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# A review of Ordovician rocks in Shropshire

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DEAN, W.T. (1981). A review of Ordovician rocks in Shropshire. *Proceedings of the Shropshire Geological Society*, **1**, 2-5. The Ordovician System was named by Lapworth in 1879 from the Ordovices to resolve the problem of the boundary between the Cambrian and Silurian systems which resulted from the controversy between Adam Sedgwick and Roderick Murchison. The primary sub-divisions are as follows: Arenig, Llanvirn, Llandeilo, Caradoc, and Ashgill. There are three main areas of Ordovician rocks in Shropshire: Shelve, Caradoc and Pontesford.

Whittard mapped the "Bohemian faunas" using groups of trilobites, include: *Ampyx*, *Cyclopyge*, *Calymenid* trilobites and *Trinucleids*. At Hazler Hill, crevices in the Precambrian rocks - so called neptunian dykes - are filled with a sandy development of Harnage Shales with no representative of the usually underlying Hoar Edge Grits.

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The Ordovician System, named by Lapworth in 1879 from the Ordovices, a Celtic tribe whose territory once covered part of North Wales and the Welsh Borderland, includes rocks which, according to recent estimates, were deposited between approximately 500 and 430 million years ago.

Lapworth introduced the Ordovician in an attempt to resolve the problem of the boundary between the Cambrian and Silurian systems which resulted from the controversy between Adam Sedgwick, working on the Cambrian of northwestern Wales, and Roderick Murchison, who established the Silurian System on the succession in the Welsh Borders. Lapworth was familiar with the work of Joachim Barrande, who had demonstrated that there were, in the older rocks of Bohemia, three distinct faunas. The oldest of these three corresponded to the Cambrian, and the youngest to the Silurian; the middle group formed the basis of Lapworth's concept of Ordovician, though he did not specify a single type section.

The primary sub-divisions of the Ordovician systems are called Series, each founded on a type section. As often happens in other geological systems, the type sections of the Ordovician series are scattered over a wide area, as follows: Arenig, based on Arenig Fawr, west of Bala; Llanvirn, based on an area at and near Llanvirn Quarry in Dyfed; Llandeilo, named after the town in Dyfed; Caradoc, based on the area south of Church Stretton, Shropshire; and Ashgill, based on the Cautley area of northwest Yorkshire, though named after Ashgill Beck in the Lake District.

One must also take into account the Tremadoc Series, based on the Portmadoc area, northwest Wales and regarded as topmost Cambrian by some British geologists, though finding increasing favour, particularly internationally, as the lowest series of the Ordovician.

There are three main areas of Ordovician rocks in Shropshire:

1. Shelve Inlier, the most important of the three
2. Caradoc District
3. Pontesford area, west of the Long Mynd.

## *1. Shelve Inlier*

The first major work on the Shelve Inlier was carried out during the late 19th and early 20th Centuries by Lapworth and Watts, who established the basic rock succession; a complete remapping was subsequently undertaken by the late Professor W.P. Whittard. The rocks of the inlier, some 4,000 m thick, are gently folded, as evidenced by the Ritton Castle Syncline and the Shelve Anticline. For most people the inlier starts with the escarpment of Stiperstones Quartzite rather than the Shineton Shales of the Tremadoc Series.

The succession passes upwards into siltstones of the Mytton Flags which form conspicuous topographic features and contain the principal lead-zinc ores of the area, known since Roman times. The mineralisation is largely confined to the flags by the impermeable capping of softer, darker mudstones of the succeeding Hope Shales. Above are volcanic rocks which are an important feature in the interpretation of regional relationships, and

 

the rest of the succession mostly comprises sandy beds, dark shales and mudstones.

There is a certain amount of continuity in the lithological development, from bottom to top, of the Shelve Ordovician succession. However, the section ends in the middle of the Caradoc Series and only some 80% of the Ordovician is represented in the inlier. In the highest part of the Shelve succession are the Hagley and Whittery volcanic groups, in which Whittard identified volcanic agglomerates near Whittery. These were considered by him as providing evidence for the proximity of events in this part of the inlier during the later phases of volcanicity in the Shelve Ordovician. Further north-westwards, in the Welshpool area, the younger Ordovician succession is more complete and rocks of the highest Caradoc Series and the Ashgill Series are represented; it is possible that the latter are present in the Shelve area beneath the unconformable Silurian cover.

Mapping of the inlier by Whittard during more than 35 years showed that the Silurian rocks rest unconformably on the Ordovician and that there was a considerable time gap, during which folding and faulting took place, between the end of Ordovician deposition there and the onset of Silurian deposition, as the sea transgressed across what had become a land mass. Indeed the Lower Silurian (Llandovery Series) is also incomplete in South Shropshire, further emphasising the gap in deposition between the Caradoc Series and the earliest Silurian strata there.

