this species were available. Albeit this species is very similar to *E. manzonii* in many aspects, it shows considerable differences (see above, and Figs. 50.A-B). However, because there is a large overlap between this species and *E. manzonii* in many features it is named in open nomenclature and placed into the affinity of *E. manzonii*. More material is necessary to explore the intraspecific variability of this species and *E. manzonii* and to test if *E.* aff. *manzonii* is just an end-member of the morphospace of *E. manzonii*.

**Occurrence:**

Austria: Early Badenian (Langhian)
Eisenstadt-Sopron Basin: Eisenstadt (Hartl Fm., Hartl hill), Bgld ([NHMW])
Vienna Basin: Stotzing (sandpit Mayer), Bgld ([NHMW])

## *Echinolampas sayni* Lambert, 1913

(Fig. 43; Pl. 53, Figs. 1-6; Pl. 54, Figs. 1a-c)

| | | | |
|---|---|---|---|
| pp | 1847a | [*Echinolampas*] *hemisphæricus* Agass. – Agassiz & Desor: 165 |
| pp | 1858 | *Echinolampas hemisphaericus* Agass. – Desor: 307 |
| #? pp | 1869a | *Echinolampas angustistellatus* Laube. – Laube: 183 |
| ? pp | 1870 | *Echinolampas angustistellatus* Lbe. – Laube: 314 |
| ? pp | 1871 | *Echinolampas angustistellatus* Laube. – Laube: 67; pl. 18, fig. 4 |
| *. | 1913a | *Echinolampas sayni* Lambert. – Lambert: 148-149; pl. 11, figs. 3-5 |
| ? v | 1915 | *Echinolampas* cfr. *Sayni* Lamb. – Vadász: 215-216 |
| pp | 1965 | [*Echinolampas*] *hemisphaerica* Lamarck 1816 (*Clypeaster*) – Roman: 283-284 |
| . | 1974 | *Echinolampas hemisphaerica sayni* Lamb. – Roman: 332 |
| . | 1984 | *Echinolampas sayni* Lambert, 1913 – Negretti: 113-114; pl. 8, figs. 2-6 |
| | 1990 | *Echinolampas hemisphaerica* (Lamarck, 1816) – Philippe et al.: 244 |
| pp | 1998 | *Echinolampas hemisphaerica* (Lamarck, 1816) – Philippe: 86-90; pl. 17, fig. 5 |

**Type-material:**

*Echinolampas sayni* Lambert, 1913:
Syntypes: specimens figured by Lambert (1913: pl. 11, figs. 3-5), nos. L 19 670 and 19 671; Lambert collection, Muséum national, Paris, France (Philippe, 1998: 290)
Locus typicus: Cap Couronne, Martigues, France
Age: Burdigalian

? *Echinolampas angustistellatus* Laube, 1869:
Syntypes: specimens housed at the k. k. Hof-Mineraliencabinet (today the Naturhistorisches Museum Wien) and k. k. geol. Reichsanstalt (today the Geological Survey of Austria) according to Laube (1871); see below
Type area: Eggenburg Basin (localities Eggenburg and Gauderndorf) and Horn Basin (Maria Dreieichen, east of Horn), Lower Austria, Molasse zone
Age: Eggenburgian (Early Burdigalian)
Remarks: The overwhelming part of Laube's types and reference material was not marked as such in the collections. Only in few cases new labels were attached to the specimens in the collections. Hence tracing of this material is difficult in most cases. Only a single specimen (NHMW 1866.XX.16) in the NHMW and GBA collections labelled *E. angustistellatus* could be located. Whether or not the hand-writing on the label is that of Laube could not be ascertained as no sample of Laube's hand-writing (e.g. letters,...) was available for comparison [neither at the archive of the Geological Survey of Austria (Tillfried Cernajsek, pers. comm. April 2003), nor at the archives of the Naturhistorisches Museum Wien (Christa Riedl-Dorn, pers. comm. April 2003)]. The potential syntype (NHMW 1866.XX.16) is a moderately well preserved specimen of *E. schultzi*. A second specimen (NHMW 1850.IX.83) attributed here to *E. sayni*, could be a potential syntype of *E. angustistellatus*. Although the latter is not accompanied by a label with the name *E. angustistellatus* it is the only specimen in the NHMW and GBA collections that has a large similarity to Laube's figure of the aboral surface of *E. angustistellatus* [similarities include: the shape of the petals, the outline, the missing apical disc, the crushing of the test in interambulacra 1 and 2 and ambulacrum II, as well as two round penetrations of the test [cassid predation ?] in poriferous zone Vb and along the central suture of aboral interambulacrum 5 [in Laube's figure they are located in different areas, but their relation to each other is identical; a similar mistake happened in his figure of *S. leithanus*: the two strongly visible arched sutures in interambulacrum 1 of the type were drawn in both interambulacrum 1 and 5 in Laube's figure]; all specimens in Laube, 1871 are mirror images, as can be seen by comparison of the type material of *Spatangus austriacus* (Pl. 75, Fig. 2a) and *Schizaster leithanus* (Pl. 66, Fig. 1a) with Laube's figures (pl. 19, fig. 1a, and pl. 18, fig. 7 respectively)]. Why Laube's figure of *E. angustistellatus* does not show a periproct but a tuberculated area instead, is dubious. Considering the problems associated with identifying the type material of *E. angustistellatus* and the fact that the two potential syntypes belong to different species *E. angustistellatus* is here considered as *nomen dubium*.

**Material:**

Early Eggenburgian (Early Burdigalian) – Maria Dreieichen, NÖ, Austria
GBA: 1 specimen, tentatively referred to *E. sayni* (GBA 2004/1/27)
Late Eggenburgian (Early Burdigalian) – Eggenburg, NÖ, Austria
GBA: 2 specimens (GBA 2004/1/21, 2004/1/25), and 1 specimen, tentatively referred to *E. sayni* (GBA 2004/1/29)
Late Eggenburgian (Early Burdigalian) – Gauderndorf (Zogelsdorf Fm.), near Eggenburg, NÖ, Austria
NHMW: 2 specimens [NMHW 1850.IX.83 (potential syntype and figured specimen of *Echinolampas angustistellatus* Laube, 1869); 1866.XI.57]
GBA: 1 specimen, tentatively referred to *E. sayni* (GBA 2004/1/16)
Late Eggenburgian (Early Burdigalian) – Grübern (Zogelsdorf Fm.), near Maissau, NÖ, Austria
NHMW: 18 specimens (NMHW 1914.VII.20/2-14, 2003z0035/0001-3)

**Dimensions:** see Tab. 10

**Description:**

Size and shape: The test is of medium size, its outline is subcircular to slightly antero-posteriorly elongated. Test width ranges of the studied specimens from 93.9 to 98.9 % of TL with a mean of 96.7 %. The anterior and posterior margins are rounded. The maximum width lies posterior of the apical disc, about 53 to 60 % of TL from the anterior margin. In profile the test is low arched, the maximum height coinciding with the position of the apical disc. Test height ranges from 31.6 to 41.6 % TL, with a mean of 35.7 %. The ambitus is rounded and tumid.
Apical disc: The apical disc lies slightly anterior of the centre, about 38 to 42 % TL from the anterior margin. The apical disc is monobasal with 4 circular gonopores. The madreporite is subpentagonal and crowded with numerous small madreporic

pores. The gonopores lie at the apices of the madreporite. The ocular pores are small and circular in outline.

