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## Pwlluog (Whitesand Bay)

[SM 7319 2734]–[SM 7302 2759]

### Introduction

Pwlluog, an inlet at the northern end of Whitesand Bay, affords the best and most accessible exposure of strata of mid-Arenig (Whitlandian) age in south-west Wales. It has for over a century been renowned as a source for dendroid graptolites and has also yielded numerous trilobites; it is the type locality for several species of each.

The section was described originally by Hicks (1875a), who differentiated 'Lower' and 'Middle' Arenig strata here, representing the first identification of rocks of this age in south-west Wales; Hicks' Upper Arenig' is now included largely within the Llanvirn Series and is not exposed in Pwlluog. With Hicks' and Hopkinson's investigations in the early 1870s, rich faunas of graptolites and trilobites were found, and the former were described by Hopkinson and Lapworth (1875); the trilobites had been described some years earlier by Salter (1866b, 1864–1883). The entire trilobite fauna was revised by Fortey and Owens (1987) and parts of the graptolite fauna by Bulman (1927–1967) and by Beckly and Maletz (1991).

The term 'Penmaen Dewi Shale Formation' was used for Hicks' Lower' and 'Middle' Arenig in a field guide (Hughes *et al.*, 1982). On the basis of its fauna, Fortey and Owens (1987) were able to correlate the Penmaen Dewi Formation at Pwlluog with the Whitlandian. It is the type locality for several fossils diagnostic of this stage, such as the trilobites *Gymnostomix gibbsii* (Salter), *Bohemopyge scutatrix* (Salter), *Cyclopyge grandis grandis* (Salter) and *Cnemidopyge salteri* (Salter) and the graptolite *Azygograptus hicksii* (Hopkinson). Whilst the Penmaen Dewi Formation is well exposed at Pwlluog, its base is a faulted contact there, and the base is defined formally at Porth Gain (Fortey and Owens, 1987, p. 96). However, Pwlluog is regarded as the body stratotype of the Penmaen Dewi Formation and is the only locality at which the succession and faunas can readily be examined. Following the revision of the stratigraphy by Fortey and Owens (1987), Traynor (1988) used this as one of the sections for his analysis of the sedimentology of the Arenig in south-west Wales.

### Description

The promontory of Trwynhwrddyn forms the southern end of the inlet of Pwlluog, which itself is divided by a smaller promontory into northern and southern parts. Much of Trwynhwrddyn is formed of Upper Cambrian 'Lingula Flags', which on its southern side contains occasional bands crowded with *Lingulella* sp. or with *Hymenocaris*. The nature of the junction with the Arenig has been controversial (Jones, 1940; Evans, 1948), but the presence of a thin conglomerate on the neck of the promontory around [SM 7320 2735] suggests that it is unconformable. The sandy and silty Arenig sediments on Trwynhwrddyn itself have been assigned to the Ogof Hên Formation, of early Arenig (Moidunian) age, although nowhere have they yielded any trace of the rich brachiopod—trilobite fauna characteristic of this formation on nearby Ramsey Island (Bates, 1969) and in the Carmarthen district (Fortey and Owens, 1978, 1987). Lithologically they closely resemble the Abercastle Formation at Abercastle (Fortey and Owens, 1987, p. 94), which is where they were included by those authors, although this correlation remains to be proved.

In Pwlluog, some 600 m of dark-coloured shales and slates dip north between 60° and 90°. The lowest beds of the Penmaen Dewi Formation are faulted against the supposed Abercastle Formation in the south-east corner [SM 7327 2738] (Figure 8.8), but how much of the succession is missing is not known. Steeply dipping bedding planes in the cliffs between 10 m and 15 m north of the fault have yielded *Callograptus*, poorly preserved trinucleid trilobites (probably *Furcalithus*), small lingulate brachiopods, orthoconic nautiloids and occasional articulate brachiopods; none of this fauna is age-diagnostic. From about 25 m north of the fault and as far as the small promontory in the centre of Pwlluog, volcanoclastic sandstones in beds up to 50 cm thick are prominent, especially on the wave-washed platform on the beach. They commonly show grading and may contain scattered mudstone clasts. The sediments are invaded by occasional thin intrusions of intermediate composition. On the south side of the small promontory around [SM 7321 2746], dendroid graptolites and lingulate brachiopods occur. The promontory marks the approximate boundary between

Hicks' Lower' and 'Middle' Arenig, and that part of Pwlluog to the south of it is the type locality for several of Hopkinson's dendroid graptolite species (Hopkinson and Lapworth 1875), for example *Dendrograptus arbusculus*, *Callograptus radiatus* and *Dictyograptus cancellatus*, but the precise levels from which these originated is not known.

On the north side of the promontory [SM 7318 2748] a nearly vertical bedding plane facing a prominent stack of thick, slightly graded silicic tuff has long been known as a source of both graptoloid and dendroid graptolites, including *Tetragraptus* spp., *Azygograptus hicksii* and *Callograptus*. The type locality for *A. hicksii* and *Aspidograptus implicatus* Hopkinson must lie hereabouts.

