Isambard Kingdom Brunel (1806-1859)

Introduction

In understanding the man and his contribution it is important to emphasise the guiding hand of his father Marc and enormous influence. With his Royalist sympathies Marc left France at the height of the Revolution after meeting the English Sophia, his future wife. He obtained a passage to New York where he became involved in canal routes and construction projects and met George Spencer, First Lord of the Admiralty. Being an earl too this connections enabled emigration to England in 1799. Marc made his name by creating a system to manufacture rigging blocks for the Royal Navy based in Portsmouth where Isambard was born in 1806.

Isambard was taught mathematics and geometry by his father at an early age before school education at Hove and Chelsea where the curriculum broadened to include Latin, Greek and modern languages. Mace encouraged his son to draw and use an Engineer's Alphabet he developed to observe, measure and record systematically to ensure neat precision. When 14 Isambard attended the famed Lyceé Henri-Quatre to study mathematics and science-based subjects, returning in 1822 on his father's release from the local Debtors' Prison. Highly adept at innovation and design, Marc lacked any real business acumen. Horrified by the footwear of soldiers in the Battle of Corunna in 1812, he patented and produced wellington boots but was not paid by the Government. It is unclear if any contract existed, or any promise of one, but historian Adrian Vaughan says his boots were worn at Waterloo. Unable to settle sizeable debts, prison beckoned. This was a fate not uncommon at the time as Charles Dicken's father would testify. The Duke of Wellington stepped in and paid the debt of £5,000 for his release, the proviso being Marc stayed in Britain. He well understood Marc's contribution, not only in producing these boots, but rigging blocks for the Royal Navy. He was a national asset.

This was the era of canal mania and building roads and soon came the railways. All projects were privately funded, involving share capital and private bills submitted to Parliament. This meant consulting all landowners and getting their approval and seeking finance via banks and those willing to invest. Civil engineers saw themselves of a higher status than professionals such as solicitors with a need to build an image, especially to attract substantial funding and patronage to experiment and engage in public works. For Isambard this was his opportunity. Being extremely ambitious, confident and persuasive he saw himself as the leading industrial engineer of his time.

The Thames Tunnel

A BBC archive shows advanced techniques and the high quality of construction. The legacy of Marc Brunel continued as the Thames Tunnel built between 1825 and 1843 forms part of the £1bn East London Railway Line, running between Rotherhithe and Wapping. Marc employed his son Isambard, aged just 19, as resident engineer. It was their first job together, the first tunnel anywhere through soft ground under water, and the oldest tunnel on the present London Underground.

"Victorian brickwork, particularly the early brickwork, was of a tremendous standard," stated Barrie Noble, construction manager for Transport for London, who worked on the building of the new railway. Brunel invented a tunnelling shield as a way of dealing with the waterlogged soft ground beneath the Thames - a cast iron structure that moved forward as the ground was cut, with bricklayers constructing the double tunnel behind. It was, said Mr Noble, "a long way before its time". With no giant cutting tools, it meant 36 miners, each in his own cell, removing oak planks one at a time to cut the soil behind to a depth of four inches. Poor ventilation was compounded by the geology. Workers had to deal with sudden ignitions of marsh gas and constant inflows of water, including five major floods, in the worst of which Isambard Brunel nearly died. Seven men drowned during the digging.

"Here - almost by accident - Brunel stumbled on how you build mass urban transport," said Robert Hulse, director of the Brunel Museum in the old pump engine house at Rotherhithe. Inventing systems of mass transportation was not Brunel's intention. Conceived in the pre-railway age, the tunnel was meant to provide a route under the river for cargoes which had been landed on the wrong bank. On its first day of opening 50,000 people walked through the tunnel, which was hailed as one of the new wonders of the world, and a million visits were chalked up in the first 15 weeks. The novelty soon wore off, and after 20 years of precarious existence as an underwater shopping arcade and a venue for tightrope walkers and sword swallowers, it was sold in 1869. It became a railway tunnel before being electrified, becoming part of Underground system in 1913.

The arches for the Kingsland Viaduct, built in 1862, have joints to the new brickwork, added when they were widened in 1872. "All of those joints were totally watertight. We never found any that leaked. The standard of workmanship is incredible," said Noble. In one set of arches, an attempt was made to inject grout into the brickwork to fill voids which engineers thought must have developed. "There was very little flow - and we were astounded because these are so old we thought they'd be falling apart. We just couldn't understand, so we did intrusive investigations: we took out bricks and we actually did radar surveys." Of the five levels of brickwork, only the first, exposed to the elements, had deteriorated to any extent.

