

On the significance of a glacially-derived Lower Jurassic ammonite fragment from Vennington, west Shropshire

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WORSLEY, P. ¹ (2024). On the significance of a glacially-derived Lower Jurassic ammonite fragment from Vennington, west Shropshire. *Proceedings of the Shropshire Geological Society*, **19**, 7–13. The re-discovery of a fragment of a Lower Jurassic ammonite close to the Welsh border in western Shropshire supports the hypothesis that an incursion of the Irish Sea Glacier during the Last Glaciation Maximum (LGM) extended further westwards than hitherto understood. The most likely source of the ammonite is the Lower Jurassic Prees outlier which crops out some 40 km to the north east. Liassic fossils eroded by the Irish Sea glacier and later incorporated within its sediments in south Shropshire have been reported since 1864 and are to be expected in the area which it covered.

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INTRODUCTION

Western Shropshire has long been identified as an area where two ice sheets of different provenance have been present during the Last Glacial (Devensian) Stage (Pocock *et al.*; 1938, Wills, 1949). Stratigraphical relationships revealed by exposures in the former aggregate quarry at Mousecroft Lane (Radbrook) in the outer suburbs of south west Shrewsbury unambiguously demonstrated that an ice lobe moving south from out of the northern Irish Sea basin arrived first and then retreated before a later glacier advance sourced in the mid-Welsh uplands moved east over the terrain previously occupied by Irish Sea ice. The sediments deposited by these glaciers are now respectively assigned to the Stockport and Shrewsbury Formations (Worsley, 1991), Figure 1.

An unknown is how far south-westwards did the Irish Sea glacier penetrate in the first instance, prior to the later arrival of Welsh-sourced ice. Previously it has been suggested that ‘The Dorrington ridges [eskers] represent the maximum westwards penetration of the Irish Sea ice’ (Thomas, 2005, p 57). This is considered here to be implausible since in the Hanwood area, several km westwards of Dorrington, Irish Sea till unconformably overlain by Welsh outwash and a local till was identified as early as 1886 in a railway cutting near Great Hanwood by H.C. Lewis, a visiting American glacial geologist



Figure 1. Regional glacial succession as was exposed in the Mousecroft Lane sand and gravel quarry in south west Shrewsbury on 25 March 1970. The Shrewsbury Formation, comprising Welsh Till and its underlying proglacial sandur can be seen to lie unconformably on the Stockport Formation, an ice-contact complex of Irish Sea till and associated glaciofluvial sands and gravels. The unconformity is highlighted by white dashes.

(Lewis, 1894, p. 297). Lack of exposure led to the Geological Survey in the 1920s being unable to verify this key stratigraphic relationship but recently this has been confirmed (Worsley, 2023). Unfortunately, borehole records obtained by shell and auger percussion drilling which potentially shows tills associated with glaciogenic deposits are often ambiguous and, in particular, discrimination of tills of differing provenance is problematic.

A pertinent clue towards solving this basic question regarding Irish Sea ice extent comes from the recent identification of a fragment of a Lower Jurassic ammonite associated with till and glaciofluvial sediments at ca. 155 m OD on Lower

Farm close to Vennington village, just four km east of the Welsh Border on the eastern flanks of Long Mountain, ca. 20 km WSW of Shrewsbury. Its presence signifies that Irish Sea ice incursion reached at least some 12 km further west than previously understood. Interestingly, Talbot Whitehead, who was a member of the team of Geological Survey geologists in the 1910-1930 period which mapped the western borders of the Cheshire-Shropshire lowlands, stated ‘that there seemed to be no evidence in this area there ever was ice from Wales contemporary with or prior to the ice which brought in the Irish Sea erratics’ (Whitehead, 1961). Indeed, at 335 m OD on Glop Farm [SJ 263 316], four km north west of Oswestry, Irish Sea glaciogenic sediments with a derived marine fauna were documented by Wedd *et al.* (1929) and are still exposed in former sand and gravel workings.

