

# ***Cottreaucorys kollmanni* n. sp. (Echinodermata: Echinoidea) and other new records from the Early Paleocene Bruderndorf Formation in Austria**

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(With 3 textfigures and 2 plates)

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## **Zusammenfassung**

Diese Arbeit stellt eine Ergänzung zur Revision der Echinidenfauna des Oberen Danium der Bruderndorf-Formation (Waschberg Zone, nordöstliches Österreich; siehe KROH 2001) dar. *Cottreaucorys kollmanni* n. sp., eine neuer Vertreter der Aeropsidae, einer Gruppe von seltenen Tiefwasser-Spatangiden, wird beschrieben. Weiters konnten die Arten *Procassidulus* cf. *elongatus* und *Galeaster bertrandi* erstmals aus Österreich nachgewiesen werden. Zusätzlich wird neues, besser erhaltenes Material von *Adelopneustes montainvillensis* und *Linthia houzeau* abgebildet, Arten die ursprünglich anhand von relativ schlecht erhaltenem Material nachgewiesen wurden.

**Schlüsselwörter:** Echinoidea, Echinodermata, Danium, Paläogen, Österreich, *Cottreaucorys kollmanni* n. sp.

## **Abstract**

This paper concerns additional new records of echinoids from the Late Danian Bruderndorf Formation outcropping in the Waschberg Zone in North-eastern Austria. *Cottreaucorys kollmanni* n.sp. is established for a new small aeropsid, a group of rare deep-water spatangoids. Furthermore, the species *Procassidulus* cf. *elongatus* and *Galeaster bertrandi* are recorded for the first time from Austria. New and better preserved material of *Adelopneustes montainvillensis* and *Linthia houzeau* is illustrated. These taxa were based on rather poorly preserved material formerly.

**Keywords:** Echinoidea, Echinodermata, Danian, Palaeogene, Austria, *Cottreaucorys kollmanni* n. sp.

## **Introduction**

Since the first publication on the echinoid fauna of the Bruderndorf Formation (KROH 2001), a number of taxa not known from this locality or Austria before have turned up. Among them is a small aeropsid similar to *Cottreaucorys blayaci* (COTTREAU, 1909). Refined investigation and comparison with the type material of the latter, as well as investigations of extant aeropsids revealed that this specimen necessitates the establish-

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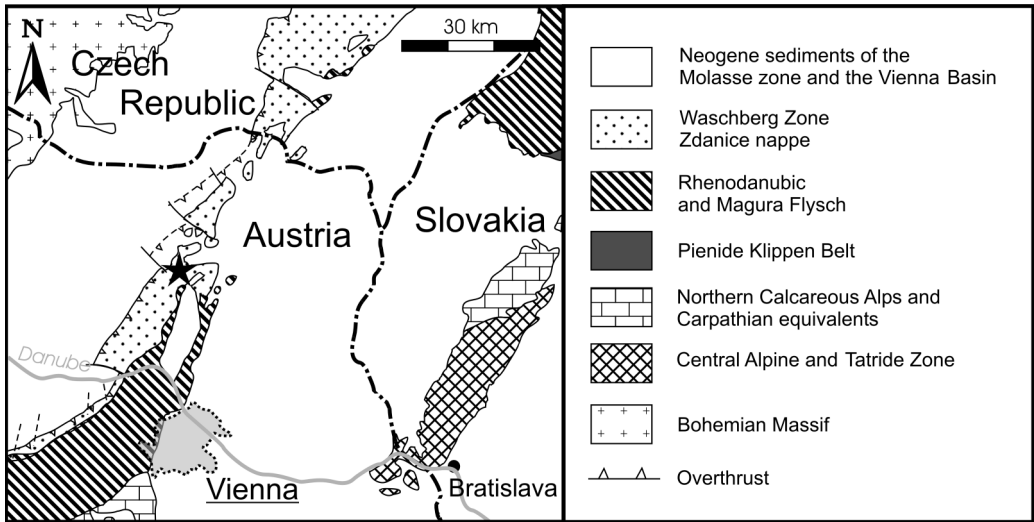


Fig. 1: Geological overview of the Austria-Czech Republic-Slovakia border region (redrawn and modified from FUCHS 1981). The asterisk marks the locality Haidhof near Ernstbrunn (Lower Austria, Austria).

ment of a new species, which is described below. During the unsuccessful search for more material of this new taxon in the field and public as well as private collections, a number of other taxa not previously known from Austria have been found.

Part of the material represents specimens studied by KÜHN (1960), which were discovered during recent refurbishing activities at the Natural History Museum Vienna. These specimens are accompanied by labels stating that they are reference material of a publication by O. KÜHN in 1947. This work, however, seems never to have been published and the specimens are first mentioned in KÜHN (1960). The remaining material comes from collections of private collectors contacted since the first publication in 2001 (KROH 2001). All studied specimens were collected from agriculturally used farmland east of the small village Haidhof, west of Ernstbrunn (Lower Austria) and come from the Late Danian Bruderndorf Formation (see Fig. 1). Bed by bed collection was not possible due to the lack of suitable outcrops. For details on the geological setting and stratigraphic age of this unit the reader is referred to KROH (2001). A palaeoecological analysis of the echinoid fauna and its biogeographic relations can be found in KROH (2003).

