

Discussion:

Re-investigation of the type material of *Brissomorpha fuchsi* LAUBE, 1871 (the only known specimens of this species) with the help of light microscopy after careful cleaning revealed the presence of a latero-anal fasciole branching off the peripetalous fasciole just behind the end of the anterior paired petals. Combined with an ethmolytic apical disc (Fig. 72.A) and a mesamphisternous plastron (Fig. 72.B) this feature is typical for the schizasterid genus *Prenaster*. Thus a relation to the Asterostomatidae, as suggested by FISCHER (1966: U616) or the Palaeopneustidae, as suggested by MORTENSEN (1950) can be ruled out.

Brissomorpha LAUBE, 1869 [Type-species: *Brissomorpha fuchsi* LAUBE, 1871, p. 73; by subsequent designation (LAUBE, 1871: 72)] differs from *Prenaster* mainly by its large size, hood-like projection over periproct and the large, oblique periproct. These characters are best considered of specific value. Otherwise many of the species currently placed within *Prenaster* too would have to be placed into several monotypic genera [e.g. *P. nelsoni* (McCoy, 1882) in *Wraunia*]. Records of the genus *Brissomorpha* from Algeria and Indonesia listed by FISCHER (1966) are based on misidentifications (see below).

BÖHM (1882: 364-365; pl. 2, figs. 1a-d) described another species of this genus *Brissomorpha mojsvari* from the northern coast of Madura (north of Java). The specimens, however, does not show the features characteristic of *Brissomorpha* (respectively *Prenaster*), but instead seems to belong to the genus *Eupatagus*. [JEANNET & MARTIN (1937: 277) referred this species to the genus *Maretia*. BÖHM (1882), however, explicitly mentioned the presence of a peripetalous fasciole (contrary to JEANNET & MARTIN, who assume that a peripetalous fasciole is lacking based on the distribution of the aboral primary tubercles in BÖHM's figure). Thus this species is tentatively referred to *Eupatagus* here.]

POMEL (1887: 27) mentioned a *Brissomorpha welschi* from the Miocene of Algeria, according to LAMBERT & THIÉRY (1924: 442), however, this is a *nomen nudum*.

Based on illustrations and descriptions given in the literature LAUBE (1871: 72) suggested that *Brissus depressus* LEYMERIE & COTTEAU, 1856 from the Eocene of Bise (Aude) (COTTEAU, 1863: 140, pl. 7, fig. 10) and *Brissus tuberculatus* WRIGHT, 1864 from the Messinian of Malta (WRIGHT, 1864: 486; pl. 22, fig. 1) should probably also be referred to *Brissomorpha*. Concerning *B. depressus*, this statement is difficult to evaluate, since the specimens described by COTTEAU (1863) are poorly preserved. *B. tuberculatus*, however, was revised by STEFANINI (1908b: 118-119), who referred it to the spatangid genus *Trachypatagus* [for good illustrations of this genus see VALDINUCCI (1974b)]. The holotype of this species is located in the British Museum (Natural History) under the number E.1866 (CHALLIS, 1980: 275).

Occurrence:

Austria: Late Eggenburgian (Early Burdigalian)

Molasse Zone: Gauderndorf, near Eggenburg, NÖ (LAUBE, 1869a, 1871; QUENSTEDT, 1875; FUCHS, 1877; HESSE, 1900; SCHAFFER, 1912a)

Genus *Pseudobrissus* LAMBERT, 1905

Type-species: *Brissus corsicus* COTTEAU in LOCARD, 1877; by original designation (LAMBERT in DONCIEUX, 1905)

Emended diagnosis: Test ovate without frontal sinus; apical disc anteriorly displaced, ethmolytic with four gonopores; ambulacrum III flush with the remaining surface adapically, narrow and with very small, oblique partitioned isopores; paired ambulacra petaloid aborally; petals strongly sunken, long and parallel-sided; anterior paired petals strongly divergent (around 180°), extending almost to the ambitus; posterior paired petals long and only weakly divergent; plastron structure unknown;

peristome strongly anteriorly displaced; periproct high on truncate posterior face, overhung by a (slight?) rostrum; peripetalous and latero-anal fascioles present; peripetalous fasciole broadly indented in interambulacra 1 and 4, and running at the ambitus anteriorly (based on COTTEAU, 1877; PHILIPPE, 1998; SMITH "The Echinoid Directory", 03.11.2003; and the new specimen described below).

Distribution: Early to Middle Miocene – Mediterranean and Paratethys

Remarks: This genus seems to be closely related to *Protenaster* which can be distinguished from *Pseudobrissus* by the presence of a frontal sinus (albeit often shallow) and well developed pores in aboral ambulacrum III (see McNAMARA, 1985b for details on *Protenaster*).

Based on the present specimen from the Middle Miocene of the Vienna Basin (Austria, Central Paratethys) the presence of a latero-anal fasciole could be confirmed. Additionally the previously unknown structure of the apical disc is shown to be ethmolytic. These two features support the placement in the family Schizasteridae suggested by FISCHER (1966) and later authors.

Pseudobrissus corsicus (COTTEAU in LOCARD, 1877)

(Fig. 74-75; Pl. 70, Figs. a-d)

- * 1877 *Brissus corsicus*, COTTEAU, 1877 – COTTEAU in LOCARD: 325-327; pl. 16, figs. 1-2
- 1887 *Brissus corsicus*, COTTEAU – PARONA: 306
- 1895 *Brissus corsicus*, COTTEAU, 1877 – COTTEAU: 50-51
- 1899 *Brissus corsicus*, COTT. – AIRAGHI: 164-165
- 1901 *Brissus corsicus*, COTT. – AIRAGHI: 197
- 1905 *Pseudobrissus corsicus* (COTTEAU) – LAMBERT in DONCIEUX: 155
- 1906d *Pseudobrissus corsicus* – LAMBERT: 63-64
- 1909 *Pseudobrissus corsicus* COTTEAU (*Brissus*), 1877. – LAMBERT: 81
- 1913a *Pseudobrissus corsicus* COTT. – COTTREAU: 72
- 1915a *Pseudobrissus corsicus* COTTEAU (*Brissus*), 1877. – LAMBERT: 185-186
- 1951 *Pseudobrissus corsicus* (COTTEAU) – MORTENSEN: 352-353; fig. 167
- 1966 *Pseudobrissus corsicus* (COTTEAU) – FISCHER: U578; fig. 462.3
- 1974 *Pseudobrissus corsicus* (COTT.) – ROMAN: 332
- 1989 *Pseudobrissus corsicus* (COTTEAU) – PHILIPPE: 31, tab. 1
- 1990 *Pseudobrissus corsicus* (COTTEAU, 1877) – PHILIPPE et al.: 246
- 1998 *Pseudobrissus corsicus* (COTTEAU, 1877) – PHILIPPE: 182-184; pl. 19, figs. 7a-b, 8a-b

