

- Clypeaster scillae* DES MOULINS, 1837**  
(Pl. 33; Figs. 1-3; Pl. 34, Figs. 1-8; Pl. 35, Figs. 1-2)
- \* 1837 *C.[clypeaster] scillae*. Nob. – DES MOULINS: 65-65, no. 13
- 1837b *Clypeaster grandiflorus* – BRONN: 14; pl. xxxvi, fig. 9a-d [*nomen nudum*]
- # pp 1838 *Clypeaster grandiflorus* nob. . *humilis* (fig. nostr.) – BRONN: 903-905
- 1840b *Clypeaster crassus* AG. – AGASSIZ: 6 (moulage en plâtre 55) [*nomen nudum*]
- 1840b *Clypeaster crassicosatus* AG. – AGASSIZ: 6 (moulage en plâtre Q 12) [*nomen nudum*]
- pp 1847a [*Clypeaster*] *Scillae* DESML. – AGASSIZ & DESOR: 131 [placed *C. latirostris* AG. into the synonymy of *C. scillae*]
- 1852 *Clypeaster grandiflorus* LAM. – ČŽÍŽEK: 51
- 1855 *Clypeaster crassicosatus* AG. – ANDRAE: 302
- 1856a *Clypeaster grandiflorus* ( , 903, pars). – BRONN in BRONN & ROEMER: 324-325
- 1856b *Clypeaster grandiflorus* BR. – BRONN & ROEMER: 83; pl. 36, fig. 9a-d
- 1856 *Clypeaster crassicosatus* AG. – ROLLE: 591
- 1856 *Clypeaster grandiflorus* BRONN excl. synonym. (*C. crassus* AG.) – ROLLE: 591
- 1857 [*Clypeaster*] *Scillae*, id. – PICTET: 220
- pp 1858 [*Clypeaster*] *Scillae* DESMOUL. – DESOR: 241; pl. 29, figs. 1-3
- 1859 *Clypeaster crassicosatus* – ZOLLIKOFER: 217
- 1861 *Clypeaster Scillae*, DES MOULINS – MICHELIN: 114; pl. 16, figs. 1a-f
- 1861 *Clypeaster crassicosatus*, AGASSIZ – MICHELIN: 115; pl. 17, figs. 1a-f
- 1867 *Clyp. crassicosatus* AG. – STACHE: 143
- 1868 *Cl. Scillae* – KARRER: 570 (footnote)
- 1869 *Clypeaster Scillae* DESM. – FUCHS: 194
- 1869a *Clypeaster crassicosatus* AGASSIZ. – LAUBE: 183
- 1869a *Clypeaster Scillae* DESMOULINS. – LAUBE: 183
- 1870 *Clypeaster crassicosatus* DESM. – LAUBE: 314
- 1870 *Clypeaster Scillae* DESM. – LAUBE: 314
- 1871 *Clypeaster crassicosatus* AGASSIZ. – LAUBE: 63
- 1871 *Clypeaster Scillae* DESMOULINS. – LAUBE: 63
- 1871 *Clypeaster grandiflorus* BRONN – STUR: 590
- ? 1871 *Clypeaster crassicosatus* AG. – STUR: 590
- 1874 *Clypeaster grandiflorus* – QUENSTEDT: pl. 82, fig. 12, 18
- 1875 *Clypeaster grandiflorus* – QUENSTEDT: 539-541
- 1877 *Clypeaster Scillae* DESM. – KARRER: 312
- 1878 *Clypeaster crassicosatus* AG. – HILBER: 560, 575
- 1879 *Clypeaster* aff. *Clyp. crassicosatus*, DESOR. – HERMITE: 242
- 1879 *Clypeaster crassicosatus*, AGASS. – HERMITE: 253
- 1885 *Clypeaster crassicosatus*, Agass. – POMEL: pl. B25, figs. 1-8
- 1885 *Clypeaster Scillae?* DESM. – POMEL: pl. B26, figs. 1-7
- 1887b *Clypeaster crassicosatus*, AGASSIZ. – KOCH: 263-264
- # 1887 *Clypeaster bunopetalus* – POMEL: p. 204 [refers to the specimen figured as *C. scillae?* in 1885]
- # 1891 *Clypeaster pentadactylus*, PERON et GAUTHIER, 1891. – PÉRON & GAUTHIER in COTTEAU, PÉRON & GAUTHIER: 183-187; pl. 6, figs. 4-5
- 1894 *Clypeaster crassicosatus*. AGASS. – LÖRENTHEY: 61
- 1898 *Clypeaster crassicosatus* AG. – KORNHUBER: 31
- . 1900 *Clypeaster Geneffensis* GAUTHIER 1898 – GAUTHIER in FOURTAU: 705-707; pl. 3, figs. 4-6
- . 1900 *Clypeaster pentadactylus* PERON et GAUTHIER 1891 – FOURTAU: 708-709; pl. 4, figs. 5-9
