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Significance of crinoid preservation: Clare Shale Formation (Upper Carboniferous), Fisherstreet Bay, Doolin, County Clare, Ireland

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ABSTRACT

Some fossils, such as crinoid stems, are not widely appreciated by collectors and researchers, yet can provide unique data regarding taphonomy and palaeoecology. A long crinoid pluricolumnal showing a distinctive pattern of preservation was collected from the Clare Shale Formation (Upper Carboniferous) at Fisherstreet Bay, Doolin, County Clare, western Ireland. The specimen is partly disarticulated and represents the mesistele to mesistele/dististele transition; attachment was by unbranched long, slender radices; pluricolumnal heteromorphic; fragments of pluricolumnal are of multiples of a unit length. This specimen, *cladid?* sp. indet., slumped to the seafloor after death and started to disarticulate as ligaments rotted. By reference to the broken stick model, the pattern of disarticulation suggests that the noditaxis of the heteromorphic stem was N212.

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1. Introduction

There are fossils that are beautiful and those that provide information; many specimens contribute to both. Beauty is in the eye of the beholder and there are many beautiful fossils. We all have our favourites, but surely ammonites, trilobites and echinoids are among the most popular invertebrates, collected by professionals, amateurs and the general public. In consequence, these groups have also been studied in detail by several palaeontologists and have been the subject of many semi-popular volumes for the general reader (such as Fortey, 2001) as well as serious palaeontological treatments.

In contrast, there are those fossil groups that set few hearts racing and which, to be frank, are commonly ignored. Even if found in the field, they are the fossils that may be left behind; it is burdensome to collect them. Again, we suggest a list, this time of palaeontological non-favourites, including crinoid stems, bryozoans, acorn barnacles and borings. Yet each of these ignored specimens represents a source of data and data ignored is data lost.

The present authors consider that they can recognise a source of noteworthy palaeontological data when they see one. The crinoid pluricolumnal described herein was collected from float by E.N.D. for precisely this reason. It is noteworthy in several ways, and

important to describe, analyse and record, but many would have passed over it and moved on to the next trilobite.

Terminology of the morphology of the crinoid stem and columnals follows Moore et al. (1968, 1978), Ubaghs (1978) and Webster (1974). Our philosophy of open nomenclature follows Bengtson (1988).

2. Locality and horizon

(Adapted from Donovan and Doyle, 2019, p. 697.) The specimens are from a loose block of dark grey/black shale from the Clare Shale Formation (Sevastopulo, 1981, p. 173 *et seq.*) found on the storm beach at the base of the exposed cliff section at Fisherstreet Bay, Doolin, County Clare, western Ireland (Donovan and Doyle, 2019, figs 1, 2). The Clare Shale Formation is approximately 10 m thick at Fisherstreet, Doolin. The lithology is dark grey/black shales with carbonate nodules common in some horizons. Abundant thin fossiliferous bands contain dense accumulations of ammonoids, often with plant remains, uncommon orthoconic nautiloids, bivalves, trilobites, crinoids, rare corals and shark teeth. Ammonoids at Fisherstreet Bay indicate an ammonoid biostratigraphic upper horizon of the section as R1a and a lower horizon of H2c (Kinderscoutian and Alportian regional substages, respectively, of the Bashkirian Stage). Conodonts show the Clare Shale Formation to be Serpukhovian to Bashkirian, spanning the mid-Carboniferous (Mississippian to Pennsylvanian) boundary in the more central parts of the Shannon Basin (Fallon and Murray, 2015).

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3. Description

The specimen, RGM.unnumbered (specimen registration number will be inserted once the Covid-19 crisis has ended) (Fig. 1), is a long (c. 220 mm), partly disarticulated crinoid pluricolumnal,

preserved in a disturbed line, in original calcite, coated with diagenetic calcite (which obscures detail) and as external moulds. Columnals circular in section. Articulation radial symplectial, with short, unbranched crenulae; broad sunken, circular claustrum; other features of articular facet not seen. Latera unsculptured,

