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ENGINEERS' WALK IN BRISTOL (Blue Plaques) - Part 2

by John Coneybeare

Part 1 gave mini biographies of eight engineers with Bristol connections who are celebrated by blue plaques on the walls of the Bristol science museum "We the Curious". This part 2 does the same for another seven engineers, including three who led diverse careers, but worked together on some projects, notably the SS Great Britain. You can read more at engineerswalk.co.uk.

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Isambard Brunel (1806 – 1859)

Isambard's father Marc was a French engineer who fled to New York during the Reign of Terror in 1793. He moved again to Portsmouth, UK. where his invention of a machine to cut wooden pulley blocks for ships was used by the Royal Navy. Isambard was born in Portsmouth but the family soon moved to London. Isambard was ambitious and from 1820 to 1822 he studied engineering in France and on his return, he joined his father's office. In 1824 the Thames Tunnel Company was formed to dig a tunnel under the river from Wapping to Rotherhithe with Marc as Chief Engineer and Isambard working on site. In 1828 the tunnel was flooded; six men were drowned and Isambard suffered serious injuries. Marc spent years raising money to complete the tunnel in 1843.

Isambard Brunel went to Bristol for recuperation where he entered two competitions to build a bridge across the Avon gorge. His suspension bridge design won. Construction was delayed by the Bristol riots of 1831 (Brunel enrolled as a special constable) and the available funds ran out in 1843, with only the towers built. In 1832 Brunel began an association with the Bristol Docks Company which lasted for 15 years and produced many improvements.

In 1833 the Great Western Railway Company was formed (**Thomas Guppy** was a leading Board member and investor) and appointed Brunel as Chief Engineer to build a railway from London to Bristol. It had a broad gauge (7 ft.) and very shallow gradients, both features giving a smoother and faster ride, and was completed in 1841. At one Board meeting Brunel suggested extending the 'line' to New York by steamship. The SS Great Western, a large wooden paddle steamer was built in the Wapping shipyard in Bristol of **William Patterson** in 1837. The 'mother of all modern ships' was the SS Great Britain, built in the Great Western dry dock by Patterson, with Guppy as Construction Manager and Brunel as Consulting Engineer and was launched in 1843.

With assistants and pupils, Brunel built many other railways in the West of England, and in South Wales. A famous experiment was the atmospheric railway at Newton Abbott. A piston located in a tube was pushed along by increasing the air pressure behind and exhausting air in front. The piston was connected to the train through a slot in the tube. The slot was sealed by leather flaps which were momentarily forced open to allow the piston to move along. The flaps had to be kept flexible by the application of tallow. Unfortunately, rats ate the tallow and damaged the leather and the system did not work well. In 1850 Brunel designed displays for the Great Exhibition of 1851. In 1855 he designed a prefabricated hospital which was erected in the Dardanelles during the Crimean War.