Personal Achievements and Failures

Isambard is famed for the Clifton Suspension Bridge over the Avon Gorge in Bristol. In 1829 the timing was right as money was put up by a prominent Bristol merchant. A competition was held and he put in several designs, all for very long spans. In came Thomas Telford, the grand old man of engineering, who referred to the length of the Menai Suspension Bridge at 597 feet, the longest span he felt achievable, whereas Brunel proposed 900 feet. All spans of greater length were rejected, leaving Telford to design his own but this proved impractical. A second competition was held with Isambard Kingdom Brunel the winner but the price was a compromise with Telford and his original design was modified.

The next major project was the Great Western Railway in 1833 following the first passenger rail system from Liverpool to Manchester in 1830. His aim was for passengers to purchase just one ticket from Paddington to New York, travelling by ship from a rail terminus in West Wales. The intention was not to follow George Stephenson but start from first scientific principles and

reinvent a new railway system to maximise speed, comfort and efficiency. This led to his broad gauge system for the proposed route from Bristol to London. A battle of the gauges ensured. Broad gauge was problematic in design as various faults arose, especially in design of the track that did not match an expanding national rail network using a standard guage. Shareholders were critical of what they thought was a wild project even though journey times were quicker. The Guage Act of 1846 was decisive in siding with a standard gauge network for all but extensions to existing lines using broad gauge. The combative Brunel was not helped by his inclination to make all decisions, unlike George Stephenson who delegated to Robert his son and others. Locomotion design was soon taken out of Brunel's hands.

Railways historian Adrian Vaughan describes the GWR route an "invisible masterpiece" and work of a genius with his wonderful eye for topography and strategic ability in mapping the future network. H avoided turnpike roads and Marlborough which would rule out branch lines spurring off to Wales and the North of England. Nothing could be built without Parliamentary approval for a project estimated at almost £3m. Apart from raising capital, objections had to be overcome from landowners and those owning bridges. Brunel's evidence lasted 11 days, delivered with more than Gallic charm. Says Simon Shaffer, "If you look at journalists' reports about Brunel's speeches, it's obvious that he was a pretty impressive and compelling speaker." The House of Lords threw out the bill. Undaunted, Brunel appeased objectors with meticulous calculations with Euston the terminus rather than densely populated and wealthy Brompton. The bill received Royal Assent on 31st August 1835. The first section from London of 24 miles was completed in May 1838 with the Bristol to London line opening in June 1841. Known as 'Brunel's billiard table' the cost had more than doubled to £6.5m. The Euston terminus was to be temporary and in 1854 Paddington opened to connect to Bristol Temple Meads.

Brunel turned his attention to developing what he called an atmospheric railway from Exeter to Plymouth using vacuum traction to increase efficiency and reduce running costs. The train ran at 68 mph. Pumping stations were sited at two mile intervals with air sucked from pipes installed along the route. The system proved unreliable and costly and Brunel called a halt. GWR financial accounts for 1848 show a running cost of 3s 1p per miles compared with 1s 4p for steam power, well over double. The project was never going to be viable.

The feasibility of a transatlantic crossing by steam ship was questioned but Thomas Guppy was prepared to back the idea. Steam was the new technology with the prospect of a much faster and reliable crossing with a timetable. The First Great Western, the longest ship in the world at 72m, was unusual in design. The intention was to minimise air resistance using paddle wheels with four sails fitted too for stability and economy. Size did matter as Andrew Lambert explains. A small ship carries disproportionately more coal as it uses more, relative to volume. It was he says the ultimate status symbol; the Concorde of its day. The ship left Avonmouth on its maiden voyage on 8th April 1838, bound for New York. This was a few days later than intended due to a small fire on the final fitting out; a crucial delay as the Sirius arrived a day ahead to claim the title as the first steam ship to cross the Atlantic, albeit given four days head start from Cork, a shorter journey than from Bristol. In the eight years to 1846 a total of 64 crossings were made with the Great Western holding the Blue Riband for the fastest westbound voyage of 13 days and slightly less for the eastbound crossing too.

Brunel was convinced that propeller driven ships were better than paddle wheels and these were incorporated into the Great Britain, launched by Prince Albert on 19th July 1843.. This was considered to be the most modern ship ever built using metal rather than wood, complete with an engine and the propellor system. In 1846 the Great Britain ran aground off County Down, bankrupting investors. Whilst Brunel was criticized, most blame attached to inaccurate charts but the screw propellor system came under scrutiny too. After salvage the Great Britain sailed to and from Australia and now resides at Bristol quayside.

