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# Porth Neigwl

## Highlights

An important site which records possible evidence for three glacial events in this part of North Wales: a pre-Devensian glacial event, a Late Devensian Irish Sea invasion of ice and a later Welsh ice advance moving in a different direction.

## Introduction

Porth Neigwl provides evidence to suggest that southern Llŷn was inundated by southward moving ice from the Irish Sea Basin. The site has a long history of research commencing with the work of Jehu (1909). Porth Neigwl has also featured in studies by Nicholas (1915), Matley (1936), Synge (1963, 1964), Saunders (1963, 1968a, 1968b, 1968c, 1968d, 1973), Whittow (1960), Whittow and Ball (1970) and Boulton (1977a).

## Description

Porth Neigwl or Hell's Mouth Bay is situated on the southern coast of Llŷn and opens out to the southwest. To the south-east, the bay is bounded by the high ground of Mynydd Cilan, a promontory of Cambrian rocks, and to the north-west, by Ordovician shales and basic intrusive rocks. Between these rock masses, the head of the bay is formed entirely of Late Pleistocene and Holocene sediments which extend for about four miles, giving one of the finest drift sections in north-west Wales. In the lowland plain behind Porth Neigwl, boreholes have proved a drift cover in excess of 110m (360 ft) (Saunders 1968b). The cuffed sequence comprises mostly thick, blue-grey to brown Irish Sea till, up to 30m in thickness, and the western part of Porth Neigwl Bay between Pen-yr-Alit [SH 243 286] and Trefollwyn [SH 269 274] is almost entirely composed of this thick,

homogenous till. The area included within the GCR site, however, extends from near Pen-towyn Farm [SH 283 263] to just beyond Nant Farm [SH 291 255] in the east, where the drift stratigraphy is more complex and potentially more rewarding for elaborating Late Pleistocene and Holocene events see (Figure 31). Immediately south of Pen-towyn Farm, the Irish Sea till is well exposed and forms massive faces. To the south-east of this, Saunders (for example, 1963, 1968d) recorded a sequence showing:

- 9 Blown sand
- 8 Peat with birch and hazelnuts (Pollen Zone VII-VIII?)
- 7 Gravelly local till (Llanystumdwy Till)
- 6 Weathered horizon
- 5 Shelly outwash sands, gravels and laminated clays (Aberafon Formation)
- 4 Blue-grey, calcareous Irish Sea till (Trevor Till)
- 3 Soliflucted local till
- 2 Fine flaky head with pseudo-stratification
- 1 Coarse, blocky head

The chief elements of this succession are shown in (Figure 31).

## Interpretation

Jehu (1909) was the first to describe the deposits at Porth Neigwl, which he did as part of a comprehensive classification of drift deposits in western Caernarvonshire. As at Gwydir Bay in northern Llan, he described a tripartite sequence of two tills separated by sands and gravels, which, he argued, showed evidence for two glacial advances separated by possible interglacial conditions. He described a wide range of rock types from the lower till (bed 4) including Chalk flints, various granites from southern Scotland and Ailsa Craig microgranite, which he considered indicated derivation from the Irish Sea Basin. The lower till also contained pieces of wood and a comprehensive marine mollusc fauna, further proof that it was deposited by ice which moved south over the floor of the Irish Sea. He demonstrated that the overlying sands and gravels (bed 5) also contained typical Irish Sea erratics and shells, and regarded them as sea-floor materials transported by ice and subsequently redeposited by fluvioglacial action. Jehu noted that the upper till (bed 7) was only present in the southern part of the bay; and, because it contained far-travelled erratics and marine shell fragments, argued that it too had been derived, at least in part, from the Irish Sea Basin. In contrast, Nicholas (1915) interpreted the upper till as the product of local Welsh (Snowdonian) ice which had invaded Llan following retreat of Irish Sea ice from St Tudwal's Peninsula.

Matley (1936) described the Pleistocene sequence at Porth Neigwl near Tyddyn-y-don Farm. He showed that Jehu's lower till was overlain by a series of laminated clays and sands (leaf-clays), which he argued had been deposited in a marine lagoon largely shut off from the sea by a barrier of ice. These sediments formed part of a 50 ft (15m) terrace which Matley traced at various locations in southern Llan, and which he judged to be of 'Late-glacial' age.

The Late Pleistocene and Holocene deposits at Porth Neigwl were also described by Synge (1963, 1964). He argued that the main calcareous shelly till (Jehu's lower till and Saunders' bed 4 — see (Figure 31)) was probably Saalian in age and that the soliflucted local till (bed 3) showed evidence for an even earlier local glacial phase. Evidence from coastal sections around Llan was used by Synge to suggest that only the northern coastal margin had been affected by Devensian Stage ice. He suggested that during this glacial phase a rubbly head (equivalent to Saunders' bed 7 — gravelly local till) was formed at Porth Neigwl. Elsewhere along the south Llan coast, Saalian drifts were cryoturbated under periglacial conditions.

