One Thousand Years of Industry

Scotland has a rich industrial tradition. While ship-building and coal mining have left the most obvious scars on the landscape in the past century, the country also has many survivals from earlier industrialisation, amongst them fishing ports, distilleries, mills, iron foundries, bridges, docks and harbours. Pioneering communities such as New Lanark all have engaging stories to tell.

But the most frequently-found industrial relic is probably the corn mill – the focal point of every agricultural community, and a key component of the food supply chain. The mill's location was dictated by geography. Ideally it needed to be near the farming community whose corn it ground, near those who bought and used its flour, and located close by a plentiful supply of water.

While some mills were established in remote locations simply because there was a ready supply of fast running water, a number of towns and villages owe their very existence to their mill, being developed around this key facility and sharing its water supply.

The first mills in Scotland were probably 'Norse mills' (also known as 'Greek mills'), so it is not surprising that examples are still to be found in the Orkneys, Shetland and in the Western Isles. Such mills were in use over 2,000 years ago, their simple design being easy to construct with even rudimentary expertise. However, they were not efficient, so could only be used when there was a substantial supply of water. While Orkney today has but a single example, those on Shetland and in the Hebrides have fared a little better.

The design was very simple: a stream of fast moving water drove a rotating set of paddles beneath the mill floor, directly turning the millstone above. With some mills it was the natural force of the water which did the business, but where the water moved more slowly, it was collected in large millponds and when the mill was working, it was directed through narrowing channels to increase its flow, eventually passing under the mill and driving the rotor.

In more populous and 'civilised' places, Roman influences saw the rotor mills replaced with what were known as 'Vitruvian mills' – presumably named after the Emperor Vitruvius

[opposite page] The reconstructed Norse Mill at Siabost, now known as Shawbost, on Lewis is a survivor of over 200 such mills on the island. This view looks past the dry stone wall of the mill itself towards the kiln room. The group of thatched buildings was restored in the 1990s. The millstones are directly driven by a rotor or paddle mechanism beneath the floor of the mill building.

[above left] Dounby Click Mill, Orkney. Now in the care of Historic Scotland, this turf-roofed 'Norse' style undershot rotor mill is the last horizontal watermill left in the Orkneys.

[above] The reconstruction of the type of paddle rotor that would originally have powered Dounby Mill.

[left] The remote Glendale water mill on the Isle of Skye. An early overshot mill, dating in part from the 18th century, Glendale was fully restored to working order in the 1970s, but has since fallen into disrepair once again. At the time of writing, part of the roof has collapsed.

(1st century BC) – and they marked the introduction of the overshot mill into Britain. Perhaps surprisingly, enthusiasm for the overshot mill did not last and much mediaeval development went into the development of the undershot wheel, where it was the speed of flow which propelled the blades of the waterwheel forwards.

A fine example of a 17th-century undershot mill can be found in the Lothian village of East Linton. Preston Mill (see opposite page) has been restored to working order by the National Trust for Scotland. Undershot wheels were fine when rivers were in flood and the water flow was considerable, but tended to be at their least efficient in the dry autumn when the corn was ready to be ground. So water needed to be conserved and stored for when it was needed, and that requirement drove the development of the mill-pond, or in many cases, a series of ponds sited successively higher above the mill.

More efficient was the breastshot design, where water was introduced via a narrowing mill-lade to fall on to the blades of the wheel at axle level. This proved twice as efficient as the undershot wheel, and with this design the same quantity of water produced over double the energy, combining the water power itself with the natural forces of gravity.

But it was the overshot wheel (see left), where water was introduced at the top of the wheel, which drove later mills and the water-powered 'manufacturies' of the Industrial Revolution.

[opposite page] The eccentric shapes and pan-tiled roofs of Preston Corn Mill in East Lothian form a quaint group of buildings around a small pond. Set in the midst of corn-fields on the edge of the village of East Linton and drawing water from the River Tyne, the mill, its oast house and kiln, date back to the 17th century. There was a major overhaul and rebuild in the middle of the 18th century, but corn has been milled on this site since the 12th century.

[left] The overshot waterwheel of New Abbey Corn Mill in Dumfriesshire. The mill buildings today date from the 18th and 19th centuries, but corn has been milled on this site for over 700 years. The original mill was erected by the Cistercian monks of New Abbey (Sweetheart Abbey) nearby, initially to grind flour for their own food, but they also operated the mill as a commercial venture offering milling services to local farmers. The restored mill today is still driven by water from the large and ancient mill-pond (see next page) located on an elevated position above the site.

[opposite page] The mill-pond is every bit as much a part of the industrial landscape of Scotland as the mills themselves, and also of the later factories and the textile mills which depended on water for their power. Without the mill-ponds – the first industrial reservoirs – there would rarely have been sufficient water-power to drive the heavy machinery. This is the pond for New Abbey Corn Mill in Dumfriesshire. A watermill has stood on the site since the early 1300s, so the origins of the mill-pond can also be traced back seven centuries.

