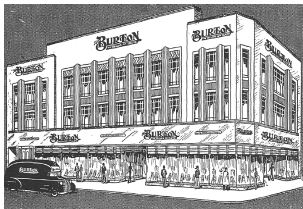


Fast, clean, quiet public transport - why a Victorian innovation failed

Roger Boyle
Aberystwyth

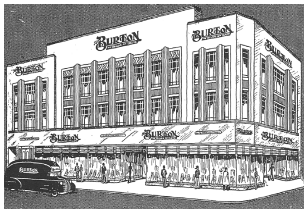
August 24, 2021



The Atmospheric Caper

Roger Boyle
Aberystwyth

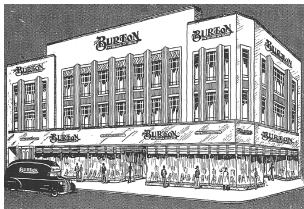
August 24, 2021



From Papin to Musk, via the Exploding Samuda

Roger Boyle
Aberystwyth

August 24, 2021

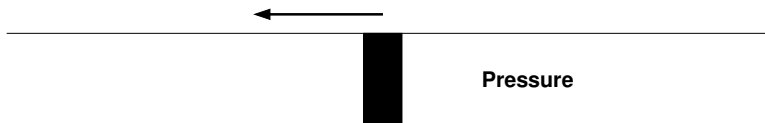
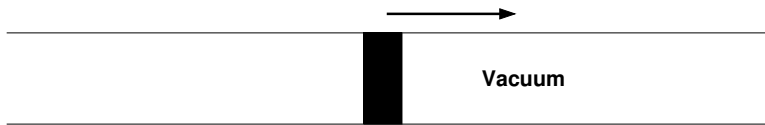


Caveat

I have no serious credentials in history or engineering.

Vacuum/pressure propulsion

Imagine a pea in a hosepipe, and you either blowing or sucking at one end.



Overview

Development

Dalkey

South London

South Devon

St Germain

The end

And then ...

The Real End

1689



1689



Denis Papin (1647-1713), 1689, FRS

1689



Denis Papin (1647-1713), 1689, FRS

French physicist, mathematician and inventor, best known for his pioneering invention of the steam digester, the forerunner of the pressure cooker and of the steam engine.

Denis Papin

Grenoble; Gare du Nord, Paris



1827

Shoreham, Kent



1827

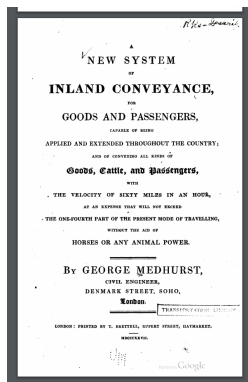
Shoreham, Kent



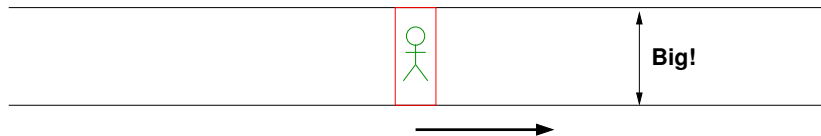
George Medhurst (1759-1827)

George Medhurst, 1827

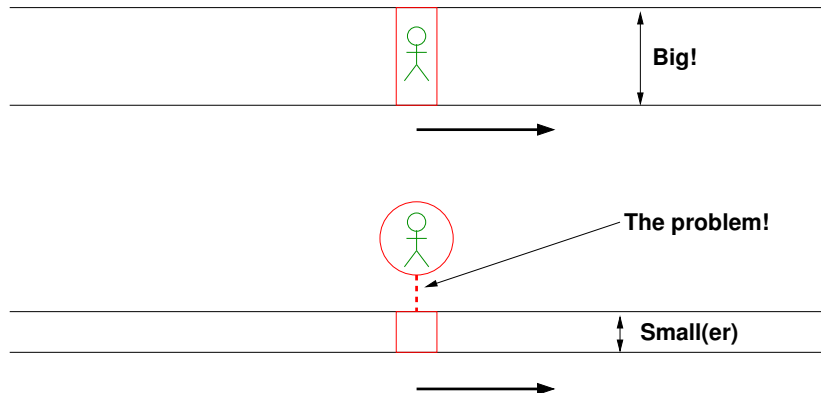
Google books



Carrying the passenger(s)



Carrying the passenger(s)



What's going on?