The most detailed work at Porth Neigwl was done by Saunders (1963, 1968a, 1968b, 1968c, 1968d, 1973) whose reconstructed succession is shown in (Figure 31). He envisaged that before deposition of the Irish Sea till (bed 4), periglacial conditions were experienced in the area and resulted in formation of head deposits (beds 1 and 2) and the redistribution of existing Welsh glacial sediments (bed 3). Detailed pebble lithology and till fabric measurements showed that the till (bed 4) was deposited by Irish Sea ice moving onshore from NNW to SSE. The typical erratic assemblage, including limestones from the central plain of Ireland, metamorphic and fine-grained basic igneous types from Anglesey and northern Llŷn, provided strong evidence of an Irish Sea origin for the till. Saunders correlated the Irish Sea till at Porth Neigwl with the lower till or Trevor Till of the north Llan coast. He regarded the shelly sands and gravels (bed 5) overlying the Trevor Till as fluvioglacial deposits associated with decay of the Irish Sea ice and interpreted the laminated leaf-clays as lagoonal or lacustrine deposits probably associated with temporary still water conditions in the fluvioglacial environment. Although no correlation was made by Saunders, these sands, gravels and clays are broadly equivalent to the sands and gravels 'of the Aberafon Formation (Simpkins 1968) along the north Llan coast.

The overlying gravelly till (bed 7) was, according to Saunders, clearly differentiated from the Irish Sea sediments beneath. Both Irish Sea and Welsh erratics were recorded from this till but Saunders emphasised that the preponderance of Welsh erratics, particularly those from southern Snowdonia, suggested a Welsh origin. These conclusions were also supported by fabric analyses which showed that the Welsh till had been deposited by ice moving from north-east to southwest. Because a zone of weathering (unit 6) separated the Welsh till from the Irish Sea sediments beneath, Saunders argued that the upper till represented an entirely separate and later advance of ice from Snowdonia, which in moving south-westwards incorporated Irish Sea erratics from the previous glacial episode.

Fundamental to Saunders' interpretation of the sequence was a radiocarbon date of  $29,000 \pm 1200$  BP (1–3262) from marine shell fragments taken from the lower (Trevor) till. A comparable sample from Porth Dinllaen on the north Llan coast gave an age of  $31,800 \pm 1,800$  –  $1,200$  BP (1–3273). On the basis of these dates, Saunders referred the Trevor Till at Porth Neigwl and elsewhere in Llan to the Late Devensian. The gravelly upper till at Porth Neigwl he considered to represent a readvance of the Late Devensian Welsh ice-sheet, sometime after c. 17,000 BP, on the basis of Foster's

(1968, 1970a) radiocarbon date from Bryncir. This readvance was tentatively correlated by Saunders with the Scottish Readvance.

Bowen (1973, 1977b) accepted this interpretation. The weathering horizon (unit 6) described by Saunders, he took to indicate interstadial weathering (Bowen 1973a, 1977b; Saunders 1968a, 1968d; Whittow and Ball 1970), and not fully interglacial conditions as proposed by Synge (1964). Bowen considered that Forth Neigwl represented the most westerly occurrence of the upper Welsh till in southern LI■n, and correlated it with the gravelly Welsh till farther east at Glanllynau and Criccieth, named locally the Llanystumdwy Till (Simpkins 1968). Such sedimentary data were used to reconstruct a maximum limit (Figure 27) for the proposed readvance of Late Devensian ice (Bowen 1974, 1977b) with the extreme parts of south-west Ulm remaining ice-free. The Irish Sea till at Porth Neigwl was correlated with the Trevor Till on the north coast.

An alternative explanation for the sequence at Porth Neigwl was proposed by Boulton (1977a). He suggested that the sequence was similar to that at Glanllynau where he had demonstrated that the sediments had formed in a supraglacial landform and sediment association, in a single Late Devensian glacial event. In this interpretation, the weathering horizon simply reflected a relatively short break in sedimentation and not a protracted period of deglaciation or interstadial conditions as had previously been suggested.

The age of the deposits at Forth Neigwl is controversial. Mitchell (1960, 1972) and Synge (1963, 1964) stressed the much-weathered and frost-heaved nature of the tills in southern LI■n, and used the evidence to suggest that it was not glaciated during the Late Devensian, with ice restricted largely to the northern coastal margin. This view has not, however, been widely accepted and most workers (for example, Saunders 1968a, 1968b, 1968c, 1968d, 1973; Bowen 1973a, 1973b, 1974, 1977b; Whittow and Ball 1970) believed that all the till in LI■n was deposited during the Late Devensian. Forth Neigwl is one of very few Pleistocene sites in North and north-west Wales to have yielded a radiocarbon date, which although potentially unreliable, may provide evidence to confirm that the area was glaciated during the Late Devensian.

