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Abstract: Lost sites that formerly produced exceptional fossils may be lamented, but, rarely, specimens re-emerge from obscurity. One such specimen was formerly in the private collection of the junior author, namely the Pendleian (Mississippian; Namurian) cladid crinoid *Woodocrinus macrodactylus* de Koninck. This species is only known from the type locality, now an infilled quarry. The most complete specimen on this slab of limestone does not expose the cup, but the proximal column and, particularly, the arms are well-preserved. A second species is referred to crinoid sp. indet. and is only known from a fragment of the arms. Fragments of arms and stems of *W. macrodactylus* on the bedding plane are suggestive of energetic sedimentation of autotomized (= self-mutilated) components.

Introduction

Lost localities are a fact of geological life. Through the action of natural or man-made phenomena, what was once well-exposed and widely known may be lost to present and future generations. The most ephemeral are temporary exposures associated with engineering works (e.g., Collins, 1962), but even substantial man-made structures such as cuttings on canals, roads and railways, and quarries may be overgrown and filled in. Such sites lack the advantages of natural erosion found on, for example, coastal and river exposures to keep them fresh.

One such lost site is Mr. Wood's quarry near Richmond, North Yorkshire, which in the 19th Century yielded the type and many other fine specimens of the cladid crinoid *Woodocrinus macrodactylus* de Koninck, 1854. The type material is in the Museum of Comparative Zoology at Harvard University (Wright, 1951, p.49). The type locality is

now infilled and lost, and there have been persistent rumours among crinoid specialists of unscrupulous collectors pulling apart dry stone walls in this area in the search for further specimens. It is therefore exciting to record a hitherto unrecognised specimen of *W. macrodactylus* found by 'accident', albeit in a collection in Lancashire, not Yorkshire.

Locality, horizon, material and methods

The slab was formerly in the private collection of Brian Jeffery, but has been donated to the national collection of the Natural History Museum, London, registration number (prefix BMNH) EE16661. It is presumed to have come from the type locality of *Woodocrinus macrodactylus*. This was the quarry of Mr Edward Wood, near Richmond, Swaledale, North Riding of Yorkshire (de Koninck, 1854). Wright (1951, p.49) considered the horizon to be "Namurian, E_1 (Red Beds above Main Limestone)". In more modern terms, this translates to Carboniferous (Late Mississippian; Namurian), Serpukhovian (Pendleian); red beds above Main Limestone, Yoredale Group, North Yorkshire (Ramsbottom *et al*., 1978, fig.9; Ogg *et al*., 2008, fig.8.6; Webster and Webster, 2016, p.2218). Ausich and Kammer (2006, p.105) listed this species only from their locality '10RI' at Richmond [NGR NZ 169 009].

The specimen was cleaned in a dilute solution of domestic bleach to remove mosses and algae. All photography was by a Canon G11 digital camera; the specimen was not whitened for photography. Terminology of the crinoid endoskeleton follows Moore and Jeffords (1968), Moore *et al*. (1968, 1978a), Ubaghs (1978) and Webster (1974). Descriptions are written in the style advocated by Fearnhead (2008).

Systematic palaeontology

Class Crinoidea J.S. Miller, 1821
Subclass Cladida Moore and Laudon, 1943
Order Dendrocrinida Bather, 1899
Incertae familiae
Genus *Woodocrinus* de Koninck, 1854

Type species. *Woodocrinus macrodactylus* de Koninck, 1854, p.210, by monotypy (Wright, 1951, p.47; Moore *et al*., 1978b, p.T651), from near Richmond, Swaledale, North Yorkshire.

Other nominal species. Webster and Webster (2016) accepted nine further nominal species of *Woodocrinus*, but reassigned many more to other genera; only one (further) species in open nomenclature was accepted in their list.

Diagnosis. (After Moore *et al*., 1978b, p.T651.) "Crown widely expanded. Cup low cone shaped; 5 infrabasals upflared but not prominent, tendency toward short sutures between basals, 3 anal plates in normal (primitive) arrangement. Arms typically 20, uniserial, composed of exceptionally wide, very short brachials, first branching on primibrachs *1* in all rays, second branching on about secundibrachs *6-8*, no higher bifurcations, branching variable among specimens and species, including lack of second bifurcation in some rays."

