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An erratic Baltic *Eucalyptocrinites*? Goldfuss (Monobathrida, Crinoidea) from the Lower Rhine district, Germany

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Abstract

The Palaeozoic palaeontological diversity of glacio-fluvial erratics in the Lower Rhine (Niederrhein) district of the federal state of Nordrhein-Westfalen (Germany), close to the Dutch/German border, may be locally varied, but can be limited. Nominal crinoids are almost unknown. Most sea lily material is in the form of generally indeterminate external moulds of pluricolumnals and rare thecal remains in various Lower and Middle Devonian sandstone facies types that are often lumped as 'Spiriferen-Sandstein'. An incomplete theca from the Siemes Sand- and Kiesbaggerei at Wemb, close to Weeze and Kevelaer, is here tentatively assigned to the monobathrid camerate genus *Eucalyptocrinites*. The vase-shaped theca has crystal apple-type preservation; some brachial series and large interbrachial plates are apparent; and a central broad canal is rounded in outline. This specimen was probably derived by glacial and/or fluvial action from the east or, more likely, north. Although left in open nomenclature, the specimen is close to *Eucalyptocrinites granulatus* (Lewis) from the Silurian (Wenlock) of Gotland.

Key words: Camerata, Eucalyptocrinitidae, reworked fossil, Quaternary, Silurian

1. Introduction

Context is an essential defining factor in systematic palaeontology. Locality is commonly easily demarcated – specimen X was found here. But what of horizon? A specimen collected *in situ* from within a stratigraphical section may be defined with relative ease. The nominal formation may be determined by reference to the published lithostratigraphical literature; biostratigraphical correlation is enabled by the included fossils. Even float specimens, transported locally under the influence of gravity and/or transported laterally, such as on a beach, may have their correct provenance determined. The most famous example of the former was, of course, the discovery of the Burgess Shale in a float block (Gould, 1989, pp. 70–75; Yochelson, 2001, pp. 48–50).

In general, neighbouring provinces in the Netherlands (Limburg and Gelderland) are poor in *in-situ* Palaeozoic fossils due to a lack of outcrops, but rich in *ex-situ* material. Commonest in the latter category throughout the Netherlands are certain richly fossiliferous building stones (Reumer, 2016). Amongst these, pride of place must go to Mississippian (Lower Carbo-

niferous) building stones that include a rich diversity of marine invertebrates, such as brachiopods, gastropods, corals (Van Ruiten and Donovan, 2018) and crinoids (Donovan, 2020). Much less common are erratic fossils found in fluvial settings (Van der Lijn, 1986; Jagt et al., 1994, 2019; Donovan et al., 2016; Reumer et al., 2020), on the coast and in man-made island environments (Donovan et al., 2020).

We therefore consider it significant to record a fossil crinoid found as a glacio-fluvial Baltic(?) erratic in a sand and gravel deposit at Wemb, close to the border between Germany and the Netherlands. Although incomplete, enough is preserved to permit a generic identification with some confidence. This specimen is undoubtedly of pre-Mississippian (Early Carboniferous) age. It is of a type that differs from crinoid remains (external moulds) that are common in several types of sandstone of Early and early Middle Devonian age, commonly referred to as 'Spiriferen-Sandstein'. Examples of such erratics are well represented in gravel deposits of the rivers Maas (Meuse) and Rhine (Van der Lijn, 1986; Jagt et al., 2019). Amongst erratic fossils of a northerly provenance, transported by glaciers during the Pleistocene, identifiable mid-Palaeozoic crinoids are rare. Schuijf and Boelens (1949, pp. 116–117, fig. 70; see also Hucke and Voigt, 1967, pl. 23, fig. 1) listed only *Crotalocrinites* spp. preserved as disarticulated pluricolumnals.

2. Locality and horizons

In mid-January 2018, one of the authors (Eduard T. M. Messemaeckers: E.T.M.M.) and his field associate, Sjeng Smits of Venray (the Netherlands), searched for erratics at Siemes GmbH & Co. Kommanditgesellschaft Sand- und Kiesbaggerei at Wemb, Germany, close to Weeze and Kevelaer (Nordrhein-Westfalen; Fig. 1) and just south-west of Weeze Airport. This quarry, operated by a Dutch combination, is located less than a kilometre from the German-Dutch border and is part of four other so-called projects. It is a dry excavation, which means that the groundwater is not affected. Since 1992, sand and gravel have been extracted here to a depth of approximately 7 m. The sand and gravel excavated are put on conveyor belts and transported to the forecourt, where