THE VENNINGTON DISCOVERY

The fragment is part of an ammonite whorl. Some 50 years ago, Mrs Janet Tozer picked the clast from the incised stream bed which forms a tributary to Westbury Brook (at SJ 334 096) and, because of its unusual shape, she retained it as a curiosity. By chance, its existence came to the writer’s attention in April 2024. As might be expected, the clast edges have been rounded as a result of rolling due to stream bedload transport and the surfaces are partially polished (Figures 2a & 2b). It is likely that the shape was determined prior to its recent movement by the stream and was acquired during the glaciation.



Figure 2a. The Vennington fragment of *Coroniceras* sp.



Figure 2b. A complete specimen of *Coroniceras* sp. for comparison with 2a.

The ammonite appears to be part of a *Coroniceras* sp., an ammonite characteristic of the Lower Lias Hettangian–Sinemurian stages. It is estimated that the original fossil had a diameter of c. 130 mm, i.e. dinner plate size. The classic locality for observing numerous intact *Coroniceras* is on an inter-tidal limestone ledge popularly known as the ‘ammonite pavement’ just east of Seven Rock point at Monmouth Beach, west of Lyme Regis (Hart, 2009).

GLACIAL GEOLOGY OF THE AREA

Digimap Geology shows that the area immediately west of Vennington has a glaciofluvial unit lying on Devonian bedrock. A recent field examination failed to identify *in situ* bedrock in the stream bed at the find site and poor bank sections exposed only superficial sediments dominated by dark grey gravels formed from Lower Palaeozoic rocks. However, within 200 m towards the village undoubted Welsh till cropped out along the approach track. These sediments are considered to be part of the Shrewsbury Formation.

Vennington falls within the BGS Welshpool 1:50,000 scale map Sheet 151 which was first published in a combined Solid and Superficial edition in 2008. The previous map was of Victorian vintage. It is unclear whether the declared ‘rapid resurveying’ methodology

adopted for parts of the new sheet involved any revision of the superficial deposit distribution.

Although the village lies 4 km beyond the western limit of the adjacent Sheet 152 (Shrewsbury), unusually it is covered by the Pocock *et al.* (1938) memoir since the western fringe of the Hanwood Coalfield is included despite its western part strictly being part of the Welshpool sheet. Thus, a sketch-map by C.B. Wedd (Fig. 30, p 205) of the glacial deposits in the Westbury–Great Hanwood area, extends to Vennington. This shows a tributary to the trunk Westbury stream underlain by till although the south bank feeder streams flow over bedrock apart from their lowermost reaches (Figure 3).

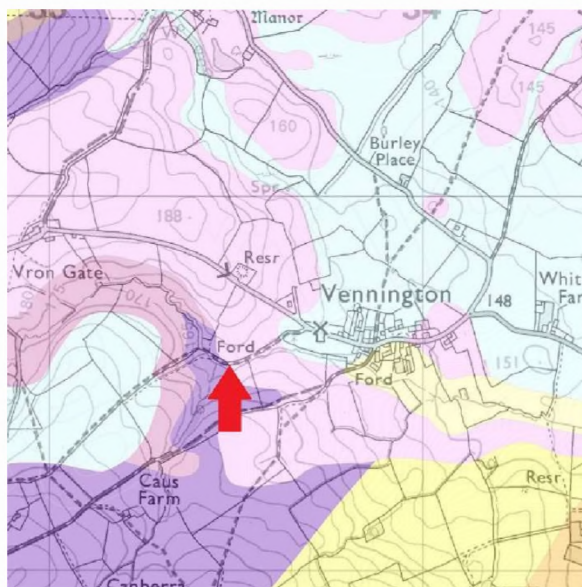


Figure 3. Extract from Digimap Geology of the area immediately around Vennington showing the glacial sediment cover over the bedrock - till (blue) or glaciofluvial (pink). Scale - 1 km grid lines. (OGL, contains BGS materials © UKRI 2024).

