engines. It was the completion of the reservoir at Hallington and the increased supplies taken from the Tyne that enabled the Company to afford supplies to the neighbouring North Shields company and in fact, to supply up to 75% of that company's needs.

The establishment and development of Armstrong's works and the growth of the chemical and engineering industries on Tyneside caused yet greater demands for water and in 1888 the Company, under its Engineer Forster, investigated many sites for potential reservoirs in Northumberland, eventually choosing that at Catcleugh, near the Scottish border. The design and construction of these works was, however, entrusted to Thomas Hawksley and under his supervision the 27 miles long pipeline was laid, so enabling the river Rede to be used as a source of water while the construction of the reservoir was proceeding. The earth dam itself, however, became the responsibility of his son Charles and its completion in 1905 ended a period of continuous expansion and development.

Such has been the expansion of Tyneside that the Newcastle and Gateshead company had at one time contemplated using the river Font as a source. In 1870 it had been considered for supplying east Northumberland, including North Shields, but the adoption of Catcleugh led to the Font becoming the river adopted by Tynemouth Corporation, which had succeeded the North Shields Company and with James Mansergh as Engineer the Fontburn reservoir was completed in 1908. The beginning of the 20th century saw the region still served by three undertakings in spite of the fact that much discussion on municipal control had taken place in the 1870's, when ever more far-reaching proposals had been suggested, including the use of Ullswater as a source for the whole region, in effect the Kielder Scheme now under construction by the Northumbrian Water Authority.

[*A review of Mr. R. W. Rennison's book 'Water to Tyneside' will appear in the next issue of the Bulletin.—Ed.*]

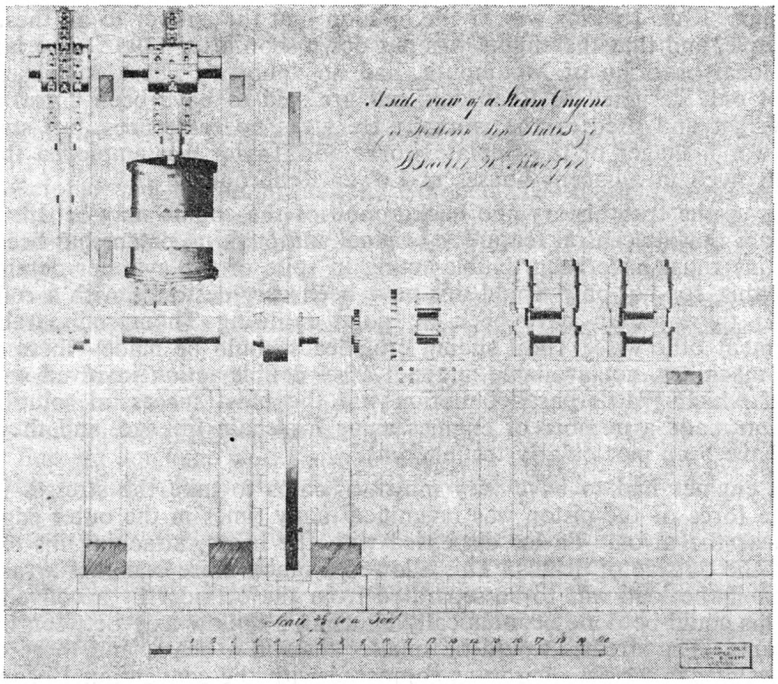
WILLIAM TAYLOR'S CHAIN-AND-DRUM DOUBLE-ACTING STEAM ENGINE OF 1798 (THE REDBROOK ENGINE)

By D. G. Tucker.

This engine had what is believed to be a unique feature, namely a drum-and-axle arrangement in place of the conventional massive beam, thus saving much material and space. Double-acting coupling from the piston to the drum and from the drum to the connecting rod was obtained by the three-chain method which had been used successfully by Francis Thompson on beam engines.[1]

The background of the design is the famous Tinplate Works at Lower Redbrook, by the River Wye, on the Gloucestershire side just below Monmouth. These works involved a rolling mill, originally water-powered; steam power came and went; water power was augmented by taking water from the next side-valley;[2] increased steam power was installed; finally the works were powered by electricity. The engine we are concerned with here is but a small and shadowy part of the history of the works, and it is not even certain that it was ever built. What is certain, however, is that a drawing was made of it,[3] dated 20 May 1798, signed by W. Taylor, and here reproduced as Fig. 1. The critical detail has been redrawn with more clarity in Fig. 2.