[inset] The interior of Tormiston Mill, Orkney. Built in the 1880s, the original waterwheel and much of the internal machinery still survives. The mill, in the care of Historic Scotland, now serves as a reception centre for Maeshowe, the spectacular Neolithic chambered cairn which dominates the surrounding landscape.

[left] The 18th-century limekilns which occupy much of the waterfront at Charlestown on the Fife shore of the Firth of Forth are, perhaps, Scotland's most neglected industrial monuments. Built in the 1750s by Charles Bruce, Earl of Elgin, they were still being expanded in number and output when Thomas Pennant visited in 1772. The kilns were, he said: 'the greatest perhaps in the universe, placed amidst inexhaustible beds of limestone, and near immense seams of coal.' The kilns were so vast that it took two weeks for the limestone to fall to the bottom of the furnaces and be raked out as lime.

[above] Telford's elegant bridge over the River Spey at Craigellachie.

[right] The 'Atlantic Bridge' to Seil Island.

[centre right] A reminder of bridge design from earlier times: the Clapper Bridge at Altbea in the Highlands.

[opposite page] An unusual view of the most recognisable of Scotland's bridges – the Forth Bridge seen from on board the Inchcolm ferry as it passes underneath. The Forth Bridge, opened in 1890, took 60,000 tons of steel and seven years to build, and cost 57 lives. The Forth Road Bridge was opened in 1964.

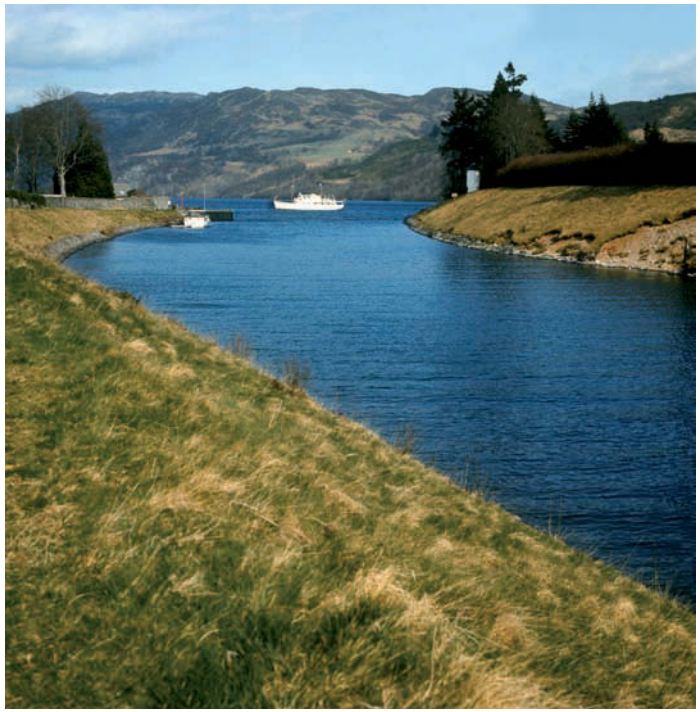
As larger mills were developed, and demands on farmers and millers increased to meet a growing population, getting the grain to the mills and the flour from the mills to the bakers clearly demanded an improved transport system. The drove-roads and tracks of old were ill-suited to the needs of larger horse-drawn vehicles and ever-heavier loads.

No one was more central to the development of Scotland's network of roads and bridges than Thomas Telford. The poet Robert Southey once described the Eskdale shepherd's son who became one of Britain's finest engineers as the 'Colossus of Roads'; so important was his contribution to developing the nation's transport system. On a plaque on the bridge which crosses the river at Invermoriston on the north shore of Loch Ness, can be read the claim that this bridge was 'one of nearly a thousand built by Thomas Telford between 1803 and 1819' to improve the transport system of the Scottish Highlands – and if that is anywhere close to the truth, it's more than 60 bridges a year in Scotland alone!

In a career which spanned 60 years, Telford's vision changed the face of Scotland – and of Britain. He designed and oversaw the construction of thousands of miles of road, some of the most imposing bridges of his day, hundreds of miles of canals, some major docks, several harbours, and a host of little churches. His tally of bridges included mighty structures such as the Menai Straits Bridge linking Anglesay with mainland Wales – in its day celebrated as the longest bridge span in the world – Dean Bridge in Edinburgh, and the tiny 'Atlantic Bridge' to Seil Island off the west coast of Scotland.

While the sheer scale of Telford's achievements is reason enough to celebrate him, it is the beauty of many of his constructions which give them an enduring attraction. He didn't just build bridges, canals, harbours and churches; he endowed them with style and proportion which raised them to the level of engineering art. So many of his creations still survive today – indeed so many of them are still in everyday use – that there is much for the explorer to discover right across Britain. Working both in stone and cast iron, his bridges and his buildings survive as evidence that he could combine function with real

[right] When the original designs for the Caledonian Canal were drawn up in the closing years of the 18th century by James Watt, the dimensions of the canal and its locks had been chosen to ensure easy passage for the largest naval vessels of the day – 32-gun frigates – but by the 1840s those locks were already much too small. The canal also had serious construction faults and had to be closed for extensive modifications and repairs, including the insertion of an additional lock to help control water flow. As far as its original purpose was concerned, it was all but obsolete by the time it was re-opened in 1847.