- # 1902 *Clypeaster Vasseli* GAUTHIER, 1901. – GAUTHIER in FOURTAU: 97; pl. 4, figs. 1-3 [fide FOURTAU, 1920, who placed it in the synonymy of *C. crassus*]
- 1905 *Clypeaster crassicosatus*, AG. – GAÁL: 362
- 1906b *Clypeaster crassus* – LAMBERT: 27; pl. 7, figs. 1-2 [not seen, fide PHILIPPE, 1998]
- 1906b *Clypeaster grandiflorus* – LAMBERT: 23-26 [not seen, fide PHILIPPE, 1998]
- 1912 *Clypeaster Scillae* DESMOULINS, 1837. – LAMBERT: 93-94
- 1912 *Clypeaster crassus* AGASSIZ, 1840. – LAMBERT: 94-95; pl. 7, fig. 6
- 1912 *Clypeaster grandiflorus* BRONN, 1838. – LAMBERT: 95-96
- 1912 *Clypeaster pentadactylus* PERON et GAUTHIER, 1891. – LAMBERT: 96-97
- 1913a *Clypeaster grandiflorus* – COTTREAU: 103; pl. 10, fig. 2
- . 1913a *Clypeaster pentadactylus* PERON et GAUTHIER – COTTREAU: 102-104; pl. 10, figs. 1, 1a; pl. 13, figs. 1, 1a
- # 1914b *Clypeaster Manini* LOV. – LOVISATO: 557-561; pl. 9, figs. 1a-d
- 1915 *Clypeaster Scillae* DESMOULINS. – LAMBERT: 223
- 1915 *Clypeaster grandiflorus* BRONN. – MÁJER: 35, 88
- 1915 *Cl. Scillae* DERM. – MÁJER: 35, 88
- ? 1915 *Cl. Crassis* AG. – MÁJER: 35, 88
- ? 1915 *Cl. crassicosatus* SISM. – MÁJER: 35, 88
- v. 1915 *Clypeaster grandiflorus* BRONN. – VADÁSZ: 126-128; pl. 12 (6), fig. 4
- # v. 1915 *Clypeaster grandiflorus* BRONN. var. *anteacutus* VAD. – VADÁSZ: 126-128; figs. 19, 21
- v. 1915 *Clypeaster grandiflorus* BRONN. var. *rhabdopetalus* POM. – VADÁSZ: 126-128; figs. 20, 22
- # 1915 *Clypeaster grandiflorus* BRONN. var. *basiconcava* – VADÁSZ: 128 [type material lost]
- # 1915 *Clypeaster grandiflorus* BRONN. var. *altipetalus* – VADÁSZ: 128 [type material lost]
- v. 1915 *Clypeaster Scillae* DESMOULINS. – VADÁSZ: 129-131
- # v ? 1915 *Clypeaster digitalis* n. sp. – VADÁSZ: 135-136; fig. 28
- v. 1915 *Clypeaster altus* KLEIN. – VADÁSZ: 152-153, figs. 44
- v pp 1915 *Clypeaster crassus* AG. Junges Exemplar. – VADÁSZ: pl. 6, fig. 2
- 1920 *Clypeaster crassus*, AGASSIZ 1840 – FOURTAU: 47-48
- 1920 *Clypeaster geneffensis*, GAUTHIER 1898 – FOURTAU: 49-50
- 1920 *Clypeaster pentadactylus*, PERON et GAUTHIER 1891 – FOURTAU: 53-55
- 1920 *Clypeaster Scillae*, DESMOULINS 1837 – FOURTAU: 56
- # 1927b *Clypeaster Zanoni* CHECCHIA-RISPOLI – CHECCHIA-RISPOLI: 12-15; pl. 3, figs. 1, 1a; pl. 4, figs. 1-2
- 1927a *Clypeaster crassicosatus* SISMONDA, 1841 – LAMBERT: 14-15
- 1927a *Clypeaster Scillae* DESMOULINS, 1837 – LAMBERT: 15
- 1927b *Clypeaster Scillae* DESMOULINS, 1837. – LAMBERT: 94
- 1931 *Clypeaster Scillae* DESMOULINS. – LAMBERT: 45
- 1931 *Clypeaster Scillae* DESMOULINS variété *geneffensis* GAUTHIER – LAMBERT: 212; pl. 8, figs. 1-3
- 1938a *Clypeaster scillae* DESM. – KALABIS: 2-3, 5, 8, 10
- 1938a *Clypeaster scillae* DESM. var. *grandiflorus* BRONN – KALABIS: 3, 5, 8, 10
- 1938b *Clypeaster scillae* DESM. – KALABIS: 3-5, 8-9
- 1938 *Clypeaster pentadactylus* PERON & GAUTHIER 1891 – POLJAK: 177-178; pl. 3, figs. 1, 1a
- 1938 *Clypeaster airaghi* LAMBERT 1913 – POLJAK: 178; pl. 3, fig. 2