#### Abbreviations:

BMNH – British Museum of Natural History London

CSTUB – Centre des Sciences de la Terre, Université de Bourgogne

IPUW – Institut für Paläontologie, Universität Wien

NHMW – Naturhistorisches Museum Wien

UPMC – Université de Paris, Marie Curie

### Systematic part

Class Echinoidea LESKE, 1778  
 Order Holoctypoida DUNCAN, 1889  
 Family Conulidae LAMBERT, 1911  
 Genus *Adelopneustes* GAUTHIER, 1889

***Adelopneustes montainvillensis* (SORIGNET, 1850)**  
 (pl. 2, figs. 1a-c)

- v. 1960 *Pseudopyrina subovalis* Ravn. – KÜHN: 164  
 2000 *Adelopneustes montainvillensis* (SORIGNET). – SMITH & JEFFERY: 149; figs. 63 A-B, 64 A-B, D  
 v. 2001 *Adelopneustes montainvillensis* (SORIGNET, 1850) – KROH: 387-389; figs. 7-8; pl. 2, figs. 3-7  
 [cum syn.]

**M a t e r i a l:** 1 specimen from Haidhof, near Ernstbrunn, Lower Austria (NHMW 2004z0075/0001).

**R e m a r k s:** An additional, better preserved specimen than those recorded by KROH (2001) was found among material studied by KÜHN. The label accompanying the specimen states "*Pseudopyrina subovalis* RAVN, Beleg zu KÜHN 1947". Therefore, this specimen can be considered to represent the reference material of *Pseudopyrina subovalis* mentioned in KÜHN (1960). The specimen is clearly conspecific with those described in 2001, albeit better preserved. This verifies the earlier assumption (KROH 2001: 387, tab. 1) that KÜHN's record referred to the present species.

Order Cassiduloidea CLAUS, 1880  
 Family Faujasiidae LAMBERT *in* DONCIEUX, 1905  
 Genus *Procassidulus* LAMBERT, 1918

***Procassidulus cf. elongatus* (d'ORBIGNY, 1856)**  
 (pl. 2, figs. 2a-b)

- v. 1960 *Procassidulus leymeriei* (COTT.). – KÜHN: 164

**M a t e r i a l:** 1 specimen from Haidhof, near Ernstbrunn, Lower Austria (NHMW 2004z0075/0002).

**D e s c r i p t i o n:** Medium-sized cassiduloid (length: 27.5 mm, width: 23.2 mm, height: 10.2 mm) with oval, antero-posteriorly elongated outline. Maximum width posterior, situated approximately at the level of the interradiial suture of the posterior paired interambulacra (1 and 4). In profile test low and rounded with obliquely truncated posterior end. Maximum height slightly posterior to the apical disc. Apical disc anteriorly eccentric situated about 40 % of test length away from the anterior margin. Presumably four genital pores, three of which are visible (genital plate 4 not present). Petals straight and narrow, frontal petal longest, others subequal in length. Petals seem to have been more or less flush with the surface of the test. Oral surface flattened with slightly anteriorly eccentric peristome, other details obliterated. Periproct supramarginally, close to the posterior margin and situated in a short anal sulcus.

**R e m a r k s :** Only a single poorly preserved specimen of this species is available. It was discovered during refurbishing activities at the Natural History Museum Vienna among material originally belonging to O. KÜHN in a box containing material from the locality Haidhof. The label accompanying the specimen states "*Procassidulus leymeriei* (COTT.), Beleg zu KÜHN 1947".

The identification of this specimen is very difficult since it lacks nearly all the original test, and most features used in cassiduloid systematics are not preserved. Based on general shape, shape of the petals, location and shape of the periproct and the anal sulcus, as well as position of the peristome the specimen is referred to the genus *Procassidulus*, as already indicated by KÜHN. Two other Maastrichtian to Paleocene genera, *Nucleopygus* and *Petalobrissus*, have a similar shape. The former, however, has a longitudinally concave oral surface, while the specimen considered here has a flat oral surface. Furthermore, the present specimen does not fit in any of the *Nucleopygus* species known from this time interval (compare SMITH & JEFFERY 2000). *Petalobrissus* can be excluded by its broader, differently shaped petals and differences in overall test design. Additionally, *Petalobrissus* is restricted to Northern African, Arabian, Pakistanian and Indian localities.

Among the species of *Procassidulus* reported in the literature the present specimen fits best to *P. elongatus* (compare SMITH & JEFFERY 2000 and JAGT 2000). However, this identification must be regarded as tentative, owing to the poor preservation of the single specimen.

