



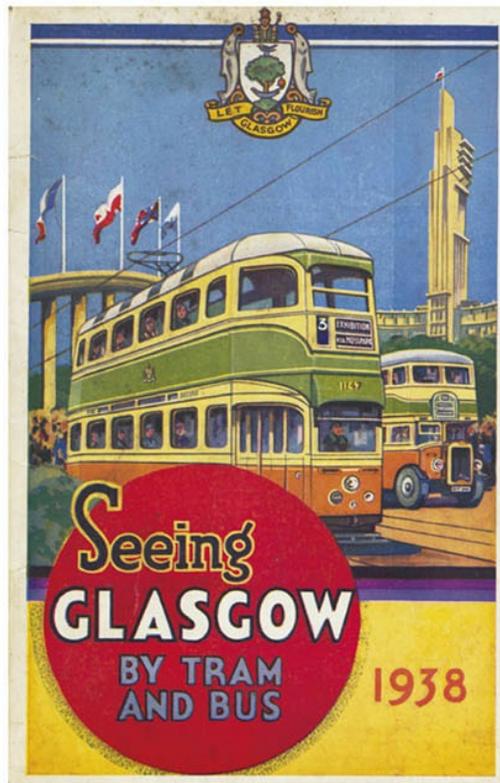
TRAMS AND TROLLEYBUSES

Oliver Green



TRAMS AND TROLLEYBUSES

Oliver Green





CONTENTS

HORSE AND RAIL

STEAM AND CABLE

GOING ELECTRIC

THROUGH WAR AND PEACE

FROM BLITZ TO CLOSURE

LIGHT RAIL RENAISSANCE

FURTHER READING

PLACES TO VISIT

HORSE AND RAIL

The tram and the tramway have had a roller coaster ride in Britain. Both names have been used for more than two hundred years, but their meaning has shifted as well as the technology they represent. In 1800 they referred to the vehicles and tracks of primitive goods railways. Neither name has ever been commonly used in the United States, where the first true 'street railways' were introduced. Early passenger trams there were known simply as horsecars and their mechanised successors have always been called streetcars or trolleys.

The distinction between a tramway and a railway has also been blurred over the years both in legal terminology and in popular use. Although the term light rail has been widely adopted on both sides of the Atlantic since the 1970s, it is a catch-all description rarely used in everyday speech. In the simplest definition today, a tramway is a type of light railway which shares its right of way with other traffic, often on a public highway.

A full-scale railway in the United Kingdom has always had its own defined and authorised right of way, a distinction never strictly applied in the United States. The new generation of light railways built in Britain since the 1980s often combines operation on former railway alignments with sections of urban street running. These are still known in the United Kingdom as tramways, operated by rail vehicles called trams.

At the start of the nineteenth century the terms were almost interchangeable. Both tramway and railway were used to describe the short early plateways on which goods and minerals were transported between mines, canals and harbours. All of them used horse power before the development of reliable steam locomotives in the 1820s. Their freight, usually coal or iron ore, was carried in small open wagons, which were referred to individually as trams or trucks but became trains when coupled together. The primitive iron trackwork enabled horses to pull heavier loads over these tracks than was possible on an uneven road surface.

None of these lines were designed to carry passengers but inevitably some tried it as a sideline to their main business of goods transport. The first

recorded passenger operation was on the ‘Oystermouth Railway or Tramroad’ in South Wales, which advertised a carriage service along the Gower Peninsula from Swansea in 1807. This was essentially a novelty sightseeing attraction for parties of wealthy tourists. Although it continued to operate for some years it was not copied anywhere else in Britain. The Oystermouth ‘tramcar’, which resembled a one-horse stagecoach with iron wheels, was a one-off not a prototype or a trendsetter.



Is this the first or second passenger tramcar built in Britain? A sketch of the original Oystermouth rail carriage at Swansea drawn by Miss J. Alford in 1819. A full-size reconstruction of the car based on this drawing is on display at Swansea Museum.

A tramway providing a regular public transport service on urban streets came many years later in New York City. Urban coach services by ‘omnibus’ (a fleet name adopted from the Latin meaning ‘for all’) were introduced on fixed routes in Paris (1828) and London (1829). Rapidly growing New York followed soon afterwards, where the omnibus owners often had difficulty running their heavy vehicles on the badly made up city streets of Manhattan in winter. It occurred to someone that running horsecars on rails in the road would give a smoother ride and make much more efficient use of horse power.