Ambulacra: Adapically the ambulacra are petaloid, moderately broad, straight and slightly closing distally. The frontal petal extends about 64 to 70 (mean 66.7) % of the corresponding test radius, the anterior paired petals about 69 to 89 (mean 80.7) % and the posterior paired petals about 67 to 82 (mean 75.7) %. The poriferous zones within the anterior paired petals are not of equal length. The anterior poriferous zones (IIb and IVa) are shorter than the posterior ones (IIa and IVb) extending only 63 to 78 (mean 70.8) % of the length of the petal. In the frontal petal, the right-handed poriferous zone is slightly longer than the left-handed. The poriferous are slightly arched, resulting in a slightly lanceolate shape of the petals. The ambulacral pores in the petals are conjugated anisopores, which are strongly conjugated and slightly oblique. The interporiferous zones within the petals are inflated and up to four times as wide as a single poriferous zone. The poriferous zones are distinctly depressed.

Adorally the ambulacra form moderately depressed phyllodes consisting of four series of unipores in each ambulacrum. Two adradial series consisting of large closely spaced unipores and two perradial series consisting of smaller, slightly vertically elongated unipores, which are more widely spaced. The two buccal pores are of similar size as the pores from the adradial series, but distinctly elongated vertically. In the adoral third of the phyllodes there is a double row of shallow pits running along the central suture (interpreted as sphaeridial pits).

Interambulacra: Adapically the interambulacra are slightly inflated between the petals. On the aboral surface they are covered with small, crenulate, perforate tubercles which are deeply sunken and closely spaced. On the oral surface the tubercles are distinctly larger. From the margin towards the peristome the tubercles are increasingly widely spaced, with distances of up to the diameter of the areole between the tubercles in the area immediately around the peristome. Adorally the interambulacra are only slightly inflated and form indistinct bourrelets. In some of the specimens, usually in those with lower tubercle densities, a narrow, not very prominent "naked zone" can be found medially in interambulacrum 5 (about halfway between peristome and periproct).

Peristome: The peristome lies slightly anterior of the centre, about 42 to 46 % TL from the anterior margin. It lies in a shallow depression. It is oval, transversely elongated and measures 14 to 17 % test width.

Periproct: The periproct is situated inframarginally in interambulacrum 5 and lies fully on the oral surface. It is oval (transversely elongated) and measures 17 to 19 % test width.

**Differential diagnosis** (see Figs. 43, 45-48)**:**

As outlined above, *E. sayni*, is characterised by its rounded, oval and only weakly rostrate outline, low test height, very weakly developed bourrelets, large peristome (~15 to 17 % of TW) and periproct (~17 to 19 % of TW), the latter of which lies very close to the edge or at of the posterior margin, moderate tubercle densities in the aboral interporiferous zones (usually between 256-288 tubs./cm²) and moderately high number of tubercles across the interporiferous zone in the posterior petals (usually 7 to 8).

For the difference to *E. schultzi* see below under that species.

*E.* sp. 1, from the Badenian (Langhian-Early Serravallian), differs from *E. sayni* by its more elongated distinctly oval outline, much higher profile, flatter oral surface, smaller periproct and peristome, and higher tubercle densities.

*E. hemisphaerica* from the Late Badenian (Early Serravallian) differs from *E. sayni* by its more elongated, subpentagonal outline, more globose profile and larger test height.

*E. barcinensis* from the Late Badenian (Early Serravallian) differs from *E. sayni* by its subpentagonal and more rostrate outline, more pentagonal peristome, lower test height, usually smaller periproct and peristome and position of the periproct which lies higher on the ambitus.

*E. manzonii* and *E.* aff. *manzonii*, both from the Early Badenian (Langhian) differ from *E. sayni* by their very unequal poriferous zones in the paired petals (among other features, but this is the most easily recognised).

*E. richardi* from the Burdigalian of the Aquitaine Basin differs by its slightly more subpentagonal outline, shorter petals, less depressed and narrower poriferous zones, and less concave oral surface.

**Discussion:**

This species is similar to the contemporaneous/co-occurring *E. schultzi* but is well differentiated by the features outlined under the latter species. There are a few specimens of *E. schultzi*, which are also more or less subcircular in outline, but these specimens, do retain a bluntly pointed (rostrate) posterior end, whereas specimens of this *E. sayni* usually have a rounded posterior end. Additionally, these specimens can easily be distinguished from *E. sayni* by their stronger inflated bourrelets, smaller periproct, which is also farther from the posterior margin and higher tuberculation densities.

The Austrian material is attributed to the species *E. sayni* Lambert, 1913 from the Burdigalian of the southern Rhône Basin. This species was placed into the synonymy of *E. hemisphaerica* by Roman (1958: 257; 1965: 283-284), Philippe et al. (1990: 244) and Philippe (1998: 89). An opinion, with which the present author disagrees: *E. sayni* can be well distinguished from *E. hemisphaerica* by its more rounded, not rostrate outline, lesser test height, more strongly sunken poriferous zones and smaller petals (compare Figs. 43, 46.A). Roman (1974: 335) and Negretti (1984: 113-114) considered it as subspecies of *E. hemisphaerica*.

In this species, contrary to the other species of *Echinolampas* described in the present paper, a naked, granular zone may be developed along the central suture of adoral interambulacrum 5. This feature is not present in all specimens of E. sayni and varies continuously from being absent to being small, but well visible. It is thus not possible to separate two groups on base of this feature.

The description of *E. angustistellatus* given by Laube (1871) reveals many similarities to *E. sayni* and it is likely that part of the material attributed to *E. angustistellatus* by Laube, 1871 belongs to this species. For the status of *E. angustistellatus* see above under "Type-material".