[below right] An empty lock at Fort Augustus. The locks were designed to accommodate ships up to 150ft in length and up to 35ft beam, with a draught of up to 9ft: very large indeed by 1801 standards, but tiny by today's.

[right] The *Vital Spark* of Neil Munro's stories will always be captained by Duncan Macrae or Roddy McMillan as Para Handy, and Rothesay will always be a 'terrible place'. The puffer which starred in the original 1960s television series has long gone, but the *Vital Spark* captained by Roddy McMillan is tied up at Crinan Basin at the western end of John Rennie's Crinan Canal, under its original name of Vic 32.

[far right] Lock 13 at Dunandry on the Crinan Canal. More than 200 years after it opened, it is largely pleasure craft that make their way through on the canal today.

beauty. His designs are both practical and elegant, combining strength and endurance with visual features that raise them well above the level of his contemporaries. While many of the thousand bridges may just have been simple structures crossing tiny streams, Telford's major spans followed no standard pattern. Each was an individual creation.

From his early days as an apprentice mason, through to his two years working as a stonemason in Edinburgh's developing 'New Town', Telford was apparently fascinated by the ability of architects – then a relatively new profession – to produce the detailed drawings others used to construct buildings, bridges, or in the case of Edinburgh, complete new towns. The skill of the architectural draughtsman would be the foundation of Telford's later success. Indeed, his involvement with the majority of those thousand Highland bridges may have been only as architect or designer – not that that belittles his achievement in any way! Amongst his many bridges, the solidly-built Tongland Bridge in Dumfries and Galloway and the elegant Craigellachie Bridge over the River Spey are both worthy of a closer look. Most remarkable of them all perhaps, is the tiny bridge which links Seil Island to the Scottish Mainland near Oban. Until the completion of the Skye Bridge a few years ago, this tiny span, basking in the acquired name of the "Atlantic Bridge", could claim to be the only bridge in Scotland to span the Atlantic Ocean!

But Telford's transport achievements were not limited simply to roads and bridges. He was responsible for the completion of the Caledonian Canal, intended as the ultimate 'short cut' from Scotland's west coast to the northeast – saving hundreds of miles of often-treacherous sailing. Telford was not the first to suggest such a canal – two other eminent Scots had similar ideas. James Watt had proposed just such a project in the 1770s, and 20 years later John Rennie had resurrected it; but it was a report by Telford in 1801, in consultation with Watt, which had finally received Government backing. The canal was officially opened in 1822, over 60 miles in length, with 13 locks and designed to accommodate what were considered to be large vessels at the time. Each lock was 170 feet long and 40 feet deep.

While John Rennie's earlier plans to build a canal through the Great Glen came to nothing, his Crinan Canal across the top of the Mull of Kintyre was completed and opened in 1801 – the year Telford had received approval for the Caledonian Canal. The canal was initially quite successful, and David MacBrayne even built a steamer especially for it to ferry passengers from his Clyde steamers at Ardrishaig to connect at Crinan with his west-coast steamers to Oban and the islands. But the Crinan Canal proved equally unsuitable for the increasing size of vessels.

[right] The Leamington Lift Bridge on the Union Canal at Fountainbridge, Edinburgh. After years of dereliction and virtual abandonment, the canal is seeing a revival of interest, thanks in no small part by the completion of the Falkirk Wheel project breathing new life into the canal network.

[below right] The Forth & Clyde Canal at the Falkirk Wheel.

[below] Reflections on the still waters of the Union Canal near Polwarth, Edinburgh.

[opposite page] The magnificent Falkirk Wheel: the world's only rotating boat lift, completed as the centrepiece of Scotland's major Millennium Link project. So perfectly engineered is the structure that rotating the wheel – 1800 tons fully laden – uses no more electricity than six electric kettles. Thanks to the boat-lift, the Union Canal – running from Falkirk to Edinburgh – and the Forth & Clyde canal – linking Glasgow with Grangemouth – are connected once again after nearly 50 years. The Falkirk Wheel is one of the most impressive new landmarks created in Scotland for many decades, as well as being a highly original and elegant solution to a centuries-old problem. Before the canal link was severed during road-building projects in the 1950s and 1960s, raising boats up from the Forth & Clyde Canal to the Union Canal required a flight of 11 locks at Camelon. The new layout uses the wheel and three locks, after which the Union Canal – a contour canal built in 1822 – makes its way to Edinburgh without any further locks.

Robert Owen's New Lanark is now a World Heritage Site, retaining the integrity of this remarkable group of buildings, combining modern housing interiors with a faithful restoration of the 18th-century working environment. Clockwise from above: demonstrations of cotton spinning continue daily; the village shop doubles as a souvenir shop, and a recreation how it might have been 200 years ago; the view from the doorway of Owen's house; the mills as seen from the riverside walk; and the view of the buildings constructed along the narrow valley floor through which the River Clyde flows. The Clyde and its fast-moving waters proved ideal for powering the complex of mills.