Type-material:

Brissus corsicus COTTEAU, 1877:

Holotype: the specimen figured by COTTEAU (1877: pl. 16, figs. 1-2); collection PÉRON

Locus typicus: Bonifacio, Corsica, France

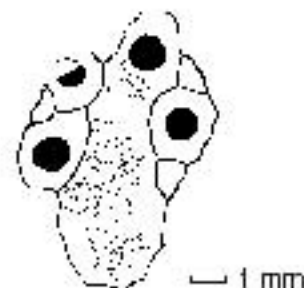


Figure 74: *Pseudobrissus corsicus* (COTTEAU in LOCARD, 1877): apical disc (Badenian, Wöllersdorf, NÖ, KNÖPPEL coll.).

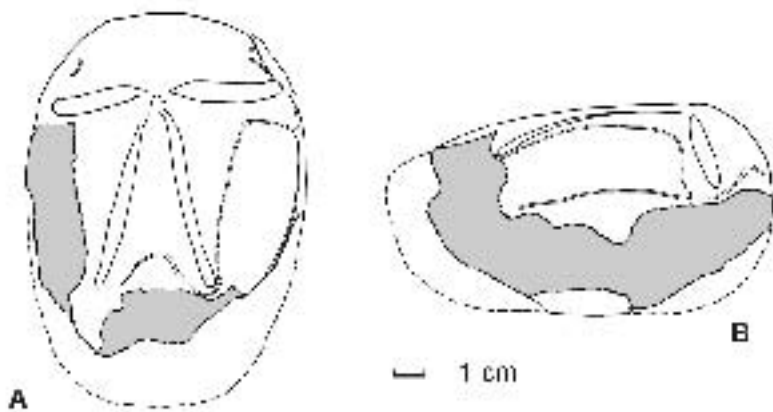


Figure 75: *Pseudobrissus corsicus* (COTTEAU in LOCARD, 1877): fasciole outline in aboral (A) and right lateral view (B) [Badenian, Wöllersdorf, NÖ (KNÖPPEL coll.)].

Age: Burdigalian, Early Miocene (according to PHILIPPE, 1998)

Remarks: The marine sedimentation in the Bonifacio Basin started in the Burdigalian and continues into the Early Serravallian. A radiometric age of the basal volcanites gave an age of 17.8 Ma (ORSZAG-SPERBER in STEININGER et al., 1985: Vol. 1: 27, Vol. 2: 57, area 20b Corsica, Bonifacio Basin).

Material:

Badenian (Langhian-Early Serravallian) – Wöllersdorf, NÖ, Austria

R. KNÖPPEL coll.: 1 specimen (a cast of this specimen is housed in the collection of the NHMW under the number 2005z0008/0001)

Dimensions (in mm):

As the specimen is crushed and lacks the posterior end, as well as most of the oral surface, it is difficult to provide accurate measurements. The preserved fragment is 11.5 cm long, 9.5 cm wide, and 5.5 cm high. Before fragmentation and deformation the test is estimated to have been around 13 cm long.

Description:

Size and Shape: Test large, with oval, antero-posteriorly elongated outline. No frontal sinus. In profile the test is rectangular with rounded or vertically truncated anterior end.

Apical disc: The apical disc is situated strongly anteriorly, about 3 cm from the anterior margin. It is ethmolytic with four large circular gonopores, the anterior ones of which are slightly smaller (Fig. 74).

Ambulacra: Frontal ambulacrum nonpetaloid, narrow, bearing numerous small, strongly oblique to vertically elongated, partitioned isopores. Aborally ambulacrum III is flush with the test, below the ambitus it forms a shallow groove leading to the peristome. Aborally the paired ambulacra are petaloid, parallel-sided and rather narrow. The petals are strongly sunken, with large elongate iso- to anisopores (outer pores oval to teardrop-shaped in each pair) and narrow interporiferous zones. The anterior paired petals more or less form a straight line, diverging at about 180°. They extend nearly to the ambitus and their tips are slightly flexed anteriorly. The posterior paired petals are even longer (c. 120 % of the length of the anterior paired petals) and form an acute angle of about 35°.

Interambulacra: The interambulacra are covered with small perforate primary tubercles. On the aboral surface the tuberculation is relatively homogenous, only in the interambulacral columns 2b and 3a larger, more widely spaced tubercles are found. The tubercles are non- or very weakly crenulate. Oral surface not preserved.

Peristome: Not preserved in the present specimen; strongly anteriorly displaced in French specimens (PHILIPPE, 1998).

Periproct: Not preserved in the present specimen; high on the truncated posterior face in French specimens (PHILIPPE, 1998).

Fascioles: Both peripetalous and latero-anal fascioles are present. The fasciole band varies in width, but is usually relatively broad and of the orthofasciole type (*sensu* NÉRAUDEAU et al., 1998b). The peripetalous fasciole is strongly indented in interambulacrum 5 and runs at the ambitus anteriorly in interambulacra 2 and 3, and ambulacrum III. In interambulacra 1 and 4 it is also strongly indented, half way up the anterior petals, however, it changes its course and forms a straight line running towards the midpoint of the posterior petals. It follows the margin of the distal half of the posterior paired petals closely (Fig. 74.A). The latero-anal fasciole branches of the peripetalous fasciole just behind the tips of the anterior paired petals and runs towards the posterior end just above the ambitus (Fig. 74.B). Its subanal part is not preserved in the present specimen.

Discussion:

Despite the numerous entries in the synonymy list this species is extremely rare. Until now only seven specimens of this species are known [one from Bonifacio, Corsica, France (COTTEAU, 1877), one from San Michele, Sardinia (PARONA, 1887; COTTEAU, 1895; LAMBERT, 1909), four from the southern Rhône Basin (LAMBERT, 1915a, PHILIPPE, 1998) and one from Italy (AIRAGHI, 1899, 1901)]. Just three of these specimens have been figured (by COTTEAU, 1877 and PHILIPPE, 1998). As in most large spatangoids all described specimens of *P. corsicus* are more or less crushed, thus obscuring some important features. The present specimen from the Middle Miocene of Austria is the first in which the structure of the apical disc could be observed and in which the presence of a latero-anal fasciole could be ascertained. These features confirm the placement in the family Schizasteridae suggested by earlier authors.

