HOTTINGER, 1966 - Spain (Conia.)	15 *Sulcorbitoides* BRÖNNIMANN, 1954 Type species: *Sulcorbitoides pardoi* BRÖNNIMANN, 1954 - Cuba, U.S.A. (Texas) (Camp.)
8 *Dizerina* MERİÇ, 1978 Type species: *Dizerina anatolica* MERİÇ, 1978 - Turkey (Maast.)	16 *Helicosteginopsis* CAUDRI, 1975 Type species: *Helicostegina soldadensis* GRIMSDALE, 1941 - Trinidad (Eocene)

Figure 1- Location map, showing the geographic distribution of the genera in the Tethyan and American provinces.

Vanderbeekia BRÖNNIMANN and WIRZ (Plate II, Figure 9), *Helicorbitoides* MacGILLAVRY (Plate III, Figures 1-4), *Orbitokathina* HOTTINGER (Plate III, Figures 5, 8), *Dizerina* MERİÇ (Plate III, Figures 9, 11), *Cideina* SİREL (Plate IV, Figures 1, 4), *Sirelella* ÖZGEN-ERDEM (Plate IV, Figures 5, 7) and *Postorbitokathina* SİREL (Plate IV, Figures 8, 11) from the Tethys region and five genera viz, *Helicolepidina* TOBLER (Plate V, Figures 1, 4), *Orbitocyclina* VAUGHAN (Plate V, Figures 5, 6), *Eulinderina* BARKER and GRIMSDALE (Plate V, Figures 7, 10), *Helicostegina* BARKER and GRIMSDALE (Plate VI, Figures 1, 3), *Sulcorbitoides* BRÖNNIMANN (Plate VI, Figures 4, 7) and *Helicosteginopsis* CAUDRI (Plate VI, Figures 8, 11) from the American province were transferred from the improper old families to the Pseudorbitoididae RUTTEN.

2. Systematic Palaeontology

The suprageneric classification is based particularly on Loeblich and Tappan (1987) and BouDagher-Fadel (2008). The genera are arranged in the text in chronological order, except for the type genus *Pseudorbitoides* DOUVILLÉ, 1907. The following diagnostic characters of the family Pseudorbitoididae and its genera have been compiled largely from the Plates I-VI.

Superfamily: Rotalioidea EHRENBERG, 1829

Family: Pseudorbitoididae RUTTEN, 1935

Type genus: *Pseudorbitoides* DOUVILLÉ, 1907

Type species: *Pseudorbitoides trechmanni* DOUVILLÉ, 1907

Description of Pseudorbitoididae RUTTEN: Test free, inflated lenticular-discoidal, ornamented with pustulates (Plate I, Figures 6, 7; Plate II, Figure 7; Plate III, Figure 6), the rotaliid spiral chambers coiling planispiral-involute (Plate II, Figure 5; Plate VI, Figure 10) or trochospiral-evolute in patterns (Plate II, Figure 8; Plate III, Figures 7, 8; Plate IV, Figures

2, 5, 6, 8; Plate 6, Figure 5); the spiral chambers sometimes become uncoiled or from a helicolepidine string towards the periphery (Plate 2, Figures 1, 2; Plate III, Figure 1; Plate V, Figure 1), the well-developed orbitoidal equatorial chamberlets occur in the median plane (Plate I, Figures 3, 6), the smaller secondary orbitoidal chamberlets appear between the equatorial chamberlets (Plate III, Figures 1, 4; Plate VI), the lateral orbitoidal chamberlets occur on both sides (Plate I, Figures 1, 5, 8; Plate II, Figures 3, 5, 8, 9; Plate III, Figures 2, 3; Plate V, Figures 2, 6; Plate VI, Figures 3, 5, 10), or only on the dorsal side of the test (Plate II, Figures 5, 8, 9; Plate IV, Figure 1, 2).

In consequence of these analyses, all representative genera here illustrated in Plate I-VI of Pseudorbitoididae have characteristic common rotaliid and orbitoidal chambers and chamberlets in the early and late stages respectively. Therefore, they are collected in the aforementioned family.

*Remarks***:** The name of Pseudorbitoididae was translated from the subfamily Pseudorbitoidinae RUTTEN by Brönnimann (1958). The family Orbitocyclinidae without description established by van Gorsel (1972) instead of Pseudorbitoididae is not available according to the International Code of Zoological Nomenclature (ICZN). Recently, the family Pseudorbitoididae RUTTEN was adopted by Loeblich and Tappan (1987) and BouDagher-Fadel (2008). In this study, the revision of the family was realized by means of the shared rotaliid and orbitoidal growth stages described here sixteen Tethyan and American genera (Plate I-VI). Brönnimann (1955, p. 63) and Loeblich and Tappan (1987, p. 652-653) already reported the spirally enrolled chambers in early stage, followed by orbitoidal chamberlets of adult stage. Besides some of the genera such as *Pseudorbitoides* DOUVILLÉ, *Arnaudiella* DOUVILLÉ, *Helicorbitoides* MacGILLAVRY and maybe *Dizerina* MERİÇ have rods (radiating rowes/ radial plates) appearing in the equatorial sections just as mentioned in previous studies (Vaughan 1929, p. 294; Rutten 1935, p. 543-544; Brönnimann 1955, p. 58; Loeblich and Tappan 1987, p. 652-653).

Seven Tethyan genera such as *Arnaudiella* DOUVILLÉ (Plate II, Figures 1, 3), *Sirtina* BRÖNNIMANN and WIRZ (Plate II, Figures 4, 8), *Vanderbeekia* BRÖNNIMANN and WIRZ (Plate II, Figures 9), *Helicorbitoides* MacGILLAVRY (Plate III, Figures 1, 4), *Dizerina* MERİÇ (Plate III, Figures 9, 11), *Sirelella* ÖZGEN-ERDEM (Plate IV, Figures 5-7) which have come from Lepidorbitoitidae VAUGHAN in Loeblich and Tappan (1987) and BouDagher-Fadel (2008), were transferred to the family Pseudorbitoididae RUTTEN. In the same way, *Cideina* SİREL (Plate IV, Figures 1, 4) was transferred from the Lepidorbitoitidae in Sirel (1991) to the foregoing family by having a rotaliid early stage; in that Lepidorbitoitidae differs from Pseudorbitoididae in its characteristic bilocular embryonic apparatus consisting of the spherical protoconch and reniform deuteroconch, whereas the latter family has a rotaliid early stage with planispiral-trochospiral chambers (Plate I, III, IV).

Two genera *Orbitokathina* HOTTINGER and *Postorbitokathina* SİREL which have previously been included within Rotaliidae EHRENBERG by Loeblich and Tappan (1987) and Sirel (2012) respectively, are here included in the Pseudorbitoididae RUTTEN, in that they differ from the Rotaliidae in possessing well developed equatorial orbitoidal chamberlets in the adult stage of the microspheric forms (Plate III, Figure 5; Plate IV, Figures 9, 11).

The four American genera, viz, *Helicolepidina* TOBLER *Helicosteginopsis* CAUDRI, *Eulinderina* BARKER and GRIMSDALE and *Helicostegina* BARKER and GRIMSDALE have previously been placed in the subfamily Helicolepidininae TAN, 1936 within the Lepidocyclinidae SCHEFFEN by Loeblich and Tappan (1987) and BouDagher-Fadel (2008), but are here transferred to Pseudorbitoididae, in that Lepidocyclinidae differs from Pseudorbitoididae in having a bilocular embryonic apparatus instead of the rotaloid early stage with planispiral-trochospiral chambers (Plates I, III, IV).

Earlier, other three genera, the herein described type genus *Pseudorbitoides* DOUVILLÉ, *Orbitocyclina* VAUGHAN and *Sulcorbitoides* BRÖNNIMANN had been included within the family Pseudorbitoididae RUTTEN by Loeblich and Tappan (1987, p. 611) and BouDagher-Fadel (2008, p. 356-357).