Coincidentally, the New York & Harlem Railroad Company was given permission in 1831 to build the city’s first railway right on the streets. It was only allowed to use animal power in the built-up area of the city. Steam locomotives were banned from the built-up area following a number of boiler explosions. This led directly to the development of a local horsecar service on the new street railway in Manhattan.

The horse-drawn streetcar soon emerged in New York as a distinct vehicle type. It was smaller than a long-distance railroad car but twice the size of a city omnibus. A new form of urban passenger transport had appeared, though it was not immediately emulated in other growing towns in the United States or Europe. In Britain the notion of street railways was already against the law. In the early railway booms of the 1830s and '40s parliamentary permission was only given for railways entering towns and cities on their own right of way and completely separated from the public highway.

In the United States only New Orleans quickly followed New York in opening a horsecar line in 1834. Street railways did not take off in other US cities until the 1850s. One young American trader who was impressed by the new horsecar lines he found in Philadelphia was convinced that the system could appeal to the businessmen of Britain. This was the appropriately named George Francis Train, who arrived in Liverpool in 1859 determined to sell the idea on Merseyside.

Train's flamboyant and bombastic manner was both a help and a hindrance to tramway development. He managed to launch the first purpose-built street railway in England at Birkenhead in 1860. However, Train soon ran into trouble in London, mistakenly choosing the wealthy areas of Westminster and Bayswater for his early trial lines in the capital. He faced strong opposition from both omnibus operators and carriage owners who claimed that his patent step rail, which protruded above the road surface, was a danger to other vehicles. When Train opened his third London tramway in Kennington he was successfully prosecuted for 'conspiracy and causing a public nuisance'. His rails were removed and Train went back to the United States, defeated by vested interests and legal process even though his tram trials had been quite a success both financially and with the general public.

Only a handful of tramway proposals got through the required parliamentary route to the statute book in the 1860s. Each line had to be authorised by a private (and costly) Act of Parliament but in 1870, bowing to pressure, Parliament passed the Tramways Act, which established a clear set of procedures to be met before a street tramway could be introduced anywhere in Britain.



An artist's impression of George Train's first proposed street railway in London, 1860. Train's tramway was authorised as a 'temporary concession' but removed after only a few months. The vehicle design is an ornately decorated version of early American horsecars.

The 1870 Act simplified the process, but it was a classic compromise, giving local authorities the power to approve and even build but not actually to operate tramways. A working contract could be awarded to an independent company for a maximum of twenty-one years, after which the council had the right to purchase the tramway company and all its assets at their scrap value.



Middle class Londoners comfortably seated in one of the new horse trams introduced in 1870. Cars were soon crowded with travellers of all classes and the American expression 'straphanger' for standing passengers quickly crossed the Atlantic.

Horse tramways now began to appear in towns all over the country. For the previous forty years, omnibuses had catered almost exclusively for the urban middle classes, especially in London. Omnibus fares were high and services started late in the mornings, often after 8:00am. The new tram companies had to provide cheap early morning workmen's fares and services were usually running by 5:00am. As each tramcar was twice the size and capacity of an omnibus, the companies could still make a good profit with low fares. It was the start of an urban transport revolution.

By 1878, 237 miles of tram line were in operation in the United Kingdom, mostly in urban areas. Twenty years later this figure had quadrupled and was close to the peak mileage for horse traction. In the early 1890s services were provided by at least one hundred separate tram companies across the country, roughly the maximum number before the twenty-one-year leases began to expire and council takeovers of many undertakings began.



A horse tram in Sheffield, c.1890.

Tramway staff were not well paid and the companies were hardly benevolent. Jobs were insecure, with fines or even dismissal for quite minor rule breaking. Perks and benefits were few, and in the 1880s tram crews were not provided with uniforms or any kind of protective clothing except perhaps a leather apron for the driver. The horses were far more valuable to a tramway company than its staff and actually worked shorter hours than the men on the trams. It made financial sense to look after the most costly of a company's assets and keep them in good condition, while most of the unskilled men were dispensable and easily replaced. There was always a large turnover of labour, especially in London. During 1891, for example, the

North Metropolitan Tramways, which employed 1,800 men, dismissed drivers and conductors at an average rate of between two and five a week.

