Türkiye Jeoloji Kurumu Bülteni, c. 21, 145-152, Ağustos 1978
Bulletin of the Geological Society of Turkey, v. 21, 145-152, August 1978

Inarticulate Brachiopods from Cambro - Ordoicivan Formations in the Western Taurus (Turkey)

Batı Toroslar'daki (Türkiye Kambro-Ordovisiyen Formasyonlarında Menteşesiz Brachiopoda'lar

G. TERMIER, *Universite Paris VI, Laboratorie de Géologie Structurale*
O. MONOD, *Universite Paris - Sud, Laboratoire de Géologie Historique*

ABSTRACT: Stratigraphical positions of **Craniotreta** n.gen., **Schizotretoides** n. gen., **Conotreta** sp., **Schizotreta** sp. from Lower Ordovician and Middle Cambrian Strate of Western Taurus are discussed and their paleontological descriptions are presented.

ÖZ: Batı Torosların Alt Ordovisiyen ve Orta Kambriyen tabakalarındaki **Cranioireta** n. gen., **Schizotretoides** n. gen., **Conotreta** sp., **Schizotreta** sp.'nin Stratigrafik konumu tartışılmış ve paleontolojik tanımlamaları verilmiştir.

INTRODUCTION

Middle Cambrian Carbonates and Lower Ordovician shales are known from the region of Seydişehir (Monod, 1967; Dean and Monod, 1970; Haude, 1972) (Fig. 1) where they underlie the thick Mezozoic series of the Western Taurus (Brunn et al, 1971).

STRATİGRAPHY*

Two formations have been defined:

Çaltepe Formation

The Çaltepe Carbonates consist of coarse-grained dolomites and dark limestones with **Protoleridae** of Uppermost Lower Cambrian age followed by richly fossiliferous bioclastic limestones with Trilobites **(Paradoxides, Corynexochus, Solenopleuropsis)**, and ends with a key-horizon of red nodular limestone containing the same fauna but also **Conocoryphe,** and **Peronopsis** (Middle Cambrian), for a total thickness of about 120 m.

Seydişehir Formation

Above the carbonatic sequence the Seydişehir shales consist of a Lower member (yellow shales, 50 m) containing rare **Paradoxides** (Middle Cambrian), followed in apparent continuity by shales and sandstones (more than 1000 m) which yielded rich assemblages of Lower Ordvician Trilobites in the upper half of the formation **(Neseuretus, Colpocoryphe, Thaihungshania, Geragnostus,**-Arenig). In the Lower half of the shales, a careful search for fauna of possible Upper Cambrian age has disclosed instead new occurences of Lower Ordovician fauna in small limestones lenses which also contained rich assemblage of Inarticulate Brachiopods, which are described below.

Positon of the samples (Fig 1, 2)

a) **Yavşanlı Tepe Fauna (C 800).** North of the town of Seydişehir, one mile WSW from Çal Tepe, a small height in the Seydişehir shales is named Yavşanlı Tepe on the topographic sheet N 27 bl (1/25000). Immediately close to that point, several carbonatic lenses may be seen protruding from the dark shales with a clear NNE trend. Each

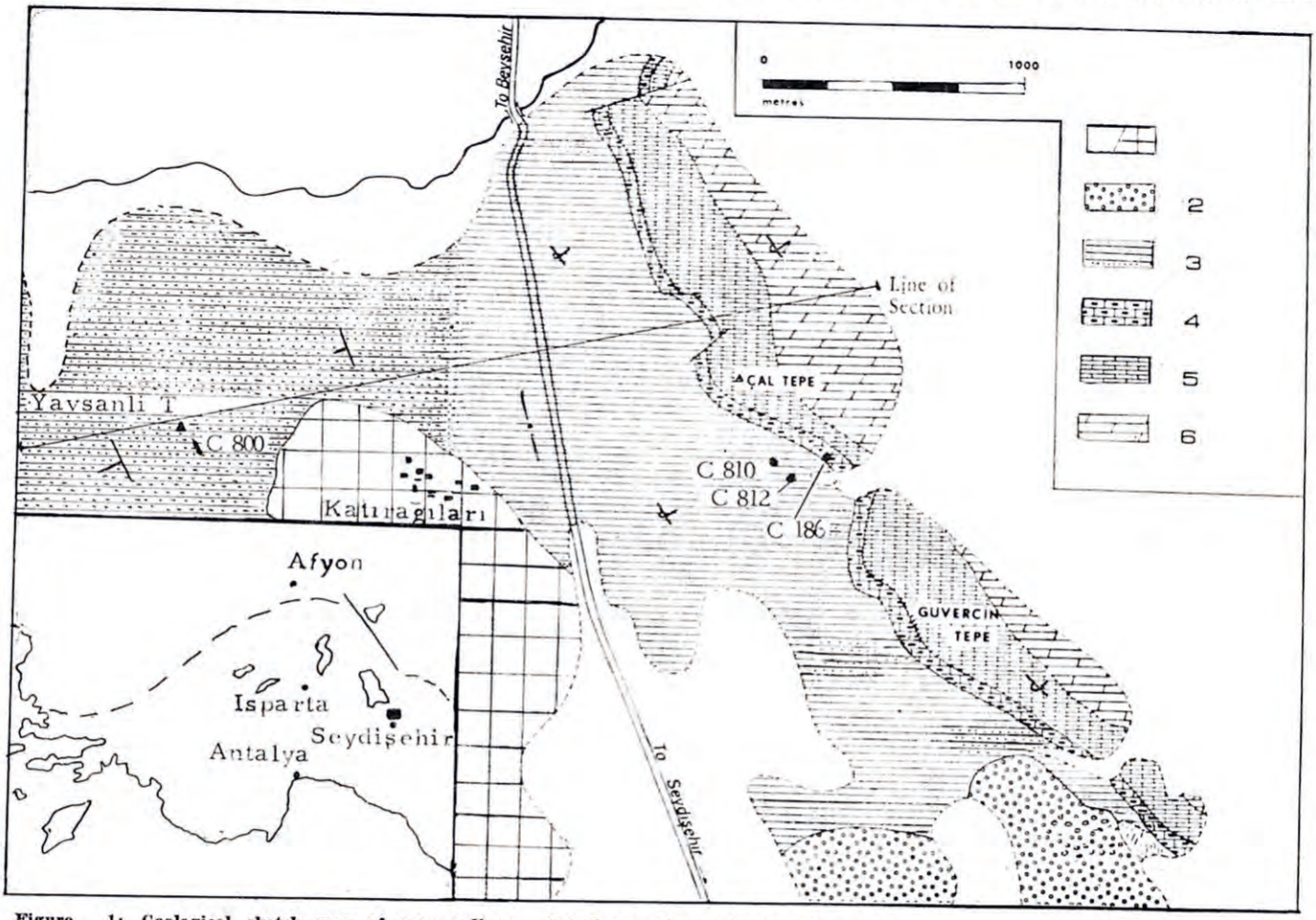

Figure 1: Geological sketch map of surroundings Çal Tepe and sample Locations.

