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# Gelli-grin

[SH 944 339]

## Introduction

Gelli-grin is the type locality for the Gelli-grin Formation of Longvillian–Woolstonian age; the basal Pont-y-Ceunant Ash has yielded radiometric and fission-track ages that provide a basal Longvillian tie on the chronometric time-scale. The Gelli-grin Formation is richly fossiliferous and has had a significant, sometimes controversial, historical role in the understanding of the succession of the Bala area. For ecological reasons, the faunal associations are very different from those at equivalent levels in the type Caradoc and provide a text-book example of the need to disentangle environmental distribution (particularly above species level) from time-range.

The present site includes the type section for the historically important Cymerig Limestone Member, named by Bassett *et al.* (1966, p. 237), who outlined the controversy previously surrounding it. The limestone constituted part of the Bala Limestone of Sedgwick (1845). Jukes (in Ramsay, 1866) argued, erroneously, that it was the same unit as the Rhiwlas Limestone (see the Rhiwlas site report); Elles (1922a) considered that they are distinct but that this, the older limestone, was really a number of discrete lenses at different stratigraphical levels, to which she applied different names. Bassett *et al.* (1966) followed Bancroft (1928a) in arguing that although the limestone is a set of lenticular bodies, they occur at one stratigraphical level. Bancroft also argued that a distinct sequence of faunal assemblages can be recognized in the Gelli-grin Formation, and, subsequently (Bancroft, 1945, p. 182), that there is a hiatus below the Cymerig Limestone. Bassett *et al.* (1966; also Williams, 1963) supported neither of these contentions, but argued (1966, p. 258) that the strong ecological control at generic level had hindered correlation with the type Caradoc of Shropshire and resulted in some earlier misconceptions about the age of the formation.

The rich faunas have an important role in the understanding of both biofacies distribution and biostratigraphy in the Caradoc of the British Isles and include the type material of several species of brachiopod. Lockley's (1980b, 1983) quantitative analyses of the shelly faunal changes through the formation here and at several other localities showed that a sequence of lithofacies-related assemblages is recognizable and can be fitted into the overall pattern of recurring bio-facies in the Caradoc of Wales and the Welsh Borderland. Furthermore, the Cymerig Limestone Member contains an abundant conodont fauna, including, at a nearby locality, the type material of the zonal species *Amorphognathus superbus*. The interpretation of that species is critical in the international definition of the base of the succeeding *A. ordovicicus* Zone and its relation to the base of the Ashgill Series.

## Description

Natural outcrops and old quarries west of Gelli-grin farm (Figure 9.17) reveal that the Gelli-grin Formation is almost 60 m thick in its type development. Bassett *et al.* (1966), who considered the Gelli-grin Formation to be the most recognizable formation in the Bala district, provided logs through the formation here. Lockley (1980b) did likewise, showing more explicitly the significant gaps in exposure in the middle part of the unit that make estimates of thickness somewhat uncertain. The formation dips SSE at about 30°, but locally somewhat more steeply, and the outcrop is offset by faults (Figure 9.17).

The Gelli-grin Formation overlies the dark-blue, silty mudstones of the Allt Ddu Mudstone Formation and its base is marked by the 3 m thick Pont-y-Ceunant Ash Member. Schiener (1970) described the sedimentology and petrography of this coarse, water-lain vitric tuff. It has an irregular base and its lower parts contain mudstone clasts derived from the underlying formation. It thickens to over 6 m at Y Garnedd [SH 945 354] and its development elsewhere is intermittent. Ross *et al.* (1982) obtained fission-track ages of 460 ± 14 Ma and 469 ± 12 Ma from the Pont-y-Ceunant Ash at Gelli-grin and, more recently, radiometric ages of 448 ± 4 Ma, 454 ± 8 Ma and 457 ± 2.2 Ma were obtained using U—Pb isotopic techniques (Tucker and McKerrow, 1995, p. 375).