Horses, on the other hand, were chosen carefully and generally well looked after. The working life of a tram horse was short and tough, on average only four years to the omnibus horse's five. It was not unusual to see a horse collapse and even die in harness on the street, but no tram company wanted to see its reputation sullied by being taken to court for animal cruelty. To keep a tramcar in service for a working day, covering around 65 miles, required ten horses, working in relays. That is five pairs, each pair hauling the tram over some 14 miles per day. Spare horses were required to cover sickness and accidents as well as a stock of extra animals to assist on gradients, known as tip or trace horses.



A typical North Metropolitan horsecar in Hackney, north London c.1888. It has its original back-to-back 'knifeboard' seating on the upper deck.

Initially, the tramcars used in the United Kingdom were either American imports, or British built but following similar designs to those of experienced US makers like John Stephenson of New York. By far the largest car builder and supplier in the United Kingdom was the Starbuck company in Birkenhead, set up by one of G.F. Train's American associates who stayed on in England and created a thriving business after Train returned to the United States.



A horsecar passing a much smaller standard omnibus at the Elephant & Castle junction in south London, c.1895. The tram is being hauled by three mules instead of the usual two horses, an unsuccessful experiment at this time that was quickly abandoned.

After around 1895 very few new horsecars were built as systems were mechanised, but a surprising number lasted well into the twentieth century working as trailer cars on both steam and electric tramways. Most of them were redundant and sold off in the early 1900s only to have a second and often longer life grounded as outbuildings and storage sheds. None were preserved at the time but decades later a handful were rediscovered around the country and have been restored for museum display and occasional operation.

JOHN STEPHENSON COMPANY, LIM.,
NEW YORK, U.S.A.

TRAMWAY CARS.

LIGHT.

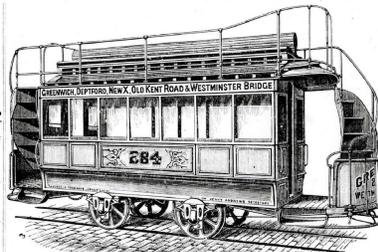
ELEGANT.

DURABLE.

Every Description.

Best Materials.

Minimum Prices.



LIGHT.

ELEGANT.

DURABLE.

Orders Quickly Filled.

Careful attention to Shipments.

All Climates Suited.

JOHN STEPHENSON COMPANY, LIM.,
New York, Etats-Unis.

OMNIBUS POUR TRAMWAYS.
Légers, élégants et durables.

Faits dans toutes les formes.
Construits des meilleurs matériaux et
aux prix les plus modérés.
On exécute les commandes promptement.
On donne des soins spéciaux à l'exportation.
Les omnibus s'adaptent à tous les climats.

John Stephenson Company, Lim.,
New York, Vereinigte Staaten.

Pferdebahnwagen.
Leicht. Elegant. Haltbar.

Von jeder Art.
Aus besten Materialien hergestellt, zu den
niedrigsten Preisen.
Bestellungen werden rasch ausgeführt.
Besondere Sorgfalt bei Aufträgen für Ausfuhr.
Für jedes Klima geeignet.

JOHN STEPHENSON COMPANY, LIM.,
Nueva York, Estados Unidos.

COCHES DE TRANVIA.
Ligeros. Elegantes. Duraderos.

De toda clase.
Materiales de 1ª calidad.
Precios módicos hasta no más.
Se ejecutan pedidos con prontitud.
Especial cuidado para exportación.
Los productos de la Co. se adaptan a cada clima.

A John Stephenson Company trade advertisement c.1880. Around three hundred horsecars like the one shown were shipped across the Atlantic from New York to work in London, including the tram now on display in the London Transport Museum.

A few of the horsecar operations survived into the 1920s as leisure attractions, mostly in seaside resorts. Traditional horse trams are still running along the front at Douglas, Isle of Man, in the summer season. The Douglas Bay line was opened during the first British tramway boom in 1876 and has run with few breaks or interruptions ever since. Faced with growing costs and a need to economise, Douglas Borough Council announced closure plans in 2016. Fortunately the Manx government stepped in to take over and run the whole operation, as it had done earlier with the island's heritage steam and electric railways. This unique Victorian survivor now has a secure future.



Belfast Street Tramways had over one hundred horsecars in service by 1900. This coloured postcard shows Donegal Place in the city centre just before electric trams took over in 1906.