- 1938 *Clypeaster scillae* DESMOULINS 1837 – POLJAK: 175-176; pl. 2, fig. 3
- ? 1938 *Clypeaster crassus* AGASSIZ 1840 – POLJAK: 176-177
- ? 1938 *Clypeaster scutiformis* LAMARCK 1824 – POLJAK: 182-183; pl. 2, fig. 4 [very probably a juvenile *C. scillae*]
- 1939 *Clypeaster Scillae* DREG. – KAPOUNEK: 67
- 1939 *Clypeaster grandiflorus* BRONN. – KAPOUNEK: 72
- 1939 *Clypeaster Scillae* DESM. – KAPOUNEK: 72, 74
- 1949 *Clypeaster scillae scillae* DESMOULINS, 1837. – KALABIS: 33-35, 86-89; pl. 1, figs. 1-2
- 1949 *Clypeaster scillae crassus* L. AGASSIZ, 1840. – KALABIS: 35-37, 89-91; pl. 1, figs. 3-5
- 1949 *Clypeaster crassicosatus* SISMONDA – SCHOUPPE: 143
- 1955 *Clypeaster crassicosatus* SISM. – TOLLMANN: Tab. 5b
- 1955 *Clypeaster grandiflorus* BRONN – TOLLMANN: Tab. 5b
- 1955 *Clypeaster scillae* DESM. – TOLLMANN: Tab. 5b
- non 1958 *Clypeaster Scillae* DESMOULINS – IMBESI SMEDILE: 20-21, 35-36; pl. 3, figs. 3, 3a-b; pl. 14, figs. 2, 2a; pl. 15, fig. 1
- non 1958 *Clypeaster grandiflorus* BRONN – IMBESI SMEDILE: pl. 16, figs. 4, 4a-b; pl. 18, figs. 1, 1a-b [probably a juvenile *C. altus*]
- 1960 *Clypeaster (Pliophyma) altus* (KLEIN 1734, in LESKE 1778) – KOJUMDJEVA & STRACHIMIROV: 230; pl. 7, fig. 9; pl. 8, fig. 16-8 [misidentified *C. scillae*]
- 1962a *Clypeaster scillae* – THENIUS: 27; pl. 6, fig. 33
- 1963 *Clypeaster Zanoni* CHECCHIA RISPOLI – COMASCHI CARIA: 22-23; pl. 4, figs. 1-2
- v. 1964 *Clypeaster campanulatus partschi* MICHEL. – ERTL: 253-255; figs. 1-2 [misidentification]
- 1968 *Clypeaster scillae* – KÜPPER: pl. 4, fig. 32
- 1968 *Clypeaster grandiflorus* BRONN. – SCHMID: Anhang
- 1969 *Clypeaster scillae alienus* VAD. – MITROVIĆ-PETROVIĆ: 125-126; pl. 4, fig. 2; pl. 5, figs. 1, 1a
- 1969 *Clypeaster altus* KLEIN – MITROVIĆ-PETROVIĆ: 126; pl. 5, figs. 2, 2a
- 1969 *Clypeaster grandiflorus anteaecutus* VAD. – MITROVIĆ-PETROVIĆ: 129; pl. 12, figs. 1, 1a-b
- 1969 *Clypeaster manini* LOV. – MITROVIĆ-PETROVIĆ: 129-130; pl. 13, figs. 1, 1a-b
- 1969 *Clypeaster chiassi* LOV. – MITROVIĆ-PETROVIĆ: 130; pl. 14, figs. 1, 1a-b
- 1969 *Clypeaster danubicus* VAD. – MITROVIĆ-PETROVIĆ: 131; pl. 15, fig. 2; pl. 16; figs. 1, 1a
- 1969 *Clypeaster majocchii* LOV. – MITROVIĆ-PETROVIĆ: 131-132; pl. 16, figs. 2, 2a-b
- 1969 *Clypeaster mostoi* LOV. – MITROVIĆ-PETROVIĆ: 132; pl. 17, figs. 1, 1a-b
- 1969 *Clypeaster zanoni* CH-RISP. – MITROVIĆ-PETROVIĆ: 134; pl. 22, figs. 1, 1a-b
- pp 1969 *Clypeaster acclivis* POM. – MITROVIĆ-PETROVIĆ: 135; pl. 23, figs. 1, 1a; pl. 24, fig. 1 [pl. 23, figs. 2a-b may be a juvenile *C. calabrus*]
- 1970 *Clypeaster scillae* – THENIUS: p. 211; pl. 3, fig. 32
- 1972 *Clypeaster crassicosatus* AG. – MITROVIĆ-PETROVIĆ: 71, 74; figs. 5, 5a
- 1984 *Clypeaster tauricus* DESOR – MITROVIĆ-PETROVIĆ: 221-222; pl. 1, figs. 1, 1a; pl. 2, fig. 1
- 1984 *Clypeaster chiassi* LOVISATO – MITROVIĆ-PETROVIĆ: 225; pl. 5, figs. 1, 1a-b [juvenile specimen]
- 1984 *Clypeaster grandiflorus anteaecutus* VADASZ – MITROVIĆ-PETROVIĆ: 225; pl. 5, figs. 2, 2a-b
- 1984 *Clypeaster scillae* DESMOULINS – MITROVIĆ-PETROVIĆ: 232; pl. 12, figs. 1, 1a-b
- ? 1984 *Clypeaster acclivis* POMEL – MITROVIĆ-PETROVIĆ: 233; pl. 13, figs. 1, 1a-b [juvenile specimen]
- 1993 *Clypeaster scillae* DESMOULINS, 1837 – MACZYŃSKA: 110; pl. 4, figs. 1a-1d; pl. 5, fig. 1
- 1996 *Clypeaster scillae* DESMOULINS, 1837 – MACZYŃSKA: 41; pl. 2, figs. a-e
- 1996 *Clypeaster altus* KLEIN – GHIURCA: 190, unnumbered fig.
- 1997 *Clypeaster scillae alienus* VADÁSZ – MAJECEN et al.: 106; pl. 6, fig. 1
- v. 1998 *Clypeaster* sp. – HIDEN: pl. 1, figs. 1-5
- 1998 *Clypeaster scillae* DESMOULINS, 1837 – PHILIPPE: 119-122; pl. 17, figs. 1-2
- 1999 *Clypeaster altus* – PILLER & HARZHAUSER: 224; fig. 25
- 2000 *Clypeaster* sp. – ZORN: 19; fig. 8
- v. 2001 *Clypeaster scillae* (MICHELIN) – SCHMID et al.: 13, 23
- . 2001 *Clypeaster scillae* DESMOULINS, 1837 – MIKUŽ & MITROVIĆ-PETROVIĆ: 50-52; pl. 1, figs. 1, 1a, 2
- . 2001 *Clypeaster scillae* cf. *alienus* VADÁSZ, 1915 – MIKUŽ & MITROVIĆ-PETROVIĆ: 52-53; pl. 1, figs. 3, 3a-b; pl. 2, figs. 2, 2a-b
- v. 2002b *C. [Clypeaster] scillae* DES MOULINS – KROH: 11
- v. 2002 *Clypeaster* sp. – PLÖCHINGER & KARANITSCH: 165, fig. 354
- 2002 *Clypeaster* – PLÖCHINGER & KARANITSCH: 168, fig. 364
- 2004 *Clypeaster scillae* – HARZHAUSER et al.: 82, fig.