Lithology : 1 — Recent deposits and travertine. 2 — Young neogene conglomerate 3 — Seydişehir shale (Lower Ordovician). 4 — Çal Tepe red nodular limestones (Middle Cambrian). 5 — Çal tepe black Limestones (Middle to Lower Cambrian). 6 — Dolomites (Lower Cambrian).

Şekil 1: Çal Tepe dolayının şematik jeoloji haritası ve örnekleme yerleri

Litoloji : 1 — Genç çökeller ve travertenler 2 — Genç neojen çakıltaşı, 3 — Seydişehir şeyli (Alt Ordovisiyen). 4 — Çal Tepe kızıl kireçtaşları (Orta Kambriyen). 5 — Çal Tepe kara kireçtaşları (Orta ve Alt Kambriyen). 6 — Dolomitler (Alt Kambriyen).

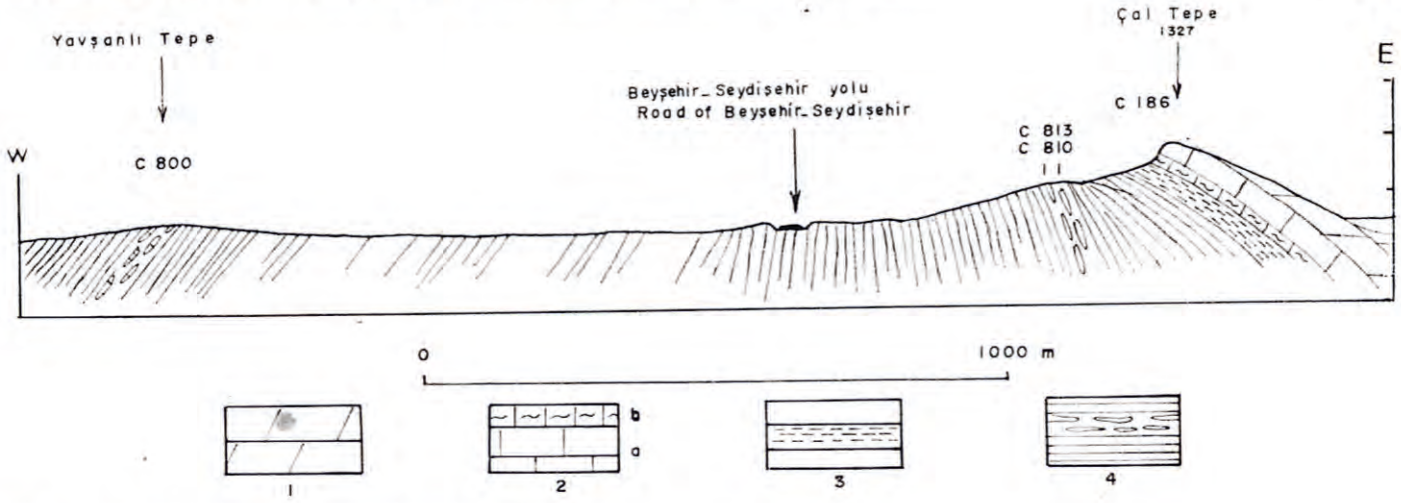

Figure 2: Schematic section from Çal Tepe to Yavşanlı Tepe.
Lithology : 1 — Dolomite (Lower Cambrian). 2 — Çal Tepe Carbonates: a) Black Limestone, b) Red nodular Limestone (Middle Cambrian). 3 — Yellow shale (Middle Cambrian). 4 — Seydişehir shale, with carbonatic lenses (Lower Ordovician).

Şekil 2: Çal Tepe'den Yavşanlı Tepe'ye şematik kesit.
Litoloji : 1 — Dolomit (Alt Kambriyen). 2 — Çal Tepe Karbonatları: a) Kara kireçtaşı, b) Kızıl nodüler kireçtaşı (Orta Kambriyen). 3 — Sarı şeyl (Orta Kambriyen). 4 — Seydişehir şeyli, karbonatlı mercekli (Alt Ordovisiyen).

lens is about 0.5 to 1 meter thick and several meters long, and consists of bioclastic limestones with numerous fragments of Trilobites, among which Dean (1971) has identified:

Euloma (Lateuloma) of. **laticeps**
Nileus sp.

which indicate a Lower Ordovican age for the lenses. To this fauna are associated some **Conotreta** sp. described there after (C 800, Pl 3).

b) Fauna C 810 and C 812 (Western slope of Çal Tepe). Green and red shales are found on the western slope of Çal Tepe, half way to the top, which contain several red carbonatic lenses of nodular fabric, very similar to the red nodular facies of the Çal Tepe limestones; for that reason they were, considered as Middle Cambrian in age up to now. Some of the lenses are well exposed in the Pass between Çal Tepe and Güvercin Tepe (Figure 1). Although extremely poor in Trilobitic remains, repeated sampling has yielded some badly preserved fragments of probable **Euloma**, which exclude a Cambrian age, and allow a Lower Ordovician age for these lenses. Associated with the Trilobites, some **Schizotretoides** are described below (C 810 and C 812, plates 2 and 4).

c. Upper Çal Tepe Fauna (C 186). Within the key-horizon of red nodular limestones which end the Çal Tepe formation, a small and quite distinct Brachiopod fauna was found (C 186, Pl 1). It is assocciated with typical Middle Cambrian Trilobites (Dean and Monod, 1970).

DISCUSSION

In spite of the lack Conodonts in the samples that were examined, the Trilobite fragments and the small Brachiopod fauna allow a biostratigraphical scale in the lower half of the Seydişehir shales formation and show more precisely the probable emplacement of the limit between Cambrian and Ordovician systems (Fig. 3); The existence of Upper Cambrian strata on the Çal Tepe Typesection becomes highly improbable, since only 100 meters of shales separate the highest Middle Cambrian fauna (Yellow shales) from the lowest Ordovician lenses (C 812). However, Özgül and Gedik (1973) have described some Conodonts from the Seydişehir shales of Egiste-Hadim (50 km SE from Seydişehir), which bear close resemblance to some Upper Cambrian American genera.

More generally, the problem of the limit between Ordovician and Cambrian formations in the Western Taurus is remarkably similar to what is known in western Mediterranean countries (South of France, Spain, Sardinia, Morocco; see Boyer and Guiraud, 1964; Capera et al, 1975; Arthaud, 1970; Matte, 1969; Destombes et al, 1969) where Upper Cambrian strata are always missing (one exception, Colchen, 1967). The facies of Cambrian and Ordovician formations also appear surprisingly similar to the Çal Tepe Limestones and Seydişehir Shales especially in the Montagne Noire in Southern France (see Courttessole, 1973) and the Trilobitic faunas are identical (Dean, 1975). Such well defined cemparisons certainly mean that the problem of the Cambro-Ordovician limit is not restricted to the Western Taurus but should on the contrary be examined all the Mediterranean countries.

