

Figure 84: *Spatangus austriacus* LAUBE, 1869: oral plating (A: Grübern, NÖ, NHMW 1914.VII.19c; B: Grübern, NÖ, NHMW 2002z0159/0002). Interambulacra shaded.

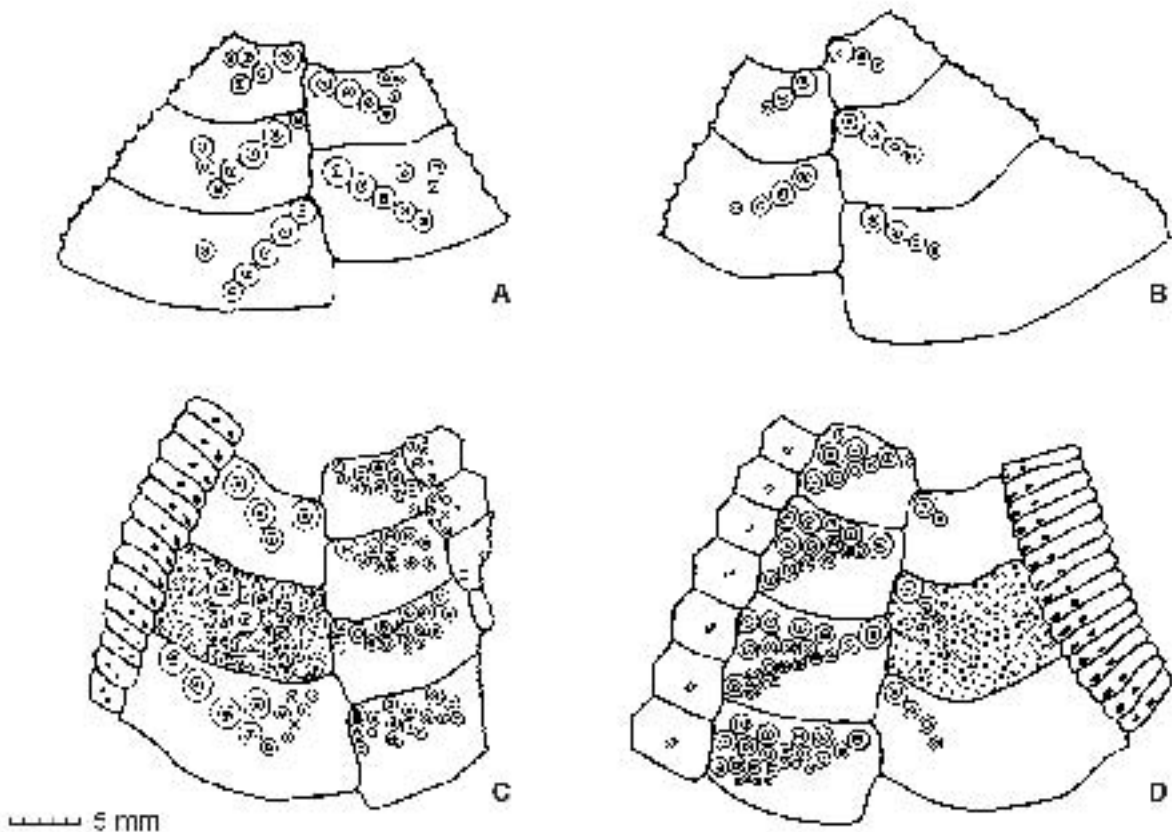


Figure 85: *Spatangus austriacus* LAUBE, 1869 (A, C) and *Spatangus* sp. 2 (B, D): comparison between the tuberculation on the adapical plates in the posterior (A, B) and anterior paired interambulacra (C, D). Secondary tuberculation has been omitted on all but one plate in each figure; specimens are of similar size, their test length range from 78 mm to c. 90 mm. *S. austriacus* has a much more strongly developed primary tuberculation. In interambulacral columns 1a, 1b, 2a, 3b, 4a, and 4b a marked en-chevron arrangement is developed in *S. austriacus*, whereas in *S. sp. 2* there is only a single oblique row of primary tubercles. (A: interambulacrum 1, NHMW A2254, Grübern, NÖ; B: interambulacrum 4, NHMW 1984/138/139, Kummer quarry, St. Margarethen, Bgld; C: interambulacrum 2, NHMW 2002z0159/0004, Grübern, NÖ; D: interambulacrum 3, NHMW 1976/1844/45, Kummer quarry, St. Margarethen, Bgld).

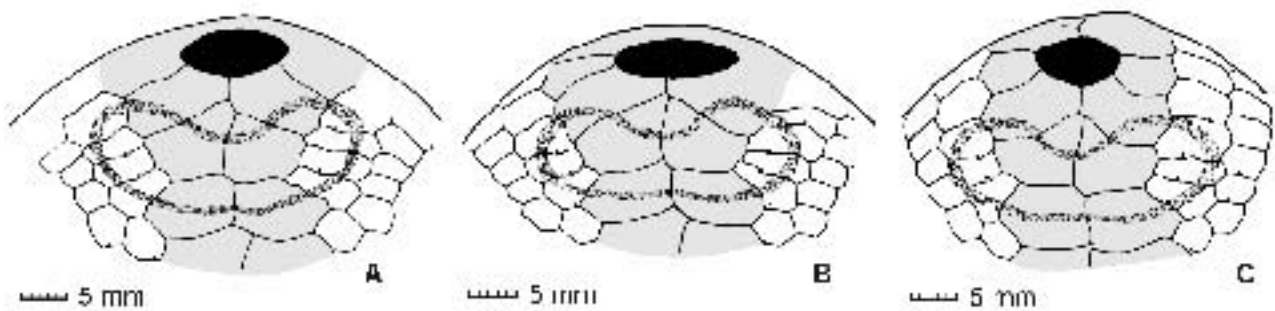


Figure 86: *Spatangus austriacus* LAUBE, 1869 (A, B) and *Spatangus cf. austriacus* LAUBE, 1869 (C): shape of the subanal fasciole and plating of interambulacrum 5 and the adjacent ambulacra below the periproct (A: Grübern, NÖ, NHMW 1914.VII.19c; B: Grübern, NÖ, NHMW 1914.VII.19d; C: Maria Dreieichen, NÖ, NHMW 1860.L.205). Interambulacra shaded, subanal fasciole densely stippled.

episternal plates. The plastron is holamphisternous with a broad sternum (sternum width ranging from 85 to 95 % sternum length) and slightly elongate labrum (labrum width ~ 82 to 88 % labrum length) (see Fig. 84). The labrum extends to the second ambulacral plate.

