

- 1895 *Hipponoë Parkinsoni* (AGASSIZ), COTTEAU. – COTTEAU: 10
- 1910a *Tripneustes Parkinsoni* AGASSIZ, 1846. – LAMBERT: 44-46; pl. 2, figs. 21-24
- 1910a *Tripneustes planus* AGASSIZ (*Echinus*), 1840. – LAMBERT: 46-47; pl. 2, figs. 1
- 1913a *Tripneustes Parkinsoni* AGASSIZ. – COTTREAU: 51, 84-85; pl.1, fig. 17
- 1928 *Tripneustes planus* AGASSIZ (*Echinus*) – LAMBERT & JEANNET: 135, no. X.63
- 1928 *Tripneustes Parkinsoni* AGASSIZ – LAMBERT & JEANNET: 179, no. S.60
- 1931 *Tripneustes Parkinsoni* AGASSIZ. – LAMBERT: 45, 208
- 1973 *Tripneustes parkinsoni* AGASSIZ, 1846 – PHILIPPE: 183-184
- 1974 *Tripneustes parkinsoni* AG. – ROMAN: 332, 333, 334
- 1974 *Tripneustes planus* (AG.) – ROMAN: 334
- 1984 *Tripneustes parkinsoni* AGASSIZ, 1846 – NEGRETTI: 89-90: pl. 1, fig. 6
- 1989 *Tripneustes planus* (AGASSIZ) – PHILIPPE: 28, tab. 1
- 1990 *Tripneustes planus* (AGASSIZ, 1840) – PHILIPPE et al.: 240
- 1998 *Tripneustes planus* (AGASSIZ, 1840) – PHILIPPE: 61-64; pl. 4, figs. 23-24; pl. 5, figs. 1-2 [cum. syn.]

#### Type-material:

*Tripneustes planus* AGASSIZ in AGASSIZ & DESOR, 1846:

Holotype: specimen figured by LAMBERT (1910a: pl. 2, fig. 1); housed at the Ecole nationale supérieure des Mines, Lyon, France (PHILIPPE, 1998: 64).

Locus typicus: Villeneuve, lès-Avignon, Gard, France

Age: Burdigalian, Early Miocene

*Tripneustes parkinsoni* AGASSIZ in AGASSIZ & DESOR, 1846:

Holotype: specimen MGS AI-2 44, figured by DESOR (1858: pl. 18, fig. 9 [contrary to DESOR's figure only a small part of the aboral surface is preserved according to PHILIPPE, 1998: 64]); housed at the Muséum d'Histoire naturelle de Genève (PHILIPPE, 1998: 280)

Locus typicus: Lavalduc, France (PHILIPPE, 1998: 280)

Age: Burdigalian, Early Miocene

#### Material:

Late Eggenburgian (Early Burdigalian) – Limberg (Zogelsdorf Fm., Hengl quarry), NÖ, Austria

NHMW: 36 test fragments (NHMW 2003z0002/0001-5)

Late Eggenburgian (Early Burdigalian) – Roggendorf [Zogelsdorf Fm., Teufelslucke (cave)], NÖ, Austria

NHMW: 1 test fragment (NHMW 2003z0001/0001)

#### Description:

**Size and shape:** The size, thickness and curvature of the studied test fragments indicate a test diameter of up to 70 mm and a depressed profile. The test thickness ranges from 1.0 to 2.8 mm in ambital test fragments.

**Ambulacra:** The ambulacra are trigeminate with pores arranged in three vertical series in each half ambulacrum. The ad- and perradial series are more or less straight; the middle series forms a zigzag pattern. Primary tubercles are found on each third plate. Enlarged secondary tubercles are found perradially of the primary tubercle and between the vertical pore series. The development and distribution of the secondary tubercles is highly variable, depending on the position of the fragment on the test. In subambital test fragments, not every ambulacral plate reaches the perradial suture, approximately every third plate (the ones adorally of these, which bear the primary tubercles) terminates just short of the perradial suture.

**Interambulacra:** The interambulacra bear multiple subequal nonperforate, noncrenulate tubercles on each plate. "Normal" secondary tubercles are sparse. They are found mainly along the adapical and adradial sutures.

#### Differential diagnosis:

According to PHILIPPE (1998: 64) *T. planus* differs from the extant representatives of the genus by its more depressed shape and more numerous, but less well developed tubercles.

For the differences to *T. cf. ventricosus* recorded from the Badenian of the Central Paratethys see below under that species.

#### Discussion:

When PHILIPPE (1998) synonymised *T. planus* and *T. parkinsoni* in his recent revision of the Miocene echinoids of the Rhône Basin, he failed to realise that *planus* AGASSIZ, 1840b is in fact a *nomen nudum* according to ICZN, since it is not accompanied by either description or illustration. The designation of a holotype alone is not enough to establish a valid species (ICZN 4<sup>th</sup> ed., 2000, Article 12.1.). Therefore AGASSIZ in AGASSIZ & DESOR, 1846 is the correct authorship.

The description given above is based on the abraded and fragmentary material preserved in the Austrian collections. An extensive description of this species can be found in PHILIPPE (1998), who described whole coronas with preserved apical disc and partly attached spines from the Burdigalian of the Rhône Basin. He also demonstrated that only a single species was present in the Rhône Basin during the Burdigalian and showed that *T. parkinsoni* AGASSIZ, 1846 and *T. planus* AGASSIZ, 1846 are conspecific. As proposed already by COTTREAU (1913a: 51, 85).

#### Occurrence:

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

Molasse Zone: Limberg (Zogelsdorf Fm., Hengl quarry), NÖ ([NHMW]); Teufelslucke (Zogelsdorf Fm.), near Roggendorf, NÖ ([NHMW])

**Mediterranean:** Burdigalian

Western Mediterranean: **Corisca, France:** Santa-Manza (COTTEAU in LOCARD, 1877); **Morocco:** Melilla, (LAMBERT, 1931); **Sardinia, Italy:** Capo Sant'Elia, near Cagliari (COTTEAU, 1895), Fontanazzo (COTTEAU, 1895)

Eastern Mediterranean: Gebel Geneffé, Egypt (LAMBERT, 1932)

