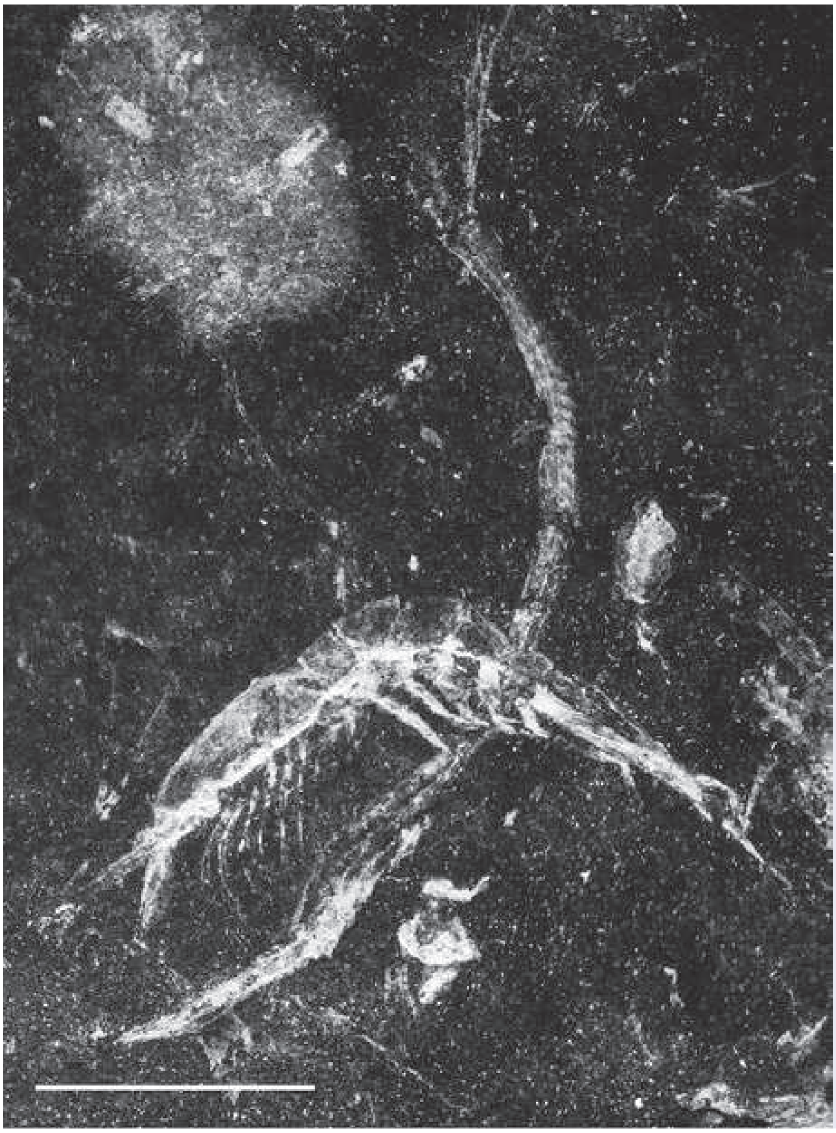
Shrimping at Granton—the Muirhouse 'shrimp-bed' revisited

By Dr Neil Clark

An Edinburgh Geological Society evening field excursion on Wednesday 5th June 2013 added to our knowledge of one of the most famous palaeontological localities in the world: the Muirhouse 'shrimp-bed'. It is exposed on the shores of the Firth of Forth, just to the west of Edinburgh's Granton Harbour [NT 219 772], and is best known for its shrimps, fish and, most significantly, the elusive conodont animal (Figure 1) (Aldridge *et al*. 1993; Knell 2012).



Conodonts have been used extensively since the mid-1800s for everything from very precise relative age dating to defining the thermal maturation of sediments, and have aided environmental

***Figure 1** One of the famous conodont animals (overlain by a shrimp) from the Muirhouse 'shrimp-bed'. This specimen was found by the author in 1984 and is now in the collections of the Hunterian Museum, University of Glasgow (GLAHM Y221), scale bar = 1cm.*

interpretations in rocks from the Precambrian to the Triassic. Despite this huge range, until recently there were few clues as to what organism conodonts derived from. Some speculated that they were parts of plants, snails, worms or fish, but it was not until 1982, when Professor Euan Clarkson was studying the shrimps from Muirhouse in the Edinburgh collections of the British Geological Survey, that the mystery was solved (Briggs *et al*. 1983). He found a complete lamprey-like animal that had conodont teeth in the head region. Subsequently, there were *in situ* discoveries at Muirhouse with ten animals from that locality now adding to our understanding of this most enigmatic of fossils.

