

JOHN PADMORE'S CRANES AT BATH AND BRISTOL

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BIOGRAPHICAL NOTES

Surprisingly little is known of the life of John Padmore, whose major achievements in engineering occurred in the 1730's. He was involved in the design and construction of Ralph Allen's Combe Down tramway, built c.1729-30 for transporting stone from the newly-opened Combe Down quarries to Dolemead Wharf¹, on the river Avon at Bath, and in about 1731 his name is linked with attempts to solve structural problems in the Bristol Church of St Nicholas². In 1735 the Great Crane of Bristol was erected on the side of the new Mud Dock³, and in the 1742 edition of his *Tour*, Daniel Defoe refers to this crane as being 'the workmanship of the late ingenious Mr Padmore'. It is possible that Padmore had died a little earlier, in about 1740, for a minute of the Committee of the Society of Merchant Venturers for the 18th of October of that year notes that Mrs Padmore attended and offered to sell a crane 'which is already made'⁴.

An unsigned and undated portrait in oils in the permanent collection of the Victoria Art Gallery, Bath, of a man holding a pen or pencil in his left hand and with a model crane in front of him is, in all probability, of John Padmore. The crane is certainly a model of the Dolemead Wharf crane, and in the auction catalogue of the contents of Ralph Allen's Prior Park in 1769, a 'portrait of Mr Padmore, in a painted frame' is listed. The man in the portrait would appear to be about 30 to 40 years of age, so it is perhaps possible that John Padmore was born at the turn of the century, and died in about 1740.

THE CRANES

Although Padmore was involved with several varied engineering projects in the Bristol region, his work on the design and construction of cranes has been unusually well-documented by contemporaries who were obviously impressed with his work. The two main sources of information on his work are J T Desaguliers' *A Course of Experimental Philosophy*, Volume I, published in 1734, and James Ferguson's *Lectures on Select Subjects*, first published in 1760. The contemporary drawings of the more local William Halfpenny also provide a valuable record.

COMBE DOWN CRANES

Richard Jones, Ralph Allen's Clerk of Works from 1731 until Allen's death in 1764, states, in his autobiography compiled from manuscript sources by William Gregory in 1886, that 'in the hill for taking the stone out of the Quarry was four horse cranes, and one to lay the stone down to square it, which crane stood in the centre of two roads'⁵. This type of crane is illustrated and described by Desaguliers⁷, and although neither Padmore's name nor the Combe Down quarry is mentioned, the crane illustrated is identical to that shown by Halfpenny and described as 'belonging to Mr Allen's Stone-Works, near the City of Bath'⁶. The crane consists of a triangulated timber gibbet or jib, of fixed height but capable of working within a radius of 180°, and a vertical rope windlass turned either, as Desaguliers suggests, by four men, or, as Jones implies, by four horses. The whole is within a timber structure, with a roof 'to shelter the Rope from Rain, when the Crane is not in use, the gibbet being brought under it ...'. The rope is guided through pairs of wheels between the windlass and the jib, and the jib itself is controlled in its horizontal swing by an inverted trundle wheel on the jib upright geared to a pinion turned by a hand-wheel on a short horizontal shaft. As Desaguliers points out, there is no safety device to prevent the load running down if the men leave off turning the windlass, and he describes a compound gearing system to give control to the weight at any point of its lift, and to make it possible for one or two men to raise a load.

Desaguliers' description is important because he advocates the use of iron in the gearing and, certainly until the middle of the 18th century, most such millwork was of timber. Jones states that after Allen's death, when the tramway and cranes were sold up, 'one crane was sold for £14 to the proprietor, and is now in the Quars'. The site of the Combe Down quarry has now been built over, but the alignment of the tramway can still be followed, along the road from above Prior Park to the end of Ralph Allen Drive, where Dolemead Wharf was situated on the river side.

THE DOLEMEAD WHARF CRANE

The crane for loading the blocks of cut stone onto barges on the Avon is definitely credited to Padmore by Desaguliers⁹, and, although this type of crane, described as Rat's Tail or Rat Tailed, was already known, Padmore made some important improvements. The form of the crane closely resembles a post windmill, simply a box of machinery turning on a vertical post which is supported by diagonal braces from horizontal cross timbers, - quarterbars and cross-trees. The whole substructure of the crane was buried in the ground, obviously for reasons of stability, and again a parallel can be drawn with the practice of burying the trestle of a post mill in a mound, a practice which seems to have been the rule rather than the exception in Somerset. The jib of the crane was fixed to the timber-framed body and the whole was turned to enable the crane to work through 360°.

