Field Trip Report: Hawkstone Park - 12th June 2004

The Society's field trip to Hawkstone Park on Saturday 12th June 2004 was attended by fourteen members and friends from associated organisations. This was a workshop to walk and talk through the trail guide recently prepared by Chris Rayner. This had been requested by the Park Management, who intend to extract elements for their next edition of the Park Guide and as a foundation for a teacher's pack to enhance the value of educational visits.

The field trip was led by David Pannett and Chris Rayner, meeting at the car park [SJ 575286] for an introduction and then to walk round the corner to the Visitor Centre to see the exhibition and stock up with last minute goodies for our exertions. The 'strenuous' route was followed, but there are signed alternatives for those not comfortable with dark tunnels, high ground or uneven paths.

1. The Geological Setting

Hawkstone Park lies on fault-bounded scarps formed by outcropping Triassic sediments, largely sandstones. The oldest consist of the Bridgnorth Sandstone Formation, overlain by the Chester Pebble Beds Formation, the Wilmslow Sandstone Formation, the Helsby Sandstone Formation and capped by the Tarporley Siltstone Formation. Formerly these were known respectively as the Lower Mottled (Dune) Sandstone, the Bunter Pebble Beds, the Upper Mottled Sandstone, the Ryton and Grinshill Sandstone, and the Waterstones.

The more resistant of these strata (the Wilmslow Sandstone Formation and the Helsby Sandstone Formation) essentially outcrop in the form of an escarpment, but the faulting repeats the succession, producing a double scarp. Combined with the twisty paths and prolific rhododendrons, it is easy to lose one's sense of direction, geographically as well as stratigraphically!

Beyond the Park, Hawkstone Hall sits on the low ground of the red-brown Mercia Mudstone Formation (formerly known as the Keuper Marl).

2. The Excursion

David and Chris led the group around the trail set out by the Park for general visitors to follow, stopping at each of the monuments and view points to consider the geological features to be seen. Each member was given a copy of Chris's trail guide. Although aimed at the interested lay visitor, the guide draws attention to some most interesting features, providing plenty of opportunity for deeper consideration of the geology to be seen and how it has come to be visible here.

It's worth mentioning that hammers are not appropriate. Instead, a hand lens and a camera would be most useful, not forgetting a good torch for the tunnel sections and a compass if you don't want to lose your sense of direction. With a good map of North Shropshire together with the 1:250,000 regional geological map published by the BGS (*Sheet 52N 04W Mid Wales & Marches*) you can take maximum advantage of the excellent geovistas, especially if you climb the 152 steps of the Monument itself! As you ascend the Monument, note the red Wilmslow Sandstone obtained locally which was used to construct the base and lower part of the column, and the stronger grey Grinshill Sandstone used for the top of the column and the viewing platform. The statue on top is probably Coade Stone, as is the one on the Lord Hill column outside the Shirehall in Shrewsbury (a mixture of crushed flint, chalk and China Clay which can be cast in a mould but sets to a strong substance akin to concrete).

3. The Debate

The immediate impression provided by the cliff exposures is of dramatic cross-bedded sandstones suggesting formation as wind-blown dunes in a hot desert environment, which fits with most of the published accounts of the Permo-Triassic in England. However, closer examination of the exposures has revealed a number of features which help add detail to the basic depositional model and how it has subsequently evolved.

The following were offered as possible processes that deserve further consideration. It may be worth remarking at this point that whereas it is may seem to be relatively easy to postulate plausible theories, it is the gathering of relevant and accurate evidence that will enable the truth to be established; much work remains to be done and there is plenty of scope for new work for those so inclined and, most importantly, to make it available to a wider audience *[for instance in this Newsletter!]*. There is an on-going need to help make our subject accessible to a wider public and to publish our own work for the benefit of future studies, whether they be broadly educational or for specialised scientific research!

The context of the Hawkstone Park sediments, set at the margins of the Cheshire Basin, deserves consideration. Readers may have visited Alderley Edge, also at the margins of this basin, and seen the comparable development of cementation, copper mineralisation and faulting, all remarkably similar to what is seen at Hawkstone Park. It would thus be reasonable to suppose that these sediments have been exposed to comparable geological processes following deposition. Members suggested that the evolution of the Cheshire Basin has been particularly significant in producing the detailed characteristics of the Hawkstone Park sandstones.

But burial of basin sediment also compacts the material beneath, so what of the underlying Carboniferous strata? The Coal Measures were packed with organic materials and contained a lot of water in the pores of their sediment. As this sediment became buried, not only did it become hotter due to the natural geothermal gradient but also the pore water would be squeezed, thereby becoming capable of carrying some of the products of the 'cooked' organics along with it. Such water could readily dissolve some of the mineral matter as it flowed

through the pores and into the joints and faults cracking the now hardened and brittle sediment pile above. This mineralising fluid would tend to be in a chemically reduced state (due to bacterial action within the organics) and thus chemically quite out of equilibrium with the more oxidised water within the large pores of the Triassic sandstones. Chemical reaction ensued, element substitution took place, and precipitation of new minerals occurred. This would explain the growth of bartyes at the expense of gypsum within the Triassic at Hawkstone Park, and indeed the precipitation of metals such as copper which in an oxidised state is now responsible for the striking green colouration of the rocks around The Grotto [SJ 572297]. Indeed, could early exploratory adits excavated by miners, perhaps in the 16th or early 17th centuries, have provided a starting point for the network of tunnels within Hawkstone Park?