The ash is succeeded at Gelli-grîn by about 8 m of tuffaceous mudstone, 2 m of sandstone and almost 6 m of mudstone before the reappearance of a significant volcanoclastic component, with perhaps 25 m of calcareous tuffaceous mudstones and siltstones intermittently exposed. These are overlain by the Cymerig Limestone Member, which has its type locality in the abandoned quarry near the western end of the site. It is about 4.5 m thick, comprising several horizons of dark-blue crystalline limestone, nodular limestones and calcareous and ashy mudstones, and is overlain by about a metre of calcareous mudstones with rare limestone nodules, which pass up into some 8 m of calcareous and tuffaceous mudstones. The formation is overlain with slight angular unconformity by mudstones of the Ashgill Moelfryn Mudstone, which here lacks the Rhiwlas Limestone at its base. Shelly fossils occur in all the lithologies of the Gelli-grîn Formation (Figure 9.18) and are abundant at some horizons. Abundant conodonts have been extracted from the Cymerig Limestone Member (Savage and Bassett, 1985).

Bassett *et al.* (1966) described other outcrops of the Gelli-grîn Formation in the Bala area and Lockley (1980b) sampled through the formation at several localities for 14 km along-strike to the SSW. His suggestion that the upper part of the formation passes laterally into the Nod Glas Formation, when traced farther in that direction (Lockley, 1980a), has yet to be verified. His faunal analysis at Gelli-grîn and other localities at the northern end of the outcrop showed three successive faunas, with a *Howellites–Klouceka* Association sandwiched between variants of the *Nicolella–Onniella* Association. These were subsequently included in his wider analysis of palaeocommunity distribution in the Arenig to Caradoc of the Welsh Basin (Lockley, 1983).

