

---

# Cwm Ystwyth

## Highlights

Features occur here which have been interpreted as nivation cirques, formed by persistent snow patches during the Late Devensian. The features show little evidence of glacial erosion typical of cirques elsewhere in upland Wales.

## Introduction

Cwm Ystwyth is an important site with two features interpreted by Watson as nivation cirques, Cwm Du [SN 811 740] and Cwm Tinwen [SN 832 748]. These features occur at much lower altitudes than would normally be expected for glacial cirques in the area. They are not thought to be associated with glacial erosion and are believed to have originated from nivation processes during the Devensian Stage. The site was first described by Keeping (1882) and has been studied in some detail by Watson (1966, 1968, 1970, 1976) and Watson and Watson (1977).

## Description

The two cirque forms, Cwm Du and Cwm Tinwen (Figure 23) are developed in the north-facing slope of the Ystwyth Valley. According to Watson and Watson (1977), they are smaller and lie c. 180m lower than typical glacial cirques in the area (for instance, Cwm Cau, Cadair Idris). They possess steep rocky back walls, but apparently show none of the features often associated with glacial erosion, such as the typical rock basin with an enclosing rock lip.

Mapping at Cwm Tinwen (Watson 1966), showed a moraine-like ridge up to 17m thick, enclosing a boggy flat against the back wall. This ridge is highest in the centre, but west of a small gully that bisects the ridge, the drift accumulation becomes narrower. Where this narrowing occurs, there is some suggestion of a double ridge — a small ridge superimposed on a larger one. The material in the ridge is highly variable, comprising a mixture of loose yellow-grey head with lenses of sand, silt and gravel. Larger blocks up to 1.5m are also present (Watson 1966). The deposits show downslope stratification.

Cwm Du is larger than Cwm Tinwen, but in contrast is not simply occupied by just a 'moraine-like' ridge (Watson 1966). Instead, the basin is fronted by a steep bank of drift, some 18m high in the centre, which forms a smooth, generally concave, slope rising up to the back wall. This smooth slope is interrupted near the back wall by a small ridge of stony clay which fills the south-west corner of the cirque — see (Figure 23). The main expanse of deposits at Cwm Du forms a fan that is stepped in profile. Gully exposures through the fan show that it consists of stony clays with bedded silts and gravels.

## Interpretation

Keeping (1882) considered that the deposits at Cwm Du formed a terminal moraine "heaped up at the end of the melting glaciers". In contrast, Watson (1966, 1968, 1970, 1976) and Watson and Watson (1977) showed that the landform and its associated deposits may be the product of nivation rather than glacial processes. Watson proposed that Cwm Du and Cwm Tinwen had formed in response to the accumulation of two quite different types of perennial snow patch; one gently sloping, the other steeply sloping. At Cwm Tinwen, the steep moraine-like ridge located close to the back wall was interpreted by Watson (1966) as a protalus rampart formed at the foot of a steep perennial snow patch. He thought that the hollow enclosed by the ridge was narrow because the snow had been banked steeply against the valley side, giving a pronounced gradient down which frost-shattered debris could glissade eventually to accumulate as a ridge at the foot. The curved back wall may have produced a convergence of debris towards the centre where the rampart is thickest. Where it shows a double ridge structure, a later rampart is probably resting on a larger, older one. The age of these features is uncertain, but Watson (1966) argued that they had probably formed during the Devensian late-glacial when ice is thought to have persisted in nearby but more elevated cirques such as Cwm Cau, Cadair Idris.

The debris fan at Cwm Du, however, was attributed (Watson 1966) to an entirely different set of circumstances and processes. It was thought to have accumulated beneath a large but gently sloping perennial snow patch as a series of solifluction deposits. Watson envisaged that the drift had been built up in a series of layers, in much the same manner as the mechanism described by Botch (1946), in the Ural Mountains, with solifluction debris accumulating beneath the lower part of the snow patch and moving subaerially downslope as a series of solifluction terraces. Watson noted that waterlain silts, sands and gravels capped more poorly sorted (head) deposits on a number of the terrace 'treads' in the stepped fan profile. He postulated that these deposits might have been laid down during a recessive phase of the snow patch when summer melting was pronounced. In turn, these waterlain deposits were then partly submerged beneath the solifluction deposits of the succeeding, more rigorous climatic phase. The small ridge in the south-west corner of the cirque was interpreted by Watson as a small protalus rampart, representing the final stages of nivation, when steeply sloping neve occupied this part of the cirque. As with Cwm Tinwen, a Devensian late-glacial age seems likely in view of evidence from other areas of Wales where significant glacier development is well documented, particularly during the Younger Dryas (c. 11,000–10,000 BP).

On the basis of the evidence then available, Watson (1966) suggested that the fan at Cwm Du had been entirely built up by solifluction and related slope processes. A new exposure in 1972 near the front of the gully, however, led to a modified interpretation (Watson and Watson 1977). The greater part of this exposure consisted of grey clay containing clasts in a tangential arrangement to the outer limit of the fan, indicating possible pressure along the fan axis. Further evidence for thrusting in the beds was also seen by Watson and Watson (1977) who concluded that the lower deposits were therefore the result of an initial ice advance from the cirque. This, they suggested, had been followed by a period of nivation responsible for the remainder of the fan form.

