

Rostroconchs in Leiden

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Abstract For a land with a dearth of natural rock outcrops, the Netherlands abounds with urban ‘exposures’ of fossiliferous rocks such as building stones, street furniture and street art. In the Rapenburg in Leiden, sections through distinctive shells in Mississippian (Lower Carboniferous) limestones are identified as rostroconch molluscs (Order Conocardioidea). The generic identification is tentative, but the specimens may belong to the genus *Filicardia* Rogalla and Amler, perhaps the common *Filicardia inflata* (M’Coy). The only other mollusc taxon that has been identified from these rocks is the gastropod *Straparollus?* sp.

Keywords Mollusca · Conocardioidea · Mississippian · *Filicardia* · Building stones · Urban geology

Introduction

The Netherlands is not an exciting country for the geologist to visit, lacking as it does natural rock exposures except in the south-east and east. Nevertheless, rocks are a locally common feature of the Dutch environment, having been imported

for use as building stones, street furniture and street art, and studies of the urban geology can be instructive (see, for example, Donovan 2015a, b). Upper Palaeozoic limestones are locally common and fossiliferous in the streets of Dutch cities such as Amsterdam (van Roekel 2007), Leiden (Donovan 2016) and Maastricht (Donovan et al. 2016, in press). The identifiable enclosed fossils are of limited diversity, mainly articulated brachiopods, rugose and tabulate corals, and crinoid ossicles, apart from some rarities.

The examples described herein are among these rarities and have puzzled S. K. D. for many years. On numerous occasions he has led groups of life science B.Sc. and M.Sc. students from the University of Leiden through the street in central Leiden known as the Rapenburg in pursuit of Mississippian invertebrates. Until now, he has professed to be uncertain of the affinity of the sections through shells and discussed herein. That they have now been identified to even class level is due to serendipity, when Karen Robinson brought to S. K. D.’s notice a print of Mississippian fossils on sale at a street market in Amsterdam. The image of a Mississippian conocardioid rostroconch on this print brought instantaneous recognition of the unknown fossils of the Rapenburg.

The rostroconchs (earliest Cambrian to latest Permian) are an extinct group of benthic, univalve molluscs that were not recognized to be distinct from the bivalve molluscs, with which they share a superficially similar gross morphology, until separated from them by Pojeta et al. (1972). We recommend Pojeta (1987) and Amler and Rogalla (2013) as particularly informative introductions to the rostroconchs for the uninitiated. Although rostroconchs resemble bivalves in external morphology, the ‘halves’ were rigidly joined and the living organisms were probably infaunal burrowers, perhaps more analogous in habit to scaphopods than burrowing clams.

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Localities

The specimens (Fig. 1) are in large slabs of imported Upper Palaeozoic limestones (presumed Mississippian; see below). The examples discussed herein are to be found in front of two buildings on the east side of the Rapenburg (numbers 12 and 28), Leiden, the Netherlands, in the relatively narrow areas between the terraced buildings and the public pavement. The latter address is the Rijksmuseum van Oudheden (=Dutch National Museum of Antiquities).

No locality map is included in the present paper, but the Rapenburg will be plainly marked on any street map of central Leiden (e.g., google.nl/maps). Its major landmarks are the Rijksmuseum van Oudheden and the botanical gardens (Hortus Botanicus).

Similar slabs of limestone in front of houses are a common feature of this street, and elsewhere in Leiden and other Dutch cities. In the absence of natural rock exposures, such imported limestones are a common feature of street furniture, such as curb-stones in parts of Amsterdam

