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Hydraulic Rams

Jeremy Milln

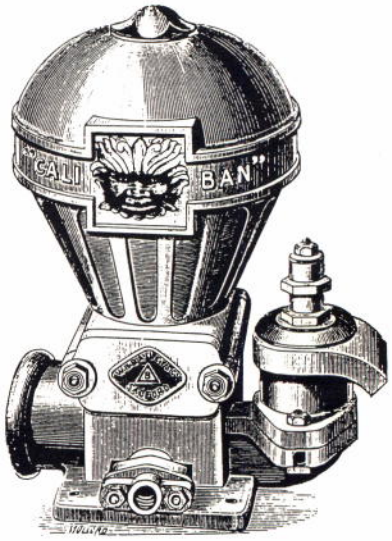
Recent water price rises (already up on average 67% since privatisation) are concentrating minds on cheaper alternative supplies. As always, the best methods are those which have been around a long time, and for the hydraulic ram this has been since 1772. The working and history of this environmentally-friendly and remarkably simple system is outlined and a case is made for conservation and further research.

Many now regard hydraulic rams to be minor industrial relics of concern only to archaeologists. Yet the use of most rams for domestic water and farm irrigation was discontinued little more than a generation ago, killed by the arrival of 'mains', the perceived convenience of oil- and electricity-powered pumps and, with agricultural intensification, of declining water quality in many areas.

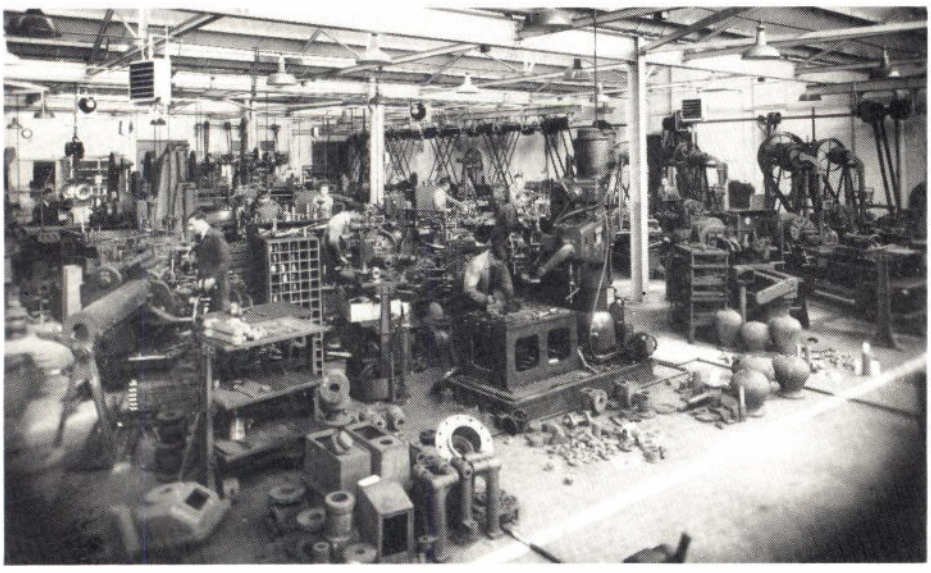
My researches with the National Trust show that scores of rams have been installed on land in its ownership, but it is no surprise that today very few (eg Hembury, Sheffield Park Garden, Castle Drogo, Erdigg, Hadrian's Wall and Sherborne Estates) are still used and only that at Cragside is interpretively displayed. Because it needs a fall of water, the only place a ram cannot be used is in entirely flat country; elsewhere, their non-use may increasingly be seen as unfortunate. Historically interesting, non-polluting, visually unobtrusive, relatively quiet, water and energy saving, durable and indefinitely maintainable, rams, more than anything else, define for us the conservation and sustainability ethos. Amongst water power schemes, hydro and turbine projects today enjoy the more vocal sanction of the environmental lobby. Rams may not be trendy, but they are cheap and they reinforce the point that by saving energy, generation anyway becomes less necessary.

