

Crinoids from the type area of the Costonian (Upper Ordovician), south Shropshire, England

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Abstract

A limestone in the Coston Formation (Costonian Substage, lower Caradoc Series, lower Upper Ordovician) in the Onny Valley, south Shropshire, England, is rich in crinoid ossicles with syntaxial calcite overgrowths. This limestone is an unusual lithology in an otherwise siliciclastic succession. Further, the limestone is particularly rich in uniserial brachials, whereas most formations in this sequence yield columnals (preserved as natural moulds). Four brachial morphologies are illustrated, probably derived from disparids and/or cladids. Rare columnals are reminiscent of the two crinoid morphospecies described from this formation, *Cyclocyclicus* (col.) *radius* Donovan and, less likely, *Ramulicrinus* (col.) *costonensis* Donovan, but linking brachials in thin section to columnal morphotaxa described from external moulds is conjectural.

Key words: brachials, Aurelucian, Caradoc, morphology, limestone

Introduction

Few identifiable crinoid cups and crowns are known from the Caradoc (Upper Ordovician) of the British Isles, and most evidence for their presence comes from their disarticulated columnals (Donovan, 1986–1995; diversity and stratigraphy summarized in table 7C). The earliest crinoids from the historical type area of the Caradoc are from the upper part of the Coston Formation at Coston Farm Quarry, south Shropshire. This is the type section of a formation which rests unconformably on the Precambrian throughout its outcrop area. The Coston Formation at this site has yielded columnals described as the morphospecies *Ramulicrinus* (col.) *costonensis* Donovan, 1995, *Cyclocyclicus* (col.) *radius* Donovan, 1989, and *Cyclocyclicus* (col.) sp. C in Donovan, 1989.

Herein, I add a new source of evidence of the diversity of these earliest Caradoc crinoids, provided by brachials, indeterminate ossicles and rare columnals seen in thin section from a second quarry section, albeit about 6.5 km northwest of the type section. Unusually for the Ordovician of the historical Caradoc type area, these ossicles were found in a limestone, a rare occurrence in a succession of mainly siliciclastic rocks preserving fossils as moulds. Even rocks called ‘limestones’ in this area are commonly sandstones with a rich shelly fauna that has not been decalcified, such as the slightly younger Alternata Limestone.

Terminology of the morphology of the crinoid endoskeleton follows Moore *et al.* (1978) and Ubaghs (1978). Specimens

discussed herein are deposited in the Department of Geology, Netherlands Centre for Biodiversity - Naturalis, Leiden (RGM). See Donovan (1986, p. 17) for explanation of the ‘(col.)’ suffix for crinoid morphogenera.

Locality and horizon

The crinoid specimens discussed herein are from locality 113 of Dean (1968, pp. 30, 32, fig. 17), south of Horderley, Onny Valley, Shropshire, England (NGR SO 412 861, 1:50,000 topographic sheet #137, ‘Ludlow and Wenlock Edge’). This disused quarry is about 50 m west from the abutments of a demolished railway bridge and on the southwest bank of the River Onny. Massive, decalcified sandstones of Costonian age dip steeply towards the southeast. A grey limestone forms part of this exposure and is about 250 mm thick. Rock samples from this limestone were used to make petrographic thin sections. Dean (1964, p. 274, 1968) made no mention of this limestone and (1968, p. 30) referred these rocks to the “Hoar Edge Grits or Coston Beds”, that is, Coston Formation in modern usage (Fortey *et al.*, 2000, fig. 14, column 35, ‘Caradoc (south)’). Costonian Substage, upper Aurelucian Stage, lower Caradoc Series, lower Upper Ordovician.

Description

The ossicles discussed herein have been examined in five petrographic thin sections, made in the early 1980s, of a grain-