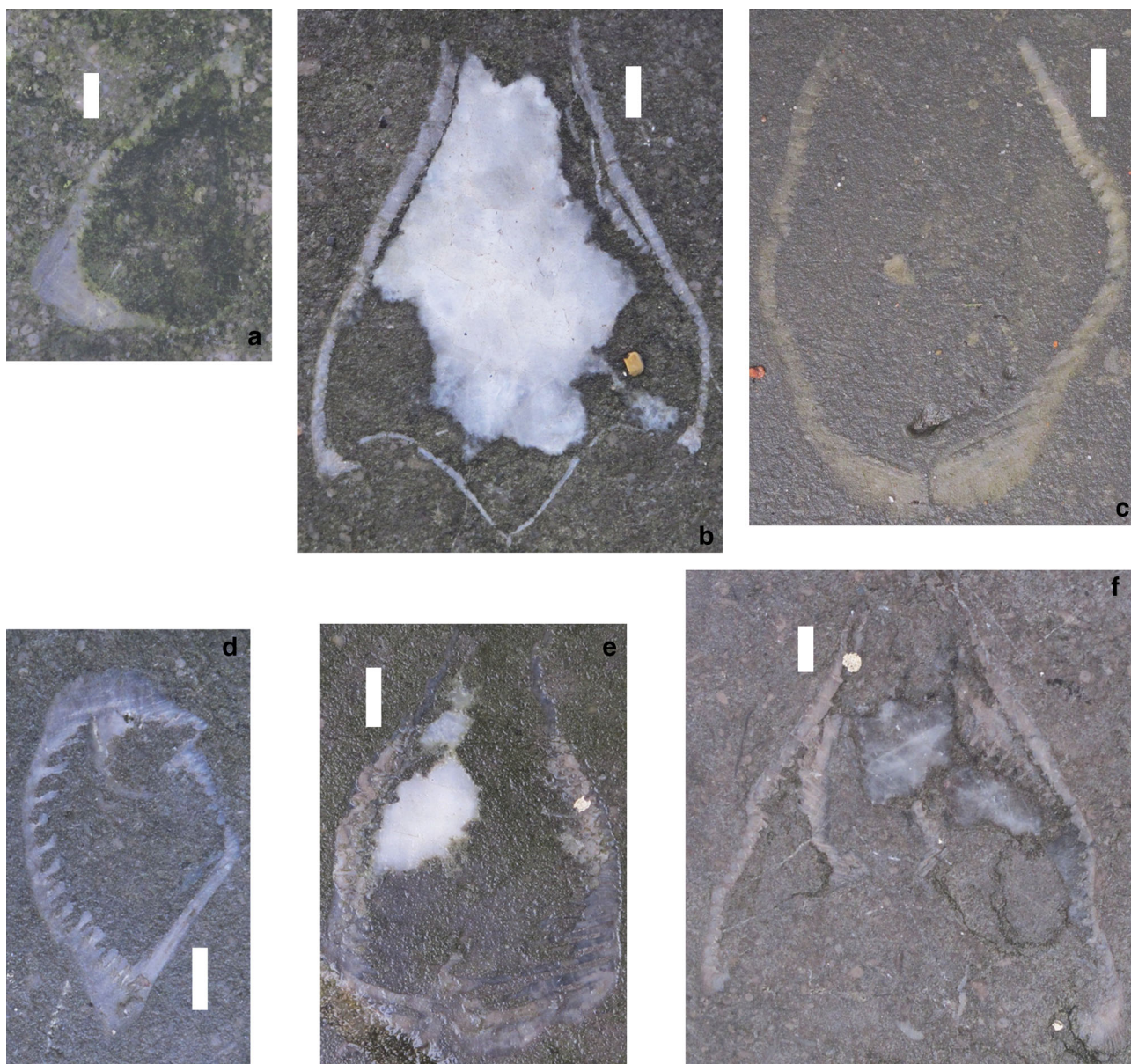


Fig. 1 Sections through rostroconchs, perhaps *Filicardia inflata* (M'Coy), in the Rapenburg, Leiden, the Netherlands. **a** Rapenburg 12. Oblique section through a shell. Structures on inside of shell to left are internal ribs (Pojeta 1987, fig. 14.77D). **b-f** Rapenburg 28, Rijksmuseum van Oudheden. **b, e, f** Antero-posterior sections

(compare with Pojeta 1987, figs 14.69A, 14.75M; Fig. 2 herein). **c** Oblique section showing strong internal ribs (contrast with **a**). **d** Oblique section through a shell. Most possibly, all images with anterior oriented towards *top of the page*. All scale bars represent 10 mm

(van Roekel 2007), and false rock ‘outcrops’ (Donovan 2014a, b).

Descriptions

The shells illustrated in Fig. 1 have an essentially similar gross morphology, taking into account the vagaries of cut effect, orientation and preservation, and most probably represent a single species or, at least, genus. The most complete specimen is shown in Fig. 1b, which is considered to present a good anterior (top) to posterior section (bottom), infilled by both calcite spar (white) and lithified limestone. It cannot be determined which ‘halves’ are left and right sensu stricto, so these terms are used informally herein.

All antero-posterior sections show a bilaterally symmetrical shell with an anterior gape (Fig. 1b, c, e, f). Left and right ‘halves’ diverge posteriorly, and each is more or less curved or sinuous. Strong internal ribs are apparent adjacent to the inner surfaces of some ‘halves’ (compare with Pojeta 1987, fig. 14.79). The shell is broadest close to its most posterior region. The posterior shell is thin, and concave on both the left and right sides, meeting at the most posterior point (Fig. 1b) which was presumably close to the position of the narrow, tubular rostrum (Pojeta 1987, p. 359) which has not been identified in the present specimens.