Additionally, *Radiorbitoides* KRIJNEN, *Vaughanina* PALMER and *Clypeorbis* DOUVILLÉ need to be examined regarding some generic characteristics. The figures of *Radiorbitoides* KRIJNEN do not reflect clearly rotaliid early chambers of Pseoudorbitoididae (Krijnen, 1993,

pl. 1, 2). Numerous annular chambers with small subrectangular chamberlets of *Vaughanina* PALMER are apparently similar to that of discocylinid type (Palmer, 1934; Krijnen, 1972; Vaughan and Cole, 1943) therefore, the aforementioned genera are out of scope of the present study. The morphometric and evolutionary study as regards to radial foraminifera (*Pseudorbitoides* DOUVILLÉ, *Vaughanina* PALMER) have been analyzed in detail through the figures of Krijnen (1972) by Drooger (1993). In contrast to the original description, *Clypeorbis* DOUVILLÉ has a lepidorbitoid embryonic stage (Hottinger and Caus, 2007, pl. 8, Figure 5) consisting of protoconch, deuteroconch and adauxiliary chambers rather than the trochoid early stage. Also Mitchell et al. (2022) have established a new family Helicosteginidae including *Tremastegina* BRÖNNIMANN and *Helicostegina* BARKER and GRIMSDALE, however *Helicostegina* BARKER and GRIMSDALE already shows the chracteristics of the Pseudorbitodidae family.

Type genus ***Pseudorbitoides* DOUVILLÉ, 1922**

(Plate I, Figures 1-9)

*Description***:** The microspheric generation has a large inflated lenticular test with pointed peripheral margin (Plate I, Figures 1, 5, 8). External surface ornamented with small pustules (Plate I, Figures 6, 7); very small microsphere followed by small shapeless rotaliid chambers lining up in two whorls or may be more (Plate I, Figures 2, 9). Later arcuate-shapeless median orbitoidal chamberlets arranged in an irregular concentric row (Plate I, Figures 2, 9). The layer of rotaliid and median orbitoidal chambers and chamberlets completely covered by the lateral layers of the orbitoidal chamberlets on both sides of the test, in which the thick pillars occur between the lateral chamberlets (Plate I, Figures 1, 5, 8).

The megalospheric test has a large spheric protoconch followed by large spiral chambers then median orbitoidal shapeless chamberlets arranged irregularly (Plate I, Figure 4), Dimorphism distinct, Campanian-Maastrichtian of American province.

The aforementioned description of the type genus *Pseudorbitoides* DOUVILLÉ is based on the figures in Figure 2 of Brönnimann (1955), Vaughan and Cole (1943), and Krijnen (1972).

Plate I-VI have been compiled, in order to show common diagnostic characters of here described sixteen genera with regard to Pseudorbitoididae RUTTEN.

2.1. Tethyan Forms

The following genera that occur in the Tethys regions were interpreted to belong to the family Pseudorbitoididae RUTTEN in the light of the generic features in the sections of Plates II-IV.

***Arnaudiella* DOUVILLÉ, 1907**

(Plate II, Figures 1-3)

*Description***:** The megalospheric generation of the type species has a lenticular test with central thickening (Plate II, Figure 3). The external surface is ornamented with numerous small indistinct pustules (Plate II, Figure 1). An excellent equatorial section (Plate II, Figure 2) clearly shows that the spherical protoconch and small second chamber are followed by the subrectangular spiral chambers in one and half whorl, later spiral chambers are entirely uncoiled and become a helicolepidine string towards the periphery as in *Helicorbitoides* MacGILLAVRY and *Helicolepidina* TOBLER (Plate III, Figures 1-4; Plate V, Figures 1-4) respectively. The septal flaps are distinct in the last spiral chambers (Plate II, Figure 2). The layer of radial canals and rods occur in the median plane instead of the orbitoidal chamberlets (Plate II, Figures 1, 2). The spiral rotaliid chambers, radial canals and rods in the median plane are completely covered by the layer of lateral orbitoidal chamberlets with pillars (Plate II, Figure 3). Dimorphism unknown, Campanian.

The foregoing description of *Arnaudiella* DOUVILLÉ is based on the figures of van Gorsel (1975, 1978) and Loeblich and Tappan (1987, p. 649).

Remarks: *Arnaudiella* DOUVILLÉ (1907) has been placed in the family Lepidorbitoididae VAUGHAN by Loeblich and Tappan (1987, p. 649) and BouDagher-Fadel (2008). However the representatives of Lepidorbitoididae (particularly the type genus *Lepidorbitoides* SILVESTRI) differ from *Arnaudiella* in possessing bilocular embryonic apparatus consisting of protoconch and deuteroconch and two primary auxiliary and numerous auxiliary chambers. Due to the rotaliid spiral chambers and lateral orbitoidal chamberlets (Plate II, Figures

1-3) *Arnaudiella* DOUVILLÉ was transferred to Pseudorbitoididae RUTTEN.

Sirtina BRÖNNIMANN and WIRZ, 1962

(Plate II, figures 4-8)

Description: The inflated small specimens have unequally biconvex rotaliids test with pointed peripheral margin (Plate II, Figure 5). The external surface is covered by small central pustules (Plate II, figure 4). The ventral side is more convex than the dorsal side. The umbilical cavity is filled by thin radial canals (funnels) occuring between the thickened pillars (Plate II, Figure 5, 8). The dorsal side is covered by the layers of lateral orbitoidal chamberlets with pillars as known from typical orbitoids (Plate II, Figures 5, 8). The chambers of the rotaloid test are coiled in asymmetric planispiral-evolute pattern during the early ontogeny, but become trochospiral in the adult stage (Plate II, Figure 5). Maastrichtian of Iran, Libya, Oman (Özcan et al., 2022) and Türkiye.

The foregoing description of *Sirtina* BRÖNNIMANN and WIRZ is based on the figures of Brönnimann and Wirz (1962) and van Gorsel (1978).

Remarks: The classification of *Sirtina* BRÖNNIMANN and WIRZ (1962) is originally uncertain. It has been interpreted as a rotaliid genus with orbitoidal characters by Brönnimann and Wirz (1962. p. 519) and van Gorsel (1978, p. 91). This genus has been placed in Lepidorbitoididae VAUGHAN by Loeblich and Tappan (1987, p. 649) and BouDagher-Fadel (2008, p. 256), despite the fact that it has a typical early rotaliid stage with trochospiral chambers (Plate II, Figures 5-8). Therefore, it has been included here within the family Pseudorbitoididae RUTTEN.

Vanderbeekia BRÖNNIMANN and WIRZ, 1962

(Plate II, Figure 9)

Description: The following description of *Vanderbeekia* BRÖNNIMANN and WIRZ is based on the non-centered section illustrated in Plate II, Figure 9 from Brönnimann and Wirz (1962, Figure 7).

According to the section (holotype of *Vanderbeekia trochoidea* BRÖNNIMANN and WIRZ, 1962), the ventral side has thick pillars with intercalated umbilical radial canals (funnels) as in typical rotaliid forms. On the contrary, the dorsal side is covered by the large arcuate lateral orbitoidal chamberlets with intercalated pillars. The large equatorial orbitoidal chamberlets with thick wall line up from the early rotaliid stage to the periphery (Plate II, Figure 9).

Remarks: The type description of the genus is based only on a non-centered incomplete axial section that is drawn by hand in Brönnimann and Wirz (1962, Figure 7), therefore, the position of the early chambers, septa and aperture are uncertain. *Vanderbeekia* (type species *Vanderbeekia trochoidea* BRÖNNIMANN and WIRZ, 1962, Figure 7) has been included in the Lepidorbitoididae VAUGHAN by Loeblich and Tappan (1987) and BouDagher-Fadel (2008). Due to the rotaliid early chambers with thick pillars and radial canals (funnels) in the umbilical region and equatorial orbitoidal chamberlets well as developed lateral orbitoidal chamberlets (Plate II, Figure 9), the genus *Vanderbeekia* has been placed here in the family Pseudorbitoididae RUTTEN.

Vanderbeekia trochoidea BRÖNNIMANN and WIRZ 1962 was described from a cutting sample from the Maastrichtian in Iran. So far we did not meet this form in Turkey, although the marine Maastrichtian sediments with *Sirtina* BRÖNNIMANN and WIRZ occur most widespread in the territory of Türkiye.

Helicorbitoides MacGILLAVRY, 1963

(Plate III, Figures 1-4)

Description: The test is inflated lenticular (Plate III, Figures 2, 3). An excellent equatorial section clearly shows that the spherical protoconch is followed by the subrectangular rotaliid small chambers arranged in one symmetric planispiral involute/evolute whorl (Plate III, Figures 1, 3), later equatorial chambers are entirely uncoiled and form a helicolepidine string towards the periphery (Plate III, Figures 1, 4) as in *Helicolepidina* TOBLER. The secondary arcuate small chambers occur between successive spiral whorls at the equatorial layer (Plate III, Figures 1, 4). The equatorial orbitoidal chamberlets occur particularly at the periphery (Plate III, Figure 1). The structural elements at the median plane are covered completely by the layer of the arcuate orbitoidal chamberlets with pillars (Plate III, Figures 2, 3). The pillars extend from early whorls to the periphery (Plate III, Figures 2, 3), the wall at the periphery has numerous pores (Plate III, Figure 4), dimorphism indistinct, Campanian; Sweden, Austria and Türkiye.