Two specimens from the Transylvanian Basin [Săndulesti (= Szind), Romania] were tentatively placed into this species by Vadász (1915: 215-216). These specimens (MAFI Ech 304) are indeed similar to the French and Austrian material of *E. sayni*. Unfortunately the stratigraphic age of the locality is unclear, although Vadász (1915: 216) considers it to belong to the so-called "Obermediterran", which in most cases translates into Badenian (Langhian-Early Serravallian) today. The present author found no evidence supporting or rejecting this dating.

**Occurrence:**

Austria: Early to Late Eggenburgian (Early Burdigalian)

Molasse Zone: Eggenburg, NÖ ([GBA]); Gauderndorf (Zogelsdorf Fm.), near Eggenburg, NÖ (pp Laube, 1869a, 1870, 1871; [NHMW]); Grübern (Zogelsdorf Fm.), near Maissau, NÖ ([NHMW]); Maria Dreieichen, NÖ ([GBA])

Paratethys (non-Austrian occurrences):

Transylvanian Basin: ? Săndulesti (= Szind), Romania [Vadász, 1915 (specimens poorly preserved, stratigraphy unclear)]

Mediterranean: Burdigalian

Rhône Basin: Littoral de la Nerthe [Beaumaderie (Negretti, 1984; Philippe, 1998); Cap Couronne (pp Agassiz & Desor,

1847a; pp Desor, 1858; Wright, 1864; Laube, 1871; Manzoni, 1873; Gregory, 1891; Lambert, 1913a; Roman, 1974; Negretti, 1984; Philippe et al., 1990; pp Philippe, 1998); Verdon (pp Philippe, 1998)], southern France

### *Echinolampas schultzi* Kroh, *nomen novum*

(pro *E. laurillardi acuminata* Schaffer, 1912, preoccupied by *E. acuminata* Abich, 1882)
(= *E. laurillardi* sensu Laube, 1871, non Agassiz in Agassiz & Desor, 1847)

(Fig. 43.5, 51; Pl. 54, Figs. 2-3; Pl. 55, Figs. 1-3; Pl. 56, Figs. 1-2)

| | | |
|---|---|---|
| | 1850 | *Clypeaster Linkii* – Hörnes: 668 |
| | 1866a | *Echinolampas Linkii* – Suess: 94, 95, 99, 101, 103, 112-114, 139 |
| | 1868 | *Echinolampas Kleinii* – Fuchs: 586, 588, 596 |
| | 1869a | *Echinolampas Laurillardi* Ag. – Laube: 183 |
| # ? pp | 1869a | *Echinolampas angustistellatus* Laube. – Laube: 183 |
| | 1870 | *Echinolampas Laurillardi* Agassiz. – Laube: 314 |
| | 1870 | *Echinolampas angustistellatus* Lbe. – Laube: 314 |
| | 1871 | *Echinolampas Laurillardi* Agassiz. – Laube: 66-67; pl. 18, fig. 1 |
| ? pp | 1871 | *Echinolampas angustistellatus* Laube. – Laube: 67; pl. 18, fig. 4 |
| pp | 1873 | *Echinolampas Laurillardi*, Agass – Manzoni: 10-11, 19 |
| | 1875a | *Echinolampas Linkii* – R. Hoernes: 342 |
| | 1891 | *Echinolampas Laurillardi* Agass. (non *Linkii*) – Suess: 409 |
| ? | 1891 | *Echinolampas* sp. aff. *Laurillardi* – Suess: 413, 415 |
| | 1898 | *Echinolampas Laurillardi* Ag. – Abel: 212, 215, 216 |
| non | 1899 | *Echinolampas Laurillardii*, Agas. (non Laube). – Airaghi: 161-162; pl. 6 (1), figs. 7a-b, 8a-b, 9a-b |
| | 1900 | *Echinolampas Laurillardi* – Fuchs: 861 |
| ? | 1900 | *Echinolampas* – Fuchs: 873-874 |
| | 1903 | *Echinolampas Laurillardii* – Hoernes: 931 |
| ? | 1904 | *Echinolampas* cfr. *Laurillardi* – Abel: 20 |
| | 1904 | *Echinolampas Laurillardi* – Abel: 24 |
| | 1912a | *Echinolampas Laurillardi* Ag. – Schaffer: 189; text-fig. 2; pl. 60, fig 4, 6 |
| # | 1912a | *Echinolampas Laurillardi* Ag. var. *acuminata* Schff. – Schaffer: 190; pl. 60, fig. 5 |
| ? | 1913a | *Echinolampas* – Schaffer: 6, 67, 73-74, 82 |
| | 1913a | *Echinolampas Laurillardi* Ag.– Schaffer: 9, 17, 36, 47, 56; 155-157; pl. 10, fig. 9 |
| | 1924b | *Echinolampas Laurillardi* – Schaffer: 484 |
| | 1927a | *Echinolampas Laurillardi*. – Schaffer: 56 |
| non | 1938 | *Echinolampas laurillardi* Agassiz 1843 – Poljak: 195; pl. 10, fig. 1 [not conspecific with *E. schultzi*; probably misidentified *E. hemisphaerica*, although the subcircular outline and the long poriferous zones are unusual] |
| non | 1939 | *Echinolampas laurillardi* Agassiz – Taviani: 38; pl. 2 (4), figs. 14a-b [misidentified *E. barcinensis*] |
| | 1943 | *Echinolampas laurillardi* Ag. – Schaffer: 521, 523, 525, 527 |
| non | 1950 | *Echinolampas laurillardi* Ag. Des. 1847 – Szörényi: 145; pl. 1, fig. 7 (the specimen on which this record is based is very poorly preserved, it might belong to *E. barcinensis* or *E. hemisphaerica*, but this cannot be decided without re-examination; based on the photograph of the aboral surface an attribution to *E. schultzi* can be excluded) |
| | 1951 | *Echinolampas laurillardi* Ag. – Schaffer & Grill: 709, 711, 712, 714 |
| | 1955 | *Echinolampas* sp. – Bernhauser: 182 |
| | 1955 | *Echinolampas laurillardi* – Thenius: 108-109; pl. 12, fig. 10 |
| | 1957 | *Echinolampas laurillardi* Ag. – Tollmann: 173 |
| | 1962 | *Echinolampas laurilardi* – Papp & Thenius in Kühn: 118 |
| | 1962a | *Echinolampas laurillardi* Agassiz – Thenius: 18; pl. 5, fig. 10 |
| | 1962b | *Echinolampas laurillardi* – Thenius: 106-107; pl. 7, fig. 10 |
| pp | 1965 | [*Echinolampas*] *richardi* Desmarest in Brongniart 1829 (*Clypeaster*) – Roman: 297 |
| | 1974 | *Echinolampas laurillardi* Agassiz – Thenius: 46-47; fig. 1/21 |
| | 1971a | *Echinolampas laurillardi* Agassiz, 1847 – Steininger: 595; pl.3, fig. 3-4 |
| | 1971b | *Echinolampas laurillardi* Agassiz – Steininger: 119 |
| | 1971c | *Echinolampas laurillardi* Agassiz – Steininger: 129 |
| | 1975 | *Echinolampas* (*Echinolampas richardi*) Desmarest in Brongniart, 1829. – Kalabis: 175 |
| | 1979 | *Echinolampas laurillardi* – Thenius: 50; pl. 2, fig. 21 |
| | 1983 | *Echinolampas laurillardi* – Thenius: 118; pl. 6, fig. 21 |
| non | 1997 | *Echinolampas laurillardi* Agassiz – Majcen et al.: 106; pl. 5, fig. 1 |
| v. | 1997 | *Echinolampas* sp. – Nebelsick et al.: 272-274; figs. 2-3 |
| v. | 1999 | *Echinolampas laurillardi* – Harzhauser & Kroh: 221 |
| v. | 1999 | *Echinolampas laurillardi* Agassiz & Desor, 1847 – Kroh & Harzhauser: 158-159; pl. 2, figs. 1-3 |
| v. | 2002 | *Echinolampas laurillardi* – Lukeneder & Harzhauser: 462 |