William Taylor was negotiating for an appointment to the staff of Boulton and Watt during 1799-1800,[4] and appears to have sent the drawing to them in support of his application. As his letter which must have accompanied the drawing does not appear to be on record, we cannot be sure (a) that the engine was ever built, (b) that, if it was, it was erected and used at Redbrook, and (c) that it was Taylor's



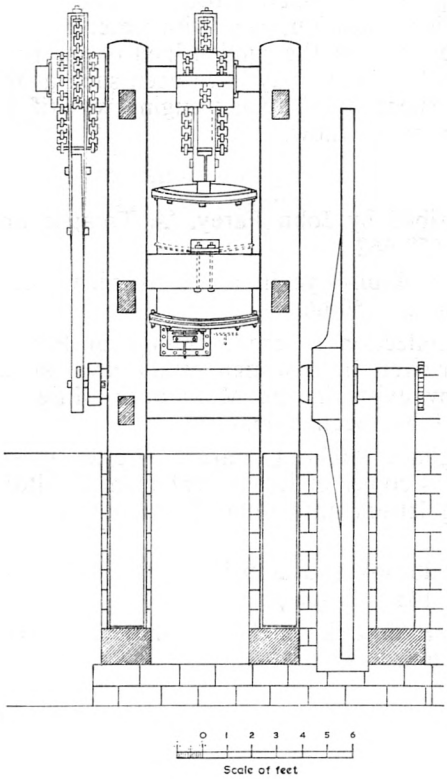


Fig. 1. William Taylor's drawing of 1798, photographed from a photocopy in Monmouth Museum by kind permission of the Curator.

Fig. 2. The steam engine of Fig. 1 redrawn for clarity.

own design. Rhys Jenkins was of the opinion that the answer to all these doubts was positive, and that the engine was put down soon after 1790.[5] The late Percy Harris, local historian of Monmouth, had no doubts:[6] 'These engines [*plural!*] were not only designed in Redbrook, but are said to have been constructed by John Wright and used in the works'. He gives no references, but states that Wright was manager of the tinplate works and Taylor was employed there; the two men lived in adjacent houses at Lower Redbrook.

Whatever the true history and background of the engine may be, there seems little doubt that its central feature is original, although no patent has been found. The engine must have been double-acting in spite of the cylinder detail not indicating this, for not only would this have been very desirable with a rolling-mill load, but there would have been no point in using Thompson's treble-chain arrangement otherwise. Until sliding crossheads could be made—these required planing machines, not available in the 1790s—double-action involved some difficulty, of which Watt's parallel motion was the most successful solution. But Thompson made a number of engines using his chain linkage, and they appear not to have been particularly troublesome.[7]

Beam engines had to have very massive beams to take the stresses involved, since the force of the piston was magnified many times in the outer edge of the beam near the pivot. Taylor dispensed with the beam, attaching his chains instead to the outside of drums. This allowed a much more compact arrangement, and even if the load was to be separated from the cylinder by a convenient distance, this could be done economically by using a hollow axle between drive and load drums. The stresses would be smaller than in a beam, and there could be a great saving in weight of iron as compared with the conventional beam.

It is believed that Thompson's chain-coupled double-acting beam engines were never used for driving rolling mills. For this application, even with water power, heavy flywheels were always used to store energy for the sudden load of the rolling operation. Nevertheless, the strains on the chains may have been such as to make their maintenance a problem. How successful Taylor's engine was (if it was actually built) we shall presumably now never know.

References

1. Thompson's arrangement is fully described by John Farey, 'A Treatise on the Steam Engine', London, 1827, pp. 658-662.
2. D. G. Tucker, 'Power at Lower Redbrook-on-Wye in the early nineteenth century', *J.Glos.Soc.Ind.Archaeol.*, 1971, pp. 59-66.
3. Formerly in the Boulton and Watt Collection at the Birmingham Public Libraries. Searches made by the author over the past eight years have failed to find it, but fortunately a photocopy exists in the Monmouth Museum archives, and it is from this that Fig. 1 has been prepared.
4. Boulton and Watt Collection, Birmingham Public Libraries. Letter book (office) for appropriate period. This gives copies of letters sent from Boulton and Watt; the corresponding incoming letters unfortunately do not appear to be in the collection.
5. Rhys Jenkins, 'The copper works at Redbrook and at Bristol', *Trans. Bristol & Glos. Archaeol. Soc.., 63,* 1942/3, pp. 145-167, see p.160.
6. P. Harris, 'Industrial history of Lower Redbrook' in 'Wye Valley Industrial History', typescript in Monmouth Museum.
7. See ref. 1.