The geology of the foreshore at Muirhouse (Figure 2) is complicated by numerous small faults through a series of sandstones and shales of Early Carboniferous age. Nearby Cramond Island and Lauriston House are on an igneous, Carboniferous-Permian olivine-rich intrusion which extends across the Forth to Hawkcraig Point near Aberdour.

The sandstone that is exposed at low-tide at Birnie Rocks is the Wardie Sandstone, which also crops out

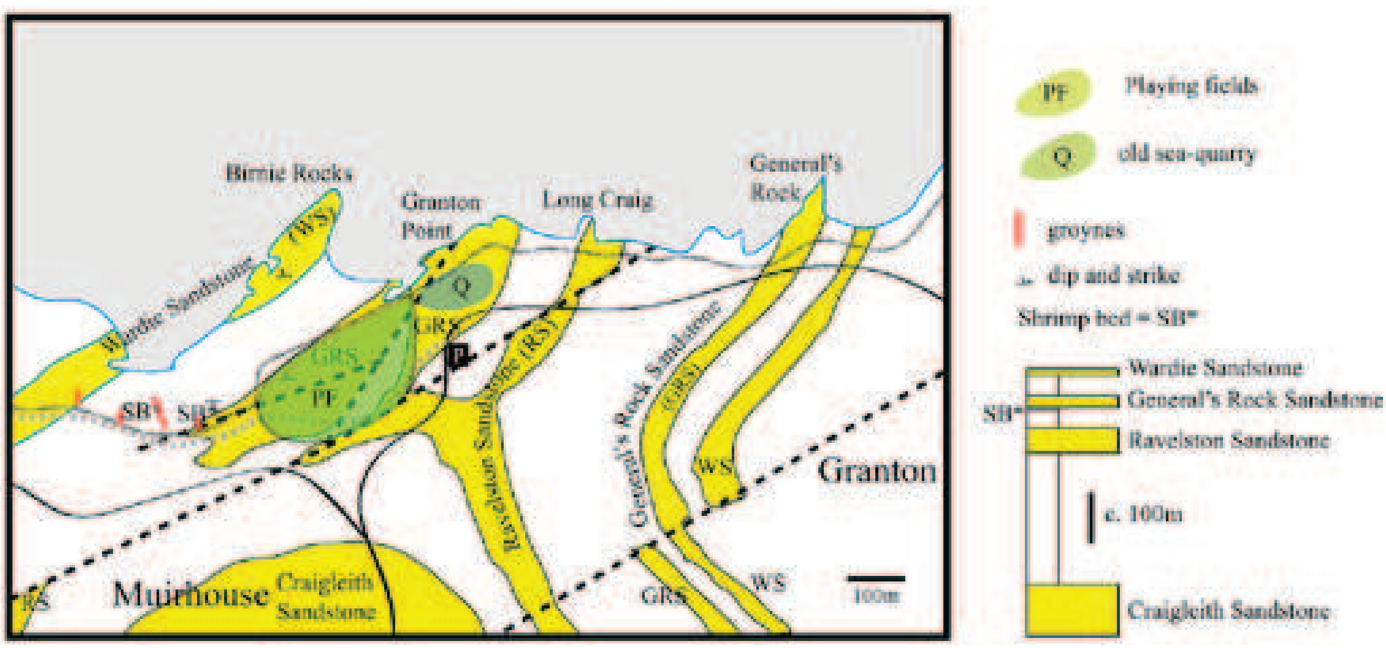


***Figure 2** Geology of the Muirhouse shore based on Edina Digimap. At low tide the shrimp beds can be found below the General's Rock Sandstone at several points to the south west of Granton Point.*

on the western edge of Granton Harbour. The stratigraphically lower General's Rock Sandstone is mostly covered by playing fields but is exposed west of the Wardie Sandstone at the harbour, within the east limb of an open anticline trending northeast-southwest. Immediately to the east of the playing fields is the site of the old sandstone quarry from which the first conodont animal was unknowingly collected in the 1920s.

