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Early Carboniferous (Mississippian) crinoids from Eindhoven, the Netherlands

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Abstract

The geological outcrop of the Netherlands is dominated by Pleistocene and Holocene fluvial, wetland, aeolian and glacial deposits. Mississippian fossiliferous limestones have no exposure *in situ*, but occurrences *ex situ* are locally common as building stones and street furniture. The most important crinoid-rich limestone among these far-travelled relicts is found in Eindhoven railway station. Here are the only crinoid thecae known of this antiquity in the Netherlands. A transverse section of a theca, filled by calcite spar and thus a crystal apple, is likely a monobathrid camerate. The most complete specimen retains the heteromorphic proxistele, a monocyclic cup and proximal arms; it is a platycrinitid monobathrid camerate. Crinoid(?) sp. indet. may be a theca with arms, but is somewhat disrupted. These are the best-preserved fossil crinoids known from Dutch building stones; exotic imports from abroad (south-central Belgium?), ignored every day by myriad passengers more intent on travel than geology.

Key words: systematics, Camerata, Platycrinitidae, facing stones, preservation

Introduction

Searching for fossils in building stones may be a casual entertainment in many countries (such as the UK; for example, Donovan, 2018), but not in the Netherlands. Fossiliferous sedimentary rocks that are *in situ* are rarities in a country whose surface geology is dominated by Holocene and Pleistocene fluvial, wetland, aeolian and glacial deposits (IDG, 1985, pp. 6–7; de Gans, 2007). The search for Palaeozoic fossiliferous rocks is thus reduced to the examination of the right rocks presented as street furniture and facing stones on buildings. It is thus a search for the three dimensional in two dimensions. Examining polished slices and sections are standard techniques for some groups of organisms, such as stony corals; their occurrence in Dutch building stones is well known and specimens may commonly be identified to genus, at least (van Roekel, 2007; Reumer, 2016; van Ruiten and Donovan, 2018). Other groups are more problematic (see, for example, Donovan and Madern, 2017).

Many Dutch building stones are of Mississippian (Early Carboniferous) age, having been imported from Belgium and elsewhere. The Mississippian was, of course, the 'Age of Crinoids' (Kammer and Ausich, 2006) and, indeed, these rocks are commonly rich in the disarticulated ossicles of stalked sea lilies. More complete specimens are much rarer. Hitherto, in almost 18 years in which I have been pursuing Mississippian crinoids in these building stones, the most

complete specimen that I have seen was a long pluricolumnal discovered by my co-workers (Donovan et al., 2017).

Serendipity has now shown the author the specimens that he has been seeking for so long. Changing trains early one morning at Eindhoven and with 15 minutes before my connection, I was inquisitive enough to use my time to examine the dark limestones in the main entrance. The results of this casual inspection are described below.

Terminology of the crinoid endoskeleton follows Moore et al. (1968, 1978), Ubaghs (1978) and Webster (1974). My philosophy of open nomenclature follows Bengtson (1988).

Locality and horizon

The locality is the main entrance to Eindhoven NS (= Nederlandse Spoorwegen) railway station, which is on the south side of the mainline from Utrecht to Maastricht. There are six automatic double doors at the front of the station (Fig. 1B) separated by tall pillars with dark-colored and highly fossiliferous limestone facing stones. The right-hand pillar to the exit on the far left (Fig. 1B) bears notable crinoid remains (Fig. 1A).

These rocks are undoubtedly Mississippian (Early Carboniferous) in age. The limestones have a typical fauna from this interval including abundant crinoid debris, thick–shelled brachiopods (probably productids, but may include some pentamerids), the tabulate coral *Michelinia* sp. and solitary rugose corals. For discussion of the Belgian origins of such facing stones in the Netherlands, at least in Leiden, but undoubtedly of wider applicability, see van Ruiten and Donovan (2018, p. 40–42), amongst others.

Descriptions

Globular theca (Figs 1A (upper right), 2A): A rounded structure, undoubtedly a crinoid theca in more or less transverse section, composed of small, blocky plates with two blunt-ended protuberances (at 5 and 11 o'clock in Fig. 2A). There is one large break in the structure where plating is absent (towards 7 o'clock in Fig. 2A) and other, shorter gaps towards the bottom of the figure. The theca is entirely filled by calcite spar.