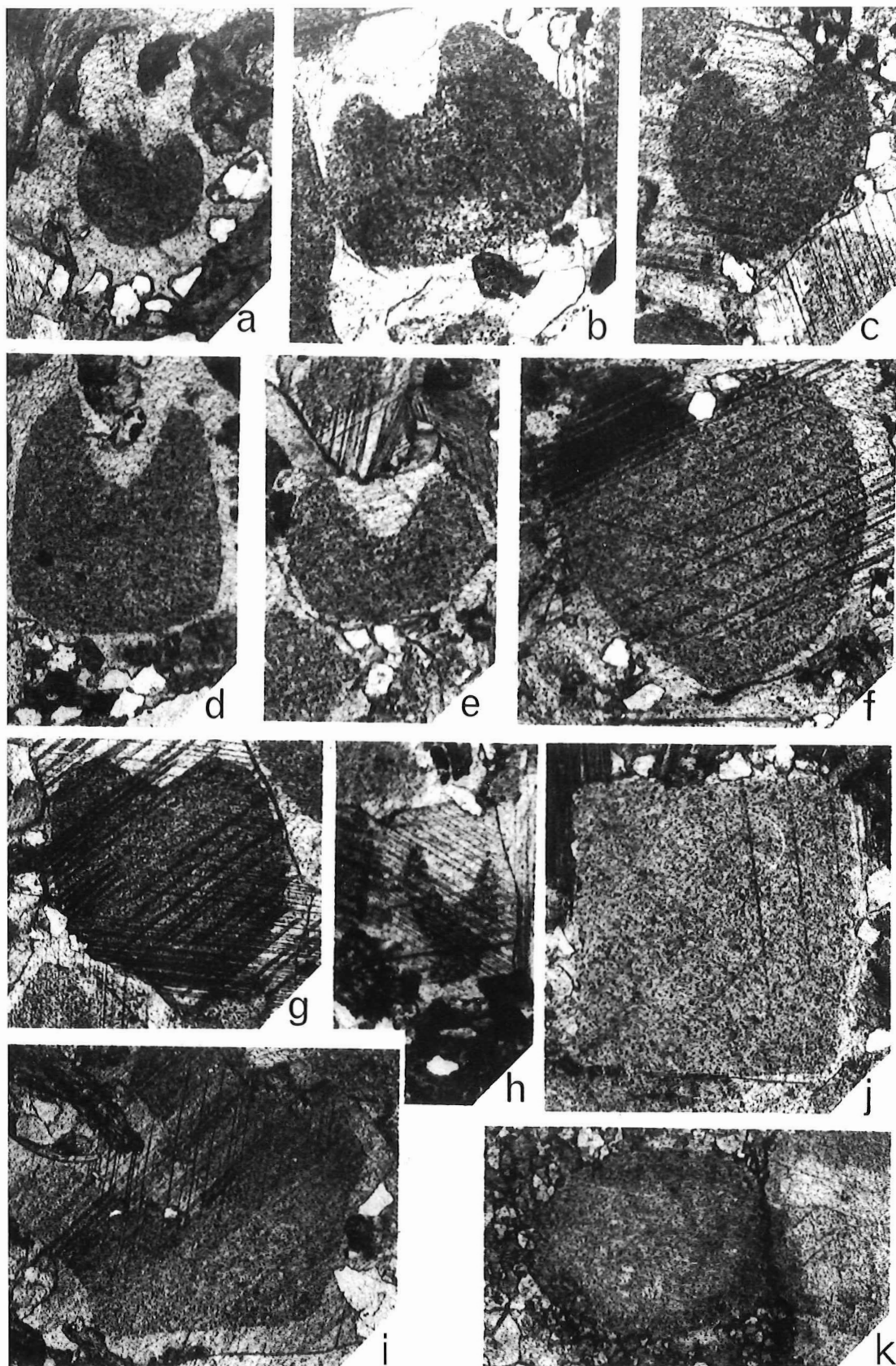


Fig. 1. Disarticulated crinoid ossicles in thin section from the Coston Formation (Costonian, Upper Ordovician) exposed south of Horderley, Onny Valley, Shropshire, England (after Donovan, 1983, pl. 19). a-i, brachials. a, RGM [617 970d]. b, RGM [617 970a]. c, RGM [617 970b]. d, RGM [617 970e]. e, RGM [617 970c]. f, RGM [617 970c]. g, RGM [617 970 slide uncertain]. h, RGM [617 970e]. i, RGM [617 970b]. j, k, indeterminate ossicles. j, RGM [617 970c]. k, RGM [617 970 slide uncertain]. All $\times 40$.

supported bioclastic limestone with common quartz grains. Ossicles can be conveniently be divided into three groups, brachials, columnals and indeterminate ossicles. Other bioclasts include bryozoans, trilobites and brachiopods.