The present specimen comes from a coarse maerl sediment (tightly packed debris of coralline red algae branches with a greenish, fine grained marl matrix). As it is morphologically very similar to *Protenaster australis* it might have inhabited similar environments (see above under *Prenaster*).

Occurrence:

Austria: Badenian (Langhian-Early Serravallian)
Vienna Basin: Wöllersdorf, NÖ ([KNÖPPEL coll.]

Mediterranean: ? Late Oligocene, Burdigalian to Langhian
Western Mediterranean: **Corsica, France:** Bonifacio (COTTEAU, 1877); **Italy, mainland:** Dego (AIRAGHI, 1899, 1901); **Rhône Basin, France:** Carro, à Martigues, Bouches-du-Rhône (LAMBERT, 1915a; PHILIPPE et al., 1990; PHILIPPE, 1989, 1998); cap Couronne, à Martigues (PHILIPPE, 1998); **Sardinia, Italy:** San Michele, near Cagliari (PARONA, 1887; COTTEAU, 1895; LAMBERT, 1909)

Suborder Micrasterina FISCHER, 1966
Family Brissidae GRAY, 1855
Genus *Brissus* GRAY, 1825

Type-species: *Spatangus brissus* var. *unicolor* LESKE, 1778; by subsequent designation (ICZN, opinion 209, p. 385, 8th May 1954)

Diagnosis: Test ovoid, lacking frontal sinus; apical system anteriorly displaced, ethmolytic, with four gonopores; ambulacrum III flush with the test aborally, with small, simple isopores; paired ambulacra petaloid and distinctly sunken; anterior pair transversely orientated, diverging at about 180°; petals straight

sided, with narrow interporiferous zones; periproct on truncated posterior face, oral rim formed by interambulacral plates 5a5 and 5b5; peristome transversely elongate and strongly displaced anteriorly; plastron ultramphisternous, with near-symmetrical sternal and episternal plates; labrum wide, but short, in broad contact with sternal plates; no enlarged primary tubercles; well developed peripetalous and subanal fasciole; subanal fasciole bilobed, usually enclosing four penicillate tube feet on each side; peripetalous fasciole indented in all interambulacra, although to a variable degree in interambulacra 2 and 3 (modified from FISCHER, 1966; MORTENSEN, 1951; and SMITH "The Echinoid Directory", 03.11.2003).

Distribution: Eocene to Recent – cosmopolitan (FISCHER, 1966)
Ecology and biogeography: Extant species of the genus *Brissus* live in muddy sand, coarse sand, shell grit, sand-filled pockets of reef rock, under rock slabs or within sea grass (KIER & GRANT, 1975; RIEDL, 1983; HENDLER et al., 1995; MISKELLY, 2002). They may be buried up to 20 cm deep (MISKELLY, 2002). Most species live at shallow depth between 0 and 250 metres, but are also found much deeper occasionally (MORTENSEN, 1951; HENDLER et al., 1995). They occur widely throughout the tropical and warm temperate climate zones.

***Brissus abeli* (REIDL, 1941)**

(Figs. 76-77; Pl. 73, Figs. 1-4)

- 1937 *Plagiobrissus abeli* nov. spec. – REIDL: 36-39
(*nomen nudum*; unpublished thesis)
- v * 1941 *Plagiobrissus abeli* nov. spec. – REIDL: 24-28;
figs. 1-2
- ? 1953 *Brissus jacquementi* LAMBERT, 1915. – SZÖRÉNYI:
41, 92-93; pl. 4, figs. 5, 5a-b

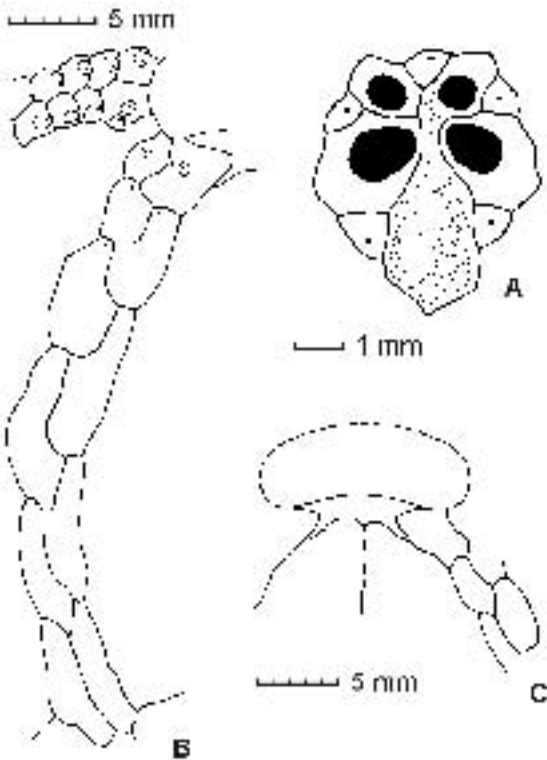


Figure 76: *Brissus abeli* (REIDL, 1941): apical disc (A: NHMW 1997z0178/1742b), plating of adoral ambulacra I and II (B: NHMW 2002z0180/0004), and labrum shape (C: NHMW 1997z0178/1742a); all from the Late Badenian of Müllendorf, Bgld.

- # 1961 *Brissus (Allobrissus) miocaenicus* n. sp. –
SCHAFFER: 149-155; fig. 1a-d; pl. 1, fig. 1-6; pl. 2,
fig. 1-9
- 1978 *Brissus (A.) miocaenicus* SCHAFFER, 1961 – KIER &
LAWSON: 111
- 1978 *P.[lagiobrissus] abeli* REIDL, 1941 – KIER &
LAWSON: 118

Type-material:

Plagiobrissus abeli REIDL, 1941:

Holotype: figured in REIDL (1941: fig 1-2, right-hand specimen in both figs.), presumably lost; reported to be in the collection of the Institute of Palaeontology, University of Vienna (REIDL, 1941: 25) but cannot be traced at this institution.

Paratype: No. IPUW Reidl-50, figured in REIDL (1941: fig 1-2, left-hand specimen in both figs.); housed at the Institute of Palaeontology, University of Vienna; a cast of this specimen is housed at the NHMW (no. 2002z0180/0006).