Proxistele and crown (Figs 1A (lower left), 2B): A crinoid in longitudinal section. The proxistele (= proximal column) is heteromorphic, being comprised of

Fig. 1. Mississippian limestones of Eindhoven station, the Netherlands. ***A*,** The facing stones that include the specimens discussed herein, marked by (*). Upper right = Fig. 2A; lower left = Fig. 2B; centre left = Fig. 2C. The cane is about 92 cm long. ***B*,** General view of the main exit to the station; the pillar on the right side of the nearest (far left) exit contains the crinoids discussed herein.

columnals of different heights and diameters. The proxistele appears to have a regularly inserted suite of columnals, perhaps N3231323. Nodals are highest and widest *et seq*.; all columnals have convex latera except tertinternodals, in which they are planar.

The cup is broad and is formed of two circlets of large plates; that is, it is monocyclic. The lower plates (=basals) are large and angled away from the proxistele to form a dish-like base to the cup; the attachment with the column is in a central depression. The succeeding radial plates are larger than the basals and nearly parallel to the long axis of the specimen.

One of the radial plates (left in Fig. 2B) supports a sequence of at least four low plates; this is an incomplete arm formed of four proximal brachial ossicles. It is not determinable if the arm was branched. The cup is filled with numerous disarticulated plates, at least some of which are likely debris from a collapsed theca and disarticulated arms.