The ram takes its pedigree from the piston pressure pumps invented to clear water from medieval mines, illustrated by Georgius Agricola in *De Re Metallica* (1556). The principle is that a vacuum/pressure created within the pump cylinder will draw water/have water forced in and this is then expelled via an outlet valve. A ram has a pair of flexible rubber check valve diaphragms (its only moving parts) instead of a piston. The energy comes from the natural gravitational fall of water in a stream, which at a point of flow past the diaphragm in the inlet pipe causes it to close suddenly. A kinetic pulse is produced causing the second diaphragm to open allowing some water into the air chamber and up the discharge pipe. The pressure then falls in the inlet water pipe and the first diaphragm reopens while the air compressed into the air chamber causes the second diaphragm to close and the water in the discharge pipe to move away under pressure. The whole cycle is repeated approximately 50 times per minute and will continue to operate automatically in this way ad infinitum or, at least, until either the valve rubbers perish or the water supply is interrupted. Admirers consider the ram to be the nearest thing to the perpetual motion machine yet invented.

The pump rate varies according to the volume and fall of the water supply, the height of the outlet pipe and the size of the chamber. About 15% of the supply will be raised to a height five times the fall in the inlet pipe. Water may be raised as much a 60 ft (18.3 m) on a fall of 2 ft (0.6 m), but with greater falls or volumes 300 ft

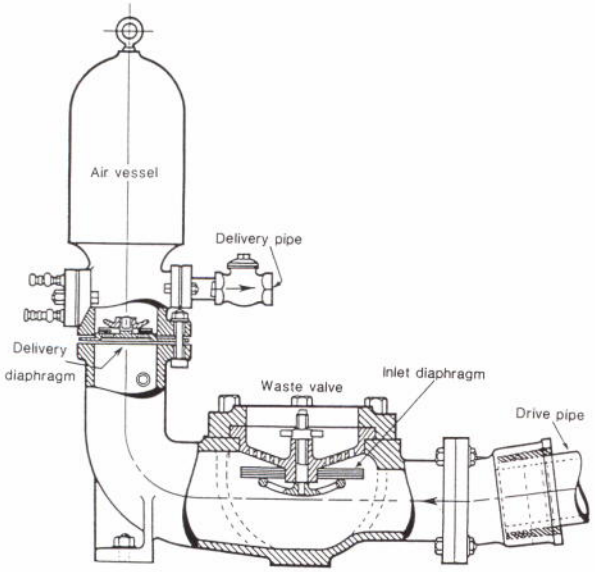


Ram by W H Bailey & Son of Salford, from a nineteenth-century trade catalogue. Caliban is, of course, the hideous water-girt slave in Shakespeare's The Tempest



W H Bailey's engineering workshop, c1935 Note the rather plainer air vessels the firm was using at this time. The workshop, in Ordsal Road, Salford, was destroyed during an enemy raid in World War II

Photo: The National Trust



The Blake simple-type 'hydram': longitudinal section, at approximately 1:20 scale. *Drawing: The National Trust*

(91.4 m) in height and 2 miles (3.2 kilometres) in distance with an output of up to 50,000 gallons a day are commonly achieved, making it an ideal installation for many estates. For demanding water requirements, eg in irrigation, Green & Carter make reinforced and outsize ('Leviathan') rams capable of lifts of 1,000 ft (305 m) or, with 36-inch (914 mm) drive pipes, huge outputs. A Compound ram is used where either the fall or flow rate of a stream is inadequate. Deriving its power from a plentiful supply of impure water, such as a river, it is capable of pumping the water of the stream from the point of confluence.

The history of the ram goes back to 1772, when the principle was discovered by John Whitehurst and a machine was produced for work in a brewery in Oulton, Cheshire. Whitehurst's pulse valve took the form of a tap which had to be opened and closed manually by a small (and presumably very bored) boy. It was Pierre Montgolfier, better known for the hot air balloon, who in 1796 invented the automatic pulse valve, patenting it for mass commercial production.

