
Rheidol Gorge

[SN 7495 8090]–[SN 7488 7905]

Introduction

The rocks of the hilly country around Plynlimon in Central Wales, inland from Aberystwyth, were first examined by Sedgwick in 1832 and 1846. From these studies he believed the strata to be below the 'Upper Silurian' and above the 'Bala Limestone', and attempted a broad classification (Sedgwick, 1847). At about the same time, officers of the Geological Survey of England and Wales were producing the first maps of the area, which were published in 1848. These showed the solid rocks as being of Silurian (Lower Llandovery) age. The first full account of the rocks of the area was provided by Keeping (1881), who identified three units, but misinterpreted their superpositional order. This error was detected by Marr (1883) and by Jones (1909), the latter of whom undertook a very detailed and careful study of the strata exposed around Plynlimon and Pont Erwyd, in which he determined the lithostratigraphical succession, investigated the biota and produced a geological map.

The Rheidol Gorge is near the western margin of the area mapped by Jones (1909). The GCR site extends roughly north–south, following the meandering course of Afon Rheidol (Figure 3.47), (Figure 3.48); the northern limit is at Ponterwyd and the southern at Parson's Bridge. The strata exposed in and alongside the river span the entire thickness of the 'Pont Erwyd Stage' as defined by Jones (1909). Within this 'stage', Jones recognized three subdivisions, in ascending order the 'Eisteddfa Group', the 'Rheidol Group' and the 'Castell Group'. Graptolites suggested that the 'Eisteddfa Group' could be assigned to the *persculptus* and *acuminatus* biozones, that the 'Rheidol Group' spanned the *atavus* to *communis* biozones, and that the 'Castell Group' represented the *convolutus* and *sedgwickii* biozones. Some of the graptolites from the area were figured by Elles and Wood (1901–18), and Sudbury (1958) later studied the triangulate monograptids from the Rheidol Gorge; graptolites from this section were also included in the studies of Packham (1962) and Zalasiewicz and Tunnicliff (1994). The lithostratigraphy was extended northwards and modified by Jones and Pugh (1916, 1935a), who subdivided the 'Pont-erwyd Stage' into two, rather than three, units: the 'Cwmnere Group', which spanned the *persculptus* to *triangulatus* graptolite biozones, and the 'Derwen Group' which ranged from the *magnus* Biozone to the *halli* Biozone.

The Aberystwyth and Machynlleth areas were remapped by the British Geological Survey between 1965 and 1975, and a 1:50 000 map (solid edition) published in 1984. In the accompanying memoir, Cave and Haim (1986) broadly followed the lithostratigraphy established by Jones and Pugh (1916). They renamed the 'Cwmnere Group' as the Cwmnere Formation, and distinguished a Mottled Mudstone Member at its base; this member contains the graptolite *Glyptograptus* (= *Normalograptus*?) *persculptus* and is of latest Ordovician age. The lower part of the Derwen Group' was renamed as the Derwenlas Formation, with its base revised to include strata referable to the *triangulatus* Biozone. The Cwmnere Formation above the Mottled Mudstone Member is, therefore, of Rhuddanian age, and the Derwenlas Formation spans the Aeronian Stage. Cocks *et al.* (1992) gave the thickness of the Cwmnere Formation as 70–160 m, and that of the Derwenlas Formation as 20–80 m. Cave and Haim (1986) commented briefly on the exposures in the Rheidol Gorge, and the locality is also covered in a number of field excursion guides (Bates, 1982b, 1995; Siveter *et al.*, 1989).

The Rheidol Gorge section provides intermittent, but good exposures of the Cwmnere and Derwenlas formations. The section has produced numerous excellently preserved graptolites, sometimes replaced by pyrite in full relief; it is a very important site for graptolite taxonomy and biostratigraphy. Several graptolite specimens from the Rheidol Gorge have been figured in the literature, and it is the type locality for the biozonal species *Atavograptus atavus* (Jones, 1909) and other graptolite taxa including *Monograptus pseudoplanus* Sudbury, 1958, *M. walkerae walkerae* Rickards *et al.*, 1977, *Climacograptus tamariscoides* Packham, 1962, *C. alternis* Packham, 1962, *Glyptograptus enodis* Packham, 1962, *Metaclimacograptus slalom* Zalasiewicz, 1996, and *Neodiplograptus peggyae* Cullum and Loydell, 1997. The fullest description of the strata in the Rheidol Gorge section was given by Jones (1909, pp. 483–92, 502–5). He recorded that structural measurements of the strata in and around the gorge revealed a faulted anticline, to the east of which is a shallow syncline. The lowest beds recognized by Jones (1909) are exposed on the east side of the river some 500 m