PALEONTOLOGY*

Gastrocaulid rests extracted from Çal Tepe and Seydişehir Cambro-Ordovician formations do not exceed 1 mm in their widest diameter. Only scanning test electronmicrography is able to display their structure, the primitive test having likely been phosphated from the beginning.

The valval complexity of Acrotacea and Siphonotretacea was recognized by Biernat and Williams (1970); Poulsen (1971) : they distinguished an apical (neanic) protegulum, the fabric of which is a pit pattern, from the adult shell, smooth and ornamented only by

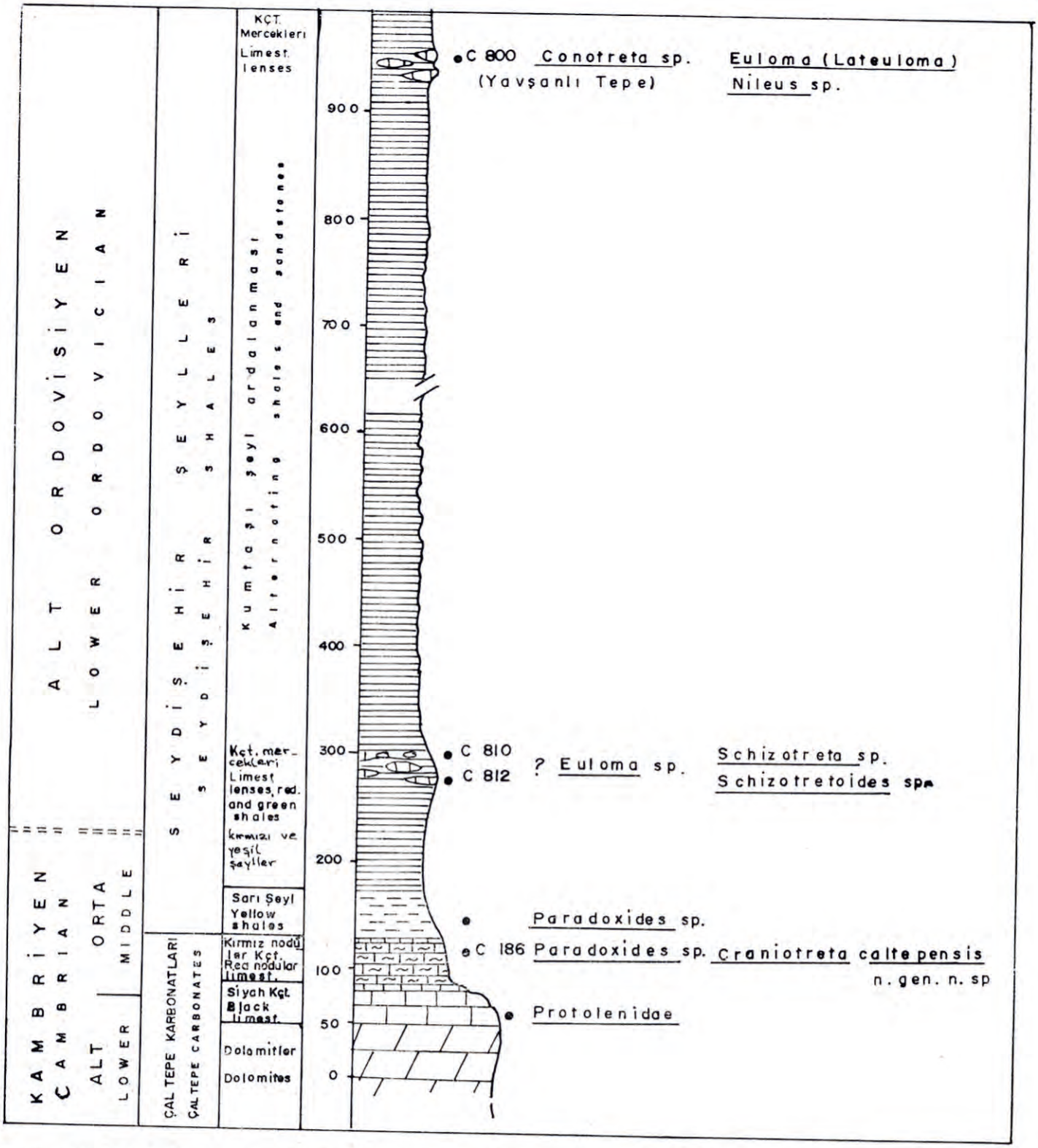

Figure 3: Stratigraphical succession of the Cambro-ordovician formations in the region of Seydişehir and relative position of the samples.

Şekil 3: Seydişehir bölgesindeki Kambro-ordovisiyen oluşuklarının stratigrafi istifi ve örneklerin göreli konumu.

growth lines. Many of these Brachiopods might have belonged to algalfastened microfaunus (Rowell and Krause, 1973).

Acrotretida test-fabric

Cambrian and Ordovician Acrotretides display a primitive pattern from which seem to originate the many secondary Craniacean types (cf. Williams and Wright, 1970). Poulsen (1971) describes the pedicle valve of Tremadocian **Acrotretacea** from Norway as having inner phosphatic la yers, forming parallel bands connected by pillars, which are the phosphatic moulds of caeca (punctae) crossing organic interlayer bands. The outer layer should be a periostracum wrapping alterned organic (chitine+proteine) and phosphatic layers of hollow tubes, rectangular in crosssection, secreted by epithelial cells,

Among the material here described, and ultrastructure of parallel bands conneced by caecal tubes is displayed in a Middle-Cambrian Siphonotretid, **Craniotreta** nov. gen. (C 186 and in a Lower Ordovician Acrotretid, **Conotreta** (800). It is the pattern shown by ohotonic microscope in the very thin shell of **Glyptacrothele courtessolei** Termier and Termier (1974), where a single fibro-phosphatic interlayer is crossed by caeca, Just as in **Acrotreta socialis** v. Seebach (cf. Poulsen, 1971) in which the thick shell includes several fibrous interlayers of the same kind.

Ultrastructure and protegulum fabric in Acrotretids.. Acrotretidprotegulum (probably for the whole group), preserved on the umbo of the adult shell, is characterized by its honeycomb pattern, quoted by Biernat and Willams (1970) in a lot of genera **(Angulotreta, Apsotreta, Conotreta, Ephippelasma, Linnarssonella, Myotreta, Prototreta, Rhysotreta, Scaphelasma, Torynelasma).** Among Acrothelids, **Curticia** displays a similar pattern (but not Acrothele). For the authors, an external vesicular periostracum covered the larval shell, the vesiculae of which allowed buoyancy and facilitated current-disperssion during the protegular phase. Çraniids do not display such a protegular ornamentation, but a similarity does exist with the polygonal areas around ceeca of the **Crania** myotst (Williams and Wright, 1970).

In brachial and pedicle Acrotretid valves studied, the protegulum is frequently preserved.