Forth Neigwl is the finest exposure through the Irish Sea (Trevor) till in southern LI■n. It demonstrates that the south-west tip of LI■n was invaded by Irish Sea ice moving broadly north to south. Both the inferred direction of ice movement and the considerable thickness of the Trevor Till strongly suggest that during the principal invasion of the Late Devensian ice-sheet, Irish Sea ice was dominant on south-west LI■n and at this time was unimpeded by Welsh ice. In this context, Forth Neigwl provides contrasting evidence to the sites at Porth Ceiriad, Glanllynau and Morannedd (Criccieth) which display sediments of predominantly Welsh derivation.

The upper gravelly Welsh till at Porth Neigwl, of proposed Late Devensian readvance age, demonstrates a later incursion of ice moving broadly east to west into the area. Its limited exposure at Forth Neigwl has been used to demonstrate that Late Devensian readvance Welsh ice was here near to its most westerly limit. The site therefore provides important evidence to constrain the limit of Welsh ice on south-west LI■n during the proposed Late Devensian readvance. Porth Neigwl further demonstrates that the area around St Tudwal's Peninsula was glaciated by both Welsh and Irish Sea ice masses during the Late Pleistocene.

The sequence at Porth Neigwl is also important for demonstrating a period of periglacial conditions before deposition of the thick Irish Sea till, when head was deposited and pre-existing glacial sediments redistributed by solifluction. The site provides sedimentary evidence in north-west Wales for a glacial event prior to deposition of the main Irish Sea (Trevor) till.

The site was once regarded as important for a Holocene raised beach which occurred at the base of the coastal cliffs near high water mark (Whittow 1960). West (1972) has since shown that this feature was merely part of the present day beach, cemented by inorganic calcite and providing no evidence for the height of a Holocene raised beach in north-west Wales. The Holocene peat and sand cliffed in the southern part of the bay provide additional interest.

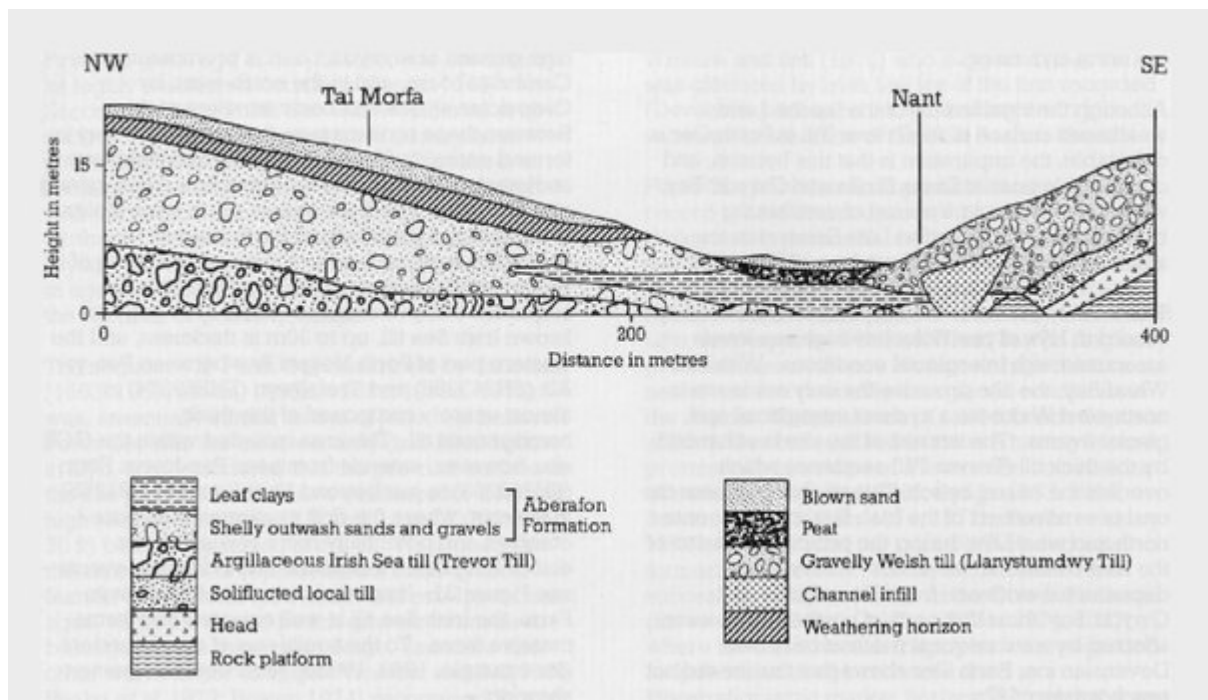
Porth Neigwl is important for reconstructing the Late Pleistocene history of north-west Wales. It provides the finest sections in southern LI■n through till of Irish Sea provenance (Trevor Till). A radiocarbon date on shell gives evidence to

suggest that the Trevor Till was deposited by Late Devensian ice. The upper gravelly till at Porth Neigwl demonstrates a later incursion of Welsh ice into the area. The sequence helps to establish the directions of ice movement and the relative strength and interactions of the Irish Sea and Welsh ice masses during both recorded glacial episodes. The site also shows evidence for periglacial conditions prior to deposition of the Trevor Till. Redeposited Welsh erratics in the periglacial sediments record possible evidence for an even earlier glacial episode.