SSE of the bridge at Ponterwyd; here hard sandy flags and shales have yielded the graptolites *Parakidograptus acuminatus* and *Normalograptus scalaris normalis*. These strata belong to the Cwmere Formation, presumably only a little above the top of the Mottled Mudstone Member. On the western bank a fault brings down higher flags and shales, within which three bands of coarse sandstone are prominent, the highest and thickest is about 5 m thick. These beds are probably about 40 m above the top of the Mottled Mudstone Member, and are referable to the upper part of the *acuminatus* Biozone (Cave and Hains, 1986).

The succeeding strata are exposed between the sandstone outcrop and the next bend in the Rheidol, where a small tributary enters from the west; these again comprise flags and shales, with the hemipelagic shale component increasing upwards. Jones (1909) recorded *N. scalaris normalis* as almost the only fossil present in the lower part of this exposure, but in the upper, shalier, units it is joined by *Atavograptus atavus*, the diagnostic species of the *atavus* Biozone. At the bend, the rocks are sharply folded, and here Jones (1909, p. 485, his locality Ell; [SN 7490 8005]) reported the occurrence of *A. atavus*, *N. scalaris normalis*, *Dimorphograptus erectus* and *Rhaphidograptus toernquisti*.

The succession can be picked up again on the eastern limb of the anticline at Jones' locality F.12 [SN 7510 7988]. A change in lithology is marked by a bed of small calcareous nodules, which is followed by somewhat harder and sandier beds. The characteristic graptolite is *Lagarograptus acinaces* (= *Monograptus rheidolensis* of Jones), with *R. toernquisti*, *Orthograptus mutabilis*, *Glyptograptus tamariscus* and *N. scalaris normalis* also common. A higher band of larger calcareous nodules occurs at the bend, where the river turns to the east. For the next 200 m the shales are folded and faulted, and Jones (1909, p. 486) determined that only about 13 m of strata were represented; the top of this unit is marked by another band of large calcareous nodules (individual nodules are up to 30 cm across). Some of the bedding planes in this interval are covered with large graptolites, principally specimens of *A. atavus*. Exposures in the leat (Jones' localities F. 13 and F. 14) also yield abundant and diverse graptolites, especially horizons 8 m and 1.8 m below the upper nodule bed. Many of the specimens are exquisitely preserved in three dimensions in pyrite, with the fauna in the upper horizon containing *O. mutabilis*, *G. tamariscus*, *R. toernquisti*, *A. atavus* and *Coronograptus cyphus*, indicative of the *cyphus* Biozone.

The upper bed of calcareous nodules marks the boundary between the Cwmere and Derwenlas formations, approximately coinciding with a change from dark grey, thinly bedded, graptolitic mudstones to paler, bluish-grey, thickly bedded, poorly fossiliferous mudstones within which dark-grey graptolitic bands occur. Jones (1909) identified four particular graptolite bands (F15–E18) in the lower part of the Derwenlas Formation around [SN 7538 7970], spanning the *triangulatus*, *magnus* and *argenteus* (*leptotheca*) biozones. In the lowest band (E15), 1.9 m above the base of the formation, *Monograptus revolutus* and *R. toernquisti* dominate, with *A. atavus*, *Pristiograptus concinnus* and *Monograptus triangulatus* common; bivalves, orthid brachiopods and fragmentary orthocones also occur. The second band (F.16), 9.1 m above the base of the formation also has common *R. toernquisti*, *M. communis*, *P. concinnus* and *M. triangulatus*, but *Orthograptus insectiformis* and species of *Rastrites* are also characteristic. A little higher, at 10 m above the base, the third band (E17) is distinguished by abundant *Diplograptus magnus*, which first appears at this level; rastritids and several monograptid species are also common. The highest graptolite band (E18), 17 m above the base, was designated the *leptotheca* band by Jones (1909, p. 489), reflecting the abundance of *Pribylograptus leptotheca*; other common species include *Monograptus* cf. *argenteus*, *Monograptus* cf. *millipeda* and *Pseudoclimacograptus* (*Metaclimacograptus*) *hughesi*. This band can be widely traced throughout the area, and was used by Jones (1909) to delimit the top of his 'Rheidol Group'.

