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NEW SPECIES OF RADIOLITIDAE FROM THE BOLU AREA (W. BLACK-SEA) AND KOCAELİ PENINSULA

Sacit ÖZER*

ABSTRACT.- Five new species of Radiolitidae from the Maastrichtian of the Bolu area (Western Pontides) and Kocaeli Peninsula, are determined: *Radiolites corporatus* n.sp. *Radiolites simpliformis* n.sp., *Durania carinata* n.sp.. *Sauvagesia sulcata* n.sp. and *Sauvagesia herekeiana* n.sp.

INTRODUCTION

Some rudist genera of the Radiolitidae Gray such as Radiolites Lamarck, Durania Douville and Sauvagesia Choffat have not yet been studied sufficiently in Turkey. Only, some known species of these genera have been described or presented by Bohm (1927), Noth (1931), Kuhn (1933) and Özer (1983) from the central and northwestern Turkey. According to Özer (1988a, 1991), these rudist genera have very wide distribution in the Pontides according to the other regions of Turkey.

The aim of this study is mainly to describe new species of the genera Radiolites Lamarck, Durania Douville and Sauvagesia Choffat from the western Pontides and Kocaeli Peninsula. However, stratigraphic features of the localities with radiolitids are also presented.

STRATIGRAPHY

The late Senonian rudistid formations crop out in some localities of western Pontides such as north of Gökçesu and Bolu, and around Konuralp and Yığılca. These formations are also observed around Hereke in the Kocaeli Peninsula (Fig. 1).

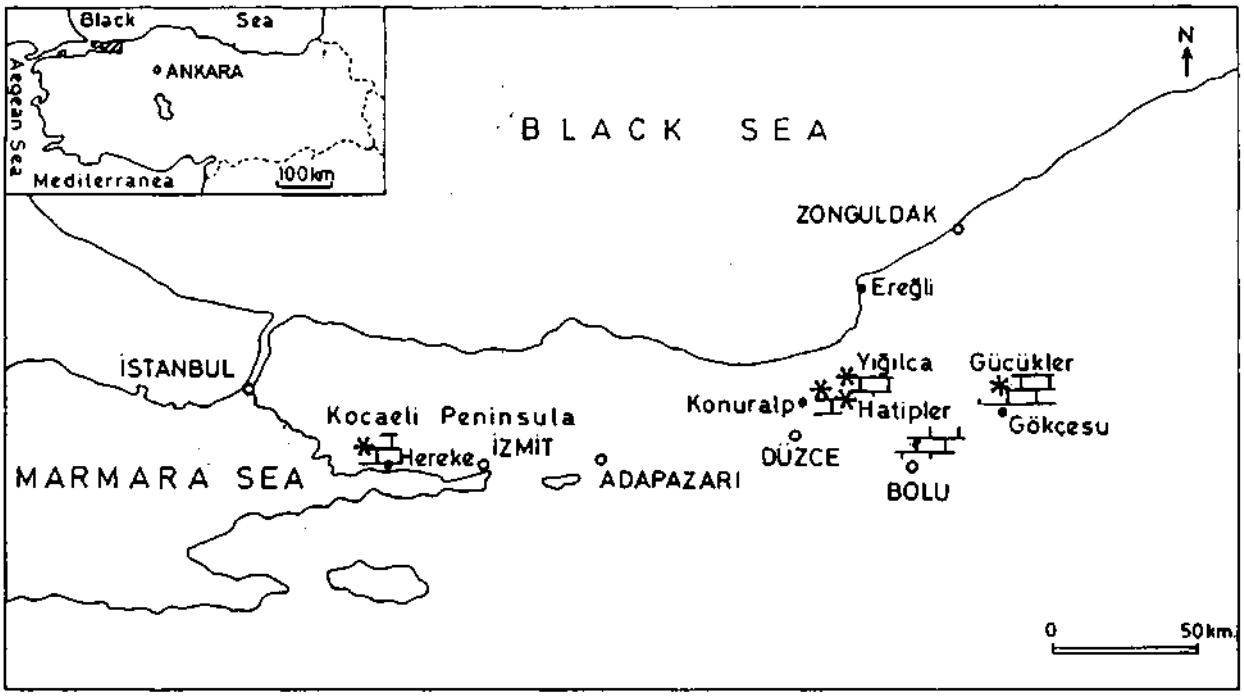

Fig. 1- Map showing the distrubition of the late Senonian rudistid formations (hachured) and the localities of the new species in western Pontides and Kocaeli Peninsula.

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The Upper Cretaceous stratigraphy of the western Pontides and Kocaeli Peninsula have been studied by Erguvanlı (1949), Altınlı (1968), Altınlı et al. (1970), Kaya and Dizer (1984a, *b),* Kaya et al. (1986a,b), Özer (1989b) and Özer et al. (1990). Stratigraphic features of the rudistid localities are as follows.

