

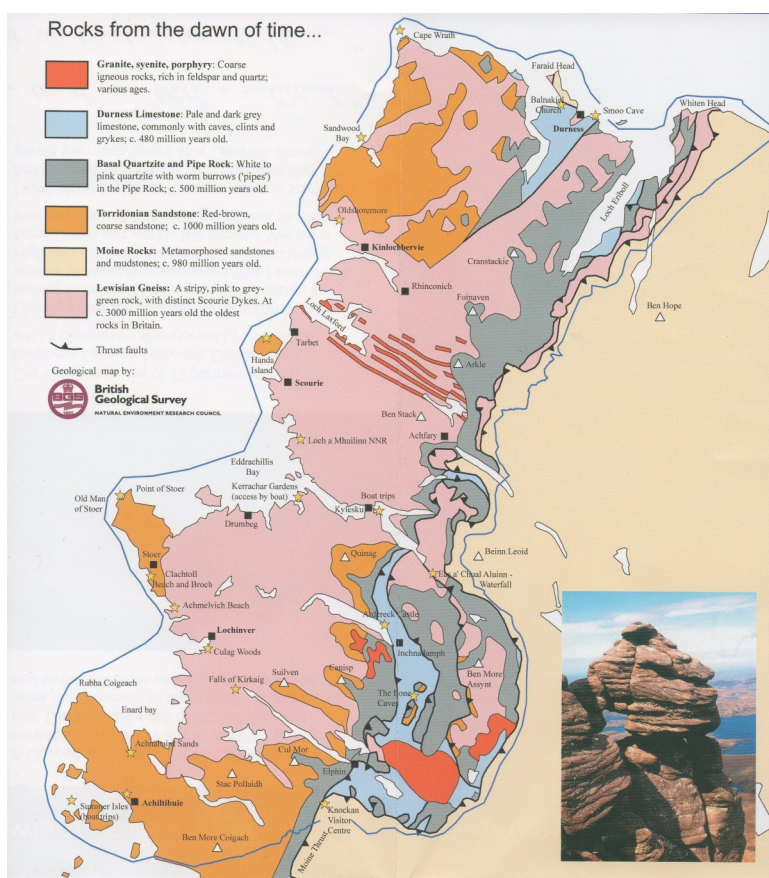
THE NORTH WEST HIGHLANDS GEOPARK – A Moving story *Charles Hiscox*

The North West Highlands Geopark was established in 2004 and was the first of its kind to be established in Scotland because of the importance of the Highlands of Argyll and Sutherland through the history surrounding the unravelling of the Moine Thrust story and the superb exposures of all the rock formations which have been involved in the story. The Geopark covers a large area of over 2000 sq. Kilometres, stretching from just north of Ullapool up the west coast to Cape Wrath, across the north coast to just east of Loch Eriboll, and then south south west along the western edge of the Moine Schist outcrop down almost to Ullapool. Within this huge

region lies the more discrete area of Assynt, ancient lands of the MacLeods of Assynt, with Loch Assynt in the northern half of the area. It is this beautiful, lonely and awesome landscape that is the subject of this 'travelogue' and where we hoped the 'moving story' would be unravelled for us. We also had with us the walkers' guide and map published in 2004 by the National Environment Research Council 'Exploring the Landscape of Assynt' which describes 10 walks of varying levels of difficulty and terrain. We were not disappointed! Also with us was one of the leaflets published by the North West Highlands Geopark which includes a small but detailed map of the Park, reproduced here by kind permission of the Sutherland Partnership Manager.

We set off from home at the end of May 2010 and leisurely travelled north, stopping near Oban for a few days before continuing on to

the few houses which form the hamlet of Elphin, 14 miles north of Ullapool. Our caravan site lay centrally within the Assynt region and was a green oasis of fields within the vast areas of moorland, mountain and bare rock. It was also superbly placed, being only 2 miles from our first place of interest and a compulsory stop for those wanting to know about the geological history of Assynt – Knockan Crag Visitor Centre. A distinctive roadside sign points the way up the mountainside to the car park from where a path leads up to the visitor centre. As one leaves the car park, a construction called 'The Knockan Crag Puzzle' faces you. This ingenious work shows not only the rock sequence but each type has been cut flat across the bedding, polished to show the



Geological map of the GeoPark

internal structure, then carved with the name of each rock type and then all set in a cairn-



Knockan Crag Puzzle

like mound. Starting on the left at the bottom is the Lewisian Gneiss 3000-2700 mya, which is overlain in order by Torridonian Sandstone 1100-750 mya, Basal Cambrian Quartzite 570-550 mya, Cambrian Pipe Rock 550-520 mya, Cambrian Fucoid Beds c. 520 mya, Cambrian Salterella Grit c.510 mya, Cambrian Durness Limestone 500 mya (note that they are getting 'younger', so far, as the construction rises) and then, topping the lot – The Moine Schists age 1100-913 mya (after the Gaelic A Mhoine, meaning peaty moor).