Steam locomotion became established in the first decade (or two) of the 19th century.

By 1820 it was a reality, but inefficient and underdeveloped.

By 1830, there was an epidemic of demand, both industrially and for passenger traffic.

By 1840, 'Railway Mania' had taken hold, culminating in an economic collapse 1846-47.

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By 1840, 'Railway Mania' had taken hold, culminating in an economic collapse 1846-47.

Development of Medhurst's ideas came in the mid-late 1830s – just at the right time!

What's going on?

Locomotives were very inefficient: they struggled with gradients of any kind, or tight curves. They were exceptionally heavy and needed to generate enough power to move *themselves* before moving any payload.

This is an easily understood problem. What if, instead, we keep the power generation stationary and transmit the power to where it is needed?

This was a well-established principle in watermills. A lot of people wanted to adopt the principle for track-guided transport (trains).

What's going on?

As Railway Mania grew, several attempts were made to construct railways that would transmit *atmospheric* propulsion to carriages outside the tube.

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The winner – or, at least, the most successful – was:

- Patent No. 7920, January 3, 1839
- Samuel Clegg
- **A New Improvement in Valves, and the combination of them with machinery**

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- Samuel Clegg
- **A New Improvement in Valves, and the combination of them with machinery**

Clegg was heavily involved with the Samuda brothers Joseph and Jacob, established and successful marine engineers. He left the atmospheric project shortly after the patent, leaving the Samudas holding the baby.

Joseph Samuda

1873



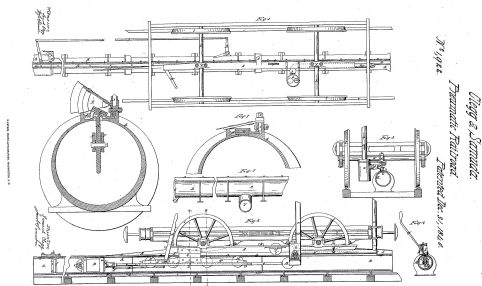
Jacob Samuda

1845



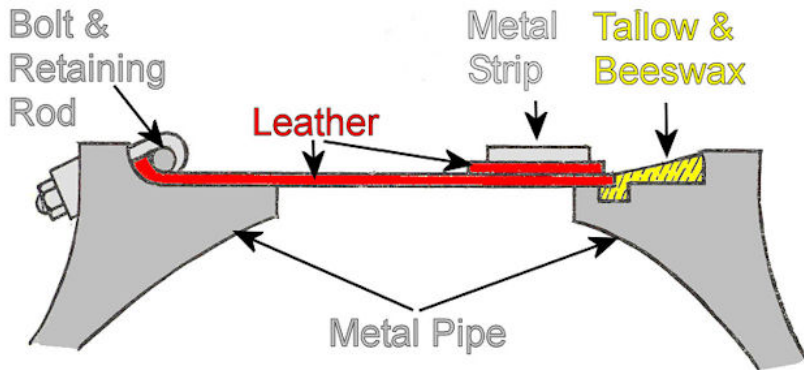
The explosion of the 'Gypsy Queen', the Isle of Dogs.

US Patent no. 1922



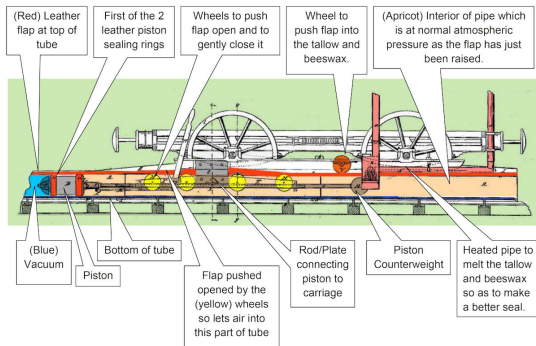
Clegg/Samuda valve

<http://www.epsomandewellhistoryexplorer.org.uk/AtmosphericRailway.html>



Clegg/Samuda valve

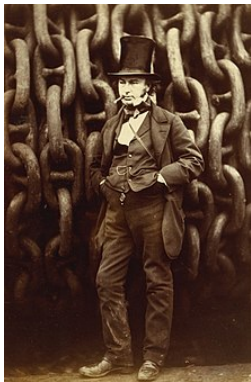
<http://www.epsomandewellhistoryexplorer.org.uk/AtmosphericRailway.html>