In 1852 Brunel turned to his third ship, The Great Eastern. This was the largest of all with the intention of sailing between England, India and Australia. Called a Leviathan by many it was 700 ft long, luxuriously equipped and capable of carrying 4,000 passengers. It was designed to cruise non-stop from London to Sydney on its regular runs and, amazingly, back again with no need to refuel. The ship soon ran over budget and behind schedule in the face of a series of technical problems. Although called a white-elephant there is a strong argument to say that Brunel was ahead of his time. Construction required advanced engineering solutions in its manufacture and several decades would elapse before transatlantic crossings were made using similar technology. A role was found later for the Great Eastern in oceanic cable laying.

In 1855 Brunel accepted the task of designing and making a pre-fabricated field hospital to be shipped to the Crimea. Within five months he had completed the project. The sections were transported to Gloucester Docks in 16 ships for Scutari where the assembled building was called Renkloi Hospital. At the instigation of Florence Nightingale the design incorporated specific hygiene, ventilation and sanitation features and drainage too and was to house up to 1300 men. Whist highly successful in hospital care and in reducing death rates, it illustrated the inability of Brunel to resist a challenge with this project coming at an awkward time with his construction of the Great Eastern, let alone numerous other projects in hand.

A Retrospective of Brunel's Contribution

Isambard Kingdom Brunel was admitted as a Fellow of the Royal Society in 1830 and, after marrying Mary Horsley in 1836, lived in Duke Street, just off Oxford Street. Diagnosed with Bright's Disease in his early fifties he suffered a catastrophic stroke on 15 September 1859. He died aged 53, just before the Great Eastern made her first voyage to New York. A quiet funeral was held with burial in the family plot in Kelsal Green Cemetery. Four weeks later Robert Stephenson was dead, aged 56. In contrast, Robert Stephenson was buried in Westminster Abbey, next to Thomas Telford. Brunel's obituary in The Times set out all his faults whilst Robert Stephenson was given a glittering tribute.

In *Men of Iron* author Sally Dugan talks of friendship but perhaps mutual professional respect and admiration is nearer the mark. Competition was fierce but neither openly criticized the other. Whilst Brunel located in Duke Street, off Oxford Street, Stephenson set up in Great George Street, opposite the House of Commons. It was a wise move as he became MP for Whitby in 1847 at the height of the railway boom. His biographer Samuel Smiles said it gave him the aura of a secretary of state, with ready access given the volume of legislation gong through Parliament.

Apart from an extraordinary capacity for inventions, technical design and imagination, Brunel is remembered best in Swindon where he chose to locate the GWR sheds. Apart from worker housing he was instrumental in helping to build community infrastructure of a hospital, clinics, churches and a Mechanics Institute. Widely regarded as an engineering genius, Brunel did not live to see completion of the Clifton Suspension Bridge that opened in 1864.

For Andrew Lambert the GWR is still the best railway in England and was used for the Intercity 125 high speed trials. "He makes something that catches the imagination and opens people's eyes and gives them a new way of thinking about the world. Robert Stephenson gets them to work on time." Flair, style and revolutionary design contrasted with engineering pragmatism.

A testimony to Brunel's life and approach to his work is best summed up by Kenneth Clark in the landmark book, Civilization: "He remained all his life in love with the impossible." The final observation belongs to Brunel 200 which was set up to celebrate his bi-centenary and legacy that remains an inspiration. "He successfully applied his considerable knowledge and limitless imagination to the new opportunities offered by a technologically advancing age, opening up the world of global travel and communications, and to making great leaps forward in the development of all aspects of engineering. It was this that contributed to Britain's unrivalled international standing in the latter half of the nineteenth century."

Brunel 200 reflects the views of many historians in saying, "Despite his achievements, Brunel was often faced with disappointment and his early death could be partly attributed to the stress of taking on such huge commitments. He serves as an example of the advantages and dangers of brilliant, driven people taking full responsibility for every phase of their projects. A closer examination of his work also reveals the hidden costs of such fierce ambition in the lives of workers killed on the job and financial ruin of some of his backers. This was part of the price of the Industrial Revolution and being the workshop of the world."

"Brunel's significance today is two-fold. First, there is his lasting engineering legacy, visible in the bridges, tunnels, viaducts, buildings and rail routes he left behind. Second, is the example he set for the engineers and innovators who followed him and who are inspired to translate creative thought into action. Brunel 200 continues to celebrate those following in Brunel's footsteps and to inspire the Brunels of the future."

****

References

Men of Iron by Sally Dugan (2004) Channel Four Books

The Thames Tunnel: extracts: BBC News 19.09.2007 – Trevor Timpson

In Our Time – BBC Radio 4: 13 November 2014

Brunel 200: www.brunel200.com

Wikipedia

History TV: www.history.co.uk