Theca? (Figs. 1A (lower centre), 2C): Although this

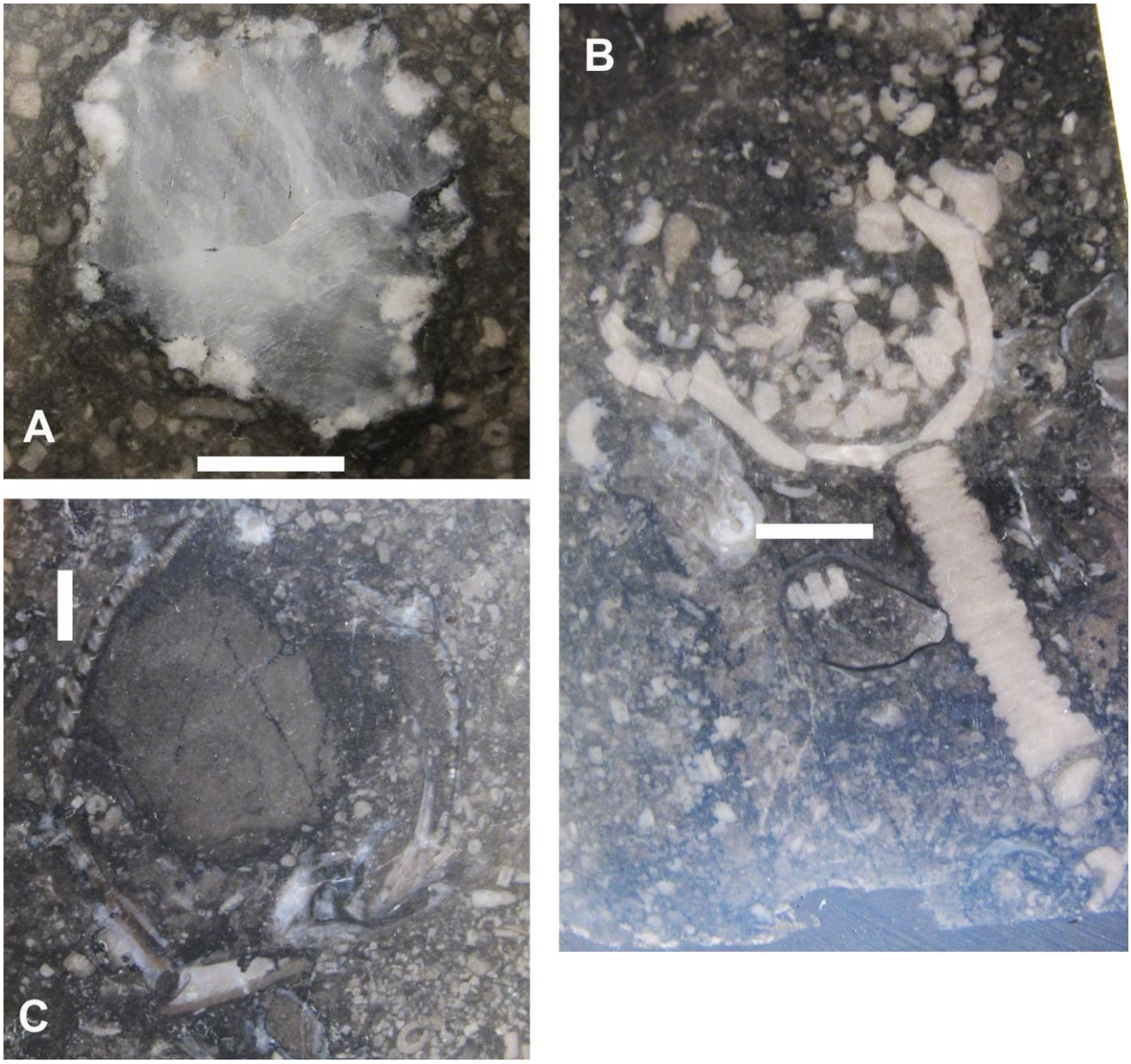

Fig. 2. Mississippian crinoids of Eindhoven station, the Netherlands. ***A*,** Globular theca = monobathrid(?) camerate sp. Arms are towards 5 and 11 o' clock. Note 'crystal apple' preservation. ***B*,** Proxistele and crown = platycrinitid monobathrid camerate. This is rotated 90° anticlockwise from its position in the wall. ***C*,** Theca? = crinoid(?) sp. indet. This is rotated 90° clockwise from its position in the wall. Scale bars represent 10 mm.

is less well preserved, this specimen is comparable to the crown in Figure 2B. Most distinctive is the sequence of plates on the left-hand side which are arm-like (Fig. 2C). A grey, near-featureless central are may be a sedimentary infill of a theca, but there is no regular sequence of plates on any other side except to the right, separated by a broad zone of limestone with disarticulated ossicles. Particularly towards the bottom, a group of large, encircling plates appear disrupted and may represent a collapsed crinoid cup.

Discussion

Exceptionally well-preserved fossils may be found in building stones (see, for example, Donovan and Wyse Jackson, 2018), but they are rare and worthy of record. Each of the specimens discussed above presents different information, but poses different problems of interpretation; crinoids are commonly examined in three dimensions, not two. The globular theca (Fig. 2A) is undoubtedly a section through the multiplated, golf ball-like theca of a camerate crinoid with an armoured tegmen, most likely a monobathrid (monocyclic), which were more common and diverse in the Late Palaeozoic than the broadly similar diplobathrids (dicyclic). The section cuts through two out of five arms (= protuberances), so is likely oblique to the long axis of the crinoid. This, and the uniform small size of the plates, suggests that the section may mainly be through the tegmen; certainly, there is no evidence for the base of the cup and stem attachment. The broad, unplated area (Fig. 2A, lower left) may be the opening of the periproct from which any plating has been disarticulated. The calcite spar infill is a form of preservation commonly known as a crystal apple (Paul, 1980; Donovan and Portell, 2000).

The most complete specimen is illustrated in Figure 2B. The proxistele, cup and a proximal arm are still articulated, and the plates inside the cup may be parautochthonous, derived from a collapsed tegmen and disarticulated arms. The cup is monocyclic, but is unlikely to have been a disparid, which were gracile and uncommon in the Mississippian. Rather, it is certainly a monobathrid camerate, most likely a platycrinitid, which were both common and had large cup plates similar to those of this specimen. Certainly, the saucer-like base and high radials support this interpretation (compare with, for example, Donovan and Westhead, 1987, figs. 1A, B, 2). Although the stems of platycrinitids are best known as being formed from elliptical columnals with synarthrial articulations, the proxistele may be relatively short, circular in section, heteromorphic and with symplectial articulations (see, for example, Wachsmuth and Springer, 1897, pl. 72, figs. 1, 6a).

The third specimen is less well preserved and, in consequence, yet more enigmatic (Fig. 2C). The thick plates represent a somewhat disrupted cup and the two strings of small plates are crinoid arms. This is plausible, albeit it is less certain than those interpretations of the other figured specimens. The grey sedimentary mass is devoid of identifiable crinoid ossicles and there is no stem preserved. I refer to this specimen as crinoid (?) sp. indet.; it does show some similarities to the platycrinitid.

It might well be asked, what is the significance of these specimens, found in a facing stone and only seen in two dimensions? I would suggest that there are at least three features of these specimens that are worthy of note. They are, without hesitation, the best-preserved fossil crinoids ever found in a building stone in the Netherlands. This alone makes them worthy of record.