Konuralp and Yığılca localities: In these localities (Fig. 1), the rudists are observed in the Hatipler formation. This formation conformably overlies the unfossiliferous Çamlı formation consisting of sandstones and mudstones (Fig. 2). According to Stratigraphic position of the Çamlı formation in the Upper Senonian sequence, a Late Campanian age has been assigned to it by Kaya et al. (1986a).

The Hatipler formation consists of sandstones, mudstones and rudist bearing limestones. The rudists are very abundant in the northeast of Konuralp and northwest of Hatipler villages, whereas they are sparse around Yığılca. The rudist fauna consist of the forms indicating a Maastrichtian age, as follows: *Hippurites lapeirousei* Goldfuss, *Hippurites colliciatus* Woodward, *Hippurites nabresinensis* Futterej, *Hippurites sulcatoides* Douville, *Vaccinites ultimus* Milovanovic, *Joufia cappadociensis* (Cox), *Joufia reticulata* Boehm, *Radiolites corporatus* n.sp., *Radiolites simpliformis* n.sp., Salvagesia *herekeianan.sp., Durania sp.* and *Biradiolites sp.*

In the Konuralp locality, the specimens of *Hippurites colliciatus* are dominant, and the species *Joufia cappadociensis* and *Joufia reticulata* are also represented by large specimens.

The contact between the Hatipler and the overlying Akveren formations is gradational (Fig. 2). The Akveren formation consists of mudstones, clayey limestones and limestones with planktonic foraminifera indicating a Maastrichtian-Paleocene age (Kayaetal., 1986a).

Gücükler locality: The rudists are very sparse around Gücükler village (Fig. 1). The rudist bearing Gücükler formation rests unconformably on the Kırık-formation. (Fig. 2) consisting conglomerates, and mudstones of Early Triassic age (Kaya and Dizer, 1984 *b).* The rudists are not well pre-

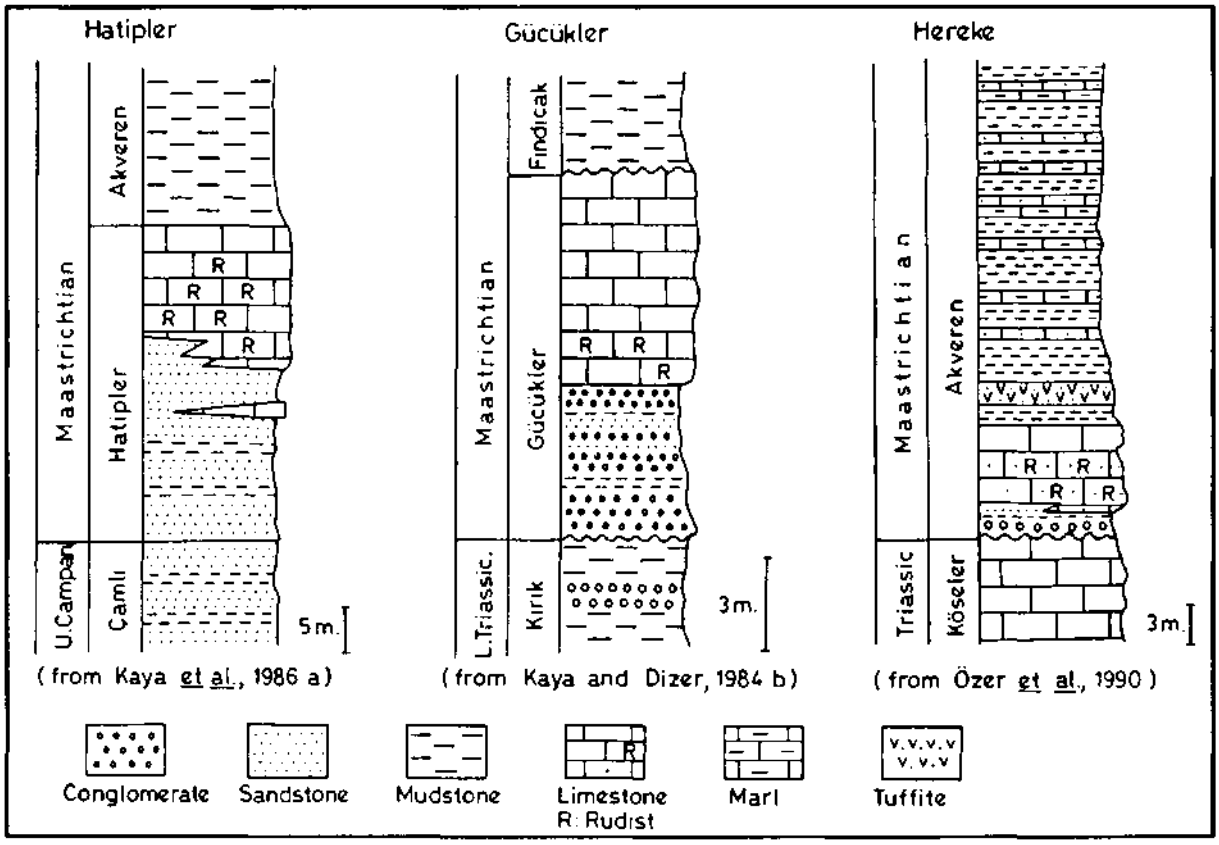

Fig. 2- Columnar sections of the rudistid localities.

served generally are severely fractured. Some rudists such as *Vaccinites loftusi* Woodward, *Hippurites* sp., *Biradiolites* sp., *Radiolites* sp. and the new species *Durania carinata* n.sp. and *Sauvagesia sulcata* n.sp. have been determined. According to Kaya and Dizer (1984b), the age of the Gücükler formation is Maastrichtian because of the presence the benthonic foraminifers such as *Orbitoides medius* d'Archiac and *Siderolites calcitropoides* Lamarck.

