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George Stephenson

- June 9, 1781 - August 12, 1848

George Stephenson (9 June 1781 - 12 August 1848) was an English civil engineer and mechanical engineer who built the first public railway line in the world to use steam locomotives, and he is renowned as being the "Father of Railways". His rail gauge of 4 feet 8½ inches (1,435 mm), sometimes called "Stephenson gauge", is the world's standard gauge.

George Stephenson was born in Wylam, Northumberland, 9.3 miles (15.0 km) west of Newcastle upon Tyne. He was the second child of Robert and Mabel, and neither of them could read or write. Robert was the fireman for Wylam Colliery pumping engine, earning a low wage, so there was no money for schooling. At 17, Stephenson became an engineman at Water Row Pit, Newburn. George realised the value of education and paid to study at night school to learn reading, writing and arithmetic. In 1801 he began work at Black Callerton colliery as a 'brakesman', controlling the winding gear of the pit. In 1802 he married Frances (Fanny) Henderson and moved to Willington Quay, east of Newcastle. There he worked as a brakesman while they lived in one room of a cottage. George made shoes and mended clocks to supplement his income.

In 1803 their son Robert was born, and in 1804 they moved to West Moor, near Killingworth while George worked as a brakesman at Killingworth pit. His wife gave birth to a daughter, who died after a few weeks, and in 1806 Fanny died of consumption (tuberculosis). George, then decided to find work in Scotland, and he left Robert with a local woman while he went to work in Montrose. After a few months he returned, probably because his father was blinded in a mining accident. George moved back into his cottage at West Moor and his unmarried sister Eleanor moved in to look after Robert. In 1811 the pumping engine at High Pit, Killingworth was not working properly and Stephenson offered to fix it. He did so with such success that he was soon promoted to engine wright for the neighbouring collieries at Killingworth, responsible for maintaining and repairing all of the colliery engines. He soon became an expert in steam-driven machinery.

The miners' safety lamp

In 1818, aware of the explosions often caused in mines by naked flames, Stephenson began to experiment with a safety lamp that would burn without causing an explosion. At the same time, Sir Humphry Davy, the eminent scientist was looking at the problem himself. Despite his lack of any scientific knowledge, Stephenson, by trial and error, devised a lamp in which the air entered via tiny holes. Stephenson demonstrated the lamp himself to two witnesses by taking it down Killingworth colliery and holding it directly in front of a fissure from which fire damp was issuing. This was a month before Davy presented his design to the Royal Society. The two designs differed in that, the Davy's lamp was surrounded by a screen of gauze, whereas Stephenson's lamp was contained in a glass cylinder.

For his invention Davy was awarded £2,000, whilst Stephenson was accused of stealing the idea from Davy. A local committee of enquiry exonerated Stephenson, proved that he had been working separately and awarded him £1,000 but Davy and his supporters refused to accept this. They could not see how an uneducated man such as Stephenson could come up with the solution that he had. In 1833 a House of Commons committee found that Stephenson had equal claim to having invented the safety lamp. Davy went to his grave believing that Stephenson had stolen his idea. The Stephenson lamp was used exclusively in the North East, whereas the Davy lamp was used everywhere else.

Early locomotives

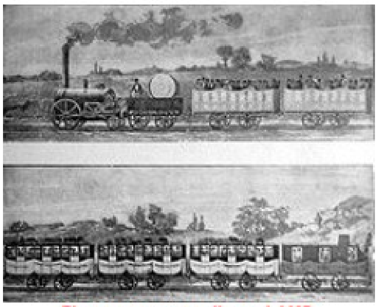
Richard Trevithick is credited with the first realistic design of the steam locomotive in 1804. Later, he visited Tyneside and built an engine there for a mine-owner. Several local men were inspired by this, and designed engines of their own. Stephenson designed his first locomotive in 1814, a travelling engine designed for hauling coal on the Killingworth wagonway, and named Blücher after the Prussian general Gebhard Leberecht von *Blücher*. It was constructed in the colliery workshop behind Stephenson's home, Dial Cottage, in Lime Road. This locomotive could haul 30 tons of coal up a hill at 4 mph (6.4 km/h), and was the first successful flanged-wheel adhesion locomotive: its traction depended only on the contact between its flanged wheels and the rail.