Remarks: *Helicorbitoides* MacGILLAVRY (type species *Helicorbitoides longispiralis* (PAPP and KÜPPER, 1953) and other species *Helicorbitoides boluensis* SİREL have previously been placed in the family Lepidorbitoididae VAUGHAN by Loeblich and Tappan (1987, p. 650), Sirel (1995, p. 86) and BouDagher-Fadel (2008, p. 256). Because of the well-developed planispiral-involute early stage with thick pillars, orbitoidal chamberlets in the equatorial layer and lateral orbitoidal chamberlets (Plate III, Figures 1-4), *Helicorbitoides* MacGILLAVRY was transferred from Lepidorbitoididae to Pseudorbitoididae RUTTEN (Plate III, Figures 2, 3).

Orbitokathina HOTTINGER, 1966

(Plate III, Figures 5-8)

Description: The microspheric generation has a convexo-concave lenticular test with rounded peripheral margin (Plate III, Figure 8). The very small trochospiral early chambers are lined up in the very narrow two-three whorls (Plate III, Figure 5). This early stage is followed by a stage with orbitoidal chamberlets in the equatorial layer of the late ontogeny, where they are arranged in irregular concentric rows (Plate III, Figure 5). The dorsal side is covered by thick hyaline calcareous walls, on the contrary the ventral side has thin vertical canals (funnels) that occur between the thick pillars (Plate III, Figure 8).

The megalospheric generation (Plate III, Figure 7) resembles the microspheric form by the rotaloid stage with trochospiral chambers, but it has not a late stage with orbitoidal chamberlets as in *Postorbitokathina* SİREL (2012, Plate V, Figure 6).

Remarks: The Santonian genus *Orbitokathina* HOTTINGER (type species: *Orbitokathina vonderschmitti* HOTTINGER, 1966) has not been placed in any family in the original description. The microspheric and megalospheric forms of *Orbitokathina* have been interpreted as rotaliid genus with orbitoidal character by Hottinger (1966, p. 290).

The genus has been placed in Rotaliidae by Loeblich and Tappan (1987, p. 662), although it has well developed equatorial orbitoidal chamberlets in the adult stage (Plate III, Figure 5). It was included here within the Pseudorbitoididae RUTTEN in the light of the distinct rotaliid and orbitidal stages.

Dizerina MERİÇ, 1978

(Plate III, Figures 9-11)

Description: The megalospheric form has an inflated discoidal to elongated ovoid test with broadly rounded peripheral margin (Plate III, Figure 10). The spherical megalosphere is followed by the spiral chambers of the early stage arranged in two whorls which tend to uncoil (Plate III, Figure 11). The shapeless rotaliid chambers have a septal flap (Meriç, 1978, Plates II, IV). The equatorial sections clearly show the orbitoidal chamberlets occuring at the equatorial layer particularly near the periphery (Plate III, Figures 9, 11). The very small lateral orbitoidal chamberlets and pillars are recognizable in the well preserved axial sections (Plate III, Figure 10). Dimorphism indistinct, Maastrichtian of Türkiye.

Remarks: The Maastrichtian genus *Dizerina* MERİÇ has been placed originally in Lepidorbitoididae VAUGHAN by Meriç (1978, p. 97) and Loeblich and Tappan (1987, p. 650), in spite of the fact that it has developed rotaliid chambers of the early stage (Plate III, Figures 9-11). It has been placed here in Pseudorbitoididae RUTTEN because of the rotaliid, orbitoidal growth stages in the equatorial layer (Plate III, Figures 9, 11) and orbitoidal chamberlets in the lateral layers (Plate III, Figure 10).

Cideina SİREL, 1991

(Plate IV, Figures 1-4)

Description: The specimens have medium size, discoidal to low conical test with rounded peripheral margin (Plate IV, Figures 1, 2). The external surface of the test is ornamented with irregular reticular network and numerous pores (Sirel 1991, Plate I, Figure 12). Very small, spheric protoconch is followed by trochospiral early chambers in two-three whorls (Plate IV, Figures 1-4). Later adult spiral shapeless chambers with septal flap increase suddenly towards the periphery (Plate IV, Figures 3, 4). The coarsely perforated thick wall of the last chambers contains large vacuoles and marginal sutural canals (Plate IV, Figure 4). The dorsal side is covered by a few rows of arcuate orbitoidal chamberlets (Plate IV, Figures 1, 2). Thick pillars and radial canals (funnels) occur in the ventral region (Plate IV, Figures 1, 2). Dimorphism indistinct, late Maastrichtian in the Black Sea region, Türkiye.

Remarks: In the original description, *Cideina* has been placed in Lepidorbitoididae VAUGHAN by Sirel (1991), in spite of the fact that it has rotaliid early chambers with pillars and radial canals (Plate IV, Figures 1, 2). However, because of the existence of the common rotaliid and orbitoidal characters, a new family was proposed for *Cideina* SİREL, *Sirtina* BRÖNNIMANN and WIRZ and *Orbitokathina* HOTTINGER by Sirel (1991, p. 69). Therefore, the aforementioned genera which have two common growth stages were transferred to Pseudorbitoididae RUTTEN.

Sirelella ÖZGEN-ERDEM, 2002

(Plate IV, Figures 5-7)

Description: The diagnostic characters of the genus are interpreted from the megalospheric generation. The generation has low conical test with rounded peripheral margin (Plate IV, Figures 5, 6). The juvenile stage of the test is composed of an embryo (protoconch and second chamber) and large trochospiral chambers of the juvenile stages (Plate IV, Figure 6). The nepionic stage has large orbitoidal chamberlets in the equatorial layer (Plate IV, Figures 6, 7). The umbilical area is pierced by thick pillars and radial canals (funnels) that occur indistinctly among the pillars, Lutetian, Safranbolu town, N Türkiye.

Remarks: *Sirelella* ÖZGEN-ERDEM was not placed in any family in the original description by Özgen-Erdem (2002), However, she has proposed to introduce a new family for the genus, *Cideina* SİREL, *Sirtina* BRÖNNIMANN and WIRZ and *Orbitokathina* HOTTINGER as in Sirel (1991, p. 69). Recently, this middle Eocene genus was placed within the family Lepidorbitoididae VAUGHAN by BouDagher-Fadel (2008, p. 361). However, it differs from the representatives of Lepidorbitoididae VAUGHAN in possessing well developed trochospiral chambers of the early stage (Plate IV, Figures 5, 7). Therefore, it was included here within Pseudorbitoididae RUTTEN.

Postorbitokathina SİREL, 2012

(Plate IV, Figures 8-11)

Description: The microspheric test is discoidal, concave-convex or near the margin it curves up to meet the spiral side (Sirel, 2012, Plate V). The wall of the test is perforated, hyaline calcareous. The test of the genus is composed of rotaliid early and orbitoidal adult stages (Plate IV, Figures 8-11). The spherical, small microsphere is followed by subrectangular trochospiral chambers of the early stage arranged in the multiple spirals; duplication of spirals starts in the early ontogeny (Plate IV, Figures 9, 11). The septa with intraseptal canals of the trochospiral early chambers are very thin, they become bifurcate when they reach the latter whorl, producing the small intraseptal interlocular space (Plate IV, Figure 9). The numerous thick umbilical canals (funnels) occur among the thick pillars of the early rotaliid stage (Plate IV, Figure 8). The numerous orbitoidal chamberlets in the equatorial layer of the adult stage vary in shape and size and are arranged irregularly (Plate IV, Figures 9-11). The connection of the adjacent orbitoidal chamberlets is through basal stolons. Dimorphism distinct, occurs in the early Thanetian (*Glomalveolina primaeva* Reichel-*Vania anatolica* Sirel and Gündüz assemblage zone), Türkiye.

Remarks: The type species *Orbitokathina sarayi* SİREL, GÜNDÜZ and ACAR has not been placed any family of Foraminiferida EICHWALD in the original description, however it was hinted to belong to the family Rotaliidae (Sirel et al. 1983, p. 150) by trochospirally coiled early stage (Plate IV, Figure 8). Later on the new genus *Postorbitokathina* SİREL (type species *Orbitokathina sarayi* SİREL, GÜNDÜZ and ACAR) has been placed in the Rotaliidae EHRENBERG because of the rotaliid early stage by Sirel (2012, p. 277). However well preserved equatorial and superficial sections (Plate IV, Figures 9-11) clearly show numerous orbitoidal chamberlets to occur around the rotaliid stage, this structural characteristic does not correspond with the representatives of Rotaliidae EHRENBERG. For this reason, *Postorbitokathina* SİREL was included here within the Pseudorbitoididae RUTTEN in the light of the distinct rotaliid and orbitidal stages.