Locus typicus: Müllendorf (Mühlendorfer Kreide AG quarry), Bgld, Austria

Stratum typicum: Leitha limestone

Age: Late Badenian (Early Serravallian), Middle Miocene

Brissus (Allobrissus) miocaenicus SCHAFFER, 1961:

Holotype: No. IPUW, 1561, figured in SCHAFFER (1961: pl. 1, figs. 1-2), presumably lost; reported to be in the collection of the Institute of Palaeontology, University of Vienna (SCHAFFER, 1961: 149) but cannot be traced at this institution.

Locus typicus: Müllendorf (Mühlendorfer Kreide AG quarry), Bgld, Austria

Stratum typicum: Leitha limestone

Age: Late Badenian (Early Serravallian), Middle Miocene

Material:

Late Badenian (Langhian – Serravallian) – Mannersdorf, Bgld, Austria

NHMW: 2 specimens (NHMW 1978/2020/23, 2002z0181/0002)

Late Badenian (Langhian – Serravallian) – Müllendorf (Mühlendorfer Kreide AG quarry), Bgld, Austria

NHMW: 13 specimens (NHMW 1987/13/4, 1988/19a-b, 1997z0178/1742a-d, 2002z0180/0001-5, 2002z0181/0001)

IPUW: 1 specimen [IPUW Reidl-50 (paratype of *Plagiobrissus abeli* REIDL, 1941)]

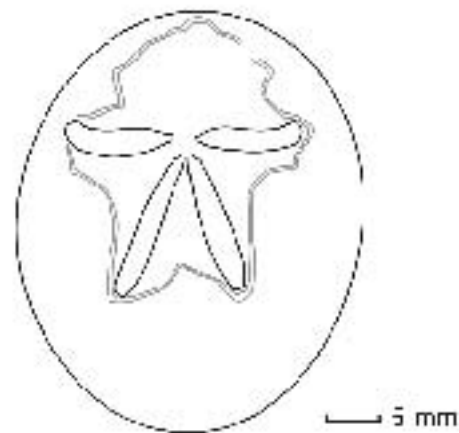


Figure 77: *Brissus abeli* (REIDL, 1941): peripetalous fasciole outline (grey) (Late Badenian of Müllendorf, NHMW 1997z0178/1742d).

Dimensions (in mm):

Inv. No.	TL	TW	TH
NHMW 1997z0178/1742a	55.2	46.0	26.3
NHMW 1997z0178/1742b	55.2	46.2	21.5
NHMW 1997z0178/1742c	52.4	43.3	20.2
NHMW 1997z0178/1742d	37.2	29.9	15.3
NHMW 2002z0180/0002	~49.5	40.8	-
NHMW 2002z0180/0003	~46	-	24.8
NHMW 2002z0180/0005	> 62	56.5	> 26.5
NHMW 2002z0181/0001	51.4	~43	-
IPUW Reidl-50 (paratype)	56.0	44.5	22.3

All specimens are more or less slightly deformed.

Description:

Size and shape: Test of medium to large size, ranging from 37 to more than 62 mm TL. The outline of the test is oval, antero-posteriorly elongated. A frontal sinus is not present. The maximum width lies sub-centrally but may be slightly displaced anteriorly or posteriorly. In profile the test is slightly wedge-shaped with tumid anterior and obliquely truncated posterior end. The maximum height lies on the raised keel in interambulacrum 5 posterior of the tips of the posterior paired petals. The test width ranges from 79.5 to 83.7 % TL and the test height from ~42 to 48 % TL.

Apical disc: The apical disc lies anterior of the centre, about 30 to 38 % TL from the anterior margin. It is ethmolytic with four large, radially elongated gonopores, the anterior pair of which is distinctly smaller than the posterior pair (Fig. 76.A). The ocular pores are small and circular.

Ambulacra: The frontal ambulacrum is nonpetaloid and nearly flush with the test aborally. It bears minute, vertically oriented partitioned isopores. The paired ambulacra are petaloid, consisting of closely spaced elongated anisopores. The petals are strongly depressed, narrow and extend approximately two third of the corresponding test radius. The anterior paired petals form an obtuse angle between 160° and 170°, the posterior petals an acute angle of 40 to 50°. In juvenile or subadult specimens the anterior paired petals diverge at a larger angle of about 170 to 180° (compare Pl. 73, Fig. 4a). The distal parts of the anterior paired petals are slightly flexed anteriorly, those of the posterior petals are flexed laterally. The interporiferous zones are very small, about 0.25 times the width of a single poriferous zone and lack primary tubercles.

Adorally the ambulacra form moderately large phyllodes with large unipores with extensive periporal area. Ambulacra I and V form narrow, naked peri-plastral areas on the oral side (Fig. 76.B). Within the subanal fasciole 5 enlarged constricted unipores are found in each ambulacrum.

Interambulacra: The interambulacra are densely covered by perforate, crenulate primary tubercles with inclined areoles. The aboral tuberculation is rather homogenous, only adapically within the peripetalous fasciole there are slightly enlarged tubercles. On the oral side, the tubercles are distinctly larger. On the plastron they are arranged in a fan-shaped pattern radiating from a posterior elevation.

Adapically the interambulacra are inflated between the petals. Interambulacrum 5 forms a broad rounded keel posterior of the tips of the posterior paired petals. The distinctly inflated plastron is ultramphisternous with very short, crescentic labrum (Fig. 76.C) and large sternum.

Peristome: The peristome lies close to the anterior margin and its anterior margin lies about 13 to 15 % TL from it. The peristome is kidney-shaped, transversely elongated with a slightly projecting labrum and measures 12.2 vs. 4.0 mm in a 55.2 mm TL specimen.

Periproct: The periproct lies on the overhanging posterior face, about halfway up the ambitus. It is oval, vertically elongated to slightly teardrop shaped and measures 9.1 vs. 6.3 mm in a 55.2 mm TL specimen. The area immediately beneath the periproct is sparsely tuberculated, bearing mainly secondary and miliary tubercles.

Fascioles: Both a peripetalous and subanal fasciole are present. The fasciole band is well distinguished from the remaining tuberculation and corresponds to the orthofasciole type of NÉRAUDEAU et al. (1998b). The peripetalous fasciole is deeply embayed in the interambulacra 1 and 4 and forms a zigzagging pattern in the interambulacra 2 and 3 (see Fig. 77). The subanal fasciole is bilobed to slightly heart-shaped.

