# Penylan Quarry

[ST 198 787]

## Introduction

The Wenlock rocks of the Cardiff district form part of an inlier of Wenlock and Ludlow strata around which is Old Red Sandstone of P■ídolí and Lower Devonian age together with Triassic sediments (Figure 4.19). The inlier forms an end member of the chain of Silurian inliers trending SSW to the south Wales and Mendips areas from Walsall and Dudley in the West Midlands. Penylan Quarry is situated near the centre of the inlier, and exposes some of the oldest Wenlock rocks in the district.

Silurian strata were first recognized in the Cardiff district in 1861 by Glass, who sent fossils from Penylan Quarry to be identified by Murchison. After Murchison, and also Salter, had examined them, the former declared them to be '*par excellence*' of Wenlock age. At the same time Bevan (1861) suggested that the beds in the quarry 'appear to be Wenlock Shale'. The slightly later study of Sollas (1879) includes description of the strata at Penylan and represents the first detailed, comprehensive account of the Cardiff Silurian, it remaining so for over 100 years. The Geological Survey memoir from the turn of the century that took in the Cardiff Silurian (Strahan and Cantrill, 1902, 1912) drew heavily on the findings of Sollas. Further information was, about then and subsequently, added on these rocks through more limited investigations (e.g. Storrie, 1879, 1908; North, 1915a, 1915b; Anderson and Blundell, 1965).

In relatively recent years Bassett (1969) has dispelled the notion that Llandovery age rocks are present in the inlier and (1974a) has summarized the stratigraphy of the Wenlock rocks here. Lately, the Cardiff Silurian has been reinvestigated by the British Geological Survey (1986; Waters and Lawrence, 1987), who established in large part a new lithostratigraphy for it and also refined aspects of its chronostratigraphy, for example the position in the sequence of the Wenlock–Ludlow boundary (Figure 4.20). This account, which included the strata at Penylan and details from a new borehole ((Figure 4.21); Waters and White, 1980), is now by far the best. It also resulted, from re-examination of previous borehole material (Anderson, 1968, 1974), in the discovery of two further small, Silurian inliers in the district.

## Description

Wenlock rocks in the main (Rumney and Penylan) Cardiff Inlier emerge from beneath the Triassic cover to the south in the form of an anticline, the E-W trending axis of which lies just a few metres to the south of Penylan Quarry (Sollas, 1879; Strahan and Cantrill, 1902). The northern part of the inlier is composed largely of Ludlow strata and these in turn give way to the north to the P■ídolí age Old Red Sandstone facies of the Raglan Mudstone Formation. Wenlock strata comprise the Pen-y-Lan Mudstone, which has a possible maximum thickness of 255 m, and the succeeding 70–80 m thick Cae Castell Formation. The Pen-y-Lan Mudstone passes upwards into the Rhymney Grit, the basal unit of the Cae Castell Formation, but the base of the mudstone has not been proved.

Some of the oldest beds of the Pen-y-Lan Mudstone, which occur as part of the E-W strip of this unit between Penylan and Rumney, are exposed in Penylan Quarry. Overall, the unit comprises very fossiliferous mudstones (80–90% of the total thickness), with thin sandstone and impure limestone horizons (Waters and Lawrence, 1987). When fresh the mudstones are grey, but they weather to grey-green, olive-green and buff. Their mica, calcium carbonate and silt content is variable and in places they grade into siltstone. Two main types of mudstone (though with all gradations between them) have been identified: the most common consists of massive, often blocky beds 0.1–0.45 m thick, which are strongly bioturbated (mainly *Chondrites*) and have shelly fossils, commonly broken, scattered throughout; the scarcer type is in the form of blocky beds only 2–7 cm thick, which are generally less fossiliferous, have little bioturbation and can normally be split parallel to bedding.

Sandstones within the Pen-y-Lan Mudstone are usually between 2–20 cm thick, though exceptionally they can reach 0.6 m. They are grey to greenish-grey when fresh, weathering to buff-coloured: they have flat bases and flat to gradational or

ripple-marked upper surfaces and can grade into siltstones. Comminuted shells often occur in the basal centimetre of a bed; burrows may be present. Irregular, ball-like masses of bioclastic limestone (averaging 10 cm in diameter) composed of crinoid and shell debris are scattered within the bioturbated mudstones. Bentonites up to 0.85 m thick have been recorded The Pen-y-Lan Mudstone in general is richly fossiliferous, containing, at least, brachiopods, trilobites, corals, gastropods, bivalves, cephalopods and graptolites.