**Peristome:** The peristome is situated about 25 % of TL from the anterior margin. It is kidney-shaped with a slightly projecting labrum.

**Periproct:** The periproct is situated inframarginally and overhung by a small rostrum. It is rather large and oval (transversely elongated). There is a distinct subanal depression, which is sparsely tuberculated.

**Fascioles:** Only a subanal fasciole is present. The fasciole band is moderately broad, slightly depressed and corresponds to the orthofasciole type of NÉRAUDEAU et al. (1998b). The fasciole is broad and bilobed to kidney-shaped. Within the fasciole up to three enlarged constricted unipores (or partitioned isopores?) are found in each ambulacrum (Figs. 86.A-B).

#### Differential diagnosis:

This species differs from *S. sp. 2* from the Badenian of Austria by its different plastron architecture (compare Fig. 84 and Fig. 89), especially in the shape of the labrum which is antero-posteriorly elongated in *S. austriacus* extending to the second ambulacral plates, whereas it is transversely elongated and not extending beyond the first ambulacral plates in *S. sp. 2*. The sternum of *S. sp. 2* is more "serrated" and more elongated (sternum width 82 to 88 % sternum length, vs. 85 to 95 % in *S. austriacus*). Moreover, the sternum of *S. austriacus* seems to get relatively broader during ontogeny, whereas in *S. sp. 2* it shows the reverse trend. Additionally there are strong differences in aboral tuberculation (Fig. 85).

*S. delphinus* DEFRANCE, 1827 from the Burdigalian of the Rhône Valley differs (but see remarks section) from *S. austriacus* by its smaller, more lanceolate petals, higher test (based on the values given by PHILIPPE, 1998: 206, the test height ranges from 32 to 68 % TL, with a mean of 46 %) and the position of the maximum height, which coincides with the apical disc (based on PHILIPPE, 1998: 204-209).

#### Discussion:

This species is closely related to *Spatangus delphinus* DEFRANCE, 1827 from contemporaneous deposits of the Rhône Basin. Due to the fact that no topotypic specimens of *S. delphinus* were available for examination during this study and the plating pattern of this species is not known, it is difficult to decide if these two species are conspecific or not. In case the plating patterns (in particular plastron architecture and labrum shape) turn out to be identical the two can likely be regarded synonymous.

*S. austriacus* is rather rare in the study area, only few localities are known. Most specimens are rather poorly preserved and often deformed. The specimens from the immediate vicinity

of Eggenburg are slightly, but consistently different from the type material of LAUBE (1869a) and are discussed below under *Spatangus sp. 1*.

In his description LAUBE (1871: 73) mentioned three specimens of this species, two of them from the Eggenburgian of Bayersdorf, NÖ (the figured specimens) and one from the Badenian of Großhöflein (= Nagyhöflány), Bgld, Austria (then belonging to Hungary). The Badenian specimen could not be located, and it is unclear if it is conspecific with the Eggenburgian specimens. All Badenian *Spatangus* specimen from Austria are clearly different (but see remark under *S. hungaricus*).

Reports of *S. austriacus* from the Badenian of Poland MAČZYŃSKA (1979: 31-32; 1988: 62), the Ukraine (SZÖRÉNYI, 1953: 37-38, 88-89) and Romania (KOCH, 1887b: 270) are doubtful. The descriptions are largely inconclusive. The illustrations suggest that they might not be conspecific with LAUBE's type material (see under *S. sp. 2*). Most Badenian literature records of *S. austriacus* have therefore been tentatively placed in the synonymy of *S. sp. 2*.

This species has also been reported from many localities in Northern Italy [e.g. MANZONI (1879: 160, 1881:174), MAZZETTI (1882b: 129), STEFANINI (1908b: 109-112)], where a wide range of morphotypes were placed into *S. austriacus*. Unfortunately illustrations and descriptions rarely include oral plating patterns. Thus nearly all specimens need to be re-examined to decide whether or not they are conspecific with *S. austriacus*. In these specimens, where the plastron structure is known (e.g. specimen in MANZONI, 1879: pl. 3, fig. 21), it is often markedly different from *S. austriacus*. However, since a re-examination of all these specimens is out of the scope of this study, this problem must be solved later. Moreover, all of the figured specimens attributed to *S. austriacus* originally were placed into other (new) species by subsequent authors [MAZZETTI (1882b: 21, pl. 2, fig. 2) established the new species *S. subconicus* for the specimen figured on pl. 3, figs. 19-20, the same specimens together with the one on pl. 4, figs. 40-41, were used as types for *Prospatangus fabianii* LAMBERT, 1924 (in LAMBERT & THIÉRY, 1909-1925: 462), the latter figure (pl. 4, fig. 41) again served as type for *S. destefanii* STEFANINI, 1908 (STEFANINI, 1908b: 112, pl. 16, fig. 3). For the specimens on the figures 10-15 on plate 2 and 21-22 on plate 3 LAMBERT & THIÉRY, 1909-1925: 462) established the species *Prospatangus airaghii* LAMBERT, 1924. NELLI (1903: 194) and AIRAGHI (1908: 256), in contrast, placed all of MANZONI's specimens and most subsequent reports into the synonymy of *S. manzonii* SIMONELLI, 1884. Similarly the specimens reported under *S. austriacus* from the Piedmont area by AIRAGHI (1901: 215-216; pl. 27 (9), fig. 8) were later placed into a new species (*S. taramellii*) by the same author (AIRAGHI, 1908: 255)].