## Interpretation

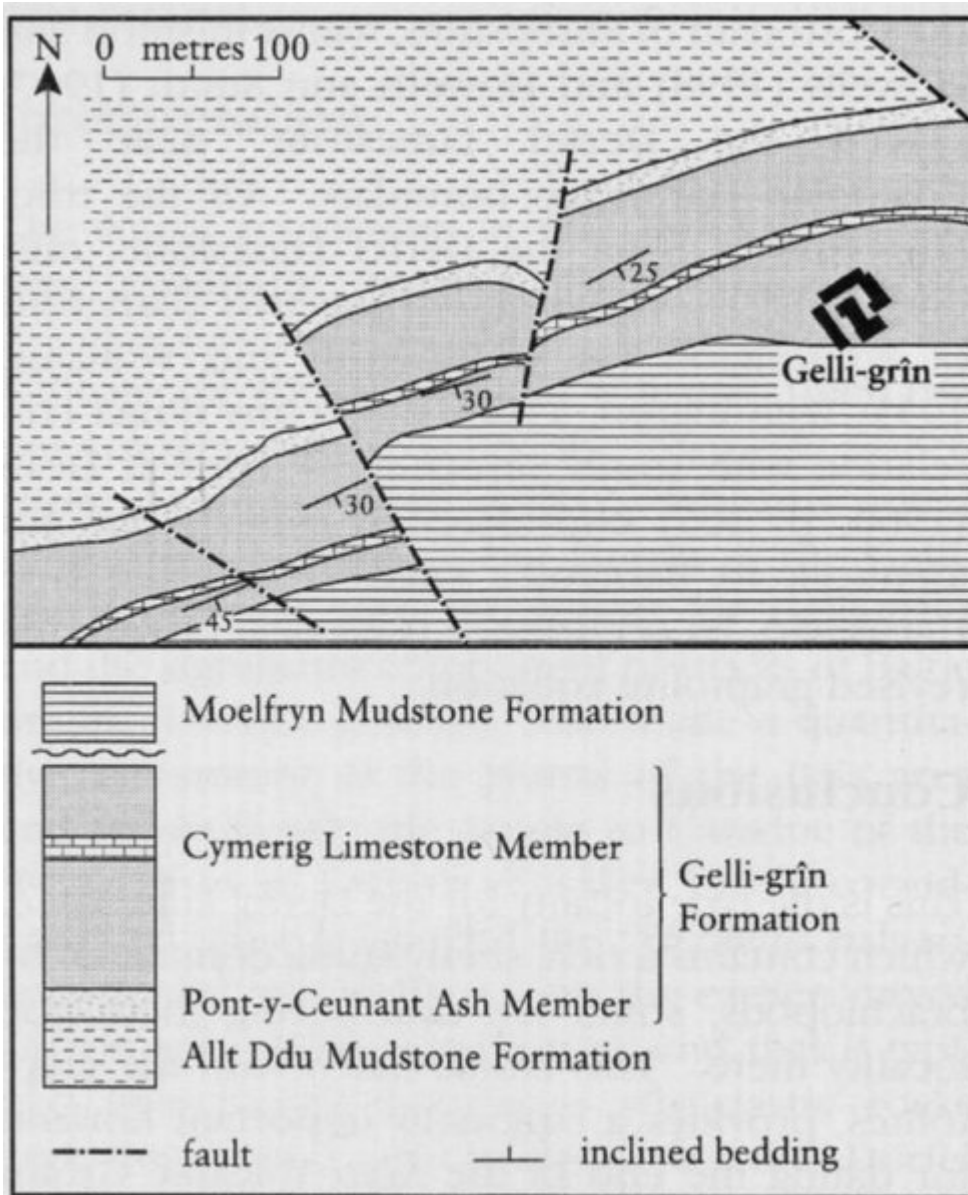
The Gelli-grîn Formation has yielded over 30 species of brachiopod (e.g. (Figure 9.18)) (Williams, 1963; Bassett *et al.*, 1966; Lockley, 1980b) and 19 of trilobite (Whittington, 1968; Lockley, 1980b), together with molluscs, conulariids, tentaculitids, bryozoans, ostracods and echinoderms. Many of these occur at the type locality and several species have their type material there. The faunal associations differ considerably from those at equivalent levels in the type Caradoc of Shropshire, and this led to correlation problems by several workers that were largely resolved by Williams (1963) and Bassett *et al.* (1966, p. 258). Of the brachiopods, only the appearance of *Howellites antiquior* (M'Coy) in the Pont-y-Ceunant Ash indicates a correlation with the base of the Longvillian, and the appearance of *Bancroftina* sp. in the beds above the Cymerig Limestone suggests a correlation with the Woolstonian Stage. Although trilobites are not known from the Pont-y-Ceunant Ash or the Cymerig Limestone, the intervening strata have nine species in common with Longvillian strata in Shropshire and the north of England, including the trinucleid *Broeggerolithus nicholsoni* (Reed). The beds above the Cymerig Limestone yield *Estoniops alifrons* (M'Coy), which characterizes Woolstonian (= 'Upper Longvillian' of earlier authors) in northern England.

The Cymerig Limestone contains a rich conodont fauna at several localities, including Gelli-grîn (Bergström and Orchard, 1985; Savage and Bassett, 1985). These all belong to the *Amorphognathus superbus* Zone, and this is the type horizon for *A. superbus* itself, with a type locality at Y Garnedd, 1.5 km ENE of Gelli-grîn. Its understanding is vital to the debate on the definition of the base of the succeeding *A. ordovicicus* Zone and international correlation at this level (see site report for Gwern-y-brain).