2.2. American and Caribbean Forms

The following genera occurring in the American and Caribbean provinces have been interpreted to belong in the family Pseudorbitoididae Rutten by means of the original figures of the authors.

Helicolepidina TOBLER, 1922

(Plate V, Figures 1-4)

Type species Lepidocyclina (*Helicolepidina*) *spiralis* TOBLER, 1922;

nomen translatum GALLOWAY, 1928 (=name transferred to a different rank)

Description: The microspheric generation has a very small microsphere with very small planispiral-trochospiral chambers arranged in two whorls, but helicolepidine string is unclear. The very small arcuate orbitoidal chamberlets in the equatorial layer are lined up irregularly from the early planispiral-trochospiral chambers to the periphery (Plate V, Figure 3).

The megalospheric generation has a small inflated lenticular test with rounded peripheral margin (Plate V, Figures 2, 4). The spheric megalosphere is followed by few rotaliid chambers that uncoil as from the first whorl and they become a helicolepidine string towards the periphery (Plate V, Figure 1). The very small shapeless equatorial orbitoidal chamberlets line up irregularly (Plate V, Figure 1). The early rotaliid and orbitoidal chambers in the median plane are completely covered by the lateral orbitoidal chamberlets on both sides of the test; rather thick pillars occur between lateral orbitoidal chamberlets (Plate V, Figures 2, 4). Dimorphism distinct, middle-late Eocene of North and South America.

Remarks: *Helicolepidina* TOBLER has previously been placed in the family Lepidocyclinidae SCHEFFEN by Loeblich and Tappan (1987, p. 611) and BouDagher-Fadel (2008, p. 356), whereas it differs from the representatives of Lepidocyclinidae SCHEFFEN in having early planispiral/trochospiral rotaliid and helicolepidine string adult chambers (Plate V, Figure 1). Therefore, *Helicolepidina* TOBLER was transferred from the family Lepidocyclinidae to Pseudorbitoididae RUTTEN.

Orbitocyclina VAUGHAN, 1929

(Plate V, Figures 5-6)

Description: The macrospheric generation has an inflated lenticular test with pointed peripheral margin and the surface of the test covered by numerous small pustules (Galloway 1928). Unclear early spiral rotaliid chambers followed by very small arcuate equatorial orbitoidal chamberlets arranged irregularly. Aforementioned early and adult chambers in Galloway (1928) are covered definitely by lateral orbitoidal chamberlets and pillars.

The megalospheric generation has an inflated lenticular test with pointed peripheral margin (Plate V, Figure 6). The small, spheric megalosphere and second chamber followed by small spiral rotaliid chambers of the early stage (Plate V, Figure 6), then the equatorial arcuate orbitoidal chamberlets are arranged irregularly (Plate V, figure 5). The rotaliid spiral chambers and arcuate orbitoidal chamberlets are completely covered by the lateral orbitoidal chamberlets with pillars (Plate V, Figure 6). Dimorphism distinct, Campanian-Maastrichtian of the American province.

Remarks: *Orbitocyclina* VAUGHAN, 1929 has previously been placed already in the family. Pseudorbitoididae RUTTEN because of the rotaliid and orbitoidal stages (Plate V, Figures 5, 6) by Loeblich and Tappan (1987, p. 656) and BouDagher-Fadel (2008, p. 260).

Eulinderina BARKER and GRIMSDALE, 1936

(Plate V, Figures 7-10)

Description: The microspheric generation has a lenticular to discoidal test with thick perforated outer wall (Plate V, Figure 9). Very small microsphere followed by small spiral chambers of the rotaliid early stage arranged in two whorls or maybe more later numerous small, shapeless orbitoidal chamberlets lined up irregularly (Plate V, Figure 8). Because of the thick outer wall, the lateral orbitoidal chamberlets are indistinct (Plate V, Figure 9).

The megalospheric generation has a small, inflated lenticular test with slightly rounded peripheral margin (Plate V, Figure 10). The large, spheric megalosphere followed by large rotaliid spiral chambers of the early stage that are arranged in one and half whorls (Plate V, Figure 7), later small median arcuate orbitoidal chamberlets line up regularly in concentric rows (Plate V, Figure 7). The equatorial orbitoidal chamberlets are completely covered by lateral orbitoidal chamberlets with pillars on both sides of the test (Plate V, Figure 10). Dimorphism distinct, middle-late Eocene of Mexico.

Remarks: *Eulinderina* has been placed originally in the family Orbitoididae SCHUBERT by Barker and Grimsdale (1936, p. 237), but *Eulinderina* differs from the representatives of Orbitoididae SCHUBERT in its spiral chambers in the early stage (Plate V, Figures 7, 8). Later *Eulinderina* BARKER and GRIMSDALE was included within the family Lepidocyclinidae SCHEFFEN by Loeblich and Tappan (1987, p. 611) and

BouDagher-Fadel (2008, p. 356). Also, *Eulinderina* differs from the representatives (particularly the type genus *Lepidocyclina* GÜMBEL) of Lepidocyclinidae in possessing early rotaliid chambers (Plate V, Figures 7, 8). The rotaliid early equatorial orbitoidal adult chambers and lateral orbitoidal chamberlets of *Eulinderina* are similar to the structural elements of the type genus *Pseudorbitoides* DOUVILLÉ of Pseudorbitoididae RUTTEN (Plate V, Figures 7, 10), therefore *Eulinderina* BARKER and GRIMSDALE, 1936 was transferred here to Pseudorbitoididae.

Helicostegina BARKER and GRIMSDALE, 1936

(Plate VI, Figures 1-3)

Description: Megalospheric *Helicostegina* has an inflated lenticular test with rounded peripheral margin (Plate VI, Figure 3). It has characteristic retrorse septa on the chamber floor (Plate VI, Figure 1). The external surface of the test is ornamented by coarse granules (Barker and Grimsdale, 1936). The equatorial section clearly shows that the test developed as large trochospiral early and orbitoidal equatorial adult chambers/chamberlets (Plate VI, Figures 1, 2). The large, spheric megalosphere is followed by large arcuate trochospiral chambers arranged in one and a half whorl (Plate VI, Figures 1, 2). Later shapeless orbitoidal equatorial chamberlets line up at around the periphery and few very small underdeveloped secondary median chamberlets occur among the successive spiral chambers (Plate VI, Figures 1, 2) according to Barker and Grimsdale (1936). The growth stages are covered by the lateral orbitoidal chamberlets (Plate VI, Figure 3), dimorphism unknown. Middle-late Eocene of Cuba, Trinidad and Mexico.

Remarks: *Helicostegina* BARKER and GRIMSDALE has previously been placed originally in the family Asterigerinidae D'ORBIGNY, but *Helicostegina* BARKER and GRIMSDALE differs from the representatives Asterigerinidae in possessing main orbitoidal equatorial chambers and lateral orbitoidal chamberlets and in lacking stellar chamberlets (Plate VI, Figures 1-3; Barker and Grimsdale, 1936, Plates 32, 34). Later it has been included in Lepidocyclinidae SCHEFFEN by Loeblich and Tappan (1987, p. 611) and BouDagher-Fadel (2008, p. 356), but it differs from the representatives (particularly the type genus *Lepidocyclina* GÜMBEL) of Lepidocyclinidae SCHEFFEN in having large trochospiral early chambers and smaller secondary equatorial chambers/chamberlets (Plate VI, Figures 1, 2). Therefore, it was transferred here to Pseudorbitoididae RUTTEN.

Sulcorbitoides BRÖNNIMANN, 1954

(Plate VI, Figures 4-7)

Description: Very inflated lenticular test has two growth stages (Plate VI, Figures 4-6), the trochospiral chambers of the early stage which follow the small protoconch increase towards the periphery (Plate VI, Figure 6). The shapeless equatorial orbitoidal chamberlets arranged irregularly around the trochospiral chambers (Plate VI, Figure 6); trochospiral early chambers and shapeless equatorial orbitoidal chamberlets are covered entirely by the 4-7 layers of the lateral orbitoidal chamberlets with pillars (Plate VI, figures 4, 5, 7). Campanian of the American province.