**Type-material:**
*Echinolampas laurillardi acuminata* Schaffer, 1912:
Holotype: figured by Schaffer (1912a: pl. 60, fig. 5); the specimen could not be located at the Krahuletz Museum (Eggenburg, NÖ) where it was housed according to Schaffer (1912a: 190) and is considered to be lost
Locus typicus: Eggenburg (Kremserberg), NÖ
Stratum typicum: Zogelsdorf Fm.
Age: Late Eggenburgian (Early Burdigalian)

*Echinolampas schultzi* Kroh, *nomen novum*:
Neotype: specimen NMHW 2003z0040/0001 from the train station in Eggenburg; housed at the Naturhistorisches Museum Wien, Geologische Abteilung
Dervatio nominis: In honour of my colleague Ortwin Schultz (Geologische Abteilung at the Naturhistorisches Museum Wien). Without his continuous support and willingness to discuss all the numerous nomenclatorial problems that arose during the preparation of the present volume of the Catalogus Fossilium Austriae this work would not be the same.
Remarks: As the holotype of Schaffer (1912a) is lost, a neotype is selected. The historical locality Eggenburg (Kremserberg) is not longer exposed. It consisted of outcrops of the Zogelsdorf Fm. along the road from the centre to the train station and in immediate the vicinity of the latter (F.F. Steininger, *in litt.*, Sept. 2004; for a section of Zogelsdorf Fm. outcrops exposed during excavations in the 1980ies see Nebelsick, 1989). Therefore the specimen collected at the train station Eggenburg (NMHW 2003z0040/0001) can be considered as topotype and is available for neotype-selection.

? *Echinolampas angustistellatus* Laube, 1869:
Syntypes: specimens housed at the k. k. Hof-Mineraliencabinet (today the Naturhistorisches Museum Wien) and k. k. geol.

Reichsanstalt (today the Geological Survey of Austria) according to Laube (1871); see below
Type area: Eggenburg Basin (localities Eggenburg and Gauderndorf) and Horn Basin (Maria Dreieichen, east of Horn), Lower Austria, Molasse zone
Type area: Eggenburg and Horn Basin, Molasse Zone; Eggenburgian (Early Burdigalian)
Remarks: *E. angustistellatus* is here considered as *nomen dubium* because the type-material could not be unequivocally be identified and potential syntypes belong to two different species (see above under *E. sayni*).

**Material:**
Early Eggenburgian (Early Burdigalian) – Horn, NÖ, Austria
NHMW: 1 specimen (NMHW 2002z0181/0018)
Early Eggenburgian (Early Burdigalian) – Maria Dreieichen, near Horn, NÖ, Austria
NHMW: 4 specimens (NMHW 1849.XIII.39, 1860.L.206, 2003z0037/0001-2)
Late Eggenburgian (Early Burdigalian) – Eggenburg, NÖ, Austria
NHMW: 6 specimens (NMHW 1904.VIII.24, 1972/1551/121, 1997z0178/0466, 2002z0181/0019)
Late Eggenburgian (Early Burdigalian) – Eggenburg (Schindergraben), NÖ, Austria
NHMW: 1 specimen (NMHW 2003z0038/0002)
Late Eggenburgian (Early Burdigalian) – Eggenburg (Zogelsdorf Fm., train station), NÖ, Austria
NHMW: 1 specimen [NMHW 2003z0040/0001 (**neotype**)]
Late Eggenburgian (Early Burdigalian) – Gauderndorf (Zogelsdorf Fm.), near Eggenburg (often referred to as Gauderndorf-Himmelreich), NÖ, Austria
NHMW: 32 specimens (NMHW 1851.VI.65, 1852.XII.7 [A605], 1860.L.445, 1860.L.446, 1860.L.449, 1860.L.744, 1861.L.295, 1866.XX.14, 1866.XX.15, 1866.XX.16, 1866.XX.17, 1869.III, 1869.III.38, 1869.III.39, 1869.III.40, 1869.III.41, 1934.I.168, 592/1964, 1973/1615/355, 1997z0178/0511, 1998z0048/0006, 2002z0181/0021, 2003z0036/0001, 2003z0036/0002-8)
GBA: 25 specimens [GBA 2004/1/15, 2004/1/17-18, 2004/1/20, 2004/1/22-24, 2004/1/26, 2004/1/28, 2004/1/30-44, 2004/43 (figured specimen of Nebelsick et al., 1997: figs. 2a-b, 3c)]
IPUW: 1 specimen (IPUW 1992/209)
Late Eggenburgian (Early Burdigalian) – Grübern (Zogelsdorf Fm.), near Maissau, NÖ, Austria
NHMW: 5 specimens (NMHW1914.VII.20/1, 1914.VII.21)
Late Eggenburgian (Early Burdigalian) – Limberg (Zogelsdorf Fm., Hengl quarry), NÖ, Austria
NHMW: 1 specimen (NMHW 1998z0048/0049)
Late Eggenburgian (Early Burdigalian) – Unternalb (Retz Fm., Hungerfeld), NÖ, Austria
NHMW: 1 specimen (NMHW 1999z0049/0002)

**Dimensions:** see Tab. 10

**Description:**
Size and shape: The test is large, subpentagonal in outline and is slightly elongated antero-posteriorly. The anterior margin is rounded, the posterior margin bluntly pointed. The maximum width lies posterior of the apical disc, about 62 to 66 % of TL from the anterior margin. In profile the test is domed, the maximum height coinciding with the position of the apical disc. The ambitus is rounded and tumid. The test width is about 89.3 to 97.7 % of TL (mean 93.2 %), the height about 39.8 to 49.8 % (mean 44.2 %).
Apical disc: The apical disc lies slightly anterior of the centre, about 42 to 44 % TL from the anterior margin. The apical disc is monobasal with 4 circular gonopores. The madreporite is pentagonal and crowded with numerous small madreporic pores. The gonopores lie at the apices of the madreporite. The ocular plates are small, bearing a small, circular ocular pore each.