The Gücükler formation is overlain unconformably by the Fındıcak formation (Kaya and Dizer, 1984b) of Maastrichtian Paleocene age.

Hereke area: The rudists are very abundant in this area (Özer, 1988b, 1992; Özer et al., 1990) and they are observed in the Akveren formation lying directly on the Triassic rocks (Fig. 1, 2). The basal section of the Akveren formation consists of red conglomerates, bioclastic limestones, rudist bearing sandy limestones and mudstones presenting facies changes. The upper section of the formation is made of marls and mudstones with planktonic foraminifera indicating a Maastrichtian-Paleocene age (Kayaetal., 1986b; Özer et al., 1990).

The rudist bearing limestones include *Hippurites lapeirousei* Goldfuss, *Hippurites nabresinensis* Futterer, *Hippurite? cornucopiae* Defranee, *Vaccinites braciensis* Sladic-Trifunovic, *Vaccinites ultimus* Milocanovic, *Pironaea ti*macensis,Milovanovic, *Joufia cappadociensis* (Cox), *Sabinia klinghardtiBöhm, Pseudopolyconites ovalis* Milovanovic, *Miseia hekimhanensis* Karacabey-Öztemür, *Gorjanovicia* sp., *Plagiopthycus* sp., *Bournonia* sp., *Sauvagesia* sp., *Sauvagesia herekeiana* n.sp. and *Radiolites simpliformis* n.sp. which indicate probably and Early Maastrichtian age.

PALEONTOLOGY

Class: BIVALVIA

Order: Hippuritoida Newell, 1965

Super family: Hippuritacea Gray, 1848

Family: Radiolitidae Gray, 1848

Subfamily: Radiolitinae Gray, 1848

Genus: Radiolites Lamarck, 1801

Radiolites corporatus n.sp.

(Plate I, fig. 1-4)

Material: One sample with lower and upper valves and one sample with partly preserved upper valve.

Derivation of name: *corporatus*- because of the valve's being massive and strong.

Holotype: Pl. I, fig. 1, 2, 4, sample no: PK 19, the laboratory of Dokuz Eylül University, İzmir.

Diagnosis: Lower valve cylindrical, massive and big. Outer lamellae thin, upturned towards the upper part of the valve densey undulating around the periphery of the valve. Lamellae are represented by a wide curve on the ventral side only. Siphonal bands concave. Interband slightly bulge and very wide. Ligamental ridge thin, long and truncated at the top. Upper valve conical and inclined towards the cardinal area.

Description: The lower valve is cyclindrical, massive, big and 85 to 90 mm in length. The diameter in the commissure is approximately equal to the length of the valve. Outer lamellae are thin, upturned towards the upper part of the valve and regularly and densely undulating around the whole periphery of the valve. Lamellae are formed partly bulge irregular costae. Outer lamellae represent only a wide undulation in the ventral side of the valve which results also an undulation at the commissure line (Plate I, fig. 2). The siphonal bands are clearly observed and concave. Posterior band (S) is marked with a 15 mm wide groove and it is wider than the anterior band (E). Interband (I) is slightly convex, very wide (35 mm) and it consists of the lamellae which upturn towards the upper part of the valve. The shell wall of the valve is prismatic and consists of irregular, small and polygonal cells. The thickness of the pristamic layer is not same everywhere; it is 30 to 35 mm between the cardinal area and ventral region, whereas only 15 to 20 mm in the siphonal region (Plate I, fig. 3). Ligamental ridge is thin, long (7-8 mm) and it is truncated at the top. The teeth are not same size and well observed. The myophores are partly preserved.

The upper valve is conical, inclined towards the cardinal area and 28 mm in height (Plate I, fig. 1,4). The surface of the valve is ornamented by the cyclic growth lamellae.

Discussion: The new species somewhzt resembles *Radiolites crassus* Polsak by the conical upper valve, short and big lower valve (Polsak, 1967). But it differs from *R. crassus* Polsak by the concave siphonal bands, thin lamellae, long ligamental ridge and evidently a massive valve.

The new species presents some similarities to *Radiolites sauvagesi* (d'Hombres-Firmas) by the structure of the siphonal bands (d'Orbigny, 1847; Toucas, 1909; Polsak, 1967); however it distinguishs from *R.sauvagesia* (d'Hombres-Firmas) by the undulation of the commissure line, the shape of outer lamellae in the ventral side of the lower valve and especially short and massive lower valve.