Padmore's design is important in that for the first time the brake and brake-drum, described by Desaguliers as being similar to a windmill brake, and the ratchet and pawl were combined to give maximum protection to the load and to the two men required to turn the handles to raise or lower it. Again iron was used in the mechanism, in particular for the ratchet wheel, and the iron stub-axes of the gearing ran in 'Bell-metal Boxes'. From the illustration of the crane in the portrait, it would appear that the two men required to work it did so from the ground beside the structure, and the scale of the crane appears to be quite small.

The crane is also illustrated, though in no detail, in the South East Prospect of the City of Bath, by Samuel and Nathaniel Buck, 1734, with the shelter sheds to protect the Dolemead Yard masons built by Richard Jones after the tramway was completed. A pen and watercolour painting in the Victoria Art Gallery, Bath, by one T C W Bampfylde, died 1791, shows the crane and stone yard viewed from across the river, with a sailing barge moored at the Wharf. According to Jones, the tramway, wagons and cranes altogether had cost Ralph Allen about £10,000, and 'the other [crane] in Dolemead in the yard was sold for £8 after Mr Allen's death'¹⁰

The carriageway¹¹ had effectively reduced the price of stone from 10s to 7s 6d per ton [20 cubic feet], and some 1800 tons were exported per annum from Dolemead Wharf during the time it was active, from about 1730 to the mid 1760's¹². The Avon had been made navigable to Bath after a subscription was raised by 'Mr John Hobbs, a Deal Merchant of Bristol' in 1724¹³, and was completed in 1727. The site of Dolemead Wharf and the stone-yard appears to have been finally destroyed by the entrance to the Kennet and Avon Canal, opened in 1810, although a stoneworks to the north side of the inner canal basin at Dolemead is marked on the 1886 1:500 OS map. The whole area has recently been obscured by roadworks.

THE GREAT CRANE, BRISTOL

The structure for which John Padmore was styled the ingenious by Defoe, and subsequently by many other writers, was the Great Crane which, according to Halfpenny, was erected at the Gibb of Bristol in 1735¹⁴. It is marked on Rocque's A Plan of the City of Bristol of 1742, and in a vignette on his 1745 map of the city. The same illustration appears in Barrett's The History and Antiquities of the City of Bristol of 1789, but the clearest representation is that by William Halfpenny, made in 1747, and in the possession of Bristol City Museum.

The Bristol crane is of the house type, in its way a large enclosed version of the Combe Down cranes, and was raised up on 14 columns which are variously described as being of timber and of cast iron. If they were of cast iron they are certainly an important early instance of iron being used structurally. That John Padmore was willing to use the then new material is evidenced by the iron-work in his crane mechanisms, and his screw-jack, which was presumably of iron, proposed to solve the structural problems in St Nicholas' Church. There are few surviving examples of cranes contemporary with Padmore, but a mid 17th century double treadwheel crane has been preserved at Harwich¹⁵ and a single wheel crane, of mid 18th century date, survives at Guildford, where it was built to serve the Wey navigation¹⁶. These are predominantly of timber construction in the mediaeval tradition, and treadwheel cranes of a similar type were in use in Newcastle until the early 19th century¹⁷.

The Great Crane consisted, from Halfpenny's drawing, of three different jibs, each with its own lifting gear. The lifting gear is illustrated and described by Ferguson¹⁸, but he made the illustration from memory some 12 years after visiting the crane and a footnote to the description in the later editions of his book remarks that certain parts of the mechanism were 'better contrived than I have described them'. The drawing was not, however, corrected, and this inaccuracy was perpetuated in later works dealing with descriptions of cranes, such as Rees' Cyclopaedia¹⁹. The chief innovation by Padmore in this design, as described by Ferguson, seems to be the introduction of morticed cogs around the outside rim of the treadwheels which meshed with a horizontal lantern pinion to enable the wheel, and thus the crane, to be braked effectively by the combination of a ratchet and pawl and a band brake, as used in the Dolemead crane. The rope was wound around the horizontal axis of the treadwheel, as was common in this type of lifting device, and in contrast to the vertical winding drum of the windlass type crane.

