



## Llandegley Rocks: a guided tour

Llandegley Rocks is a complex, sprawling mass of a hill, which dominates the surrounding landscape. There are many layers of history, prehistory and natural history to explore, and one could spend weeks trying to understand all the different aspects of it... but this tour will take you to some of the most prominent, mainly natural, highlights!

The route up starts in Llandegley village, with a footpath leading towards the hills from the churchyard. From there it can be a wet walk across fields and up a steep track and path, past the cottage at Pearl Rock and onto the open hillside. The walk involves quite a lot of ascent and several miles to explore it all, so take a packed lunch, waterproofs, and sturdy shoes! To see some of the features, you also need to wander off the easy paths, and be comfortable on steep slopes and loose rocks. If in doubt, enjoy the walk and skip the parts you're not comfortable with!

### 1. An ancient view

A good place to start is from a little plateau to the northeast of the main hill. There are stunning views over the Radnor Forest, and the high crags of the Llandegley Rocks summit rise behind you. It's a view that has been enjoyed for thousands of years, as well... the plateau is oddly lumpy and scarred, because this was the site of **Iron Age huts and quarry pits**, the traces of some of which are still very obvious. At that time, it would probably have been much more heavily forested, but having a viewpoint like this would have allowed them to see long distances.

As well as the archaeology, this is an ideal spot to look at the scenery... and understand what it means. Take the Radnor Forest, for example: soft, gently rounded hills with deep valley and occasional scars cut in by streams. This might make us think that the rocks are soft... but still, the Radnor Forest reaches 2000 feet high, forming a large mass of rock that has resisted the scouring of the Ice Age (and, indeed, thousands of years of Welsh weather...).

In contrast, look behind you, to the Rocks themselves: jagged, scarred outlines with jumbled crags and little ravines. It has a totally different appearance, and looks like the rock must be much harder... and yet, the hills only reach 1400 feet. What gives?

The difference is that the rocks forming the Radnor Forest are a thick sequence of moderately soft siltstones and sandstones, but they're consistent. Layer after layer they built up (as at The Pales, if you want a closer look!), and there aren't many cracks or planes of weakness where the water that get in and cut them up. So, the hills weather as a great rounded lump, all as one mass. In contrast, the bedrock of Llandegley Rocks is indeed (mostly) very hard, but also complicated. It is brittle, fractured, and has layers of hard rock with soft rock between. There are also large faults cutting through the hills. All these features lead to a fractured, irregular landscape, with each layer and each summit eroding separately. Steep slopes help the hills to be eroded away, and we're left with the landscape you see.

So... why is that plateau you're sitting on there? Let's have a look...

### 2. Whose fault is it anyway?

From the plateau, you can go either direction to get around to the base of the crags beneath you; it's probably slightly quicker to go south, then down at the end, and circle back around. The ground here is quite uneven, with lots of fallen blocks, but it's worth the effort. Carry on until you reach an area where the cliffs are coated in white crystals; at the best place, there is a large upright slab, as tall as the crags themselves, leaning against them. (There may be a barn owl or peregrine falcon nesting near the top of the fallen slab, though, so try not to disturb them!)

Look closely at the white surface of the crags, and you'll see that it's not completely flat: there are shallow, parallel grooves running all across it. Aside from that, though, it feels remarkably smooth – not like the jagged crystal surfaces you might expect.

What you're looking at here is an ancient fault plane. Earthquakes are (mostly) caused by blocks of the crust moving past each other, under the stresses of the tectonic forces that move continents around. When the rocks break, they crack along particular planes (known as faults), and grind against each other. The larger the movement, the larger the earthquake that results from it.

Crystals often grow in these cracks, deep underground, when hot water flows along them. The water has lots of dissolved minerals in it, and as it cools, these crystallise along the edges of the crack to form a **vein**. Usually they form typical crystal shapes, but some faults don't just move once... they keep moving, as the crystals are forming. The result is that the crystals are smeared out by the movement, as the rocks scrape past each other. The grooves on the surface are the traces of that ancient scraping, and show you exactly what direction the rocks moved in. Such surfaces are known as **slickensides**.

This might just be the finest example of an exposed slickenside in Britain. It's really quite amazing, and should be enthusiastically admired. Although much of the crag is weathered, effectively the entire face, all the way along, is an ancient fault plane. That's why the plateau is there... the rest of it was cut off, millions of years ago, and was scoured away by the ice.