Rhône Basin: **Burdigalian:** Littoral de la Nerthe (Beaumaiderie, St-Paul près St-Rémy) (LAMBERT, 1910a; ROMAN, 1974; NEGRETTI, 1984; PHILIPPE et al., 1990), Secteur des étangs (Fos-sur-Mer, Istres, Port-de-Bouc, Saint-Mitre-les-remparts) (AGASSIZ in AGASSIZ & DESOR, 1846; DESOR, 1858; LAMBERT, 1910a; COTTREAU, 1913a; LAMBERT & JEANNET, 1928; PHILIPPE, 1998), Bassin d'Avignon-Carpentras (Aramon, Saint-Etienne-du-Grès, Théziers, Vaison-la-Romaine, Vedène, Villeneuve-les-Avignon) (AGASSIZ in AGASSIZ & DESOR, 1846; DESOR, 1858; LAMBERT, 1910a; LAMBERT & JEANNET, 1928; PHILIPPE, 1998), Bassin d'Apt-Reillanne-Forcalquier (Apt, Auribeau, Buoux, Lacoste, Ménerbes, Reillanne, Rocsalrières, Viens) (LAMBERT, 1910a; ROMAN, 1974; PHILIPPE, 1998); **Late Burdigalian** (faciès "Marnes Bleues"): Bassin de Faucon-Mollans-Malaucène (Entrechaux) (PHILIPPE, 1998)

#### *Tripneustes cf. ventricosus* (LAMARCK, 1816)

(Fig. 20; Pl. 19, Figs. 5-13; Pl. 20, Figs. 1-10)

- cf 1943a *Tripneustes ventricosus* (LAMARCK). – MORTENSEN: 490-498, figs. 299-304; pl. 33, fig. 4; pl. 36, figs. 1-4; pl. 37, figs. 3, 11-12; pl. 38, figs. 5-8; pl. 61, figs. 3, 6, 7, 9, 15-17

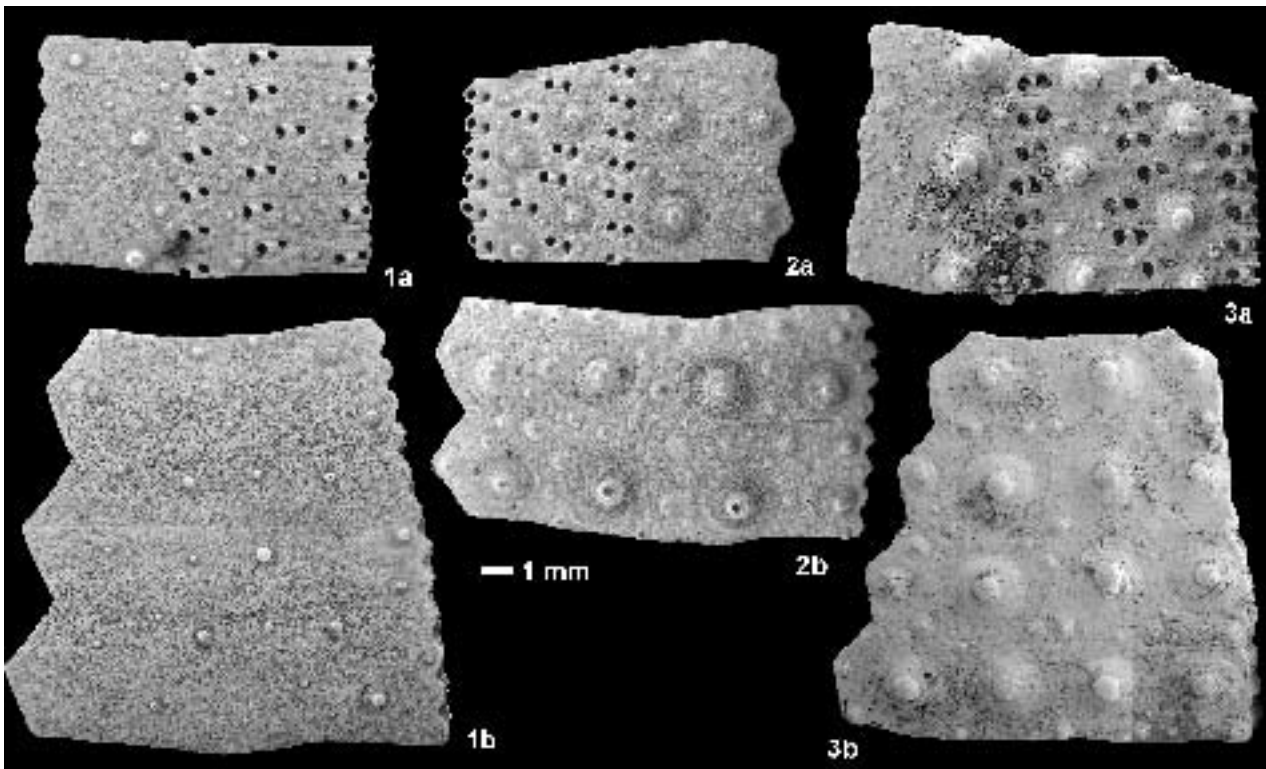


Figure 20: Comparison between extant and fossil species of *Tripneustes*: 1a-b: *T. gratilla* (LINNÉ, 1758), recent, Safaga, Red Sea; 2a-b: *T. ventricosus* (LAMARCK, 1816), recent, aquarium reared; 3a-b: *T. cf. ventricosus* (LAMARCK, 1816), Badenian (Middle Miocene) of Gainfarn, NÖ (3a: NHMW 2003z0003/0004; 3b: NHMW 2003z0003/0001)

- # 1951 *Tripneustes ventricosus austriacus* nov. ssp. – TAUBER: 312-318; figs. 2, 3, 4b; pl. 1, figs. a-b  
 1978 *T.[ripneustes] ventricosus* (LAMARCK) *austriacus* TAUBER, 1951 – KIER & LAWSON: 44  
 v. 2002b *Tripneustes cf. ventricosus* – KROH: 12

**Type-material:**

*Tripneustes ventricosus austriacus* TAUBER, 1951:

Holotype: 1 subambital test fragment figured by TAUBER (1951: figs. 1a-b); originally in the private collection of TAUBER; presumed to be lost (see discussion)

Locus typicus: Kalksburg

Stratum typicum: "Grobsand unter der fossilreichen Kalkbank"

Age: Badenian (Langhian-Early Serravallian), Middle Miocene

**Material:**

Early Badenian (Langhian) – Gainfarn, NÖ, Austria

NHMW: 10 test fragments (NHMW 2003z0003/0001-9, 2004z0076/0069), 9 spine fragments (NHMW 2003z0003/0011-19), 1 rotula (NHMW 2003z0003/00010), 9 spines (NHMW 2003z0003/0011-19)

WANZENBÖCK coll.: 128 test fragments, 5 rotulae, 127 spine fragments

NEITZ coll.: 13 test fragments, 33 primary spine fragments

Early Badenian (Langhian) – Hartl Fm., Hartl hill, Eisenstadt, Bgld, Austria

WANZENBÖCK coll.: 1 test fragment (W29)

Early Badenian (Langhian) – Stotzing (sandpit Mayer), Bgld, Austria

WANZENBÖCK coll.: 1 test fragment (no inv. no.)

**Description:**

Size and shape: The size, thickness and curvature of the studied test fragments indicate a test diameter of more than 80 mm

and a high, domed profile. The test thickness ranges from 1.5 to 2.3 mm in ambital test fragments.

