An unexpected crinoid – cephalopod association from the Blue Lias Formation (Lower Sinemurian, Lower Jurassic) near Watchet, Somerset, England

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Palmer's bed E(V) in Hellwell Bay, near Watchet, Somerset contains many nautiloids (*Cenoceras*) but few ammonites. It is exposed in two parts 160 and 130 m long east and west of the groynes, with 24 and 21 nautiloids recorded, respectively. Twelve nautiloids lie on their left side, 14 on their right and a further eight are vertical or nearly so. Others are too eroded to tell. Fifteen nautiloids host epifaunal oysters, with a further 14 having oysters and/or byssally-attached bivalves (pectinids, ?pteriids) preserved nearby. Fourteen nautiloids and the largest ammonite from the east exposure plus 18 nautiloids from the west have crinoid debris (*Isocrinus psilonoti*) associated with them. The crinoid debris rarely extends >1 m from the centre of the cephalopod shells. At least 17 more similar patches of crinoid debris occur, without associated cephalopods. Between patches, with or without cephalopods, crinoid debris is very rare. Crinoids were apparently associated with large cephalopod shells. Living isocrinids are unable to attach directly to substrates, but entangle the cirri on their stems with other benthic objects to help anchor themselves. A similar relationship apparently occurred between the fossil cephalopods and isocrinids, which were not attached to floating cephalopod shells.

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Introduction

Although rare, associations between crinoids and cephalopods have been reported previously in the literature. For example, Simms (1989a, pl. 2, fig. 3) illustrated three small examples of *Pentacrinites doreckae* Simms, 1989a, attached to a large ammonite. Pentacrinitid crinoids are frequently found attached to fossil wood and they have been repeatedly interpreted as having led a pseudoplanktonic mode of life (see the review by Simms, 1986), although others (e.g., Rasmussen, 1977; Kauffman, 1981) have disputed this interpretation. Nevertheless, it does raise the possibility that pentacrinitids may have been able to attain a pseudoplanktonic mode of life by attaching to floating cephalopod shells as well as to floating wood. Isocrinid crinoids, on the other hand, have always been interpreted as obligate benthos (Rasmussen, 1978; Simms, 1986). The association reported here is unexpected for two reasons; it largely involves the nautiloid *Cenoceras*, despite the fact that ammonites are generally more common and diverse in the British Lower Jurassic, and it exclusively involves benthic isocrinid crinoids. Almost all the material discussed occurs in a single limestone bed (Palmer's, 1972, series E, bed V; hereafter 'bed V' for brevity) exposed in Helwell Bay, east of Watchet, Somerset, which Whittaker and Green (1983, p. 61) suggested corresponds to their bed 228. Palmer (1972, p. 23) specifically mentioned that his bed V contained the nautiloid *Cenoceras*, so the exact bed is known in Palmer's (1972) numbering scheme. However, Palmer was uncertain how the beds in his series E exposed in Helwell Bay correlated with the general succession he recognized, hence there is some uncertainty as to precisely which of Whittaker and Green's (1983) beds is involved. The latter authors suggested that Palmer's beds E(I) to E(XV) correlated with their beds 224 to 238 (Whittaker and Green, 1983, Table 7, p. 61), which makes Palmer's bed V equivalent to Whittaker and Green's bed 228. In their description of the section Whittaker and Green (1983, p. 66) recorded the presence of *Cenoceras* sp. in the shale immediately above bed 228. Whittaker and Green attributed this level to the Semicostatum Zone, in the Lower Sinemurian stage, but it has since been established that it lies within the upper part of the Bucklandi Subzone (Page, 1992, p. 138; Simms *et al.*, 2004, fig. 2.18, p. 86).

The purposes of this paper are to document the crinoid-cephalopod association, to interpret its original significance to the animals involved and any possible relevance to the sedimentation processes during the deposition of the Blue Lias Formation in Somerset.

Methods

The exposures of Palmer's bed V occur either side of three groynes in Helwell Bay, together with a very small exposure between the middle and western groyne (Figure 1). The eastern exposure is about 160 m from east to west and the western exposure about 130 m. The bed is about 30 cm thick. Crinoid debris occurs in patches usually less than 2 m across and separated by crinoid free limestone. The entire exposure was searched for patches of crinoid debris, which were photographed and a 10-figure grid reference (giving a nominal accuracy of 1 m) recorded for each occurrence using a hand held GPS device. The presence or absence of any cephalopods associated with the crinoid debris was recorded, together with a record of the diameter of the cephalopod and its orientation (lying on the left or right side or orientated vertically) wherever