**O c c u r r e n c e :** *Procassidulus elongatus* was reported from the Late Danian of Belgium (SMISER 1935, as *P. geliberti*) and the Early Danian of the Maastricht district, south-east Netherlands/north-east Belgium (VAN DER HAM 1988, JAGT 2000).

Order Holasteroidea DURHAM & MELVILLE, 1957

Family Pourtalesiidae A. AGASSIZ, 1881

Genus *Galeaster* SEUNES, 1889

***Galeaster bertrandi* SEUNES, 1889**

(pl. 2, figs. 3a-c)

2000 *Galeaster bertrandi* SEUNES, 1889 – SMITH & JEFFERY: 265-267; figs. 112A-E [*cum syn.*]

**M a t e r i a l :** 1 specimen from Haidhof, near Ernstbrunn, Lower Austria (NHMW 2004z0075/0003).

**D e s c r i p t i o n :** The specimen is small with a test length of 21.0 mm and has a very thin shell. It has a distinctly heart-shaped outline with deep frontal sinus. In profile it is high (~ 68 % test length), gibbous with obliquely truncated, slightly overhanging posterior end. Both aboral and oral surface are distinctly keeled. Ambulacra nonpetaloid with minute pores. Aboral ambulacral plates of the paired ambulacra are relatively high. Peristome subcircular, small (2.3 mm largest diameter) and located close to the anterior margin at the end of a moderately deep groove connecting it with the frontal sinus. Periproct oval, vertically elongated, slightly overhanging, located marginally, about halfway up the ambitus.

**R e m a r k s :** A single laterally deformed, but otherwise relatively well preserved specimen from the locality Haidhof can be referred to this widespread Maastrichtian to Danian species. More detailed descriptions and illustrations can be found in JEFFERY (1997), SMITH et al. (1999) and SMITH & JEFFERY (2000).

**O c c u r r e n c e :** Maastrichtian of Spain and southern France (SEUNES 1889, SMITH & JEFFERY 2000), Early Danian of Denmark (RAVN 1927, ASGAARD 1979), Late Maastrichtian to Late Danian of Georgia (GONGADZE 1979), Early Danian of Mangyshlak, Kazakhstan (JEFFERY 1997), Early to Late Danian of the Crimea (POSLAVSKAYA & MOSKVIN 1960, POSLAVSKAYA & SOLOVJEV 1964), Early to early Late Maastrichtian and Early to Late Maastrichtian of the northern Caucasus (MOSKVIN & POSLAVSKAYA 1959, POSLAVSKAYA & MOSKVIN 1960, POSLAVSKAYA & SOLOVJEV 1964), late Early to early Late Maastrichtian and Early to Middle Danian of the Transcaspien Region (POSLAVSKAYA & MOSKVIN 1960).

Order Spatangoida CLAUS, 1876

Family Aeropsidae LAMBERT, 1896

Genus *Cottreaucorys* LAMBERT, 1920

***Cottreaucorys kollmanni* KROH n. sp.**

(fig. 2: 1a-d; pl. 1, figs. 1a-d)

**H o l o t y p e :** specimen NHMW 2004z0075/0004, Natural History Museum Vienna, Geological-Palaeontological Department

**L o c u s t y p i c u s :** Haidhof, near Ernstbrunn, Lower Austria, Austria

**S t r a t u m t y p i c u s :** Bruderndorf Formation, Late Danian, Paleocene

**D e r v a t i o n o m i n i s :** In honour of my colleague Heinz KOLLMANN, head of the Geological-Palaeontological Department at the Natural History Museum Vienna. His knowledge on the Late Cretaceous and Palaeogene in Austria and the Gosau Formation in special helped solving many question concerning my own research.

**D i a g n o s i s :** A small species of *Cottreaucorys*, differing by the single other known species *C. blayaci* (COTTREAU, 1909) by its more globose shape, weaker subanal heel, the presence of only two gonopores (the posterior pair?) and the reduction or fusion (?) of two genital plates.

**D e s c r i p t i o n :** The thin-shelled specimen is small with a test length of 11.1 mm (width: 9.9 mm, height: 9.4 mm) and has a globose shape with a distinct subanal heel. The frontal sinus is shallow, but deepens to a distinct groove leading to the peristome subambitally. In profile the test is more or less oval and strongly inflated. The maximum height lies subcentrally, the maximum width slightly anteriorly of the centre. The apical disc lies anteriorly, about 20 % TL from the anterior margin. Structure of the apical disc similar to that of *Aeropsis rostrata* and *Sphenaster larumbensis* (figs. 2: 3d and 3: 1d respectively). It consists of only two genital plates with a single, large, slightly posteriorly displaced gonopore each and five ocular plates (fig. 2: 1d). While the genital and some of the ocular pores are clearly visible, the madreporic pores are obliterated. It is not clear if the other

genital plates are reduced or fused with the others. The ambulacra are nonpetaloid and bear minute pore pairs. Ambulacra and interambulacra are flush, only the plastron is inflated, forming a prominent keel on the oral surface. The plastron is elongated, the labrum extending to the second ambulacral plate. The sternal plates are very narrow. Tuberculation and fascioles obliterated by weathering. Peristome small (c. 1.4 mm in largest diameter), subcircular, facing obliquely forwards and lying at the end of a broad groove close to the anterior margin. The periproct is slightly larger and lies supramarginally, high on the posterior side above a distinct subanal heel. It is visible in aboral view.