Remarks: The trochospiral early (Plate VI, Figure 5) and adult equatorial orbitoidal chambers (Plate VI, figure 6), as well the lateral orbitoidal chamberlets (Plate VI, Figures 5, 6) of *Sulcorbitoides* BRÖNNIMANN 1954 are virtually identical with that of the structural elements of the type genus *Pseudorbitoides* DOUVILLÉ of Pseudorbitoididae RUTTEN. Already, it has been placed in Pseudorbitoididae RUTTEN by Loeblich and Tappan (1987, p. 654) and BouDagher-Fadel (2008, p. 259).

Helicosteginopsis CAUDRI, 1975

(Plate VI, Figures 8-11)

Description: The megalospheric generation has inflated lenticular test with thick wall (Plate VI, Figure 10). The globular megalosphere is followed by characteristic numerous main rotaliid spiral chambers which are arranged in 2-3 involute whorls (Plate VI, Figures 8-11). The smaller secondary orbitoidal chambers occur among the rotaliid spiral chambers as in *Helicorbitoides* MacGILLAVRY, the equatorial orbitoidal chambers occur at the periphery and are small when compared with the rotaliid chambers (Plate VI, Figures 8, 9, 11). A central knob and weakly developed lateral orbitoidal chamberlets are present (Plate VI, Figure 10), dimorphism unknown, late Eocene of Trinidad.

Remarks: *Helicosteginopsis* CAUDRI 1975 has rotaliid early, main and secondary orbitoidal

median chambers/chamberlets and orbitoidal lateral chamberlets in common with *Helicostegina* BARKER and GRIMSDALE. It has previously been placed in the family Lepidocyclinidae SCHEFFEN by Loeblich and Tappan (1987, p.611) and BouDagher-Fadel (2008, p.357), It differs from the representatives (particularly the type genus *Lepidocyclina* GÜMBEL) of Lepidocyclinidae SCHEFFEN in possessing planispiral early chambers in four whorls (Plate VI, Figure 10) and the smaller secondary chamberlets among the spiral chambers (Plate VI, Figures 8, 9, 11). Thus, it was included with the family Pseudorbitoididae RUTTEN as *Helicostegina* BARKER and GRIMSDALE.

3. Conclusion

The main objective of this study is finding a suitable foraminiferal family for *Helicorbitoides* MacGILLAVRY species (*Helicorbitoides boluensis* SİREL), *Postorbitokathina* SİREL (type *Orbitokathina sarayi* SİREL, GÜNDÜZ and ACAR), *Dizerina* MERİÇ (type *Dizerina anatolica* MERİÇ), *Cideina* SİREL (type *Cuvillierina soezerii* SİREL), *Sirelella* ÖZGEN-ERDEM (type *Sirelella safranboluensis* ÖZGEN-ERDEM) which occur in Türkiye.

The here described and figured nine known genera from Tethyan and four genera from American and Caribbean provinces have been placed previously in different families in Loeblich and Tappan (1987. p. 654) and BouDagher-Fadel (2008, p. 259). Namely, *Arnaudiella* DOUVILLÉ**,** *Sirtina* BRÖNNIMANN and WIRZ, *Vanderbeekia* BRÖNNIMANN and WIRZ, *Helicorbitoides* MACGILLAVRY, *Dizerina* MERİÇ, *Sirelella* ÖZGEN-ERDEM and *Cideina* SİREL were included in the Lepidorbitoitidae VAUGHAN; *Postorbitokathina* SİREL and *Orbitokathina* HOTTINGER in Rotaliidae EHRENBERG, *Helicolepidina* TOBLER, *Helicosteginopsis* CAUDRI, *Eulinderina* BARKER and GRIMSDALE and *Helicostegina* BARKER and GRIMSDALE in Lepidocyclinidae SCHEFFEN, although all of them in Plates II-VI have characteristic both rotaliid early and orbitoidal adult stages. Owing to the structural elements such as rotaliid early and orbitoidal adult chamberlets, the known family Pseudorbitoididae RUTTEN (type genus *Pseudorbitoides* DOUVILLÉ, Plate I) is identified as the suitable family for the aforementioned genera. Thus the herein described and figured sixteen Tethyan, American and Caribbean genera have been included within Pseudorbitoididae RUTTEN.

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PLATES

PLATE I

Abbreviation for Figure 2-7: Equatorial orbitoidal chambers (eoc), Rotaliid early chambers (rch), Protoconch (pr), Pustules (pu), Lateral orbitoidal chamberlets (loc), Rotaliid stage (rs), Secondary equatorial chambers (sec), Pillar (pi), funnel (umbilical radial canals) (f), Vacuoles (vu), Radial canals and rods (rcr), septal flap (sf), retrorse septa (ret). Following figures show the structural elements of ***Pseudorbitoides*** DOUVILLÉ (type species ***Pseudorbitoides trechmanni*** DOUVILLÉ, 1922).

Figure 1: Axial section,

Figure 2: Incomplete median section, B form,

Figure 3: Incomplete median section B form,

Figure 4: Centered median section, A form,

Figure 5: Axial section,

Figures 6, 7: External views (topotypes),

Figure 8: Incomplete axial section,

Figure 9: Incomplete equatorial section, B form. The figures were compiled from the following authors: (Figure 2A, B) from Brönnimann (1955), (Figure 2C, F, G) from Vaughan and Cole (1943) and (Figure 2D, E, H, I) from Krijnen (1972).

PLATE I

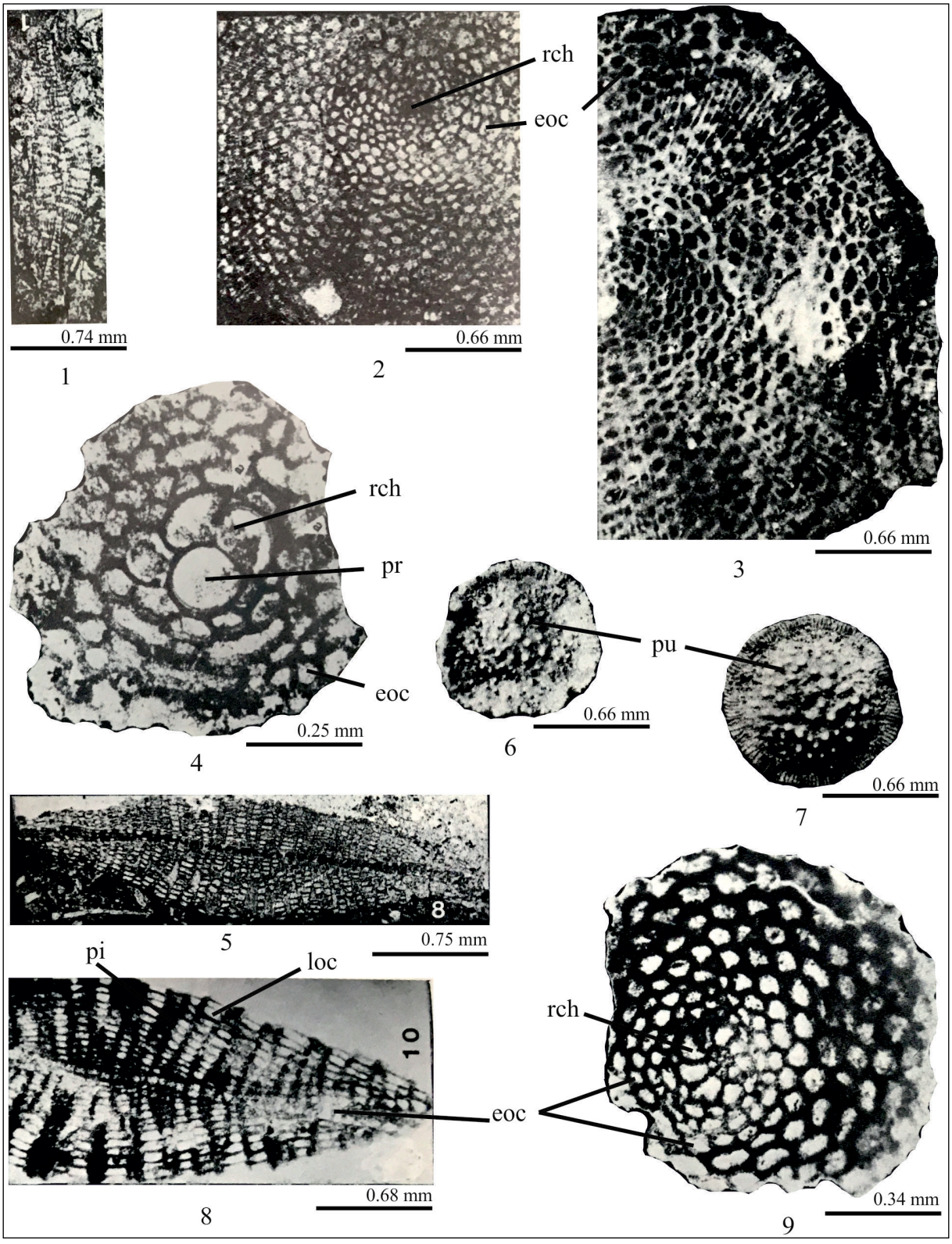
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PLATE II