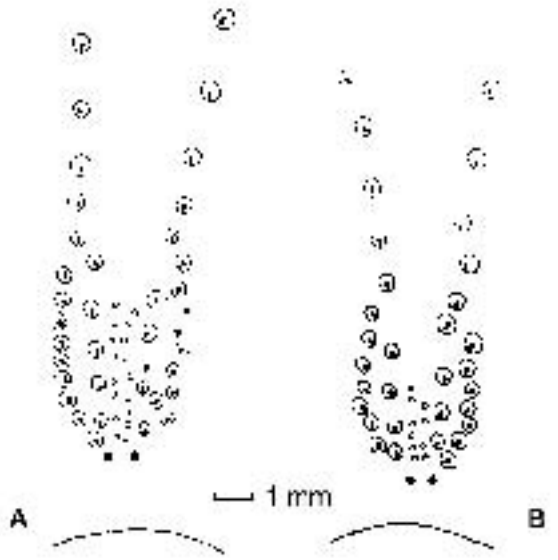

Figure 51: Phyllodes I (A) and III (B) of *Echinolampas schultzi* Kroh, nov. nom. (Gauderndorf, NÖ; NHMW A606).

Ambulacra: Adapically the ambulacra are petaloid, moderately broad, straight and moderately closed distally. The frontal petal extends about 60 to 70 (mean 66) % of the corresponding test radius, the anterior paired petals about 70 to 87 (mean 79) % and the posterior paired petals about 71 to 80 (mean 76) %. In contrast to the frontal and posterior paired petals, the poriferous zones within the anterior paired petals are not of equal length. The anterior poriferous zones (IIb and IVa) are shorter than the posterior ones (IIa and IVb) extending only 66 to 80 (mean 75) % of the length of the petal. Poriferous zones Ib, IIa, IVb and Va are distinctly arched, whereas the other poriferous zones are more or the less straight. The ambulacral pores in the petals are conjugated anisopores, which are strongly conjugated and slightly oblique. The interporiferous zones within the petals are inflated and up to five times as wide as a single poriferous zone. The poriferous zones are distinctly depressed. Adorally the ambulacra form moderately depressed phyllodes. They consist of four series of unipores in each ambulacrum. Two adradial series consisting of large, closely spaced unipores with rather large attachment area and two perradial series consisting of smaller, slightly vertically elongated unipores, which are more widely spaced. The two buccal pores are of similar size as the pores from the adradial series, but distinctly elongated vertically. In the adoral third of the phyllodes there is a double row of shallow pits (sphaeridial pits) running along the central suture.
Interambulacra: Adapically the interambulacra are slightly inflated between the petals. They are covered with small, crenulate, perforate tubercles which are deeply sunken and closely spaced. The areoles are inclined towards the margin of the test. The tubercle density in the aboral interambulacra ranges from 200 to 300 tubercles/cm², being highest near the apical system and decreasing gradually towards the margin, where the tubercles are larger. On the oral surface the tubercles are slightly larger and their density ranges from 110 to 210/cm²; the highest densities on the oral side are found near the margin. The tubercles are closely spaced, with the areoles nearly "touching" each other. On the oral side the interambulacra are slightly inflated and form well developed bourrelets adorally. There is no "naked zone" along the central suture between peristome and periproct in interambulacrum 5, as reported in other species of *Echinolampas*.
Peristome: The peristome lies slightly anterior of the centre, about 42-44 % TL from the anterior margin. It lies in a shallow

depression. It is subpentagonal and transversely elongated. It is nearly of the same size as the periproct, being 11 to 14 % of the test width wide. In subadult specimens it can be up to 19 % test width.

Periproct: The periproct lies near the posterior margin in interambulacrum 5, fully on the oral surface and not visible in posterior view. It is usually between 2 and 3 mm from the posterior margin, which is more than in all other species of *Echinolampas* considered here. The periproct is about 12 to 15 % test width wide, except in subadult specimens it can be up to 19 %. The shape of the periproct is oval, transversely elongated and it is slightly rostrate.

**Emended diagnosis:**
As outlined above, *E. schultzi* is characterised by its subpentagonal, rostrate outline, strongly developed bourrelets, small peristome (~11 to 14 % of TW) and periproct (~12 to 15 % of TW), the latter of which lies fully on the oral surface, high tubercle densities, especially in the aboral ambulacra (usually exceeding 300 tubs./cm²) and large number of tubercles across the interporiferous zone in the posterior petals (8-16 in adult specimens).

**Differential diagnosis** (see Figs. 43, 45-48)**:**
*E. sayni*, a co-occurring species, differs from *E. schultzi* by its more rounded, oval and only weakly rostrate outline, lower test height, very weakly developed bourrelets, larger peristome (~15 to 17 % of TW) and periproct (~17 to 19 % of TW), the latter of which lies very close to the edge or at of the posterior margin. Tubercle densities in the aboral ambulacra are distinctly lower (usually between 180-260 tubs./cm²) and there are less tubercles across the interporiferous zone in the posterior petals (usually 5 to 8).

*E.* sp. 1, from the Badenian (Langhian-Early Serravallian), differs from *E. schultzi* by its more elongated distinctly oval outline, higher profile and flatter oral surface.

*E. hemisphaerica* from the Late Badenian (Early Serravallian) differs from *E. schultzi* by its more globose profile, less rostrate outline, weakly developed bourrelets, and larger periproct (usually ~ 16% of TW), which lies closer to the edge. Tubercle densities in the aboral interporiferous zones are distinctly lower (usually below 200 tubs./cm²) and there are less tubercles across the interporiferous zone in the posterior petals in specimens of similar size. Additionally the poriferous zone of the paired petals is wider in *E. hemisphaerica* than in *E. schultzi*.

*E. barcinensis* from the Late Badenian (Early Serravallian) differs from *E. schultzi* by its lower profile, lower test height, larger periproct (~16 to 19 % of TW) which lies very close to the edge or at of the posterior margin. Tubercle densities in the aboral interporiferous zones are distinctly lower (usually below 200 tubs./cm²) and there are less tubercles across the interporiferous zone in the posterior petals in specimens of similar size.