Fig. 1. Features and specimens of Siemes GmbH & Co. Kommanditgesellschaft Sand- und Kiesbaggerei at Wemb (Weeze, Nordrhein-Westfalen, Germany). **a,** the weighbridge and administration building of the Siemes gravel pit. **b,** various sorting installations on the forecourt. **c,** some Siemes finds in the collection of E.T.M.M., such as polished Rhine agates, Mississippian goniatitids and a few hair quartz. **d,** the rare Ordovician sponge, *Zittelella* cf. *typicalis* Ulrich and Everett, 1890 (compare Koops and Rhebergen, 2006).

both are sorted and subsequently dumped. Until a few years ago, finds from Quaternary gravel deposits at this site were diverse, but more recently a notable decline in specimen richness and variety has set in. An exception to this were Mississippian (Early Carboniferous) goniatitid ammonites (see, for example, Burger, 2012) and Rhine agates, both small and large (Fig. 1c). The principal discovery of that morning in January 2018 was the crinoid cup, described below; it was recovered by (E.T.M.M.) in the gravel fraction 16/32, which reflects the size, in millimetres, of isolated pebbles and cobbles.

From information obtained subsequently, it appeared that this specimen had been excavated at the site. Judging from the geological map of the Weeze area (http://www.geologie-digital.de/regionaleGeologie/weeze/geologie.html), the Siemes gravel pit deposits represent the 'Niederterrasse mit überwiegend sandigen Deckschichten' ['Lower Terrace with a predominantly sandy cover'] and 'Jüngere Hauptterrasse' ['Younger Main Terrace'], of Early Pleistocene age. During the Saalian glaciation (late Middle Pleistocene, 0.238–0.126 Ma), the Scandinavian ice sheets penetrated as far south as the Lower Rhine district, the Weeze area being only a few kilometres to the west of the maximum extent of the glacier. In post-Saalian times, the area remained free of northerly ice sheets (compare Klostermann, 1992; Skupin and Zandstra, 2011; http://www.geologie-digital.de/regionaleGeologie/dinslaken/quartaer.html; http://avn.geo.uu.nl/13geologie/55/55.html; https://geopaden.nl/portal/stuwwal/index.php/nl/geologie/64-saalien-glaciaal; all accessed March 15th, 2020). It is a well-known fact that, also at Siemes, gravel fractions have been excavated elsewhere – for instance, in the province of Gelderland, between the cities of Nijmegen and Arnhem (Mr Jos Siemes, personal comment to John W. M. Jagt, February 2020) – are dumped and handled. This may explain the presence of fossils of a northerly/north-easterly origin at a site where normally only material brought from the south and south-east (northern France, Belgian Ardennes and southern and west-central Germany) by the rivers Rhine and Meuse are processed.

3. Material and methods

The single specimen is described and illustrated as collected; it has not been coated for photography (Fig. 2). The images were taken with a Canon G11 digital camera in natural light. The specimen is registered in the collections of the Naturalis Biodiversity Center, Leiden, the Netherlands (prefix RGM), RGM.1320210.

Terminology of the morphology of the crinoid endoskeleton follows Ubaghs (1978a), Hess et al. (1999) and Fearnhead (2008). Our philosophy of open nomenclature follows Bengtson (1988).

4. Systematic palaeontology

Class Crinoidea J.S. Miller, 1821
Subclass Camerata Wachsmuth and Springer, 1885
Order Monobathrida Moore and Laudon, 1943
Family Eucalyptocrinitidae Roemer
in Bronn and Roemer, 1855

Genus *Eucalyptocrinites* Goldfuss, 1831

Type species: *Eucalyptocrinites rosaceus* Goldfuss, 1831, p. 214, pl. 64, fig. 7, by monotypy, from the Lower Devonian (Pragian/Eifelian; see 'Discussion' below) of north-west Germany (Ubaghs, 1978b, p. T495; Webster and Webster, 2014, pp. 1082, 1094).

Other nominal species: Webster and Webster (2014) listed about 50 further nominal species of *Eucalyptocrinites*, plus numerous specimens left in open nomenclature.

Diagnosis: (After Ubaghs, 1978b, pp. T495–T496.) "First primibrachs invariably present in Silurian species, may be absent in Devonian representatives; single interbrachial plate in each ray subequal in shape and size to pairs of distal interprimibrachs in each interray. Tegmen composed of 1) 4 large plates forming roof over viscera (recorded only from *E. crassus*), 2) 10 high, riblike plates resting against 4 lower tegminal plates (which they conceal) and cup, 3) shorter ribbed plates capping higher riblike ones to form apex of tegmen and meeting around central opening, which may be protected by special anal plates or raised on anal tube."