Type locality: Holotype northeastern Konuralp (Bolu), paratypes northwestern Hatipler and Konuralp (Bolu).

Type level: Maastrichtian.

Radiolites simpliformis n.sp.

(Plate II,fig. 1-3)

Material: One sample with lower and upper valves and three lower valves.

Derivation of name: Because of the very simple structure of the siphonal region and outer lamellae.

Holotype: Plate II, fig. 2, 3, sample no: PY 12, the laboratory of Dokuz Eylül University, İzmir.

Diagnosis: Lower valve conical. Outer lamellae in horizontal position throughout the periphery of the lower valve. Siphonal region with very simple structure. Siphonal bands widely concave. Interband slightly convex.

Description: The lower valve is conical and 105 mm in length in the holotype. The diameter is 80 to 90 mm and circular. The outer lamellae are horizontal throughout the periphery of the valve (Plate II, fig. 1, 2). The siphonal region is of a very simple difficulty structure and narrow (35 mm). The bands can be observed with (Plate II, fig. 1). The siphonal bands (S and E) are slightly concave and approximately of the same size. Interband is 16 mm wide, and it is represented by a slightly bulge undulation. Interband is less wider than the siphonal bands. Outer layer consists of small and polygonaj.cells. This layer is thinner in the ventral and dorsal side than those of the cardinal area and siphonal zone (Plate II, fig. 3). Ligamental ridge is thin, short, truncated and slightly widen at the top. The teeth and myophores are not preserved.

The upper valve is flat and smooth.

Discussion: The new species resembles to *Radiolites mamillaris* Matheron by the shape of the siphonal bands (Matheron, 1842; Parona, 1912; Polsak, 1967). But, it differs from this species by the less developped siphonal bands and horizontal position of the outer lamellae. The new species can be compared by the shape of the outer lamellae with *Radiolites sauvagesi* (d'Hombres-Firmas) which is determined by Polsak (1967, Plate 35, fig. 4). However, it differs from this sample by the very narrow and very simple structure of interband and less development of the siphonal bands.

Type locality: Holotype Yığılca (Bolu), paratypes Hereke (Kocaeli) and Konuralp (Bolu).

Type level: Maastrichtian.

Genus: Durania Douville, 1908.

Durania carinata n.sp.

(Plate III, fig. 4-6)

Material: One sample with lower and lower valves and one lower valve.

Derivation of name: Because of presence of a caren in the ventral side of the lower valve.

Holotype: Plate III, fig. 4-6, sample no: PG 4, the laboratory of Dokuz Eylül University, İzmir.

Diagnosis: Ventral side of the lower valve with an outer caren as longitudinal costae. Posterior siphonal band slightly convex. Anterior band smooth or less convex. Interband bulge and separated form siphonal bands by a groove which is more narrow and more deep. Siphonal area of the upper valve plicated.

Description: The lower valve is conical, short and 30-35 mm in langth. The diameter is 60 mm in the commissure. The surface of the valve has most-

ly been eroded; however, around antero-ventral side a few thin and longitudinal costae can be observed. Posterior band is slightly convex, 15 mm in width and ornamented with 8-10 longitudinal and very thin costae. Anterior band is smooth or less convex and ornamented with 6-8 thin and longitudinal costae. This band is twice as narrow as the posterior band (Plate III, fig. 4, 6). Interband is separated from the siphonal bands by a narrow and deep groove (Plate III, fig. 6). An outer caren of the ventral side of the valve is characteristic for the new species. This caren is rather bulgy as a longitudinal costae around commissure and shows a triangular transverse section (Plate III, fig. 5, 6). The outer layer consists of irregular prismatic cells. These prisms are radially elongated along the inner part of the shell wall. The thickness of the outer layer is 20 mm in the cardinal area, whereas it is very thin in the siphonal region. Ligamental ridge is not developed. The teeth and myophores are very well preserved (Plate III, fig. 6). The anterior tooth and myophore are more developed than the others.

The upper valve is slightly convex and smooth. The siphonal region is plicated and it contains a slightly bulgy and wide costae corresponding to the posterior band of the lower valve. Interband is represented by a deep and narrow groove (Plate III, fig. 4, 5).

Discussion: *Durania carinata* n.sp. differs from all of the known species of the genus by the structure of the siphonal area and especially by the presence ventral caren.

The new species can be compared with *Durania gaensis* (Dacque), *Durania ruanensis* (Choffat) and *Durania spadai* Parona by the shape of the interband (Choffat, 1891; Dacque, 1903; Douville, 1910; Parona 1911 a, 1912; Polsak, 1967). However it differs from these species by the structure of the siphonal bands.

Type locality; Holotype and paratype Gücükler (Bolu).

Type level: Maastrichtian.

Genus: Sauvagesia Choffat, 1986

Sauvagesia sulcata n.sp.

(Plate III, fig. 1-3)

Material: One sample with lower and upper valves and one lower valve.

