HOLIDAY HAUNTS;
COASTAL GEOLOGY AT ABERYSTWYTH

Charles Hiscock

Wales has been a magnet for geologists from earliest times with William Smith producing a cross-section from Snowdon to London in 1817, based on his journeys across the two countries. Later in the l9th century, Adam Sedgwick, working eastwards, called all central Wales 'Cambrian' while, at the same time, Roderick Murchison, who worked from England westwards devised the Silurian System for the same area. The disagreement was very public and bitter, lasting for many years. After they had both died, Charles Lapworth, who had been working quietly and discreetly in the same areas, named the disputed rocks the Ordovician. With a few minor changes since, the succession in Central Wales remains as he finally devised it. Others who made definitive discoveries and interpretations were O.T. Jones on Plynlimon and in Pembrokeshire, and Wood and Smith in the Aberystwyth area.

Gill and I had decided to take a holiday near Aberystwyth, revisiting country we had last been in 16 years before, in the hopes of seeing Red Kites, travelling on the Vale of Rheidol Railway, and, of course, examining the superb geology of the area, particularly the coastal sections north and south of Aberystwyth. Yes, we did see Red Kites daily, sometimes in twos and even once, three and we did ride on the railway up the Rheidol valley. Here we were able to look down on these beautiful birds as they soared over the trees below us. Also, it gave us good views of the big scars left by the lead mines of the very early 20th century, for which the railway was built.

I had looked at the coastal sections in 1989 but had not really 'taken them in', so, armed with Professor Mike Bassett's "Geological Excursions in Dyfed, South West Wales" (1982 National Museum of Wales) I spent time on the beaches north and south of Aberystwyth. The Silurian Aberystwyth Grits are, and I quote, "justly regarded as one of the best examples of a turbidite sequence in Great Britain" (Wood and Smith 1959), being exposed from Newquay to Harp Rock, Borth. Sedimentary and tectonic structures can be seen throughout, while, for myself, the added interest is the good number of trace fossil species which can be found on the undersides of the beds, and with careful looking, can be found as pebbles on the beach, albeit some waterworn. The rock sequence in the Aberystwyth district lies in the Telychian Stage of the Llandovery Series, mainly in the *Turriculatus* Biozone. At the base is the Devil's Bridge Formation, overlain by the Borth Mudstones and the Aberystwyth Grits.

Walking from the north end of Aberyswyth promenade along the beach, the sequence of mudstones and fine sandstones are beautifully displayed in the cliffs with the bedding dipping steeply east, *photograph 1*. Erosion of the cliffs has laid bare the soles of the beds on which flute marks, burrows and traces can be seen, binoculars being essential for the higher beds.

Photograph 1: Headland at north end of Aberystwyth. Note the hard, thin sandstones with interleaving mudstones - a typical turbidite sequence.

High in the cliff, prominent ripple marks *(photograph 2)* on a flat face are orientated in a totally different dip from the beds lower down. This difference is one demonstration of the tectonic features that can be seen. To gain access to the next cove from the beach, one has to walk around the end of a short breakwater (or climb a nearly vertical ladder both sides of the structure).

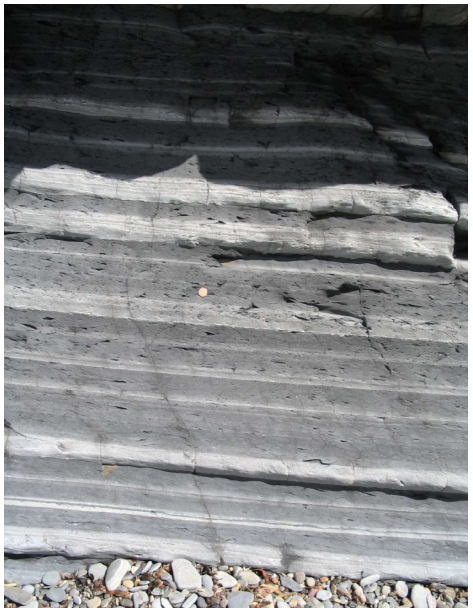
Photograph 2: Ripple marks high in the cliff