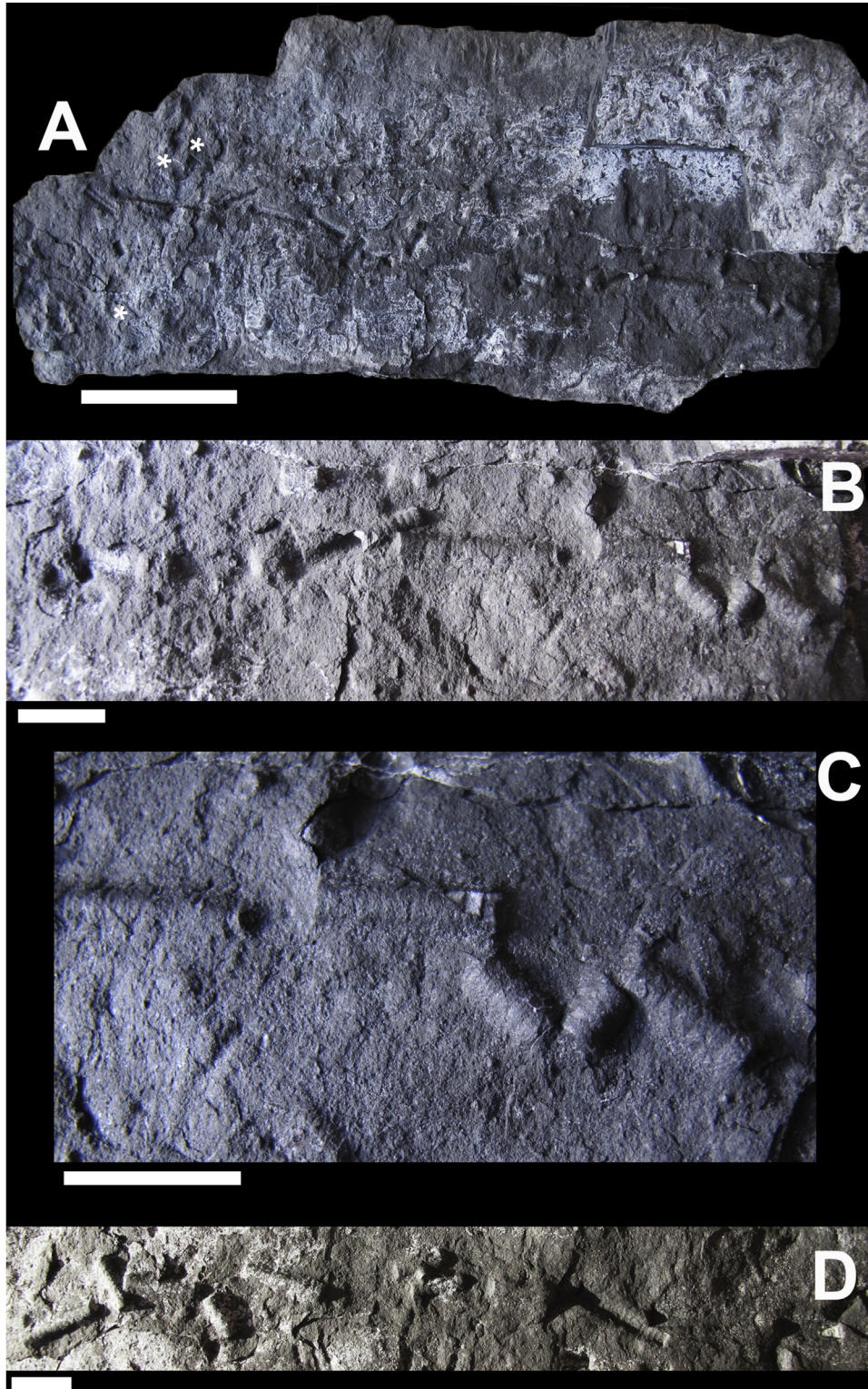


Fig. 1. Partially disarticulated crinoid pluricolumnal, cladid? sp. indet., collected from float. Clare Shale Formation at Fisherstreet Bay, Doolin, County Clare, western Ireland. (A–C) RGM.unnumbered a, the most complete slab. (A) Bedding surface showing the full extent of the pluricolumnal. Probable radices are indicated thus (*). Scale bar represents 50 mm. (B, C) Enlargements of details of the zig-zag pattern of disarticulation to the right in (A). (D) RGM.unnumbered b, counterpart of RGM.unnumbered a and in same orientation to other images. Specimens uncoated. Scale bars represent 10 mm unless stated otherwise.

planar or slightly convex. The column is of consistent diameter; variations in columnal height are subtle. Unbranched long, slender radices(?) preserved towards left in Fig. 1A. Pluricolumnal heteromorphic, nodals highest *et seq.*, probably N212 (see 'Discussion'). Fragments of pluricolumnal of an approximately standard unit length $\times 1$ (best seen in Fig. 1C), $\times 2$ or $\times 3$.