Differential diagnosis:

This species differs from the extant transatlantic species *Brissus unicolor* (LESKE, 1778), the fossil record of which dates back at least to the Early Pliocene (MORTENSEN, 1951: 512; DONOVAN & VEALE, 1996: 635), by the smaller angle between its anterior paired petals (180 to 190° in *B. unicolor*), its oblique posterior end and stronger wedge-shape.

B. aegyptiacus GAUTHIER in FOURTAU, 1900 is based on a single, badly damaged specimen from the Early Miocene of Gebel Genefe in Egypt. It differs from *B. abeli* by its more diverging anterior petals but otherwise comparison is difficult due to the poor preservation of the Egyptian material (compare GAUTHIER in FOURTAU, 1900: 718-720. pl. 3, figs. 11-12).

B. bastiae OPPENHEIM, 1902 from the Oligocene to Early Miocene of Northern Italy and the Rhône Basin differs by its more elongated outline (TW ~ 70 to 75 % TL), the larger angle between its anterior paired petals (> 180°) and its more anteriorly situated apical disc (~ 20 to 25 % TL from anterior margin) (compare OPPENHEIM, 1902a: 261-262, fig. 21; LAMBERT, 1915a: 179-180, pl. 14, figs. 14-16; PHILIPPE, 1998: 184-185, pl. 21, fig. 5).

B. cordieri AGASSIZ in AGASSIZ & DESOR, 1847 from the Early (?) Miocene of France was never properly described nor figured. The only figure available is that of LAMBERT (1915a: 180-181; pl. 14, figs. 12-13), which shows a specimen lacking its aboral side and most of the oral side too. Until better preserved specimens are described and figured a comparison is impossible and this species has to be considered as *nomen dubium*.

B. cottreaui LAMBERT, 1915 from the Pliocene of the Rhône Basin differs by its larger angle between the anterior paired petals (~ 180°), more anterior situated apical disc (~ 28 % TL from the anterior margin), more elongated test (TW ~ 75% TL) and bluntly pointed posterior end. Furthermore, the whole petalodium is smaller and positioned more anteriorly than in *B. abeli* (compare LAMBERT, 1915a: 182-185; pl. 15, figs. 1-3).

B. gregoryi STEFANINI, 1909 from the Burdigalian (?) and Messinian of Malta differs by its larger angle between the anterior paired petals (~ 180°) and characteristic low profile (~ 25 % TL) (compare GREGORY, 1891: 620-621, pl. 2, fig. 2; CHALLIS, 1980: 239-243, pl. 96, figs. a-c, pl. 98, figs. a-c, pl. 99, fig. a).

B. jacquemeti LAMBERT, 1915 is a junior synonym of *B. bastiae* OPPENHEIM, 1902a (PHILIPPE, 1998: 184; see above).

B. oblongus WRIGHT, 1855 from the Upper Coralline Limestone (Messinian) of Malta differs by its larger angle between the anterior paired petals (~ 180°), more anterior situated apical disc (~ 25 % TL from the anterior margin), less anterior positioned peristome (~ 20 % TL from anterior margin) and more elongated test (TW ~ 75% TL) (compare WRIGHT, 1855: 184-185, pl. 5, figs. 2a-c; CHALLIS, 1980: 243-246, pl. 97, figs. a-c, pl. 99, figs. b-c).

Discussion:

REIDL (1941: 27) originally placed his species in the genus *Plagiobrissus*, arguing that it could not be placed in the genus *Brissus* because of its continuous fasciole and enlarged tubercles between the petals. However, neither the type material nor topotypic specimens show tubercles as in the genus *Plagiobrissus*, and the continuous fasciole is no reason for excluding this species from *Brissus*, since it is present in nearly all species including the type species. *B. miocaenicus* SCHAFFER, 1961 is clearly a junior synonym of *Brissus abeli* (REIDL, 1941). The type material of both species comes from the same. Obviously

SCHAFFER (1961) did not know REIDL's publication since it is not discussed or cited in his paper.

SZÖRÉNYI (1953: 92-93) reported a specimen of *B. jacqueti* LAMBERT, 1915 from the Early Badenian (Langhian) of the Ukraine. This species (now considered to be a junior synonym of *B. bastiae* OPPENHEIM, 1902, see PHILIPPE, 1998: 184-185), however, differs from the Ukrainian specimen by its more strongly diverging anterior petals and more anteriorly positioned apical disc. Based on SZÖRÉNYI's description and poor illustration her specimen is tentatively placed into *B. abeli*. Her specimen differs from Austrian specimens of *B. abeli* by its more elongated test and slightly more diverging anterior paired petals. This last feature, however, could be an effect of allometric growth, since the Ukrainian specimen is rather small (TL = 30 mm) and could therefore represent a juvenile or subadult specimen.

Occurrence:

Austria: Late Badenian (Early Serravallian)

Vienna Basin: Mannersdorf, NÖ ([NMHW]); Müllendorf (Mühlendorfer Kreide AG quarry), Bgld (REIDL, 1937, 1941; SCHAFFER, 1961; [NMHW])

Paratethys (non-Austrian occurrences): Early Badenian (Langhian)

Fore-Carpathian Basin: ? Zbarazh (= Zbaraz), Podolia, western Ukraine (SZÖRÉNYI, 1953)

Genus *Brissopsis* AGASSIZ in AGASSIZ & DESOR, 1847

Type-species: *Brissopsis lyrifera* FORBES, 1841; by subsequent designation (DESOR, 1858: 378).

Diagnosis: Test ovate, somewhat depressed, with shallow frontal notch; apical disc ethmolytic with four gonopores; ambulacrum III slightly depressed with differentiated pores; paired ambulacra petaloid; petals sunken, distally closed; anterior paired petals more strongly diverging than posterior ones, which are parallel in some species; both anterior and posterior paired petals may be confluent and may have rudimentary or completely reduced pores in the adapical plates; periproct high on the truncated posterior end; peristome transversely elongated, and anteriorly displaced; plastron ultramphisternous, with symmetric sternal and episternal plates; contact between 1st and 2nd pair of episternal plates constricted; labrum broadly T-shaped, not extending beyond first ambulacral plate in most species; peripetalous fasciole indented between anterior and posterior petals; subanal fasciole bilobed (modified from MORTENSEN, 1851; and SMITH "The Echinoid Directory", 13.05.2004).