There are two known shrimp beds exposed immediately below the General's Rock Sandstone, but they are generally referred to jointly as the Muirhouse 'shrimp-bed' (or sometimes as the Granton 'shrimp-bed'). They consist of black, laminated, dolomitic mudstone. Their crustacean fauna (Figure 3) mostly comprises *Waterstonella grantonensis* and *Crangopsis eskdalensis* (Briggs & Clarkson 1983; Clarkson 1985) but a number of other crustaceans, fish, plants and worms are also present (Briggs *et al.* 1991). The environment of deposition of the original sediments varied from low-energy lagoonal muds and shales, to a higher energy environment of deltaic sands and pro-deltaic muds; the

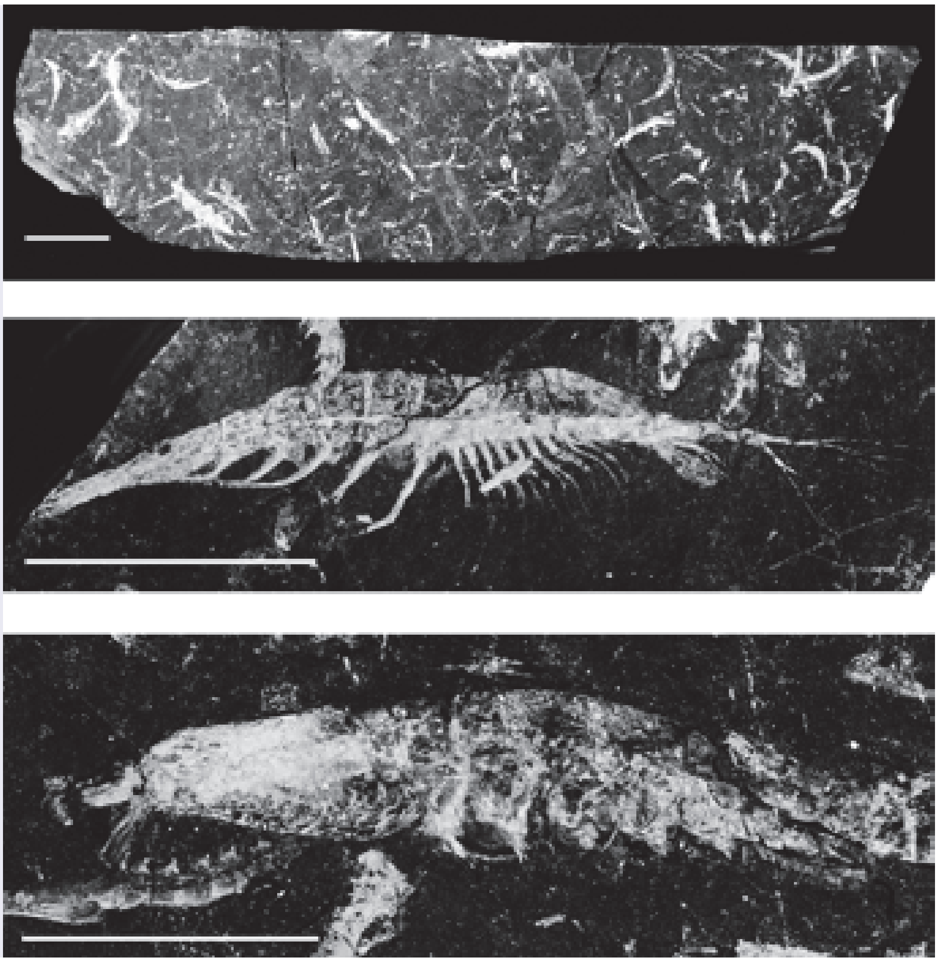


***Figure 3** Some of the more common crustaceans collected on the 5th June, 2013: top = Muirhouse 'shrimp-bed' (Bergman Collection), scale = 2cm; middle =* **Waterstonella** *(GLAHM 152323), scale = 1cm; bottom =* **Crangopsis** *(GLAHM 152337), scale = 1cm).*

Muirhouse 'shrimp-bed' represents a marine incursion across intermittently exposed mud-flats.

NE-SW extensional faulting has disrupted the 'shrimp beds' which are also affected by folding, thrusting and smaller-scale 'pinch and swell' structures caused by the dislocation of less-ductile layers and the thickening of more-ductile layers. Trying to interpret the sequence of lithologies is therefore far from easy, and new exposures seen during the excursion suggest that Cater (1987) got the sequence slightly wrong. It now appears that the lower of the rusty brown sediment layers with the shrimp *Tealliocaris* is slightly above the main black 'shrimp bed' and that both are beneath the General's Rock Sandstone.