Remarks: For a recent discussion of this genus, see Donovan et al. (2012, pp. 191–192).

Range: Silurian (Llandovery to Niagaran) of North America; Lower Silurian (Wenlock) to Middle Devonian

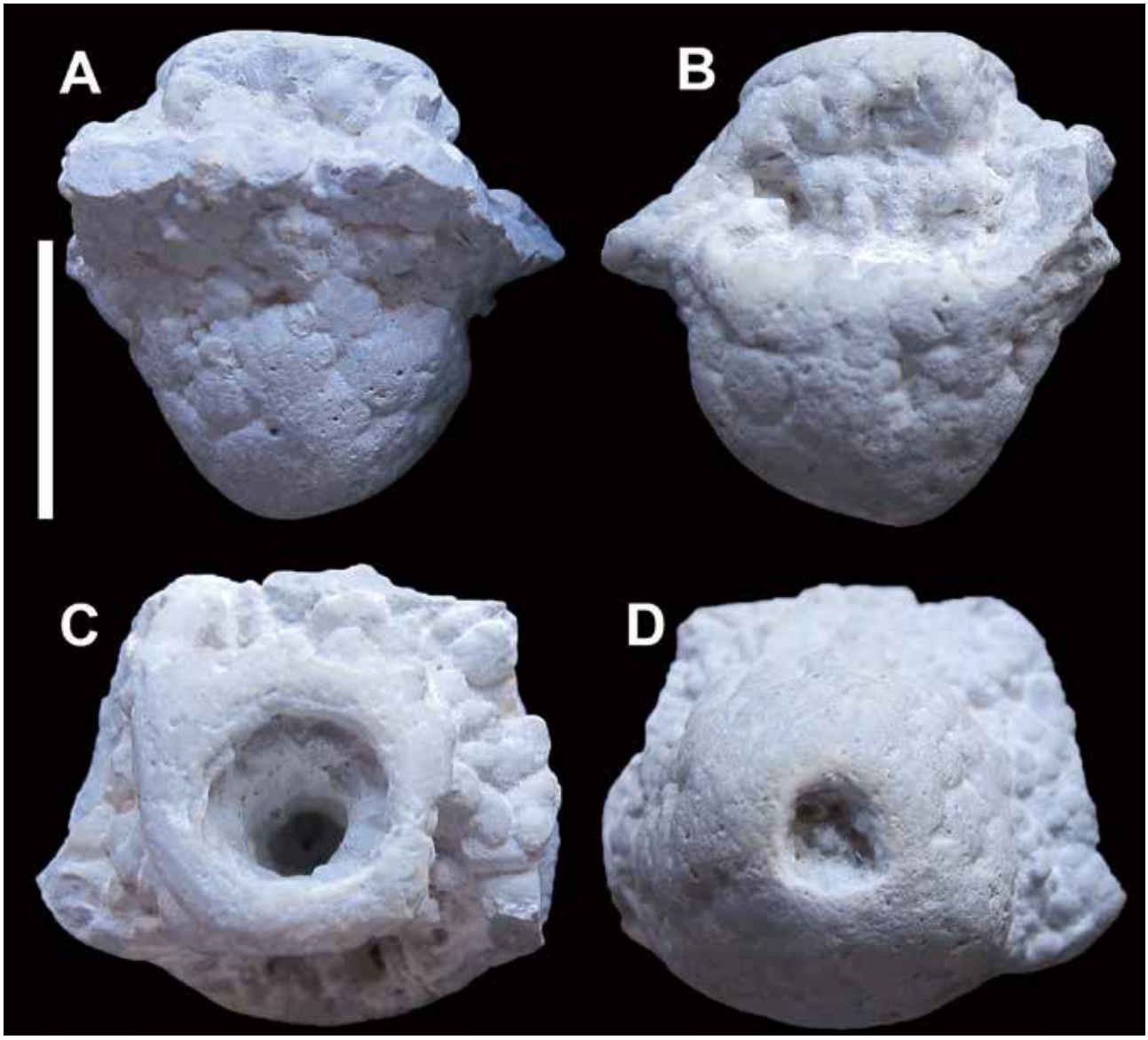

Fig. 2. *Eucalyptocrinites*? sp. from Siemes GmbH & Co. Kommanditgesellschaft Sand- und Kiesbaggerei at Wemb (Weeze, Nordrhein-Westfalen, Germany), RGM.1320210. **a, b,** lateral views; plating poorly apparent and confused by crystal apple overgrowths of calcite, subsequently abraded in transport. **c,** apical view with broad central canal. **d,** basal view showing depression for proximal column. Specimen uncoated. Scale bar represents 10 mm.