Ambulacra (Pl. 19, Figs. 9-10; Pl. 20, Figs. 1-2): The ambulacra are trigeminate with pores arranged in three vertical series in each half ambulacrum. The ad- and perradial series are more or less straight, the middle series forms a slightly undulating pattern. Primary tubercles are found on each third plate. Enlarged secondary tubercles are found perradially of the primary tubercle and between the vertical pore series. The development and distribution of the secondary tubercles is highly variable, depending on the position of the fragment on the test. In sub-ambital test fragments, not every ambulacral plate reaches the perradial suture, approximately every third plate (the ones ad-orally of these, which bear the primary tubercles) terminates just short of the perradial suture. Adapically there is a conspicuous naked median area in the ambulacra.

Interambulacra (Pl. 19, Figs. 11, 13; Pl. 20, Figs. 3, 9): The interambulacra bear multiple subequal nonperforate, noncrenulate tubercles on each plate. "Normal" secondary tubercles are sparse. They are found mainly along the adapical, adradial and interradian sutures. Adapically there is a conspicuous naked median area in the interambulacra.

Spines (Pl. 19, Figs. 12a-b; Pl. 20, Figs. 4-7): The spines are rather short and stout with a bluntly pointed tip. The shaft is striate, with small granules on the ridges. The bases of the spines are about as wide as the basal part of the shaft, only the ring is wider.

Rotulae (Pl. 20, Fig. 8): Rotulae found in association with the coronal fragments described above are indistinguishable from rotulae of extant *T. ventricosus*.

**Differential diagnosis:**

The present material differs from the extant *T. ventricosus* (LAMARCK, 1816) (Fig. 20.B) from the Caribbean Sea by its larger primary tubercles in the interambulacra, which are about 75 to

80 % of the plate height in diameter (vs. 50-60 % in *T. ventricosus*). Moreover, the mamelon of these tubercles is much larger in *T. cf. ventricosus* than in *T. ventricosus* (30-35 % of corresponding tubercle diameter vs. 10-15 % in *T. ventricosus*). Additionally, the small secondary and miliary tubercles are less numerous in the interambulacra of *T. cf. ventricosus* than in *T. ventricosus*.

In the extant *T. gratilla* (LINNÉ, 1758) (Fig. 20.A) from the Red Sea there is only a single primary tubercle on each ambital interambulacral plate, not multiple subequal tubercles as in *T. cf. ventricosus*. Moreover, the middle pore row of each poriferous zone is more or less straight in *T. gratilla*, whereas it is undulating in *T. cf. ventricosus*.

*T. planus* AGASSIZ in AGASSIZ & DESOR, 1846 from the Burdigalian of the Rhône Basin and Austria differs from this species by its low profile, thinner test, and lack of a naked median zone in the interambulacra (compare PHILIPPE, 1988: pl. 5, figs. 1-2).

#### Discussion:

The studied test fragments are very similar to extant *Tripneustes ventricosus*, differences are small (see above). TAUBER (1951) established the subspecies *T. ventricosus austriacus* based on a single subambital test fragment from the Badenian of Kalksburg, Vienna. Unfortunately the specimen, which was located in the private collection of TAUBER could not be found. After his death in 1984 part of the collection of TAUBER was given to the Naturhistorisches Museum Wien, but the type specimen of TAUBER'S subspecies was not among that material (pers. comm. H. SUMMESBERGER and O. SCHULTZ, 2000). Since the specimen could not be traced in the NHMW collection or in any other public and private collection available to the author, it is presumed to be lost.

Since the material available for examination consists of small test fragments only, the specimens are named in open nomenclature. The question if the present material is really conspecific with the extant Caribbean and West African species *T. ventricosus* and the validity of TAUBER'S subspecies must wait until more, better preserved material becomes available.

#### Occurrence:

**Austria:** Badenian (Langhian-Early Serravallian)  
Vienna Basin: Gainfarn, NÖ (KROH, 2002b; [NHMW]); Kalksburg, W (TAUBER, 1951); Stotzing (sandpit Mayer), Bgld ([WANZENBÖCK coll.])  
Eisenstadt-Sopron Basin: Eisenstadt (Hartl Fm., Hartl hill), Bgld ([WANZENBÖCK coll.])

### *Tripneustes* sp.

(pl. 21, Figs. 9-12)

- 1915 *Tripneustes* sp. – VADÁSZ: 112  
1955 *Tripneustes* ? sp. – TOLLMANN: tab. 1  
? 1981 *Tripneustes* sp. – HALMAI: 106  
v. 2003a *Tripneustes* sp. – KROH: 163-164; figs. 3a, c; pl. 2, figs. 8-10

#### Material:

Late Eggenburgian (Early Burdigalian) – Grübern (Zogelsdorf Fm.), NÖ, Austria

NHMW: 6 spine fragments (NHMW 2003z0075/0002)  
Late Eggenburgian (Early Burdigalian) – Limberg (Zogelsdorf Fm., Hengl quarry), NÖ, Austria

NHMW: 103 spine fragments (NHMW 2003z0002/0006)  
Early Badenian (Langhian) – Bad Vöslau (?), NÖ, Austria

NHMW: 3 spine fragments (NHMW 1997z0178/1326a-c)  
Early Badenian (Langhian) – Niederleis, NÖ, Austria

NHMW: 3 spine fragments (NHMW 2002z0087/0066-68)  
Early Badenian (Langhian) – Stotzing (sandpit Mayer), Bgld, Austria

NHMW: 4 spine fragments and 1 test fragment (NHMW 2004z0050/0004-5)

Badenian (Langhian-Early Serravallian) – Forchtenau, Bgld, Austria

NHMW: 4 spine fragments (NHMW 2004z0001/0006, 2004z0001/0015b)

Badenian (Langhian-Early Serravallian) – old sandpit between Großhöflein and Kleinhöflein, near Eisenstadt, Bgld, Austria

NHMW: 7 test fragments (NHMW 2003z0081/0006, .../0040), 18 spines (NHMW 2003z0081/0007, .../0027-28)

Badenian (Langhian-Early Serravallian) – Steinebrunn (formerly Steinabrunn), NÖ, Austria

NHMW: 2 spine fragments (NHMW 1859.XLV.631b), 22 spine fragments (NHMW 1865.I.612d, 612m)

#### Foreign material for comparison:

Badenian (Langhian-Early Serravallian) – Nový Rybík (= Portzteich), near Sedlec, W Lednice, Czech Republic

NHMW: 1 spine fragment and 1 test fragments (NHMW 1858.XLVII.78c)

#### Description:

**Primary spines:** The examined spine fragments are striate, with small granules on the ridges. The base of the spine is about as wide as the basal part of the shaft, only the ring is wider. Where the base is corroded, a stacked pattern of tubes is revealed. The cross-sections of the spines is highly similar to that seen in extant *Tripneustes ventricosus* and to that of spines found in association with *T. cf. ventricosus* in the Badenian of Gainfarn.