So, forgive me for stating the obvious, but why does a great thickness of very ancient rocks overlie a sequence of much younger ones? Well, this was the 'puzzle' that faced the geologists of the 18th and 19th centuries in the north west highlands and caused much head scratching, not a few rows and the odd nightmare (more of that later). From the car park a footpath leads up to a round, wooden hut, the Visitor Centre, which is partially roofed with bracken to disguise its presence on the mountainside. It is about 20 feet in diameter and contains two concentric galleries with interpretation panels which tell the story of the unravelling of the Moine Thrust. There are panels aimed at children in which the two main actors, Ben Peach and John Horne are seen to travel in a time machine back to the

Precambrian and then, in stages, forward



Moine Thrust Machine

through the Caledonian Orogeny, the Silurian period, up to the Ice Ages and then into the 21st century. All a bit fanciful for the reasonably informed geologist but an excellent means of telling the story to the general public. Just in case the thrusting processes were also a bit hard to understand, there is 'the thrust machine' where, by turning a wheel, a series of wedge-shaped blocks slide up over one another to represent the layers of rocks being shoved by the thrusting process.

Within the centre, there are also samples of the different rocks to handle and also descriptions of the landscape features left following the Ice Ages.

The Visitor Centre provides all the information needed to understand the processes of the Moine Thrust. However, the Moine Thrust and its secrets has been one of those 'must do' things for me for many years (you know – like finding your first trilobite, going to Shark Bay, Australia to see the stromatolites which we did a few years back). I have read about the Moine Thrust and been to the Moine Schist areas of Scotland before but found the concept difficult to understand from books. So, next best thing is to go and see it for oneself. So, here we were at last and, by taking the footpath from the visitor centre and following

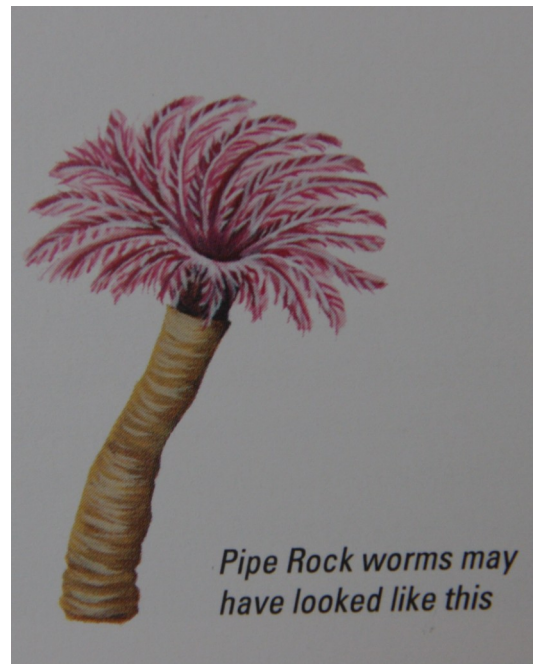
the Knockan Crag walk in the Assynt guide, the whole process and its constituent parts could be seen, touched, photographed – and wondered at! (Sadly, very few visitors actually follow the path and see the features so well described and highlighted.) The path leads



Cambrian Furoid Beds overlain by Salterella Grit

gently along the mountainside and drops towards the main road beneath you. Soon, it leads you to a rock exposure with an explanation board telling you that the rocks in front of you – cut and polished (yes – on the mountainside) were the Cambrian Furoid Beds and, above it, the Salterella Grit. The Furoid Beds are a mottled brown to black softish mudstone which was thought to be the fossilised remains of seaweed, hence the name 'furoid'.

