

REPORT OF SOCIETY MEETING

THE EVOLUTION OF PNEUMATIC RAILWAYS AND THE WORLD'S SECOND UNDERGROUND LINE

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Air pressure technology was first tried for railway traction in the 1840s, known as Atmospheric Railways. Examples in Britain include the London & Croydon in 1846 and Brunel's 1847 South Devon Railway in Exeter. The telegraph was also introduced in the 1840s; we can think of it as the Victorian Internet! But this, ironically, led to a new air technology. Telegram messengers were slowed by street congestion between the Telegraph Station and the Stock Exchange, in what was then the largest city in the world. People, carriages, goods wagons, street hawkers, livestock, beggars, greasy pavements; all impeded travel. Everything moved on the narrow streets, much like many Indian cities today.

Engineer J. Latimer Clark designed and installed the first pneumatic message tube in 1853, which became the server hub for the Victorian Internet. This is explored on our sister site, LapsedHistorian.com, in "Get Them on the Blower – London's Lost Pneumatic Messaging Network". But you'd rather hear about railways. New railway termini in the 1850s brought even more people, goods and trade into London; over two million by 1850. This was a great problem for the Post Office, responsible for the communications hub of the vast Empire, with foreign and inland mail, parcels and telegrams. Speed was crucial for commerce and government. Two urban passenger railway technologies were proposed, the underground Metropolitan Railway with steam locos, and the Pneumatic Despatch Company's railway.

The Pneumatic Despatch Company was incorporated in 1859 by Latimer Clark and Thomas Rammell. It proposed air-propelled small railcars, as pistons, in tunnels to carry mail bags and parcels between Government buildings, railway termini and Post Offices. A stationary steam engine turning a reversible fan would create air pressure to blow or suck the cars along. The company was well connected, with board members including close friends of Benjamin Disraeli, William Henry Smith (who ran some railway bookstalls) and Robert Stephenson, although he died shortly thereafter. The Pneumatic Despatch railway was to be the missing connector, the belief being that the government, the Post Office and companies would pay well for a secure, expedited service.

A trial at Battersea Fields used nine-foot-long cast iron pipe segments, made at Staveley Coal and Iron Co. works, where Victoria Line tunnels were later made. The trial was a quarter-mile long with gradients of 1 in 22 to simulate the expected profile underground. The 2ft gauge three-ton cars fitted the tunnel to within an inch all around, with india rubber flanges to make an effective seal. Test runs reached 40 mph with weights simulating mail. Even human passengers were successfully sent through, and the prototype was deemed a success. The tunnel sections and steam pump were later moved from Battersea and laid from the North West District Post Office under Eversholt Street to beneath Platform 1 at Euston Station, one-third of a mile south.

The tunnel was tested from 17 January 1863, with thousands of runs. Following inspection by the Post Office, the first mails were carried on 20 February 1863. Three-car trains carried up to 14 tons of mail at 30mph, more than twice as fast as the 12mph trains on the new Metropolitan Railway that opened the month before. Thirteen trips a day operated, but a much higher frequency was possible. The Post Office was charged a nominal carriage fee to encourage use of the line.

The potential for this new motive power seemed large and hopes were high. Many notables and potential investors made a journey in the cars, including Prince Napoleon. Most of the tunnel was just under the road surface, using cut and cover construction. The tunnel air was cool, clean and fresh even on the hottest summer's day, with no vibration, jolting or dangerous steam or soot. The Times of 10 February 1863 wrote "Between the pneumatic dispatch and the subterranean railway the days ought to be fast approaching when the ponderous goods vans which now ply between station and station shall disappear for ever from the streets of London." Unfortunately, we still have those goods vans today.

Later in 1863 the Pneumatic Despatch Company started concurrent construction of a larger 3ft 8½in narrow gauge line in a 4ft 6in by 4ft 1in tunnel. The Duke of Bedford objected to a direct route across his land, and the line was diverted via Tottenham Court Road. The speaker's daughter calls them sewer tubes, as they were built using brick sewer tunnel design.