A roofed 'toast rack' tram on the Douglas Bay Tramway. Still operational today in the summer season, this unique Manx survivor is the oldest working tramway in the United Kingdom, opened in 1876.

STEAM AND CABLE

Costly though horse power was, it allowed most British tramway companies to make good profits throughout the 1870s and '80s. There was little incentive to look for alternatives to the horse or to invest in new forms of motive power that had not been tried out. At the same time the limitations of horse power were becoming all too apparent. Most city systems had reached their maximum growth by the late 1880s and could not expand beyond the horse's physical capacity, even though the passenger market was clearly there as urban centres grew.

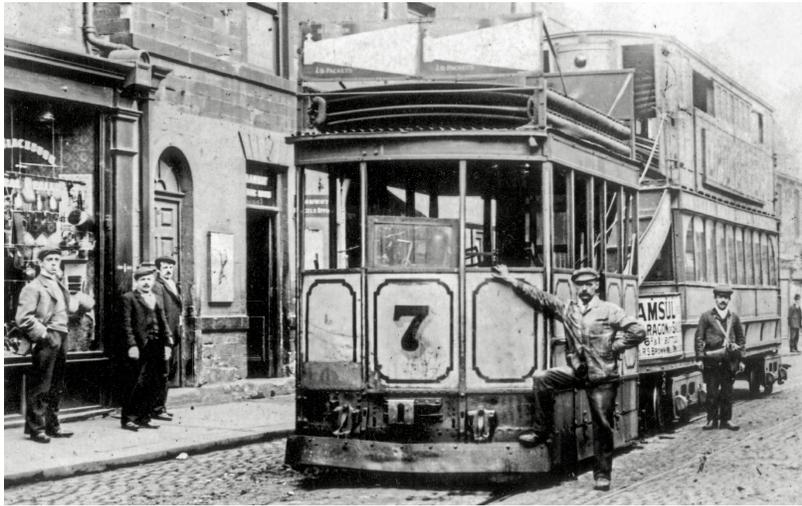
In theory, tramways could obviously follow railway practice and use steam locomotives, but there were safety concerns about using mechanical vehicles of any kind on the public highway. Neither risk-taking nor innovation was encouraged, and the Board of Trade drew up stringent operating regulations in 1875. Tram engines could not emit visible steam or smoke, must be 'free of noise' and all fire and machinery had to be fully enclosed.



The Wantage Tramway was more like a light railway than a tramway, running alongside a road in rural Berkshire. It was the first tramway to use steam power in 1876, but later used a variety of second-hand rolling stock, as shown in this view c.1914.

Not surprisingly, these rules were more strictly enforced on town tramways than on the small number of rural tramways, which mostly ran alongside

rather than actually on roads. The rural lines were often called tramways but were in effect light railway branch lines, and many of them used similar small steam locomotives to the main lines. The urban street railways, which shared the road space with horse-drawn traffic, all used boxed-in, purpose-built tram engines and trailers to meet the regulations.



A Merryweather steam tram on the Dewsbury, Batley & Birstal Tramway in Yorkshire, c.1885. Trailers for steam trams had the first enclosed upper decks to keep the smoke away from passengers.

Steam trams were not a great success in Britain, although in some European countries, notably Belgium, they were widely used until the 1950s. Most of the UK operations started in the 1880s only continued for about twenty years. They were never popular with passengers because of the smoke and dirt, which were almost impossible to control. Some operators found the heavy steam trams unsuitable because they damaged lightweight street track, which was not always reconstructed and strengthened where steam replaced horses. In north London one company's problematic trials with steam trams lasted six years, after which reliable horsecar operation was brought back in 1891. Steam operation fared better in the industrial areas of the West Midlands, Yorkshire and Lancashire, where the largest single system had nearly one hundred tram engines and more than 30 route miles.

An ingenious alternative method of harnessing steam power for tramways was developed in the United States by a British-born engineer who had emigrated to California and developed a successful wire rope making

business for mining operations. Andrew Smith Hallidie was the promoter of the first practical passenger cable car system, the Clay Street Hill Railroad in San Francisco. This opened in 1873, using Hallidie's cables to haul tiny passenger cars up the steep hills of the city, where conventional horsecar operation was almost impossible.