Although the Ordovician shales of the Shelve Inlier are often described as highly fossiliferous, many of the beds yield fossils only after long and patient search, a task for which Whittard's assistant, Tom Fry, showed such remarkable aptitude. The fossil faunas are of a type which used to be known in the 1930's as "Bohemian faunas" from their close affinities to those found in the rocks in Czechoslovakia described by Barrande and mentioned earlier.

The main groups of trilobites include the following: *Ampyx*, a blind genus with a long spine on the front of the cephalons. *Cyclopyge* and related genera, in which the eyes are very large and sometimes join in front and extend underneath the head. Such animals were probably semi-planktonic as the sea floor muds at that time were deposited in an environment low in oxygen and high in hydrogen sulphide. *Calymenid* trilobites occur sporadically throughout the succession but *Neseuretus* is particularly important because it is found not only in Wales, but also in Spain, North and South France, North Africa, the Middle East, eastern Newfoundland and South America. Finally, *Trinucleids*, apparently blind trilobites, the cephalon of which has a well developed perforated brim and small lateral tubercles which may have been light sensitive.

Whittard described the distribution of these and other trilobites throughout much of the Shelve Ordovician and it is possible to sub-divide the rocks into zones based on them. There are, however, some difficulties since the composition of the faunas depends on the environment of deposition of the rocks. *Trinucleids* with a rectangular cephalic outline are generally found in sandy rocks rather than in dark mudstones, in which thin-shelled forms with well rounded cephalic outline tend to occur. Graptolites are an important element in the Shelve faunas and have been found in many of the shaly beds.

### *2. Caradoc District*

The Ordovician rocks of the Caradoc district extend from Coston Farm, near Clunbury, in the south to Cound in the north, where they are involved in part of the Church Stretton fault complex, an important line of geological structure which, like the Linley-Pontesford Fault, probably extended into South Wales. Cobbold showed the Church Stretton fault complex to comprise a number of faults: $F_1$, a vertical fault; $F_2$, a sinuous fault and probably a line of thrusting; and $F_3$, probably a wrench fault, which moved rocks into an almost vertical position on its western side. All the Ordovician rocks of the Onny Valley, Marshbrook and Cound form an outcrop within and east of this fault complex.

We owe the name Caradoc Series to Murchison, who cited the Onny Valley between Rock Cottage, Horderley, and the "Cliff Section" near Wistanstow as stratotype for his Caradoc Sandstone. This is a classic area for a succession which can be subdivided on the basis of the brachiopods, trilobites and other shelly fossils it contains. Although the strata are generally calcareous, there is no development of massive limestones such as one associates with, for example, the Silurian rocks of Wenlock Edge. The base of the type Caradoc Series lies unconformably on Precambrian, Cambrian and

 

Tremadoc rocks, and the entire sequence can be interpreted broadly as comprising two cycles of deposition, each starting with sandstones, locally calcareous and fining upwards through siltstones, mudstones and shales. The oldest strata are interpreted as the deposits of a sea transgressing across an irregular topography of pre-Ordovician rocks.

The shales around Harnage and the Onny Valley are younger than the Hoar Edge Grits and pass laterally into sandy deposits; these too form part of the transgression and the basal beds become younger as the sea lapped further onto the landmass, so that at Hope Bowdler, Harnage Shales are seen forming the local base of the Caradoc Series.

At Hazler Hill, crevices in the Precambrian rocks - so called neptunian dykes - are filled with a sandy development of Harnage Shales with no representative of the usually underlying Hoar Edge Grits, a unit found at Coston, Hoar Edge and Cressage. Some of the shelly faunas of the Caradoc district are related to those of Wales, but others show affinities with regions outside the British Isles. For example, the Harnage Shales, Horderley Sandstone and Alternata Limestone contain the trilobite *Kloucekia*, which belongs to a genus named after the Bohemian palaeontologist Kloucek and is found in various parts of southwestern Europe and the Mediterranean area. In the middle Caradoc Series are found trinucleid trilobites having affinities with other parts of the Anglo-Welsh area, the Lake District and Belgium. During late Caradocian times there must have been a significant change in conditions of deposition, with deepening of the sea indicated by the finer grain size of the sediments. In mudstones of the Acton Scott Beds the trilobite *Chasmops extensa* is found; this is a zonal fossil in corresponding Ordovician strata in south southern Norway and parts of Sweden. Graptolites are generally uncommon in the type Caradoc Series and it is difficult to correlate the graptolite zones of, for example, the Southern Uplands of Scotland with strata in the Welsh Borders.