(Givetian; Bohatý et al., 2012, fig. 2) of Europe; and Lower Devonian (Pragian) of the Czech Republic, Australia and Russia (Webster and Webster, 2014, p. 1083).

Eucalyptocrinites? sp.

(Fig. 2)

Material: A single specimen, RGM.1320210.

Locality and horizon: Glacio-fluvial erratic fossil at Siemes GmbH & Co. Kommanditgesellschaft Sand- und Kiesbaggerei (Wemb, close to Weeze Airport).

Description: Stem not preserved. Theca poorly preserved and incomplete, abraded crystal apple-type of preservation (Paul, 1980; Donovan and Portell, 2000). Theca rounded vase-shaped, flared outwards (presumably) in region where arms became free (Figs. 2a, b). Base of cup depressed (Fig. 2d), partly filled by calcite crystals, surrounding area worn smooth. Plating(?) apparent more apically, swollen, but confused due to calcite overgrowth; some brachial series and large interbrachial plates apparent. Fixed primaxillary apparent in more than one arm. Free arms not preserved. Central broad canal rounded in outline (Fig. 2c).

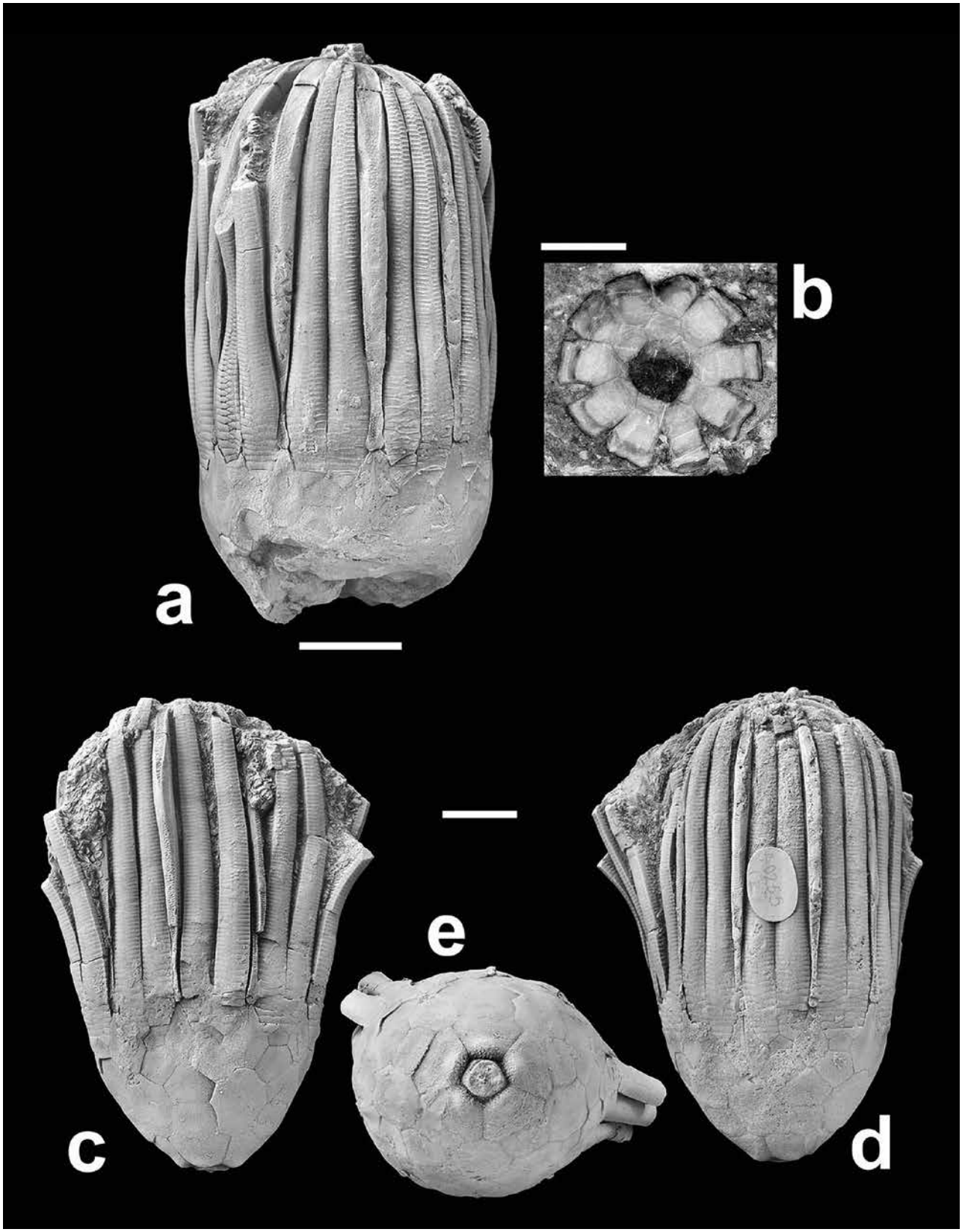

Fig. 3. *Eucalyptocrinites* spp. from the Wenlock (Lower Silurian) of England (after Donovan et al., 2012, pl. 51, figs. 2a, 3b, pl. 52, figs. 1a–c, respectively). Specimens in the collection of the Natural History Museum, London (prefix BMNH). **a, *Eucalyptocrinites granulatus* (Lewis, 1847)**, BMNH 40255(1), lateral view of crown. Specimen whitened with ammonium chloride. **b, *Eucalyptocrinites decorus* (Phillips, 1839)**, BMNH 57038, thin section through crown, presumably from near the apex of the tegmen. **c–e, *Eucalyptocrinites granulatus* (Lewis, 1847)**, BMNH 40255(2): *c*, *d*, lateral views of crown; *e*, basal view of theca. Scale bars represent 10 mm.

5. Discussion

Origins and transport: Reworked Palaeozoic fossils are well known from the border region between Germany (Lower Rhine district) and the Netherlands (provinces of Gelderland, Overijssel and Limburg; Van der Lijn, 1986; Rhebergen et al., 2001; Akkerman, 2012; Burger, 2012). Donovan et al. (2016, p. 344 and references therein) noted that they were "… transported … by Pleistocene glaciers in the north-central and east parts, and the Eridanos River [Wong et al. 2007] in the north and east". Added to that can be material of a southerly origin, from the upper ranges of the rivers Rhine and Maas (Meuse), mostly of Devonian and Carboniferous age.