The rocks of Jones' 'Castell Group' are now incorporated in the Derwenlas Formation. In the Rheidol valley, south of Bryncwirth, the strata above the *leptotheca* band comprise pale mudstones and flags, which are exposed in the inaccessible walls of the gorge. Intermittent sections are also available in an old leat above the gorge, where the pale mudstones contain numerous graptolitic bands, in which *Monograptus convolutus* and '*Monograptus*' *lobiferus* are characteristic. The stretch of the river from [SN 7540 7957] to [SN 7488 7935] follows the line of the mineralized Castell Fault, but the course turns southwards again some 300 m north of Parson's Bridge. The strata here are cleaved sandy mudstones with few fossils, but Jones (1909, p. 503) found one locality 60 m south of the bend (F.40) that again yielded *M. convolutus* and '*M.*' *lobiferus*, showing the presence of the *convolutus* Biozone. Nearby, above the eastern bank of the river (F41) a graptolite fauna with *Monograptus sedgwickii* indicates the latest Aeronian *sedgwickii* Biozone. Jones (1909) suggested that the top of the *sedgwickii* Biozone must lie somewhere in the neighbourhood of the Parson's Bridge.

The GCR site area also includes the ravine at the north end of the locality, below the George Borrow Hotel [SN 7474 8055]. This is a glacial diversion channel (Challinor, 1933), with precipitous walls, within which Jones (1909) identified the calcareous nodule band that defines the base of the Derwenlas Formation, together with good specimens of *L. acinaces* in beds some distance below.