Derivation of name: sulcata -because of the groove type shape of the posterior siphonal band.

Holotype: Plate III, fig. 1-3, sample no: PG 11. the laboratory of Dokuz Eylül University, Izmir.

Diagnosis: Posterior band groove. Anterior band and interband flat. Transverse section of the valve oval.

Description: The lower valve is conical and about 60 mm in lenght. The diametre of holotype is 45x66 mm. The transverse section of the valve is oval (Plate III, fig. 3). The surface of the valve is eroded, so, the ornamentation is not clearly observed. But, the dorsal side of the valve contains a few thin costae. Posterior band is narrow, 7 mm in width and a deep groove at commissure (Plate III, fig. 1-3). Posterior band is probably ornamented with a few thin costae. Anterior band is flat, and it has very thin costae. Interband is also flat. The wideness of the bands is approximately equal. The shell wall consists of regular polygonal cells. Ligamental ridge is thin, 2 mm in length and enlarged at the top.

The upper valve is flat or silghtly convex and smooth (Plate III, fig. 2).

Discussion: The new species shows resemblances to *Sauvagesia turriculata* Catullo and *Sauvagesia stachei* Polsak by the shape of the posterior siphonal band (Catullo, 1838; Parona, 1911b; Polsak, 1967; Civitelli and Mariotti, 1975). But, it differs from these species by the ornamentation of the anterior band, by the shape of the interband and by well developed the lower valve's being.

Type locality: Holotype and paratype Gücükler (Bolu).

Type level: Maastrichtian.

Sauvagesia herekeina n.sp.

(Plate I, fig. 5, 6; Plate II, fig. 4)

Material: One sample with lower and upper valves and one lower valve.

Derivation of name: herekeina -from Hereke where the specimens have been found.

Holotype: Plate I, fig. 5, 6, sample no: KT 36, the laboratory of Dokuz Eylül University, İzmir.

Diagnosis: Lower valve conical. Posterior band and interband flat. Anterior band slightly concave. Lower valve ornamented with longitudinal and regular thin costae.

Description: The lower valve is conical (Plate I, fig. 5). The lenght of the lower valve is about 65 mm. The surface of the lower valve is ornamented by a few slightly bulgy costae which is about 1 mm in width. The costae are separated by shallow longitudinal grooves. Some costae 2-3 mm in width are also observed. Posterior band is flat. Anterior band is broadly concave. These bands are ornamented with 10 thin longitudinal costae and limited from their edges with the bulge and a wide costae (Plate I, fig. 5). The width of the bands is about 18 mm and nearly in the same size. Interband is flat, 8 mm in width and ornamented by 8 thin costae. The shell wall consists of irregular prism. The thickness of the shell wall is not same everywhere; it is 18 mm in the cardinal and siphonal region, whereas only 8 mm in the ventral side (Plate I, fig. 6). The siphonal bands are represented with the wide curves at the inner side of the shell wall. An anterior pseudopillar which separated from the prismatic layer by an oblique lam, are observed (Plate I, fig. 6; Plate II, fig. 4). Ligamental ridge is short and triangular. The teeth are partly preserved.

The upper valve is flat and smooth.

Discussion: The new species can be compared with the species *Sauvagesia tenuicostata* Polsak, *Sauvagesia sharpei* (Bayle) and *Sauvagesia nicasei* (Coquand) by the ornamentation of the lower valve (Bayle, 1857; Coquand, 1862; Douville, 1891; Polsak, 1967; Pons, 1977; Civitelli and Mariotti, 1975). It differs from *S.tenuicostata* by the flat and smooth upper valve, by the conical lower valve, by the width of the interband and posterior band, by the shape of the anterior siphonal band and by the thickness of the shell wall. It differs from other species by the flat interband; the interband of *Sauvagesia nicasei* is convex, whereas concave in *Sauvagesia sharpei* (Pervinquiere, 1912; Polsak, 1967).

Sauvagesia herekeiana n.sp. shows much resemblance to *Sauvagesia ginestousi* Pervinquiere by the structure of the siphonal area; but it differs from this species by the equal width of the siphonal bands, by the marked and wides interband and by the shape of the ligamental ridge.

The anterior pseudopillar of the new species can be compared with those of *Eoradiolites davidsoni* (Hill) and some of the species of the genus Miseia Patrulius (Hill, 1893; Douville,. 1909; Milovanovic, 1938; Patrulius, 1974; Karacabey-Öztemür, 1979; Özer, 1992). But, these pillars are not really pseudopillars observed in the species (Milovanovic, 1938) of the subfamilly Lapeirousiinae Kühn.

Type locality: Holotype Hereke (Kocaeli) and paratype Konuralp (Bolu).

Type level: Maastrichtian.

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PLATES

PLATE -I

Fig. 1-*4-Radiolites corporatus* n.sp.

Fig. 1 - Lower (VI) and upper (VS) valves, view of the siphonal region, X 0.6, holotype, No. PK 19, Konuralp (Bolu).
S- posterior siphonal band
I- interband

Fig. 2- Lower and upper valves, ventral side, X 0.7, holotype. Note wide ondulation of the lamellae and also the ondulation of the commissure (arrow).