Arnaudiella DOUVILLÉ, 1907 (type species ***Arnaudiella grossouvrei*** DOUVILLÉ, 1907),

Figure 1: Almost equatorial section,

Figure 2: Equatorial section, A form,

Figure 3: Axial section, all figures from van Gorsel (1974, 1978); ***Sirtina*** BRÖNNIMANN and WIRZ, 1962 (type species ***Sirtina orbitoidiformis*** BRÖNNIMANN and WIRZ, 1962),

Figure 4: External view,

Figure 5: Axial section, A form,

Figure 6: Equatorial section, B form, all figures from Brönnimann and Wirz, (1962 Figure 2a, Figure 5); ***Sirtina granulata*** (RAHAGHI),

Figure 7: External view,

Figure 8: Axial section, B form, all figures from Van Gorsel, (1974 and 1978, Figure 27 b, c, f); ***Vanderbeekia*** BRÖNNIMANN and WIRZ 1962 (type species ***Vanderbeekia trochoidea*** BRÖNNIMANN and WIRZ 1962),

Figure 9**:** Subaxial section, from Brönnimann and Wirz (1962, Figure 7).

PLATE II

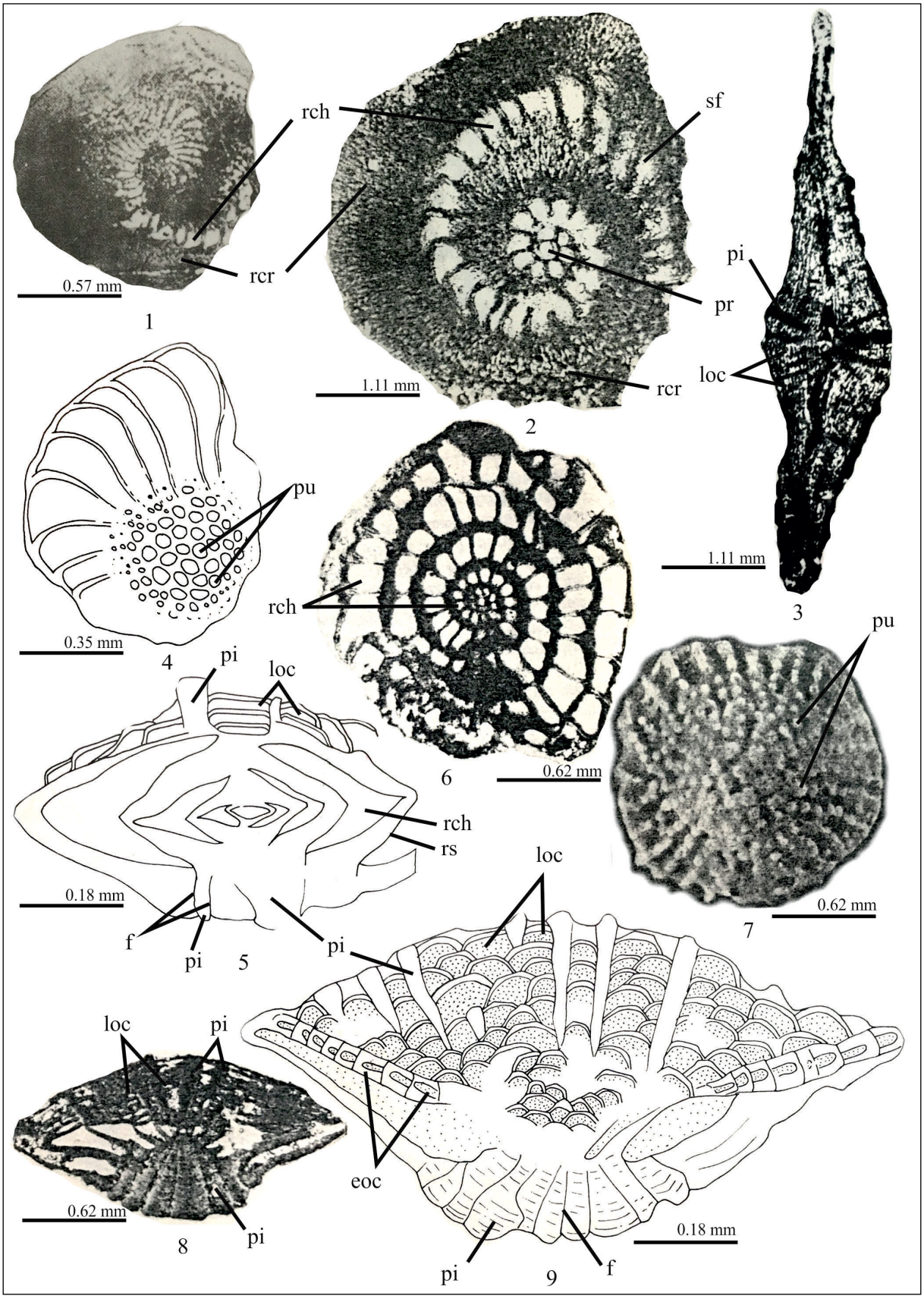
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PLATE III

Helicorbitoides MacGILLAVRY, 1963 (type species ***Pseudorbitoides longispiralis*** PAPP and KÜPPER, 1953),

Figure 1: Equatorial section, A form,

Figure 2: Axial section, all from van Gorsel (1975); ***Helicorbitoides boluensis*** SİREL, 1995,

Figure 3: Axial section,

Figure 4: Equatorial section, A form, all figures from Sirel (1995); ***Orbitokathina*** HOTTINGER, 1966 (type species ***Orbitokathina vonderschmitti*** HOTTINGER, 1966),

Figure 5: Incomplete equatorial section, B form,

Figure 6: Superficial tangential section,

Figure 7: Incomplete subaxial section, A form,

Figure 8: Axial section, B form; all figures from Hottinger (1966); ***Dizerina*** MERİÇ, 1978 (type species ***Dizerina anatolica*** MERİÇ, 1978),

Figure 9: Equatorial section, A form,

Figure 10: Almost axial section,

Figure 11: Equatorial section, A form; all figures from Meriç (1978).

PLATE III

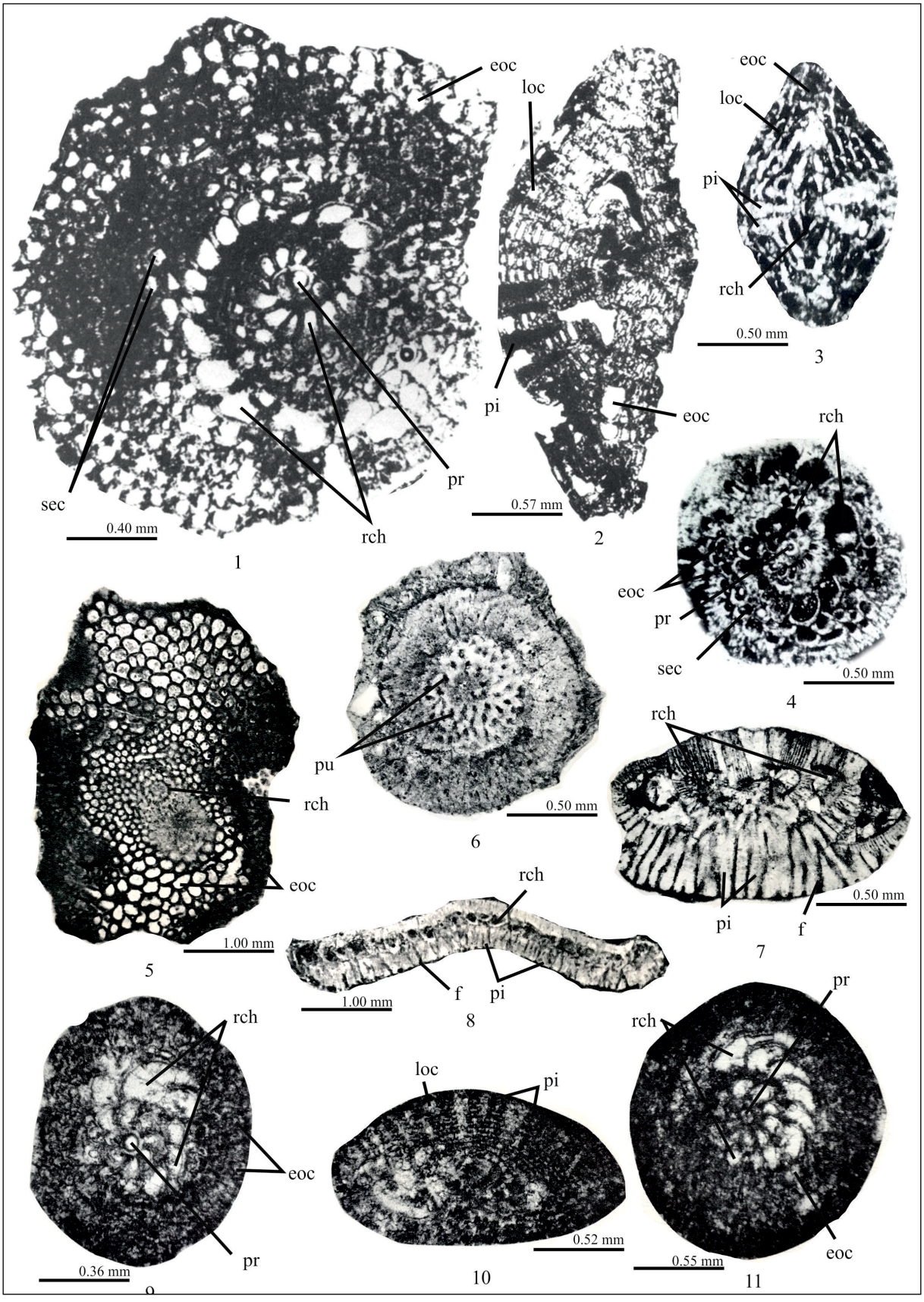
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PLATE IV