Remarks. The genus was named after Mr. Edward Wood of Richmond, Yorkshire, who owned the quarry from which the type material was collected. We understand that this site has not been exposed for many years; it was not listed by Arkell *et al*. (1954).

Range. Carboniferous, Mississippian, Tournaisian – Namurian, British Isles; Permian of Pakistan (Webster and Webster, 2016, p.2216).

***Woodocrinus macrodactylus* de Koninck, 1854**

Figures 1, 2, 3A, B

Synonymy. See Webster and Webster (2016, p.2218).

Material. BMNH EE16661, a slab of limestone (Figure1) bearing one well-preserved specimen (Figure 2) and several arms (Figure 3A, B) from this or another individual(s).

Locality and horizon. Presumably the type locality: quarry of Mr. Edward Wood, near Richmond, Swaledale, North Riding of Yorkshire;

Carboniferous (Late Mississippian), Serpukovian (Pendlian), red beds above Main Limestone.

Diagnosis. (New, based on Wright, 1951, pp.48-49, and description below.) Attachment by radices in dististele; proximal column N3231323, round in section. Cup dicyclic, resembling a spinning-top in shape; infrabasals low, basals and radials about equal in height; radianal and greater part anal X and right proximal plate of anal tube within cup. Arms commonly 20; IBr_1 and $IIBr_{6-8}$ axillary; tertibrachials 40-70.

Description. (See also Wright, 1951, pp.48-49.) Based solely on BMNH EE16661 (Figs 1, 2, 3A, B). Stem incomplete; attachment structure unknown. About 61 mm of most proximal column preserved. Column circular in section; articulation radial symplectial, marginal(?); broad areola; lumen(?) small, central. Column heteromorphic, regularly N3231323, nodals highest *et seq*., tertinternodals particularly low and largely concealed. Latera unsculptured, convex, except tertinternodals, in which they are planar.

Cup not preserved.

Arms robust, uniserial, pinnulate, branching twice isotomously. Primaxillary close to cup; secundaxillary at *c*.$IIBr_6$. Tertibrachials numerous, low, branches tapering distally. Pinnules close-packed, long, each composed of several long pinnular ossicles.

Remarks. Ausich and Kammer (2006, p.105) listed one other species of *Woodocrinus* from their locality 10RI, *Woodocrinus*? *longidactylus* (de Koninck MS *in* Wright, 1925). Wright (1951, p.59) noted that "There is no sign of a cup in connection with the arms and from the length and structure of the brachials it more probably belongs to another genus, e.g., *Poteriocrinites*." This is confusing as the species was referred to as "? *Poteriocrinites longidactylus* (de Koninck)" on its original publication (Wright, 1925, p.282); why did Wright transfer it to *Woodocrinus* in 1951 if he thought the designation incorrect? Ausich and Kammer (2006, p.105) regarded *W.*? *longidactylus* as a *nomen dubium*

"… because it consists only of a single specimen of a complete ray with long arms." Examination of an image of the only specimen (Wright, 1951, pl.29, fig.2) shows that the arms branch at least four times, *contra W. macrodactylus* and the generic diagnosis of *Woodocrinus* (see above).

Ausich and Kammer (2006, p.105) listed two further species of *Woodocrinus* from their (coeval) locality 10SW (Swaledale, near Richmond; NGR SE 018 986), *Woodocrinus expansus* de Koninck and Wood, 1858, and *Woodocrinus fimbriatus* de Koninck MS. *in* Wright, 1951. The arms of *W. expansus* branch at least four times (Wright, 1951, pl.21, fig.2), unlike those of *W. macrodactylus* and, again, *contra* the generic diagnosis. *Woodocrinus fimbriatus* is based on a solitary, poorly preserved specimen (Wright, 1951, p.58; 1952, pl.36, fig.2). Wright noted its similarities to *W. macrodactylus*, while speculating that it may not be congeneric.

Incerti ordinis

crinoid sp. indet.

Figures 1, 3C

Material. BMNH EE16661, towards the upper left in Figure 1.

Locality and horizon. Uncertain, but presumably the quarry of Mr. Edward Wood, near Richmond, Swaledale, North Riding of Yorkshire; Carboniferous (Late Mississippian), Serpukovian (Pendlian), red beds above Main Limestone.