Fig. 3- Transverse section of the lower valve passing below 20 mm of the commissure, X0.6, paratype, No. PH 6, Hatipler-Konuralp (Bolu). Note the thickness of the prismatic layer in the cardinal area.
L- ligamental ridge
B, B'- teeth of the upper valve
S, E- siphonal bands
I- interband

Fig. 4- Upper view of the upper valve, X0.6, holotype. Upper valve is indined towards the cardinal area.

Fig. 5-6- *Sauvagesia herekeiana* n.sp.

Fig. 5- Lower and upper valves, view of the siphonal region, X1, holotype, No. KT 36, Hereke (Kocaeli).

Fig. 6- Transverse section of the lower valve passing below 15 mm of the commissure, X1, holotype. Note the anterior pseudopillar (arrow) separated from the prismatic layer by an oblique lam.

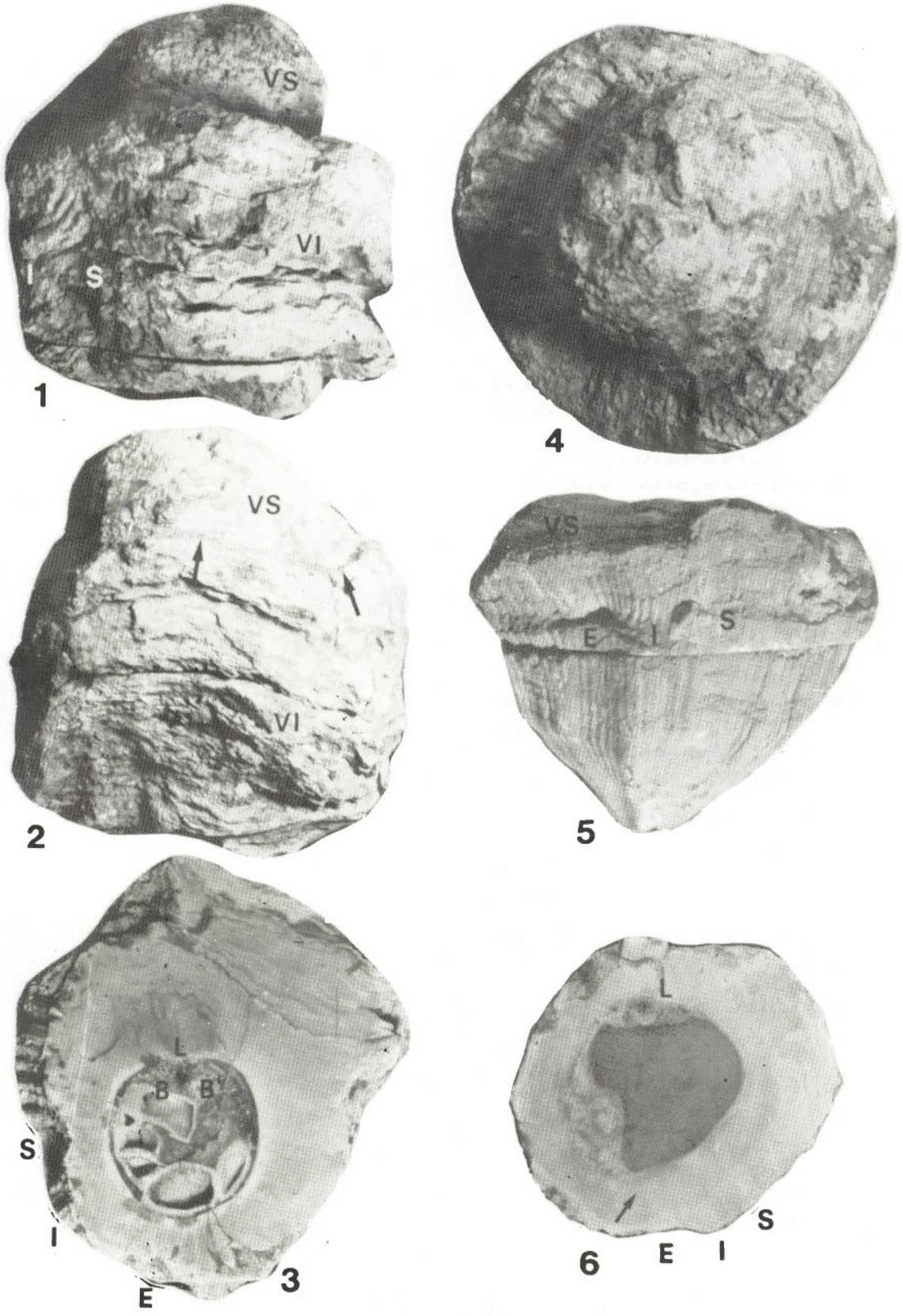

VS
VI
I
S
1
4
VS
VI
2
VS
E
I
S
5
L
B
B'
S
I
E
3
L
S
E
I
6

PLATE -II

Fig. 1 -*3-Radiolites simpliformis* n.sp.