Cwm Ystwyth is important for a series of cirque landforms and associated deposits, the interpretation of which remains crucial to the understanding of Late Pleistocene events and processes in the area. Cwm Tinwen shows a fine example of a feature which is fairly common in upland Wales, a moraine-like ridge fronting a narrow basin elongated parallel to the ridge. Such features are found in strongly shaded positions and frequently below the level of more typical glacial cirques. The ridge at Cwm Tinwen is thought to be a protalus rampart developed at the base of a former, steeply sloping snow patch (Watson 1966). It contrasts with Cwm Du with its more open cirque-like basin floored by terraced superficial deposits. It has been proposed that this debris accumulated in Cwm Du as solifluction deposits beneath an inert mass of neve. Although there is also some evidence that glacier ice may have played a role in the formation of these deposits, the major part of the landform and sediment association is thought to have been derived from nivation processes beneath a relatively gently sloping snow patch. It has been proposed therefore that these 'nivation' cirques were occupied by perennial snow patches, of demonstrably different character, not of sufficient thickness for plastic deformation and flow as glacier ice. The precise place of these features in the Late Pleistocene chronology of the region is not exactly determined, although it seems likely that considerable development probably occurred during the Devensian late-glacial. Watson, however, considered that the preponderance within the region of these nivation and other periglacial landforms, rather than true glacial features, was indicative of an extremely restricted Late Devensian Welsh ice mass; a view that has not been widely accepted.

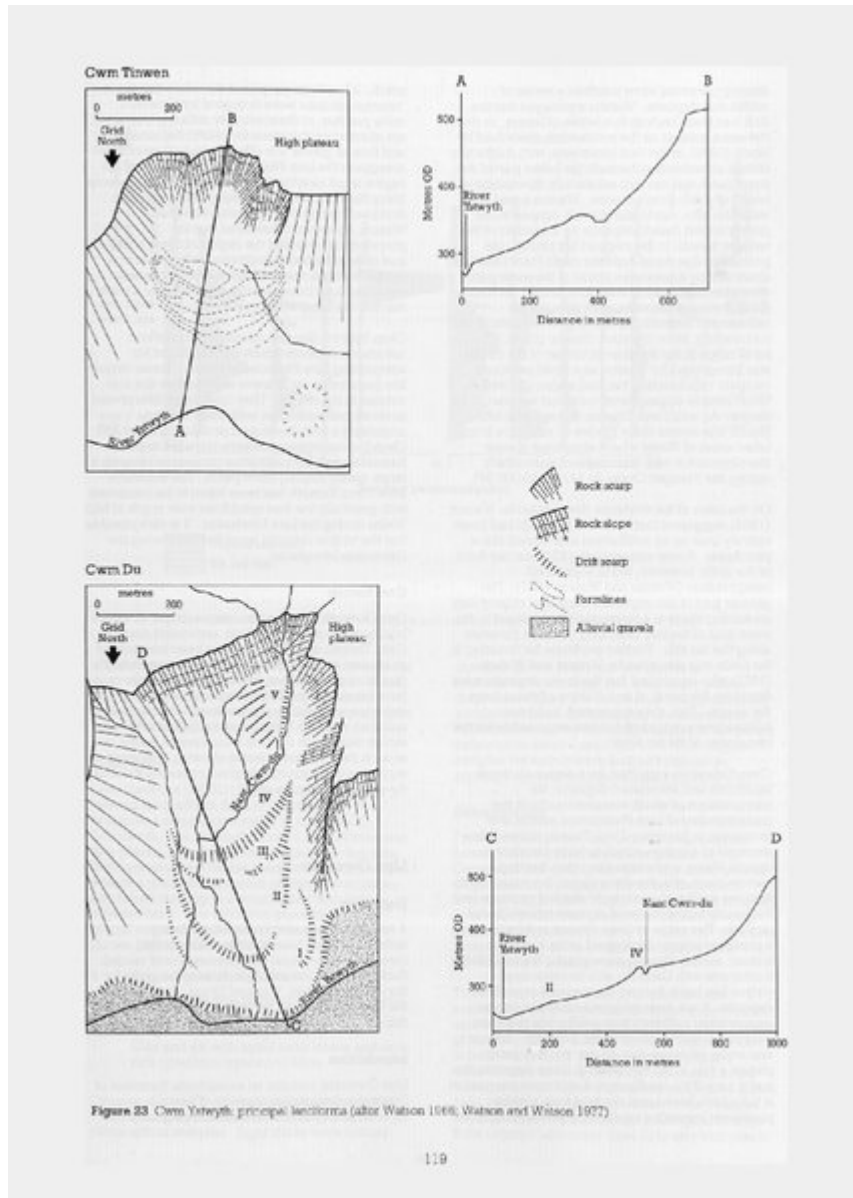
Cwm Ystwyth displays cirque landforms and associated deposits which are significant for interpreting Late Pleistocene events. These cirque-like features occur at lower altitude than the true cirques in the region. They have been interpreted as nivalational landforms; with Cwm Tinwen containing a well developed protalus rampart and Cwm Du containing extensive terraced deposits, formed largely by solifluction processes beneath a large, gently sloping snow patch. The evidence from Cwm Ystwyth has been taken to be consistent with generally ice-free conditions over much of Mid Wales during the Late Devensian. It is also possible that the cirque deposits were formed during the Devensian late-glacial.

## Conclusions

Cwm Ystwyth contains two unique cirque landforms, together with their associated deposits. Cwm Tinwen and Cwm Du have been interpreted as nivation cirques (that is landforms resembling glacial cirque features, but which are thought to have been fashioned by periglacial or cold climate and snow accumulation processes). The cirques and their deposits have been compared with similar features in the Ural Mountains of Russia and as such they are important in showing

important variations in geomorphological processes towards the end of the last ice age.

## References



(Figure 23) Cwm Ystwyth: principal landforms (after Watson 1966; Watson and Watson 1977)