Superfamily Siphonotretacea Kutorga 1848

After Rowell (1965), Craniids are characterized by o punctuated calcareous shell, aften fastened by their flattened ventral valve lacking and pedicle. A single exception (concerning the chemical composition) is the Ordovician **Eoconulus** Cooper, 1956 (Monotypic family **Eoconulidae,** Rowell, 1965) of which the shell is phosphatic.

The hereunder described genus has an Acrotretid fabric. The most plausible interpretation is for a Siphonotretacea. The general characters underline the similarities of the superfamily with Craniids, as suggested by Chuang (1968, 1971).

Genera Craniotrata nov. gen.

Type-species: Craniotreta çaltepensis nov. gen., nov. sp.

Upper part of Çal-Tepe formation (Middle Cambrian with **Paradoxides).** Acrotretid test-fabric. Conic brachial valve with 3 inner cornet-shaped organs, two symmetric ones being possibly adductor muscles scars, the third, in the symmetry plane, either a "siphonal tube" or a diductor muscle scar. Flattened pedicle valve with two folds.

Craniotreta Çaltepensis nov. gen., nov. sp.

(Pl. 1, fig. 1-5; Fig. 4)

Cone-shaped shell with slightly anterior apex and some radial ridges. The shape is guite near an Acrotretid pedicle or a Craniid brachial valve (the Craniids pedicle valve having lost a part of its features by welding).

Inner features (SEM). Smooth periphery, lining around center an inner layer which forms an interior convex area displaying radial (pennate) canals (sinuses) issued from two symmetric arcuate vascula media. Behind are three cornet-shaped processus: the smaller, hinder, apical and in the symmetry plane; the other two, larger are symmetric. The "cornets" fabric is Acrotretid with parallel bands connected by caecal pillars. We think that these cornet-shaped organs square with abraded myotest.

Such an arrangement strides up to Craniids. While mucle scars in **Kayserlingia** are lateral, the two symmetric cornets are quite similar in position to the mighty posterior adductors in **Crania.** The anterior convex plated area, with a main canal (formed by the two vascula-media) from which radial canals set off, looks much like a Craniid brachial valve (Fig 4). The third "cornet", apical and smaller,

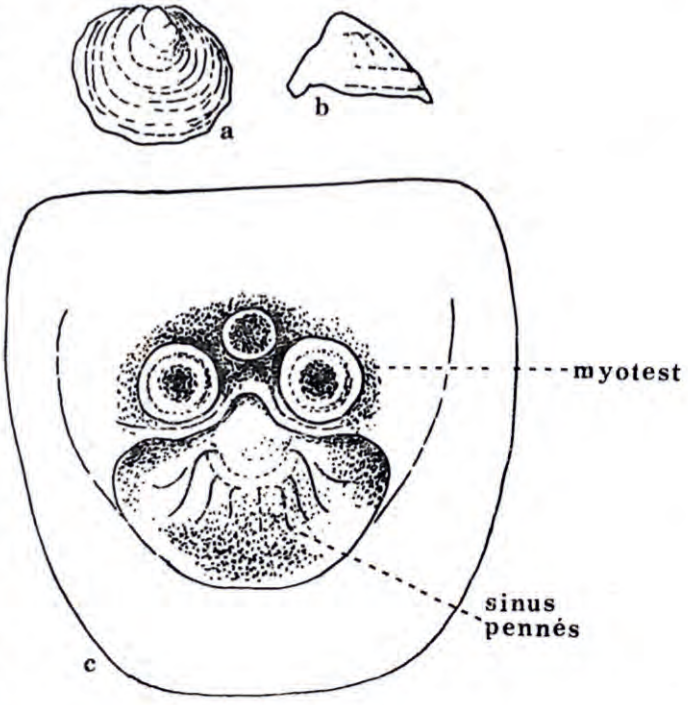

Figure 4: Craniotreta caltepensis, nov. gen. nov. sp. Brachial valve. a) Dorsal view, b) Profile, c) Detail from the internal face.

Şekil 4: Craniotreta caltepensis, nov. gen. nov. sp. Brakyal valv. a) Dorsal görünüş, b) Profil, c) İç yüzden ayrıntı.

included within the myophone plate, is more difficult to interpret In Craniids, the ventral valve welded to the substratum has lost any pedicular, foraminal or apical structures; the conical valve of **Craniotreta** is parallel to the Craniid brachial valve.

Chuang (1971) compared the perforate Siphonotretid valve of **Schizambon australis** Ulrich and Cooper (Tremadocian) with a **Crania** brachial valve: the perforation would not be a pedicle pass but the mark of a siphonal inner tube. The author applied such an interpretation to **Conotreta** and Keyserlingia. Chuang siphonal tube would connect the pallial cavity recess (opened in front of lophophore arms in Crania) with outside; it would open directly outside in **Schizambon.** Such a hypothesis is heavily questioned by Rowell (1977).

Paralleling inner "cornets" of Craniotreta with "brachial" (fide Chuang) myotest of **Schizambon typicalis** Walcott would lead to interpretation of the apical "cornet" of Craniotreta as a siphonal tube.

Flattened ventral (?) valve.- In the same stratum (C 186) a flattened valve bearing two radial ribs issued from posterior edge might be the fastened (ventral?) valve of **Craniotreta.** The outer fabric (pl. 1, fig. 3, 4, 5,) displays a large honeycomb posterior area, similar to the Acrotretid protegulum surface. The anterior adult shell surface is granulo-thorny.

COMPARISONS

Eoconulus Cooper, 1956 seems to have an inner structure very similar to that of **Craniotreta,** but its shell is imperforated, without caecal pillars. Yet **Eoconullus sp.** from Nevad Ordovician (Rowell and Krause, 1973, p. 799, pl. 1, fig. 16) has a phosphatic fastened pedicle valve and mighty cardinal (postero-lateral) muscle scars, framing a hump "resembling some acrotretid apical process" but without any inner foramen.

The pedicle valve of the Upper Cambrian **Angulotreta** Palmer (in Bell and Ellionwood, 1962) is interiroly similar: an apical process with an inner pedicular hole, opening into a collar, and apical posterolateral or slightly anterior pits. This genus has a pseudointerarea.

Among Craniids and illustrated in Russian Cambrian and Ordovician by Goriansky (1969), brachial valves of **Philhedra** and **Orthisocrania** present some similarity to those of **Craniotreta.**

Whatever the chosen interpretation, **Craniotreta** is a typical Acrotretid but with a muscle insertion of Crania type. So it is probably quite near the origin of this huge group. Acrotretid ultrastructure of organs attributed to myotest might even survive in that of Crania myotest.

Superfamily **Acrotretacea**
Family **Acrotretidae** Schuchert 1893
Genus **Conotreta** Walcott 1889

Generotypus: Geinetizina rutti Hall

Stratigraphical repartition: Ordovician.

Conotreta sp.
(fig. 5; pl. 3, fig. 1-5; pl. 4, fig. 1)
cf. 1971. Acrotratacean Brachiopod (unnamed) Poulsen.