Distribution: Eocene to Recent – cosmopolitan, except polar regions

Ecology and biogeography: Extant species of *Brissopsis* occur on mud and silt bottoms, where they lived buried between 40 and 100 mm deep (NICHOLS, 1959a; CHESHER, 1968; KIER & GRANT, 1975). Most species occur in relatively deep environments (down to 3200 m; AGASSIZ, 1904; MORTENSEN, 1951), but some are known from shallow depth [e.g. *B. elongata* MORTENSEN, which occurs between 13 and 72 m off Belize (KIER, 1975), or *B. lyrifera* (FORBES) and *B. luzonica* (GRAY) which occur between 5-1400 and 10-1000 metres respectively (MORTENSEN, 1951)]. Due to its habitat (mainly deep-water, fine siliclastic sediments) the distribution of *Brissopsis* is not as strongly affected by temperature as in other genera. It occurs widely throughout the tropical, warm temperate and cold temperate climate zones.

***Brissopsis ottnangensis* HOERNES, 1875**

(Figs. 78-81; Pl. 71, Figs. 1-6; Pl. 72, Figs. 1-7)

v. * 1875a *Brissopsis ottnangensis* nov. sp. – HOERNES: 385-386, 389-391; pl. 12, fig. 4; pl. 15, figs. 2-7

- v. 1875b *Brissopsis ottnangensis* nov. sp. – HOERNES: 211
- ? 1879 *Brissopsis ottnangensis* R. HÖRN. – MANZONI: 154
- ? 1882 *Brissopsis Ottnangensis*, R. HOERNES. – DE LORIO: 24-25; pl. 3, figs. 4-7 [according to LAMBERT (1915a: 175-175) the specimens figured in fig. 7 (from Drôme, France) belongs to *B. urrensis* FONTANNES]
- 1884 *Brissopsis ottnangensis* – HOERNES: 305
- 1884 *Brissopsis ottnangensis* R. HÖRN. – TOULA: 246
- 1886 *Brissopsis Ottnangensis* – KITTL: 22
- 1891 *Brissopsis ottnangensis* R. HOERN. – SUESS: 416
- 1892a *Brissopsis, Ottnangensis* R. HOERN. – PROCHÁZKA: 734, 736, 743
- 1897 *Brissopsis ottnangensis* R. HOERN. – SCHAFFER: 535, 547
- 1900 *Brissopsis Ottnangensis* – COMMENDA: 159
- 1900 *Brissopsis Ottnangensis* Rud. HOERN. – HOLLER: 71
- 1902 *Brissopsis Ottnangensis* – ABEL: 1175
- 1903 *Brissopsis attnangensis* – HOERNES: 936
- 1903 *Brissopsis Ottnangensis* – HOERNES: 947
- v. 1904 *Brissopsis* spec. – ABEL: 97, 99
- 1908 *Brissopsis ottnangensis* R. HÖRN. – SCHAFFER: 30
- 1913 *Brissopsis* cf. *ottnangensis* HÖRN. – DREGER: 70
- 1914 *Brissopsis ottnangensis* R. HÖRN. – TOULA: 203, 209
- 1915 *Brissopsis* cf. *ottnangensis* R. HÖRNES – TOULA: 640, 642, 666; pl. 39, figs. 19-20
- ? 1915 Stachel aus der *Brissomorpha*-Gruppe – TOULA: 672
- 1915 *Brissopsis consobrinus* LAMBERT. – VADÁSZ: 230-231; pl. 9 (3), fig. 15
- v. 1915 *Brissopsis (Brissoma) ottnangensis* R. HOERN. – VADÁSZ: 229-230; pl. 9 (3), fig. 16
- 1927 *Brissopsis Ottnangensis* HÖRN. R. – HORUSITZKY: 25, 165
- 1930 *Brissopsis ottnangensis* R. HOERN. – VENDL: 43
- 1930 *Brissopsis (Brissoma) ottnangensis* R. HOERN. – VENDL: 50
- 1935 *Brissopsis ottnangensis* – SIEBER: 96
- 1936 *Brissopsis (Brissoma) ottnangensis* R. HÖRN. – MEZNERICS: 119
- 1940 *Brissopsis ottnangensis* HÖRN. – JASKÓ: 305, pl. 9, figs. 19-20
- 1940 *Brissopsis (Brissoma) cfr. ottnangensis* HOERNES. – JASKÓ: tab. 11
- 1943 *Bryssopsis ottnangensis* R. HOERN. – JANOSCHEK in SCHAFFER: 433-434, 448
- 1943 *Brissopsis ottnangensis* R. HÖRN. – VEIT: 6
- 1951 *Bryssopsis ottnangensis* R. HOERN. – JANOSCHEK in SCHAFFER: 548, 567
- 1951 *Brissopsis ottnangensis* R. HOERN. – SCHAFFER & GRILL: 707
- 1953a *Brissopsis ottnangensis* HÖRN. – SIEBER: 207
- ? 1955 *Brissopsis (Brissoma) ottnangensis* R. HÖRN. – SENEŠ: 6
- ? 1955 *Brissopsis* cf. *consobrinus* LAMB. – SENEŠ: 6, 26; pl. 1, fig. 1-2
- 1956 *Brissopsis ottnangensis* R. HÖRN. – SIEBER: 312
- 1960 *Brissopsis (Brissoma) ottnangensis* R. HOERN. – GIVULESCU & DUȘA: 937-938; figs. 3, 5 [the legends of fig. 3 and 6 were confused]
- 1962 *Brissopsis ottnangensis* – PAPP & THENIUS in KÜHN: 330
- 1967 *Brissopsis (Brissoma) ottnangensis* R. HOERN. – CÍCHA et al.: 87
- 1967 *Brissopsis (Brissoma) ottnangensis* R. HOERN. – CÍCHA et al.: 92
- ? 1967 *Brissopsis* cf. *consobrinus* LAMB. – CÍCHA et al.: 93
- pp 1970 *Brissopsis* cf. *crescenticus* WRIGHT – BÄLÜK: 113; pl. 1, fig. 7

- 1975 *Brissopsis ottngangensis* R. HOERNES 1875 – STOJASPAL: A192
 1976 *Brissopsis ottngangensis* R. HOERN. – RÖGL & MÜLLER: 222
 1978 *Brissopsis ottngangensis* HOERN. – ČIČHA: 170
 1980 *Brissopsis* cf. *ottngangensis* HÖRNES? – WANK & STOJASPAL: 448
 1981 *Brissopsis* cf. *ottngangensis* R. HÖRNES – WANK: 382; pl. 3, fig. 6
 1985 *Brissopsis ottngangensis* – HAMOR: tab. 25, tab. 28
 1985 *Brissopsis ottngangensis* HOERNES – TOLLMANN: 452
 1991 *Brissopsis ottngangensis* HOERNES – RUPP et al.: 40
 v 1998 *Brissopsis* cf. *ottngangensis* R. HOERNES – TOMAŠOVÝCH: 361, 385
 v. 2002b *Brissopsis ottngangensis* HOERNES – KROH: 11
 2003 *Schizaster laubei* – WEIDLINGER: 199, unnumbered fig. [misidentified *Brissopsis ottngangensis*]
 v. 2003b *Brissopsis ottngangensis* HOERNES, 1875 – KROH: 251; pl. 1, fig. 4