#### Discussion:

The material discussed under this heading is identifiable to genus rank. The unified discussion under the heading "*Tripneustes* sp." does not imply all these specimens are conspecific. It is very likely that the Eggenburgian ones belong to *T. planus* and the Badenian ones to *T. cf. ventricosus*.

Spines of *Tripneustes* are clearly identifiable by their external (ornamentation) and internal (cross-section) morphology. Comparison with spines of extant *Tripneustes* species (KROH, 2003a: fig. 3) shows that they are closely similar. A specific determination of isolated spines, however, is impossible (at least at the current state of knowledge).

#### Occurrence:

**Austria:** Late Eggenburgian (Early Burdigalian), Early and Late Badenian (Langhian-Early Serravallian)

Molasse Zone: Grübern (Zogelsdorf Fm.), NÖ ([NHMW]); Limberg (Zogelsdorf Fm., Hengl quarry), NÖ ([NHMW])

Vienna Basin: ? Bad Vöslau, NÖ ([NHMW]); Müllendorf (Müllendorfer Kreide AG quarry), Bgld (TOLLMANN, 1955); Niederleis, NÖ (KROH, 2003a; [NHMW]); Steinebrunn (formerly Steinabrunn), NÖ ([NHMW]); Stotzing (sandpit Mayer), Bgld ([NHMW])

Eisenstadt-Sopron Basin: Eisenstadt, Bgld (TOLLMANN, 1955); Eisenstadt (Hartl Fm., Hartl hill), Bgld (TOLLMANN, 1955; [NHMW]); Forchtenau, Bgld ([NHMW]); Großhöflein, Bgld (TOLLMANN, 1955); between Großhöflein and Kleinhöflein (old sandpit), near Eisenstadt, Bgld ([NHMW]); Kleinhöflein, Bgld (TOLLMANN, 1955)

**Paratethys (non-Austrian occurrences):** ? Karpatian (Late Burdigalian), Badenian (Langhian-Early Serravallian)

Vienna Basin: Nový Rybík (= Portzteich), near Sedlec, W Lednice, Czech Republic ([NHMW])

Great Hungarian Basin (Pannonian Basin): ? Kisalag, Hungary (HALMAI, 1981)

Transylvanian Basin: Lăpuşiu des Sus (= Lapușiu), Hunedoara, Romania (VADÁSZ, 1915)

## Echinacea indet.

(Pl. 21, Figs. 1-8)

- ? 1902 Echinusstachel – RZEHAČ: 48, 60
- pp 1952 „Seeigelstachel, Echinidenkiefer, Pedicellarien“ – KÜHN: 124
- pp 1955 Echiniden: Platten, Zähne, Kiefertelle, Echiniden-Stachel indet. – TOLLMANN: tab. 1
- 1968 Piese din lanterna lui Aristotel – STANCU & ANDREESCU: 468, figs. 80-81 [demipyramids]
- 1977 Elements of the Aristotle's lanterns – MAĆZYŃSKA: pl. 2, figs. 1-6
- 1987 Isolated lantern parts – MAĆZYŃSKA: 147; pl. 7, fig. 2; pl. 8, figs. 1-2
- 1988 Aristotle's lantern – MAĆZYŃSKA: pl. 2, figs. 3a-b
- pp ? 1992 Seeigelstachel – SAUER & al.: fig. 76H
- 1993 Loose elements of the Aristotle's Lantern – MAĆZYŃSKA: pl. 6, figs. 1i-h, 2a-c, 3
- 1996 Elements of Aristotle's Lanterns – MAĆZYŃSKA: pl. 1, figs. 11a-b
- v pp 1999 Undetermined echinoid ossicles – KROH & HARZHAUSER: 164; pl. 9, fig. 1-7
- v. 2003a Echinacea indet. – KROH: 164-165; pl. 4, figs. 1-14
- pp v 2003 *Arbacina* sp. – KROH et al.: 92
- 1 (NHMW 2002z0087/0027-30), 1 primary spine type 2 (NHMW 2002z0087/0024), 12 demipyramids (NHMW 2002z0087/0025, 2002z0089/0003-4, 2002z0090/0002).
- Early ? Badenian (Langhian) – Rauchstallbrunngraben (bryozoan marl), near Baden, NÖ  
NHMW: 11 test fragments (NHMW 2004z0121/0040-50)
- Early Badenian (Langhian) – Stotzing (sandpit Mayer), Bgld, Austria  
NHMW: 2 spines (NHMW 2004z0050/0007), and 8 test fragments (NHMW 2004z0050/0008)
- Early Badenian (Langhian) – Wiesfleck (sandpit Hohlreich), Bgld, Austria  
NHMW: 1 specimen (NHMW 2004z0113/0003)
- Badenian (Langhian-Early Serravallian) – Bruck an der Leitha, NÖ, Austria  
NHMW: 27 spine fragments (NHMW 2004z0001/0021c)
- Badenian (Langhian-Early Serravallian) – Brunn am Steinfeld, NÖ, Austria  
NHMW: 6 rotulae (NHMW 1997z0178/1586), 34 demipyramids and 3 epiphyses (NHMW 1997z0178/1587)
- Badenian (Langhian-Early Serravallian) – Enzesfeld, NÖ, Austria  
NHMW: 8 spine fragments (NHMW 1981/56/7a)
- Badenian (Langhian-Early Serravallian) – Grinzing, Vienna, Austria  
NHMW: 2 demipyramids (NHMW 1846.37.953c)
- Badenian (Langhian-Early Serravallian) – old sandpit between Großhöflein and Kleinhöflein, near Eisenstadt, Bgld, Austria  
NHMW: 139 test fragments (NHMW 2003z0081/0008, .../0019-22), 3 juvenile coronas (NHMW 2003z0081/0016-18), 77 spines (NHMW 2003z0081/0009, .../0026), 3 rotulae (NHMW 2003z0081/0033-35), 2 epiphyses (NHMW 2003z0081/0036-37), and 78 demipyramids (NHMW 2003z0081/00010)
- Badenian (Langhian-Early Serravallian) – Mattersburg, Bgld, Austria  
NHMW: 1 spine fragment (NHMW 1981/56/11a)
- Badenian (Langhian-Early Serravallian) – Nussdorf, Wien, Austria  
NHMW: 1 abraded corona (NHMW 2004z0001/0019), 14 spines (NHMW 2004z0001/0022), 2 rotulae (NHMW 2004z0001/0013), 3 demipyramids (NHMW 2004z0001/0023)
- Badenian (Langhian-Early Serravallian) – Oslip (sandpit E of the village), Bgld, Austria  
NHMW: 5 demipyramids (NHMW 2004z0083/0002), and 1 rotula (NHMW 2004z0083/0003)
- Badenian (Langhian-Early Serravallian) – Perchtoldsdorf (Brunnergasse, highway-ramp), NÖ, Austria  
NHMW: 1 spine + 1 rotula (NHMW 1981/56/9b)
- Badenian (Langhian-Early Serravallian) – Steinebrunn (formerly Steinabrunn), NÖ, Austria  
NHMW: 3 abraded coronas (NHMW 1857.XIV.55), 1 poorly preserved corona (NHMW 1857.XIV.56), 123 spines (NHMW 1859.XLV.631a), 323 spines (NHMW 1865.I.612c, 612g-612l), 8 spine fragments (NHMW 1865.I.612f), 34 rotulae (“*Schizechinus*-type”, NHMW 2004z0001/0020a)
- Badenian (Langhian-Early Serravallian) – Teischl quarry, (? Hartl Fm., Eisenstadt), Bgld, Austria  
NHMW: 18 spine and 3 test fragments (NHMW 2004z0001/0008c)
- Late Badenian (Early Serravallian) – Müllendorf (Mühlendorfer Kreide AG quarry), Bgld, Austria  
NHMW: 69 abraded coronas (NHMW 2004z0006/0013-0017, 2004z0045/0001), 3 demipyramids (NHMW 2004z0045/0002), and 1 rotula (NHMW 2004z0045/0003)
- Late Badenian (Early Serravallian) – Winden (Nirgl quarry, N of the village), Bgld, Austria  
NHMW: 43 spines (NHMW 1859.L.832b)
- Material:**  
Late Eggenburgian (Early Burdigalian) – Eggenburg, NÖ, Austria  
NHMW: 150 spine fragments, demipyramids and rotulae (NHMW 2004z0110/0001, 0008-0012)
- Late Eggenburgian (Early Burdigalian) – Grübern (Zogelsdorf Fm.), near Maissau, NÖ, Austria  
NHMW: 10 coronal fragments and 6 spines (NHMW 2003z0075/0003, 2003z0075/0011)
- Late Eggenburgian (Early Burdigalian) – Limberg (Zogelsdorf Fm., Hengl quarry), NÖ, Austria  
NHMW: 2 spine fragments (NHMW 2003z0002/0008)
- Late Eggenburgian (Early Burdigalian) – Maissau (Zogelsdorf Fm.), NÖ, Austria  
NHMW: 7 spine fragments (NHMW 1860.L.191a), 1 juvenile corona (NHMW 1869.V)
- Late Eggenburgian (Early Burdigalian) – Unternalb (Retz Fm.), SE Retz, NÖ, Austria  
NHMW: numerous spine fragments, demipyramids and rotulae (NHMW 1999z0051/0023-24, 27)
- Ottngian (Late Burdigalian) – Höbmansbach, Taufkirchen Bay, ESE Schärding, OÖ, Austria  
NHMW: 53 spines (NHMW 1978/1966/12h, 12v, 12h1-12h4)
- Ottngian (Late Burdigalian) – Mitterndorf (sandpit Denk), 3.2 km NNE Sigharting, NNE Andorf, OÖ, Austria  
NHMW: 2 spines (NHMW 1989/58/25a)
- Ottngian (Late Burdigalian) – Offenhausen, S Grieskirchen, OÖ, Austria  
NHMW: 17 primary spine fragments (NHMW 1978/1966/14b)
- Early Badenian (Langhian) – Eisenstadt (Hartl Fm.), Bgld, Austria  
NHMW: 19 coronas and test fragments (NHMW 1659.L.801)
- Early Badenian (Langhian) – Gainfarn, NÖ, Austria  
NHMW: 7 demipyramids (NHMW 2004z0076/0013-16, .../0018-19, .../0038), 4 test fragments (NHMW 2004z0076/0031-33, .../0044)
- Early Badenian (Langhian) – Niederleis, NÖ, Austria  
NHMW: 77 rotulae type 1 (tentatively referred to *Schizechinus* sp. by KROH, 2003a; NHMW 2002z0087/0031-36, NHMW 2002z0089/0005), 1 rotula type 2 (tentatively referred to *Genocidaris* by KROH, 2003a; NHMW 2002z0087/0026), 4 primary spines type