Stephenson's Rocket

A six-wheeled locomotive was built for the Kilmarnock and Troon Railway in 1817 but it was soon withdrawn from service because of damage to the cast iron rails. **http://en.wikipedia.org/wiki/George_Stephenson** - cite_note-3 A further locomotive was supplied to Scott's Pit railroad at Llansamlet, near Swansea in 1819 but it too was soon withdrawn, apparently because it was under-boilered and also because of damage to the track. The new engines were too heavy to be run on wooden rails, and iron rails were in their infancy, with cast iron exhibiting excessive brittleness. Together with William Losh, Stephenson improved the design of cast iron rails to reduce breakage. According to Rolt, he also managed to solve the problem caused by the weight of the engine upon these primitive rails. He experimented with a 'steam spring' (to 'cushion' the weight using steam pressure), but soon followed the new practice of 'distributing' weight by utilising a number of wheels. For the Stockton and Darlington Railway, however, Stephenson would use only wrought iron rails, notwithstanding the financial loss he would suffer from not using his own, patented design. Stephenson was hired to build an 8-mile (13-km) railway from Hetton colliery to Sunderland in 1820. The finished result used a combination of gravity on downward inclines and locomotives for level and upward stretches. It was the first railway using no animal power.

Stockton and Darlington Railway

In 1821, a parliamentary bill was passed to allow the building of the Stockton and Darlington Railway (S&DR). The 25-mile (40 km) railway was intended to connect various collieries situated near Bishop Auckland to the River Tees at Stockton, passing through Darlington on the way. The original plan was to use horses to draw coal carts on metal rails, but after company director Edward Pease met Stephenson he agreed to change the plans. Stephenson surveyed the line in 1821, assisted by his eighteen-year-old son Robert. That same year construction of the line began.


First passenger railway, L&MR

A manufacturer was now needed to provide the locomotives for the new line. As it turned out, Pease and Stephenson jointly established a company in Newcastle to manufacture locomotives. The company was set up as Robert Stephenson and Company, and George's son Robert was the managing director. A fourth partner was Michael Longridge of Bedlington Ironworks. In September 1825 the works at Forth Street, Newcastle completed the first locomotive for the new railway: originally named Active, it was soon renamed Locomotion. It was followed by "Hope", "Diligence" and "Black Diamond". The Stockton and Darlington Railway opened on 27 September 1825. Driven by Stephenson, Locomotion hauled an 80-ton load of coal and flour nine miles (15 km) in two hours, reaching a speed of 24 miles per hour (39 km/h) on one stretch. The first purpose-built passenger car, dubbed Experiment, was attached, and carried dignitaries on the opening journey. It was the first time passenger traffic had been run on a steam locomotive railway.

The rails used for the new line were wrought-iron ones, produced by John Birkinshaw at the Bedlington Ironworks. Wrought-iron rails could be produced in much longer lengths than the cast-iron ones and were much less liable to crack under the weight of heavy locomotives. William Losh of Walker Ironworks had thought that he had an agreement with Stephenson to use his cast-iron rails, and Stephenson's decision caused a permanent rift between the two men. The gauge that Stephenson chose for the line was 4 feet 8½ inches (1,435 mm), and this subsequently came to be adopted as the standard gauge for railways, not only in Britain, but also throughout the world.

Liverpool and Manchester Railway

While building the Stockton and Darlington Railway, Stephenson had noticed that even small inclines greatly reduced the speed of locomotives (and slight declines would have made the primitive brakes nearly useless). He came to the conclusion that railways should be kept as level as possible. He used this knowledge while working on the Bolton and Leigh Railway, and the Liverpool and Manchester Railway (L&MR), executing a series of difficult cuts, embankments and stone viaducts to smooth the route the railways took. Defective surveying of the original route of the L&MR caused by the hostility of some of the affected landowners meant that Stephenson encountered difficulty during Parliamentary scrutiny of the original bill, especially under cross-examination by Edward Hall Alderson. The Bill was rejected. A revised bill with a new alignment was submitted and passed in a subsequent session. The revised alignment presented a considerable problem: the crossing of Chat Moss, an apparently bottomless peat bog, which Stephenson eventually overcame by unusual means, effectively floating the line across it.