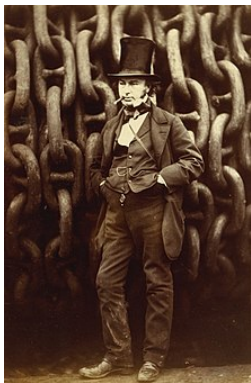
The Samudas set up a full-size, albeit short, demonstration system and invited interested parties.

Interested parties duly arrived –

1857



1857



Isambard Kingdom Brunel, 1857, by the launching chains of the
Great Eastern

1856



1856



Robert Stephenson, 1856

To cut a long story short ...

... omitting a lot of detail

There followed aggressive public campaigns by proponents and opponents; Brunel championed the idea and Stephenson was foremost in rubbishing it.

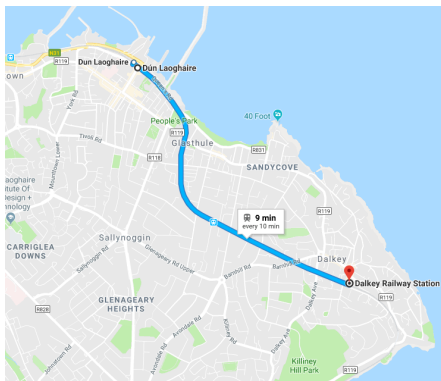
In the febrile atmosphere of the mid-1840s, eventually four atmospheric lines were built: the latter two were heavily influenced by the perceived performance of the two earliest.

- Dalkey, Ireland:
- South London/Croydon:
- South Devon:
- St Germain, Paris:

Overview

Dalkey Atmospheric Railway

Route (Google maps)



Dalkey Atmospheric Railway

Details

The Dalkey Railway ran 29th March 1844 – 12th April 1854

- Dalkey to Kingstown; 1.75m, single track
- One stationary engine to vacuum-haul trains uphill; return by gravity
- Land-speed record (ave. 84mph) established by Frank Ebrington, 1844
- A successful system, overtaken by broader developments; *interoperability* was an issue.

Dalkey Atmospheric Railway

Remains

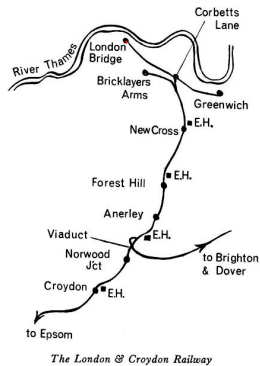


Overview

South London Atmospheric Railway

Route

(<http://www.epsomandewellhistoryexplorer.org.uk/AtmosphericRailway.html>)



'EH' = Engine House

South London Atmospheric Railway

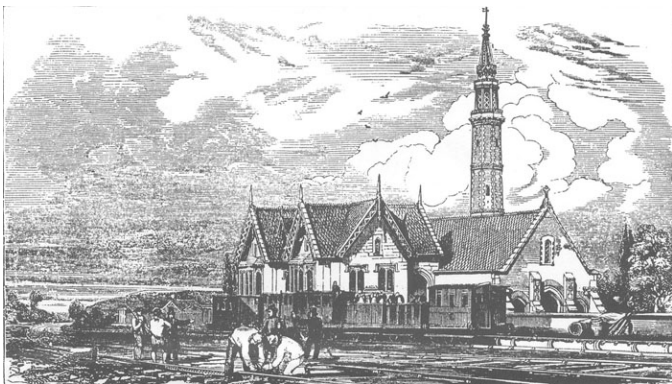
Details

The South London Railway ran 19th March 1846 – 3rd May 1847

- Forest Hill to Croydon; 5m, single track
- Three stationary engines, worked in both directions
- Widely visited by interested engineers
- Failed because of under-powered engines, valve problems, and interoperability issues

South London Atmospheric Railway

Forest Hill Engine House, <https://sydenham.org.uk/forum/viewtopic.php?t=1023>



South London Atmospheric Railway

Surrey Street Waterworks, <https://www.hows.org.uk/personal/rail/wwr/atmos.htm>



The West Croydon pumping station, relocated to form part of the Surrey Street waterworks building.