*3. Pontesford Area*

In recent years a new interpretation of the Pontesford Ordovician has been put forward. On the west side is the important Linley-Pontesford Fault, subparallel to the Church Stretton Fault and probably more fundamentally important than the latter in Shropshire geology. The Pontesford outcrops were originally thought to be signif cantly different to those of the Caradoc district but are now known to be essentially of the same type, though much less complete. The relatively small Ordovician outcrop near Pontesford Hill includes shales equivalent to chose found at Harnage and fossiliferous mudstones identical to those at Glenburrell Farm, Horderley. That is to say, it represents only part of the lower Caradoc Series in the type area.

Taking a regional view of Ordovician deposition, the thin, incomplete succession east of the Linley-Pontesford Fault was developed on the Midland Platform, whereas to the west of the fault there was a deeper water environment in which much greater thicknesses of sediments were deposited, together with volcanic rocks.

The Ordovician was a period of great tectonic activity, with large-scale development of volcanic and other igneous rocks, in contrast to the preceding Cambrian and succeeding Silurian periods, both of which were times of relative stability, at least in Britain. In terms of plate tectonic theory, we now know that it was a time of extensive plate movements involved in the closure of the Iapetus (or Proto-Atlantic) Ocean which lay to the west of the Midland Platform, itself extending eastwards into the Brabant area of Belgium and apparently an integral part of the continental mass known as Gondwanaland. The two groups (Stapeley and Hagley-Whittery) of volcanics in the Shelve Ordovician constitute part of intermittent volcanicity which occurred over the Anglo-Welsh area and southern Ireland from the Arenig to the Caradoc and which represent the activity of an island arc system extending from Scotland across Ireland.

Much evidence for the existence and behaviour of lapetus is based on the interpretation of the eastern Appalachians, which are situated along the eastern edge of the North American craton and are particularly clearly developed in Newfoundland, New Brunswick and Nova Scotia. Shale from the McCleod Brook Formation on Cape Breton Island is almost identical lithologically with the Shineton Shales of Shropshire and contains some of the same trilobites, including *Shumardia pusilla* and *Asaphellus homfrayi*.

On Bell Island, eastern Newfoundland, Arenigian quartzites similar to both the Stiperstones Quartzite of Shropshire and the

 

Armorican Quartzite of Brittany are found. These Newfoundland quartzites are followed by a series of silty shales and siltstone corresponding to the Mytton Flags, in which so-called "trace fossils" occur, representing tracks of marine animals (particularly arthropods but also worms), the hard parts of which are not preserved. Some trace fossils can be used for crude stratigraphic zoning over a wide geographical area; for example *Cruziana* (arthropod) and *Phycodes* (probably a worm) are found in North Wales, the Shelve Inlier, the Mediterranean Region, southern Turkey, the Middle East, Afghanistan and eastern Newfoundland. Using such data it is possible to show that the Shropshire Ordovician rocks form part of an area of deposition extending around the margins of Gondwanaland from the eastern Appalachians through Brittany, lberia and northwest Africa.

Palaeomagnetic studies locate the Ordovician South Pole in west Africa, then part of Gondwanaland, with an extensive ice cap developed in Morocco during the late Ordovician. Contemporaneous offshore sediments are therefore unlikely to have been formed in warm water and this is probably the reason for the non-development of limestones in rock successions such as those in the Shelve Inlier. Any small vertical movement of the platform would cause extensive marine transgressions and regressions. The Appalachian Mountains themselves, though now much eroded, were formed by the collision of the two sides of lapetus.

When the present-day Atlantic Ocean opened during the Mesozoic, part of the old margin of Gondwanaland remained on the western side of the ocean, while the rest was pushed eastwards together with remnants of the previous North American margin such as we now see it the Northwest Highlands of Scotland. As one might expect, the changing relative distance (for which no reliable figures are available) between the two sides of Iapetus affected the distribution of Ordovician marine animal life. Whittington and Hughes have shown that early Ordovician trilobite faunas of the North American craton were very different from those of Gondwanaland, including most of present-day Europe, but that late Ordovician faunas were more cosmopolitan, suggesting that the two regions were then in closer proximity. The later part of the Ordovician period in Shropshire was marked by extensive earth movements connected with the closure of lapetus. The latter were followed by a time of erosion and non-deposition which bridged the boundary between Ordovician and Silurian and was followed by relative calm, tectonically speaking, which persisted throughout the Silurian period.

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