### Foreign material for comparison:

Early Badenian (Langhian) – Coșteiu de Sus (= Kosteĵ), Romania

NHMW: 1 test fragment (NHMW 2003z0084/0005)

Early Badenian (Langhian) – Lăpușiu des Sus (= Lapușiu), Romania

NHMW: 5 juvenile coronas (NHMW 1859.XXXVII.59b), 2 coronal plates, 1 demipyramid, 1 juvenile corona + 1 spine fragment (NHMW 2004z0001/0004c), 1 spine (NHMW 1859.XLV.617B.c), 3 test fragments, 1 juvenile corona, 4 spine fragments (NHMW 2004z0001/0027c), 1 spine (NHMW 2004z0001/0028a)

Late Badenian (Early Serravallian) – Buituri (= Bujturi), Romania

NHMW: 1 juvenile corona (NHMW 1852.II.1603c)

Late Badenian (Early Serravallian) – Devínska Nová Ves (= Neudorf an der March), Slovak Republic

NHMW: 15 spines (NHMW 1859.XXXVIII.88)

Remark: The material discussed under this heading is identifiable to superorder rank only due to the nature of the studied specimens. The unified discussion under the heading "Echinacea indet." does not imply that they are conspecific or even generic.

### Discussion:

Disarticulated coronal plates as well as primary spines and lantern elements (mostly rotulae and demipyramids, more rarely epiphyses) of echinaceans are quite common in bulk samples from shallow water environments from the Eggenburgian, Ottnangian and Badenian of Austria. In most cases a more refined identification is very difficult or not possible at all (depending on the preservation). Based on comparison with fossil [*Schizochinus hungaricus* (LAUBE, 1869)] and extant (*Genocidaris maculata*) material KROH (2003a) could tentatively assign rotulae from the Niederleis section to coronal material of co-occurring echinacean taxa. In the scope of this study it was not possible to follow a similarly refined approach and all this material is listed under Echinacea indet. In case of the primary spines, however, short remarks are given in the plate description, as spine ornamentation is very characteristic (see Plate 21).