In this cove, the flute marks, trace fossils and sole marks are easily examined, p*hotographs 3 and 4.*

Photograph 3: Sole marks and trace fossils including one large burrow

Photograph 4: Flute marks and ripples show the palaeocurrent direction was predominantly from south to north

Photograph 5: In the cliff on both sides of the cove, a small thrust can be seen. On the north side it is marked by a small cave



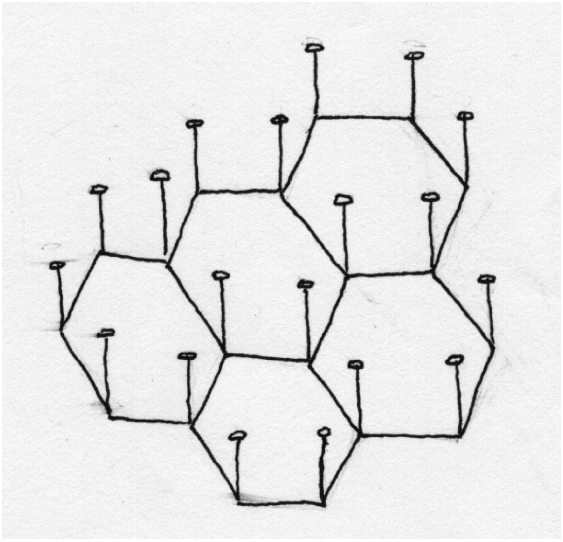
Photograph 6: Sea-worn bedding at the top of the beach; a typical turbidite sequence

On both sides, by following the dip of the beds, a small thrust is seen striking N—S across the cove, *(photograph 5)* with a small cave eroded through to the next cove to the north, marking the thrust. At the back of the beach, the turbidite sequence of mudstones and fine sandstones are exceptionally well presented because they have been washed clean by the sea. The mudstones have mainly flat laminations and separate similar thicknesses of fine sandstones, *(photograph 6).* These demonstrate parallel lamination, cross and convolute lamination, the latter caused by de-watering of the sandstones, *(photograph 7)*.

In the Aberystwyth area, the turbidites are fine-grained although, further south, the sediments coarsen with intraclasts and thicken as the sequences move closer (proximally) to the source of the turbidite flows. North of the town, the opposite is true - very fine sediments and thinning bedding indicate distal turbidites. Across the beach just north of the first cove, a gully filled with seawater shows the centre of a small anticline in which beds to the west are nearly vertical while they dip steeply east in the cliff, *(photograph 8).*

South of Aberystwyth, one has to walk about a mile across the pebble ridge which closes off the Ystwyth valley from the sea, causing the river to run north-westwards for some distance until it reaches the sea through the southern limb of Aberystwyth harbour. However, the walk is well worth-while as the pebble ridge (paved along its length) supports good flower and bird habitats and bounds the western edge of a nature reserve which includes the hill Penparcau, topped by a monument to the Duke of Wellington.

Photograph 7: Laminations in fine sandstone bedding



Diagrammatic representation of the burrows of Palaeodictyon in the sediment

Photograph 8: The rock pool marks the centre of an anticline. To the left the bedding is nearly vertical while, to the right, it dips steeply to the east.

Photograph 9: Palaeodictyon meshes on beach blocks from the cliffs south of Aberystwyth

Unlike the cliffs on the north side of the town, the rocks here dip to the west very steeply. Indeed, at the back of the beach they are vertical, forming a wall towards the sea. At one point, the vertical bedding clearly shows a thrust with the bedding pushed over westwards. The steep dip has caused great instability, with large blocks lying randomly on the lower cliffside. Lithologically, the rocks are very similar to the northern cliffs but the beds are more accessible in the fallen blocks. The trace fossil *Palaeodictyon* has held a fascination for many years but I had never been successful in finding a specimen, *(illustration)*. Yet, here it can be found on the bedding surfaces on both fallen blocks and in the beach pebbles. One piece (about 2 x handsize) clearly shows the net-like shapes, and although waterworn, is good enough for the collection.