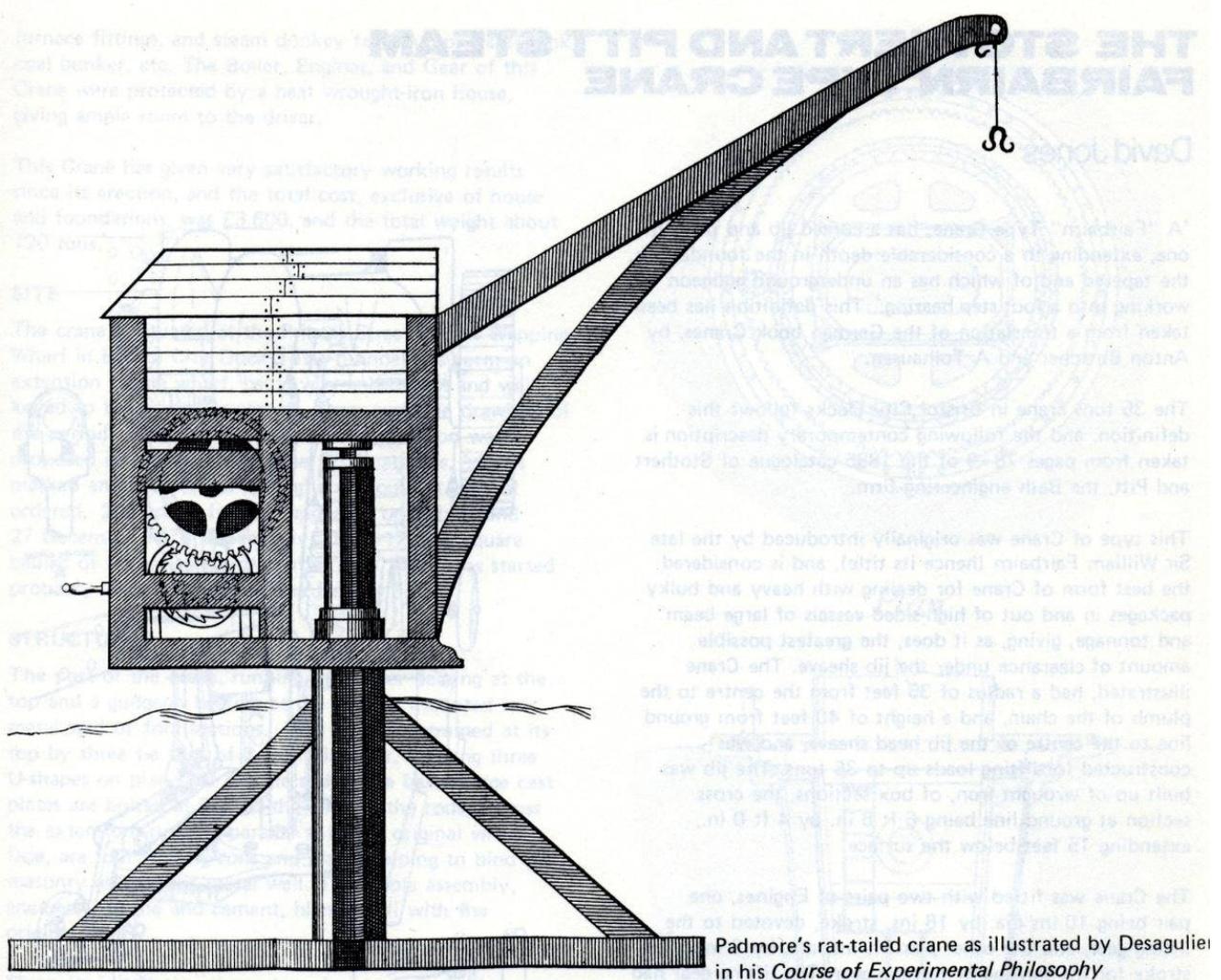
All the gearing illustrated by Ferguson appears to be of timber, and of compass-arm construction, that is, with the spokes supporting the rims being morticed through the shafts. The method of boxing the arms or spokes around the shaft - clasp-arm construction - was in use at this time, having been illustrated by Agricola in 1556²⁰, and the treadwheel in Beverley Minster, in the crossing above the vaults²¹, is of Clasp-arm construction and perhaps installed in 1716²². Clasp-arm construction is sturdier in that mortices do not penetrate and consequently weaken the shaft, but millwork of both types can be found side by side where wooden machinery survives, and is always difficult to date accurately.