Description. Brachials slightly wider than high, unsculptured. One or more arms branching isotomously at least twice. Branches slender, comprised of uniserial brachials, apparently apinnulate. Estimated *c*. ten secundibrachials; at least ten tertibrachials, but incomplete.

Remarks. Although very incomplete, enough can be seen of this specimen to say with confidence that it is not *W. macrodactylus*. Ausich and Kammer (2006, table 3) listed five species in four genera from the type locality of *W. macrodactylus*, their site 10 RI (Table 1).

The flexible cladid *Aexitrophocrinus swaledalensis* (Wright, 1954, p.157, pl.42, fig.4), whose occurrence on this site is uncertain (Ausich and Kammer, 2006, p.105), has particularly broad, robust arms quite unlike those in Figure 3C. *Rhabdocrinus swaledalensis* Wright, 1950 (pp.16-17, pl.1, figs.1-3), has particularly well-separated axillaries and its distinctive columnals would be obvious if present on BMNH EE16661 (Donovan and Birtle, 2011). *Ureocrinus bockschii* (Geinitz, 1846) (Wright, 1952, pp.112-116, numerous illustrations, but particularly pl.19, figs.1-4) has unbranched arms. *Woodocrinus*? *longidactylus* and *W. macrodactylus* have both been discussed above. In short, crinoid sp. indet. does not resemble any of the crinoids already described from the type locality of *W. macrodactylus* and is left in open nomenclature until superior specimens are available.

Discussion

The preservation of these specimens poses questions, in particular the pinnulate arm (Figure 3A). This is broken away at or near a major branch of an arm (compare with Figure 3B) and the pinnules are beautifully preserved to the right of the arm. In a modern crinoid, such as the comatulid *Antedon bifida* Pennant, 1777, "… within two days of death, specimens … in completely static sea water had collapsed into a mass of arm and cirrus fragments, even under anaerobic conditions" (Blyth Cain, 1968, p.192). The preservation of such an arm as shown in Figure 3A is likely to have occurred under conditions of high energy, which first broke the arm off, perhaps inducing autotomy (self-mutilation; Wilkie and Emson, 1988), and then led to its rapid burial.

Similarly, the most complete *W. macrodactylus* (Figure 2) lacks the distal stem, including the attachment, and may have autotomized under unfavourable, high energy conditions, after which it was transported and buried alive. Thus, it is probably allochthonous, yet well preserved due to rapid burial. The orientation of this specimen does not seem to relate directly to the preservation of pluricolumnals and disarticulated arms (Figure 1) which have accumulated in two directions at 90° to each other. These suggest current strong enough to roll some specimens while others became oriented parallel to flow.

The large, V-shaped arm fragment (Figure 3B) may indicate a flow from left to right; in contrast, assuming the crown to lie down-current, the more complete specimen (Figure 2) might have been carried from bottom towards the top.

It might be asked, why is this Yorkshire crinoid worthy of being described in *The North West Geologist*? Its provenance was uncertain when B.J. first showed it to S.K.D., but it was formerly thought to come from the Clitheroe quarries. Yet this was unlikely as the preservation of crinoid thecae from these sites rarely retains the arms (Donovan and Sevastopulo, 1986). Indeed, as demonstrated herein, it represented a specimen collected, at latest, in the early 20th Century, and perhaps before; it is a species that is now common only in museum collections; and provides certain lessons in determining provenance and palaeoecology that are of broad interest.

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Table 1: Nominal crinoids known from the type locality of *Woodocrinus macrodactylus* (after Ausich and Kammer, 2006).

Aexitrophocrinus swaledalensis (Wright, 1954)

Rhabdocrinus swaledalensis Wright, 1950

Ureocrinus bockschii (Geinitz, 1846)

Woodocrinus? *longidactylus* (de Koninck *in* Wright, 1925)

Woodocrinus macrodactylus de Koninck, 1854

Figure 1: BMNH EE16661, *Woodocrinus macrodactylus* de Koninck, 1854, and crinoid sp. indet. (towards upper left; compare with Figure 3C). The best preserved specimen of *W. macrodactylus* is right of centre; disarticulated arms are above this and to its left. Specimen uncoated, photographed in natural light. Scale bar represents 50 mm.

