`FOOTSTEPS IN THE SAND' - SOME TRACE FOSSILS AND THEIR MODERN EQUIVALENTS

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Wherever one goes, be it walking beside a river, along a beach, there are always traces of animal life left to puzzle over — is it prints left by an otter, or maybe a fox? Had a snail or worm passed that way? Maybe a trace is of a plant? Indeed, in earlier days of ichnopalaeontology (study of trace fossils) many traces were considered to be the marks of algae (seaweed) and so *Fucoides, Algacites* and species ending in *-phycus* owe their names to this thinking. It is much more difficult to determine what type of animal has left a particular trace because it is very rare that the maker is found in association with a trace fossil. An additional `complication' is that a large proportion of trace fossils are viewed upside down, ie the traces are on the base of the beds. In the photographs almost all the specimens, with the exception of the vertical burrows, are viewed as if the camera was looking up from the rock bed below the trace fossil.

Fig 1, Palaeosemaeostoma, *Damery Bed, Silurian*

In 1982 I found a (possibly) unique trace fossil of a medusa (jellyfish) in the Damery Beds, the Llandovery Series, of the Silurian Inlier at Tortworth, since when trace fossils have been a particular fascination to me. The fossil was identified at the Natural History Museum in London (BMHNZ1039) as a medusa and assigned to *Palaeosemaeostoma* Ruger and Ruger-Haas, 1925 (Fig 1) (also see Benton and Hiscock 1996). The medusa, either as a free swimming 'jellyfish' or attached to the substrate like *Hydra,* had been preserved in the very fine greenish micaceous sandstone typical of the Damery Beds. Jellyfish are about 98% water so the preservation of this specimen is an extremely rare and unusual case, almost certainly due to the conditions under which the animal was buried. The medusae described by Ruger and Ruger-Haas were found in the Liassic of Germany so my specimen pushed the age of the ichnospecies back by about 250 million years.

A year or two ago, Gill and I spent a very pleasant holiday at Towyn on the west coast of Wales. On a very windy, warm day we walked along the beach from Towyn to Aberdovey across the flat hard sand that had recently been uncovered by the receding tide. As we walked, I noticed that there were numerous imprints of human bare feet along the sand in all directions (giving me the title of this article). However, along that beach there were also innumerable traces and trails left by animals and I was particularly intrigued when I realised that I was looking at animal traces, in the 21st century, similar to those that have been preserved in the fossil record some of which I had collected as fossils from rocks as old as the Cambrian.

Human footprints are preserved in many types of substrate but in our area, they are found in the muds of the Severn estuary mainly on the Welsh side. I have not been fortunate to find one nor do mammalian prints feature in

Fig 2, *'Dinosaur' tracks—actually gull prints*

my collection but, there on that beach, modern prints were abundant. Nor have I been lucky to have found fossil dinosaur prints but there, in the sand, were numerous three-toed, or rather, three-clawed, 'dinosaur' prints — claw prints of gulls (Fig 2). Who knows, one or two of them may have been preserved for future geologists to find!

The beach was also host to a wide variety of other traces and I was excited to find examples similar to or exactly like trace fossils that I had collected.

Fig 3, *Grazing trail of a Gastropod*

Commonest on the sand were the meandering grazing traces of gastropods (snails) many shimmering in the sunlight where the mucus trails remained (Fig 3). I have found good specimens of *Nereites* in the Rheidol Formation (Eisteddfa Group) of the Llandovery Series of the Silurian of

Fig 4, Nereites, *Rheidol Formation, Silurian*

central Wales near Talybont, north Dyfed (Fig 4). Also meandering through the surface of the sand were narrow trails produced by very small gastropods, crustaceans or worms (Fig 5). In my collection I have a good example,

Fig 5, *Feeding or escape trail*

Cosmoraphe preserved in the Upper Cromhall Sandstone (Carboniferous) of Cromhall Quartzite Quarry in South Gloucestershire (Fig 6). Also, I found a specimen of another meandering trail in the Cretaceous of Aizkorri, near Bilbao,

Fig 6, Cosmoraphe, *Up Cromhall Sst, Cromhall Quartzite Quarry*

north Spain, assigned to *Planolites* (Fig 7).

Amongst the numerous meandering trails on the beach were less frequent but excellent arthropod trails, presumed to be left by crabs as they

Fig 7, Planolites, *Cretaceous, North Spain*

scurried around, finally to bury themselves in the soft sand as the tide fell (Fig 8). I do not have any fossil

Fig 8, *Arthropd trail and resting site*

specimens in my collection of similar arthropod trails, usually referred to as *Arthropodichnus,* but have excellent examples of the trace fossils *Cruziana,* , interpreted as the crawling traces of trilobites, where the diagonal scratch marks are left by the legs and the central depression by the pygidium or tail of the

Fig 9, Cruziana**,** *Breadstone Shales, Up Cambrian*

trilobite. These trace fossil are from the Breadstone Shales of the Tremadoc Series, Upper Cambrian, near Berkeley, Gloucestershire (Fig 9). From the same locality was recovered a *Cruziana* which appears to end in an oval shape, assigned to *Rhusophycus* (Fig 10), the resting trace of a trilobite.