Interpretation

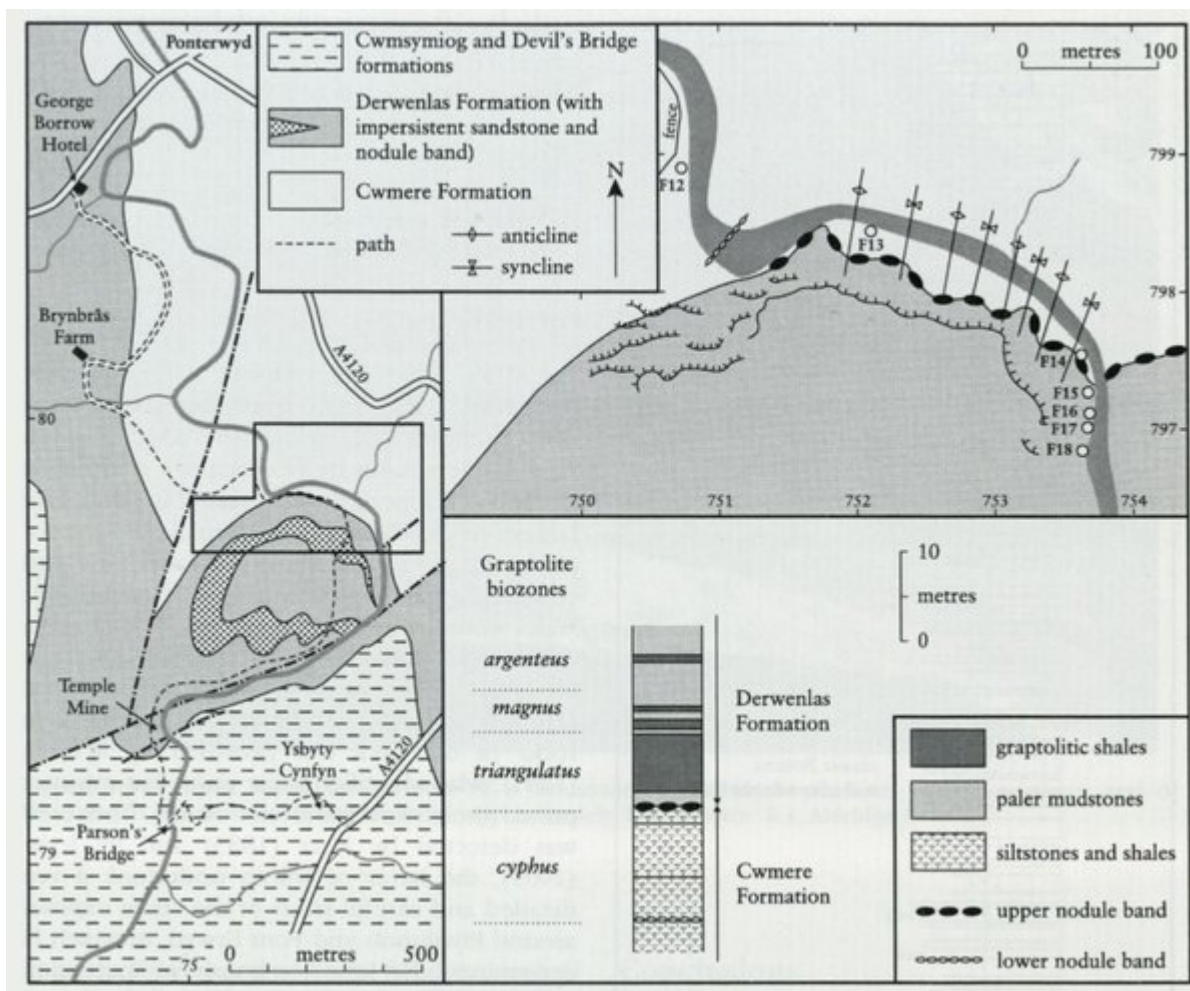
The sequence of strata in the Plynlimon and Ponterwyd areas is representative of deposition in the deeper, quieter parts of the Welsh Basin during the earliest Silurian. The Mottled Mudstone Member shows that, during the latest Ordovician, bottom waters and near-surface sediments were oxic, allowing colonization by a burrowing infauna and the bioturbation that produced the mottled appearance. Above this member, the sediments of the Cwmere Formation show that sea-floor conditions abruptly became dominantly anoxic, perhaps reflecting the onset of stagnant, warm conditions of the Spirodden Secundo Episode (Aldridge *et al.*, 1993a). Some sediments were brought into this part of the basin by extremely distal, low-density turbidity currents that introduced mainly mud grade detritus, but the dominant sedimentation was in the form of hemipelagic mud (Cave and Hains, 1986). Occasionally, turbidity currents introduced silt or fine sand into the district, and this process appears to have been dominant for a short interval represented in the middle part of the Cwmere Formation. The source of the turbidity currents appears to have been from the east or south-east, as indicated by rare bottom structures and by the thinning of the turbidite units northwestwards (Cave and Haim, 1986).

The Derwenlas Formation records an increase in turbiditic sedimentation and a change to more oxygenated bottom conditions (Cave, 1979). The sequence has been interpreted as an outer fan, or a sedimentary lobe, which was pro-grading into the basin (Cave and Hains, 1986). Quieter periods were marked by a return to hemipelagic sedimentation with the incorporation of graptolitic faunas.

Conclusions

This is an important, well-exposed site that displays typical basinal sediments of the quieter parts of the Welsh Basin during the earliest Silurian. Good sections through the Cwmere and Derwenlas formations are available, and yield rich and diverse graptolite faunas representing all the biozones of the Rhuddanian and Aeronian stages. The graptolites are often exquisitely preserved, with three-dimensional details evident through replacement by pyrite. This is a very significant locality for studies of graptolite morphology, taxonomy and biostratigraphy. It has featured widely in the graptolite literature, and will undoubtedly be incorporated in any future revisions of Rhuddanian and Aeronian graptolite faunas. The section is frequently visited by national and international specialists and is of high conservation value.

[References](#)



(Figure 3.47) Geological map of the Rheidol Gorge (left) and detailed map of the area around the contact between the Cwmere and Derwenlas formations (right), showing the positions of graptolitic horizons (after Siveter et al., 1989).



(Figure 3.48) View of the Rheidol Gorge (Photo: Derek J. Siveter.)