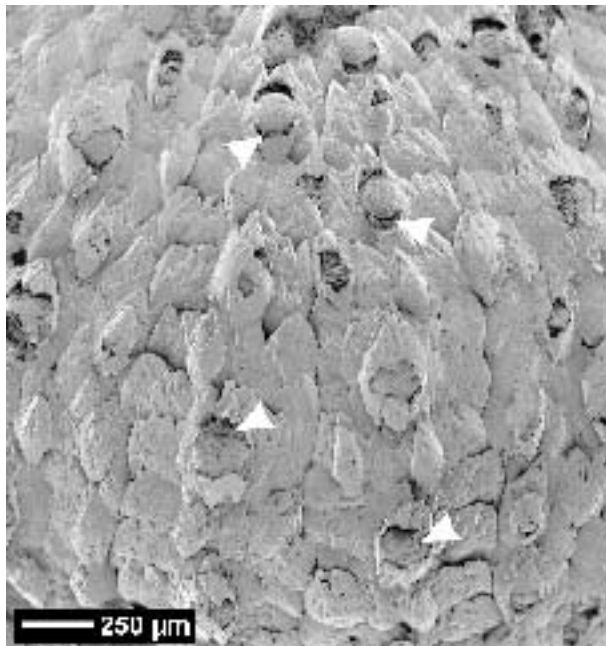


Figure 21: Echinacea indet.: Syntaxial rim cement on the primary tubercles of a juvenile echinacean producing a spindle-shaped appearance. Note the micrite trapped between cement and original shell (arrows).

Additional to the fragmented and disarticulated ossicles juvenile echinacean coronas that could not be referred to specific taxa are discussed under this heading. In many cases the coronas are too small to study tuberculation patterns and ambulatory pores. Especially the presence of syntaxial rim cement, a common diagenetic feature, hampers detailed study of the surface morphology. In many small coronas, presumably belonging to the genera *Arbacina*, *Genocidaris* or *Psammechinus*, the cement crystals strongly modify the shape of the tubercles. Instead of being more or less circular as in unaltered specimens, they are often vertically elongated becoming spindle-shaped. As this pattern is very consistent and very similar in all these specimens one could think that the vertically elongated tubercles are an original feature and not a diagenetic alteration. Albeit there is a genus which is reported to have oval, vertically elongated tubercles (*Leiocyphus* COTTEAU, 1866: p. 760-764, pl. 1185, figs. 8-14; compare FELL & PAWSON, 1966: U423), this is clearly a diagenetic modification in the present material. Specimens from the Hartl Formation clearly show that the tubercles are circular and the spindle-shape is caused by syntaxial rim cement (micritic material trapped between the original skeletal material and the cement produced a discontinuity surface where part of the cement crystals fell off during cleaning in the ultra sonic bath, thereby revealing the shape of the original test; see Fig. 21).

### Occurrence:

Austria: Late Eggenburgian (Early Burdigalian), Ottnangian (Late Burdigalian), Early to Late Badenian (Langhian-Early Serravallian)

Molasse Zone: Eggenburg, NÖ ([NHMW]); Grübern (Zogelsdorf Fm.), near Maissau, NÖ ([NHMW]); Höbmannsbach, Taufkirchen Bay, ESE Schärching, OÖ ([NHMW]); Limberg (Zogelsdorf Fm., Hengl quarry), NÖ ([NHMW]); Maissau (Zogelsdorf Fm.), NÖ ([NHMW]); Mitterndorf (sandpit Denk), NNE Andorf, OÖ ([NHMW]); Offenhausen, S Grieskirchen, OÖ ([NHMW]); Unternalb (Retz Fm.), near Retz, NÖ (KROH & HARZHAUSER, 1999; [NHMW])

Vienna Basin: Bruck an der Leitha, NÖ ([NHMW]); Brunn am Steinfeld, NÖ (KÜHN, 1952; [NHMW]); Enzesfeld, NÖ ([NHMW]); Grinzing, W ([NHMW]); Müllendorf (Mühlendorfer Kreide AG quarry), Bgld (TOLLMANN, 1955; [NHMW]); Niederleis, NÖ (KROH, 2003a; [NHMW]); Nussdorf, W ([NHMW]); Perchtoldsdorf, NÖ ([NHMW]); Rauchstallbrunngraben, near Baden, NÖ (KÜHN, 1952; [NHMW]); Steinebrunn (formerly Steinabrunn), NÖ ([NHMW]); Stotzing (sandpit Mayer), Bgld ([NHMW])

Eisenstadt-Sopron Basin: Eisenstadt, Bgld (TOLLMANN, 1955); Eisenstadt (Hartl Fm., Hartl hill), Bgld (TOLLMANN, 1955; KROH et al., 2003 [NHMW]); Großhöflein, Bgld (TOLLMANN, 1955); between Großhöflein and Kleinhöflein (old sandpit), Bgld ([NHMW]); Kleinhöflein, Bgld (TOLLMANN, 1955); Mattersburg, Bgld ([NHMW]); Oslip, Bgld ([NHMW]); ? St. Georgen (sandpit), Bgld (SAUER & al., 1992)

Danube Basin: Winden (Nirgl quarry), Bgld ([NHMW])

Paratethys (non-Austrian occurrences): Eggenburgian (Early Burdigalian) – Late Badenian (Early Serravallian)

Vienna Basin: Březi (= Bratelsbrunn), Czech Republic (RZEHAČ, 1902); Devínska Nová Ves (= Neudorf an der March), Slovak Republic ([NHMW]); Mikulov (= Nikolsburg), Czech Republic (RZEHAČ, 1902)

Fore-Carpathian Basin: Busko, Central Poland (MAĆZYŃSKA, 1993); Korytnica Clays, Korytnica, Poland (MAĆZYŃSKA, 1977, 1987); Niechobrz near Rzeszów, Southern Poland (MAĆZYŃSKA, 1996); Pińczów, Central Poland (MAĆZYŃSKA, 1993); Skowronno, Central Poland (MAĆZYŃSKA, 1993); Świniary, Southern Poland (MAĆZYŃSKA, 1988)

Transylvanian Basin: Buituri (= Bujtur), Hunedoara, Romania (INHMW); Coșteiu de Sus (= Koste), Romania (INHMW); Lăpușiu des Sus (= Lapuș), Hunedoara, Romania (INHMW); Rugi-Delnești, Romania (STANCU & ANDRESCU, 1968)

### Additional echinaceans reported from the Central Paratethys

#### *Psammechinus* ? sp.

- 1988 *Schizechinus chateleti* LAMBERT, 1910 – MAĆZYŃSKA: 60-61; pl. 2, fig. 1  
 1996 *Schizechinus chateleti* – MACHALSKI: 26; journal cover, unnumbered fig. on p. 25 (large specimen)  
 2004 "Giant *Psammechinus* sp." – RADWAŃSKI & WYSOCKA: 386; pl. 6, figs. 2a-b (large specimen)

**Remarks:** This species was erroneously attributed to *Schizechinus chateleti* by MAĆZYŃSKA (1988). Aboral tuberculation, however, clearly rules out a attribution to the genus *Schizechinus*, which is (among else) characterised by serially arranged subequal secondary tubercles (see under *S. hungaricus* for details on morphology and more information on *S. chateleti*). This was correctly recognised by RADWAŃSKI & WYSOCKA (2004: 386) who tentatively referred this species to the genus *Psammechinus*, naming it "Giant *Psammechinus* sp."