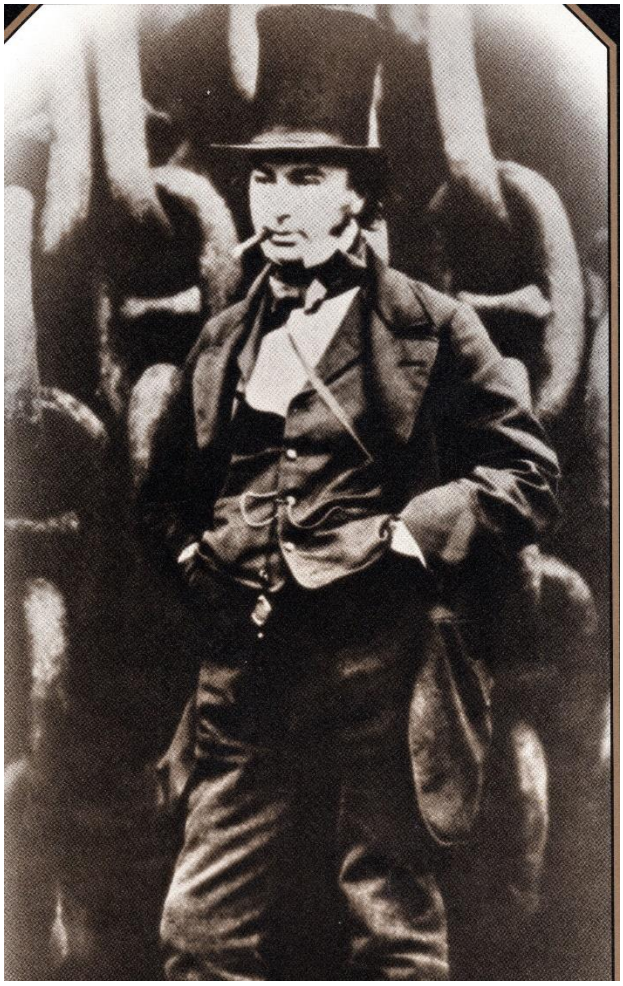

Fig.1 Brunel on the SS Great Eastern

From 1853, despite failing health, Brunel started two more major projects. He designed the SS Great Eastern (22,500 tons) to be built by J Scott Russell at Millwall on the Thames. There were disagreements and a series of mishaps, resulting in deaths, during construction and sea trials. The ship never found a long-term role and was broken up in 1888. He also designed a bridge to cross the river Tamar extending the railway from Plymouth into Cornwall. Sadly, Brunel was too ill to attend the opening of the bridge by Prince Albert in 1859 and died just 4 days later. The Institution of Civil Engineers raised funds and the Clifton Suspension Bridge was completed by John Hawkshaw and William Barlow.

William Patterson (1795 -1869)

Patterson was born in Arbroath in Scotland and his family moved to London. At 15 he was an apprentice and later took charge of William Edwards, Rotherhithe shipyard and in 1822 he built a steam packet for the Post Office. The next year he moved to Bristol and eventually took over the Wapping Yard. Bristol built ships were short, broad and generally able to sit on the bed of a dock or river, i.e. 'Ship shape and Bristol fashion'. Patterson's schooner Velox of 1834 (154 tons) was in the clipper style, longer and narrower, and was much admired. Patterson was acquainted with Brunel and Guppy and built SS Great Western, a wooden paddle steamer designed by Brunel. At 1320 tons, she was two and a half times the weight of any ship built in Bristol before. She failed to be the first steamship to cross the Atlantic by just 3 hours but impressed New Yorkers and started the age of liners.

Fig.2 Patterson's Masterpiece SS Great Britain

Another ship was required to provide a more frequent service. Brunel, Guppy and Patterson all researched the design and construction of SS Great Britain (3270tons) in the Great Western dry dock. She was the first large ship to feature an iron hull, a screw propeller, a

powerful steam engine (1000 horsepower) and a balanced rudder. Completed in 1843 she had to wait for the highest tide of the year to escape Bristol's floating harbour. Carrying emigrants to Australia she made 30 trips around the world. Patterson built many other ships and was recognised as a Naval Architect as well as a builder in 1860. In 1865 Patterson retired and moved to Liverpool.

Thomas Guppy (1797 - 1882)

Mr Maudslay of the famous engineering company, told Guppy the war with France was over, he was ruined, and Guppy should look for other employment. He travelled in America and Europe learning something of engineering and architecture. Back in Bristol he bought and operated a sugar refinery. Then he met Isambard Brunel on College Green. In 1831 they put a bill to Parliament to build the railway from London to Bristol. Later when Brunel suggested building the SS Great Western, Guppy made a tour of shipyards to learn all he could. It was Guppy who patented the idea of a hull having outer and inner skins with watertight compartments between. (This cellular system was adopted by Brunel for the SS Great Eastern).

Fig.3 Guppy's Screw Propeller

Brunel designed the SS Great Britain with flat sides amidships to accommodate paddle wheels. However a small experimental screw propeller ship, called Archimedes, came to Bristol. Guppy made investigations, took several trips and he was convinced of the advantages of screw over paddle wheels. A screw propeller was adopted for the SS Great Britain, but you can still see the flat sections amidships in the hull. Guppy also designed the 1000 HP engine for the ship. In 1844 he became manager of the Cwm Avon Copper Works and in 1846 he erected a rice mill in Dock St. London.

Due to the poor health Guppy accepted an invitation to move to Naples in 1849 to be a consultant. In 1754 he set up his own factory, employing up to 800 people making marine steam engines, paddle wheels and screws for the Italian Navy. He also built mills, pumps, bridges and farm machinery. Unusually for an engineer he erected a number of markets including the elegant market of Florence.

Charles Richardson (1814 - 1896)

Richardson moved to Bristol in 1835 and as a pupil of Brunel he worked on many projects including the Thames Tunnel, the GWR, the Box tunnel, the Bristol to Exeter line and the Clifton Bridge. He was the resident engineer for several railways including Swindon to Cheltenham, Gloucester to Hereford and Bristol to South Wales. The last named involved a ferry boat crossing of the Severn and large transfer piers at New Passage and Portskewitt.