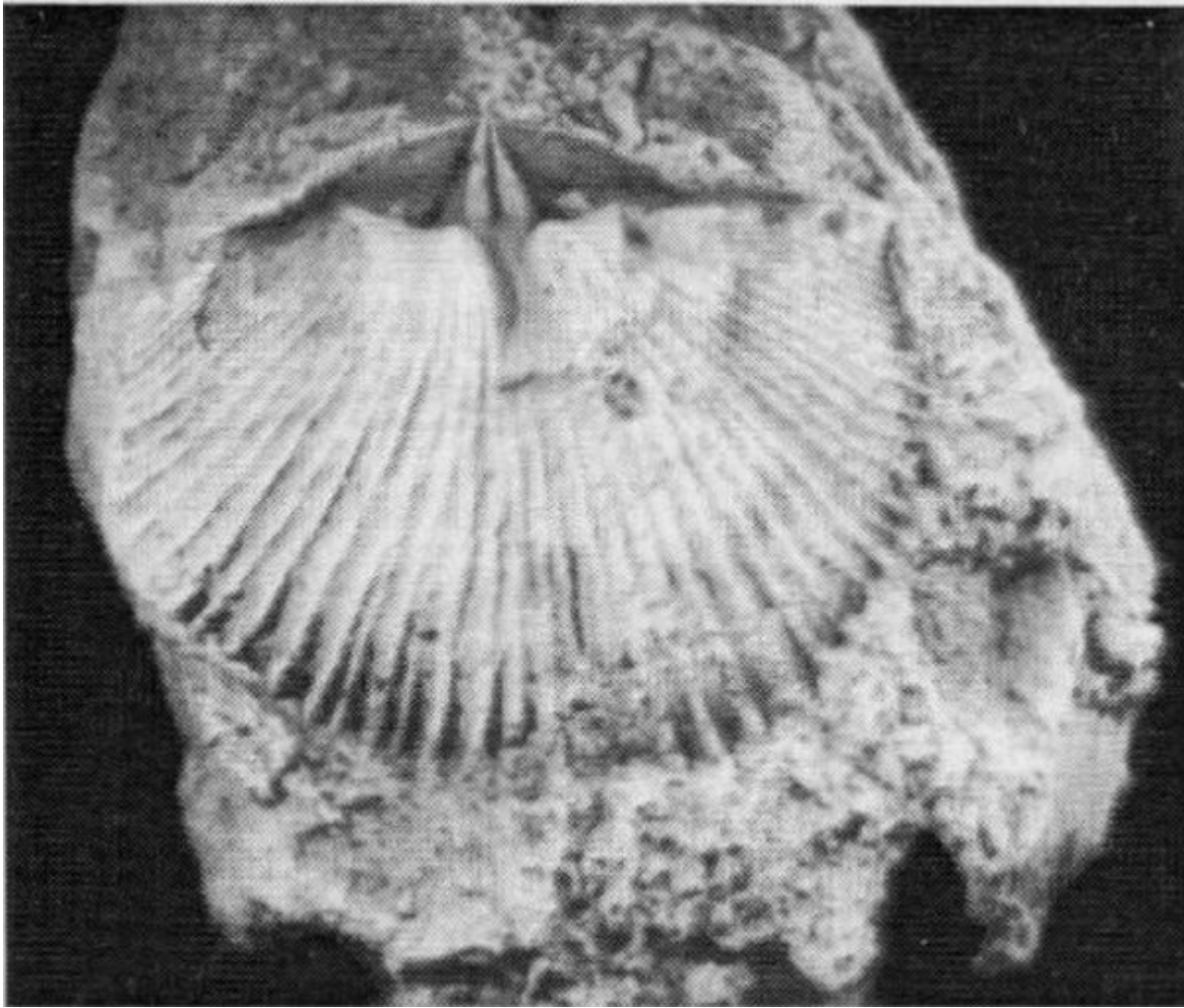
## Conclusions

The type locality of the Gelli-grîn Formation has great historical significance in the understanding of the geology of the classic Bala area. It is the type locality for several fossil species, including a zonally significant conodont used in international correlation. Because of environmental factors, the fossil associations are significantly different from coeval ones that lived on the edge of the Welsh Basin, and this has led to difficulties in correlation. These have now been surmounted but provide a text-book example of the need to disentangle environmental range from time-range of fossil organisms. The Pont-y-Ceunant Ash at the base of the Gelli-grîn Formation has been dated in the range  $448 \pm 4$  to  $457 \pm 2.2$  million years, providing a tie between the chronometric and biostratigraphical Ordovician time-scales.

## [References](#)



(Figure 9.17) Geological map of the type development of the Gelli-grîn Formation west of Gelli-grîn Farm, from Bassett et al. (1966, fig. 4).



(Figure 9.18) Dorsal valve of *Dolerorthis duftonensis prolixa* Williams, x2, Gelli-grîn.