Type-material:

Lectotype: 1 natural internal cast (GBA 1875/1/78a)
 Paralectotypes: 380 moulds and internal casts housed in the type collection of the Geological Survey of Austria under the number GBA 1875/1/78 and 5 specimens housed at the Naturhistorisches Museum Wien (NHMW 1854.XXIII.41)
 Locus typicus: Ottngang, OÖ, Austria
 Stratum typicum: Ottngang Schlier
 Age: Ottngangian (Late Burdigalian), Early Miocene
 Remarks: A lectotype has been chosen, as the syntypes encompassed also a few specimens of schizasterids.

Material:

Eggenburgian (Early Burdigalian) – Pfarrkirchen (Haller Schlier), OÖ, Austria
 NHMW: 2 specimens on a slab (NHMW 1977/1891a+b)
 Ottngangian (Late Burdigalian) – Antiesen river, near Antiesenhofen, near Schärding/Inn, OÖ, Austria
 NHMW: 22 specimens (NHMW 1971/1485a-j, 1985/67/22a+b, 1989/83/39, 2003z0090/0002)
 Ottngangian (Late Burdigalian) – Antiesenhofen, near Schärding/Inn, OÖ, Austria
 NHMW: 1 specimen (NHMW 2003z0090/0005)
 Ottngangian (Late Burdigalian) – Großwiesenhardt, near St. Marienkirchen, OÖ, Austria
 NHMW: 3 specimens (NHMW 1988/40/19, 2003z0090/0004)
 Ottngangian (Late Burdigalian) – Ottngang, OÖ, Austria
 NHMW: 8 moulds and internal casts [NHMW 1854.XXIII.41 (paralectotypes), 1928.No.23, 1997z0178/0580, 2004z0102/0001-2]
 GBA: 381 moulds and internal casts (GBA 1875/1/78 **type-material** of *B. ottngangensis* HOERNES, 1875a)
 Ottngangian (Late Burdigalian) – Pielach river, south of Völlernsdorf, NÖ, Austria
 GBA: 1 specimen (no inventory number)
 Ottngangian (Late Burdigalian) – St. Pölten (train station), NÖ, Austria
 NHMW: 1 specimen (NHMW 2004z0100/0001)
 Early Badenian (Langhian) – Bad Vöslau, NÖ, Austria
 NHMW: 5 specimens (NHMW 2004z0103/0001-3)
 Early Badenian (Langhian) – Gainfarn, NÖ, Austria
 NHMW: 1 specimen (NHMW 2004z0154/0004)
 Early Badenian (Langhian) – Retznei [Weissenegg Fm., Lafarge (formerly Perlmoser) quarry Rosenberg], Styria, Austria
 NHMW: 1 specimen (NHMW 2004z0098/0002)
 Early Badenian (Langhian) – Retznei [Weissenegg Fm., Lafarge (formerly Perlmoser) main quarry], Styria, Austria
 NHMW: 1 specimen (NHMW 2004z0098/0001)
 Early Badenian (Langhian) – Weitendorf (below basalt layer), Styria, Austria

NHMW: 2 specimens (2004z0097/0001-2)
 Early Badenian (Langhian) – Wetzelsdorf in der Weststeiermark, Styria, Austria
 NHMW: 7 specimens (2004z0096/0004-10)
 Badenian (Langhian-Early Serravallian) – Kalksburg, Vienna, Austria
 NHMW: 1 specimen (NHMW 1981/55/12)
 Late Badenian (Early Serravallian) – Walbersdorf, Bgld, Austria
 GBA: 45 fragmentary moulds and internal casts (no inventory numbers)

Foreign material for comparison:

Ottngangian (Late Burdigalian) – Mitterdorf near Griesbach, Bavaria, Germany
 NHMW: 30 fragmentary moulds and internal casts (no inventory numbers)
 Karpatian (Late Burdigalian) – Strachotín, c. 11 km N Mikulov, southern Moravia, Czech Republic
 Univ. Brno: numerous specimens (no inv. nos.; see POSPÍCHALOVÁ in KROH, 2003b)
 Badenian (Langhian-Early Serravallian) – Mogyoród, Pest, Hungary
 NHMW: 2 specimens (NHMW 1997z0178/2092)
 Late Badenian (Early Serravallian) – Devínska Nová Ves (brickyard near train station), Slovak Republic
 NHMW: 10 specimens (NHMW 2004z0095/0001-10)
 Slovak National Museum: 11 specimens [SNM z24174 to z24182; reference material of *B. cf. ottngangensis* in TOMAŠOVÝCH, 1998]

Dimensions (in mm):

Inv. No.	TL	TW	TH
GBA 1875/1/78a (lectotype)	31.9	30.3	-
GBA 1875/1/78b	31.7	30.5	-
GBA 1875/1/78c	15.9	15.0	5.1
[specimen figured in HOERNES (1875a: pl. 12, figs. 4a-b)]			
GBA 1875/1/78d	17.1	15.9	-
[specimen figured in HOERNES (1875a: pl. 15, figs. 2a-b)]			
GBA 1875/1/78g	42.2	41.6	> 15
GBA 1875/1/78j	16.6	15.4	> 5
GBA 1875/1/78k	19.6	17.9	-

Description:

Size and shape: Test of small to medium size, commonly between 15 and 45 mm in length. Outline oval, slightly antero-posteriorly elongated. Anterior margin rounded with shallow frontal sinus, posterior margin transversely truncated. The profile is low and slightly wedge shaped with obliquely truncated posterior end and distinct subanal heel (Pl. 72, Fig. 1a-c). The ambitus is round and tumid. The test width is about 92–96% of TL.

Apical disc: The apical disc is ethmolytic with four circular gonopores. The anterior gonopore pair is more closely spaced and the pore diameter is smaller. Ocular pores are barely visible. The madreporite is very long and separates both genitals 1 and 4, as well as oculars I and V (Figs. 78.A-B). It is crowded by many small madreporic pores. The position of the apical disc changes during the growth of this species. In small specimens (around 15 mm TL) the distance to the anterior margin varies from 46 to 55 % TL, in large specimens (30 to 40 mm TL) it is distinctly larger, usually between 58 and 60 %.