Fig. 1- Lower (VI) and upper (VS) valves, vie of the siphonal region, X0.7, holotype, No. PY 12, Yığılca (Bolu).
Note the simple structure of the siphonal region and the horizontal position of the outer lamellae.
S,E- siphonal bands
I- interband

Fig. 2- Lower and upper valves, ventral side, X0.7, holotype. Compare the position the outer lamellae with the fig. 1.

Fig. 3- Transverse section of the lower valve, commissure unknown, X 1, paratype, No. KT 34, Hereke (Kocaeli).
L- ligamental ridge

Fig. 4- *Sauvagesia herekeiana* n.sp.

Transverse section of the lower valve, commissure unknown, X1, paratype, No. PK. 23, Konuralp (Bolu).
Note the anterior pseudopillar (arrow).

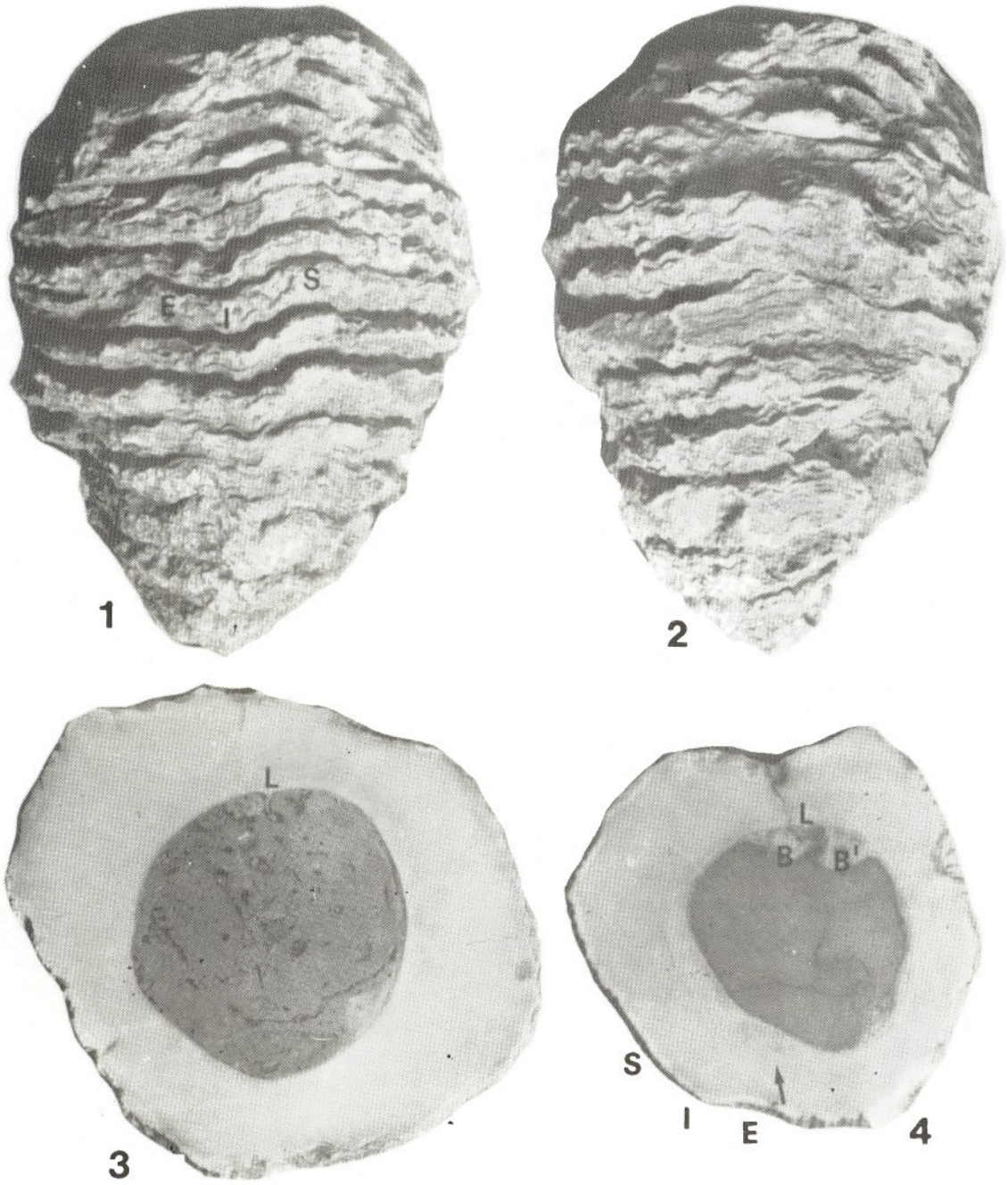

S
E
I
1
2
L
3
L
B
B'
S
I
E
4

PLATE -III

Fig. 1 -*3-Sauvagesia sulcata* n.sp.