Although the available material is rather limited, it spans a broad size range including subadult specimens as well as very large ones. This allowed to observe some of the morphological

changes which occur during growth due to the allometric growth of this species: the depth of the frontal sinus increases; the heart-shaped outline becomes more pronounced; the petals close and become more lanceolate in shape; the inflation of the oral ambulacral plates lessens; the sternum gets broader; and the wedge shape in profile becomes more evident.

**Occurrence:**

Austria: Early ? to Late Eggenburgian (Early Burdigalian); Badenian records omitted because identifications are doubtful

Molasse Zone: Achberg, near Maria Dreieichen ("Scutellensande"), NÖ (STEININGER, 1971a, b); Bayersdorf, near Maissau, NÖ (LAUBE, 1869a, 1871; SCHAFFER, 1912a; [NHMW]); Eggenburg, NÖ (THENIUS, 1974); Eggenburg (Brunnstube), NÖ (STEININGER, 1971a, c); Eggenburg (Kremserberg), NÖ (SCHAFFER, 1912a); Eggendorf, NÖ ([NHMW]); Fels am Wagram, NÖ (STEININGER, 1971a); Grübern, NÖ (SCHAFFER, 1912a; SCHULTZ, 1998; [NHMW]); Klein-Meiseldorf, NÖ (SCHAFFER, 1912a); Unternalb, near Retz, NÖ (HARZHAUSER & KROH, 1999; KROH & HARZHAUSER, 1999; LUKENEDER & HARZHAUSER, 2002; [NHMW])

Mediterranean: occurrence uncertain; most Italian records have been placed into different species by subsequent authors

Western Mediterranean: Italy, mainland: ? Gaiano, Modena (COPPI, 1884), ? Montagnana, Modena (COPPI, 1884), ? Montardone, Modena (COPPI, 1884), ? Montepenna, Modena (COPPI, 1884), ? Mt. Fuscaldo, Calabria (NEVIANI, 1887), ? Quatro di Giovanzano, Sambuci (ANGELIS D'OSSAT, 1897), ? Sasso, Modena (COPPI, 1884), ? Tagliata, Modena (COPPI, 1884), ? Posano, Volterra, Prov. Pisa (MENESINI, 1967); Sardinia, Italy: ? Calada Bianca (COMASCHI CARIA, 1963), ? Funtanazza (=Fontanazzo) (PARONA, 1887; COMASCHI CARIA, 1963)

***Spatangus cf. austriacus* LAUBE, 1869**

(Fig. 86.C, 87; Pl. 77, Figs. 1-3)

- v. 1869a *Spatangus euglyphus* LAUBE. – LAUBE: 183
- v. 1870 *Eupatagus euglyphus* LBE. – LAUBE: 314
- v. 1871 *Spatangus euglyphus* LAUBE. – LAUBE: 73

non 1938 *Spatangus cf. euglyphus* LAUBE 1867 – POLJAK: 199-200; pl. 8, fig. 2 [misidentified *Brissopsis* sp.]

**Material:**

Early Eggenburgian (Early Burdigalian) – Maria Dreieichen (Loibersdorf Fm.), NÖ, Austria

NHMW: 1 specimen [NHMW 1860.L.205 (reference material of LAUBE, 1869a, 1871)]

Late Eggenburgian (Early Burdigalian) – Bayersdorf, near Maissau, NÖ, Austria

NHMW: 1 specimen (NHMW 1934.I.72 [material of LAUBE, 1871])

Late Eggenburgian (Early Burdigalian) – Grübern, near Maissau, NÖ, Austria

NHMW: 1 specimen (NHMW 1914.VII.19k)

**Dimensions (in mm):**

Inv. No.	TL	TW	TH
NHMW 1860.L.205	57.8	55.1	27.7
NHMW 1914.VII.19k	49.3	45.5	>15.3
NHMW 1934.I.72	56.7	54.8	25.2

**Description:**

Size and shape: Test of medium size, ranging from 49.3 to 57.8 mm in the studied specimens. The outline is oval, antero-posteriorly elongated to slightly cordiform with a shallow frontal notch. The maximum width lies subcentrally. In profile the test is low arched to slightly wedge-shaped, with an obliquely truncated end. The maximum height lies posterior of the apical disc on the raised keel in interambulacrum 5.

Apical disc: The apical disc lies slightly anterior of the centre, about 40 to 44 % TL from the anterior margin. It is ethmolytic with four large gonopores, the anterior ones of which are slightly smaller (Figs. 87.A-B).

Ambulacra: Ambulacrum III nonpetaloid, slightly depressed, increasingly so towards the anterior margin. The pores are strongly oblique, minute partitioned isopores. The interporiferous zone is wide and bears only secondary and miliary tubercles. The paired ambulacra are petaloid, slightly depressed adapically and moderately closed distally. The anterior paired petals form an obtuse angle of about 138 to 145°, the posterior paired petals an acute angle of about 55 to 59° with each other. The petals are lanceolate in shape and extend about