Identity: The large, multi-plated theca of this crinoid is typical of most camerates (Ubaghs, 1978b). The generic identification of this specimen is based on gross morphology rather than fine detail which is not preserved (compare Figs. 2 and 3). What appears to be an outward flaring of the theca is not a common feature of *Eucalyptocrinites* and, in part, may be a preservational artefact. The most notable feature is the broad canal in the centre of the theca (Fig. 2c) which is typical of, certainly, *Eucalyptocrinites* (Fig. 3b) and, perhaps, other eucalyptocrinitids.

RGM.1320210 is left in open nomenclature as *Eucalyptocrinites*? sp. and is perhaps closest to *Eucalyptocrinites granulatus* (Lewis, 1847) (Donovan et al., 2012, pp. 196–198, text-fig. 84, pl. 51, fig. 2, pl. 52, fig. 1; Figs. 3a, c–e herein), a species known from both Gotland and the English West Midlands. The most likely source area for RGM.1320210 is the Silurian of Gotland (or nearby areas in the Baltic), from which nine nominal species of *Eucalyptocrinites* have been described (Webster and Webster, 2014, pp. 1082–1095). Most of these have a theca that is broad and bowl-like, commonly with a flat bottom (Angelin, 1878) and unlike *Eucalyptocrinites*? sp. The other possible source is the Devonian (Givetian) Hustley Member of the Loogh Formation of the Rhenish Massif (Köln district; see Bohatý et al., 2012), which has yielded one species of relevance, *Eucalyptocrinites rosaceus*. However, *E. rosaceus* has a theca that is broad, flat-bottomed and rather unlike *Eucalyptocrinites*? sp.

Correlation: From the above discussion, the most probable age of RGM.1320210 is Silurian, although there is an outside possibility that it is Devonian. The similar *E. granulatus* is only known from the Wenlock of the English Midlands (Donovan et al., 2012, p. 196), from the Coalbrookdale Formation (Wenlock) of Walsall, West Midlands, and from the Wenlock Shale, Walsall, Staffordshire. Franzén (1983, fig. 2) only recognised *E. granulatus* from the Högklint Formation (Wenlock, Sheinwoodian) of Gotland.

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