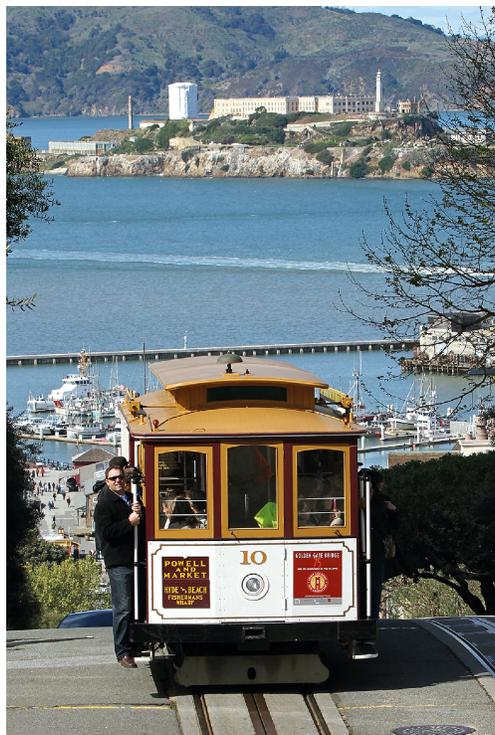
The principle of the cable tram system was simple. A stationary steam engine drove a winding drum with a continuously moving endless wire cable. This ran through a shallow conduit below the tram track. Individual tramcars could be attached to or disconnected from the moving cable by a control device known as the grip, which passed through a central slot rail in the street surface to the sub-surface cable. The tramcars all moved at the constant speed of the cable when attached to it and stopped when the driver (the gripman) released the grip and applied the brakes.



A local *in memoriam* postcard for the steam trams of Accrington, Lancashire, introduced in 1884 and closed down in 1907 when the local authority built its own electric tram system.

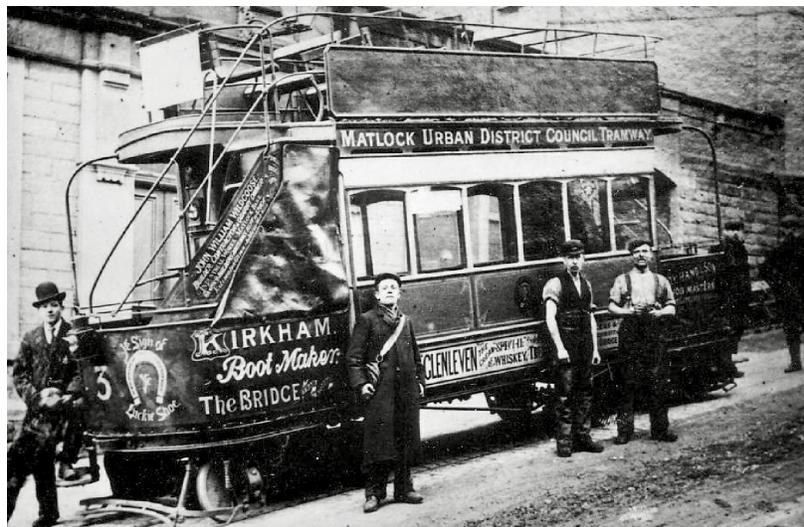
Cable operation was briefly in vogue in several American cities in the 1880s. The Chicago City Railway, opened in 1882, was a convincing demonstration that a cable system could be an efficient way to mechanise mass urban street transport even in a completely flat city. New York, Washington and Los Angeles soon followed in the United States, and cable lines opened in Australia and New Zealand. Hallidie's system was first demonstrated in Europe in 1884 up steep Highgate Hill in north London, but few other cable systems were built in the United Kingdom.

One cable tram line was opened in Birmingham in 1888 in preference to using mobile steam engines and in south London part of the existing horse tramway between Streatham and Westminster Bridge was converted to cable operation in 1892. Passengers could remain seated on the tram while the transfer from horse to cable power and vice versa took place at Kennington. The only extensive cable system in a British city was developed in Edinburgh, where it seemed a good option for the hilly terrain of the northern districts. Edinburgh could eventually boast the fourth-largest cable system in the world, but by the time it reached its greatest extent at the turn of the century, cable was an outmoded technology and being rapidly superseded by electricity everywhere. A few remnants of the cable trams can still be found in the Scottish capital, where a surviving car is being restored. The Edinburgh system was finally replaced by electric trams in 1923.