In 1740 the Society of Merchant Venturers 'voted and ordered that the standing committee should have power to erect any crane or cranes on the Key for loading and unloading ships' and in the same year bought a crane from Mrs Padmore for 80 guineas, but it is not known if this was the Great Crane. In 1747 the Great Crane was 'sett up by auction' and let in 1758 for £195. In an Account Book of the Society for 1759, however, the following is recorded: 'Paid on account of a double purchase Crane erected in place of the Great Crane, £140. Received for the materials of the old Great Crane, taken down £25'²³. It is possible that this could refer only to the machinery of the crane, for the name 'Great Crane' persists on maps of the city until the early 19th century, but in 1824 no mention is made of it in a suggested perambulation which included the Mud Dock²⁴, implying that the complete structure had gone by that time. The site of the crane is still apparent, just to the east of Princes Bridge, to the south of Queen Square.

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Apart from the valuable contemporary sources of Desaguliers and Ferguson, the paper by the late Sir Arthur Elton on The Pre-History of Railways has been an important source and inspiration.



REFERENCES

1. **The Pre-History of Railways** Arthur Elton. Proceedings of the Somerset Archaeological and Natural History Society, 107, 1963, pp 31-59.
2. **Annals of Bristol in the 18th Century** John Latimer. Bristol, 1893. pp 179-80. (Latimer erroneously calls Padmore' Podmore').
3. **Drawing by William Halfpenny**, 1747, in Bristol City Museum. 4. **Archives of the Society of Merchant Venturers**.
5. **The Benevolent Man : A life of Ralph Allen of Bath** Benjamin Boyce. Harvard University Press, 1967. p 29n.
6. **Ralph Allen and Prior Park** William Gregory. Bath, 1886. PP 32-4.
7. **A Course of Experimental Philosophy** J T Desaguliers. Volume I, London, 1734, pp 120-22, plate 12.
8. **Perspective Made Easy** William Halfpenny. London, 1731, plates 18 and 19.
9. Desaguliers, op cit, pp 179-81, plate 16. 10. Gregory, op cit.
11. For descriptions of the tramway: Elton, op cit. Desaguliers, op cit, pp 274-9, plates 21-3. **A History of British Railways down to the Year 1830** C F Dendy Marshall. Oxford UP, 1938, Chapter 4.
12. **Bath Stone : A Short History** Huggins and Pickford. Bath, May 1975. (ex Gregory, op cit.)
13. **Essay Towards a Description of Bath** John Wood. London, 1745. p 232.
14. Halfpenny drawing.
15. **The Harwich Crane** Duncan W Clark. The Essex Review, Vol.42, No 165, January 1933, pp 17-31.
16. Correspondence from J Kenneth Major.
17. **Lectures on Select Subjects** James Ferguson. London, 1774. (5th edition) pp 84-90, plate 8.
18. **Rudimentary Treatise on the Construction of Cranes and Machinery** Joseph Glynn. 1854. Kingsmead, Bath, reprint 1970, pp 26-9.
19. **Rees' Cyclopaedia 1819-20**. Manufacturing Industry. David & Charles, 1972. Volume 2, pp 199-204. Volume 3, plate 18.
20. **De Re Metallica** Georgius Agricola. 1556. Dover Reprint, New York, 1950. (Agricola also records the use of steel in mill gearing) Book 6.
21. **English Cathedral Carpentry** Cecil Alec Hewett. Wayland, London, 1974. Chapter 4 on Hoisting Machines.
22. **Tread Mill Wheels** Country Life, March 17, 1955. p 745. 23. Archives, Soc MV.
24. **A Chronological Outline of the History of Bristol ...** John Evans, 1824.