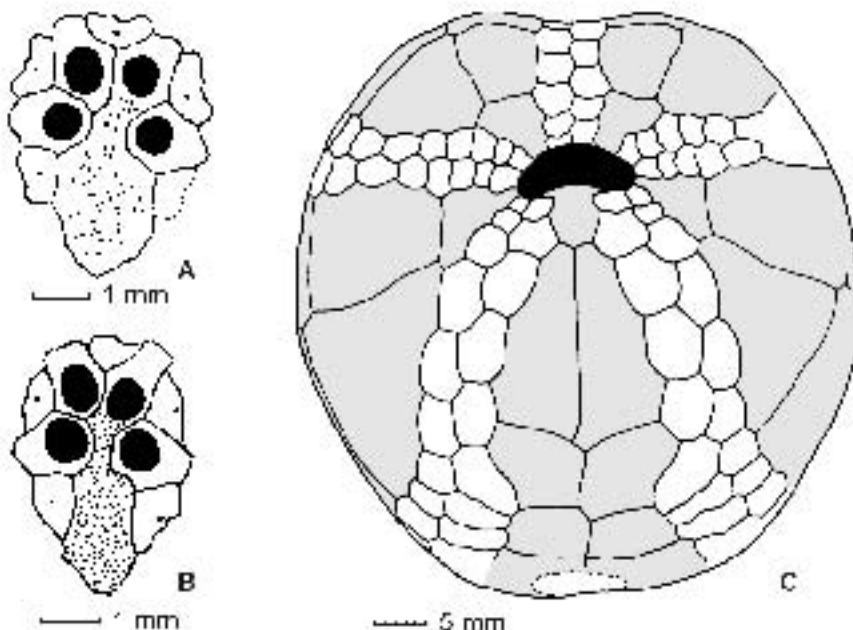


Figure 87: *Spatangus cf. austriacus* LAUBE, 1869: apical disc (A, B) and oral plating (C) (A, C: Grübern, NÖ, NHMW 1934.I.72; B: Maria Dreieichen, NÖ, NHMW 1860.L.205). Interambulacra shaded.

three quarter of the corresponding test radius. Within the petals the pores are closely spaced, elongated isopores. The pores of the uppermost 7 to 11 plates in the anterior plate row of ambulacra II and IV are minute partitioned isopores. Outside the petals only minute micropores are present, except in the phyllodes where large unipores with extensive periporal area are found. Ambulacra I and V form moderately broad periplastral areas lacking primary tubercles.

**Interambulacra:** Adapically the interambulacra are slightly inflated between the petals. They bear few crenulate, perforate primary tubercles with inclined areoles. In the interambulacra 1, 4 and 5 these enlarged tubercles are mainly found along the interradiial suture of the adapical plates. In specimen NHMW 1860.L.205 they are restricted to the area between the petals.

Adorally the interambulacra are densely covered with crenulate, perforate primary tubercles. Only few secondary and miliary tubercles are scattered among them. The tubercles increase in size from the margin towards the peristome. On the sternum and on the first pair of episternal plates the tubercles are arranged in a fan-shaped pattern radiating from posterior elevations on the plates. The plastron is distinctly inflated, it is holamphisternous with a broad sternum (sternum width ranging from 83 to 86 % sternum length) and slightly elongated labrum (labrum width 60 to 70 % labrum length) (see Fig. 87.C). The labrum extends to the second ambulacral plate.

**Peristome:** The peristome is situated about 27 % of TL from the anterior margin. It is kidney-shaped with a slightly projecting labrum.

**Periproct:** The periproct is situated inframarginally and overhung by a small rostrum. It is rather large and oval (transversely elongated). There is a distinct subanal depression, which is sparsely tuberculated.

**Fascioles:** Only a subanal fasciole is present. The fasciole band is moderately broad and corresponds to the orthofasciole type of NÉRAUDEAU et al. (1998b). The fasciole is broad and has a bilobed outline with a strong indentation below the periproct. Within the fasciole two enlarged constricted unipores are found in each ambulacrum (Fig. 86.C).

#### Differential diagnosis:

The specimens considered here differ from typical *S. austriacus* by their smaller size, oval outline, lanceolate petals, more elongated sternum and labrum, and the presence of only two enlarged pores within the subanal fasciole.

*S. sp. 2* from the Badenian of Austria differs by its different plastron architecture, especially in the shape of the labrum.

#### Discussion:

The present specimens are generally very similar to *S. austriacus* and show similar proportions when compared with large specimens of that species. Comparison with *S. austriacus* specimens of similar size reveals the following differences (compare LAUBE, 1868: p. 35-36; pl. 6, figs. 5, 5a-c): moderately closed, broad, lobate petals and a broadly heart-shaped outline with transversely truncated posterior end characterise the subadult specimens of *S. austriacus*. Moreover, *S. austriacus* has three pores within the subanal fasciole, while this species only has two. Based on these differences the specimens are kept separated from *S. austriacus*.

One of the specimens (NHMW 1860.L.205) was also examined by LAUBE (1871: 73) and referred by him to *Spatangus euglyphus* LAUBE, 1867, a species based on material from the Aquitanian of Northern Italy. If compared with the descriptions of the Italian material (LAUBE, 1868: 35-36, pl. 6, figs. 5, 5a-c), it becomes clear that these specimens are not conspecific. *S. euglyphus* is much higher, has a subcircular outline, a narrower plastron, differently shaped labrum and its periproct lies much lower on the test. *S. euglyphus* hence does not occur in Austria, contrary to the statements of LAUBE (1868, 1869a, 1870, 1871) and CAHUZAC & ROMAN (1994: 362).

#### Occurrence:

**Austria:** Early to Late Eggenburgian (Early Burdigalian) Molasse Zone: Bayersdorf, near Maissau, NÖ ([NHMW]); Grubern, near Maissau, NÖ ([NHMW]); Maria Dreieichen, NÖ (LAUBE, 1869a, 1871; [NHMW])

### *Spatangus sp. 1*

(Pl. 77, Figs. 4-5)

#### Material:

Late Eggenburgian (Early Burdigalian) – Eggenburg, NÖ, Austria

NHMW: 2 specimens (NHMW 1970/1396/977, NHMW 2002z0168/0001)

Late Eggenburgian (Early Burdigalian) – Eggenburg (Schindergraben), NÖ, Austria

NHMW: 4 specimens [NHMW 592/1964, NHMW 2002z0169/0001 (2 specimens), NHMW 2002z0169/0002]

Late Eggenburgian (Early Burdigalian) – Eggenburg (Kremserberg), NÖ, Austria

NHMW: 1 specimen (NHMW 2002z0170/0001)

#### Dimensions (in mm):

Inv. No.	TL	TW	TH
NHMW 1970/1396/977	55.4	55.6	26.1
NHMW 592/1964	62.9	63.5	~ 26
NHMW 2002z0168/0001	73.3	74.9	25.5
NHMW 2002z0170/0001	81.6	78.8	25.3

#### Discussion:

The poor preservation of the studied specimens precludes a confident specific determination. The present specimens are very similar to *Spatangus austriacus* LAUBE, 1871, but show some minor differences: the angle between the anterior paired petals is slightly larger (148 to 158°) than in *S. austriacus* (130 to 145°) and the angle between the posterior paired petals smaller (less than 55° vs. usually 60°); the test is subcircular or transversely elongated (TL TW) instead of antero-posteriorly elongated (TL > TW); the frontal notch is shallower than in *S. austriacus* specimens of comparable size; and the apical disc is situated more anteriorly (30 to 37 % TL from the anterior margin vs. 42 to 45 %). Until better material becomes available, however, the relationship to typical *S. austriacus* morphotypes remains unclear and the specimens are left in open nomenclature.