Figure 2: BMNH EE16661, *Woodocrinus macrodactylus* de Koninck, 1854. Note the stem is incomplete and the cup is concealed or lost. Specimen uncoated, photographed in natural light. Scale bar represents 10 mm.

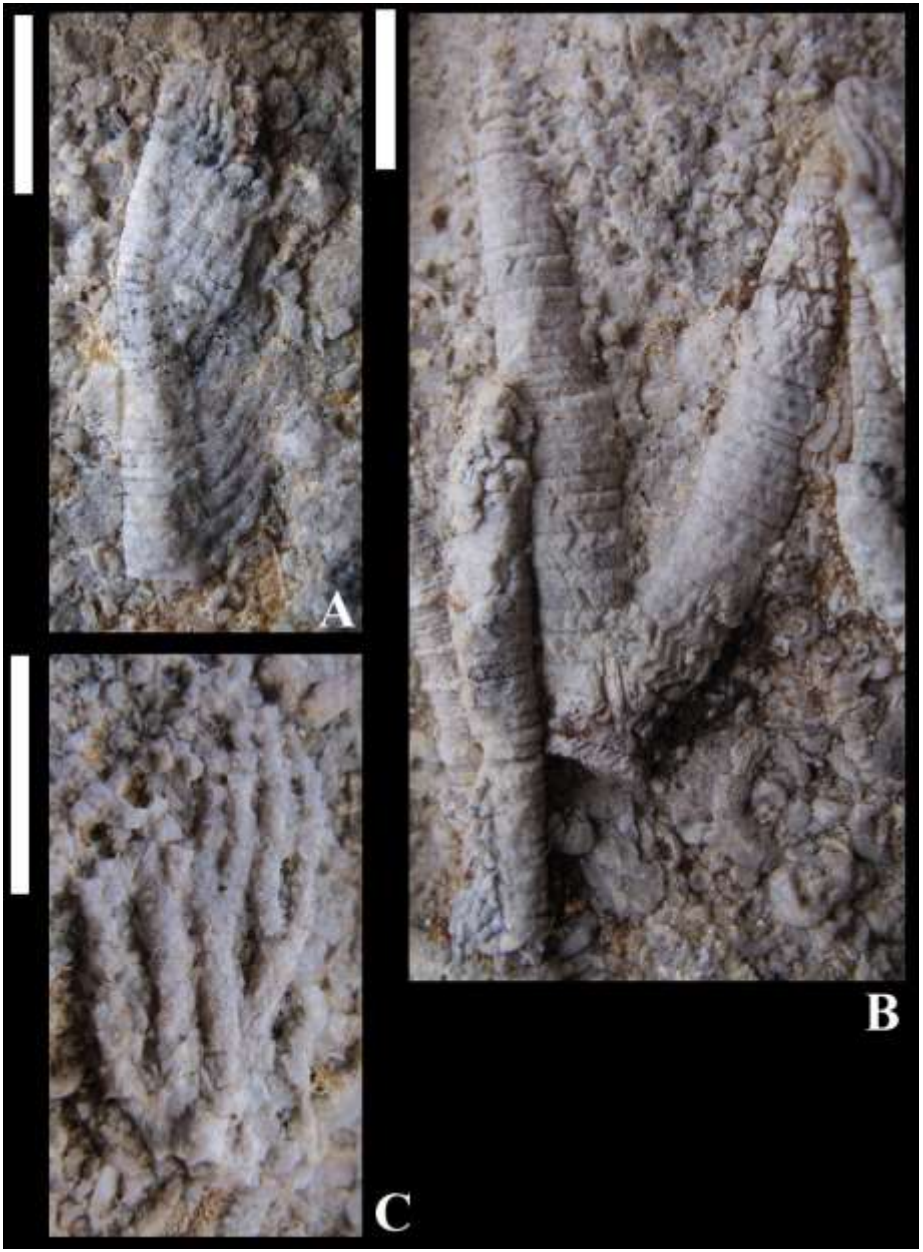

Figure 3: BMNH EE16661. (A, B) *Woodocrinus macrodactylus* de Koninck, 1854. (A) Single arm preserved with pinnules. (B) Branched arm, pinnules not apparent. (C) Crinoid sp. indet., branched arms. Specimen uncoated, photographed in natural light. Scale bars represents 10 mm.