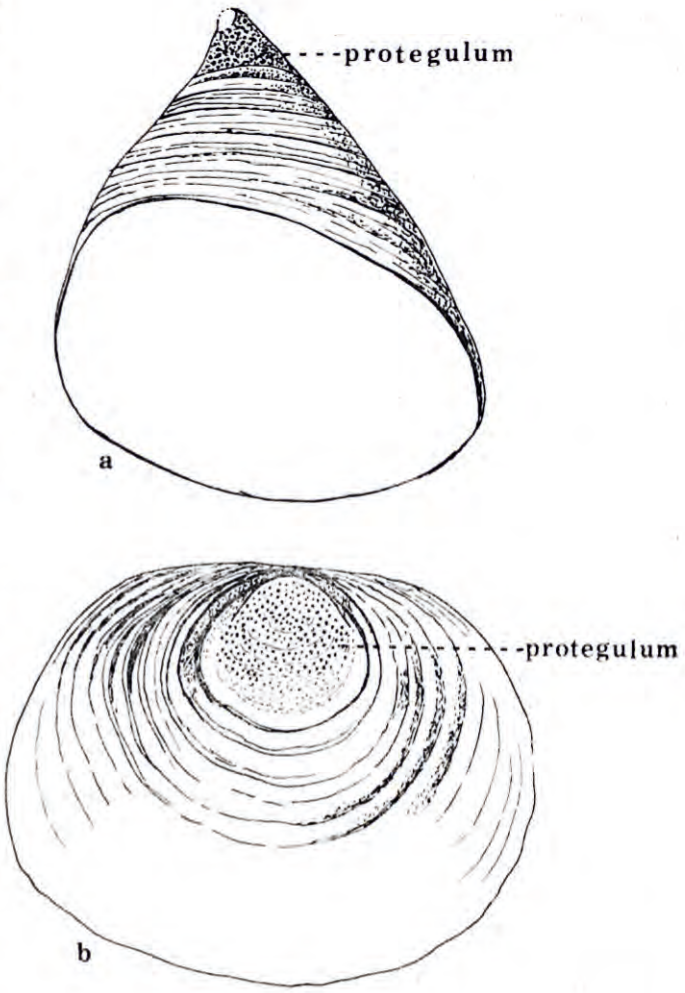

Figure 5: Conotreta sp. a) Pedoncular valve, b) Brachial valve.

Şekil 5: Conotreta sp. a) Pedonküler valv. b) Brakyal valv.

Ceratopyge and **Ampyx** limestones (Upper Tremadocian) of Oslo region.

Larval pedicle valve of 0.5 mm diameter, 0.5 mm height, including a 0.07 mm Acrotretid protegulum, similar to that of **C. depressa** Cooper illustrated by Biernat and Williams (1970),: i.e. of vacuolar type. The pits achieve a 2-3 mm diameter, set apart by varigated crystalline tracts. The shape is high conical, with subcentral mucronaled umbo, perforated by a subcircular foramien; there are inner streaked by ceacal pillars. (pl.4 fig 1). All features similar to the upper part of the pedicle valve of same size studied by Poulsen (1971). The adult shell is ornamented by similar smooth ribbons, and a light constriction marks the passage from the protegulum to the adult.

The brachial valve is unknown in the Norwegian specimen. In Turkey, a subcircular brachial valve, with a submarginal honeycomb protegulum, **Schizotreta**-shaped, has been obrerved.

C 800: part of Seydişehir shales: Yavşanlı Fauna (Lower Ordovician).

Genus **Schizotretoides** nov. gen.

Generotypus: **Schizotretoides tauricus** nov. gen. nov. sp. Lower Ordovician.

Genus similar to **schizotreta** but with a acrotretid honeycomb fabric of the protegulum.

Schizotretides tauricus nov. gen., nov. sp.

(pl. 2, fig. 3-6.)

Derivatio nominis: tauricus, from Taurus Range, South Turkey.

Stratum typicum : C 812, base of Seydişehir shales.
Diagnosis: Pidecle and brachial valve with puncturaled protegula.

The pedicle valve is 0.64 mm long and 0.43 wide. A fragmentary brachial valve is 0.8 mm wide. The shell of oval shape is very similar to **Schizotreta corrugata** but pitted. The position of the protegulum, in the two valves, is backward but not marginal.

Schizotretoides sp,

(pl. 4, fig; 2-5).

This specimen comes from C 810 level, quite near C 812. The brachial valve is very similar to **Sch. tauricus** but with a submarginal protegulum. The pedicle valve is wider than its length: 0.57 mm width, 0.47 mm length. The subcircular foramen is not submarginal but opens in the posterior 1/5. Acrotretid protegulum in the two valves.

Superfamily **Discinacea** Gray 1840
Family **Discinidae** Gray 1840
Genus **Schizotreta** Kutorga 1848

Generotypus: Orbicula elliptica Kutorga 1846-Middle Ordovician.

Repartition: Ordovician-Silurian.

This genus is distinguishable from **Acrothele** by the lack of "pseudointerarea" and by its smooth protegulum near the posterior edge of the brachial valve. The pedicular foramen, situated at the umbonal top, is described as possessing an inner posterior ridge, which places the genus in the Discinids, near Orbiculodea.

The only character distinguishing **Schizotretoides** from **Schizotreta** is the protegular-fabric, which is also the only one to set apart primitive Discinids from Acrotretids. An affiliation between the two groups can be envisaged at that level.

Schizotreta sp.

(pl. 2, fig. 1-2)

Ech. Marcoux F 131-1 (Upper Llandovery-Wenlock). Sapan Dere Shales Kemer (Antalya)

A tiny brachial valve. 0.5 mm long, 0.6 mm wide. Smooth submarginal protegulum. ardinal edge subrectilinear. The remainder shell is circular-shaped. The smooth protegulum shape and position are identical to the pitted one of **Schizotretoides.**

The adult shell is ormanented by thick growth lamellae between which 6-3 thinner lamellea are observed. At the shell-edge a fretwork is perceptible.

BIOSTRATIGRAPHY

The relative stratigraphic position of the described fossils is the following:

Seydişehir shales (Lower Ordovician)	C 800 —**Conotreta** sp. C 810 —**Schizotretoides** sp. C 812 —**Schizotretoides tauricus** nov. gen., nov. sp.
Çaltepe formation (upper part) (Middle Cambrian)	C 186 —**Craniotreta çaltepensis** nov. gen., nov. sp.

A systematic quest in the different Cambro-ordovician levels would allow a valuable scale through tiny Gastrocaules.

The extension of faunas throughout Middle Cambrian and Lower Ordovician suggests a comparison with the more complete series of North Russian Lower Cambrian-Middle Ordovician described by Goriansky (1960). At prenent the Turkish fauna has not given Lower Cambrian genera: **Conotreta** is present in Russian Llanvirnian and Llandeilian, **Schizotreta** in Caradocian.

Conotreta sp. is an Upper Tremadocian form of Norway (Poulsen, 1971). **Schizotreta,** with a smooth protegulum, appears in American Middle Ordovician.