#### Occurrence:

**Austria:** Late Eggenburgian (Early Burdigalian)

Molasse Zone: Eggenburg, NÖ ([NHMW]); Eggenburg (Kremserberg), NÖ ([NHMW]); Eggenburg (Schindergraben), NÖ ([NHMW])

### *Spatangus sp. 2*

(Figs. 85.B, D, 88-90; Pl. 78, Figs. 1-3; Pl. 79, Figs. a-b)

- ? pp 1869a *Spatangus austriacus* LAUBE. – LAUBE: 184
- ? pp 1870 *Spatangus austriacus* LBE. – LAUBE: 314
- ? pp 1871 *Spatangus austriacus* LAUBE. – LAUBE: 73; pl. 19, fig. 2, 2a
- ? 1887b *Spatangus austriacus*, LAUBE. – KOCH: 270-271
- ? 1891 *Spatangus cf. austriacus* LAUBE. – ROTH VON TELEGD: 151
- 1892 *Spatangus austriacus* LBE. – SCHAFARZIK: 196
- ? 1893 *Spatangus austriacus* LAUBE– TOULA: 288
- ? 1905 *Spatangus cfr austriacus*, LBE. – GAÁL: 344, 362
- ? 1930 *Prospatangus austriacus* LAUBE. – VENDL: 50

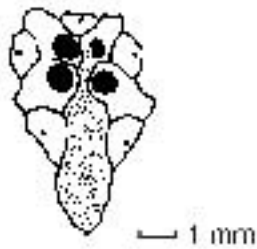


Figure 88: *Spatangus* sp. 2: apical disc (Kummer quarry, St. Margarethen, Bgld, NHMW 1976/1844/54).

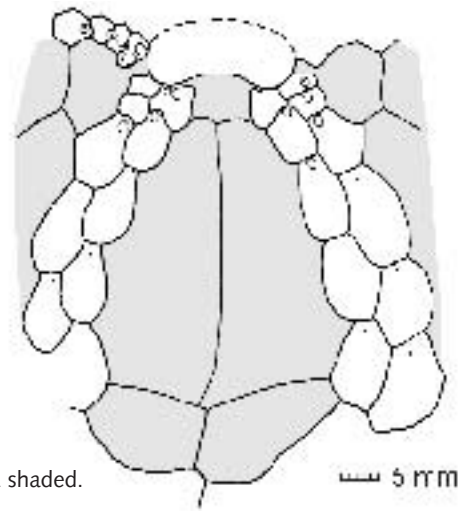


Figure 89: *Spatangus* sp. 2: oral plating (Kummer quarry, St. Margarethen, Bgld, NHMW 2005z0004/0001). Interambulacra shaded.

- 1936 *Spatangus austriacus* LAUBE – PAUCĀ: 143, 197; pl. 2, figs. 1-2  
 1938 *Spatangus austriacus* LAUBE 1871 – POLJAK: 197-198; pl. 10, fig. 2  
 ? 1953 *Prospatangus austriacus* (LAUBE), 1871. – SZÖRENYI: 37-38, 88-89; pl. 8, figs. 3, 3a-b  
 ? 1969 *Spatangus corsicus* DES. – MITROVIĆ-PETROVIĆ: 140; pl. 30, figs. 3, 3a-b  
 ? 1979 *Spatangus austriacus* LAUBE, 1871 – MAČZYŃSKA: 31-32, pl. 3, figs. 1 a-d, 2a-c; pl. 4, figs. 1a-e; pl. 5, figs. 1a, 2a-b  
 ? 1979 *Spatangus hungaricus* (VADÁSZ, 1915) – MAČZYŃSKA: 32; pl. 6, figs. 1a-e, 2; pl. 7, fig. 1a-f  
 ? 1988 *Spatangus austriacus* LAUBE, 1871 – MAČZYŃSKA: 62; pl. 4, figs. 4a-f  
 1996 *Spatangus austriacus* – MACHALSKI: 26  
 v. 2001 *Spatangus austriacus* (LAUBE) – SCHMID et al.: 13; pl. 1, fig. 5  
 2004 *Spatangus austriacus* LAUBE, 1871 – RADWAŃSKI & WYSOCKA: 385, 386; pl. 6, figs. 1a-b

#### Material:

Late Badenian (Early Serravallian) – St. Margarethen (Kummer quarry), Bgld, Austria

NHMW: 11 fragmented coronas (NHMW 1976/1844/45, ..152, ..154-56, 1986/138/130, 1992/151/3, 1992/151/4a+b, 2000z0133/0011, 2005z0004/0001)

WANZENBÖCK coll.: 1 specimen (W28)

#### Foreign material for comparison:

Early Badenian (Langhian) – Pod'yarkov (= Podjarków), near Lwów, western Ukraine

NHMW: 1 specimen (NHMW 1859.XLV.556)

Badenian (Langhian-Early Serravallian) – Loska Dolina (formerly Groß-Dollina, Unter-Krain), Slovenia

UGP: 1 specimen (UGP 1877.IV.235)

#### Dimensions (in mm):

Inv. No.	TL	TL	TH
NHMW 1986/138/130	97	92	-
NHMW 1992/151/3	~148	140-150	-
WANZENBÖCK coll. W27	~95	~93.5	-
WANZENBÖCK coll. W28	90.3	~88	-

#### Description:

**Size and shape:** Test of large to very large size, ranging from 90 to 150 mm test length in the studied material. The outline of the test is oval to slightly cordiform, with a shallow frontal sinus and bluntly pointed to transversely truncated posterior end. The maximum width lies subcentrally. Since most

specimens are badly crushed, the shape of the test in profile can only be reconstructed based on the curvature of the fragments. It seems, however, that the test was moderately arched with the maximum height around the apical disc. Estimated values for test width are c. 95 % TL and c. 40 % TL for test height.