It weathers very easily so is poorly exposed but its outcrop is easily detected as it is the only rock that supports tree growth, particularly of Mountain Ash, and also provides fertile farmland. on the good grazing. Elphin, where we stayed, was very green and fertile because the Furoid Beds outcrop was extensive around the village. The fertile land also attracted large numbers of red deer which roamed around us, feeding The Salterella Grit is a hard, pale grey quartzite marked with numerous little pits which are the moulds of the minute gastropod, Salterella. The board also tells you that, lower down the



Pipe Rock Worm



Pipe Rock bed at Knockan Crag

mountainside, the Cambrian Pipe Rock is exposed. This is the uppermost layer of the Cambrian Basal Quartzite and it was spectacularly exposed at the side of the road. In cross section, the rock shows vast numbers of white vertical marks, about 0.5-0.8mm wide, topped off with a widened disc – the trace fossil remains of the vertical burrows of a worm type organism.



Pipe rock, top part of Cambrian Quartzite

From this exposure the path winds up fairly steeply to the base of the cliff which runs along the mountainside, producing an abrupt stop to the heather - covered slopes climbed so far. Here, an interpretation board and small sculptures tell you the story of the Moine Thrust with a large hand carved from Moine Schist lying on a bedding plane of the lower of two rock beds. This rock is the Durness Limestone, grey when fresh but weathering to the creamy colour seen at this exposure. Immediately in contact with it, the upper 'bed' is very dark Moine Schist. Gill placed her hand on the discontinuity to span, in less than one hand's breadth, a break of 500 million years. On either side of this site, the unconformity stretched along the mountainside and could be followed along the footpath. Presently, the path rose steeply and somewhat precipitously to the moorland at the top from where views allowed one to see all the rock types laid out. Here, with one's back to the Crag, the moor, the 'A Mhoine' of the Gaels, rolled almost endlessly away to the east. To the west, beyond the crag in the distance, Torridonian Sandstone formed the high ground while the middle ground was Durness Limestone, marked by patches of bare rock, and then, in the foreground, a marshy strip with much Cottongrass gave away the outcrop of the Cambrian Basal Quartzite. The path turned abruptly south along the edge of the schist cliff for about half



Schist mylonite at Eagle's Rock

mile and then dropped back towards the visitor centre. At this spot, called Eagle's Rock, an exposure of thinly bedded grey rock was described with another board. This is mylonite – the geological equivalent of puff pastry where the schist and psammite had been crushed to a fine paste, in layers as thin as 1mm thick, by the intense pressure of the thrust moving the Moine rocks northwest across the Durness Limestone.

The following day we drove a few miles west of Elphin along the shore of Loch Lurgainn and parked at the base of the path which leads up to the Torridonian Sandstone mountain of Stac Polaidh (612 metres). The walk is short but very steep with a fair amount of scrambling over rocks with the last section to the summit a mass of pinnacles and gullies sculpted by the ice, being very steep and one long scree scramble. I went to the base of the last section and then turned back – it was a



Stac Polaidh showing bedding in Torridonian Sandstone

very hot day, I was tired and had left Gill near the bottom so not risking the highest part seemed good sense! When a helicopter flew in and hovered over the top to rescue a fallen walker, I realised that I had made the right decision. However, the walk gave good chances to see cross-bedding in the Torridonian Sandstone and the variety of sandstone and conglomerate which forms this impressive pile and all the other Torridonian Sandstone outcrops which have been a feature of The Highlands since the end of the ice ages. Standing on that ancient mountain side I was in awe of its age and thrilled to be experiencing the beauty of the landscape.

Like all limestone formations, and in spite of it being Cambrian (500 mya), the Durness Limestone has all the features – caves, potholes, appearing and disappearing rivers, karstic scenery. One of the walks listed in our guide is called the Bone Caves Walk which leads you up the beautiful valley of the Allt nan Uamh – ‘The Burn of the Caves’ where bones of reindeer, bears and wolves that once roamed these mountains were found in the 19th century. Later, other species were found, arctic fox, lynx, polar bear and others, along with the bones of man all dated about 4500 old. It is a gentle walk, apart from the last part, up to the caves and takes you along the edge of the small river. After about 200 yards, a small, pretty waterfall marks the spot where a



River issuing from the base of the Durness Limestone

sill of Silurian igneous rock has baked and hardened the Salterella Grit. Continuing up the valley, the pale creamy Durness Limestone crags rise up on the left, with grassy lower levels covered in a rich variety of limestone loving plants – Mountain Avens, Lady’s Mantle while the rare Globe Flower, one of the buttercup family, can be seen on the higher limestone slopes. About half a mile up the valley, the first views of the caves, high on the right flank, appear while, in the valley, the river wells up out of the limestone at the foot of the mountainside.