Although the shrimp bed is poorly exposed and was largely removed in 1985 by the National Museums of Scotland with the help of the Grant Institute of Edinburgh University and others (McAdam & Clarkson 1986), it is still possible to find the occasional loose block of the black laminated dolomitic mudstone of the main shrimp bed. During the field trip of the 5th June, several such blocks were found and split to reveal the white and blue coloured crustaceans on the dark organic-rich laminae. Despite no examples of the elusive conodont animal being found, two other rarities came to light: a new undescribed crustacean which may be an isopod, and the tomopterid worm *Eotomopteris aldridgei* (Figure 4).

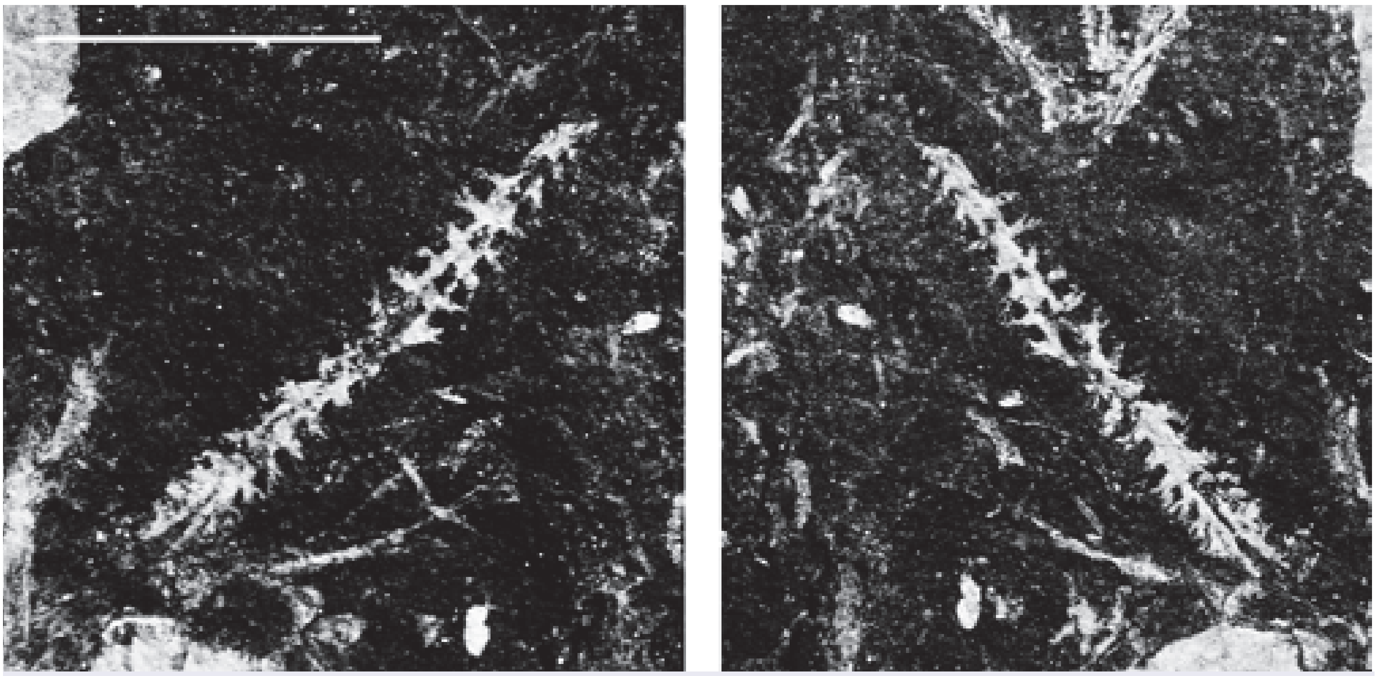


Figure 4 **Eotomopteris***: one of the rare elements of the fauna collected on the 5th June, 2013 (GLAHM 152324, scale bar = 0.25cm).*