Cideina SİREL, 1991 (type species ***Cuvillierina sözerii*** SİREL, 1973),

Figure 1: Axial section (holotype), B form,

Figure 2: Incomplete axial section,

Figure 3: Equatorial section A form,

Figure 4: Equatorial section, A form; all figures from Sirel (1991); ***Sirelella*** ÖZGEN-ERDEM, 2002 (type species ***Sirelella safranboluensis*** ÖZGEN-ERDEM, 2002),

Figure 5: Axial section, A form,

Figure 6: Axial section, A form,

Figure 7: Incomplete equatorial section, A form; all figures from Özgen-Erdem (2002); ***Postorbitokathina*** SİREL, 2012 (type species ***Orbitokathina sarayi*** SİREL, GÜNDÜZ and ACAR, 1983),

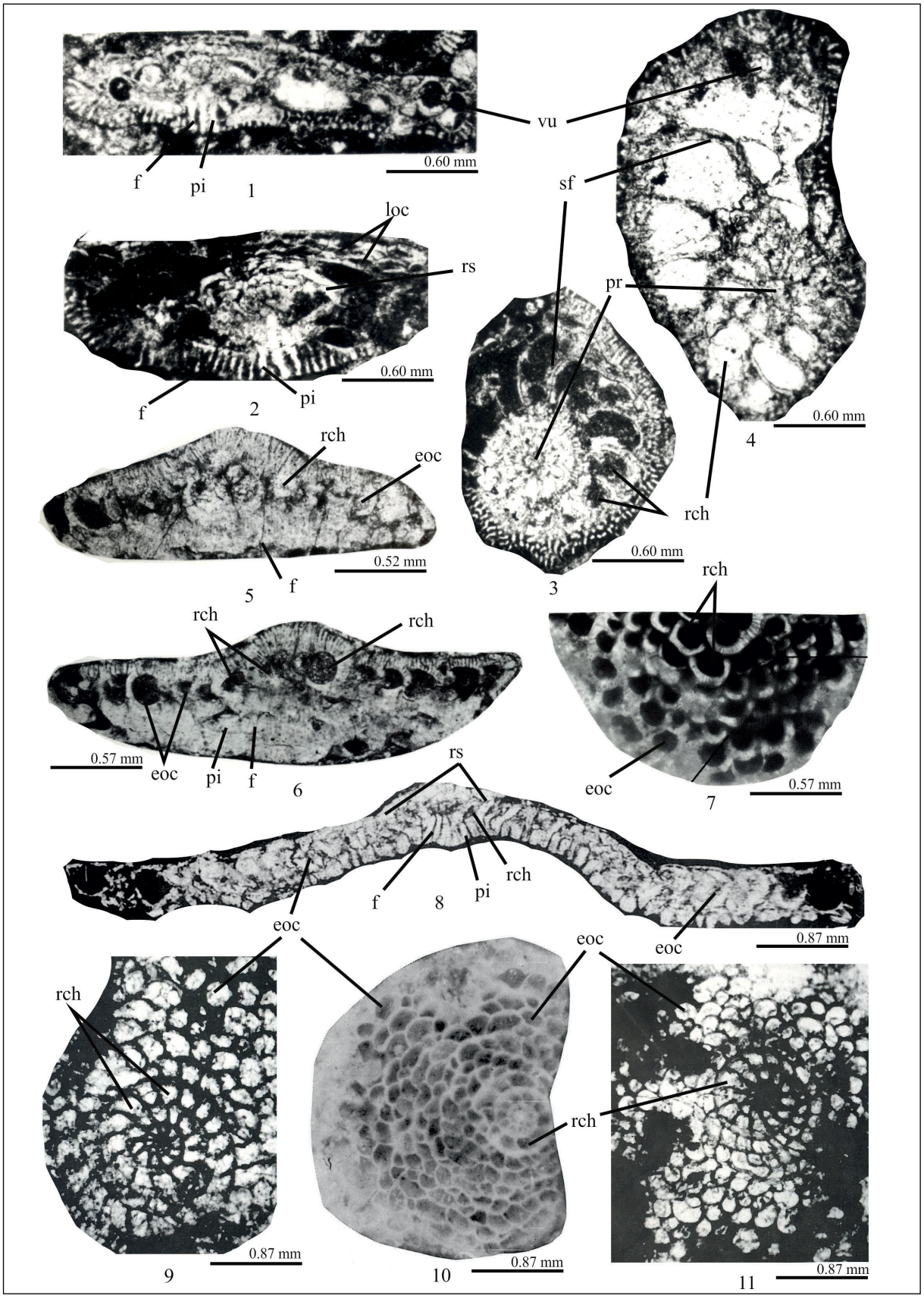
Figure 8: Axial section, B form,

Figure 9: Incomplete equatorial section, B form,

Figure 10: Incomplete superficial view dorsally, B form,

Figure 11: Incomplete equatorial section, B form; all figures from Sirel et al. (1983) and Sirel (2012).

PLATE IV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loc
rs
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f
pi
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rch
eoc
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f
5
rch
0.60 mm
3
rch
rch
rch
0.57 mm
eoc
pi
f
6
eoc
0.57 mm
7
rs
f
pi
rch
8
eoc
eoc
0.87 mm
rch
eoc
rch
0.87 mm
9
0.87 mm
10
0.87 mm
11

PLATE V

Helicolepidina TOBLER, 1922 (type species ***Lepidocyclina* (*Helicolepidina*) *spiralis*** TOBLER, 1922),

Figure 1: Equatorial section, A form from Vaughan (1936),

Figure 2: Axial section, A form from Tobler (1922),

Figure 3: Equatorial section, B form from Barker (1934),

Figure 4: Axial section from Barker and Grimsdale (1936). ***Orbitocyclina*** VAUGHAN, 1929 (type species ***Lepidorbitoides minima*** DOUVILLÉ), ***Orbitocyclina americana*** (HANZAWA),

Figure 5: Equatorial section, A form,

Figure 6: Axial section, A form, both figures from Cole (1941); ***Eulinderina*** BARKER and GRIMSDALE, 1936 (type species ***Planorbulina* (*Planorbulinella*) *guayabalensis*** NUTTALL, 1930),