This cool, crystal clear water has disappeared into the limestone much higher up the valley and only runs in the now dry river bed when in flood. In June 2010, the Highlands had had one of the driest springs for years. A benefit of this dryness was that all the different rock types in Assynt could be found in the river bed as a result of erosion and transport by the ice sheets with the Pipe Rock being one of the most obvious. At the top of the valley, one could strike off up into the rocks of the Ben More Thrust but we headed to the right to climb the narrow, vertiginous path to the Bone



View from the small cave to limestone scree and quartzite capping

Caves. There are a number of caves about 250 feet above the valley floor but none are very deep now, having been opened up by water before the ice age deepened the valley. However, one of the smaller cave entrances is

covered over, only accessible to cavers, and is the entrance to a very extensive cave system which still being investigated and mapped. The return to the path in the valley is steep and rough but gave good views up the valley where the Cambrian Quarzite caps the mountain top.

The next day we drove north again, this time to Inchnadamph and took another walk in the guide, the Traligill Caves Walk, which goes up the valley called 'Valley of the Trolls' by the Norse invaders of Assynt. After about half an hour of walking, the path splits with the left one climbing up to Conival and Ben More Assynt, both 'Monros' ie over 3000 feet high, where the Moine Thrust is spectacular with the Lewisian Gneiss being thrust west over the Cambrian Quartzite. Not for us, though. We turned right and headed down the field to the river where the Durness Limestone could be seen. Here, the limestone is in two distinct



Traligill Thrust Plane and Karstic Surface

beds. The lower, creamy coloured bed is overlain by a dark grey bed, both dipping at about 30 degrees south. The river appears from the join of the two beds and flows on down the valley. Up river of the limestone beds, the river can be seen but it disappears underground when reaching the limestone. While this feature is fairly normal in limestone country, what is so different is that the 'joint' between the two beds is one of the many thrusts in the Moine Thrust complex –

limestone being thrust over limestone.

Also, the lower bed showed extensive karstic features as well as the best show of Mountain Aens we were to see. Our intention was to go higher up the valley to the caves but we suddenly became enveloped in thick, very wet, cloud which blotted out the land. In Scotland, if not equipped properly for mountain walking, discretion is the best guide, so we returned to the car park (which was still bathed in sunlight!).

For our walk to the Traligill Caves, we had parked at Inchnadamph. This consists of a few houses, a chapel and the hotel, Inchnadamph Lodge. This is not a particularly imposing building, but it has a huge claim to fame in the unravelling of the Moine Thrust story, for it is at the Lodge that Peach and Horne stayed when they were mapping the Assynt region. Another eminent geologist, Charles Lapworth stayed there while he was trying to find out why there were older rocks overlying younger ones. He is supposed to have had nightmares where huge sheets of rock were moving westwards and crushing and grinding those in their path. He dreamt that the rocks would move again and crush him while he was asleep in the hotel. He knew that this was the right answer but was afraid to tell it out aloud to the doubting geological cognoscenti. It was many years before Peach and Horne were able to prove that Lapworth's theory was correct, and close to the road at Inchnadamph, on a low hill, a stone memorial records the work of Peach and Horne.

Along the road north of Elphin, we passed a monolith of white marble from the Ledmore Marble quarry. The large quarry is in the Durness Limestone which has been metamorphosed to marble by the Loch Borralan syenite intrusion of Silurian age, during the Caledonian Orogeny, and is

extensively quarried for ornamental purposes. It also serves as an aggregate source – road repairs, garden drives, field drains and many other uses could be seen made from this sugar white rock.

As we drove around Assynt, the thrust evidence was all around. At Knockan Crag, the thrust was the Moine but this turns east at the viewpoint high on the Knockan Crag walk but the road to Elphin follows another thrust, the Sole Thrust, ie. the lowest of the thrust planes where the Durness Limestone has been pushed over the Fucoid Beds. From Elphin north to Inchnadamph, a high cliff rises on the east side of the road and this is the continuation of the Sole Thrust northwards. Just north of Inchnadamph, Ardvreck Castle (16th century), stronghold of the Macleods, stands on a headland at the east end of Loch Assynt. The loch runs north west from the castle across the Lewisian Gneiss. On the north east side of the loch at its eastern end, a complex of up to 12 thrust planes have been mapped with the main one, the Glencoul Thrust on the eastern edge. It continues northwards and cuts the south east end of Loch Glencoul where the highest waterfall in Britain, at 200 metres, falls into the loch. The guide recommends a boat trip on Loch Glencoul so that the thrusts and waterfall can be seen but, in the event, the boat was not running so we had to be content with viewing



