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LOCOMOTION

A VISUAL HISTORY OF TRAINS



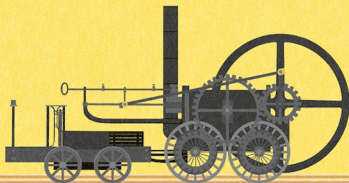
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THE FIRST RAILWAYS

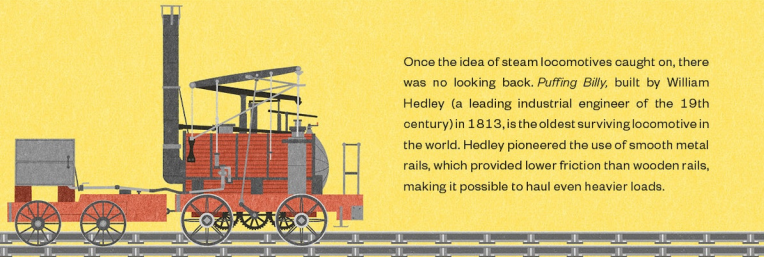
Today, railways are commonplace in many parts of the world. They snake around our coastlines, zip across our countryside and transport goods and millions of passengers every single day. It is strange to think that they have only been around as we know them for about two hundred years.



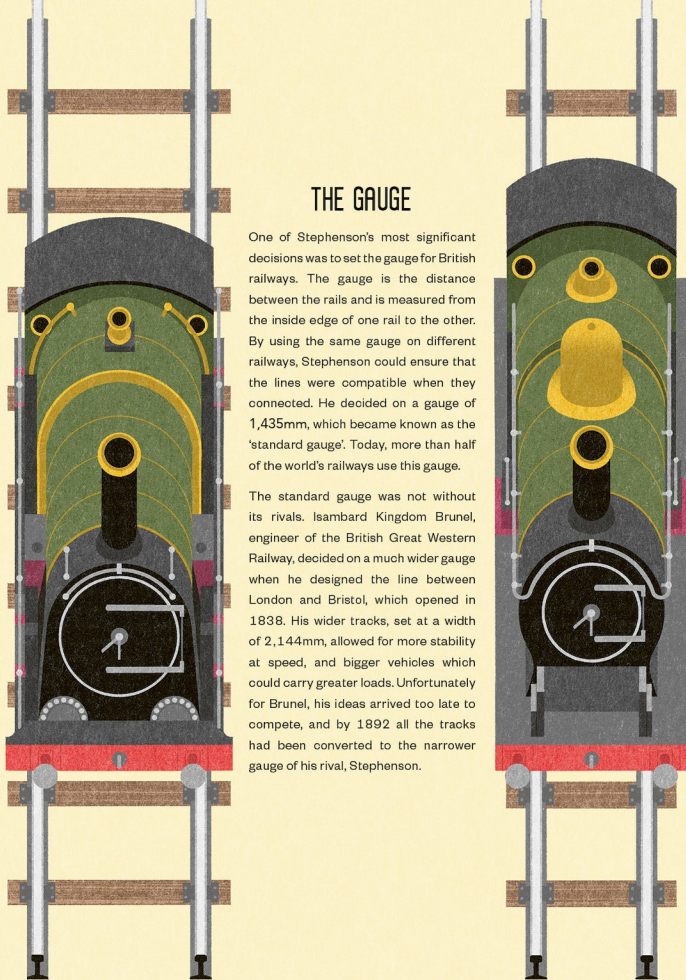
The first steam engines were used in British mines during the 17th century to pump water. It wasn't long before engineers tried using steam power to propel vehicles, and in 1802 the inventor Richard Trevithick built the very first working steam locomotive.



Once the idea of steam locomotives caught on, there was no looking back. *Puffing Billy*, built by William Hedley (a leading industrial engineer of the 19th century) in 1813, is the oldest surviving locomotive in the world. Hedley pioneered the use of smooth metal rails, which provided lower friction than wooden rails, making it possible to haul even heavier loads.



Puffing Billy went on to influence many other engineers. The first public railway to use steam locomotives, the Stockton and Darlington Railway in England, opened in 1825. It was designed by George Stephenson, who went on to be known as the 'Father of Railways' for his influential role in so many early schemes.



THE GAUGE

One of Stephenson's most significant decisions was to set the gauge for British railways. The gauge is the distance between the rails and is measured from the inside edge of one rail to the other. By using the same gauge on different railways, Stephenson could ensure that the lines were compatible when they connected. He decided on a gauge of 1,435mm, which became known as the 'standard gauge'. Today, more than half of the world's railways use this gauge.

The standard gauge was not without its rivals. Isambard Kingdom Brunel, engineer of the British Great Western Railway, decided on a much wider gauge when he designed the line between London and Bristol, which opened in 1838. His wider tracks, set at a width of 2,144mm, allowed for more stability at speed, and bigger vehicles which could carry greater loads. Unfortunately for Brunel, his ideas arrived too late to compete, and by 1892 all the tracks had been converted to the narrower gauge of his rival, Stephenson.

STEAM LOCOMOTIVES

Once the possibility of steam-powered engines had been realised, a whole host of locomotives were tried and tested around the world. Some proved too heavy, others too unreliable and some were even dangerous, but the arrival of one revolutionary design changed the course of history. *Rocket*, designed by engineer Robert Stephenson (George Stephenson's son – see page 8) was to provide the principles of design for the vast majority of steam locomotives that followed.