4. Discussion

There are two obvious questions posed by this specimen: what is it; and what is the significance of the distinctive pattern of disarticulation? The question posed by any disarticulated fragment of crinoid is, of course, 'what is it?' and the answer can rarely progress past 'It's a crinoid' because of the common focus of classification on features of the cup and crown, not the column. (The only other Upper Carboniferous pelmatozoans are the blastoids, a group with a particularly slender column quite unlike the one considered herein.) But we can do a little better than this. What it is not is *Heloambocolumnus* (col.) *harperi* Donovan and Doyle, 2019, the only other crinoid described from this site, which has markedly different articular facet geometry. Assigning RGM. unnumbered to a subclass is problematic, although it is perhaps most reminiscent of certain cladids; it is tentatively assigned to cladid? sp. indet., giving this crinoid an identity until more information becomes available.

In determining what part of the stem is represented, we can be on surer ground. Although poorly preserved, it is of consistent diameter without obvious strong variations in columnal height; towards the left in Fig. 1A are what are surely slender, unbranched radices. So, the greater length (right and centre) is the mesistele, transitioning into the dististele to the left (Fig. 1A).

There is nothing to suggest that the stem was recumbent in life, apart from the dististele, so upon death the crinoid most likely collapsed onto the sea floor with the crown directed down current. Burial was not immediate; the stem started to disarticulate and be slightly disturbed, although this has not progressed farther than breaking into short pluricolumnals (Fig. 1). Similarly, this must have occurred under conditions of low bottom energy as the specimen is only slightly disrupted. Albeit much less likely, this disruption could have been, in part, due to the effects of vagile benthos.

It is the more or less uniform lengths, or their multiples, that excites interest; it is unfortunate that the specimen is not better preserved (further cleaning has been avoided for fear of breaking pluricolumnals away from their substrate). Examine, for example, the four pluricolumnals arranged in a zigzag towards the right in Fig. 1C. From left to right, these pluricolumnals each have about 12, 5, 4 and 7 columnals. Hardly consistent, but we suggest that each of these is close to a multiple of 4. We further propose that a common pattern of columnal insertion in crinoid noditaxes is N212 (examples include Donovan, 1986–1995, pp. 35, 79, 80, 116, amongst others), that is, nodal – secundinternodal – priminternodal – secundinternodal (Webster, 1974). Careful examination of the whole specimen suggests that most fragments are comprised of 4n columnals, where n is a whole number, 1 or greater.

Such patterns are not unknown. Baumiller and Ausich (1992) demonstrated similar patterns in crinoid pluricolumnals in the Mississippian Fort Payne Formation of Kentucky. By comparing these specimens to the stalks of extant isocrinids (Baumiller et al., 1995), Baumiller and Ausich determined that the consistent lengths of pluricolumnals were a reflection of the length of the crinoid noditaxes in life as governed by the persistence of through-going collagenous ligaments. These are further reinforced by short ligaments between sequential columnals. Noditaxes fragment as a function of the decay of intercolumnal ligaments which hold them in association during life. Such patterns of breakage were not

unknown previously, but no explanation of the pattern of breakage was possible until the histology of the stem ligaments was better known (such as Grimmer et al., 1984, 1985; Wilkie and Ensom, 1988). For example, Broadhurst and Simpson (1973, p. 372, fig. 4) recognised disarticulated lengths of pluricolumnal in zigzag pattern that they compared to coaches derailed in a railway accident (Donovan, 2020a, b).

We therefore determine that cladid? sp. indet. preserves a large proportion of an individual that started to disarticulate after death on a low energy sea floor. Despite much of the detail of this pluricolumnal being only poorly apparent, the broken stick/train crash crinoid preservation indicates that the heteromorphy of the stem was N212.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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