In Britain, in 1814, Josiah Easton's hydrological and engineering company based at Sunninghill, Berks, acquired the rights of manufacture and marketing for the British Empire, but numerous other small foundries and agricultural machinery companies soon produced variants. In the north-west Midlands I know of rams by A & W J Massey of Newport, Salop, W H Smith and Wyatt's, both of Whitchurch, Salop, F W Pass of Congleton, Cheshire, J Evans (who also made the familiar Lion 'village' Pumps) of Wolverhampton, W H Bailey of Salford and J Blake of Accrington, as well as Easton's. They were prolific manufacturers. Already by 1860 Easton's (variously known as Easton, Amos & Anderson and as Easton, Courtney & Derbishire) alone had been responsible for more than 1,000 installations in the British Isles. The Green & Carter foundry at Kingsworthy, Winchester, Hants, acquired Easton's (together with all its records) in 1928 and has remained independent. Blakes did the same with some of its former competitors but it has been taken over by Allspeeds Ltd, a member of the GEI International Group. Blakes now make no more than 100 rams a year; mostly for export to the third world, but at one time it was a major player in hydraulic engineering. Until the end of the British Raj, it was Blakes rams which supplied the mighty fountains in the Taj Mahal gardens.

The location and recording of rams require the skills of the industrial archaeologist. Many ram sites are marked on the current or recent 1:2,500 O.S. map series, but others which have become silted or lost may sometimes be identified by the catchpit or causeway, by pipe-work or by a ram house. Ram houses are an interesting study in themselves and often resemble small icehouses, with which they are sometimes confused. Operating rams can withstand frosts, but a brick or stone vault ensures protection when not in use, as well as providing defence against flood and interference. Few county Sites and Monuments Records have systematically recorded rams, a deficiency common to many types of industrial site and for which the IRIS form has, of course, been designed. Rams, like so much of the 'furniture' of the historic landscape, are at risk of theft and this adds an extra urgency to the need to record.

While a ram may have an intrinsic value both to 'collectors' and to hydraulic engineering historians; to industrial archaeologists, it is the context which is most important. There is, however, a place for a National Ram Collection, the start of which was made by M J Crumpton at the Bewdley Museum, Worcs, in the 1970s. This collection joined that at the Green & Carter Works at Ashbrittle, Somerset, until 1994 when it was moved to Heligan Manor in Cornwall following the restoration of its remarkable ram/reservoir system

The ram and beehive ram house of c1845 at Ossington Hall, Newark *Photo: The National Trust*

installed by the Tremaine family. The rams may be seen by visitors to the 'lost gardens' of Heligan. If AIA members happen to know of any ram which, perhaps because it has not been possible to retain it in situ, is now 'loose', I, or John Nelson at Heligan, would be very glad to hear of it.

Today, only Green & Carter and John Blake still make rams but both retain extensive archives (at Green & Carter there survive some papers from 1774, and from 1860 every letter, plan and account) so that it is possible to identify and date many existing installations as well as readily prescribe correct parts for repair. Rams may be 'green' but they are real, not alternative, technology and you do not need to seek advice from Machynlleth! While firms of hydraulics engineers can supply, both manufacturers are approachable direct and indeed have their own engineers. Both firms are also happy for bona fide researchers to consult their records. ❑

Useful addresses:
Green & Carter Ltd, Vulcan Works, Ashbrittle, nr. Wellington, Somerset, TA21 0LQ (leading surviving manufacturer)
Tel. (01823) 672365 or (01374) 108884 (mobile), fax. (01749) 673065 or (01823) 872950
John Blake Ltd, P.O. Box 43, Royal Works, Accrington, Lancs, BB5 5LP (manufacturer)
Tel. (01254) 235441, fax. (01254) 382899
Heligan Manor Gardens, Pentewan, St. Austell, Cornwall, PL26 6EN
Tel. (01726) 844157 (National Ram Collection)

Porthcurno: Centre of the World

John Packer

Just a few miles from Land's End, and referred to as Cornwall's best kept secret, the telegraph museum at Porthcurno is of world importance. Established in 1870, the cable station 'PK' became the hub of a world-wide submarine telegraph network.

Porthcurno beach is known to holiday makers for its golden sand, backed by granite cliffs and flanked by the craggy headland of Treryn Dinas and the Logan Rock, and the famous open-air Minack Theatre cut from the cliffs. The casual visitor may have been surprised at such a remote location for the Cable & Wireless training college, set in the valley behind. The reason for this apparent anomaly stems from the choice of Porthcurno as a major landing point for submarine cables.

The cable that landed at Porthcurno ('PK') beach in 1870 was the start of a world-spanning telegraph system that stretched via the Mediterranean to Australia and the Far East. It was the brainchild of businessman and entrepreneur John Pender, who had made a small fortune from the Atlantic cable of 1866. This was the start of the Eastern Telegraph Company's (later, Cable and Wireless) great network. Other cables were landed at Porthcurno until there were 14 linking Britain with her Empire and became the largest cable station in the world. Messages were sent in cable-code, a type of Morse which was sent by hand in the early years and received as flickering spots of light or wavering ink lines on paper tape.