*E. manzonii* and *E.* aff. *manzonii*, both from the Early Badenian (Langhian) differ from *E. schultzi* by their very unequal poriferous zones in the paired petals (among other features, but this is the most easily recognised).

**Discussion:**
This species was formerly referred to *Echinolampas laurillardi* by most Austrian authors (e.g. Laube, 1869a, 1871; Schaffer, 1912a). *E. laurillardi* was proposed by Agassiz in Agassiz & Desor (1847a: 165-166), however, for fossil specimens from France recorded under the name *E. richardi* Desmarest in Brongniart, 1829 by des Moulins (1837: 188), of which it is a junior objective synonym. Although des Moulins (1869: 313) states that there are two different species of *Echinolampas* in the Early Miocene of Léognan, and were confused with each other (he considered *E. laurillardi* and *E. richardi* to be different).

Additional confusion was created by the inversion of the specimen numbers of the type specimen of *E. laurillardi* [Agassiz & Desor (1847a: 165) state that "moulage 34" is the holotype; this however, is a mistake corrected by Desor (1858), who gave the correct specimen number (moulage 35); see also Lambert & Jeannet (1928: 120)].

For the extant specimens from Senegal, originally referred to *E. richardi* by des Moulins (1837: 186), des Moulins (1869: 316, pl. 20, figs. 1-3) proposed the name *E. rangii* {more information on this species can be found in Agassiz [1872-74: 114, 552, pl. 15, figs. 5-11, pl. 15a, figs. 5-6 (under the name *E. hellei*)], Mortensen [1948a: 289-292, pl. 5, fig. 7, pl. 11, figs. 16-17] and Mooi [1990a: 79]; a synonymy is given by Lambert [1927b: 116-117]; contrary to the statement of Cotteau [1876: 196] *E. hellei* does not have priority over *E. rangii*, as it is a *nomen nudum* [see Lambert, 1927b: 116 (footnote)]}.

Roman (1965: 297) synonymised *E. laurillardi* Agassiz in Agassiz & Desor, 1847, *E. angustistellatus* Laube, 1869 and *E. laurillardi* var. *acuminata* Schaffer, 1912a with *E. richardi*, without discussion on the reasons or the problems associated with the type material of *E. laurillardi*.

The specimens from Austria are, however, distinctly different from *E. richardi* (= *E. laurillardi*), when compared to two specimens in the collection of the Naturhistorisches Museum Wien (NHMW 1914.VI.348a-b), from the type locality Léognan in the Aquitaine Basin in Western France. *E. richardi* has shorter petals, which extend only ~ 50 % (frontal petal) respectively 66 % (paired petals) of the corresponding test radius, while these of the Austrian specimens extend 66% (frontal petal) respectively 75-85 % (paired petals). Moreover, there are less tubercles across the interporiferous zones in *E. richardi*, the bourrelets are only weakly inflated, the poriferous zones only slightly sunken and the test is also less rostrate. This has already been observed by Lambert (1913a: 148), who stated that the material reported as *E. laurillardi* by Laube had nothing to do with *E. laurillardi* Agassiz. This, however, was largely ignored by subsequent workers. A synonymy and morphometric data of *E. richardi* can be found in Chavanon (1974: 192-193; pl. 13, figs. 5a-b).

The next available name is that of Schaffer (1912a), who established the subspecies *Echinolampas laurillardi acuminata* Schaffer, 1912 for material from the Eggenburgian of Austria (the reasons for excluding *E. angustistellatus* are given below). This subspecies can, however, not be simply elevated to species rank since the name is preoccupied by *Echinolampas acuminata* Abich, 1882. Therefore it is necessary to establish a *nomen novum* (*E. schultzi*).

*E. angustistellatus* Laube, 1869 might belong in the synonymy of this species, but this is unclear. The type material of *E. angustistellatus* could not be definitely traced in the collections of the Naturhistorisches Museum Wien and the Geological Survey of Austria. Two potential syntypes belong to two different species (*E. sayni* and *E. schultzi*). Hence, *E. angustistellatus* is considered a *nomen dubium* (see above under "Type-material" and under *E. sayni*).

Occurrences in the Badenian of the Vienna Basin and the Oberpullendorf Bay (Ritzing, Bgld) reported by Laube (1869a, 1871) and Manzoni (1873) could not be verified. Most probably these records refer to misidentified *E. hemisphaerica*. Likewise, records from the Badenian of other areas of the Central Paratethys (Poljak, 1938; Szörényi, 1950; Majcen et al., 1997) are misidentifications.

**Palaeoecology:**
Predation scars are common; they consist of irregular holes in the test, which are tentatively attributed to predation by cassids. These gastropods drill holes in the calcareous shell of their prey using acid and neurotoxin glands in their proboscis to weaken the shell and paralyse the spines/pedicilaria and finally enlarge the hole using their radula (Hughes & Hughes, 1971; Linder, 1990; Kowalewski & Nebelsick, 2003 and references therein). One gastropod may drill several holes into the test of their prey in order to reach all parts of the intestines, especially

in sand dollars, where the interior of the test is divided by pillars.

This species is common in mobile coarse sandy sediments in high water energy environments (e.g. the Bryozoan-balanid-sands of Retz and Gauderndorf).

**Occurrence:**

Austria: ? Egerian (Chattian-Aquitanian), Early to Late Eggenburgian (Early Burdigalian)