When was this fault moving? Around 420 million years ago, at a guess. The only substantial tectonic forces this area has experienced since the rocks were formed were when Scotland and Northern Ireland joined the rest of the British Isles in a continental collision of epic proportions. Closer to the collision zone, in Anglesey and the Scottish Highlands, the rocks are much more mangled and cooked, the result of a Himalayan-scale mountain range being pushed up over tens of millions of years. Here, out in the foothills... the rocks were tilted, crunched a bit... and, occasionally, faulted.

This is actually quite a small fault, with only a few tens of metres of total movement. Between you and the Radnor Forest, hidden beneath the soil in the valley, is a much larger one: those hills would originally have been two or three kilometres above your head!

### **3. Violent Origins**

Time to appreciate the full grandeur of this scenery. Make your way back to the plateau, through the gate, and work your way up to the summit, where there is a trig point. From here, you'll be able to see that the backbone of Llandegley Rocks is a broad ridge of hard outcrops that run all the way south along the hill towards Bwlch-y-Cefn. To the west side, the hill has a large plateau, before dropping steeply away to the flat meadows between Llandegley Rocks and Cefnlllys. On that plateau, you might notice other parallel ridges, lower than the summits, but standing out as lines of harder rock. Because of the way the rocks dip down into the ground towards the west, those layers are younger than the one you're standing on, and before the ice ages scoured them away, would have extended up over your head.

The rock you're standing on is clearly much harder than some of the layers above, and that's why it forms the summits. What is it, though? A close look will reveal no sign of layers, and a coarse, rubbly-looking texture. It can be hard to identify the grains within it, but with a fresh surface, sliced and put in a microscope, its secrets are revealed. It is made largely of crystals: plagioclase feldspar, amphiboles and quartz. It has been heavily altered by hot water flowing through it over millions of years (during the continental collision and uplift phase), with many crystals replaced by chlorite: a green crystal that gives the fresh rock its distinctive blue-green colouring.

The names of the crystals may seem dull if you're not used to them... but they can tell us a great deal. To start with, this rock is volcanic. It is what is known as a tuff: a violently-erupted mass of crystals, glass shards and broken bits of rock that represents an explosive volcanic eruption... and a big one, too. This formation is about 50 m thick on Llandegley Rocks, and although one can trace it further south, it gets thinner very quickly. This tells us that where you are standing was once close to the volcanic vent. We can't see it in the landscape—all traces of the ancient scenery are long gone!—but we know it was there. This rock unit is the Llandegley Tuffs Formation, for those who want to impress their friends!

There are more details to tease out, though. For example, the composition of the tuff is classified as andesite. This is the category that includes the most famous explosive eruptions: Krakatoa, Mt. St. Helens, and even (more familiarly, in 2010) Eyjafjallajökull... and this gives you a pretty good feel for what the eruption would have been like.

Looking deeper, the amphibole crystal known as hornblende, for example, contains water, and tells us that the magma was wet. How do we get wet magma? When it erupts above a subduction zone! As the oceanic tectonic plates sink beneath the continents (as around Japan, for example), the wet sea floor slowly grinds its way deeper. The water is driven off, and this is what causes the mantle to melt (it's a chemical effect, like changing the freezing point of water by adding salt). The water then rises with the magma, and ends up in volcanoes where it drives explosive eruptions, and is incorporated into crystals like hornblende. It is evidence like this that allows us to reconstruct ancient continental plate arrangements, and understand the world at the time the rocks formed.

All this, from a student-level examination of the rock! The rocks are important in other ways as well, though...

#### 4. Taking a lichen to geology

You don't need to go far for this, at all. In fact, just look for some large slabs of exposed rock nearby. You'll notice that you can't see much of the detail of the rock itself, because it's all covered with lichens. This flora has long been celebrated, and is extremely rich; some surfaces host dozens of species, including rare ones.

Studying these is a specialist job, and you'll need to put in a lot of effort to get to know the different types, but you can still admire them. They tend to differ by colour, texture, shape and whether they have obvious fruiting bodies. Look especially for cup lichens (*Cladonia* spp.), with tall green (and sometimes red) goblets that produce the spores. How many species can you find in one area?

The question of why this hill is so rich in lichens comes down, of course, to the rocks. Just as volcanic soils are rich enough that farmers happily live in the shadow of rumbling monsters, the volcanic rocks hold a wide range of nutrients and interesting chemistries. There are also many different types of rock in these hills, and you'll see (later) some much paler, quartz-rich rocks that are more acidic, and host a different balance of species. You might like to take photos of the lichens you find in different parts of the hill, and compare them in comfort at home!