This species is characterised by trigeminate (?) ambulacra with a marginal tubercle on each ambulacral plate, interambulacra with one moderately large primary tubercle on each plate and numerous irregularly arranged secondary tubercles. On the oral surface the secondary tubercles seem to be larger. The peristome is very small and has obviously poorly developed gill slits (as far as can be judged from the photograph in MAĆZYŃSKA, 1988).

Two specimens of this species are known, one in the collection of the Museum of the Earth, Polish Academy of Sciences, Warsaw (MAĆZYŃSKA's specimen) and one in the private collection of Marcin MACHALSKI (illustrated by MACHALSKI, 1996 and RADWAŃSKI & WYSOCKA, 2004). Neither of the specimens was examined by the present author. Albeit it seems clear that the species is distinctly different from any echinacean reported from the Central Paratethys so far it is very difficult to evaluate its status. Therefore the tentative attribution of RADWAŃSKI & WYSOCKA (2004) is accepted here.

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

Fore-Carpathian Basin: Świniary, Southern Poland (MAĆZYŃSKA, 1988; MACHALSKI, 1996; RADWAŃSKI & WYSOCKA, 2004)

### Misidentifications or dubious records of echinaceans

Apart from the taxa discussed above a number of other echinacean taxa have been mentioned from Austrian and nearby outcrops. Reference material of some of these records could be traced and referred to the taxa above (e.g. "*Echinus*" *hungaricus*, "*Psammechinus*" *mirabilis* and *serresii*). Part of these records, however, remain dubious since reference material is lost or of unknown repository and descriptions/illustrations if present at all are insufficient.

#### *Arbacina monilis* (DESMAREST in DEFRANCE, 1816)

- 1893 *Psammechinus monilis* DSM.– TOULA: 288  
 1894 *Psammechinus* cf. *monilis* DESMAREST – MÁRTONFI: 153

- v 1915 *Arbacina monilis* DESM. sp. – VADÁSZ: 109  
 1953 *Arbacina monilis* (DESMAREST), 1822. – SZÖRÉNYI: 11, 58  
 1958a *Arbacina monilis* (DESM.) – SIEBER: 152  
 1969 *Arbacina monilis* (DESMAREST) – GÁBOS & GHIURCA: 88; pl. 2, figs. 4-5 [illustration & description not sufficient for revision]  
 1977 *Arbacina monilis* DESMAREST – MAĆZYŃSKA: 195; pl. 3, figs. 6-9  
 1979 *Arbacina* cf. *monilis* DESMAREST – MAĆZYŃSKA: 30  
 1984 *Arbacina monilis* (DESMAR.) – KÓKAY et al.: 290  
 1985 *Arbacina monilis* (DESMAREST, 1858) – MIHÁLY: 237-238; pl. 1, figs. 1-2 [indeterminable juvenile echinaceans]  
 1987 *Arbacina monilis* (DESMAREST, 1822) – MAĆZYŃSKA: 146, 148

**Reported occurrence:** Badenian (Langhian-Early Serravallian): Budapest, Hungary (KÓKAY et al., 1984; MIHÁLY, 1985); Buituri (= Bujtur), Hunedoara, Romania (MÁRTONFI, 1894); Garáb, Hungary (VADÁSZ, 1915; MIHÁLY, 1985); Huta Róznaniecka, southeastern Poland (MAĆZYŃSKA, 1979); Korytnica Clays, Korytnica, Poland (MAĆZYŃSKA, 1977, 1987); Kralice nad Oslavou (= Kralitz), Moravia, Czech Republic (TOULA, 1893); Mátraverebély (Meszestető hill), Hungary (VADÁSZ, 1915; MIHÁLY, 1985); Mayaregregy, Hungary (MIHÁLY, 1985); Mykolaiv (= Mikolajów) and Radziechów (= Radziejów), S of Lwów, western Ukraine (SZÖRÉNYI, 1953); Minișu des Sus (= Felménes), Arad, Romania (LÓCZY, 1877); Steinebrunn near Drasenhofen, NÖ, Austria (SIEBER, 1958a); Vienna Basin, Austria (LÓCZY, 1877); Valea Satului, Berchezoaia, Ciolt and Buciumi, Baia Mare Basin, Romania (GÁBOS & GHIURCA, 1969).

**Remarks:** This species occurs in the Middle Miocene of Martignas, Western France (see CHAVANON, 1974: 74 for a synonymy list and additional information). A modern re-description and new illustrations are needed. Most probably Central Paratethyan records are misidentifications. Many of the specimens referred to this species are in fact indeterminable echinaceans [e.g. VADÁSZ, 1915 (MAFI Ech 314 and 454); MIHÁLY, 1985: pl. 1, figs. 1-2 ].

#### *Arbacina tenera* DE LORIO, 1902

- ? v 1915 *Arbacina tenera* LOR. – VADÁSZ: 108 [indeterminable echinaceans]  
 ? 1969 *Arbacina tenera* LORIO – GÁBOS & GHIURCA: 87-88; pl. 1, fig. 4 [illustration & description not sufficient for revision]

**Reported occurrence:** Badenian of the Baia Mare and Transylvanian Basins, Romania (GÁBOS & GHIURCA, 1969); Badenian of Budapest-Rákos, Sámsonháza (Mogyorós-pusztá), Sopron-Rákos, and ? Mátraverebély (Meszestető hill, southern slope), in Hungary (VADÁSZ, 1915).

**Remarks:** *Arbacina tenera* DE LORIO was synonymised with *A. catenata* (DESOR) by PHILIPPE (1998: 55-58, see above). During this study none of the reported Badenian occurrences of *A. catenata* could be confirmed. Most records were either misidentifications or based on poorly preserved, indeterminable material. The illustration and description in GÁBOS & GHIURCA (1969) is not sufficient for a revised identification, the identity of their material remaining unclear.

VADÁSZ's (1915) records are based on small, poorly preserved specimens. One of them (MAFI Ech 299 from the Early Badenian of Sámsonháza) could be examined by the present author. This specimen is indeterminable at species level, the whereabouts of the other specimens is unknown.