#### Type-material:

##### *Clypeaster scillae* DES MOULINS, 1837:

Holotype: current whereabouts unknown

Locus typicus: "Villeneuve-lès-Avignon"; according to PHILIPPE (1998: 120) there is no doubt that this means the quarries of Montagnet, near Angles, Gard, France

Age: Burdigalian, Early Miocene

##### *Clypeaster grandiflorus* BRONN, 1838:

Holotype: specimen figured by BRONN (1837: 14; pl. xxxvi, fig. 9a-d); collection of BRONN; current whereabouts unknown

Locus typicus: probably Kemence, Pest, Hungary (see below)

Stratum typicum: Leitha limestone

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

Remarks: BRONN mentioned the species for the first time in 1837 without description or locality information, but provided a figure (BRONN, 1837: 14; pl. xxxvi, fig. 9a-d). A figure alone is not sufficient for the establishment of a species according to the ICZN. Thus *grandiflorus* BRONN, 1837 is a *nomen nudum*. In 1838 referring to his figure from 1837 he mentioned *grandiflorus* again, but this time accompanied by a description, numerous localities and a synonymy list. The correct, valid, authorship for *grandiflorus*, therefore, is BRONN, 1838.

As BRONN included many records in his synonymy list that are not conspecific and mentioned several questionable localities the question which specimens can be regarded as types arises. Since BRONN (1838) explicitly refers to the figure of his 1837 paper, that would be a logical choice. The problem is that we do not know where that specimen came from. In a later, revised edition of his "*Lethaea geognostica*" (BRONN & ROEMER, 1856) the specimen is again figured and this time only the locality Kemence, Hungary is mentioned. It thus seems likely that this is where the specimen came from. Furthermore, the list of localities in BRONN (1838) gives us further hints: several of the localities are marked by an exclamation mark. This sign means that Bronn had specimens from the so marked localities in his collection. Under "*Clypeaster grandiflorus* nob. . humilis (fig. nostr.)" in BRONN (1838: 903-905) there are just two localities marked this way "in der Tegel-Formation in ! Steyermark, zu ! Kemence im Honther Comitatz in Ungarn". As Kemence thus

occurs again it is proposed to consider that locality as type locality of *C. grandiflorus*.

There are no features which would allow to confidently separate *C. grandiflorus* and *C. scillae*, therefore *C. grandiflorus* is placed into the synonymy of the latter. As many other, probably not conspecific taxa are mentioned in BRONN's synonymy the record is added to the synonymy list with the critical sign "pp" (meaning that part of the material included by BRONN in *C. grandiflorus* might not be conspecific with *C. scillae*).

*Clypeaster bunopetalus* POMEL, 1887:

Holotype: specimen figured by POMEL (1885: pl. B26, figs. 1-7); current whereabouts unknown

Locus typicus: Djebel Mouzaia, Algeria

Stratum typicum: "terrain cartennien"

Age: Middle ? Miocene

*Clypeaster pentadactylus* PERON & GAUTHIER in COTTEAU et al., 1891:

Holotype: specimen figured by COTTEAU et al. (1891: pl. 6, figs. 4-5); current whereabouts unknown

Locus typicus: El Hammam, Valley of Oed Abdi, Aurès, Algeria

Age: Langhian, Middle Miocene

*Clypeaster vasseli* GAUTHIER in FOURTAU, 1902:

Holotype: specimen figured by FOURTAU (1902: pl. 4, figs. 1-3); Muséum de Paris

Locus typicus: Gebel Généffé, opposite the railroad station, Eastern Desert, Egypt

Age: "Vindobonien", Middle Miocene

*Clypeaster manini* LOVISATO, 1914:

Syntypes: originally in the collection of LOVISATO; current whereabouts unknown

Type region: numerous localities in Sardinia, Italy

*Clypeaster grandiflorus anteacutus* VADÁSZ, 1915:

Holotype: MAFI Ech 125, figured by VADÁSZ (1915: figs. 19, 21); housed at the Museum of the Hungarian Geological Survey

Locus typicus: Gârbova de Sus (= Felső-Orbó), Romania

Age: Late Badenian (Early Serravallian), Middle Miocene

*Clypeaster grandiflorus altipetalus* VADÁSZ, 1915:

Holotype: single specimen mentioned by VADÁSZ (1915: 128); not preserved at the Museum of the Hungarian Geological Survey, where the VADÁSZ-material is housed

Locus typicus: Kemence, Pest, Hungary

Stratum typicum: Leitha limestone

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

*Clypeaster grandiflorus basiconcava* VADÁSZ, 1915:

Syntypes: several specimens mentioned by VADÁSZ (1915: 128); not preserved at the Museum of the Hungarian Geological Survey, where the VADÁSZ-material is housed

Locus typicus: Gârbova de Sus (= Felső-Orbó), Romania

Age: Late Badenian (Early Serravallian), Middle Miocene

? *Clypeaster digitalis* VADÁSZ, 1915:

Holotype: MAFI Ech 150, figured by VADÁSZ (1915: fig. 28); housed at the Museum of the Hungarian Geological Survey

Locus typicus: Livezile (= Ūrháza, = Vláháza), Romania

Age: Late Badenian (Early Serravallian), Middle Miocene

Remarks: Specimen damaged (posterior end missing), very probably synonymous with *C. scillae*

*Clypeaster zanoni* CHECCHIA-RISPOLI, 1927:

Syntypes: current whereabouts unknown

Locus typicus: Faehiat, Cyrenaica, Libya

Age: Middle Miocene

**Material:**

Early Badenian (Langhian) – Aflenz, Styria, Austria

NHMW: 4 specimens (NHMW 1978/2022/1, 1978/2022/2, 1978/2022/3, 2004z0072/0004)

Early Badenian (Langhian) – Gamlitz (Unterer Gnaser Bruch), near Ehrenhausen, Styria, Austria

NHMW: 1 specimen (NHMW 1868.I.Anhang)

Early Badenian (Langhian) – Leibnitz, Styria, Austria

NHMW: 1 specimen (NHMW 2003z0058/0001)

Early Badenian (Langhian) – St. Nikolai, Styria, Austria

NHMW: 2 specimens (NHMW 1978/2021/1, 1978/2021/2)

Early ? Badenian (Langhian) – Rauchstallbrunngraben, near Baden, NÖ, Austria

NHMW: 2 specimens (NHMW 1976/1843/8, 1997z0178/1680)

Early Badenian (Langhian) – Retznei [Weissenegg Fm., Lafarge quarry (formerly Perlmoser)], Styria, Austria

NHMW: 3 specimens (NHMW 1997z0178/1831, 2004z0098/0006-7)

Early Badenian (Langhian) – Wiesfleck (sandpit Hohlreich), Bgld, Austria

NHMW: 2 specimen (NHMW 2004z0113/0001-2)

Badenian (Langhian-Early Serravallian) – Brunn am Steinfeld, NÖ, Austria

NHMW: 1 specimen [NHMW 1858.XII.8 (abnormal specimen, probably deformed due to recovery after sublethal predation)]

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

NHMW: 1 specimen (NHMW 2003z0056/0001)

Badenian (Langhian-Early Serravallian) – Großhöflein, near Eisenstadt, Bgld, Austria

NHMW: 4 specimens (NHMW 1858.XV.56, 1869.I.663, 1869.I.664, 1868.VIII.42)

Badenian (Langhian-Early Serravallian) – Hainburg (*Halitherium*-locality of STACHE, 1867), NÖ, Austria

NHMW: 1 specimen (NHMW 1867.XXII.2)

Badenian (Langhian-Early Serravallian) – Kalksburg, Vienna, Austria

IPUW: 1 specimen (no inventory no.)

Badenian (Langhian-Early Serravallian) – north-western Leitha Mountains, Bgld-NÖ boundary region, Austria

NHMW: 1 specimen (NHMW 1976/1825 [specimen figured by ERTL, 1964])

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

NHMW: 21 specimens (NHMW 1978/2020/1-20, 2004z0072/0003)

Badenian (Langhian-Early Serravallian) – Neudorf near Sopron (the locality could not be traced, either in Austria or in Hungary)

NHMW: 1 specimen (NHMW 2003z0059/0001)

Late Badenian (Early Serravallian) – Hornstein (= Szarvkö), Bgld, Austria

MAFI: 1 specimen [MAFI Ech 275 (referred to *C. scillae* DESMOULINS by VADÁSZ, 1915: 129-131)]

Late Badenian (Early Serravallian) – Müllendorf (quarry of the Mühlendorfer Kreidewerke AG), Bgld, Austria

NHMW: 4 specimens (NHMW A2328, 1997z0178/1745, 2003z0031/0006, 2004z0112/0002, ..0007)

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

NHMW: 2 specimens (NHMW 1976/1844/57, 2004z0001/0041)

Foreign material for comparison purposes:

Middle Miocene – Ragusa, Sicily, Italy

NHMW: 1 specimen (NHMW 2003z0060/0001)

Middle Miocene – Una river, Bosanski Novi (= Bosnisch Novi), Bosnia and Herzegovina

NHMW: 1 specimen (NHMW 1888.93)



Early Badenian (Langhian) – Gombhegy, Kemence, Pest, Hungary

MAFI: 5 specimens [MAFI Ech 156 (material referred to *C. grandiflorus* BRONN by VADÁSZ, 1915: 126-128); Ech 321 and Ech 430 (specimens referred to *C. grandiflorus* BRONN. var. *rhabdopetalus* POM. by VADÁSZ, 1915: 126-128); Ech 324 and Ech 325 (specimens referred to *C. scillae* DESMOULINS by VADÁSZ, 1915: 129-131)]

Early Badenian (Langhian) – Mátraverebely (Meszetető), Nográd, Hungary

MAFI: 2 specimens [MAFI Ech 322 and Ech 323 (referred to *C. scillae* DESMOULINS by VADÁSZ, 1915: 129-131)]

Badenian (Langhian-Early Serravallian) – Šahy (= Ipoly-Shag), Slovak Republic

NHMW: 2 specimens (NHMW 1852.II.1547, 1852.II.1548)