In terms of extent, Penylan Quarry itself is much diminished now compared with its former size, the construction of Eastern Avenue in the early 1970s having removed most of it. However this road did provide at that time fairly continuous additional sections through the Pen-y-Lan Mudstone that were logged (by M.G. Bassett), and a part of the north side of this cutting very near to the quarry [ST 1906 7875]–[ST 1923 7876] is the designated type locality for this unit (Waters and Lawrence, 1987). In what remains of the quarry, the beds dip north-east at about 14° (British Geological Survey, 1986) and cover a stratigraphical interval of some 10 m. They comprise shelly calcareous silty mudstones which occur in blocky bedded units 0.1–0.2 m thick, with subordinate impure silty bioclastic limestones and a few fine-grained sandstones.

The faunal lists from Penylan Quarry (Sollas, 1879; Strahan and Cantrill, 1902, 1912; Waters and Lawrence, 1987) are extensive and the most recent of these includes small rugose corals; the brachiopods *Amphistrophia funiculata, Anastrophia deflexa, Atrypa reticularis, Coolinia pecten, Cyrtia exporrecta, Dalejina hybrida, Dicoelosia biloba, Eoplectodonta duvalii, Eospirifer radiatus, Gypidula galeata, Howellella* sp., *Isorthis clivosa, Lepidoleptaena poulseni, Leptaena depressa, Lingula* sp., *Megastrophia* (*Protomegastrophia*)*semiglobosa, Meristina obtusa, Nucleospira pisum, Pentlandina lewisii plakodis, Plectatrypa imbricata, Resserella canalis, ?Salopina conservatrix, Sphaerirhynchia wilsoni, Spirigerina marginalis, Streptis grayii, Striispirifer plicatellus* and *Strophonella euglypha;* the gastropod *Loxonema* sp.; the bivalves *Cypricardinia subplanulata, Modiolopsis* sp., *Nuculites* sp., and *Ptychopteria* sp.; the cephalopod *Dawsonoceras annulatum;* the trilobites *Acanthopyge* cf. *hirsuta, Acastocephala macrops, Bumastus? xestos, Dicranopeltis salteri, Encrinurus tuberculatus, ?Harpidella* (*H.*)*aitholix, Hemiarges scutalis?, Leonaspis coronata* and *Platylichas grayii;* and the graptolite *Monograptus flemingii.*

Many specimens from this quarry have been used in systematic palaeontological studies and it represents the type locality for some taxa, examples of the latter being *P. lewisii plakodis* and *L. depressa restricta* (both Bassett, 1974b), the gastropod *Cyclonema tumida* and the bivalve *Ambonychia? tumida* (both Sollas, 1879), and the trilobite *Bumastos? xestos* (of Lane and Thomas, 1978).

## Interpretation

The age of the Pen-y-Lan Mudstone was for many years in debate. Sollas concluded, like Murchison (in Glass, 1861), that the fossils from Penylan proved the beds there to be of Wenlock age, though he placed them near the base of this series and noted also that they were 'very much of a Llandovery facies'. Further, he also recorded from these beds certain brachiopods that are typical Llandovery species, for instance *Pentamerus oblongus* and '*Strophomena*' *compressa* (= *Leptostrophia compressa*), and he claimed that *P. oblongus* together with '*Stricklandinia*' *lirata* (= *Costistricklandia lirata*), another typical Llandovery species, occurred in younger Wenlock beds in the nearby River Rumney section. This record of *P. oblongus* led certain authors (Pringle and George, 1937, 1948; Anderson and Owen, 1968) to indicate the presence of Llandovery strata in the Cardiff Silurian inlier. Bassett (1969) addressed these apparent contradictions and, whilst the specimens used by Sollas may all have been lost, he determined that material in old collections from the Silurian of the Cardiff area labelled *P. oblongus* should be assigned either to *Meristina obtusa* or to *Gypidula galeata,* both Wenlock species. Bassett reassigned other specimens labelled *S. compressa to C. pecten,* also a Wenlock form. Even more compelling evidence for the Wenlock age of the Pen-y-Lan Mudstone came from his (1969, 1974a) recognition of *Monograptus flemingii* from this horizon in Penylan Quarry, a species confined to the *rigidus to lundgreni* biozones of the Wenlock Series. The Pen-y-Lan Mudstone is now generally considered to be of mid- to late Wenlock age. Cocks *et al.* (1992), for example, gave it a tentative upper age limit coincident with the boundary between the *ellesae* and *lundgreni* biozones, though they showed its lower age limit as being very uncertain. Burgess and Richardson (1995), however, on the basis of sporomorphs recovered from the uppermost part of the Pen-y-Lan Mudstone of the Rumney Borehole, and comparison of these with those from the type Wenlock area (Burgess and