### *Arbacina* sp.

- 1915 *Arbacina* sp. – MÁJER: 35, 88  
1915 *Arbacina* sp. – VADÁSZ: 109-110; pl. 8 (2), fig. 5 [isolated spines]  
1953 *Arbacina* ? n. sp. – SZÖRÉNYI: 11, 58; pl. 6, fig. 7  
1955 *Arbacina* sp. – TOLLMANN: tab. 1  
1981 *Arbacina* sp. – HALMAI: 105  
1987 *Arbacina* sp. – MAČZYŃSKA: 146, 148; pl. 2, fig. 4  
pp 1988 *Arbacina* sp. – MAČZYŃSKA: 60; pl. 1, fig. 6  
1993 *Arbacina* sp. – MAČZYŃSKA: 108; pl. 2, figs. 2-3  
1996 *Arbacina* sp. – MAČZYŃSKA: 41; pl. 1, fig. 4  
2000 *Arbacina* – PILLER: 87

**Reported occurrence:** Badenian (Langhian-Early Serravallian): Csomád, Hungary (HALMAI, 1981); Großhöflein, Bgld, Austria (TOLLMANN, 1955); Hartl, Eisenstadt, Bgld, Austria (TOLLMANN, 1955); Kleinhöflein, Bgld, Austria (TOLLMANN, 1955); Kemence, Pest, Hungary (MÁJER, 1915); Kików, Central Poland (MAČZYŃSKA, 1993); Korytnica Clays, Korytnica, Poland (MAČZYŃSKA, 1987); Lăpugiu des Sus (= Lapugy), Hunedoara, Romania (VADÁSZ, 1915); Müllendorf, Bgld, Austria (TOLLMANN, 1955); Pińczów, Central Poland (MAČZYŃSKA, 1993); Rybnica, southern Poland (MAČZYŃSKA, 1988); Szczaworyż, Central Poland (MAČZYŃSKA, 1993); Szuszkowce, near Białozurka, Volhynia, Ukraine (SZÖRÉNYI, 1953); Żerniki, Central Poland (MAČZYŃSKA, 1993).

**Remarks:** In most cases these records are based on juvenile or heavily altered echinaceans and echinacean spines. The generic attribution to *Arbacina*, at least in some of these records, seems doubtful.

The specimen figured by MAČZYŃSKA (1988: pl. 1, fig. 5) is a fragment of *Schizechinus hungaricus*.

### *Echinus* sp.

- 1877 *Echinus* – FUCHS: 669  
1958b *Echinus* – SIEBER: 297  
1981 *Echinus* sp. – HALMAI: 106

**Reported occurrence:** Karpatian of Csomád and Kisalag, Hungary (HALMAI, 1981); Badenian (Langhian-Early Serravallian): Austria (FUCHS, 1877); Steinebrunn near Drasenhofen, NÖ, Austria (SIEBER, 1958b).

**Remarks:** Non of the museum collections or the numerous bulk samples investigated during this study yielded material assignable to the genus *Echinus*. The literature records of *Echinus* from the Central Paratethys probably refer to *Psammechinus* or, even more likely, *Schizechinus*.

### *“Echinus” cucurbites* MERCATI

- 1807 *Echinus Cucurbites* MERCATI LINN. – STÜTZ: 43  
1822 *Echinus cucurbites* MERCATI – RASOUMOVSKY: 6

**Reported occurrence:** Belvédère, Vienna, Austria (STÜTZ, 1807; RASOUMOVSKY, 1822)

**Remarks:** STÜTZ (1807) refers to the German translation of LINNÉ'S “*Regnum Lapidium*” by GMELIN where the name *Echinus cucurbites* MERCATI is obviously mentioned. Being pre-Linnéan (MERCATI, 1717-19) the name is not valid. There is a chance that it has been validly established by a later author (e.g. GMELIN), but the present author was not able to find any reference to such a taxon. It is thus unclear what species this record refers to actually, moreover, as no echinoids have been reported from this locality in the last 150 years.

### *“Echinus” floridus* MERCATI

- 1807 *Echinus floridus* [...] MERCATI – STÜTZ: 75

- ? 1807 See-Igel der dem des MERCATI gleicht – STÜTZ: 111

**Reported occurrence:** Calvariberg, near Baden (STÜTZ, 1807); Sooss, near Baden, NÖ, Austria (? STÜTZ, 1807; RASOUMOVSKY, 1822)

**Remarks:** see remarks under “*Echinus” cucurbites* MERCATI.

### *Psammechinus michelotti* DESOR, 1858

- 1894 *Psammechinus Michelotti* Des. sp. – MÁRTONFI: 153  
1906 *Psammechinus Michelotti* Desor. – VADÁSZ: 329-330; pl. 10, figs. 2a-c

**Reported occurrence:** Late Badenian (Early Serravallian) of Budapest-Rákos, Pest, Hungary (VADÁSZ, 1906) and Buituri (= Bujtur), Hunedoara, Romania (MÁRTONFI, 1894).

**Remarks:** The specimens reported as *P. michelotti* by VADÁSZ (1906) were later (1915: 108) attributed to *A. tenera* by him (see above under that species).

*P. michelottii* was established by DESOR (1858: 454) for a specimen from the Late Miocene of Serravalle de Servivia. DESOR gives only a very brief description but no illustrations and it is impossible to judge whether MÁRTONFI'S of VADÁSZ'S records are conspecific with DESOR'S specimen.

### *“Prionechinus” felmenesensis* LAMBERT & THIÉRY, 1911

- 1877 *Echinus* cf. *dux* LAUBE. – LÓCZY: 63; pl. 5, figs. 3a-d  
1911 *P.[rionechinus] felmenesensis* LAMBERT et THIÉRY. – LAMBERT & THIÉRY: 230  
1915 *Prionechinus felménésensis* LAMB. & THIÉRY. – VADÁSZ: 107; pl. 9 (3), figs. 1-4  
1953 *Prionechinus felménésensis* LAMBERT & THIÉRY, 1911. – SZÖRÉNYI: 10, 57

**Reported occurrence:** Late Badenian (Early Serravallian) of Minișu des Sus (= Felménes), Arad, Romania (LÓCZY, 1877); Early Badenian (Langhian) of Szuszkowce, near Białozurka, Ukraine (SZÖRÉNYI, 1953); Badenian (Langhian-Early Serravallian) of the Vienna Basin (LÓCZY, 1877)

**Remarks:** It is difficult comment on this species without having examined LÓCZY'S material. The descriptions of LÓCZY (1877) and VADÁSZ (1915) are ambiguous. The former illustrates plates with moderately dense, small tubercles, the latter plates crowded with numerous subequal secondary tubercles (Remark: both figure the same, single specimen of this species). No similar specimens have been encountered during the present study (the only taxon that has a somewhat similar ornamentation is *Arbacina* cf. *macrophylla*). SZÖRÉNYI'S (1953) record added no additional information on the classification of this species.

### *“Prionechinus” loczyi* LAMBERT & THIÉRY, 1911

- 1877 *Psammechinus* cf. *monilis* DESMAR. – LÓCZY: 62; pl. 5, figs. 4a-d  
1911 *P.[rionechinus] Loczyi* LAMBERT et THIÉRY. – LAMBERT & THIÉRY: 230  
1915 *Prionechinus Loczyi* LAMB. & THIÉRY. – VADÁSZ: 108  
1953 *Prionechinus loczyi* LAMBERT & THIÉRY, 1911. – SZÖRÉNYI: 11, 57