Reflections on Evolution and systematic position of studied Gastrocaules.

The material studied here is not abundant enough to solve some important problems such as valve orientation in Siphonotretids-Acrotretids. Yet **Craniontreta** suggests that Craniids evolved from Siphonotretids; and **Schizotretoides** Discinids from Acrotretids. In Craniids, 1) a phosphatic composition passed to a carbonaceous one: 2) the Pedicle valve has lost any pedicle and regressed.

The caecal (pillar)-fabric of **Craniotreta** myotest subsista, modified into caecal ultrastructure of Craniid and Discinid myotest.

Protegular and myotest-fabric are but avatars of the general cuticular-type of the Gastrocaule shell. In **Conotreta** and **Schezotretoides,** the large protegular pedicle foramen points out that even in its neanic age the shell was fastened, which is against the Biernat and Willams (1970) hypothesis owing to which the honeycomb-fabric would act as a buoyancy organ. Alternately, we think that the external protegular cuticle was crassed by several sensorial endings similar to the well-khown tactile setae of the anterior edge of recent **Limula.**

DEĞİNİLEN BELGELER

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PLATE I

Craniotreta caltepensis nov. gen. nov. sp. (C 186). Middle Cambrian.

1--2: Brachial valve, inner view. 1x180; 2: detail of the three inner "cornets" displaying the Acrotretid fabric (x 600).

3—5: Pedicle valve (fastened) incomplete, viewed by its external face. 3: x 140; 4: detail (x 300) in oblique view; 5: detailed protefulum displaying the honeycomb fabric (x 1000).

LEVHA I

Craniotreta caltepensis nov. gen. nov. sp. (C 186). Orta Kambriyen

1—2: Brakyal valv. iç görünüş. 1x180; 2: Akrotretid dokuyu oluşturan üç iç "kornet"in ayrıntısı (x 600).

3—5: Dış yüzünden görünen, tamamlanmamış, pedikül valv. 3: x 140; 4: eğik bakışta ayrıntı (x 300); 5: Petek dokulu protegulum ayrıntısı (x 1000).

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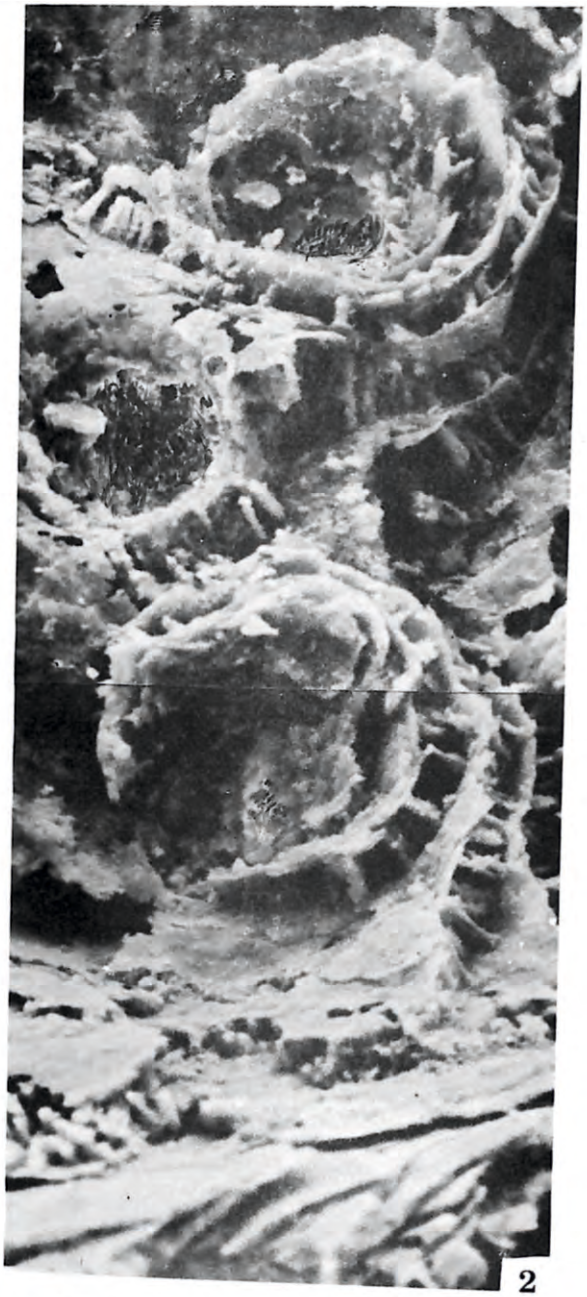

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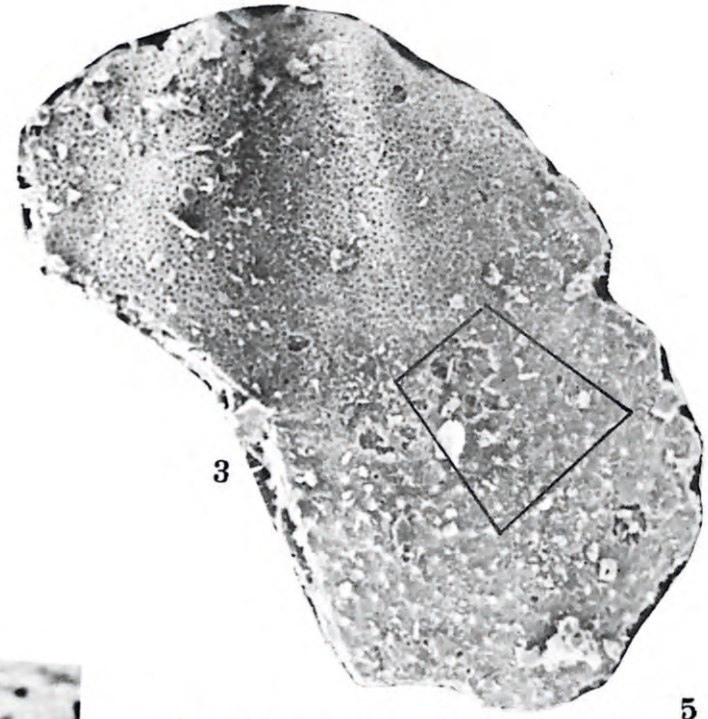

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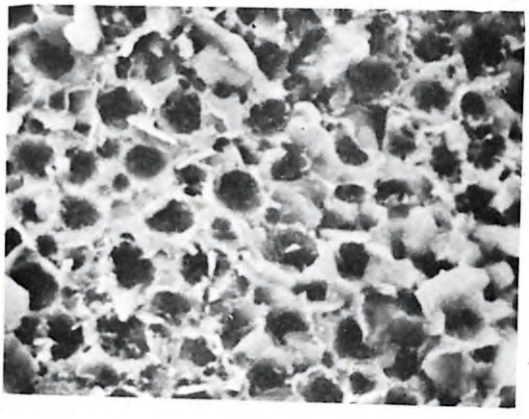

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PLATE II

1—2: *Schizotreta sp.:* brachial valve (coll. Marcoux F 131-1). Llandovery. 1: x 160; 2: detail of the inner face displaying the edge fretwork (x 300).