**Apical disc:** The apical disc lies slightly anterior of the centre, about 45 % TL from the anterior margin. It is ethmolytic with four large gonopores and 5 minute ocular pores (Fig. 88). The madreporite is very elongated posteriorly and extend far beyond the posterior ocular plates.

**Ambulacra:** Ambulacrum III is nonpetaloid, slightly depressed, increasingly so towards the anterior margin, where it forms a shallow frontal sinus. The pores are strongly oblique, minute partitioned isopores in the centre of the plates. They are closely spaced adapically but become increasingly widely spaced towards the ambitus. No primary tubercles are present within ambulacrum III. The paired ambulacra are petaloid, depressed adapically and closed distally. The anterior paired petals form an obtuse angle of about 141°, the posterior paired petals an acute angle of about 60° with each other. The petals are lanceolate in shape and extend about two thirds of the corresponding test radius. Within the petals the pores are elongated isopores. The interporiferous zones are up to four times as wide as a single poriferous zone and slightly inflated. The pores of the uppermost 11 to 14 plates in the anterior plate row of ambulacra II and IV are minute partitioned isopores. Outside the petals only minute pores (partitioned isopores or constricted unipores) are present.

Adorally the ambulacra form broad naked phylloides with large unipores with an extensive periporal area. In ambulacrum III 8 such pores are present, 9 to 10 in each of the anterior paired ambulacra, and 8 in the posterior paired ambulacra. Ambulacra I and V form moderately broad peri-plastronal areas which are covered by loosely spread secondary and dense miliary tubercles. Primary tubercles are not present.

**Interambulacra:** Adapically the interambulacra are slightly inflated between the petals. They bear a few enlarged, crenulate, perforate primary tubercles, which are arranged in short oblique rows on each plate (Figs. 85.B, D). In the interambulacra 1, 4 and 5 these enlarged tubercles are mainly found along the interradiial suture of the adapical plates and are restricted to the area between the petals (Fig. 85.B). In the interambulacra 2 and 3 they are mostly found on the anterior plate rows (2b and 3a) along the sutures to ambulacrum III (Fig. 85.D). In the posterior plate rows (2a and 3b) there are very few (up to 3) enlarged primary tubercles, which are arranged in an oblique row in the interradiial/adapical edge of each plate (Fig. 85.D). The remaining surface of the interambulacra is densely covered by small, evenly distributed, crenulate perforate secondary tu-

bercles. Small miliary tubercles are densely scattered among them.

Adorally the interambulacra are densely covered with crenulate, perforate tubercles which increase in size from the margin towards the peristome. On the sternum and on the first pair of episternal plates the tubercles are arranged in a fan-shaped pattern radiating from posterior elevations on the plates. The plastron is holamphisternous with a broad sternum (sternum width ranging from 82 to 88 % sternum length) and broad labrum (labrum width 102 to 135 % labrum length) (see Fig. 89). The labrum does not extend beyond the first ambulacral plate.

**Peristome:** The peristome is situated about 28 to 32 % TL from the anterior margin. It is kidney-shaped with a projecting labrum.

**Periproct:** The periproct is situated inframarginally and overhung by a small rostrum. It is rather large and seems to be oval (transversely elongated).

**Fascioles:** Only a subanal fasciole is present. The fasciole band is broad and corresponds to the orthofasciole type of NÉRAUDEAU et al. (1998b). The fasciole is broad and has a bilobed outline. Within the fasciole four enlarged constricted unipores are found in each ambulacrum.

#### Differential diagnosis:

This species differs from all other *Spatangus* species of the Neogene of Austria by its plastron architecture, especially in the shape of the labrum which is transversely elongated and does not extend beyond the first ambulacral plate. In specimens where the plastron is not preserved or plate outlines are weakly visible, *S. sp. 2* can be distinguished from *S. austriacus* by the arrangement and number of the primary tubercles in the adapical interambulacra 1 and 4. In *S. sp. 2* there are few (usually 3 to 4) primary tubercles arranged in oblique rows, whereas in *S. austriacus* they are more numerous, larger and arranged in chevron-shaped groups on each plate (compare Figs.

85.A, B). The same situation with more numerous coarse tubercles and an en-chevron arrangement is present in the posterior plate rows of interambulacra 2 and 3 (rows 2a and 3 b) of *S. austriacus*. (compare Figs. 85.C, D). Additionally *S. sp. 2* has four enlarged pores enclosed within the subanal fasciole in each ambulacrum and a less inflated keel in interambulacrum 5.

#### Discussion:

Badenian specimens of *Spatangus* were earlier attributed to *Spatangus austriacus* LAUBE, 1869 by most authors (see above) based on the very similar gross morphology of the aboral test. Recently collected material, however, allows to study the architecture of the plastron for the first time. The labrum of the Badenian species is distinctly different from the type material of *S. austriacus* from the Eggenburgian. Additionally the distribution and number of enlarged aboral tubercles is considerably different in the Badenian specimens.