The thesis work of Brown (1971) abuts onto the Vennington district and provides useful contextual data. A glacial geomorphological map by Geoff Thomas (2005) of the area between Shrewsbury and Welshpool includes Vennington, (Figure 4) and places it in the context of the retreat stages of the Welsh Glacier in the Middletown gap just to the north between The Breiddens and Long Mountain. No exposures of *in situ* Irish Sea glacial deposits are known.

Unfortunately, no Welshpool memoir has been published although one of the 'Brief Explanation' booklets is available (Cave, 2008). The latter account has a section devoted to the Quaternary

geology and discusses the glacial record but introduces two concepts which are muddled. First, it notes that erratics of microgabbro (= dolerite) derived from the Breidden Hills are common in tills east of Long Mountain. This is interpreted as signifying ice movement from the north and not from the west, i.e. mid Wales. It is also commented that the till matrix is not 'obviously red or sticky like that of the Irish Sea ice sheet'. Why the surface till should be of this nature when the last glacier to cover the area was sourced in Wales is not explained. Second, it notes that 'field brash' of Alberbury Breccia also supports this inferred movement from the north and not from the east although the possibility that the breccia clasts might be artifacts introduced by farmers because of its Carboniferous Limestone content is not excluded. The nearest breccia actually crops out only four km to the east.



Figure 4. Extract from a glacial geomorphological map of the Welshpool–Westbury area compiled by Thomas (2005). Note that the Long Mountain area is incorrectly labelled as 'Longmynd'. The approximate location of Vennington is indicated. All the ice margins, meltwater channels and sandurs (cross-hatched) relate to the retreat of the Welsh Readvance which had enveloped the entire map area.

GLACIALLY DERIVED FOSSILS

The provenance of the *Coroniceras* is almost certainly the Lower Lias of the Shropshire Prees outlier and the fragment was probably eroded and transported by the Irish Sea glacier around the LGM (Last Glaciation Maximum). Due to poor exposure and an extensive cover of glacial deposits, the presence of the Jurassic Prees outlier straddling the Cheshire–Shropshire border (Figure 5) is frequently overlooked or only briefly mentioned in standard textbooks of British stratigraphy (Cope, 2006); Toghill, 2006).

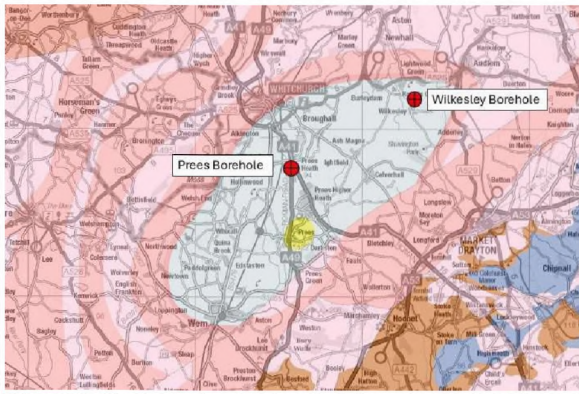


Figure 5. Geological map showing the extent of the Lower Jurassic Prees outlier and the locations of the Wilkesley and Prees boreholes. (OGL, contains BGS materials © UKRI 2024).

Until 2023, the most comprehensive details of the Liassic succession within the outlier are given by the cores obtained in the drilling of the BGS Wilkesley Borehole [SJ 628 414] during 1959–60 (Poole & Whiteman, 1966). A remarkable aspect of the Wilkesley core concerns the interface between the base of the superficial deposits and the eroded top of the Lias. The upper sequence, c. 18 m thick, consisted of glaciogenic sediments – tills and sands – which clearly are the products of Irish Sea ice and hence belong to the Stockport Formation. Below the erosional unconformity, the Lias consists of ‘siltstone, pale grey slightly calcareous; well-distributed lamellibranch clasts along bedding planes; some small pyritous ammonites and fragments of larger specimens’. Then the record adds that *Coroniceras* was present at 0.3 m below the unconformity. This suggests that potentially at this location glacial erosional processes were incorporating Liassic fossils into the basal glacial debris.