Heat from the fire passes through the **boiler** via smaller tubes. This heats the water to boiling point, raising the steam pressure.

As the pressure builds, the steam is directed to the **cylinders**. These are controlled by valves, which act like a gearbox in a car. The steam presses down on a **piston** inside the cylinders, moving the wheels via a rod which connects them.

Steam **locomotives** need water and fuel to run. The fuel (usually coal) is burnt in a fire at one end of the boiler in an area known as the **firebox**. To fan the flames, air is channelled in from below to provide the oxygen needed for the fire to burn intensely.

A crucial part of *Rocket's* revolutionary design was its boiler. Multiple tubes ran through it from the fire, which enlarged the surface area and heated the water more easily. A blast pipe was used to send steam from the cylinders into the chimney, helping to pull the hot gases along the tubes. More steam meant more power and increased efficiency. Boilers using tubes and blast pipes like *Rocket* became the standard from this point onwards.

- RAILWAYS OF THE WORLD -

THE FFESTINIOG RAILWAY



The Ffestiniog railway in North Wales is a marvel of 19th century engineering. It was built to transport slate for roof tiles from the quarries around the town of Blaenau Ffestiniog, high up in the mountains of Snowdonia, down to the harbour at Porthmadog. It opened in 1836, using a narrow gauge of 597mm to match the wagons already in use in the quarries.

The original trains were powered by horses, which hauled empty wagons uphill. The designer of the railway, James Spooner, made sure the route was downhill all the way from the quarries, so the loaded wagons could roll down to the harbour. The trains were controlled by brakemen - groups of two or three men who rode on the loaded wagons to control the trains' speed. Only some of the wagons had brakes, which were applied by pulling a lever. With some trains up to one hundred wagons long, the brakemen had to jump between the moving wagons to apply or release the brakes, which was incredibly dangerous.

By the 1860s, the railway was generating so much work carrying slate that the horses couldn't keep up. There was also increasing demand for a passenger service, which meant the railway had to be reworked. The solution was for several small steam engines to be built, which were among the first narrow gauge locomotives in the world. By 1869, there were six working the line, but soon even they began to struggle with the demand.

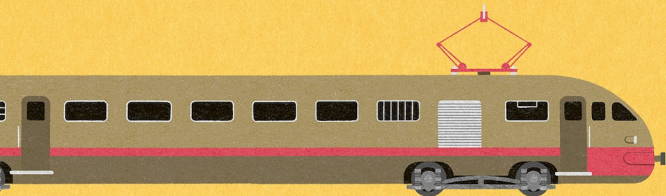
Luckily, a revolutionary idea was presented to the railway that same year. Engineer Robert Francis Fairlie had patented the 'Double Fairlie', an ingenious double-ended locomotive design. This was in effect two locomotives constructed back-to-back and running on a pair of bogies, which saved the expense of having two crews but doubled the power output. The first of these was called *Little Wonder*, and over the next 17 years another three Double Fairlie's were built for the railway. They were so successful that Robert Fairlie allowed the railway to use his patent for free forever, something it continues to do to this day.

ELECTRIC LOCOMOTIVES

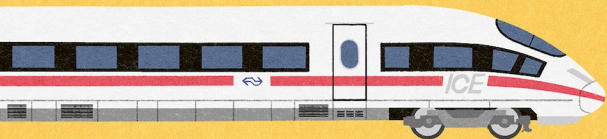
The first electric train was tested as far back as 1837. Unlike steam trains, electric locomotives do not carry fuel on-board. Instead, they are powered by electricity which can be supplied from overhead lines, a third rail or in storage such as batteries. Because electric trains can be powered by renewable energy sources, they are considered less polluting than steam or diesel trains.



The first electric passenger train was presented by Werner von Siemens at an exhibition in Berlin in 1879. Consisting of a small locomotive and three cars, it reached a speed of just 13km/h.



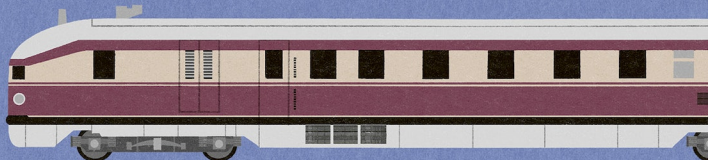
The ETR 200 is a record-breaking electric passenger train. It is widely considered one of the first ever high-speed trains and was put into service in 1936. In 1939, it broke the speed record for trains by reaching just over 201km/h.



The ICE (Intercity Express) is one of Germany's most successful electric trains. The third generation ICE 3, can reach speeds of 300km/h. Since 2018, it has run on entirely **renewable energy** sources.

DIESEL LOCOMOTIVES

In a diesel locomotive, the power comes from an engine that burns diesel oil. While a steam locomotive needed two people to crew it and hours to attain the right steam pressure, a diesel locomotive could simply be switched on and driven away, making them much easier and much cheaper to run. Rudolf Diesel patented his first diesel engine in 1898, but it wasn't until around 1912 that they were first used in a locomotive.



The famous DRG Class SVT 877 Hamburg Flyer, often referred to as the 'Flying Hamburger', was first put into service in 1933. Its smooth, rounded shape was influenced by Zeppelin airships allowing for minimal air resistance.



The Deltic, built in 1956, was considered the most powerful diesel locomotive in the world at that time.



The Intercity 125 is one of the most successful diesel trains of all time. So named because it was designed to cruise at 125 mph (about 201km/h) when in service, it also holds the all-time speed record for diesel trains of 238km/h, which it reached in 1987.