The first passenger carrying cable cars were introduced on the hilly streets of San Francisco, California in 1873. Three routes are still in operation today, more as a unique tourist attraction for the city than a public transport service. This modern view shows open sided car 10 climbing up Hyde Street with a distant view of Alcatraz, the once notorious prison island, in San Francisco Bay.

There were only two more Hallidie-style cable tramways in Britain, both opened in resort towns with steep hills. These installations were at Matlock in Derbyshire (1893) and Douglas, Isle of Man (1896). Both began as ill-fated private operations, were taken over by local authorities, required heavy subsidies, and were closed down in the late 1920s. The only surviving cable-based line in the United Kingdom still running partly on the street is the Great Orme Tramway at Llandudno in north Wales, opened in 1902. This works on a different principle as a funicular railway, with two cars permanently attached to the cable and counter-balancing each other as they ascend and descend. All other funiculars in Britain are essentially cliff lifts, not tramways, and do not run on the street. The only city in the world where street-running cable cars are still in operation is San Francisco, where Hallidie first introduced them in the 1870s.



The short but extremely steep Matlock cable tramway, opened in 1893 and closed in 1927. The cable winding house and depot at the top of the hill survives today as a garage.



A 1930s postcard of the Great Orme Tramway at Llandudno, north Wales. First opened in 1902, this is now the only surviving cable worked system in the United Kingdom.

GOING ELECTRIC

In the early 1880s the future route of tram mechanisation remained uncertain, but it seemed possible that harnessing the power of electricity for transport was a more likely way forward for the urban street railway than using steam. The German electrical engineer Werner von Siemens demonstrated the world's first miniature electric railway to visitors attending a Berlin Trade Exhibition in 1879. By May 1881 his Siemens & Halske company had graduated to equipping a full-size horse tramcar with an electric motor powered directly through the rails, and was offering the first public service on an experimental line in Lichterfelde, near Berlin.

The first electric tram to be demonstrated in London a year later carried its own power source in a series of on-board accumulators. This too was a converted horsecar, but like all subsequent early trials with batteries it could not provide enough power to offer a reliable passenger service. The trams were very slow and the large, heavy batteries under the seats gave off acrid fumes. For all its potential, battery electric power has never provided a robust transport solution over anything more than short distances and even today recharging is slow and inconvenient.



Manchester developed the second largest electric tram system in the UK after London in the early 1900s, soon linking the city with every neighbouring town. This is the first tram to arrive in Sale, five miles from the city centre, in 1907.

Brighton-born engineer and inventor Magnus Volk pioneered electric traction in England with a direct external power supply. In August 1883 he opened a miniature railway along the beach at Brighton which he promoted as ‘the first public electric conveyance in the United Kingdom’. The little tramcars on Volk’s Electric Railway were fitted with Siemens motors and worked on a similar direct power supply through the running rails. It was soon modified to a third rail supply to avoid current leakage. Volk’s Electric Railway has continued in operation to this day, with an extended and re-laid line which was fully refurbished in 2016–17 with assistance from the Heritage Lottery Fund.

In September 1883, just one month after the opening of Volk’s little beach line, a much longer and more ambitious electric railway for tourists was opened along the coast of Ulster. This was the Giant’s Causeway, Portrush & Bush Valley Tramway, which ran on hydro-electric power supplied to a raised conductor rail and offered spectacular views of Dunluce Castle and the rugged coast of County Antrim. On opening day the inaugural tram was

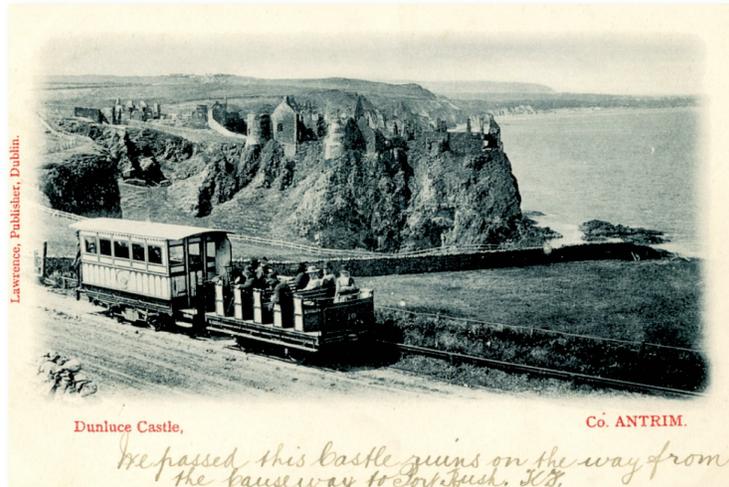
driven by Miss Jeanie Richardson, who thereby became the world's first female tram driver, if only for a day.