Overview

South Devon Atmospheric Railway

Route, <http://www.mybrunel.co.uk/railways/atmospheric.html>



South Devon Atmospheric Railway

Details

The South Devon Railway ran 13th September 1847 – 5th September 1848

- Exeter to Newton Abbot; 20m, single track
- Eight stationary engines, worked in both directions
- Ambitious: the pinnacle to date of atmospheric propulsion – many expansion plans
- Failed because of under-powered engines, valve problems, and interoperability issues

What the papers said . . .

The **atmospheric** railway

‘From *Woolmer’s Exeter Gazette* we gather a hint of a new property of this great invention. Samuda and Brunel, the two **atmospheric** heroes, have long been labouring to obtain a good vacuum in the tubes. They have not succeeded in that, but they are likely to succeed in obtaining a perfect vacuum in the South Devon Exchequer. These great geniuses, therefore, cannot be said to have accomplished nothing. Besides this, they some time ago accomplished another great thing — namely, showed that their heads were nearly as empty as they wished to make the tubes, of filled with very aerial matter.’

(Herepath’s Railway Journal, 11 December 1847)

Torquay and Totnes Engine Houses

<https://www.hows.org.uk/personal/rail/wwr/atmos.htm>



Starcross Engine House

<http://www.mikehigginbottominterestingtimes.co.uk/>



Pipe

<http://www.mikehigginbottominterestingtimes.co.uk/>



in Didcot GWR museum

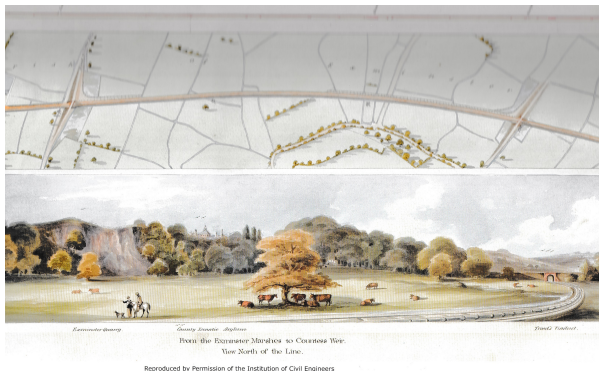
Illustrations

The South Devon was very accurately recorded in watercolour by William Dawson, an Exeter based architect, showing the land and track together.

This has been splendidly republished with commentary and present-day comparative photographs: *Brunel's Atmospheric Railway*, ed. Paul Galsworthy, pub. The Broad Gauge Society, 2013.

Illustrations

Brunel's Atmospheric Railway, BGS, 2013

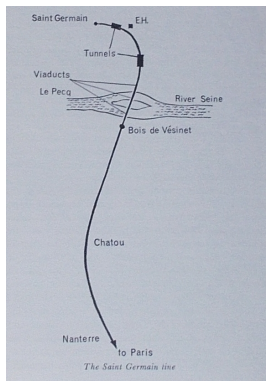


25 beautiful period watercolours and a thorough history of the line.