**R e m a r k s :** The features outlined above are characteristic of the genus *Cottreaucorys* LAMBERT, 1920. Until now only the type species *Homoeaster blayaci* COTTREAU in BLAYAC & COTTREAU, 1909 from the Maastrichtian of Algeria could be confidently attributed to the genus. *C. blayaci*, however, differs from the present species by its ethmophract apical disc with four gonopores (based on an examination of the type material at the UPMC, specimens J06071 $\alpha$ - $\epsilon$ ) and shape differences such as a much more elongated outline, less globose shape, extremely shallow frontal groove, flatter oral surface, and more prominent subanal heel. These differences warrant establishing a new species, *C. kollmanni*, for the present specimen. The two known species of the related extant genus *Aeropsis*, *A. rostrata* THOMSON, 1877 and *A. fulva* (AGASSIZ, 1881) likewise differ mainly in the structure of their apical discs. The type species, *A. rostrata* has two gonopores, whereas *A. fulva* has four.

The genus *Cottreaucorys* was wrongly placed into the synonymy of the *Homoeaster* POMEL, 1883 by JEFFERY (in SMITH & JEFFERY 2000: 358). Although, the two genera are certainly related, they are clearly not congeneric. This opinion is also shared by A.B. SMITH (pers. comm. 11<sup>th</sup> Oct. 2003; see also "The Echinoid Directory" [[www.nhm.ac.uk/palaeontology/echinoids/](http://www.nhm.ac.uk/palaeontology/echinoids/)]).

On genus/family level *Cottreaucorys* is clearly related to the aeropsids (*Aeropsis*, *Sphenaster*)<sup>2</sup> and the corasterids (*Coraster*, *Orthaster*, *Homoeaster*). Plating patterns and photographs of characteristic representatives of these genera can be found in figures 2 and 3, respectively plate 2.

Extant aeropsids occupy bathyal and abyssal settings and are relatively thin-shelled. The same may be true for the fossil representatives *Cottreaucorys* and *Sphenaster*. This would also explain the extremely poor fossil record of this group, since such settings are rarely preserved in the stratigraphic record. Even those, that are preserved, are often non-fossiliferous due to dissolution of the carbonate content. To improve our understanding of the biogeographic and phylogenetic evolution of this group it is thus very important to consider and also name species represented by single specimens like the present species or *Sphenaster larumbensis* JEFFERY in SMITH et al., 1999.

<sup>2</sup> The genus *Aceste* THOMSON, 1877 which was also included in the Aeropsidae by MORTENSEN (1950) and FISCHER (1966) is excluded from this family by A.B. SMITH (pers. comm. 11<sup>th</sup> Oct. 2003; see also "The Echinoid Directory" [[www.nhm.ac.uk/palaeontology/echinoids/](http://www.nhm.ac.uk/palaeontology/echinoids/)]) and interpreted as "apetaloid derivative of *Proraster* (a schizasterid) and thus not closely related". Examination of extant *Aceste bellidifera* THOMSON, 1877 (lent from the Centre des sciences de la Terre, Univ. Bourgogne) support this. *Aceste* has a very different test design than all other aeropsids (*Aeropsis*, *Cottreaucorys*, *Sphenaster*), i.e. an aborally deeply sunken ambulacrum III, an ethmolytic, posteriorly positioned apical disc, a deep frontal sinus, and a different plastron with a short labral plate extending only about half way of the first ambulacral plate (compare also figs. 2 and 3).