Rammell, the engineer, had always intended that pneumatic railways would be scaled up to carry passengers. He deposited a Bill with Parliament for the Oxford Street & City Railway, a pneumatic passenger railway proposed in late 1863 from Marble Arch to Farringdon. It was co-designed with John Fowler, the Metropolitan Railway engineer, presumably to provide convenient transfer to the latter's underground station. It would have run 2.4 miles under Oxford Street, New Oxford Street, High Holborn, Greville Street and Charles Street. It received serious consideration in 1864, but was not approved by Parliament. Recent academic analysis of this and many other proposed lines of the period, in a paper co-written by Antony Badsey-Ellis (author of *London's Lost Tube Schemes*), suggests high costs and a poor benefit ratio.

So Rammell constructed a short passenger pneumatic demonstration line, the Crystal Palace Railway, in 1864. A steam engine drove a giant 22ft diameter fan, and thousands were transported silently and soot free through the 600-yard brick tunnel, with a 1 in 15 gradient plus a sharp turn. The carriage seated 35 with a flange of bristles as an effective seal. It ran between the Penge and Sydenham gates. No trace of this line has since been found, and our speaker thought most materials had probably been reclaimed for further use. However, an audience member suggested that the margins of the park had been sold in the 1870s, and the area was now under housing. Another theory was that the well-known illustration used artistic licence, and the line was really constructed in the manner of the Battersea trial, with the tunnel built in a half-height trench with the soil reused to cover this, leaving little trace upon removal.

The Crystal Palace trial led to Rammell successfully promoting his next pneumatic line, the Waterloo & Whitehall Railway. Parliament approved a pneumatic passenger railway in 1865 between Waterloo station and Great Scotland Yard. A 12ft 9in diameter cut and cover brick tunnel was started from Great Scotland Yard to the Thames, constructed like sewers of the day. A trench was dredged across the River, with four circular brick piers to be lowered into it. Five 200ft prefabricated cast iron tubes would be lowered into the trench and riveted together to form the under-river single tunnel. Each station would have two side tracks and platforms, with three carriages, one standing at each station with the third traveling the tunnel. Rammell planned 15 tph between 07.00 and midnight, each carrying up to 25 passengers in a single four-wheeled carriage, providing for 750 passengers per hour. The Metropolitan Railway ran only every 15 mins but had more carriages, for 38,000 passengers per day or approximately 2,200 per hour.

Returning to the Pneumatic Despatch railway, the second tunnel started from the Arrival Parcels Office of Euston Station. The steam plant was located at the new station in Holborn. One ounce per square inch air pressure gives a tractive force of 900lb, more than enough to produce sufficient speed for a train of 15 tons. This line opened in October 1865, and London's political and business classes turned out at Holborn station to watch the first mail bags arrive from Euston. With this opening and the Waterloo & Whitehall under construction, pneumatic railways looked like 'The Next Big Thing'.

Unfortunately, London has had a history of banking failures over the years, and one in 1866 caused a large financial crisis. This had sunk the North Western & Charing Cross Railway, and halted construction of the Waterloo & Whitehall and the Pneumatic Despatch railways. The Waterloo & Whitehall couldn't be refinanced and was liquidated in 1868. (See *Ian Visit's London's Lost Pneumatic Tubes e-book for details of this pneumatic railway.*)

The second section of the Pneumatic Despatch tunnel from Holborn to the General Post Office also started construction in 1865, but was similarly delayed by the 1866 financial crisis. By the time the economy recovered in 1868, the Post Office realised that the first pneumatic tube railway at Eversholt Street didn't provide significant time savings due to transfer of mail bags at each terminal, and so declined to enter into an agreement to restore it to operation. The second section from Holborn station to the General Post Office was completed in 1869. Telegraph wires were run inside the tunnel to the three stations to signal dispatch of a mail car. The rail cars made an average speed of 9.5 mph, including two gradients of 1 in 15 across the Fleet Valley where it reached 60 mph.

But Rammell was kept busy with another pneumatic passenger railway proposal, the Hyde Park Railway, which he put forward 1868. This line was to connect Cumberland Gate at Marble Arch to Albert Gate on Knightsbridge. The scheme was modified to incorporate a 700-yard disused sewer on a near parallel course. The sewer would have to be enlarged, but this would still save tunnelling over one-third of the length of the line. Trains were to be blown northbound, then return by gravity on the 1 in 56 gradient, but this was considered a novelty line with little practical transportation use, and it did not proceed.