Ambulacra: On the aboral side ambulacrum III is slightly widened halfway between apex and ambitus (Fig. 78.C). Adapically it is slightly sunken, increasingly so towards the ambitus. The pores are small, oblique partitioned isopores and are arranged in two straight rows. The paired ambulacra are petaloid and bear closely spaced elongate isopores (pores teardrop-shaped, subequal in size, the perradial pore being slightly larger in some cases, tapering against each other; pores surrounded by a narrow rim of stereom, which is highest at the

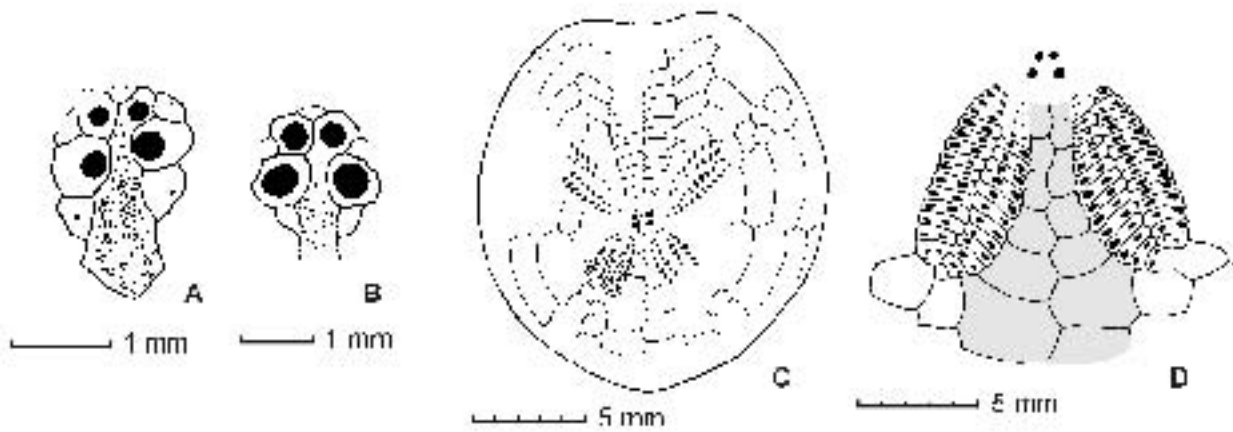


Figure 78: *Brissopsis ott nangensis* HOERNES, 1875: apical disc (A: Badenian, Kalksburg, Vienna, Austria, NHMW 1981/55/12; B: Badenian, Devínska Nová Ves, Slovak Republic, SNM z24182), aboral view (C: Ottnangian, Ottnang, OÖ, Austria, paralectotype GBA 1875/1/78c), and structure of the posterior petals (D: Badenian, Bad Vöslau, NÖ, Austria, NHMW 2004z0103/0001).

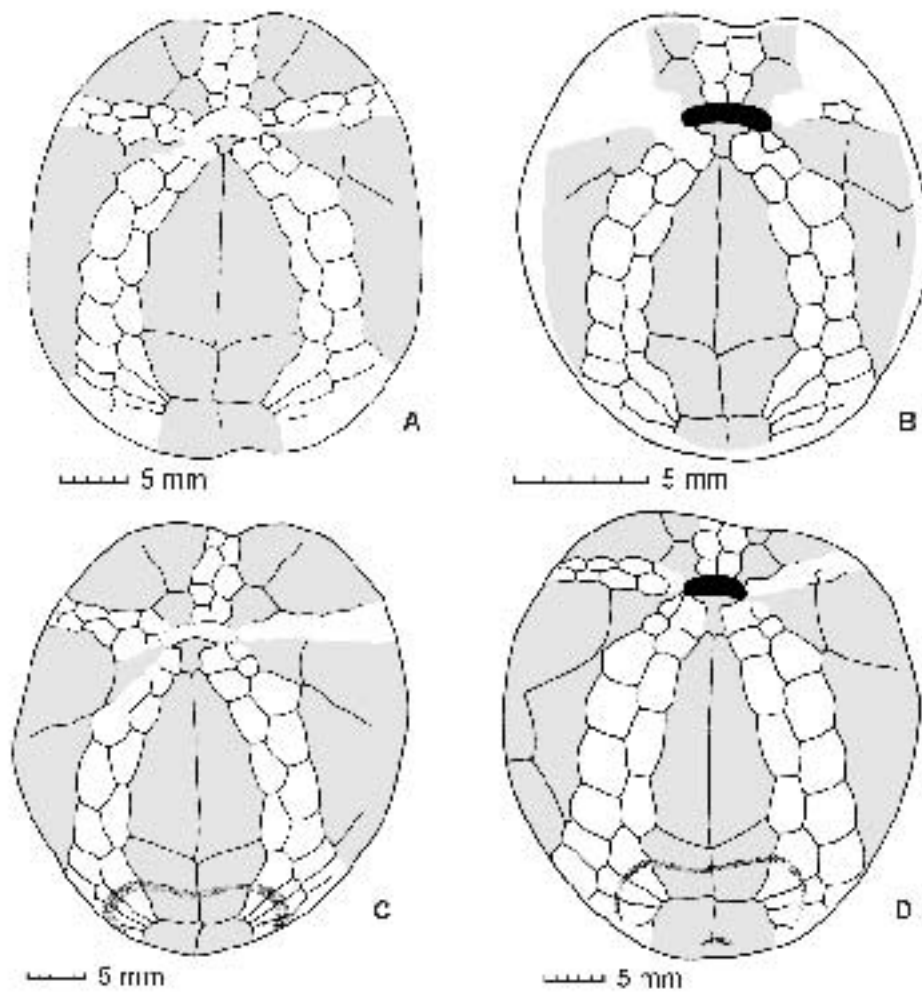


Figure 79: *Brissopsis ott nangensis* HOERNES, 1875: oral plating (A: Ottnangian, Ottnang, OÖ, Austria, paralectotype GBA 1875/1/78a; B: Ottnangian, Ottnang, OÖ, Austria, paralectotype GBA 1875/1/78c; C: Badenian, Retznei, Styria, Austria, NHMW 2004z0098/0002; D: Badenian, Devínska Nová Ves, Slovak Republic, SNM z24174). Interambulacra shaded, poorly visible sutures omitted or stippled.