While surveying for the railway on the English side he discovered a source of clay at Cattybrook which was suitable for making high quality bricks. He also studied the Severn at various states of the tide and deduced that the bed of the river was rock across the whole width and could therefore be tunnelled under without fear of collapse. He persuaded Brunel that a tunnel was viable but Parliamentary Approval was not forthcoming. Richardson took time out, invented the sprung handled cricket bat and a bowling catapult and got married at the age of 40.

Eventually the Directors of GWR saw merit in a tunnel and Royal Assent was given in 1871. Richardson was appointed resident engineer for the project with John Hawkshaw consultant. The greater part of the pilot tunnel

was excavated from the Welsh side. Richardson devised a method of ensuring the the tunnel would align with the short length to be excavated from the English side. There was only 138 yards remaining to be excavated when disaster struck. The whole workings on the Welsh side were flooded, NOT from the Severn but from a stream well away from the Severn. The Board of GWR took fright and appointed Hawkshaw in charge with Richardson to assist him. A pumping station was built on the Welsh side to remove the flood water, a function that it still serves. The tunnel was completed in 1885. It was lined with bricks from the Cattybrook Brickworks.

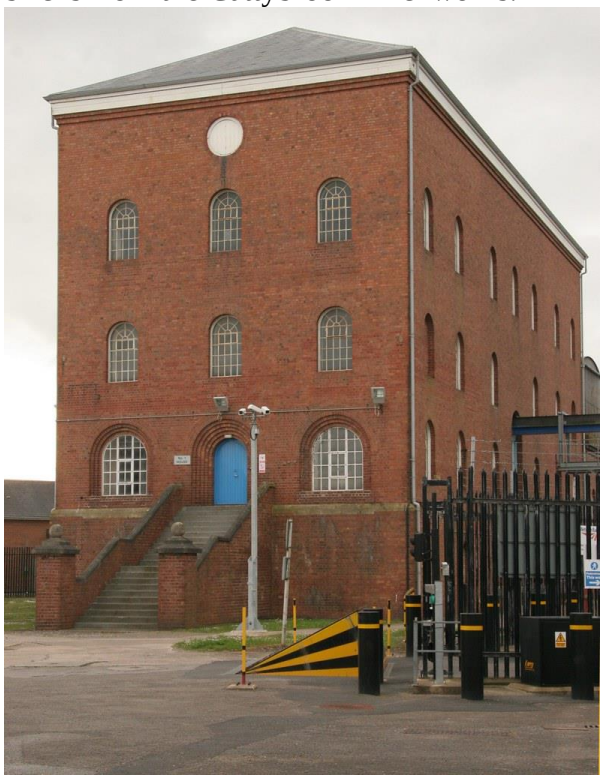

Fig.4 Pumping Station on the Welsh side

Don Cameron (born 1939)

Cameron did aeronautical engineering at Glasgow University and Cornell University in the USA and worked at the Bristol Aeroplane Company. With friends he built Bristol Belle hot air balloon in 1967 and then a series of 10 balloons for Omega Balloons. He founded Cameron Balloons in 1970 and made many first flights over the next two decades. In 1976 the Vice President of the USA presented the Harmon Trophy to him, which had such auspicious winners as Charles Lindburgh and Neil Armstrong.

Many advances were made in the design and safety of hot air balloons, building his company into the largest balloon manufacturer in the world. The envelope panels are made of woven ripstop nylon. This was coated with Teflon to improve the run off of water and delay chemical and biological decay. For rapid descent the valve at the top can be withdrawn completely and the mouth of the envelope is aerodynamically designed to stay open to avoid collapse of the balloon. The frames which support the burners and the basket have articulated joints to absorb shock on heavy landings. To reduce noise, 'whisper' burners are used to provide 80% of the burner output.

Cameron has designed over 400 special shape balloons such as Bertie Bassett and Fantasia Castle. They are all built entirely of fabric, with no solid devices to keep them in shape. In 1972 Cameron designed the world's first hot airship, driven by a small engine and propeller. In 1982 he developed the world's smallest man carrying helium airship.