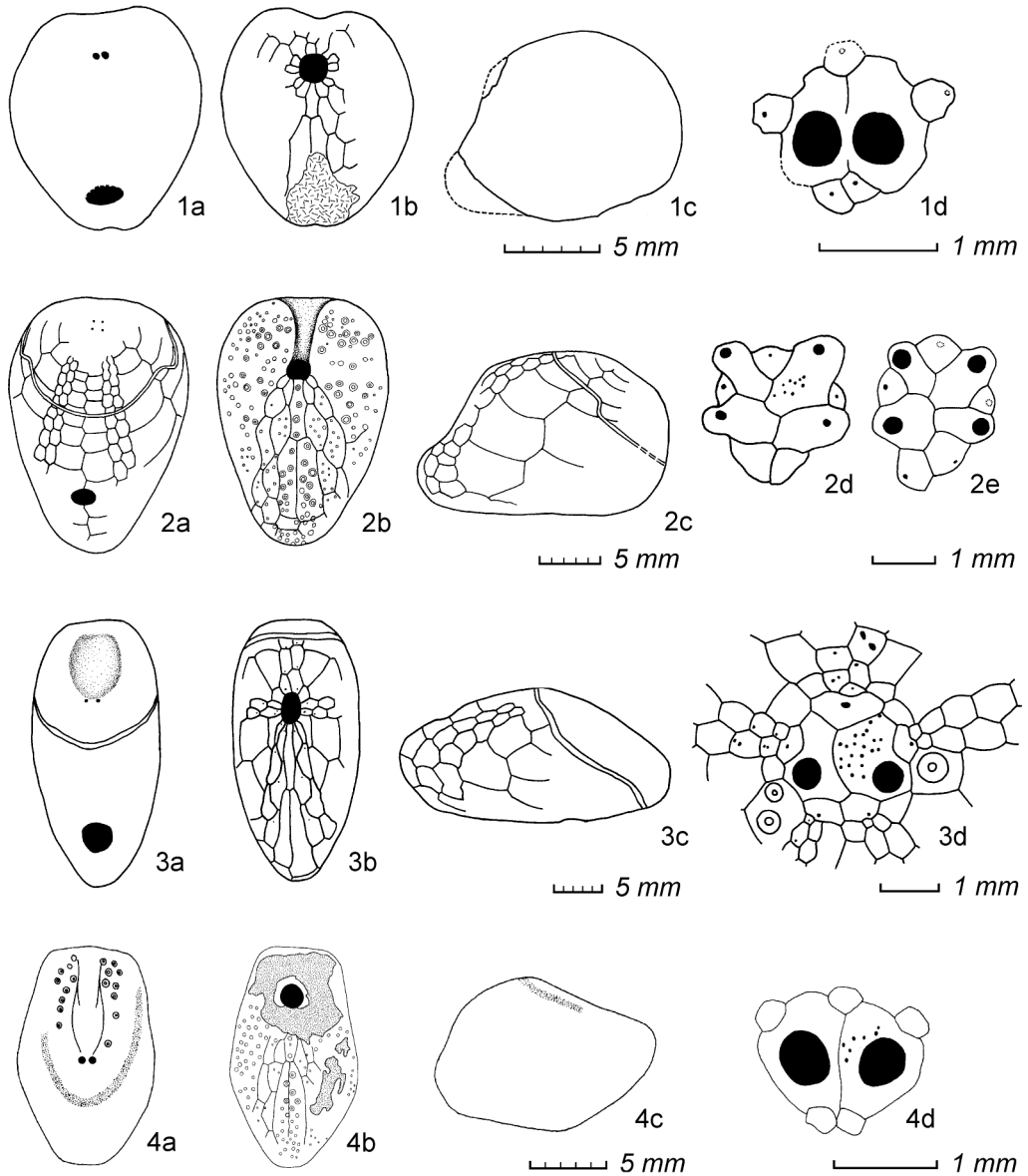


Fig. 2: Comparison of fossil and extant Aeropsidae. 1a-d: *Cottreaucorys kollmanni* nov. spec. (NHMW 2004z0075/0004; Late Danian, Paleocene of Haidhof, Lower Austria, Austria); 2a-e: *Cottreaucorys blayaci* (COTTREAU in BLAYAC & COTTREAU, 1909) (a-c: UPMC J06071/β, d: UPMC J06071/α, e: UPMC J06071/δ; all from the Late Cretaceous of Bordj-Sabath, Province of Constantine, Algeria); 3a-d: *Aeropsis rostrata* (THOMSON, 1877) (CSTUB W.Cy.09; extant, Walda Cruise, 19° 10,3' S, 9° 18.1' E, 4613 m depth); 4a-d: *Sphenaster larumbensis* JEFFERY in SMITH et al., 1999 (BMNH EE6073; Early Thanetian of Larumbe, Navarra Province, Spain; modified from SMITH et al. 1999). "5 mm" scale bars valid for figures a-c in each row; "1 mm" scale bars valid for figures d and e in each row (a: aboral views, b: oral views, c: right lateral views, d-e: apical disc).