Richardson, 1991), suggested that this part of the unit is no older than the *nassa* Biozone.

Palaeogeographically, during mid-Wenlock times the Cardiff district lay fairly close to the landmass of Pretannia (Cope and Bassett, 1987), the northern shore of which stretched in an E–W direction across the Bristol Channel to skirt the present-day southern coastline of Wales (Bassett, 1974a, Hurst *et al.,* 1978; Siveter *et al.,* 1989; Holland, 1992). By late Wenlock times, the shoreline had moved slightly north, running more or less through the Cardiff area.

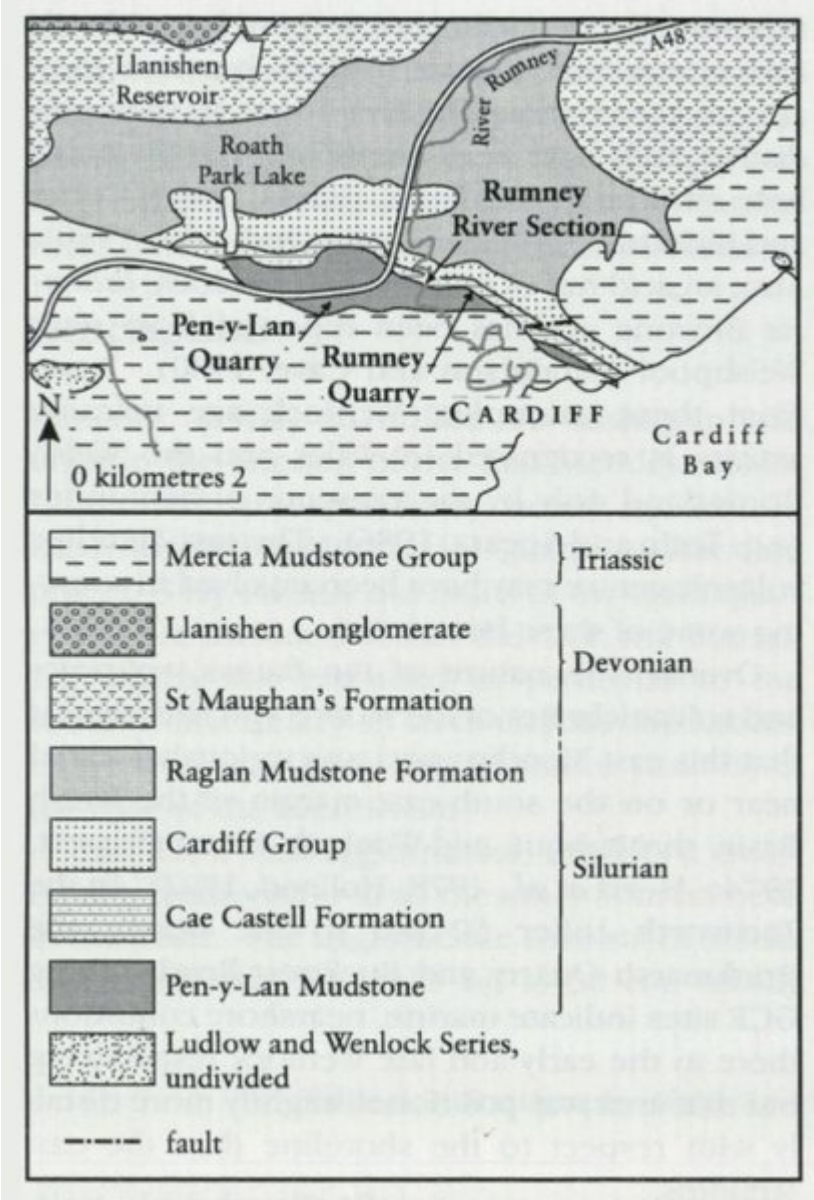
Palaeoenvironmentally, the silty mudstones formed on the mid-shelf area in water depths that were moderately shallow, but below normal wave base. The accompanying sandstones rep resent sublittoral sheet sands, probably deposited under the influence of storm-waves plus tidal or storm-surge ebb conditions which took sand from nearshore to the shelf. The limestone beds are analogous 'event deposits', possibly being formed under similar storm conditons, by transport and reworking of autochthonous bioclastic debris. The transition of the Pen-y-Lan Mudstone into the overlying Rhymney Grit, marked by an increased sandstone content and a decrease in faunal diversity in its highest part, reflects the change to a more restricted, inner shelf environment. Brachiopods from the Pen-y-Lan Mudstone have been interpreted (Hurst *et al.,* 1978) as representing a probable *Isorthis clivosa* or *Dicoelosia biloba* Community, the presumed palaeoslope position of these broadly agreeing with that deduced from the sedimentological evidence.