Molasse Zone: Bayersdorf, NÖ (Suess, 1866a); Eggenburg, NÖ (pp Laube, 1869a, 1871; Suess, 1891; Fuchs, 1900; Hoernes, 1903; Schaffer, 1943; Schaffer & Grill, 1951; Thenius, 1955; Papp & Thenius in Kühn, 1962; Thenius, 1962a, b, 1974, 1979, 1983; [NHMW]); Eggenburg (Bahnhof), NÖ (Abel, 1898; ? Schaffer, 1913a; [NHMW]); Eggenburg (Bauerhanslgrube), NÖ (Schaffer, 1912a); Eggenburg (Brunnstube), NÖ (Suess, 1866a; Hoernes, 1875a; Abel, 1898; Schaffer, 1912a; Schaffer, 1943; Schaffer & Grill, 1951; Steininger, 1971a, c); ? Eggenburg (Florianibründl), NÖ (Schaffer, 1913a); Eggenburg (Kalvarienberg), NÖ (Suess, 1866a); Eggenburg (Kremserberg), NÖ (Schaffer, 1912a, 1913a; Kroh & Harzhauser, 1999); Eggenburg (Schindergraben), NÖ (Schaffer, 1912a; [NHMW]); Gauderndorf (Zogelsdorf Fm.), NÖ (Hörnes, 1850; Suess, 1866a; Fuchs, 1868; pp Laube, 1869a, 1871; pp Manzoni, 1873; Fuchs, 1900; Abel, 1904; Schaffer, 1912a; Tollmann, 1957; Nebelsick et al., 1997; Schultz, 1998; Kroh & Harzhauser, 1999; [NHMW]); Gauderndorf (Himmelreich, Zogelsdorf Fm.), NÖ (Fuchs, 1868; [NHMW]); Gauderndorf (Kattauer Straße), NÖ (Schaffer, 1913a, 1943; Schaffer & Grill, 1951); Grübern (Zogelsdorf Fm.), NÖ (Suess, 1891; Kroh & Harzhauser, 1999; [NHMW]); Klein-Meiseldorf , NÖ (Schaffer, 1912a, 1913a); Kühnring, NÖ (Abel, 1898); Maissau, NÖ (Hoernes, 1875a; Schaffer, 1912a); Limberg (Zogelsdorf Fm., Hengl quarry), NÖ ([NHMW]); Maria Dreieichen, NÖ (Suess, 1866a; pp Laube, 1869a, 1871; Schaffer, 1912a; Schaffer, 1943); Maria Dreieichen-Eichberg, NÖ (Steininger, 1971a, b); between Mold and Maria Dreieichen, NÖ (Schaffer, 1913a); ? Plesching, Upper Austria (Suess, 1891); ? Plesching-Pfennigberg, Upper Austria (Abel, 1904); ? Roßberg near Ober-Dürnbach, NÖ (Schaffer, 1913a); Unternalb (Hungerfeld, Retz Fm.), NÖ (Bernhauser, 1955; Harzhauser & Kroh, 1999; Kroh & Harzhauser, 1999; Lukeneder & Harzhauser, 2002; [NHMW]); Zogelsdorf, NÖ (Hoernes, 1875a; Schaffer, 1912a; ? Schaffer, 1913a; Kroh & Harzhauser, 1999); "bassin de Vienne, bassin extra-alpin" (= earlier name for the Molasse Zone) (Roman, 1965); Außeralpines Wiener Becken (= earlier name for the Molasse Zone) (Schaffer, 1924b, 1927a)

Paratethys (non-Austrian occurrences): not reported (records of Poljak, 1938, Szörényi, 1950, and Majcen et al., 1997 are erroneous)

Mediterranean: not recorded

## *Echinolampas* sp. 1

(Pl. 56, Figs. 3a-b)

**Material:**

Badenian (Langhian-Early Serravallian) – Baden, NÖ, Austria
NHMW: 1 specimen (NHMW 2003z0034/0001)
GBA: 1 specimen (no inventory number)

**Dimensions:** see Tab. 10

**Description:**

Size and shape: The test is large with distinctly oval, antero-posteriorly elongated outline. The anterior margin is rounded, the posterior margin bluntly pointed. The maximum width lies far posterior of the apical disc, about 66 % of TL from the anterior margin. In profile the test is highly arched, the maximum height coinciding with the position of the apical disc. The ambitus lies low and is rounded and tumid. The oral side is conspicuously flattened and only very slightly sunken around the peristome.

Apical disc: The apical disc lies slightly anterior of the centre, about 45 % TL from the anterior margin. The apical disc is monobasal with 4 large circular gonopores. The madreporite is roughly pentagonal and crowded with numerous small madreporic pores. The gonopores lie at the apices of the madreporite. The ocular pores are minute.

Ambulacra: The ambulacra are petaloid adapically with strongly sunken poriferous zones. The frontal petal extends about 70 % of the corresponding test radius, the paired petals about 76 %. In the frontal and posterior paired petals the length of the poriferous zones is subequal, whereas in the anterior paired petals it is not. The anterior poriferous zones (IIb and IVa) are shorter than the posterior ones (IIa and IVb) extending about 83 % of the length of the petal. The ambulacral pores in the petals are conjugated anisopores, which are strongly conjugated and slightly oblique. The interporiferous zones within the petals are distinctly inflated and up to three times as wide as a single poriferous zone.

Adorally the ambulacra form depressed phyllodes consisting of four series of unipores in each ambulacrum. Two adradial series with larger, more closely spaced unipores and two perradial series consisting of smaller, more widely spaced unipores. In each phyllodes two buccal of about the same size as the pores from the adradial series are present. In the adoral third of the phyllodes there is a double row of shallow sphaeridial pits running along the central suture.

Interambulacra: Adapically the interambulacra are inflated between the petals. The aboral tuberculation consists of rather small, crenulate, perforate tubercles which are closely spaced. On the oral surface the tubercles are only slightly larger and a little bit less closely spaced. No "naked zone" along the central suture between peristome and periproct in interambulacrum 5 is observed. Well developed bourrelets are present in all interambulacra.

Peristome: The peristome lies slightly anterior of the centre, about 43 % TL from the anterior margin. It is rather small (7.2 mm wide in a 81.3 mm TL specimen) and has a subpentagonal outline.

Periproct: The periproct is situated inframarginally in interambulacrum 5. It has an oval, transversely elongated outline and is moderately large, being 9.1 mm wide in a 81.3 mm TL specimen.

**Differential diagnosis:**

As outlined above, *E.* sp. 1, is characterised by its distinctly oval, antero-posteriorly elongated outline, high profile and flattened oral surface. These features distinguish it from all other species discussed here (for more details see under the respective species).

**Discussion:**

Unfortunately, only two specimens of this species were available for study. Both are from historical collections (one from the NHMW and one from the GBA) and date back to the 19th century. The labels state Baden as locality in both specimens, the exact outcrops, where they came from, could, however, not be located. The matrix inside the test is greyish to light brown, well cemented, marly sand; similar lithologies were exposed in historical outcrops around the city of Baden. Since no contradicting evidence was found, the statement on the labels is accepted as valid. No similar species has been reported from the Miocene of the Central Paratethys until now and the present material could not be related to any species known to the author. Hence, until more material with better documented collection data is available, the species is left in open nomenclature.