Brachials: The most prominent echinoderm fossils in these thin sections are a diverse array of brachials derived from uniserial crinoid arms (Fig. 1a–i). The range of morphologies is sufficient to suggest that more than one species is present. These sections can be grouped into four morphologies, as enumerated. Morphologies 1 and 2 are the most common; two rare morphologies are noted, but not discussed.

1. Rounded brachials with or without an aboral keel and with a relatively shallow, open V-shaped adoral groove (Fig. 1a, c, f, g).
2. More rectangular brachials with a flattened aboral surface and an asymmetrically developed adoral surface with a shallow to deep, U- to V-shaped adoral groove (Fig. 1b, d). Figure 1h has a narrower aboral surface and may be from a more distal part of an arm.
3. Brachials with a well-rounded aboral surface and a moderately deep, open V-shaped adoral groove (Fig. 1e).
4. Brachial with a strongly angular aboral surface and a deep, V-shaped adoral groove (Fig. 1i).

Columnals: Recognizable columnals are less common than brachials. Donovan (1995, p. 157) considered that only cyclocyclic columnals were to be found. The most prominent of these (RGM [617 970b]) is the largest crinoid bioclast in these thin sections, a transverse section about 3.5 mm in diameter. Although features of the articular facet are not apparent, this could conceivably be *Cyclocyclicus* (col.) *radius* Donovan, but the lumen is relatively narrower and more rounded hexagonal in outline than the holotype. It may be derived from a more distal part of the column.

There is at least one section perpendicular to the articular facet of a columnal, but not through the (presumed) narrow lumen, that shows a deeply depressed areola area (RGM [617 970e]). Latera are convex, rounded and high compared with the thinness of the columnal in the areola area. This specimen was presumably a nodal or priminternodal of a heteromorphic column, lower order internodals fitting into the depression. This has similarities to *Ramulicrinus* (col.) *costonensis* Donovan, which, however, has areolae arrayed as five 'petals' (Donovan, 1995, text-figs. 50A, C, G), structures that are not apparent in the Onny Valley specimen. Although the mouldic preservation of the type series of this species would not have preserved small internodals situated between columnals, RGM [617 970e] may more likely represent an undescribed species.

Indeterminate ossicles: Many ossicles demonstrate undoubted echinoderm stereom microstructure, but are indeterminate (Fig. 1j, k). They are probably non-diagnostic sections through brachials, columnals, etc.

Discussion

The Caradoc succession of the Onny Valley preserves a suite of crinoid ossicles, mainly disarticulated columnals (Donovan, 1986–1995), but also brachials and, most complete, as pluricolumnals; distinctive taxa are unique to each formation. It is presumed that all the Costonian ossicles discussed above (Fig. 1) were derived from one or more species of crinoids in the absence of evidence for other echinoderm groups. These specimens add to the morphological diversity of crinoid remains known from the type area of the Costonian without adding to the nominal biodiversity. Brachials have not been described from the Coston Formation before. Crinoid columnals from the type section are preserved as external moulds in sandstone and are studied by taking latex rubber casts. The difficulty of comparing the rare columnal specimens seen in thin sections to latex casts was exacerbated by syntaxial calcite overgrowths (Bathurst, 1971, pp. 429–431; Fig. 1 herein) of ossicles that precluded any prospect of exposing recognizable columnals by acid etching of the limestone surface.

The limestone in the Coston Formation from the Onny Valley is unusual in the British Ordovician for the dominance of brachials; siliciclastics and other limestones contrast in containing many columnals and few brachials, such as the Ashgill Rhiwlas Limestone of North Wales (Donovan, 1986–1995). The figured brachials from the Onny Valley are derived dominantly from uniserial arms, suggesting a disparid or cladid origin(s). *Ramulicrinus* (col.) *costonensis* has an *Iocrinus*-like articular facet (compare Donovan, 1995, text-fig. 50A, C, G with Donovan & Gale, 1989, text-fig. 4D), so a disparid origin for some brachials is likely. For example, the brachials in Figure 1d and h (=Morphology 2) could conceivably come from an *Iocrinus*-like arm (compare with Donovan & Gale, 1989, text-fig. 5E). Some of the rarer or less distinctive, curved plates in these slides may be derived from biserial arms, although this is less certain.

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