Fig. 1- Lower (VI) and upper (VS) valves, view of the siphonal region, X1.2, holotype, No. PG 11, Gücükler-Gökçesu (Bolu).
S, E- siphonal bands.
I- interband.

Fig. 2- Upper view of the upper valve, X1, holotype. Note the deep grove of the posterior band.

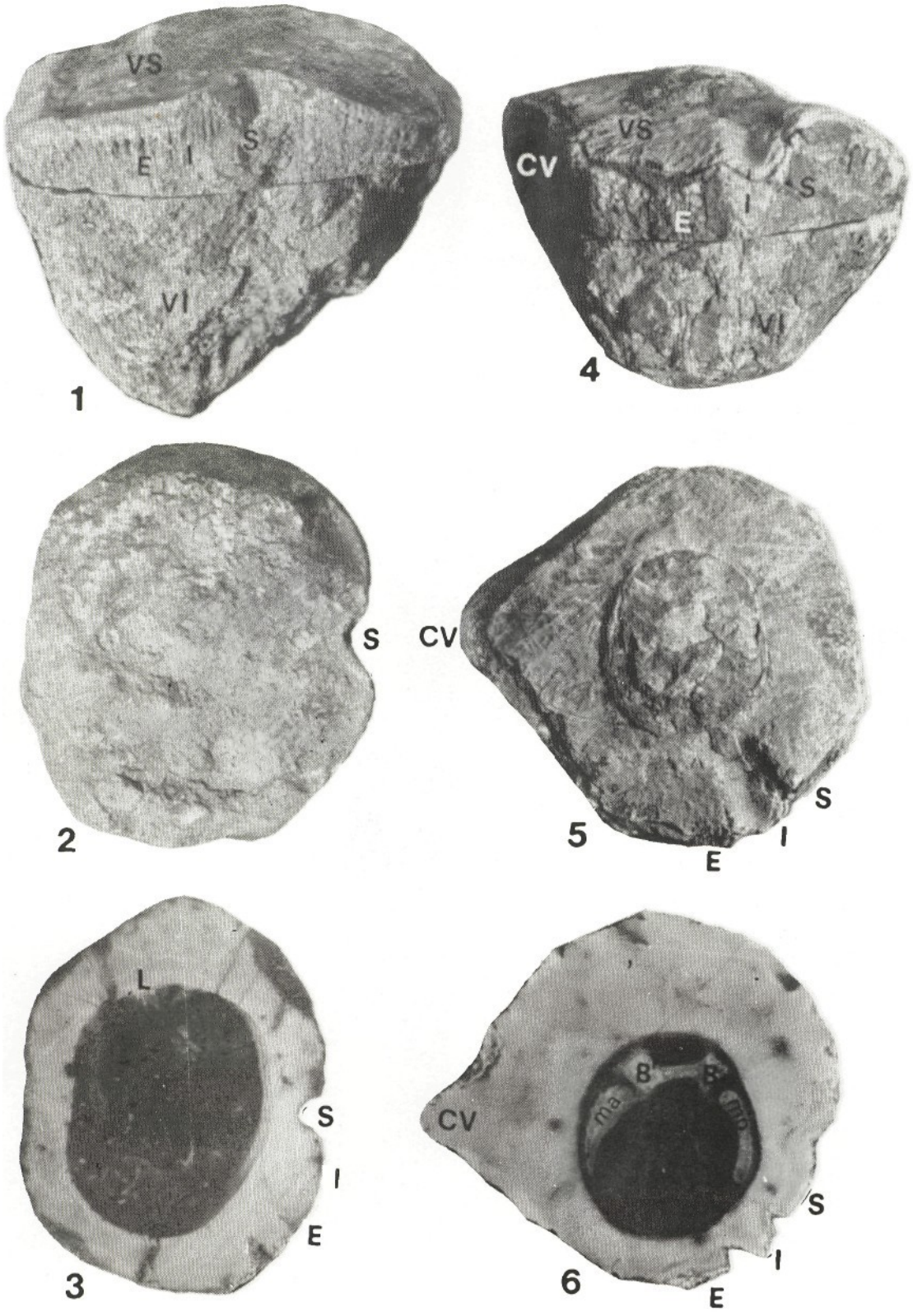
Fig. 3- Transverse section of the lower valve passing below 10 mm of the commissure, X1, holotype.
L-Ligamental ridge.

Fig. 4-6- *Durania carinata* n.sp.

Fig. 4- Lower and upper valves, view of the siphonal region, X1, holotype, No. PG 4, Gücükler-Gökçesu (Bolu).
CV-ventral caren.

Fig. 5- Upper view of the upper valve, X1, holotype. Lower valve is partly observed.

Fig. 6- Transverse section of the lower valve passing below 10 mm of the commissure, X1, holotype.
Note the structure of the siphonal region.
B, B'- teeth of the upper valve
ma, mp-myophores.


VS
E
I
S
VI
1
CV
VS
E
I
S
VI
4
S
2
CV
S
I
E
5
L
S
I
E
3
CV
B
B
ma
mp
S
I
E
6