Late Badenian (Early Serravallian) – Gârbova de Sus (= Felső-Orbó), Romania

MAFI: 5 specimens [MAFI Ech 125 (holotype of *C. grandiflorus anteaecutus* VADÁSZ, 1915: 126-128; figs. 19, 21), Ech 135 (material referred to *C. grandiflorus* BRONN. var. *rhabdopetalus* POM. by VADÁSZ, 1915: 126-128; figs. 20, 22), Ech 136 (material referred to *C. altus* KLEIN by VADÁSZ, 1915: 152-153, figs. 44), Ech 259 & 316 (material referred to *C. grandiflorus* BRONN by VADÁSZ, 1915: 126-128), Ech 260 (referred to *C. scillae* DESMOULINS by VADÁSZ, 1915: 129-131)]

Late Badenian (Early Serravallian) – Kemence, Pest, Hungary

NHMW: 14 specimens (NHMW 1852.II.1546, 1858.XXXIX.14, 1858.XXXIX.15, 1858.XXXIX.16, 1858.XXXIX.17, 1865.XXXV.16 (9047), 1865.XXXV.17 (9046), 1865.XXXV.19, 1865.XXXV.20, 1865.XXXV.21, 1865.XXXV.22, 1885.XXXV.18 (A1056), 2003z0057/0001 to 0002)

MAFI: 1 specimen [MAFI Ech 138 (referred to *C. crassus* AG. by VADÁSZ, 1915: pl. 6, fig. 2)]

? Late Badenian (Early Serravallian) – Livezile (= Vlâdhâza), Romania

MAFI: 1 specimen [MAFI Ech 150 (holotype of *Clypeaster digitalis* VADÁSZ, 1915: 135-136; fig. 28)]

**Dimensions:** see Tab. 9

### Description:

**Size and shape:** The test is of medium to large size, elongated antero-posteriorly, with a subpentagonal outline. The anterior margin is bluntly pointed, very thick and tumid. The posterior margin is transversely truncated, slightly indented and less thick than the anterior margin, but still tumid. The lateral margins may be slightly indented in interambulacra 1 and 4. The maximum width lies both anterior and posterior of the apical disc, where ambulacra II and IV respectively I and V reach the ambitus. Test width usually varies between 75 and 85% TL and shows allometric growth, larger specimens showing a more elongated outline. In profile, the test has a trapezoid shape with a domed petaloid area. The maximum height lies around the apical disc on the raised adapical parts of the ambulacral interporiferous zones. The margin is of varying thickness and tumidity; but in all investigated specimens it is very thick and tumid. The oral surface is inclined towards the peristome, which lies in a deep infundibulum.

**Apical disc:** The apical disc lies subcentrally and is slightly depressed. It belongs to the monobasal type with a large central, subpentagonal madreporite and 5 circular gonopores.

**Ambulacra:** All five ambulacra are petaloid, straight and distally closing. The frontal petal is longest, the paired petals are subequal in length, the posterior ones sometimes being a little bit longer than the anterior ones. The petals extend roughly two third of the corresponding test radius. The poriferous zones are slightly depressed and relatively wide, being widest near the distal end of the petals. The pores are conjugated anisopores. Adjacent pore pairs are separated by narrow ridges

with a single row of up to 5 primary tubercles. The interporiferous zones are strongly inflated and usually 2.2 to 3.5 times as wide as a single poriferous zone at the widest point of the petals. They are crowded by primary tubercles similar to those on the interambulacra. On the oral surface simple unbranched food grooves are present in the axis of the ambulacra.

**Interambulacra:** The interambulacra are distinctly depressed adapically between the petals. They are crowded with perforate crenulate primary tubercles in sunken areoles. Between the primary tubercles, dense miliary tuberculation is present. Between the petals the tubercle density is usually very low and the tubercles large and widely spaced. Tubercles size and density increases towards the margin. On the oral surface tubercles are closely spaced, their areoles nearly touching each other. On the oral surface the interambulacra are slightly inflated between the ambulacra, giving the a "swollen" appearance.

**Peristome:** The peristome is oval, transversely elongated and lies subcentrally on the oral side of the test in a deep, broad infundibulum with sloping walls.

**Periproct:** The periproct is subcircular to very slightly oval, transversely elongated. It lies inframarginally, about 3 to 4.5 mm away from the posterior margin.

**Internal support system:** Contrary to other species of *Clypeaster*, *C. scillae* has a rather weakly developed internal support system. Though the test is double walled and relatively thick, internal pillars are less common and present in the central part around the lantern only. There is a large cavity for the intestines running around the central part which is free from pillars. There are only two perforated septa one anterior and one next to the periproct (compare Pl. 34, Fig. 1). A dense marginal framework as in *C. barcinensis*? for example is completely missing.

### Differential diagnosis:

For the difference to *C. barcinensis*? LAMBERT, 1906 see above under that species.

For the difference to *C. calabrus* SEGUENZA, 1880 see above under that species.

*C. campanulatus* (SCHLOTHEIM, 1820) (and its phenotypes), a co-occurring species, differs by its strongly different profile, flattened oral surface, broader petals, which are more closed distally and have a much less inflated interporiferous zone and steep-walled infundibulum.

*C. folium* AGASSIZ in AGASSIZ & DESOR, 1847, a co-occurring species, is distinguished from this species by its lower test height, thin and rather sharp margin, distinct marginal indentation in all interambulacra, short petals, shallow infundibulum and deep food grooves.

*C. intermedius* DES MOULINS, 1837, an Early Miocene species of the Rhône Basin, differs from *C. scillae* by its different profile, less elongated outline, less strongly raised petaloid area, thinner and less tumid margin, and broader petals with less inflated interporiferous zones (see also PHILIPPE, 1998).