Examination of Museum collections revealed no Badenian specimens of *S. austriacus* (but see under *S. hungaricus*) and hence Badenian literature records of *S. austriacus* are tentatively placed in the synonymy of *S. sp. 2* here. The descriptions and illustrations of these records, unfortunately, do not reveal the exact morphology of the plastron in those specimens. A specimen from Pod'yarkov (formerly Podjarków), western Ukraine housed at the Naturhistorisches Museum Wien (NHMW 1859.XLV.556) clearly shows the labrum shape typical of *S. sp. 2* (Fig. 90). This specimen is very similar to those reported by SZÖRÉNYI (1953) under the name *S. austriacus* from the same locality. Additionally, the specimen from the Early Badenian of Świniary (Poland) illustrated by RADWAŃSKI & WYSOCKA (2004: pl. 6, figs. 1a-b) clearly belongs to *Spatangus sp. 2*. Although the labrum is not preserved in that specimen, the aboral tuberculation pattern is a clear evidence.

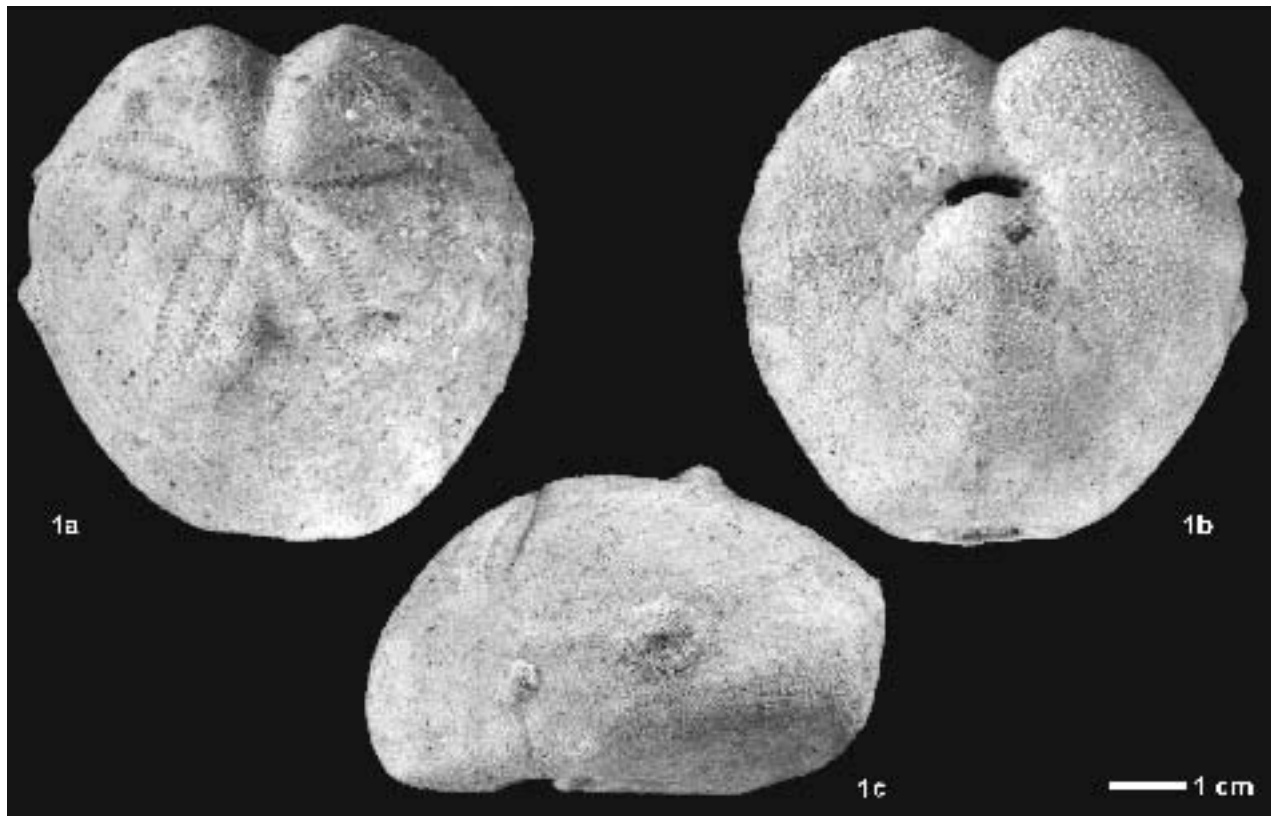


Figure 90: *Spatangus sp. 2*: undeformed specimen from the Early Badenian of Podjarków, near Lwów, western Ukraine (NHMW 1859.XLV.556)

This species could not be identified with any of the numerous established species because lack of information on plating patterns of these species. Hence it is left in open nomenclature at present.

The material figured as *Spatangus austriacus* by MAČZYŃSKA (1979) is difficult to evaluate because of its poor preservation and printing quality. The scarcity of large aboral primary tubercles, except adapically in interambulacra 2 and 3 along the border to ambulacrum III is similar to *S. sp. 2*. Additional evidence comes from the plastron shape (MAČZYŃSKA, 1979: pl. 5, fig. 1a) which is more reminiscent of that species than *S. austriacus*, although the shape the labrum is unknown. Without being able to re-examine the material the present author suggests to remove it from the synonymy of *S. austriacus* and places it tentatively into that of *S. sp. 2*.

#### Occurrence:

**Austria:** Early (?) to Late Badenian (Langhian-Early Serravallian)

Eisenstadt-Sopron Basin: ? Großhöflein, near Eisenstadt, Bgld (LAUBE, 1869a, 1871); St. Margarethen (Kummer quarry), Bgld (SCHMID et al., 2001; [NHMW])

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

Molasse Basin: ? Kralice nad Oslavou (= Kralitz), Moravia, Czech Republic (TOULA, 1893)

Great Hungarian Basin (Pannonian Basin): ? Győr, Győr-Ménfőcsanak, Hungary (VENDL, 1930); ? Hor. Strháre (= Felső-Esztergály), Slovak Republic (ROTH VON TELEGD, 1891; GAÁL, 1905); ? Sámsónháza, Nógrád, Hungary (SCHAFARZIK, 1892); ? Tótmarokháza, Nógrád, Hungary (GAÁL, 1905)