Or does the theory presented in Peter Toghill's *'Geology in Shropshire'* (p. 153-4) provide a better explanation, linking the mineralisation to the Tertiary intrusions of dolerite dykes, examples of which are seen at Grinshill not far to the south-west and linked to copper veins that have been mined there on a commercial scale?

The Triassic sand dunes did not all accumulate at once. Perhaps there were considerable gaps in time between one dune and the next. Exposures along the lower path beneath The Terrace known as Reynard's Walk [SJ 5775 2916] provide striking evidence of the presence of relict soils developed on the older dune sands during the geological past. These include discolouration of the sand, leaching of the reddened iron oxides, a laterally extensive bedding plane beneath the overlying dune (although *within* the fossil soil the bedding has been destroyed by bioturbation), and preservation of plant rootlets, now by barytes but probably originally by gypsum. Such phenomena can be seen in relatively modern fossil dunes around the Mediterranean, for instance along the east side of the Rock of Gibraltar where dunes were blown up against the rock face during periods of glacial advance (and lower sea levels) in the late Pleistocene and then subjected to weathering and soil formation in warm climatic conditions akin to those found in that region today. The suggestion is that what is seen along Reynard's Walk is a soil profile developed during Triassic times, perhaps a few thousand years after the lower sand dune had been formed, and preserved when swamped by the growth of a new dune.

Questions were also raised concerning the origins of the steep-sided gullies which cut the scarp within the Park. David Pannett reminded the group of the importance of glaciation in this area, with Irish Sea ice competing with Welsh Ice in the vicinity, covering the North Shropshire Plain with their deposits of till and fluvio-glacial outwash. Hawkstone Park would have presented a significant buttress to these ice masses. Possibly the little gullies were then carved beneath the ice as sub-glacial channels. Alternatively the gullies may be the result of severe frost action in periglacial (tundra) conditions, preceding or post-dating the glaciations. Is there any evidence to support either theory? Members noted considerable quantities of soliflucted colluvium ('Head'), not mapped on the old BGS Wem Sheet but noted in similar settings on the more recently mapped Wolverhampton and Telford Sheets to the east.

There was also a little bit of calcareous tufa noted within the steeply inclined joints of sandstone near to The Hermitage [SJ 574296], evidence of a much colder climate than at present and possibly indicative of the then relatively recent opening of the joints – could this have been the result of ice expanding as water froze within the cracks, helping columns of rock to topple away from the cliff face towards the recently steepened gully? The notes provided by Chris Rayner draw attention to these features, and to the presence of slickensides, implying that faulting might instead be responsible. Possibly all these idea could be invoked, as could a degree of anthropogenic intervention; food for geological thought and possible further research.

The fieldwork ended back at the Visitor Centre where we took advantage of the café and downed welcome pots of tea before thanking the leaders and departing for home.

Looking at the local 1:25,000 maps for Hawkstone Park, it is interesting to note the series of deep-sided gullies in the woods of Weston Heath Coppice to the south-east [SJ 557 277]: could these provide a clue as to the origins of the remarkable Hawkstone Park topography? And will the BGS significantly alter the base maps of this area when they update their knowledge during the revision of Sheet 138 (Wem), which is likely to be within the next three years? The last time this geological map was published was in 1967, by what was then the IGS, at a scale of 1:50,000 but the most recent memoir continues to be the volume published several decades earlier to accompany the New Series map published at a scale of one inch to one mile in the 1930s.

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Access:

Hawkstone Park and Follies is open for most of the year, but times are restricted, especially in winter months, so it would be wise to check beforehand. Telephone 01939 200611; Website http://www.hawkstone.co.uk.

If you want to collect specimens or examine similar exposures in the vicinity, it may be worth walking along the public footpaths in the nearby village of Lee Brockhurst where, for instance, the Wilmslow Sandstone Formation (formerly Upper Mottled Sandstone) can be seen along the edge of the wood at [SJ 550 269], and the conglomerates of the Chester Pebble Beds can be seen in a small exposure near to the river at [SJ 5487 2670]. Perhaps there could be some interesting lithologies visible in the building stones of some of the local churches and the older house walls and field boundaries *[if so, please let us know!]*. Examination of local building stones is an excellent way of getting to see the whole range of local rock types in a relatively accessible and convenient manner, many of which may no longer be visible in natural exposures or local quarries. But please remember to show appropriate respect when visiting religious establishments or studying private walls.