Further, they must have been imported, as Mississippian limestones are unknown in outcrop in the Netherlands. Thus, and however familiar they may be as building stones, they represent exotic geology. Such fossiliferous limestones have been common exports of many countries over hundreds of years. This rather suggests that the modern legislations of many countries against exporting fossils are an example of closing the stable door after the horse has bolted. (But if such legislations are aimed at vertebrates, particularly dinosaurs, Ice Age mammals and hominins, then perhaps invertebrates ‘don’t count’.)

Thirdly, many hundreds of railway passengers, travelling to and from Eindhoven, pass these specimens every day. Although there are several publications examining the invertebrate palaeontology of building stones in the Netherlands (e.g., van Roekel, 2007; Reumer, 2016), perhaps the casual passer-by needs educating with, say, an information board or a

printed pamphlet? It would be a worthwhile exercise to take such 'citizen science' direct to the people.

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References

Bengtson, P. 1988. Open nomenclature. Palaeontology 31: 223–227.

Donovan, S. K. 2018. Using urban geology: a field guide to Morpeth Railway Station, northern England. Geology Today 34: 97–99.

Donovan, S. K., J. W. M. Jagt, and E. A. Jagt-Yazykova. 2017. A well-preserved crinoid stem in a building stone (Lower Carboniferous, Mississippian) at Maastricht, the Netherlands. Bulletin of the Mizunami Fossil Museum 43: 23–25.

Donovan, S. K., and P. A. Madern. 2017. Rostroconchs in Leiden. Swiss Journal of Palaeontology 135: 349–352.

Donovan, S. K., and R. W. Portell. 2000. Incipient 'crystal apples' from the Miocene of Jamaica. Caribbean Journal of Science 36: 168–170.

Donovan, S. K., and S. Westhead. 1987. *Platycrinites contractus* (Gilbertson) and a new *Platycrinites* from the Lower Carboniferous of northern England. Proceedings of the Geologists' Association 98: 211–215.

Donovan, S. K., and P. N. Wyse Jackson. 2018. Well-preserved fenestrate bryozoans in Mississippian building stones, Utrecht, The Netherlands. Swiss Journal of Palaeontology 137: 99–102.

IDG [Information and Documentation Centre for the Geography of the Netherlands]. 1985. Compact geography of the Netherlands. Ministry of Foreign Affairs, The Hague.

Gans, W. de. 2007. Quaternary. In Wong, Th. E., D. A. J. Batjes, and J. de Jager, eds., Geology of the Netherlands. Royal Netherlands Academy of Arts and Sciences. Amsterdam. p. 173–195.

Kammer, T. W., and W. I. Ausich. 2006. The "Age of Crinoids": A Mississippian biodiversity spike coincident with widespread carbonate ramps. Palaios 21: 238–248.

Moore, R. C., R. M. Jeffords, and T. H. Miller. 1968. Morphological features of crinoid columns. University of Kansas Paleontological Contributions, Echinodermata Article 8: 1–30.

Moore, R. C., with additions by G. Ubaghs, H. W. Rasmussen, A. Breimer, and N. G. Lane. 1978. Glossary of crinoid morphological terms. In Moore, R. C., and C. Teichert, eds., Treatise on Invertebrate Paleontology, Part T, Echinodermata 2(1). Geological Society of America and University of Kansas. Boulder and Lawrence. p. T229, T231, T233–T242.

Paul, C. R. C. 1980. The Natural History of Fossils. Weidenfeld and Nicolson. London.

Reumer, J. 2016. Kijk waar je loopt! Over stadspaleontologie. Historische Uitgeverij. Utrecht.

Roekel, A. van. 2007. Discover Fossils in downtown Amsterdam. Second revised edition. De Vuurberg. Amsterdam.

Ruiten, D. M. van, and S. K. Donovan. 2018. Provenance, systematics and palaeoecology of Mississippian (Lower Carboniferous) corals (subclasses Rugosa, Tabulata) preserved in an urban environment, Leiden, the Netherlands. Bulletin of the Mizunami Fossil Museum 44: 39–50.

Ubaghs, G. 1978. Skeletal morphology of fossil crinoids. In Moore, R. C., and C. Teichert, eds., Treatise on Invertebrate Paleontology, Part T, Echinodermata 2(1). Geological Society of America and University of Kansas. Boulder and Lawrence. p. T58–T216.

Wachsmuth, C., and F. Springer. 1897. The North American Crinoidea Camerata. In three volumes. Memoirs of the Museum of Comparative Zoology, Harvard 20/21: 1–897.

Webster, G. D. 1974. Crinoid pluricolumnal noditaxis patterns. Journal of Paleontology 48: 1283–1288.