The mudstones and shales of the northern part of Pwlluog are Hicks' Middle Arenig', and they contain fewer volcanoclastic sandstone beds and a few intermediate intrusions; one of these stands slightly proud of the softer Arenig shales [SM 7318 2755]. The cliff top around [SM 7315 2760] is probably the site of the 'slate quarry' referred to by Hicks (1875a) as a source for much of the trilobite fauna from Pwlluog. In the cliffs hereabouts some bands are crowded with mostly disarticulated trilobites, including *Gymnostomix gibbsii* (Salter), *Furcalithus sedgwickii* (Salter), *Cyclopyge grandis grandis* (Salter) and *Cnemidopyge salteri* (Salter), together with occasional articulate brachiopods, hyolithids and dendroid graptolites. Similar horizons crop out at the beach level (e.g. around [SM 7310 2758], where the above fauna and *Shumardia gadwensis* Fortey and Owens occur; the latter has also been reported from shales metamorphosed by a nearby gabbro intrusion, on the north side of Craig y Creigwyr [SM 7302 2759].

## Interpretation

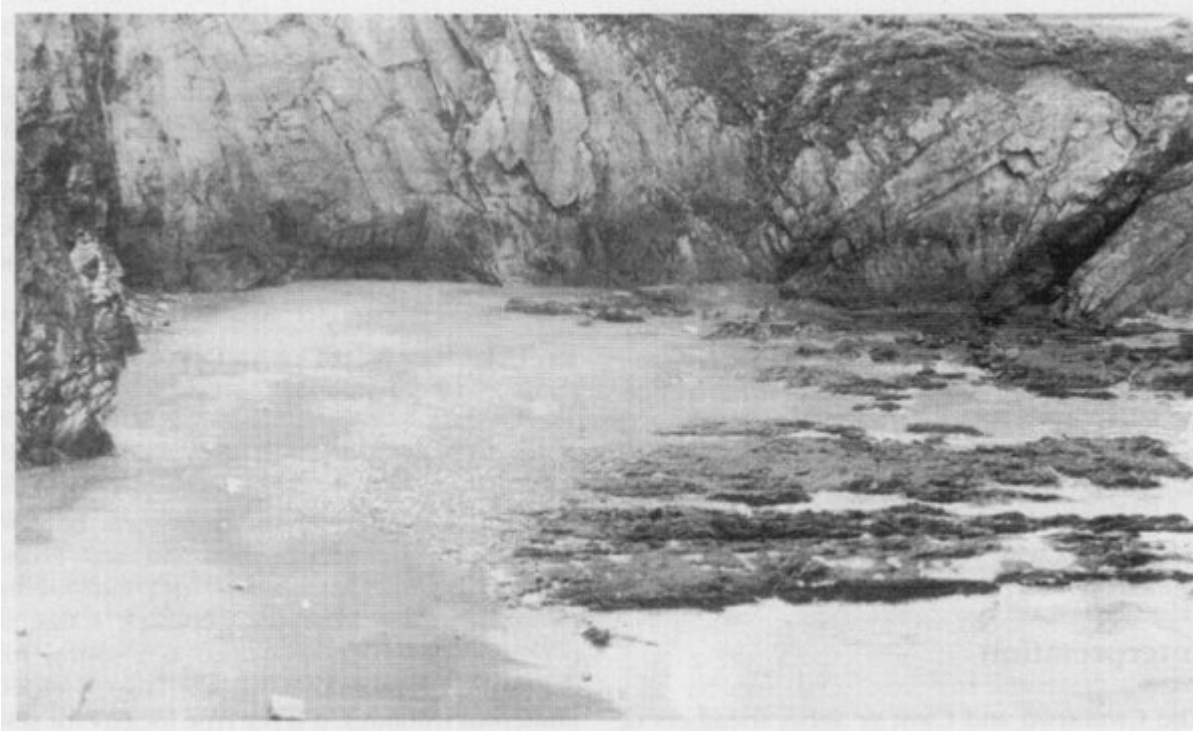
In general, the monotonous muddy sedimentation in the lower part of the succession is dominated by a dendroid graptolite fauna, accompanied by occasional lingulate brachiopods and trilobites. The repeated influxes of volcanoclastic sandstone and the silicic tuff of the stack in the centre of Pwlluog are evidence of volcanic activity in the general vicinity (e.g. Traynor, 1988, p. 282), although the location of the volcanic centre is not known. The presence of trilobite faunas comprising cyclopygids and small-eyed and blind taxa indicates the presence of the cyclopygid biofacies and an atheloptic fauna, suggestive of deep, offshore conditions (Fortey and Owens, 1987; Traynor, 1988, p. 282). It is possible that the whole succession at Pwlluog represents gradual deepening upwards, and higher beds in the Arenig sequence exposed elsewhere (see Road Uchaf site report) were certainly deposited in a deep, offshore environment. *Azygograptus hicksii*, however, may be a comparatively inshore species (Beckly and Maletz, 1991), suggesting that the lower half of the sequence may have been deposited in relatively shallower waters.

*Gymnostomix gibbsii*, *Shumardia gadwensis*, *Bohemopyge scutatrix* and *Cyclopyge grandis grandis* are widespread indicators of Whitlandian strata, being reported farther eastwards in South Wales (Fortey and Owens, 1987) and in North Wales (Beckly, 1988).

## Conclusions

Pwlluog is the best locality in South Wales for the Whitlandian fossils that are used to characterize the middle division of the Arenig Series.

## [References](#)



*(Figure 8.8) Pwlluog, St David's, south-east corner. To the extreme left and on the foreshore are dark, almost vertical, shales of the Penmaen Dewi Formation. In the background, on the northern side of Trwynhwrddyn, are grey, silty sediments probably referable to the Abercastle Formation, faulted against the Penmaen Dewi Formation in the corner of the inlet. (Photo: R.M. Owens.)*