Undeterred, Rammell kept looking for opportunities for pneumatic railways. In 1872 he concocted a scheme at South Kensington with both Metropolitan Railway and the Metropolitan District Railway backing. It seemed to have more financing and support, but cost escalation and the failure of the Metropolitan Railway to provide a loan guarantee spoke loudly to investors and doomed the scheme.

Problems with the Pneumatic Despatch railway remained, although from 1869 to 1874 many trials were run and improvements were made. It was difficult to keep the tunnel sufficiently airtight, even after engine power had been increased six-fold. Travel times sometimes doubled to 20 minutes for each leg from loss of air pressure. A worker would have to crawl into the tunnel with a rope, and tie it to the carriages to draw them out. It was not terribly reliable at actually transporting mail. Water ingress could wet the mail bags, damaging them and not impressing the Post Office.

The mail handling infrastructure to take full advantage of the Despatch Railway had not been built. Manually lugging the mail bags out of the railcars and up from the basement negated most of the time advantage. The Pneumatic Despatch Company considered further increases to steam power not to be cost effective. The investors had tired of sinking money into a leaky tunnel with no returns. It was not sufficiently reliable at actually transporting mail, and the Post Office cancelled the contract in 1874. The Company then tried running a parcels service themselves, with little uptake.

Using the Pneumatic Despatch tunnel to ventilate locomotive smoke in the Metropolitan Railway tunnels ventilation was considered where the lines crossed at Euston Road and Tottenham Court Road employing the existing fan. Whilst immediately appearing favourable, detailed investigation determined little benefit and the experiment was ended. The Pneumatic Despatch Company was liquidated in 1875, having spent £200,000 (£1.9m nowadays) and was soon forgotten amidst the burgeoning underground railway network and newer technologies like electric traction and the telephone.

This marked the demise of pneumatic railways: they didn't scale up well and were expensive to maintain at pressure. Advantages of steeper gradients, low pollution and noise did not overcome reliability problems. Steam, although far dirtier, was far more reliable. Electric traction made both steam and pneumatic traction obsolete. This is what we would now call in the tech sector the Valley of Death, where lack of financing was the shortfall between the demonstration technology and a viable commercial service.

The Pneumatic Despatch railway station was rediscovered in a basement of Euston Station in 1895 by engineer George Threlfall. Over the next five years he explored the tunnels, save below Holborn Viaduct which was full of water. He found that the straight tunnel portions were built of brick, and the bends were constructed of cast iron sections. He found the 30-year-old tube had gaps between some tunnel segments, and the railcars had rubbed the solder right off some joints, but he found the rails in good condition and determined that they could still be used. Confident of repairing them, he set up a new London Despatch Company to sell its reprinted and improved services to the Post Office. He planned new electric traction, with conductor rail between the running rails. He issued shares and was bought out by Batchellor, but there was no interest from the Post Office.

London streets were still seriously congested despite numerous Underground lines. Improved transport fuelled more traffic, and the Post Office evaluated an underground mail and parcels railway. By 1920, the Post Office realised it could re-use the old Pneumatic Despatch railway tunnels for running telephone cables, and so purchased them. They fitted ducts into the tunnels, but found that some sections had been destroyed by road work, construction, or been used by other companies for telegraph cables or for storage. Unfortunately, leaks from underground gas pipes, used for heating and lighting, had a tendency to build-up in the sewers and underground voids. In 1928 an explosion of a gas/air mix in a tunnel near High Holborn and Kingsway resulted in the filling in of the Despatch Railway tunnels. All other tunnel traces were removed by subsequent road and Underground construction, plus those caved in from wartime bombs. Only remnants remain. Two of the rail cars from the initial 2ft gauge tunnel were discovered during 1930 construction at Euston, and are currently

kept at the British Postal Museum Store in Debden, Essex. It is planned to display a car at the new Post Office Museum next year.

Pneumatic communications tubes are the only pneumatic technology still in use today, at Tesco's, in large hospitals, and at nuclear reactor facilities for uranium samples. However, the new Hyperloop system which plans magnetic levitation for propulsion, intends vehicles to operate within an air-evacuated tube to reduce resistance.

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