Overview

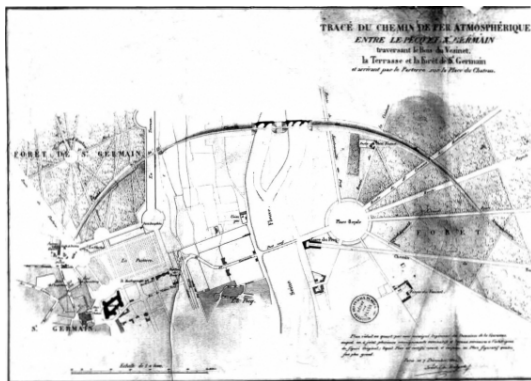
St Germain Atmospheric Railway

Route, Hadfield



St Germain Atmospheric Railway

Route, <https://journals.openedition.org/insitu/4236>



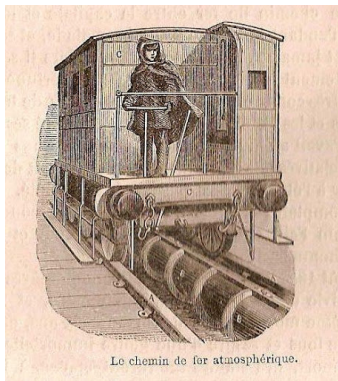
St Germain Atmospheric Railway

Details

The St Germain Railway ran 24th March 1847 – 2nd July 1860

- St Germain to Bois de Vésinet; 1.38m, single track.
- One stationary engine to haul trains uphill; return by gravity.
- Engine houses were built for an extension of 4m, but never used.
- A successful system, overtaken by broader developments such as improved steam locomotives.

St Germain Atmospheric Railway



Le chemin de fer atmosphérique.

St Germain Engine House

<https://journals.openedition.org/dht/>



Documents pour l'histoire des techniques

Overview

The influential and very active railway press spectated on the Engineers' war.

It is instructive to consider part of a very long editorial they wrote after the Croydon line had opened. This highlighted some of the high level arguments in play.

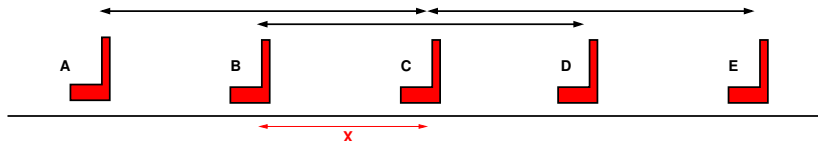
For [Clegg and the Samudas]:

- There is no need to haul the power source.
- Lighter vehicles necessitate less heavily engineered track.
- Wear and tear on engines is a factor of 18 lower.
- The full power of the engine is always available.
- Trackbed is cheaper to build as greater gradients are possible.
- Stationary engines are cheaper to run.

Against [Stephenson]:

- Power is not transmitted economically.
- Atmospheric locomotion is not faster.
- Line construction will usually be more expensive.
- The principle may work for selected short lines.

Multiple Engine houses



Trade-off:

- A large distance between engines saves lots of money
- A small distance between engines maximises power and reliability

Multiple Engine houses

Engine houses were equipped with powerful steam engines to drive similarly powerful air pumps.

They were large and expensive; they were also expensive to run.

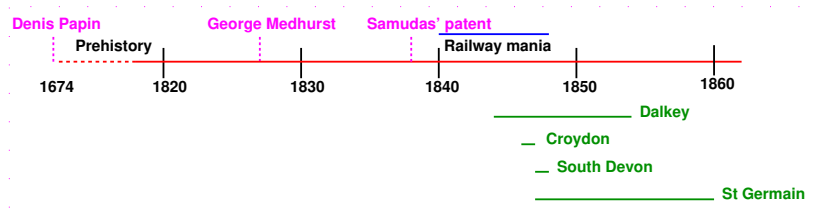
Thus, they were only driven hard when necessary – when a train was approaching their own ‘segment’.

Thus, they needed to communicate with neighbouring engines; this was done using telegraph, whose reliability was key to the whole system.

Reporting on trouble on the Croydon line:

We have begun by inquiring of those people who travel daily ...there is one undivided opinion ...irregularity, slowness, continual uncertainty, disappointment

Timeline



Overview

The Dark Ages

The pioneers had over-reached themselves: this became clear just as there was a big downturn in the rail industry: 'mania' was over.

Interest in atmospheric propulsion as envisaged by Brunel was lost.

The principle *was* used in various special-purpose applications.