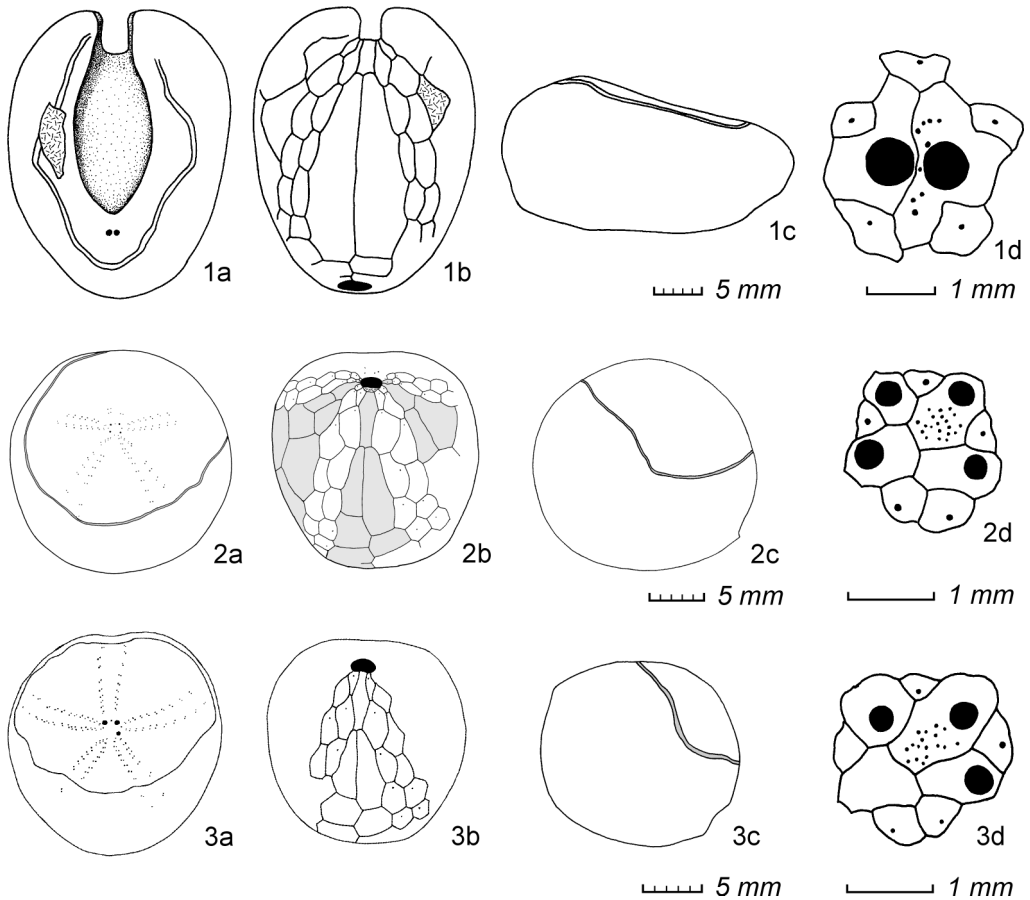


Fig. 3: Comparison with fossil Corasteridae and possible extant Aeropsidae. 1a-d: *Aceste bellidifera* THOMSON, 1877. (CSTUB Dy.Cr.01; extant, Demeraby Cruise, 8° 08' N, 49° 01.85' E, 4438 m depth); 2a-e *Coraster vilanovae* COTTEAU, 1886 (a, c: IPUW 1992/29, b: NHMW 1997z0178/0413, d: NHMW 2002z0200/0006; all from the Late Danian, Paleocene of Haidhof, Lower Austria, Austria; from KROH 2001); 3a-d: *Orthaster dagestanensis* MOSKVIN, 1982 (a: NHMW 2000z0096/0009, b: NHMW 2000z0096/0004, c: IPUW 1992/27-5 [mirrored for easier comparison], d: NHMWz0200/0005; all from the Late Danian, Paleocene of Haidhof, Lower Austria, Austria; from KROH 2001). "5 mm" scale bars valid for figures a-c in each row; "1 mm" scale bars valid for figure d in each row (a: aboral views, b: oral views, c: right lateral views, d: apical disc).

**Occurrence:** *Cottreaucorys kollmanni* is known only from the Late Danian at the type location Haidhof in Lower Austria, Austria. The congeneric *C. blayaci* has originally been reported from the Maastrichtian of Algeria (BLAYAC & COTTREAU, 1909). The Maastrichtian age of the type material is, however, highly problematic as the associated fauna indicates an older age. Moreover, ZHAGBIB-TURKI (1987; pers. comm. A.B. Smith, 11<sup>th</sup> March 2004) reported this species from the numerous localities in Tunisia accompanied by abundant planctic foraminifera indicating an upper Coniacian age. Additionally,



*C. blayaci* has been reported from the Maastrichtian of Turkey<sup>3</sup> (AKKUŞ, 1971) and the Coniacian-Santonian of Valencia, Spain (SMITH, "The Echinoid Directory" [[www.nhm.ac.uk/palaeontology/echinoids](http://www.nhm.ac.uk/palaeontology/echinoids)]; age based on associated microfauna, pers. comm. J. GALLEMI 8<sup>th</sup> Oct. 2003). *C. sulcatus* NISUYAMA, 1968<sup>4</sup> from the Maastrichtian of Japan is another possible co-generic species.