Fig 10, Rhusophycus**,** *Breadstone Shales, Up Cambrian*

Wide open, gently shelving sandy beaches are highly hazardous to jellyfish as they become stranded on the sand without the ability to swim back with the falling tide. There were a fair number of

Fig 11, *Jellyfish and impressions in sand*

dead jellyfish stranded on the beach but one had clearly been floated a short distance away leaving a circular impression on the sand (Fig 11). This immediately reminded me of the trace fossil I had collected from the bed of the Little Avon river at Damery in the Tortworth !Mier. This unusual trace fossil is *Rotomedusa* (Fig 12) and, like the trace fossil *Palaesemaeostoma* that started my interest, ,had been preserved in the soft fine sandy turbidite sediments of the Silurian Damery Beds laid down in still conditions. Although the tissues had quickly decayed the rapid burial had

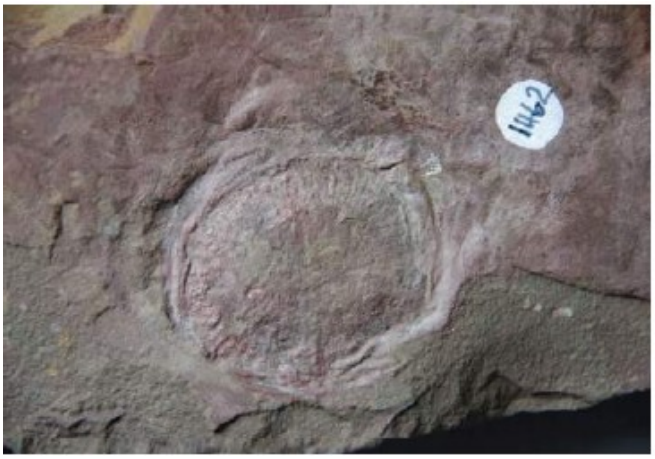

Fig 12, Rotomedusa, *Damery Beds, Silurian*

preserved the impression.

Around the time of our holiday in west Wales, we paid a visit to Weston-super-Mare where, as we all know, conditions on the beach are far from the pleasant expanses of sand of Towyn beach. Indeed, in the Knightstone harbour area the beach was mostly mud but there was an expanse of muddy sand with huge numbers of worm casts and vertical burrows of the Lugworm, *Arenicola marina*

Fig 13, *Lugworm* (Arenicola) *burrows*

(Linnaeus, 1758) (Fig 13). The Lugworm is composed of annular rings and secretes a mucus sheath as it builds its burrow in the substrate. The mucus binds the sediment particles to prevent the collapse of the tube, a feature of the Lugworm that has ensured that the worm burrows have been preserved in the trace fossil record. In the Triassic Westbury Beds particularly at Aust Cliff it is possible to find examples of the trace fossil *Archarenicola rhaetica (Horwood 1912)* (Fig 14) which show the annular rings preserved in the sediment. The trace fossil equivalent of the Lugworm burrow as seen on most beaches is

Fig 14, Archarenicola, *Westbury Beds, Triassic*

Arenicolites where the burrow is U-shaped with a cup-shaped mouth at the head end of the worm, and a worm cast at the tail end. There are, however, many species of marine worm that only use one burrow, usually in a vertical orientation, feeding by means of cilia waving in the water. In these cases where the burrows are single with cup shaped mouths, the trace fossil is *Skolithos,* the specimen pictured here being from the Tortworth Beds of the Silurian Llandovery Series at Stone,

Fig 15, Skolithos, *Tortworth Beds, Silurian*

Gloucestershire (Fig 15). In this case the bottom of the trace burrow shows a widened area similar to the shape of a brachiopod shell. The other most common single vertical burrow trace

fossil is *Monocraterion* of which the most spectacular examples are preserved in the early Ordovician Tumblagooda Sandstone of Kalbarri National Park, Western Australia. In this locality there are large numbers of closely spaced *Skolithos/Monocraterion* of great size and depth (Fig 16).

Fig 16, *Huge vertical Skolithos or Monocraterion Tumbelgooda Sst, W. Australia*

Wherever I go I instinctively look for the marks left by animals and plants in the environment, where walking in urban areas can provide good examples such as trace burrows on paving slabs in pavements or in the stonework of buildings and in the countryside. So often the maker of the trace is easily identified but it is the ones that are not obvious or identifiable which intrigue me. So it is with trace fossils of which I have examples that still puzzle me.

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