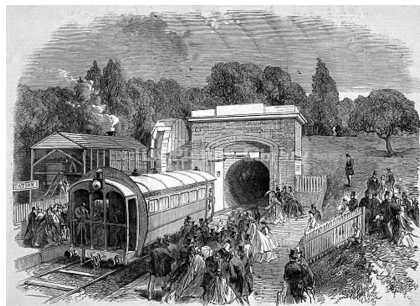
The Dark Ages - examples

Thomas Rammell, Crystal Palace, 1864

- Passenger vehicle as piston (so large!)
- Built as a demonstrator
- 600y in 50sec
- One fan that blew/sucked

Rammell, Crystal Palace

Wikipedia



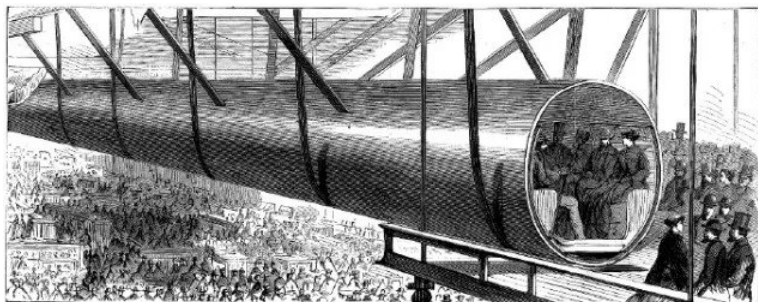
The Dark Ages - examples

Alfred Beach, NYC, 1870

- Passenger vehicle as piston (so large!)
- Built without planning permission
- 10mph
- One fan that blew/sucked

Beach, NYC Palace

Gizmodo, 13th August 2013



The Dark Ages – department stores

<https://martinturnbull.com>



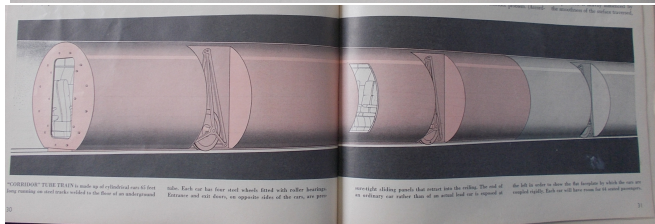
Older people will recall ...

Larger scale atmospheric public transportation eventually came back onto the radar.

High-Speed Tube Transportation

In which a system is proposed that would carry passengers from Boston to Washington in 90 minutes. Its vehicles would travel at speeds up to 500 miles an hour through dual evacuated tubes

by L. K. Edwards



Aeromovel

Porte Alegre, Brazil



<https://alponiente.com/el-aeromovel-movera-rionegro/>

2013

Heisenberg Media [CC BY 2.0 (<https://creativecommons.org/licenses/by/2.0>)]



2013

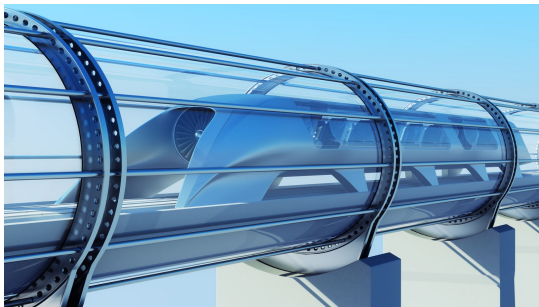
Heisenberg Media [CC BY 2.0 (<https://creativecommons.org/licenses/by/2.0>)]



Elon Musk

Musk's Hyperloop

LA \Leftrightarrow San Francisco



'... a tube through which a pod travels free of air resistance with great efficiency. Musk's version of the concept (2012) incorporates reduced-pressure tubes in which pressurized capsules ride on air bearings driven by linear induction motors and axial compressors.'

It would travel the 560Km at an average of 1200Km/hr

Musk's Hyperloop

BBC, 9th November 2020

Technology

Virgin Hyperloop pod transport tests first passenger journey

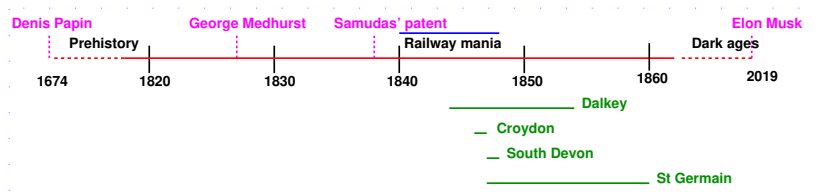
By Zoe Kleinman
Technology reporter

7 hours ago



Virgin Hyperloop has trialled its first ever journey with passengers, in the desert of Nevada.

Timeline



Overview

Diolch yn fawr

Oes unrhyw gwestiynau da chi?