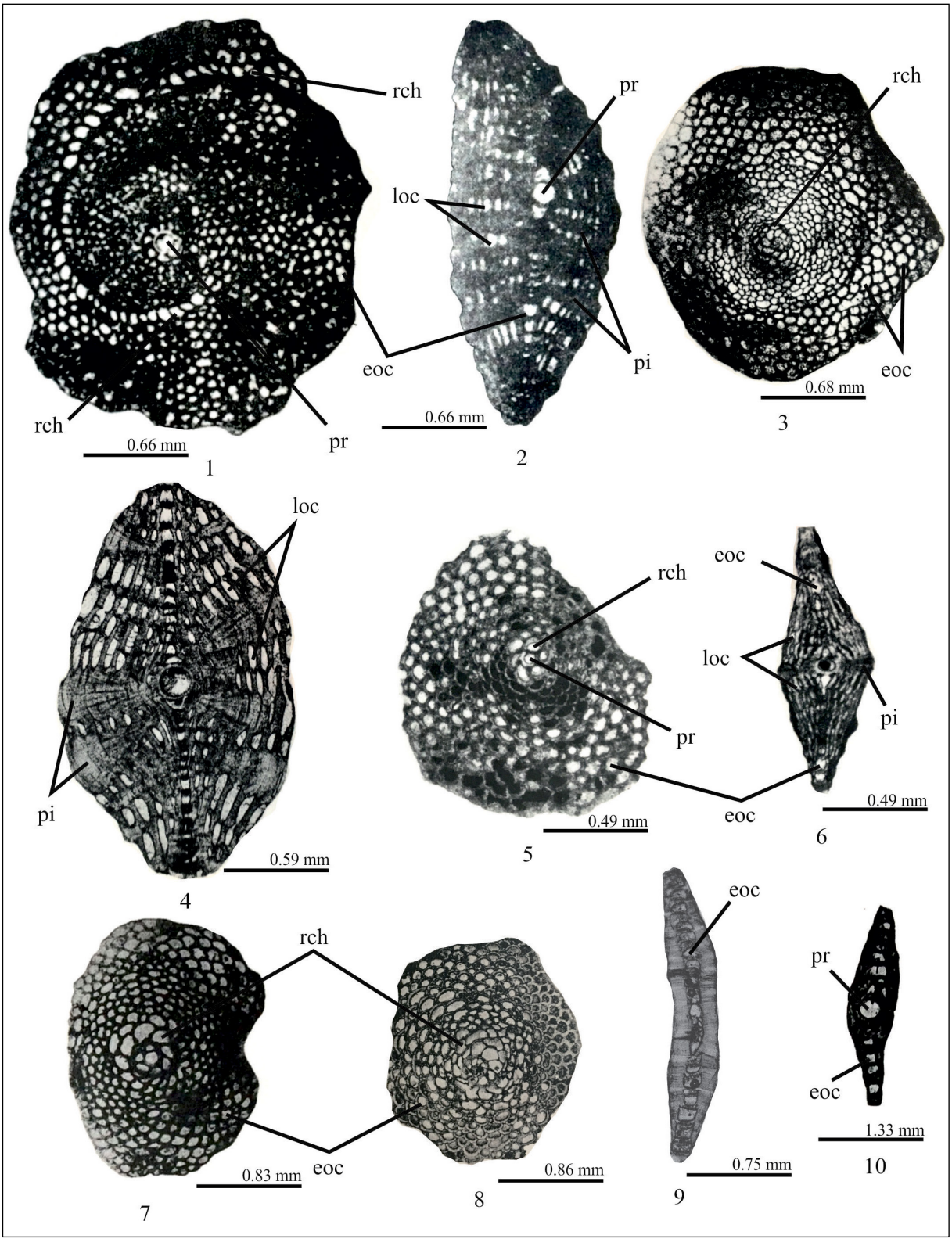
Figure 7: Equatorial section, A form,

Figure 8: Equatorial section, B form,

Figure 9: Axial section, B form,

Figure 10: Axial section, A form; all figures from Barker and Grimsdale (1936).

PLATE V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4
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0.49 mm
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eoc
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eoc
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6
rch
eoc
0.83 mm
7
0.86 mm
8
eoc
0.75 mm
9
pr
eoc
1.33 mm
10

PLATE VI

Helicostegina BARKER and GRIMSDALE, 1936 (type species ***Helicostegina dimorpha*** BARKER and GRIMSDALE, 1936),

Figure 1: Equatorial section, A form,

Figure 2: Equatorial section, A form,

Figure 3: Axial section, A form, all figures from Barker and Grimsdale (1936); ***Sulcorbitoides*** BRÖNNIMANN, 1954 (type species ***Sulcorbitoides pardoi*** BRÖNNIMANN, 1954),

Figure 4: Axial section, A form,

Figure 5: Axial section**,** A form,

Figure 6: Equatorial section, A form,

Figure 7: Axial section, all figures from Brönnimann, (1954); ***Helicosteginopsis*** CAUDRI, 1975 (type species ***Helicostegina soldadensis*** GRIMSDALE, 1941),

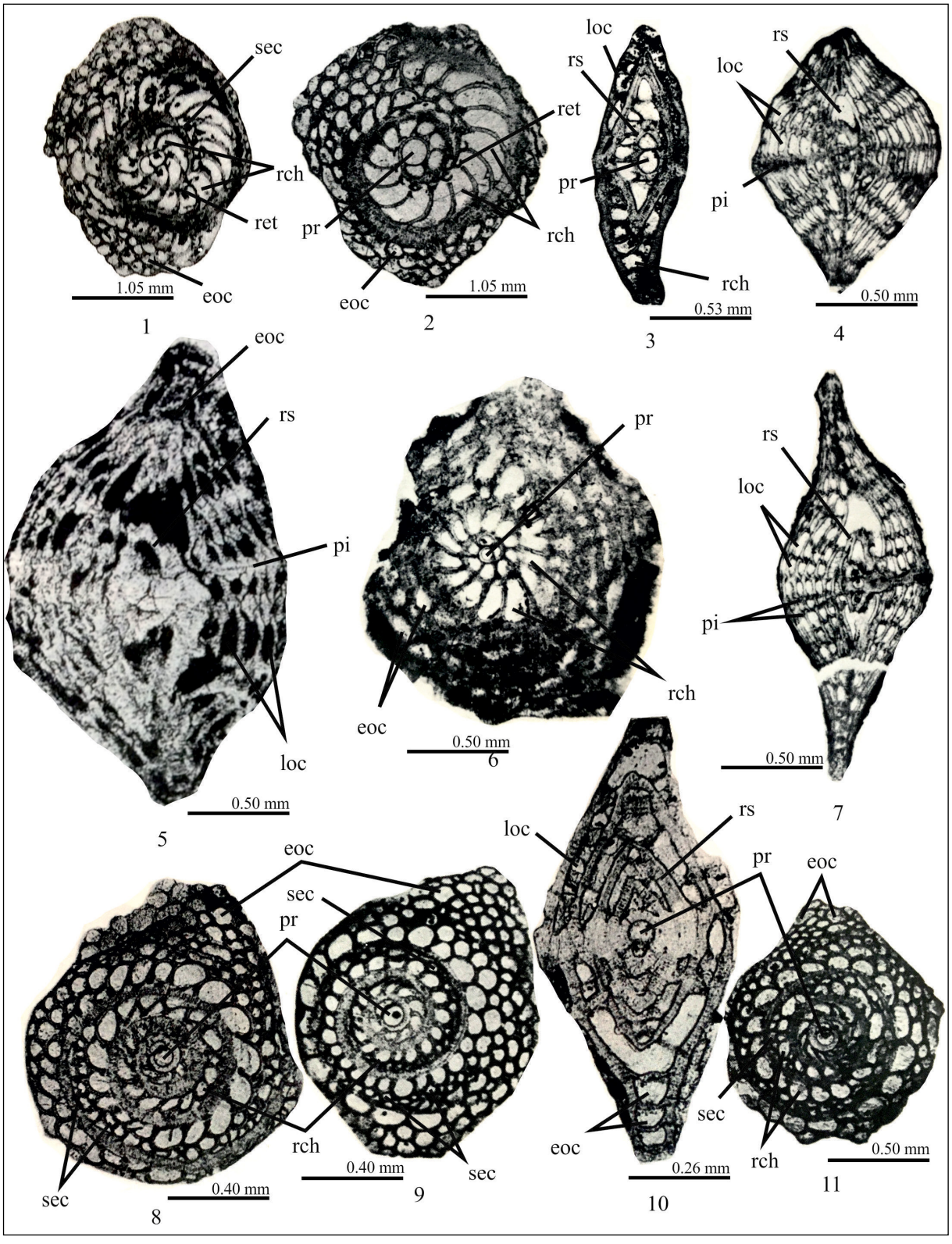
Figure 8: Equatorial section, A form,

Figure 9: Equatorial section, A form,

Figure 10: Axial section, A form,

Figure 11: Equatorial section, A form, all figures from Grimsdale (1941).

PLATE VI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ret
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sec
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eoc
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0.40 mm
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sec
rch
0.50 mm
11