The cable station's code name 'PK' is an abbreviation derived from the old name Porth Kernow or 'port of Cornwall'. It formed the link in well over 100,000 miles of cable. ETC owned 40,000 miles of cable, but other companies used Porthcurno, such as the Eastern Extension Co (24,340 miles) to India and China etc, the Western Telegraph Co, to South America, the Eastern and South Africa Co. around Africa. and the PQ cable a link across the Channel to Brest and thence to Nova Scotia (a white pyramid beside the coastal footpath now marks where this cable came ashore and up the cliff). At the back of the beach is the old cable hut which received many cables. At least 21 old cables and pieces of abandoned shore ends lie buried beneath the sand.

The telegraph network was of strategic importance in wartime. Wireless signals could be intercepted but cables were secure from eavesdropping. British cableships cut enemy cables in both world wars, which is how a German Atlantic cable was 'stolen' and diverted into Mousehole and then Porthcurno. In World War II Cornish tin-miners were employed to blast tunnels out of the granite hillside at Porthcurno and the station was moved underground, complete with its own power station and blast-proof doors. The station finally closed in 1970 following a century of service.

In the 1980s David Kendall-Carpenter of the Cable & Wireless College could see the 'end of an era' for the old cable telegraphy which had linked Britain with the world for so long. His foresight resulted in the saving of a unique collection of beautiful brass and mahogany instruments dating from the pioneering years of submarine telegraphy.

Cable & Wireless removed its training college from Porthcurno to Coventry in 1993 and with the move came the danger of this link with Cornwall's role in cable communications disappearing. A re-located museum would lose the historic context of Porthcurno with its Victorian and wartime associations and the Trevithick Trust was therefore anxious that the collection should remain at Porthcurno. This was supported by Cable & Wireless who still own the site and happily the new tenants of Porthcurno did not require the use of the north tunnel. A feasibility study was commissioned by Cornwall County Council and it was agreed to try to keep the museum at Porthcurno and open it as an all-weather attraction for visitors. With the help of the Trevithick Trust, meetings were held and 20 former Cable & Wireless staff showed interest in the preparations for public opening. Some of the superb brass and mahogany instruments needed repairing, walls redecorating, demonstration tables wiring, etc.

Inside the Porthcurno ('PK') telegraph station, c1952 Photo: The Trevithick Trust

Much of the value of the collection lies in its completeness. Not only do we have early ink recorders, but we also still have stocks of glass siphons, the siphon-grinding jigs, the beeswax and silken cords to mount them, the ink and paper slip. There are examples of submarine cables, as well as cableship reports, cable repair kits, early cable charts, cable test sets, and more.

Porthcurno is part of the history of submarine cables. Many of the methods used to locate faults on cables had their origins in experiments made here in the last century. Three cables which still terminate in the museum demonstrate various earth currents, stray polarisation effects and other classic problems associated with fault location, while regenerator equipment developed by the ETC in the 1920s to boost signals on long cables forms a chapter in the development of today's computerised digital networks.

The collection is not just electrical equipment. There are hand-written logs, photographs and social history memorabilia of all kinds, and a 24-ft scale model of a cable laying ship. There is also a small vintage wireless collection and some interesting associations with industrial espionage circa 1901!

Britain's Empire-spanning Victorian cable network had a social, political and commercial significance equal to the development of the railways. Yet almost nothing remains except miles of rusting cables at the bottom of the oceans of the world – and this one collection at Porthcurno. The potential educational value of the collection is wide. Unusual and memorable demonstrations of electricity and magnetism can reinforce Physical Science aims in the National Curriculum. Geographical and social aspects of life in Cornwall and on remote telegraph relay stations around the Empire vividly illustrate aspects of Victorian life, and the World War connections are obvious.

The museum was opened for guided tours in the summer of 1994, and work continues to improve the site. Summer opening days are still limited, so potential visitors are advised to check first with the Trevithick Trust, ☎ 01209 612142. ❑

The Cornish seaside: bringing a submarine cable ashore at Porthcurno beach, c1952 Photo: The Trevithick Trust