*C. latirostris* MICHELIN, 1861, a species occurring in the Eggenburgian (Early Burdigalian) of the Molasse Zone, is distinguished from this species by its subequal test length and width, lower test height, thin margin, slightly inflated interporiferous zones, flattened oral surface and the broad, very shallow infundibulum.

### Discussion:

*Clypeaster scillae* DES MOULINS, 1835 is a common and rather well known species, occurring abundantly in the Burdigalian to Serravallian of the Mediterranean and the Badenian of the Paratethys. In the latter it is one of the most wide-spread *Clypeaster* species, occurring as far north as Poland and the Ukraine where most other species are missing. It is characterised by its pentagonal outline, with sub-parallel sides, strongly inflated interporiferous zones, very thick, tumid margin and broad infundibulum with sloping walls.

The following species were considered junior synonyms of *C. scillae* by PHILIPPE (1998: 119) and other authors: *Clypeaster*

*grandiflorus* BRONN, 1838, *C. crassus* AGASSIZ, 1840 [*nomen nudum*], *C. crassicostratus* AGASSIZ, 1840 [*nomen nudum*], *C. bunopetalus* POMEL, 1887, *C. pentadactylus* PERON & GAUTHIER in COTTEAU et al., 1891, *C. vasseli* GAUTHIER in FOURTAU, 1902, *C. manini* LOVISATO, 1914 and *C. zaroni* CHECCHIA-RISPOLI, 1927. Based on the descriptions and illustrations of these species in the original publications, but without having seen the type material I can only agree with PHILIPPE that these species really seem to fall within the morphological variation exhibited by *C. scillae*. Several of these names have also been used for Austrian material both in publications and in collections. The records/specimens of these which I could examine belong indeed all to *C. scillae*. It is interesting to note that some authors recognised the over-splitting in this species very early (e.g. VADÁSZ, 1915) but still kept them as different species, although noting that these species were often impossible to distinguish.

PHILIPPI (1842, 1851) used the position of the gonopores as one of the major features to distinguish between the species *C. scillae*, *C. altus* and *C. turritus*. It is true that the position of the gonopores varies in relation to the madreporite (sometimes the gonopores lie directly at the apices of the madreporite, in other cases they are removed from the madreporite). This variation, however, occurs within single species and cannot be used as diagnostic feature. A very drastic example of this is the well known, extant *Clypeaster rosaceus* where the position of the gonopores varies very strongly. The function of this variation is unclear.

#### Occurrence:

##### Austria: Early to Late Badenian (Langhian-Early Serravallian)

Vienna Basin: Brunn am Gebirge, NÖ (MICHELIN, 1861; LAUBE, 1869a, 1871); Brunn am Steinfeld, NÖ (KALABIS, 1938a; [NHMW]); Gainfarn, NÖ (KROH, 2002b; PLÖCHINGER & KARANITSCH, 2002); Hainburg an der Donau, NÖ (LAUBE, 1869a, 1871; KALABIS, 1938b); Hundsheim hills, Hainburg an der Donau, NÖ (STACHE, 1867; [NHMW]); Kalksburg, Vienna (FUCHS, 1869; QUENSTEDT, 1874, 1875; KARRER, 1877; KALABIS, 1938b; THENIUS, 1962a, 1970; [NHMW]); Mannersdorf, NÖ ([NHMW]); Müllendorf (Mühlendorfer Kreide AG quarry), Bgld (KALABIS, 1938a+b; KAPOUNEK, 1939; TOLLMANN, 1955; HIDEN, 1998; ? PILLER & HARZHAUSER, 1999; ZORN, 2000; PLÖCHINGER & KARANITSCH, 2002; HARZHAUSER et al., 2004; [NHMW]); north-western Leitha Mts., Bgld/NÖ border region (ERTL, 1964; [NHMW]); Rauchstallbrunngraben, near Baden, NÖ (KALABIS, 1938a+b; [NHMW]); Rodaun, Vienna (KARRER, 1868); Hornstein (= Szarvkő), Bgld (VADÁSZ, 1915; [MAFI]); Vienna Basin (KÜPPER, 1968)

Eisenstadt-Sopron Basin: Eisenstadt, Bgld (LAUBE, 1869a, 1871; [NHMW]); Großhöflein, Bgld (ČIŽEK, 1852; LAUBE, 1869a, 1871; KALABIS, 1938a; [NHMW]); St. Georgen (Hader hill), Bgld (SCHMID, 1968); Eisenstadt (Hartl Fm., Hartl hill), Bgld (KAPOUNEK, 1939); Höflein, near Eisenstadt, Bgld (MICHELIN, 1861; LAUBE, 1869a; KALABIS, 1938b); Kleinhöflein, near Eisenstadt, Bgld (ČIŽEK, 1852); between Großhöflein and Kleinhöflein, near Eisenstadt, Bgld (KAPOUNEK, 1939; TOLLMANN, 1955); Neudorf near Sopron, Austria/Hungary border region ([NHMW]); St. Margarethen (Kummer quarry), Bgld (SCHMID et al., 2001; [NHMW])

Oberpullendorf Bay: Ritzing, Bgld (QUENSTEDT, 1874, 1875)

Styrian Basin: Aflenz, Styria ([NHMW]); Ehrenhausen, Styria (LAUBE, 1869a, 1871); Eichberg, near Zirknitz (LAUBE, 1869a, 1871); Gamlitz, near Ehrenhausen, Styria ([NHMW]); Leibnitz, Styria ([NHMW]); Nikolai-hill, St. Nikolai im Sausal, Styria (ROLLE, 1856; STUR, 1871; HILBER, 1878; [NHMW]); Ober-Mureck, Styria (ANDRAE, 1855); Retznei (Weissenegg Fm., Lafarge quarry), Styria (SCHOUPPE, 1949; HIDEN, 1998; [NHMW])