The recent Prees boreholes (Hasselbo *et al.*, 2023) throw further light on the Quaternary–Jurassic unconformity associated with the outlier. Three cored boreholes were drilled. First, 2A,2B, were relatively shallow at 32–37 m for geotechnical characterisation, and second 2C the main core penetrated the base of the surviving Jurassic succession at a depth of 590 m. In the A & B holes the upper part consisted of some 8 m mainly fluvial sediment interpreted as ‘infill of Glacial Lake Prees’, over a basal red brown till 4.7 m thick.

Of particular interest was the description of the c. 7 m thick top of the Lias. This exhibited fine

scale fracture networks with the uppermost consisting of ‘dislocated angular fine pebbles and granules of mudstone in a mudstone matrix’. The authors attributed this to glacial loading inducing hydrofracturing. This natural process involves confined high pressure fluids and a recent example is the creation of clastic dykes penetrating till deposited beneath modern temperate glaciers (Worsley & Alexander, 1975). Fracking is effectively the artificial simulation of this natural process when employed in oil and gas production.

However, it is suggested here that a more plausible alternative interpretation would attribute this distinctive structure to the effects of former permafrost-related processes. Mudstones are particularly susceptible to the development of segregated ground ice lenses. It is well established that permafrost was widespread during the Devensian stage both within and without the glacial advance limit (Worsley, 2015). Assuming permafrost was present at the Prees site, after burial by the advancing Irish Sea glacier, the sub-zero ground temperature would have risen to the pressure melting point of ice, thereby facilitating entrainment of Liassic material (and included fossils) into the glacier basal debris layer. Onward glacier flow would then move and deform the Liassic debris to form till as the glacier advanced into south Shropshire. Meltwaters would have sorted this material to deposit glaciofluvial deposits.

The presence of Lias-derived fossils within Shropshire glaciogenic deposits which can be assigned to the Stockport Formation associated with Irish Sea ice is not unprecedented. Indeed, as early as 1864, Sir Charles Lyell communicated a significant paper to the Geological Society of London on the Ironbridge Pleistocene. He did this on behalf of George Maw (1832–1912), a local Broseley industrialist and natural historian (Maw 1864). Although Maw interpreted the field evidence in terms of the submergence hypothesis, many of his observations are important since subsequently exposures have been extremely limited. Maw examined the sections created during the construction of the Wellington–Much Wenlock and the Shrewsbury–Bridgnorth railways and established the basic glacial succession. Of particular interest in the present context was the discovery of the Mollusca

Cardinia ovalis and *Gryphaea incurva* from the Lower Lias as part of a rich derived fossil assemblage which included derived Pleistocene molluscan faunas.

Seven decades later, some 8 km south of Shrewsbury, widening of the main A49 road ca. 1934 just north of Wayford bridge, exposed glacial sands and gravels. Examination of the 1930s Ordnance Survey map shows that this work was on the east side of the road around SJ 475 031. A sand and gravel pit was developed to exploit the deposit and, as is common with Irish Sea glacial deposits, the sediments yielded derived marine fossils of existing species (Thompson & Worsley, 1966).

Becoming aware of these fossils, a prominent local naturalist, H.E. Forrest (1858-1942) of Bayston Hill, asked the workmen to retain any future finds. Unexpectedly, amongst the fossil collection, were two teeth of *Ichthyosaurus* sp. Reasonably, he deduced that the teeth must have originated from the Prees Jurassic outlier and had been glacially transported to the site (Forrest, 1936). Alas, he mistakenly identified the landform into which the pit had been excavated as a drumlin rather than an esker. Nevertheless, he observed that the clast long-axes were aligned NNW-SSE but interpreted this as giving the ice movement direction rather than the palaeoflow direction of the meltwater transporting the sand and gravel. The pit lay at the southern end of an almost 2 km long complex of linear ridges of sand and gravel. This has been extensively worked and little of the original landform survives. A photograph of the Dorrington esker (Figure 6), just opposite the original pit, shows the classic arched bedding due to lateral ice-contact collapse, which often characterises esker sedimentation.