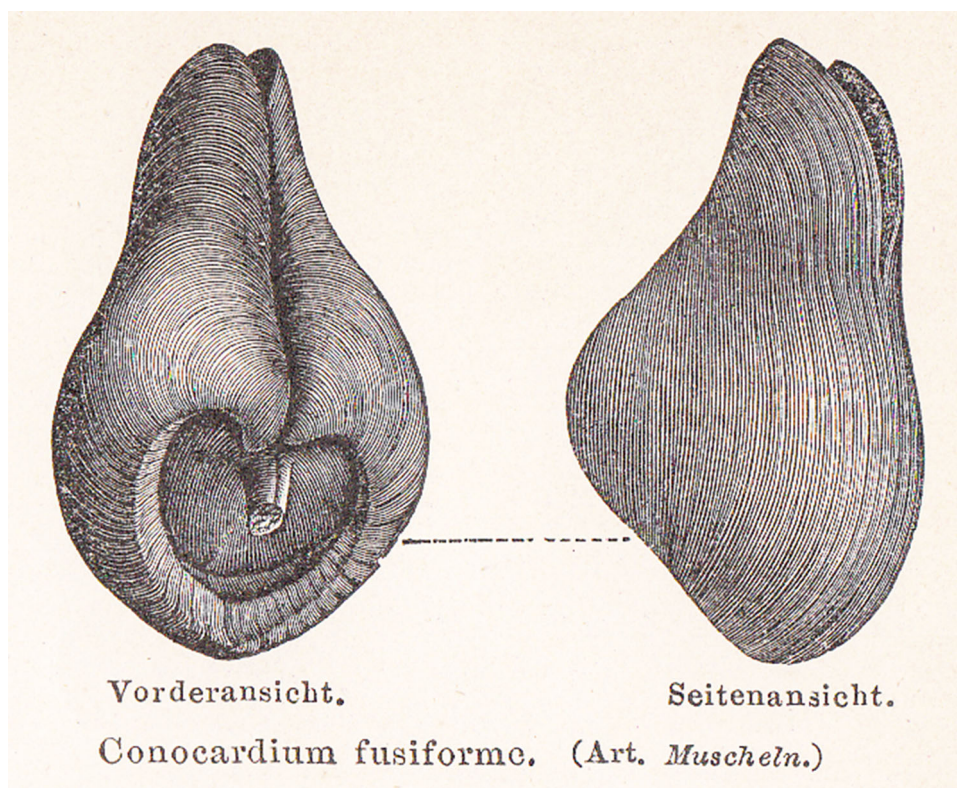
Discussion

The senior author has never knowingly seen a rostroconch in the field, despite having had a research interest in the Mississippian limestones of northern Europe for about 35 years. He uses this in mitigation for the slowness with which he has identified these specimens. Having done so, we note that rostroconchs are locally common in the Rapenburg, whereas we have not noted them in street limestones elsewhere in the Netherlands. We can only conclude that many or most of the Mississippian slabs in the Rapenburg came from a single succession or bed with a moderate number of enclosed rostroconchs; other Dutch street slabs of which we know did not.

We consider the identification of these fossils to be significant for two reasons. We confidently identify these shells as Phylum Mollusca, Class Rostroconchia and Order Conocardioidea. Dr. Michael Amler (written comm.) has suggested the taxon in Fig. 1 may be close to the hippocardioid *Filicardia* Rogalla and Amler 2006, perhaps *Filicardia inflata* (M’Coy 1844). This species is common in the Mississippian of Ireland, England, Belgium and western Germany (Rogalla and Amler 2006, pp. 361–364, figs 9, 10).

Although sections similar to those in Fig. 1 might be expected to be formed by bivalve molluscs, evidence for disarticulated valves would also be expected; there are

Fig. 2 Detail of a Mississippian (Lower Carboniferous) rostroconch, *Pleurorhynchus fusiformis* M’Coy 1844 (see Amler and Rogalla 2004), a *nomen dubium* (Rogalla and Amler 2007, pp. 42–43, fig. 19), presumed natural size, from Anon (1885–1890, plate ‘Steinkohlenformation 1’). This figure is based on M’Coy’s original illustrations. Anterior towards top of page



none. Rather, these specimens are identified as antero-posterior sections of *Filicardia*-like shells (compare with Fig. 2); other sections would be less diagnostic and have not been recognized. While some taxa are typically studied in section, such as corals and foraminiferans, this is not generally true of benthic molluscs. However, some are readily identifiable to major groups in section, such as the gastropods and ammonoids, to which can now be added the conocardioids.

Further, recognition of these rare molluscs adds to the ongoing determinations of the biodiversity of these (presumably) coeval limestones of the Rapenburg. While some groups are identifiable to genus by the use of keys and guides, such as the rugose and tabulate corals using Mitchell (2003), the identities of benthic molluscs are proving difficult to determine. Thus, even the tentative identification discussed above is considered a noteworthy step forward. Only one other mollusc has been identified from these rocks and that is similarly tentative, the gastropod *Straparollus?* sp. (Donovan et al. 2017, in press).

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