3—6: Schizotretoides tauricus n. gen. n. sp. (C 812). Lower Ordovician. 3-4. pedicle valve: 3 x 150; 4: detail of the apical foramen 5-6. incomplete brachial valve: 5 x IPP; 6: detail of the pitted protegulum and of its boundary with the pitted adult smooth valve (x 1000).

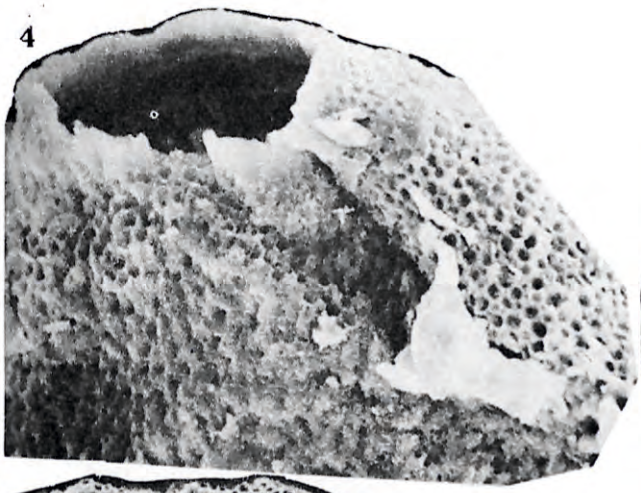
LEVHA II

1—2: *Schizotreta* sp.: Brakyal valv (Kol. Marcoux F 131-1). Llandovery. 1: x 160; köşeli ağ oluşturan iç yüzeyin ayrıntısı (x 300).

3—6: *Schizotretoides tauricus* n. gen. n. sp. (C 812) Alt Ordovisiyen.

3—4: Pedikül valv 3 x 150; 4: Apikal foramenin ayrıntısı.

5—6: Tamamlanmamış brakyal valv: 5 x IPP; 6: oyukluprotegulum ve azgelişmiş yumuşak valvli sınırının ayrıntısı (x 1000).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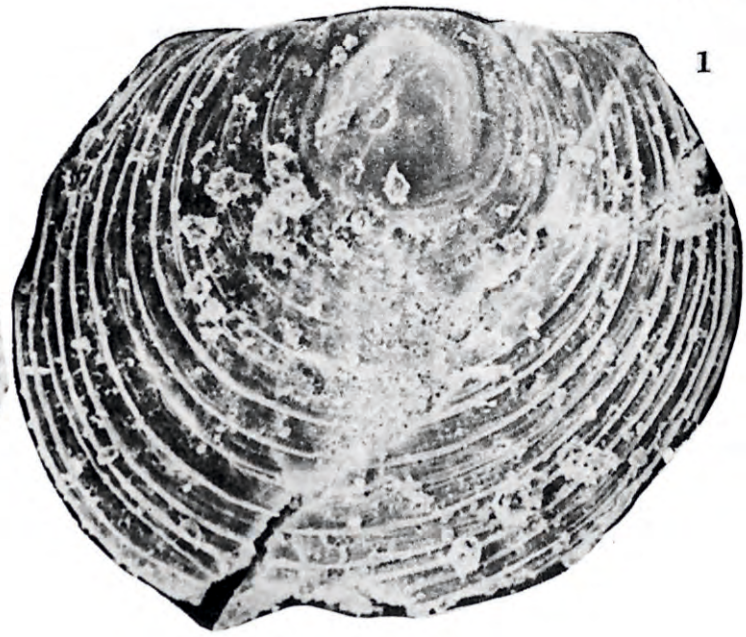
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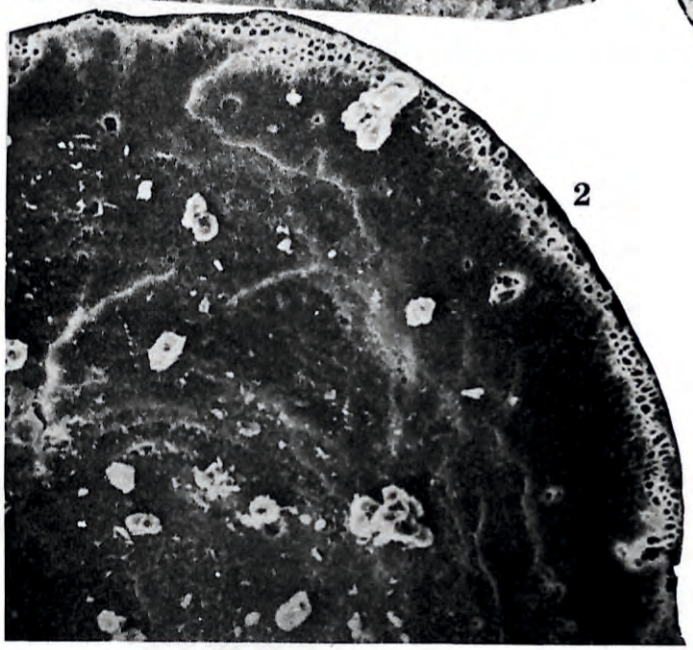
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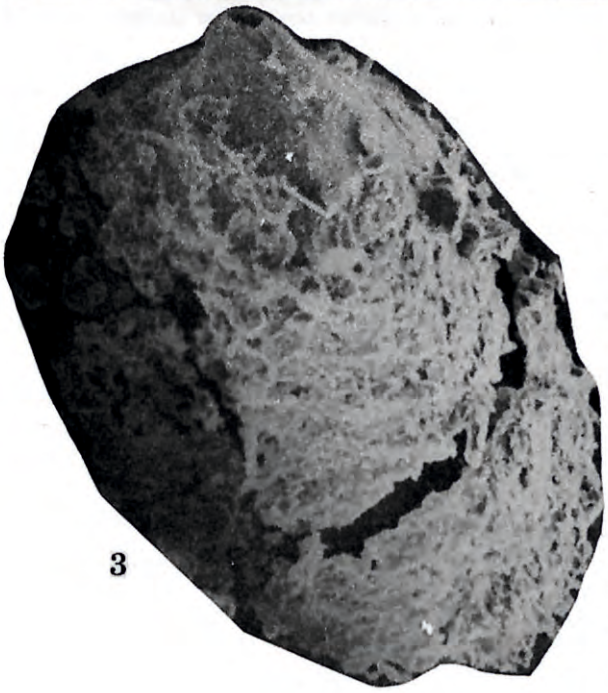
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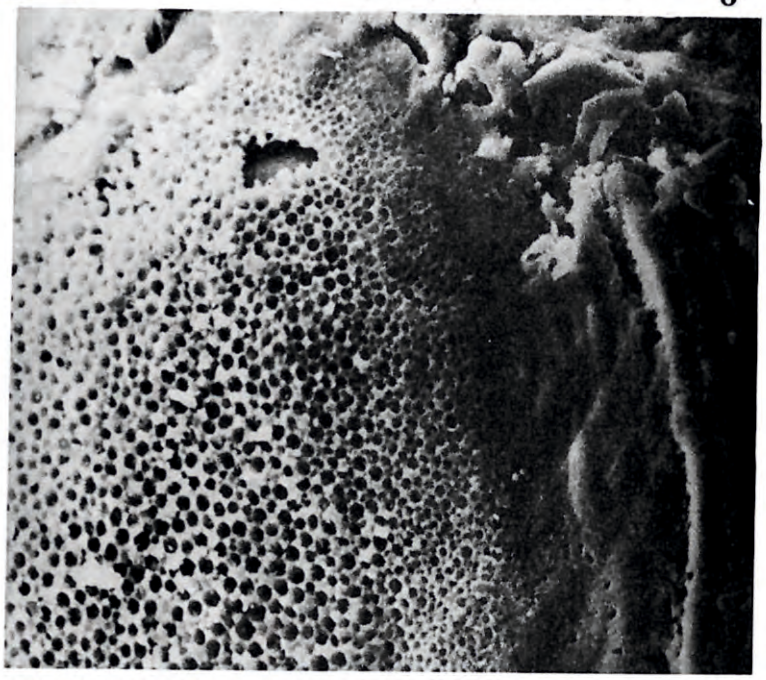
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PLATE IV