Fore-Carpathian Basin: ? Huta Lubycka, southeastern Poland (MAČZYŃSKA, 1979); ? Podgortsg (= Podhorce), Ukraine (SZÖRENYI, 1953); Pod'yarkov (= Podjarków), near Lwów, western Ukraine (SZÖRENYI, 1953; [NHMW]); Świniary, southern Poland (MAČZYŃSKA, 1988; MACHALSKI, 1996; RADWAŃSKI & WYSOCKA, 2004); ? Wozniaki, western Ukraine (probably the locality was confused with Woźniki, near Wadowice, Poland; no locality with a similar name could be located in the Ukraine) (SZÖRENYI, 1953)

Transylvanian Basin: ? Gârbova de Sus (= Felső-Orbó), Romania, Hungary (KOCH, 1887b; GAÁL, 1905); region east of Taşad, Beiuş Basin, Romania (PAUCĂ, 1936)

Zala, Sáva and Dráva Basins: "Groß-Dollina" (formerly belonging to Unter-Krain, Austria), Slovenia ([UGP]); Zaprešić Breg, Croatia (POLJAK, 1938); ? Derventa, Bosnia & Herzegovina (MITROVIĆ-PETROVIĆ, 1969)

#### *Spatangus* sp. indet.

- ? 1853 *Spatangus*. – HÖRNES: 190 (probably a misidentified schizasterid or brissid)
- 1867 *Spatangus* sp. – REUSS: 30, 109-110
- 1877 *Spatangus* – FUCHS: 662
- 1900 *Spatangus* sp. – FUCHS: 907
- 1904 *Spatangus* spec. – ABEL: 22
- 1906 *Spatangus* ind. sp. – VADÁSZ: 332-333
- 1969 *Prospatangus* sp. – MIHÁLY: 257
- 1979 *Spatangus* sp. A – MAČZYŃSKA: 33, pl. 10, figs. 1a-e
- 1979 *Spatangus* sp. B – MAČZYŃSKA: 33, pl. 10, figs. 2a-c
- 1984 *Prospatangus* sp. – KÓKAY et al.: 288
- 1987 *Spatangus* sp. – MAČZYŃSKA: 149
- 1989 *Spatangus* sp. – NEBELSICK: 15
- 1991a *Spatangus* sp. – NEBELSICK et al.: 88
- ? 1996 *Spatangus* ? sp. – MAČZYŃSKA: 41; pl. 1, fig. 12

#### Material:

Late Eggenburgian (Early Burdigalian) – Pulkau (Retz Fm.), NÖ, Austria

NHMW: 1 test fragment (NHMW 1985/81)

Late Eggenburgian (Early Burdigalian) – Unternalb (Retz Fm.), NÖ, Austria

NHMW: 1 test fragment (NHMW 1861.XXXV.169)

Late Badenian (Early Serravallian) – Winden (Nirgl quarry, N of the village), Bgld, Austria

NHMW: 5 test fragments (NHMW 1859.L.831b)

Late Badenian (Early Serravallian) – St. Margarethen (Kummer quarry), Bgld, Austria

NHMW: 1 natural cast (NHMW 1992/151/4b), 2 test fragments (NHMW 2000z0133/0010, 2004z0001/0044)

#### Discussion:

The record of *Spatangus* from the "Schlier" facies of Ottnang is most probably erroneous and likely a misidentified schizasterid of brissid, the two dominant groups in that locality.

The poor preservation of the specimens referred by MAČZYŃSKA (1979) to *Spatangus* sp. A and sp. B respectively does not allow to place them into the affinity of any of the described specimens with certainty.

#### Occurrence:

**Austria:** Late Eggenburgian (Early Burdigalian), ? Ottnangian (Late Burdigalian), Late Badenian (Early Serravallian)

Molasse Zone: Eggenburg region, NÖ (FUCHS, 1877; NEBELSICK, 1989); Eggenburg (Brunnstube), NÖ (NEBELSICK et al., 1991a); Eggenburg (Schindergraben), NÖ (FUCHS, 1900; ABEL, 1904); ? Ottnang, OÖ (HÖRNES, 1853); Pulkau (Retz Fm.), NÖ ([NHMW])

Eisenstadt-Sopron Basin: St. Margarethen (Kummer quarry), Bgld ([NHMW]); Winden (Nirgl quarry), Bgld ([NHMW])

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

Great Hungarian Basin (Pannonian Basin): Budapest, Pest, Hungary (KÓKAY et al., 1984); Budapest-Rákospuszta, Pest, Hungary (VADÁSZ, 1906; MIHÁLY, 1969)

Fore-Carpathian Basin: Huta Lubycka, southeastern Poland (MAČZYŃSKA, 1979); Korytnica Basin, Poland (MAČZYŃSKA, 1987); Niechobrz, near Rzeszów, southern Poland (MAČZYŃSKA, 1996); Wieliczka, Poland (REUSS, 1867)

Genus *Mariania* AIRAGHI, 1901

**Type-species:** *Macropneustes marmorae* DESOR in AGASSIZ & DESOR, 1847; by original designation (AIRAGHI, 1901: 211).

**Diagnosis:** Test cordate with shallow, broad frontal notch; in profile arched to highly domed with steep sides and flat base; posterior end low and slightly undercut; apical disc ethmolytic with four gonopores; paired ambulacra petaloid; petals long, open, with wide interporiferous zone; peristome close to anterior margin, facing forward; labrum projecting over peristome; sternal pates fully tuberculate; periproct on truncated posterior end; no fasciole; aboral tuberculation heterogeneous with numerous scattered primary tubercles (modified from FISCHER, 1966; and SMITH "The Echinoid Directory", 13.05.2004).

**Distribution:** Oligocene to Miocene – Southern Europe and Central Paratethys

**Remarks:** *Mariania* was placed into the affinity of the Palaeopneustidae by MORTENSEN (1950: 283-284) and later into the family Brissidae by FISCHER (1966: U591-592). Recently it was transferred to the family Spatangidae by PHILIPPE (1998: 213-216), who regarded it as a subgenus of *Spatangus*.