Fig.5 A Cameron Balloon

However, Cameron's finest achievement was leading the design team of the R650 Breitling Orbiter 3 for the 1999 round the world challenge. The main lift was provided by a helium filled ballonet surmounted by another small helium ballonet to act as a blanket smoothing the temperature of the main ballonet between day and night. To provide height control there was a hot air envelope underneath. The two-man crew, Bernard Picard and Brian Jones were housed in a Kevlar and carbon fibre capsule with the controls and their provisions. They took off from Switzerland and travelled south west at first, picking up a jet stream over North Africa which carried them eastward around world and on further to Egypt. This was the longest unrefuelled flight in history, in distance (40,813 km.) and duration (19 days 22 hours).

I am indebted to Don Cameron and his daughter Hannah for providing me with the information above, free of copyright.

John McAdam (1756 - 1836)

The Romans left Britain with a basic road system, but this was subsequently neglected. By the end of the 17th. Century, the first turnpike trusts were set up to sort out the mess.

McAdam was the son of a minor Scottish Laird and had three careers preceding his fame as a road builder. He was Secretary of the Chamber of Commerce in New York at just 18. Back in Scotland he had a part in his family's coke and tar business. Significantly he was made a trustee of Ayrshire Turnpike. In Bristol from 1798 he was a government agent victualling navy ships and selling naval prizes of war and had other private business interests.

Among several Civic honours he was also made trustee of the Bristol Turnpike which became his main interest for many years. Most trusts had no technical ability and simply heaped stones of all sizes in the middle of the road, sometimes with clay or other materials in the hope of binding the stones. McAdam's method used small stones which had to pass through a 2 inch ring. The surface was compressed by heavy rollers until it was impervious to water. Mc Adam recommended a camber of 1 inch per yard for surface water to run off.

Fig.6 John McAdam – picture by unknown artist from WJ Reader's book "MACADAM"

McAdam also constructed the Bridge Valley Road, which descends 70 yards down the side of the Avon Gorge and is still a major road in Bristol. McAdam made reports and recommendations to the Government on reorganisation of the industry. Between them his three sons were trustees of over 100 turnpikes and the method was adopted throughout the world.

Sylvanus P Thompson (1851-1912)
Sylvanus Thompson was well-known in electrical circles as he wrote numerous books on Electricity, acted as a consultant and spent much of his life setting up further education facilities for those not able to go to Universities in his day.

He was born in York in 1851 into a Quaker family and obtained a BA at the age of 19. His first job was teaching, but then got a bursary at the Royal School of Mines (RSM) at South Kensington obtaining a BSc and stayed working at the RSM. In 1877 he took up the post of Lectureship in Physics at Bristol University College, the forerunner of University of Bristol. He obtained a doctorate and was given the Chair of Physics. He got married to Jane Henderson from Glasgow and he bought a house in Clifton. His most noteworthy book was on "Dynamo Electric Machinery", which contributed to him being elected to be a member of the Society of Telegraph and Electricians, the forerunner of the Institution of Electrical Engineers (IEE, now the IET).

Fig.7 Sylvanus P Thompson

After 8 years he moved to London as Director of the Finsbury Technical College, the first Technical college of its kind in the country. The Governors of the College allowed him do outside consultancy work and one of these was for WD & HO Wills of Bristol for their tobacco factory then at Redcliffe Street. The recommended an installation in May 1886, before Bristol had public supplies, included two Edison/Hopkinson dynamos (i.e. DC system) supplying 700 Swan filament lamps of 6 & 20cp.

In the next 30 years Thompson's researches were prolific in the fields of electricity, magnetism and optics, producing over 100 papers to Physical Society and many text books. He became President of the IEE. He was honoured in so many ways, such as being elected to the Royal Society in 1891 and made a Freeman of the City of London in 1899. Being an enthusiast of Optics, he became President of the Optics Society when it was formed, presiding over a major convention in London in 1912 and died a few years later in 1916 at the age of 65.

Picture Acknowledgments

Fig.1 Isambard Kingdom Brunel Standing Before the Launching Chains of the Great Eastern - by Robert Howlett, licensed CC0 1.0

Fig.2 SS Great Britain - WPEHS

Fig.3 Guppy's Screw Propeller - WPEHS

Fig.4 Brunel's Sudbrook Pumping Station - by kitmasterbloke, licensed CC BY 2.0

Fig.5 A Cameron Balloon "Star of the Show"- by Caro's Lines, licensed CC BY-NC-SA 2.0

Fig.6 John Macadam Painting by unknown artist - by Stephencdickson, licensed CC BY-SA 4.0

Fig.7 Sylvanus P Thompson - His picture Engineers Walk C/R