Family Schizasteridae LAMBERT *in* DONCIEUX, 1905

Genus *Linthia* DESOR, 1853

***Linthia houzeau* COTTEAU, 1879**

(pl. 2, figs. 4a-c, 5a-c)

- \* 1879 *Linthia houzeau*. – COTTEAU: 10; pl. 1, figs. 27-29
- 1935 *Linthia houzeau* COTTEAU. – SMISER: 87-88; pl. 8, figs. 3 a-h
- 1960 *Linthia* nov. spec. – KÜHN: 164
- 1989 *Linthia houzeau* COTTEAU, 1878. – ROMAN: 303; pl. 1, figs. 7, 9-10
- 2000 *Linthia houzeau* COTTEAU. – SMITH & JEFFERY: 333
- v. 2001 *Linthia* cf. *houzeau* COTTEAU, 1878 – KROH: 425-426; figs. 35-36; pl. 10, figs. 5-6

**M a t e r i a l :** 7 specimens from Haidhof, near Ernstbrunn, Lower Austria [5 specimens in the NHMW coll. (NHMW 2000z0096/0027 to 31) and 2 in the private collection of Walter LUFT, Vienna]

**R e m a r k s :** Two additional specimens of this species could be located in the private collection of Water LUFT, Vienna. Albeit similarly poorly preserved as the specimens described before (KROH 2001), they provide new insight in the morphological variation of this taxon. The five specimens available earlier (KROH 2001) were left in open nomenclature as they differed from the material described by SMISER (1935) and ROMAN (1989) by their less strongly diverging anterior paired petals. The two new specimens, however, show a stronger divergence of the anterior paired petals (diverging at 137° and 147° respectively). Since that feature was the only significant feature differing from *L. houzeau*, the Bruderndorf Fm. material can now be firmly attached to this species.

**O c c u r r e n c e :** Sandstone facies of the Bruderndorf Fm. (Late Danian, Paleocene) at Haidhof (Lower Austria). Late Danian 'Calcaire grossier' of Eysden and Mons, Belgium (COTTEAU 1878; SMISER 1935); Late Danian 'Calcaire de Vigny' of the Paris Basin (ROMAN 1989).

### Conclusions

The two new records fit well into the remaining echinoid fauna of the Bruderndorf Fm., both from the stratigraphic and the biogeographic point of view. *Proccassidulus elongatus* was known only from the Late Danian of Northern Europe until now. As shown in the study of KROH (2003) the echinoid fauna of the Bruderndorf Fm. has affinities to that

<sup>3</sup> This record could not be evaluated since the taxon is mentioned in the text only, without description or illustration.

<sup>4</sup> The type material of this species is poorly preserved and does not allow specific identification according to JEFFERY (*in* SMITH & JEFFERY 2000: 361).

region, as well as to the Caucasus, the Transcaspien region and the Pyrenean Basin. *Galeaster bertrandi*, on the other hand, is a very widespread and long-lived species. It was recorded from the Early Maastrichtian to the Late Danian from all over the European shelf (see above). Its occurrence in the Bruderndorf Fm. echinoid fauna is thus not surprising and fits well with the results of earlier investigations.

The new aeropsid species *Cottreaucorys kollmanni* adds new data on the fossil record and phylogeny of this poorly known group of spatangoids. It is the second oldest species that can be firmly attached to the Aeropsidae. This species and *C. blayaci* link the extant aeropsids and *Sphenaster larumbensis* with the Corasteridae. It seems likely that the Aeropsidae evolved from the latter by acquisition of a subanal heel, elongation of the test and specialisation of the tube feet in ambulacrum III.

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## **Plates**

## Plate 1

Fig. 1: *Cottreaucorys kollmanni* nov. spec.

NHMW 2004z0075/0004

Late Danian, Paleocene of Haidhof, Lower Austria, Austria

a: aboral view, b: oral view, c: oral view, coated with ammonium chloride, d: right lateral view

Fig. 2: *Cottreaucorys blayaci* (COTTREAU in BLAYAC & COTTREAU, 1909)

UPMC J06071/β

Late Cretaceous of Bordj-Sabath, Province of Constantine, Algeria

a: aboral view, b: oral view, c: right lateral view

Fig. 3: *Cottreaucorys blayaci* (COTTREAU in BLAYAC & COTTREAU, 1909)

UPMC J06071/γ

Late Cretaceous of Bordj-Sabath, Province of Constantine, Algeria

a: aboral view, b: oral view, c: right lateral view

Fig. 4: *Aeropsis rostrata* (THOMSON, 1877)