Hamblin & Coppack (1995, p. 119) note the finding of a Liassic ammonite in till west Holmer, just north of Much Wenlock [SJ 617 015]. Incidentally, this is almost coincident with the GSSP (Global boundary Stratotype Section and Point) for the Silurian Homerian Stage at Whitwell Coppice. This locality is just inside the LGM ice limit which coincides with the foot of the Wenlock Limestone escarpment.



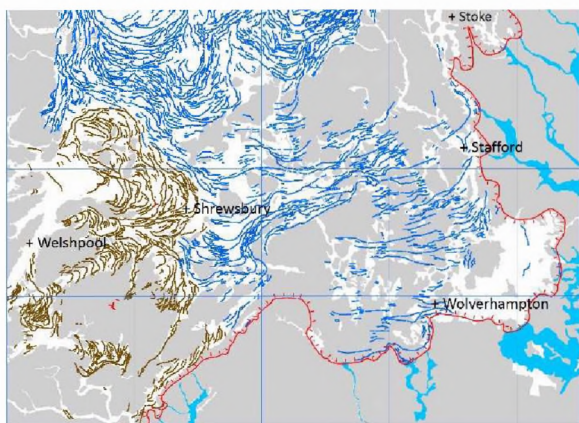
Figure 6. The interior of the Dorrington esker close to the site where the *Ichthyosaurus* teeth were discovered by H.E. Forrest. (PW 1970-03-25).

CONCLUSION

In the light of the above evidence, the Vennington ammonite confirms that the western extent of the Irish Sea glacier at the LGM was much closer to the Welsh border than previously posited and supports the assertion that the eastward advance of ice from Wales was delayed until after the Irish Sea ice had withdrawn northwards from south Shropshire.

The hiatus between the two ice advances need not necessarily have been more than a millennium nor involved any major change in the prevailing climate, rather the mass balance regimes, particularly precipitation patterns in the accumulation areas of the two glaciers, were dissimilar leading to out of phase ice-marginal responses.

A map devised by the late Geoff Thomas in 2015 shows the areas covered by the Irish Sea Glacier at the Last Glacial Maximum and the later Welsh Readvance in the Cheshire-Shropshire Basin and adjacent areas. An extract from this map covering the area between Welshpool and Wolverhampton is shown by Figure 7. Of course, it does not reveal the western limit of the Irish Sea Glacier advance since this was later obscured by the Welsh Readvance. However, the Vennington ammonite affords an insight into the extent of the Irish Sea Glacier into the Anglo-Welsh borderlands.



Figures 7. Part of a map compiled by Geoff Thomas (2015) showing the Last Glacial Maximum extent of the Irish Sea Glacier (red line) in Central Shropshire. The blue lines are reconstructed retreat margins of the Irish Sea Glacier whereas those related to the later Welsh Readvance are in brown. Note how in the south west the LGM ice limit is diachronous where it corresponded to the Welsh Glacier margin.