The Penylan Quarry site links stratigraphically with the nearby Rumney Quarry GCR site that exposes the Cae Castell Formation, in particular the Rhymney Grit. The latter formation and succeeding sediments of Ludlow age are encompassed within the geographically intermediate Rumney River site.

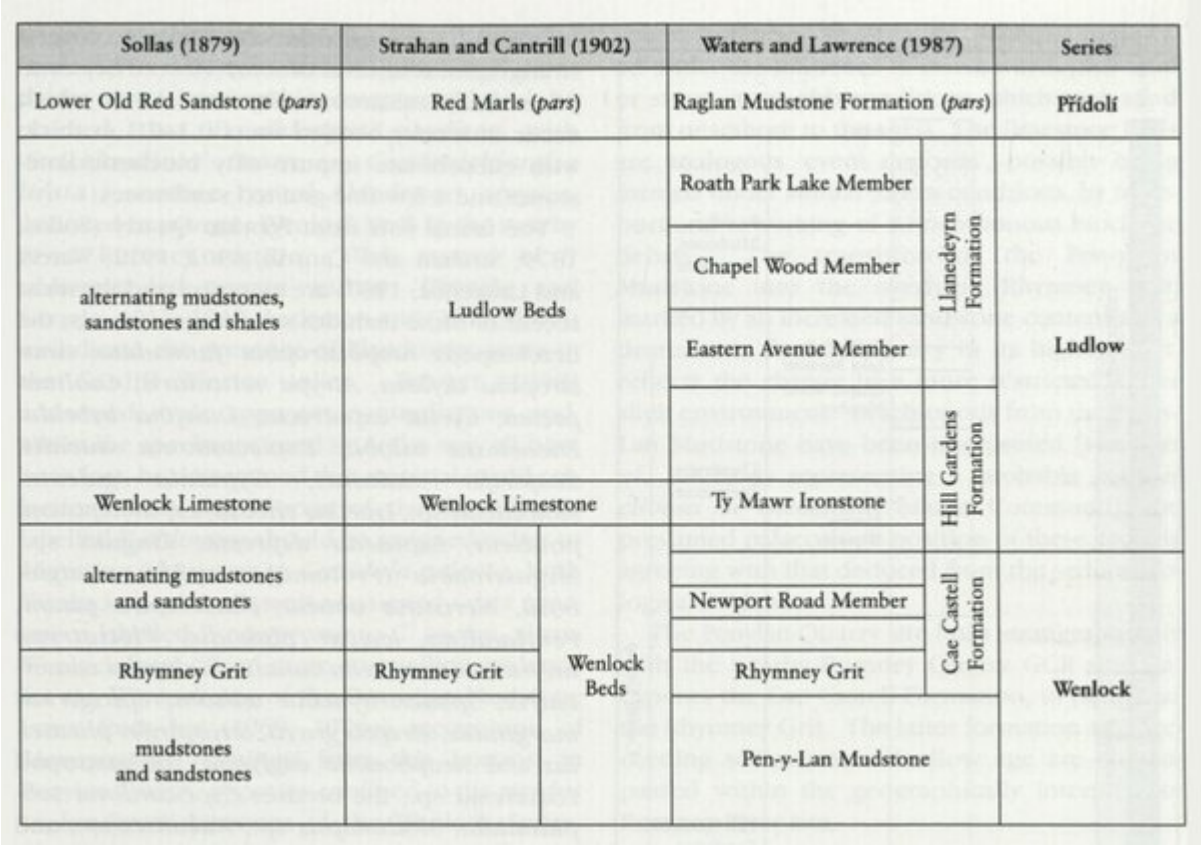
## Conclusions

Penylan Quarry has for over a century provided a wealth of mainly shelly fossils for systematic, and latterly also ecological, studies. It represents the type locality for various invertebrate species and has also provided graptolite specimens that were critical in determining the Wenlock age of the Pen-y-Lan Mudstone, the oldest stratigraphical unit of the Cardiff Silurian inlier. Together with the Rumney Quarry and Rumney River GCR sites it helps provide complete coverage of all the main lithostratigraphical units of Wenlock age in this part of south Wales. The Pen-y-Lan Mudstone, which has its best exposure here, has been widely used in mid-Wenlock facies interpretations and palaeogeographical reconstructions of this region.

**References**

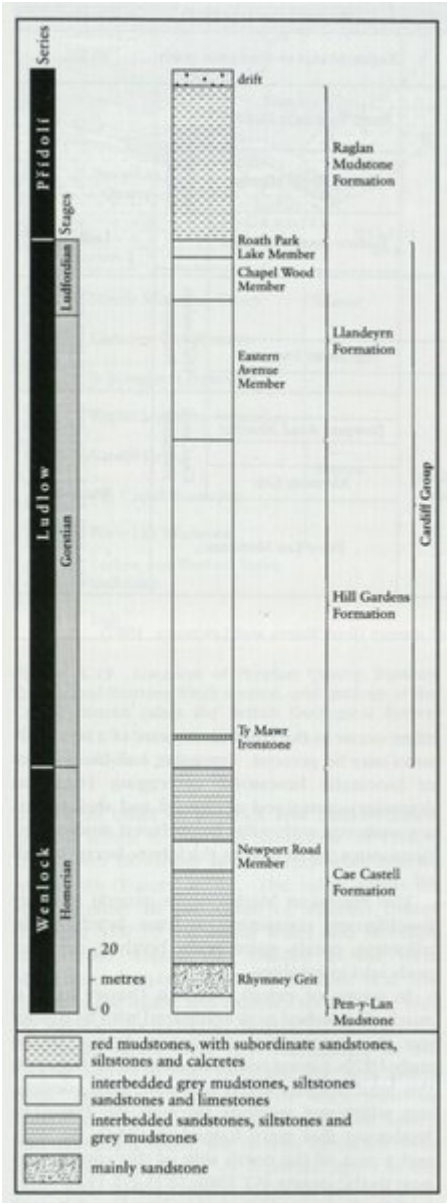