CSTUB W.Cy.09

Extant, Walda Cruise, 19° 10,3' S, 9° 18.1' E, 4613 m depth

a: aboral view, b: oral view, c: right lateral view

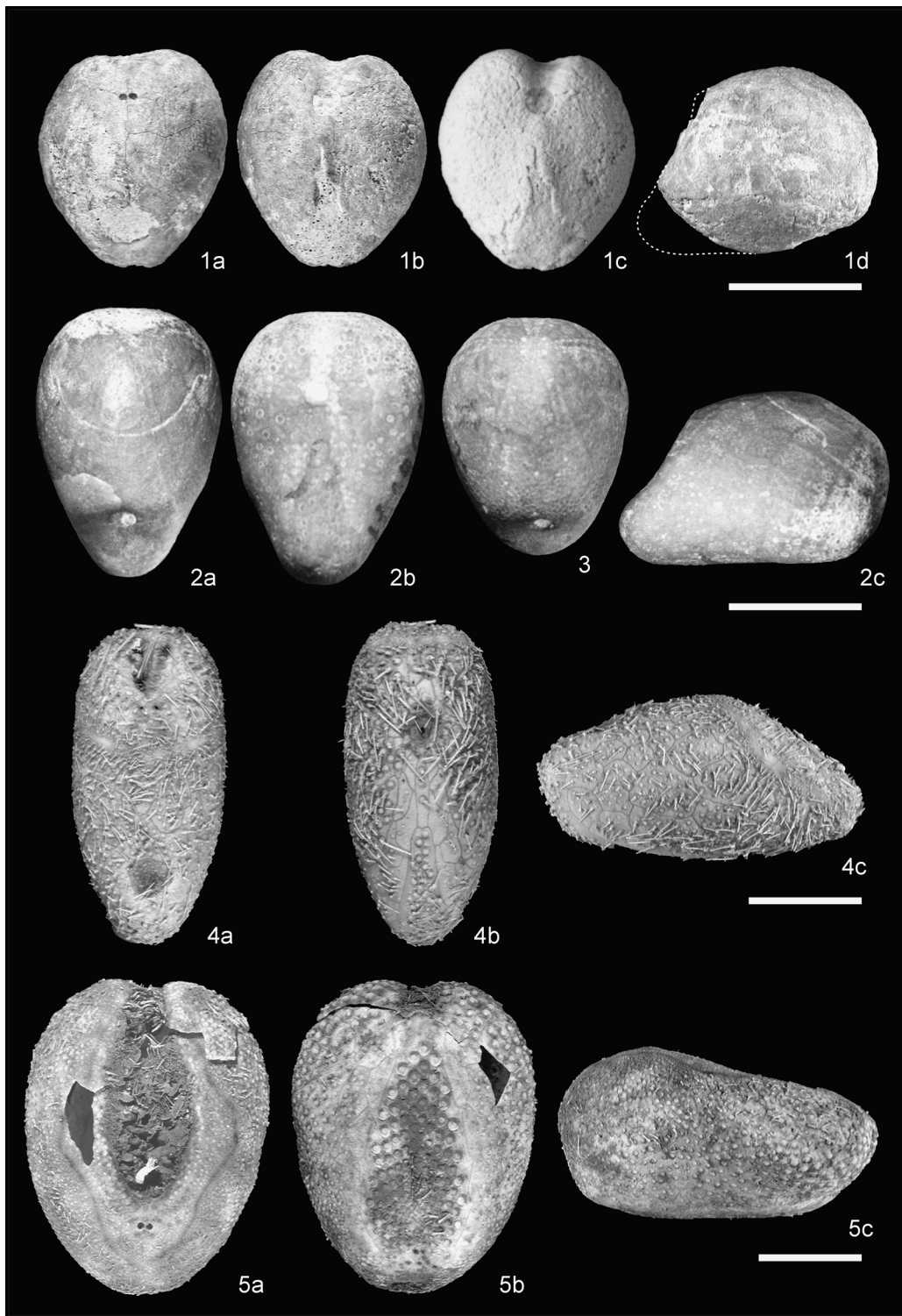
Fig. 5: *Aceste bellidifera* THOMSON, 1877

CSTUB Dy.Cr.01

Extant, Demeraby Cruise, 8° 08' N, 49° 01.85' E, 4438 m depth

a: aboral view, b: oral view, c: right lateral view

scale bars in each row equal 10 mm



**Plate 2****Fig. 1: *Adelopneustes montainvillensis* (SORIGNET, 1850)**

NHMW 2004z0075/0001

Late Danian, Paleocene of Haidhof, Lower Austria, Austria

a: aboral view, b: oral view, c: right lateral view; all coated with ammonium chloride

**Fig. 2: *Procassidulus cf. elongatus* (d'ORBIGNY, 1856)**

NHMW 2004z0075/0002

Late Danian, Paleocene of Haidhof, Lower Austria, Austria

a: aboral view, b: left lateral view; all coated with ammonium chloride

**Fig. 3: *Galeaster bertrandi* SEUNES, 1889**

NHMW 2004z0075/0003

Late Danian, Paleocene of Haidhof, Lower Austria, Austria

a: aboral view, b: oral view, c: right lateral view; all coated with ammonium chloride

**Fig. 4: *Linthia houzeau* COTTEAU, 1878**

coll. W. Luft, Vienna

Late Danian, Paleocene of Haidhof, Lower Austria, Austria

a: aboral view, b: oral view, c: right lateral view

**Fig. 5: *Linthia houzeau* COTTEAU, 1878**

coll. W. Luft, Vienna

Late Danian, Paleocene of Haidhof, Lower Austria, Austria

a: aboral view, b: right lateral view, c: posterior view

scale bars in each row equal 10 mm