ACKNOWLEDGEMENTS

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REFERENCES

- Brown, M.J.F. (1971). *The glacial geomorphology of parts of South West Shropshire and Montgomeryshire*. Unpublished Ph.D. thesis, University of London, 548 pp.. (an open access version is available via the UCL Discovery website).
- Cave, R. (2008). *Geology of the Welshpool district: a brief explanation of the geological map sheet 151*. Keyworth, British Geological Survey, 38 pp..
- Cope, J.C.W. (2006). Jurassic: the returning seas. In: Brenchley, P.J. & Rawson, P.F. *The geology of England and Wales*, 2nd edn., London, The Geological Society, 325-363.
- Forrest, H.E. (1936). Teeth of *Ichthyosaurus* in a Shropshire sandpit. *North Western Naturalist*, **11**, 271-272.
- Hamblin, R.J.O. (1986). The Pleistocene sequence of the Telford district. *Proceedings of the Geologists' Association*, **97**, 365-377.
- Hamblin, R.J.O. & Coppack, B.C. (1995). *Geology of Telford and the Coalbrookdale Coalfield*. Memoir of the British Geological Survey, England & Wales, parts of sheets 152 & 153. Keyworth.
- Hart, M. (2009). *Dorset and East Devon Landscape and geology*. Ramsbury, Crowood Press, 240 pp..
- Hasselbo, S.P. *et al.* (2023). Initial results of coring at Prees, Cheshire Basin, UK (ICDP JET project: towards an integrated stratigraphy, timescales and Earth system understanding for the Early Jurassic. *Scientific Drilling*, **32**, 1-25. (n.b. the *et al.* consists of 72 contributors !).
- Maw, G. (1864). Notes on the drift deposits of the valley of the River Severn in the neighbourhood of Coalbrook Dale and Bridgnorth. *Quarterly Journal of the Geological Society of London*, **20**, 130-144.
- Pocock, R.W., Whitehead, T.H., Wedd, C.B. & Robertson, T. (1938). *Shrewsbury District including the Hanwood Coalfield*. Memoirs of the Geological Survey England and Wales (Sheet 152), London, HMSO, 297 pp..
- Poole, E.G. & Whiteman, A.J. (1966). *Geology of the country around Nantwich and Whitchurch*. Memoirs of the Geological Survey England and Wales (Sheet 122). London, HMSO, 154 pp..
- Thomas, G.S.P. (2005). North-east Wales. In: Lewis, C.A. & Richards, A.E. eds. *The glaciations of Wales and adjacent areas*. Little Logaston, Logaston Press, 41-58.
- Thomas, G.S.P. (2015). *Irish Sea and Welsh Ice Margins*. University of Liverpool, Last Revised 11/09/2015 (unpublished).
- Thompson, D.B. & Worsley, P. (1966). A Late Pleistocene marine molluscan fauna from the drifts of the Cheshire Plain. *Geological Journal*, **5**, 197-207.
- Toghill, P. (2006). *Geology of Shropshire*, 2nd ed., The Jurassic period, 212-215.
- Wedd, C.B., Smith, B., King, W.B.R. & Wray, D.A. (1929). *The country around Oswestry (Sheet 137)*. Memoirs of the Geological Survey England and Wales (Sheet 137), London, HMSO, 234 pp..

- Wills, L.J. (1950). *The palaeogeography of the Midlands*. 2nd edn. Liverpool, Liverpool University Press, 147 pp..
- Whitehead, T.H. (1961). In discussion of E.G. Poole and A.J. Whiteman. *Quarterly Journal of the Geological Society of London*, **117**, 125.
- Worsley, P. (1991). Glacial deposits of the lowlands between the Mersey and Severn rivers. In: Ehlers, J., Gibbard, P.L. & Rose, J. eds. *Glacial deposits in Great Britain and Ireland*, 203-211.
- Worsley, P. (2014). Ice-wedge growth and casting in a Late Pleistocene, periglacial, fluvial succession at Baston, Lincolnshire. *Mercian Geologist*, **18**, 159-170.
- Worsley, P. (2023). Glacial geology of the Shrewsbury area, Shropshire, with particular reference to the Welsh readvance. *Mercian Geologist*, **20**, 229-239.
- Worsley, P. & Alexander, M.J. (1975). Neoglacial paleoenvironmental change by Engabrevatn, Svartisen, Holandsfjorden, North Norway. *Norges Geologisk Undersøkelse*, **321**, 37-66.