Statue of George Stephenson at the National Railway Museum, York

The method he used was almost exactly the same as that used by John Metcalf during his construction of many miles of road through marshes in the Pennines. He would lay a foundation of heather and branches bound together by the weight of the passing coaches with a layer of stones on top. As the L&MR approached completion in 1829, its directors arranged for a competition to decide who would build its locomotives, and the Rainhill Trials were run in October 1829. Entries could weigh no more than six tons and had to travel along the track for a total distance of 60 miles (97 km). Stephenson's entry was Rocket, and its performance in winning the contest made it famous. George's son Robert had been working in South America from 1824 to 1827 and had returned to run the Forth Street Works while George was living in Liverpool and overseeing the construction of the new line. Robert was very much responsible for the detailed design of Rocket, although he was in constant postal communication with George, who made many suggestions on the design. One significant innovation was the use of a fire-tube boiler, invented by French engineer Marc Seguin that gave improved heat exchange. This was suggested by Henry Booth, the treasurer of the L&MR.

The opening ceremony of the L&MR, on 15 September 1830, was a considerable event, drawing luminaries from the government and industry, including the Prime Minister, the Duke of Wellington. The day started with a procession of eight trains setting out from Liverpool. The parade was led by "Northumbrian" driven by George Stephenson, and included "Phoenix" driven by his son Robert, "North Star" driven by his brother Robert and "Rocket" driven by assistant engineer Joseph Locke. The day was marred by the death of William Huskisson, the Member of Parliament for Liverpool, who was struck and killed by Rocket, but the railway was a resounding success. Stephenson became famous, and was offered the position of chief engineer for a wide variety of other railways.

Stephenson's skew arch bridge

Stephensons Bridge

1830 also saw the grand opening of the skew bridge in Rainhill. The bridge was the first to cross a railway at an angle. This required the structure to be constructed as two flat planes (overlapping in this case by 6') between which the stonework forms a parallelogram shape when viewed from above. This has the effect of flattening the arch and the solution is to lay the bricks forming the arch at an angle to the abutments (the piers on which the arches rest). This technique, which results in a spiral effect in the arch masonry, provides extra strength in the arch to compensate for the angled abutments.

The bridge still carries traffic (A57 - Warrington Road) and is now a listed building.

Later Career

The next ten years were the busiest of Stephenson's life, as he was besieged with requests from railway promoters. Many of the first American railroad builders came to Newcastle to learn from Stephenson, and indeed, the first dozen or so locomotives utilized in the U.S. were purchased from the Stephenson shops. Other talented men were starting to make their marks, such as his son Robert, his pupil Joseph Locke and finally Isambard Kingdom Brunel. Despite Stephenson's losing some routes to competitors due to his caution, he was offered more work than he could cope with, and was unable to decline offers for additional work. He worked on the North Midland line from Derby to Leeds, the York and North Midland line from Normanton to York, the Manchester and Leeds, the Birmingham and Derby, the Sheffield and Rotherham among many others. Stephenson tended to become a reassuring name, rather than a cutting-edge technical adviser. He was the first president of the Institution of Mechanical Engineers on its formation in 1847. He had by this time settled into semi-retirement, supervising his mining interests in Derbyshire - tunnelling work for the North Midland Railway had revealed unworked coal seams, and Stephenson put much of his money into their exploitation.

Legacy

Britain led the world in the development of railways and this acted as a stimulus for the industrial revolution, by facilitating the transport of raw materials and manufactured goods. George Stephenson cannot claim to have invented the locomotive. Richard Trevithick deserves that credit. George Stephenson, with his work on the Stockton and Darlington Railway and the Liverpool and Manchester Railway, paved the way for the railway engineers who were to follow, such as his son Robert, his assistant Joseph Locke who went on to carry out much work on his own account and Isambard Kingdom Brunel. These men were following in his footsteps. Stephenson was also farsighted in realising that the individual lines being built would eventually join together, and would need to have the same gauge. The standard gauge used throughout much of the world is due to him.