*What you have seen so far is just a small part of the interest that these hills have. For example, the entire summit region was a large hill fort (revealed clearly by aerial photography), with standing stones and ancient quarries. The geological tale is complex, with many stages to unravel for those who have the will. There are peregrine falcons, buzzards and ravens in the skies, and numerous unusual insects in the scree, bilberry moorland and hedgerows. One could spend weeks exploring the place, and not exhaust it...*

#### 5. Life of long ago...

This volcanic island that we discussed in part 3 had a shoreline, and it wasn't violent for ever. The tuffs eventually eroded away, creating layers of sandstone and finer sediments that were deposited around the volcano's edges. There are several places around the hill where fossils have been discovered in these rocks, but usually they need a lot of effort (or just luck) to find. There is one place, however, where a reasonable number of small fossil fragments can be seen... although you **must not collect any without permission from the landowner. Do not damage the outcrops in any way, and please leave whatever you find for other people!**

The rocks at this site are interesting in their own right, though, and tell a different part of the story. You need to make your way down to the footpath running along the western side of the hill,

overlooking the cattle sheds at Graig Farm. On the side of a little valley, there are outcrops and scree underneath, beside a few stunted hawthorn trees. By this point, you've walked up (through time) through a lot of the rock sequence, and are now into the erosion of the island. The layers of rock here are quite hard, but flaky, and have weathered into obvious thin layers. The layers are made originally of bits of volcanic ash, but then washed around in the shallow seas and laid down as sand. The fossils are not in the sandstone itself, but in pebbles within it made of chert: a fine, grey, flinty-looking rock. You can see some of these pebbles in the outcrop, but are more likely to see fossils in the scree beneath.

The fossils are of typical shallow-water creatures of the day, but are mostly fragments. Most abundantly, there are the impressions of the needle-like spicules from primitive sponges that flourished in these warm seas. Small stick-like structures covered in tiny pits are the skeletons of bryozoan colonies ('moss animals'), broadly similar to those found around our shores today. There are also shells of brachiopods: an obscure group that still survives today (known as lamp-shells) but are only distantly related to the clams and mussels of our seashores. The last fossil you are likely to see looks like tiny coins with a hole in the middle; these are the broken-up remains of crinoids, or sea-lilies. Despite the name, their closest relatives are starfish, but they were delicate creatures with a long, slender stalk. It is that stalk that falls apart into hundreds of 'ossicles' – the rings that you see in the rocks.

This community was thriving on the fertile shores of a volcanic island, and possibly within a sheltered lagoon. Their remains were fossilised in layers of chert, which crystallised out of the ash-laden water. Later, the layers of chert were raised above the water (probably as the volcano inflated), eroded and worn into small pebbles. These were washed around in the sands near the coast, and laid down in what would become the sandstone you see here. It's a complicated story, but it gives us a picture of what our corner of the world at this turbulent time, and what was living in its warm, shallow seas...

### **Epilogue: The secret tying Llandegley to the Rocks**

As you make your way back over (or around) the hill to Llandegley, it's worth thinking about why it's there in the first place. Although its origin was Medieval, it thrived in the late Eighteenth and early Nineteenth Century as a result of its famous mineral springs; now neglected, but once (before Llandrindod and the railways) attracting visitors from far afield. It has a chalybeate (iron) spring, and a sulphur spring... but what are they doing there?

The sulphur dissolved in the water comes from the rocks that it trickles through... but the soft Silurian rocks of the Radnor Forest (see the activities and information about the geology of The Pales) don't really contain sulphur. The volcanic deposits of Llandegley Rocks do, though. For example, as you cross the plateau, you'll pass a prominent little ridge of hard rock sticking up through the turf. This mostly pale, rubbly-looking layer, called the Llandrindod Tuff Formation, is the remains of a massive volcanic eruption, and you might notice that the surface weathers a sort of reddish-brown colour. This is iron oxide, and results from the weathering of crystals of fools' gold: iron pyrite. Pyrite, as it happens, is iron sulphide...

Deep underground, water is trickling through these volcanic rocks, and chemical reactions are changing the sulphides to oxides... releasing both iron and sulphur into the water. As it rains, the water flows, and makes its way to the surface at Llandegley. People discover the springs, and spread the word... and soon, a little town appears, with its own church and shops. Fashions may have changed since the heyday of Llandegley... but it still owes its place in history to The Rocks.