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

Fore-Carpathian Basin: Niechobrz near Rzeszów, Southern Poland (MAĆZYŃSKA, 1996); Pińczów, Central Poland (MAĆZYŃSKA, 1993)

Molasse Zone: Židlochovice, Czech Republic (KALABIS, 1938a, 1949); Podivín, Czech Republic (KALABIS, 1949);

Vienna Basin: Devínska Kobyla, near Bratislava, Slovak Republic (KORNHUBER, 1898); Devínska Nová Ves, Slovak Republic (LAUBE, 1869a, 1871)

Great Hungarian Basin (Pannonian Basin): Hor. Strháre (= Felső-Esztergály), Slovak Republic (GAÁL, 1905); Kémence, Pest, Hungary (BRONN, 1838; BRONN in BRONN & ROEMER, 1856; MICHELIN, 1861; KARRER, 1868; LAUBE, 1869a, 1871; COTTREAU, 1913a; VADÁSZ, 1915; KALABIS, 1938b; [MAFI]); Kémence (Gombhegy), Pest, Hungary (MÁJER, 1915; [MAFI]); Letkés, Pest, Hungary (VADÁSZ, 1915); Mátraverebély, Nógrád, Hungary (VADÁSZ, 1915; [MAFI]); Nagymaros, Pest, Hungary (VADÁSZ, 1915); Šahy (= Ipoly-Shag), Slovak Republic ([MAFI])

Transylvanian Basin: Buciumi, Romania (GHURCA, 1996); Gârbova de Sus (= Felső-Orbó), Romania (KOCH, 1887b; LÖRENTHEY, 1894; GAÁL, 1905; VADÁSZ, 1915; [MAFI]); Livezile (= Ūrháza, = Vláháza), Romania (VADÁSZ, 1915; [MAFI]); Moldovenești (= Várfalva), Cluj, Romania (KOCH, 1887b)

Lom Basin: Opanez and Opansko bardo, Northern Bulgaria (KOJUMDIEVA & STRACHIMIROV, 1960)

Styrian Basin: Poljance (= Pölttschach, train station), Slovenia (ZOLLIKOFER, 1859); Šentilj in Slovenske gorice; NE Slovenia (MIKUŽ & MITROVIĆ-PETROVIĆ, 2001)

Sáva Basin: Una river, Bosanski Novi (Bosnisch Novi), Bosnia and Herzegovina ([NHMW])

Zala, Sáva and Dráva Basins: Slovenia (MAJEN et al., 1997); Hrastovica, Kaznica Potok, ? Repušnica Potok, Sutjeska, Utinje Potok and Zrinj, Croatia (POLJAK, 1938); Bosanska Kostajnica, Gradačac and Ugljevik, Bosnia & Herzegovina (MITROVIĆ-PETROVIĆ, 1969)

##### Mediterranean: Burdigalian to Serravallian

Rhône Basin: Burdigalian: ? Aramon, Bassin d'Avignon, France (PHILIPPE, 1998); Beaucaire, Bassin d'Avignon, France (PHILIPPE, 1998); Buoux, Bassin d'Apt-Reillanne-Forcalquier, France (PHILIPPE, 1998); Couronne, Bouches-du-Rhône, France (LAMBERT, 1912); Istres, Secteur des étang, Bouches-du-Rhône, France (LAMBERT, 1912; COTTREAU, 1913a; PHILIPPE, 1998); Lacoste, Bassin d'Apt-Reillanne-Forcalquier, France (PHILIPPE, 1998); Martigues, Littoral de la Nerthe, France (PHILIPPE, 1998); Martigues, Secteur des étang, France (PHILIPPE, 1998); Ménerbes, Bassin d'Apt-Reillanne-Forcalquier, France (PHILIPPE, 1998); Montagnat, near Angles, Gard, France (DES MOULINS, 1837; LAMBERT, 1912; PHILIPPE, 1998); St. Mite-les-Remparts, Secteur des étang, France (PHILIPPE, 1998); Taillades, Vaucluse, France (LAMBERT, 1912)

Langhian: not recorded

Serravallian: Cucuron, Bassin Sud-Luberon, France (PHILIPPE, 1998)

Western Mediterranean: Catalonia, Spain (LAMBERT, 1927a); Calada Bianca, Sardinia, Italy (COMASCHI CARIA, 1963); Chabbat-el-Kotta, Algeria (POMEL, 1885, 1887); Corsica, France (AGASSIZ, 1840b; PICTET, 1857; MICHELIN, 1861; LAUBE, 1871); Deya, Mallorca, Balears, Spain (HERMITE, 1879); Djebel Mouzaia, Algeria (POMEL, 1885, 1887); El Hammam, valley of Oed Abdi, Aurès, Algeria (COTTEAU, PÉRON & GAUTHIER, 1891); La Superga, near Torino, Italy (MICHELIN, 1861; LAUBE, 1871); Monte Alvu near Bosa (Planargia), Sardinia, Italy (LOVISATO, 1914b); "regione Pilaghe (d)e Badde di Pozzomaggiore", Sardinia, Italy (LOVISATO, 1914b); Poetto al Capo S. Elia di Cagliari, Sardinia, Italy (LOVISATO, 1914b); Portotorres, Sardinia, Italy (LOVISATO,