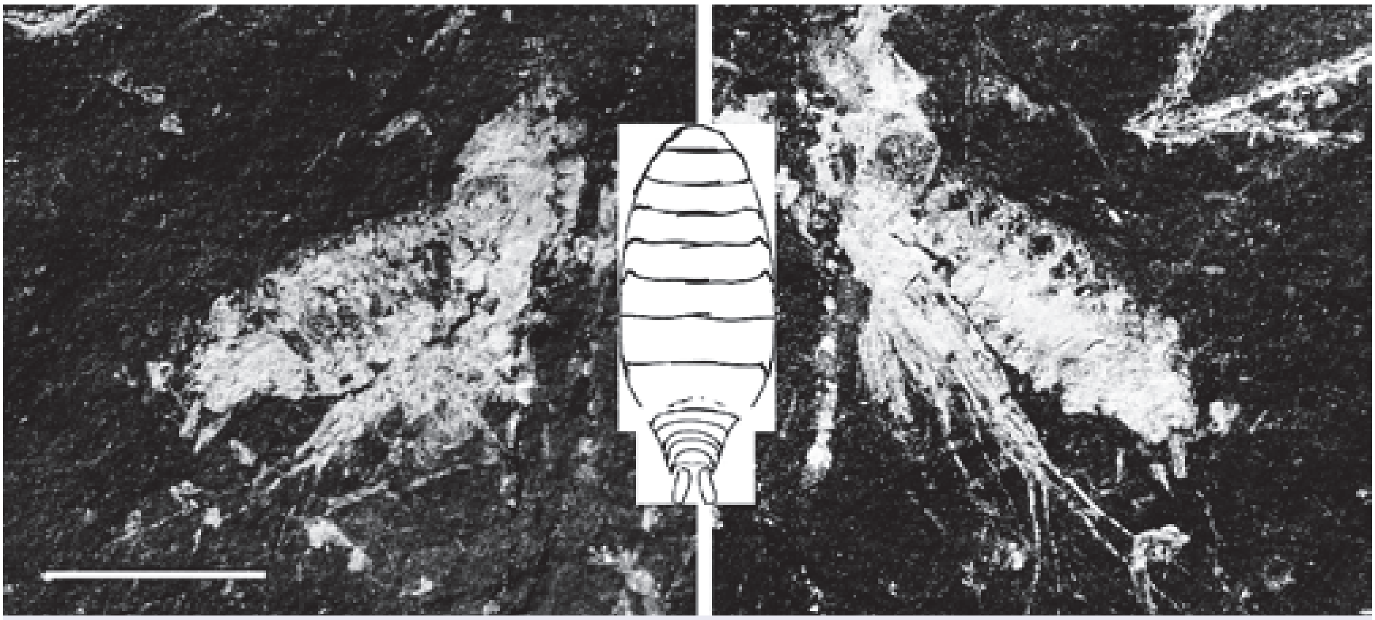


Figure 5 ***The unique possible isopod collected on the 5th June, 2013 (GLAHM 152325, scale bar = 0.25cm).***

Of the rarities, the tomopterid polychaete worm is known from only three specimens in the collections of the National Museums of Scotland (Briggs & Clarkson 1987). This fourth example is well preserved and retains the 'limb' structure which has not been observed on the previous examples.

The new crustacean (Figure 5) is a multi-segmented animal with no obvious head-shield and a pair of lobed appendages at one end (probably the tailfan). The body appears to be flattened dorso-ventrally and consists of eight wide segments of the thorax; and six tapering segments of the tail. The basic body-plan is that of an isopod. However, there are no isopods of this nature known from the Carboniferous. There are Carboniferous isopods, but they are elongate laterally-compressed animals. This new animal has more of the appearance of an oniscidian isopod (which includes the terrestrial woodlouse) for which the scant fossil record extends only as far back as the Cretaceous. This could be a highly significant discovery.

The field trip successfully helped to reinterpret the sedimentary environment, the local lithostratigraphy, and the distribution of the Muirhouse 'shrimp-bed' along the foreshore. The discovery of a further tomopterid polychaete and the new crustacean has increased our knowledge and understanding

of the fossil record of these animals. This was certainly the most successful field trip I have had the pleasure of leading and I would like to thank all those members of the Edinburgh Geological Society who spent the evening on the Muirhouse foreshore, and in particular Beverly Bergman for providing specimens to be photographed. I would also like to thank Scottish Natural Heritage and Edinburgh District Council for allowing the collecting of material from the foreshore, without which permission the excursion could not have taken place.

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Dr Neil Clark
The Hunterian Museum, University of Glasgow, Glasgow G12 8QQ