1: Fabric (bands and caecal pillars) of the pedicle protegulum of *Conotreta* (x 1000). C 800 Cf. Pl. 3 fig. 1-5.
2—5: *Schizotretoides* sp. C 810 Lover Ordovician.
2—3: Conical pedicle valve displaying the apical foramen: 2 (x 160); 3: detail of the protegular fabric and of the foramen (x 1000); 4—5: flat brachial valve, lacking its anterior part; 4 (140); 5: detail of the protegulum and its boundary with smooth adult part of the valve.

LEVHA IV

1: Conotreta (x 1000) nın pedikül protegulumunun dokusu (bandlar ve pillarlar). C. 800. Cf. Lev. 3 Şek. 1-5
2—5: Schizotretoides sp. C 810 Alt Ordovisiyen.
2—3: Apikal forameni andıran konik pedikül valvı; 2 (2 x 160); 3: protegular doku ve foramenin ayrıntısı (x 1000); 4—5: anteryor kesimi olmayan basık brakyal valv; 4 (140); 5: protegulum ve valvın yumuşak azgelişmiş kesimli sınırının ayrıntısı.

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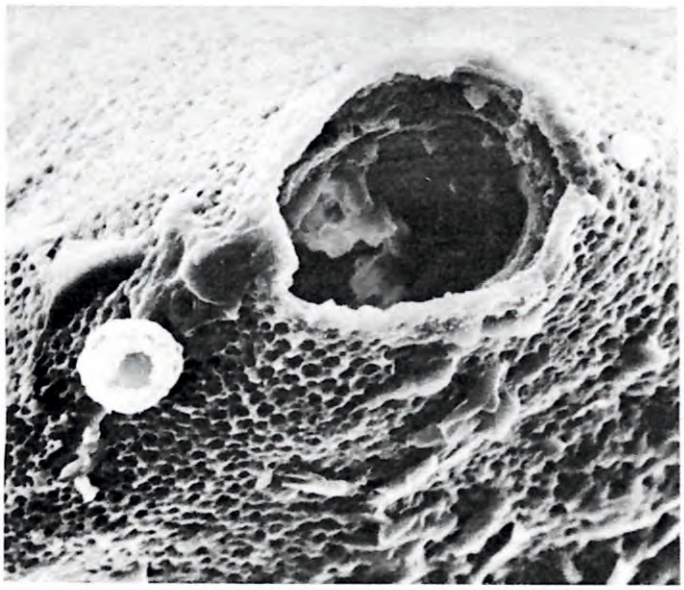

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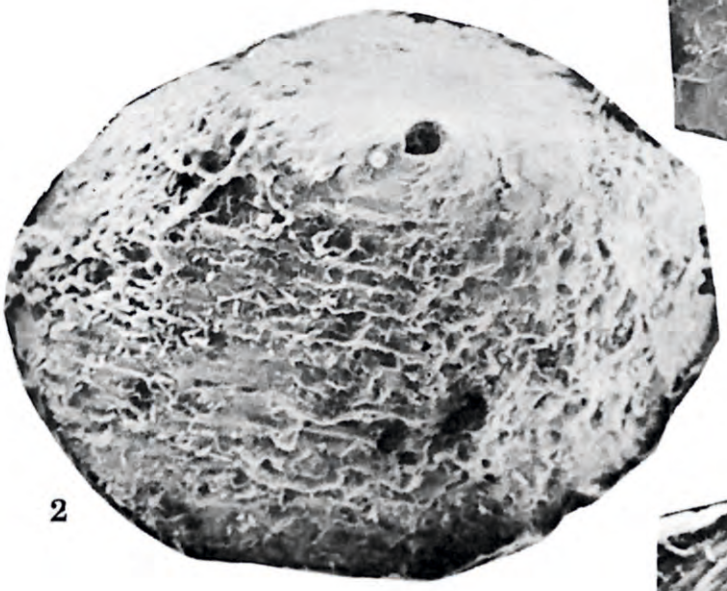

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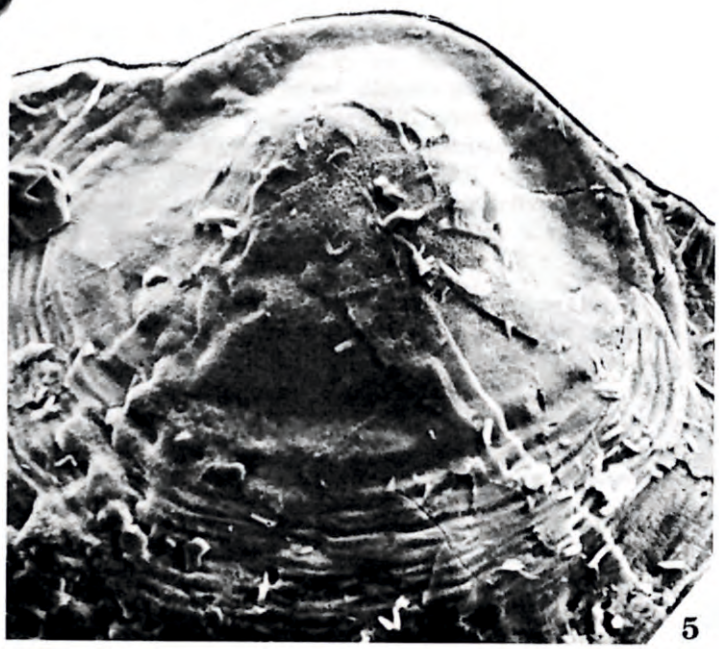

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