**Occurrence:**

Austria: Badenian (Langhian-Early Serravallian)
Vienna Basin: Baden, NÖ ([NHMW])

### *Echinolampas* sp. indet.

(Figs. 52, 53)

1877 *Echinolampas* – Fuchs: 662
1877 *Echinolampas* – Karrer: 258
1899 *Echinolampas* sp. – Roth von Telegd: 98
1903b *Echinolampas* – Fuchs: 8, 12.
1935 *Echinolampas* sp. – Grill: 46-52
1955 *Echinolampas* sp. – Tollmann: Tab. 5b
1958b *Echinolampas* – Sieber: 297
1961 *Echinolampas* – Schaffer: 149
1971d *Echinolampas* – Steininger: 135
1985 *Echinolampas* – Tollmann: 501
pp 1987 *Echinolampas* sp. – Mączyńska: 147, 149; pl. 5, fig. 1
1989 *Echinolampas* sp. – Nebelsick: 15
1991a *Echinolampas* sp. – Nebelsick et al.: 88
1991b *Echinolampas* – Nebelsick et al.: 119
1991 *Echinolampas* sp. – Roetzel et al.: 48

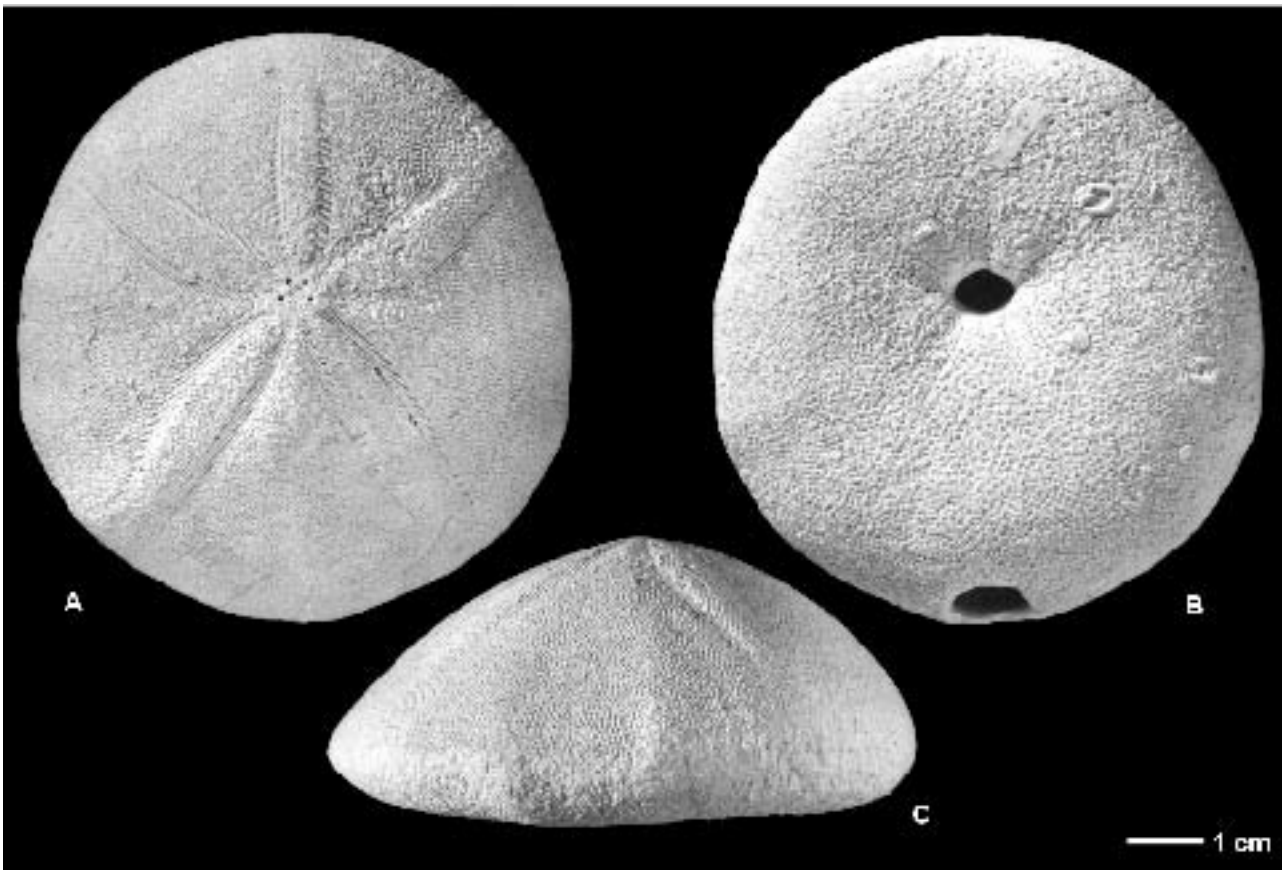


Figure 52: *Echinolampas* sp. indet., ? Gauderndorf, NÖ (AO of Schultz, 1998; NHMW 1869.III.38a); A: aboral, B: oral and C: lateral view (specimen coated with ammonium chloride in all figures).

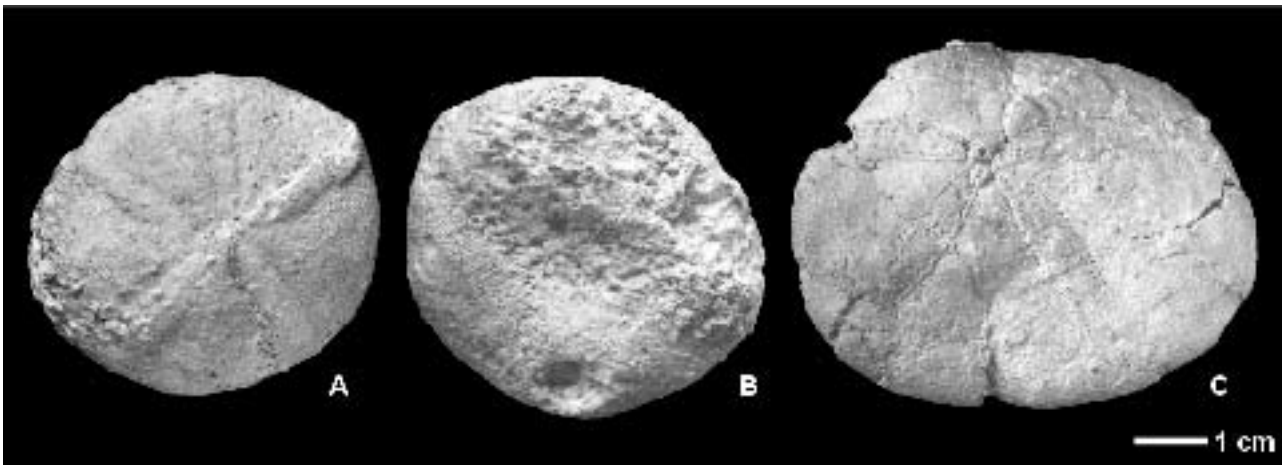


Figure 53: *Echinolampas* sp. indet., Egerian (Chattian – Aquitanian) of Steyregg, OÖ; A: aboral view, and B: oral view of specimen NHMW 2004z0092/0001, C: oral view of specimen NHMW 2004z0092/0002.