Glencoul Thrust, and, far right, The Moine Thrust

from the road. At the viewpoint overlooking the loch, the Glencoul Thrust could be clearly made out – Lewisian Gneiss on the left, overlain by Cambrian Quartzite topped by Fucoid Beds, the tree line giving its position away, overlain by the Glencoul Thrust bringing in the Lewisian Gneiss again, all dipping about 20 degrees south east. The mountain top was covered in cloud but the cloud base just followed the thrust plane. To the extreme right, the Moine Thrust was just visible, bringing in the Moine Schists.

I have called this a moving story, so what happened? The theory of Plate Tectonics is well known. For much of the 4567 million years of earth's history, the continents have been shuffling over its surface. 500 million years ago, Scotland was separated from England and Wales by the Iapetus Ocean and was part of Laurentia which also incorporated North America and Greenland. At the same time the Cambrian Quartzite and Durness Limestone were being deposited on the edge of this continent. Between 440-410 million years ago, Laurentia collided with Avalonia, which contained England and Scandinavia, causing a great mountain range to be pushed up, the Caledonian mountains. At the same time, these forces pushed the ancient Moine rocks west an average of 50 miles over the younger Cambrian sedimentary rocks forming the Moine Thrust zone - a series of thrusts as we have seen in the north west Highland area with Assynt the region in which they are so well displayed. Having found descriptions of the Moine Thrust difficult to absorb, experiencing it, literally 'hands on' in the field, made the enormity and complexity very clear.

One of the other walks, the Clachtoll walk, starts in the car park at Clachtoll on the far west end of the Stoer peninsula. A small bothy at the car park has a display about the history of the village and features the local

minister who, in 1780, led many crofters to the New World. However, I was surprised to see a display about the Stac Fada meteorite which struck the Stoer area 1200 mya. In 2008, geologists from Oxford and Aberdeen



Bedding of Torridonian Sandstone at Clochtol

Universities found a narrow band of rock in the Torridonian Sandstone that indicated that there had been a strike, leaving a tell-tale deposit, suevite, within the sandstone. They estimate that the crater was up to 10 kilometres across, probably now under the sea. This made an interesting diversion from the Moine Thrust story although the walk is designed to show the bedding of the Torridonian Sandstone which, in the Stoer area, is a remnant of continuous sheet of Torridonian sediments which were stripped off the Lewisian Gneiss by the ice ages. The road to Clachtoll passes along the shore of Loch Assynt from where two landscapes can be seen – the present one which is the result of the ice ages and the ancient Lewisian Gneiss one, before the Torridonian Sandstone was emplaced 1000mya.

I have described the geology of the Moine Thrust complex but there is so much else to see in the area of the North West Highland Geopark – Scourie dykes, Laxfordian

intrusions, Smoo Cave at Durness, the nappes in Cambrian Basal Quartzite at the head of Loch Eriboll and much more. The scenery is wonderful with a huge variety of wildlife to see and hear – all the time we were in Assynt,

cuckoos were calling from before dawn to after dusk, red deer roamed around us, at times only yards away, gorse was at its best with huge swathes over the mountainsides.

To aid the interested visitor, a number of leaflets are available from Visitor Centres entitled 'North West Highlands Geopark' of which one was a general introduction while 4 others covered

areas of the park – Eddrachilles, Assynt, Coigach and Cape Wrath. Also available were 2 leaflets on Knockan Crag. All these leaflets were very informative and useful and all available from Tourist Information Centres at Durness, Kinlochbervie and the Assynt Visitor Centre in Lochinver, or direct from – North West Highlands Geopark, Culag Building, Lochinver, Sutherland, IV27 4LE, Scotland, 01571 844000 and email – info@northwest-highlands-geopark.org.uk The guide we used 'Exploring the Landscape of Assynt' comes as a booklet of walks of varying difficulty from 'easy' to 'strenuous' with a simplified geological map and this is also available from these sources and GeoSupplies. Use the number- ISBN 978-08527241-2 .

Editor's note: The village shop at Drumbeg has leaflets giving details of walks organised by the Highland Council Ranger Service, one of which I have been on and thoroughly enjoyed.