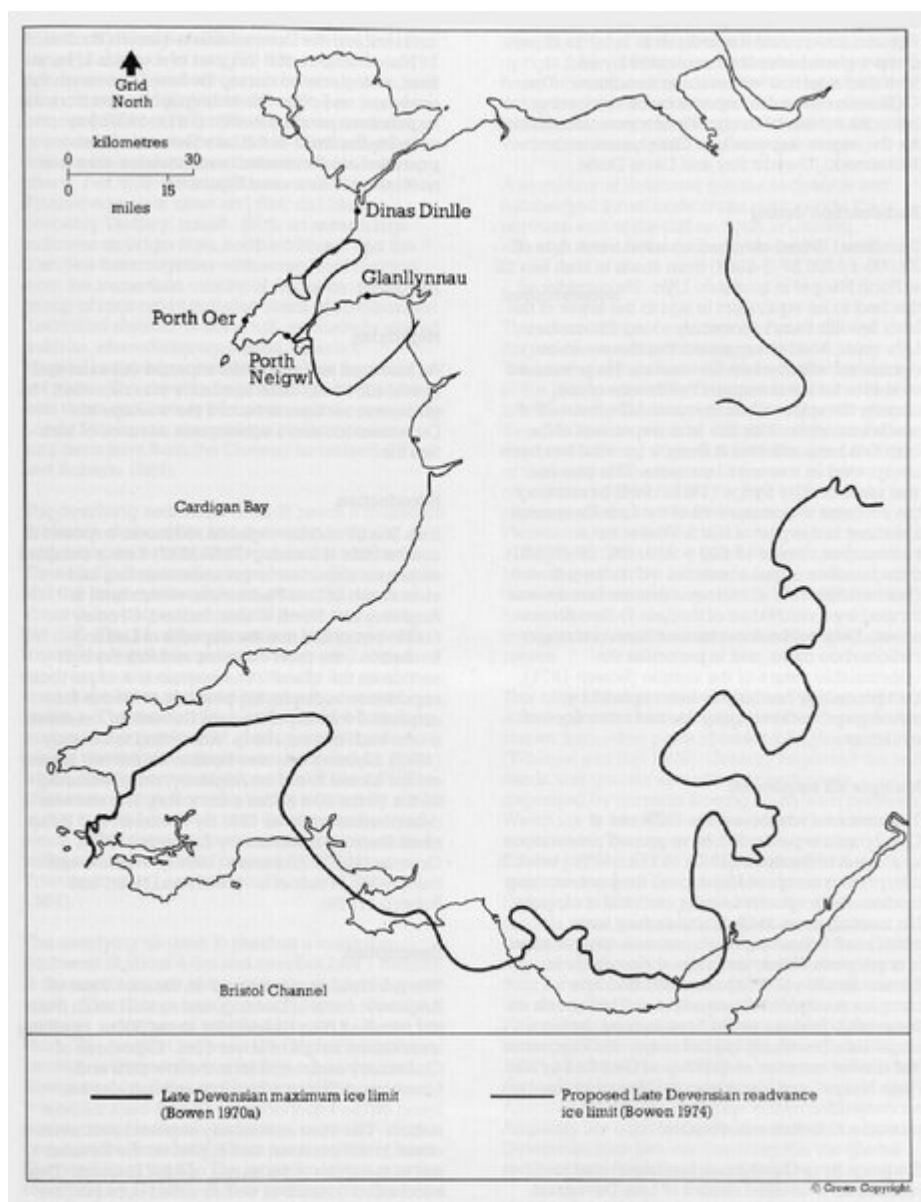
## Conclusions

The extensive exposures of ice age sediments at Porth Neigwl are important for reconstructing the ice age history of north-west Wales. The Irish Sea ice-sheet deposit (Trevor Till) has been interpreted as a boulder clay: that is, the sedimentary product of a land-based ice-sheet. On the other hand, it could perhaps be a glacio-marine deposit representing deposition in a sea, adjacent to the Irish Sea ice-sheet.

## References



(Figure 31) Quaternary sequence at Porth Neigwl (from Saunders 1968d)



(Figure 27) Late Devensian and Late Devensian readvance ice limits (from Bowen 1974, 1977b)