Photography of trace fossils is notoriously difficult but, by getting the light just right, the network of the *Palaeodictyon* can be determined in *photograph 9.*

Generally, the network is irregular but the hexagonal pattern can be made out. In a well preserved specimen, burrows extend vertically from the points where the sides of the hexagon intersect. The burrows were made within the surface layers of a turbidite sand flow and thought to be where microorganisms were encouraged to grow by the resident animal. As time progresses, slow sedimentation of mud buries the burrows and they are preserved. The other trace fossils commonly found in the Aberystwyth Grits are *Helminthoidea, (photograph 10),* - a horizontal burrow which, typically, meanders in a zig- zag form, and wandering burrows (*Planolites*) and feeding traces.

The Aberystwyth Grits and associated formations - the Borth Mudstones and Devil's Bridge Formation (famous for the graptolite zones and abundant graptolite species) outcrop well inland but, even when exposed, do not demonstrate the features seen so spectacularly on the coast, nor are the trace fossils and sole marks so easily found. In 1989, we found some very clear examples of

Helminthoidea near Bontgoch (Elert) 3 miles ESE of Talybont. In spite of searching through many exposures around where we stayed, we found little of interest. We were well rewarded, though, by the nature, views and fine weather inland and, of course, by the wonderful geology on the coast.

References:

Bassett, M.G.(ed) 1982 Geological Excursions in Dyfed, southwest Wales. National Museum of Wales, Cardiff.

Siveter, D.J., Owens, R.M. and Thomas, A.T. 1989 Silurian field excursions : a geotraverse across Wales and the Welsh Borderland. National Museum of Wales, Geological Series, No. 10 Cardiff.

Photograph 10: trace fossil Helminthoidea meandering in a zig-zag over the base of the bed

THE FISH THAT WALKED OUT OF WATER

Extract from an article by Roger Highfield from The Daily Telegraph, April 6th 2006

Missing Link between land and sea creatures found in frozen wastes of Canada *(illustration 1)*

Fossils of a species of fish in the act of adapting to life on land have been found, shedding new light on one of the most momentous events in evolution.

The well preserved remains of creatures with a crocodile-like head and flattened body neatly fill a gap between fish and the first creatures to walk on land.
The *Tiktaalik roseae* fossils were found on Ellesmere Island in Arctic Canada which was sub tropical at the time they were alive, but is now 600 miles from the North Pole. They provide the missing link between fins and limbs when animals first walked out of water on to land about 375 million years ago. They have a skull, a neck, ribs and parts of the limbs that are similar to four-legged animals known as tetrapods as well as fish-like features such as primitive jaws. It has been called a 'fishapod'!

The fossils were recovered from the layered rock of the Fram Formation - deposits of meandering stream systems formed when North America was part of a super-continent that straddled the equator.

Tiktaalik ranged from 4ft - 9ft long, had the scales and fins of a fish but the ribs, neck, head and appendage bones like those of a land animal. Most of the major joints of the fin are functional in this fish. The shoulder, elbow and even parts of the wrist are already there and working in ways similar to the earliest land-living animals.

The deposits where the fossils were found and its skeletal structure, suggest that it live in shallow water and perhaps could survive out of water for short periods.

The scientists asked the local Nunavut Inuit people to name the fossil. Tiktaalik (pronounced tic-TAH-lick) means a shallow water fish. It was said that these exciting discoveries were providing fossil Rosetta Stones (hence roseae?) for a deeper understanding of this milestone from fish to land-roaming tetrapods. This discovery has joined many of the dots of a complex picture.

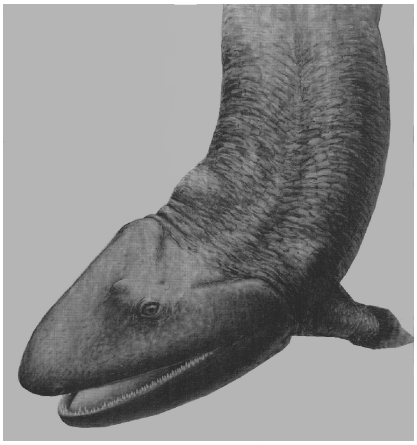


Illustration 1: Tiktaalik roseae, showing the development of tetrapod legs