*(Figure 4.19) Location of Penylan Quarry, Rumney Quarry and Rumney River section, and geology of the Cardiff district (after the British Geological Survey, 1986).*



| Sollas (1879) | Strahan and Cantrill (1902) | | Waters and Lawrence (1987) | | Series |
|---|---|---|---|---|---|
| Lower Old Red Sandstone (*pars*) | Red Marls (*pars*) | | Raglan Mudstone Formation (*pars*) | | Přídolí |
| alternating mudstones, sandstones and shales | Ludlow Beds | | Roath Park Lake Member | Llanedeyrn Formation | Ludlow |
| | | | Chapel Wood Member | | |
| | | | Eastern Avenue Member | | |
| | | | | Hill Gardens Formation | |
| Wenlock Limestone | Wenlock Limestone | | Ty Mawr Ironstone | | |
| alternating mudstones and sandstones | | Wenlock Beds | | Cae Castell Formation | Wenlock |
| | | | Newport Road Member | | |
| Rhymney Grit | Rhymney Grit | | Rhymney Grit | | |
| mudstones and sandstones | | | Pen-y-Lan Mudstone | | |

*(Figure 4.20) Silurian stratigraphy of the Cardiff district (fom Waters and Lawrence, 1987).*




*(Figure 4.21) Silurian stratigraphy of the Rumney Borehole, Cardiff District (after Waters and Lawrence, 1987).*