Magnus Volk's little electric railway on Brighton beach featured on an Edwardian postcard c.1905. When it opened in 1883 Volk promoted it as 'the first public electric conveyance in the United Kingdom'.

Two years later, in 1885, the first electric street tramway in England opened on the promenade at Blackpool. This was an early public/private partnership between an electrical engineer from Yorkshire, Michael Holroyd Smith, who designed the system, and Blackpool council, who built it. In order to ensure that the electrical supply to the trams was safe on the street, the conductor rail was buried in a sub-surface conduit between the rails. A metal 'plough' suspended below each tram picked up power by making contact with the conductor rail. The system worked well enough, but heavy waves often flooded the conduit with water and sand from the beach and in 1899 the Blackpool conduit system was replaced by an overhead wire supply to the trams.

Ultimately, Blackpool would become as synonymous with trams as its seasonal electric illuminations, and the great British tramway survivor. Decades later, it was the only street system in the United Kingdom still running beyond its centenary after every other surviving tram network had closed in the 1950s and early '60s.



The Giant's Causeway, Portrush & Bush Valley Tramway in County Antrim opened a month after Volk's line. The *Railway Times* described this as 'the first long electric tramway in the world', a tourist line with dramatic views running for nearly 10 miles along the Northern Irish coastline.

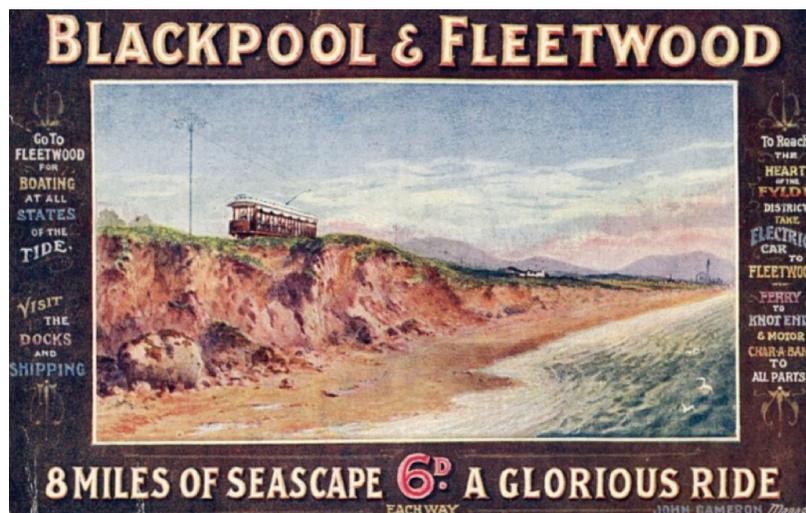
The early progress with electric tramways in Britain and Germany was overtaken in the late 1880s by developments in the United States. Here a dramatic breakthrough came through the work of Frank Sprague, who designed a complete electric streetcar system for the city of Richmond, Virginia, in 1887/8. When it opened this was the largest electric tramway network in the world, running over 12 miles of track. Sprague equipped each tram with two electric motors, a controller at either end of the car and a spring-loaded pole on the roof that picked up power through a swivelling head with a grooved wheel running under a single overhead electric wire. Current was generated at a power station, fed through the overhead wire to each car and returned through the running rails in the road surface.

Sprague's successful Richmond installation marked a seminal moment in the development of the electric tram. It heralded the transition of electric traction from a period of trial and experiment to successful commercial application. An electric streetcar boom followed in the United States, and by 1890 over 900 miles of street railway had been electrified. Suddenly the cable car system, which had boomed in the '80s, was dead. Electric streetcars, or trolleys as Americans called them after the little pick-up wheel at the end of the pole, were now the future.



The Douglas terminus of the Manx Electric Railway in a postcard sent in 1904, when the line had been open for ten years. The open-sided tramcar dates from 1898 and still runs today, a fully operational veteran that represented cutting-edge technology 120 years ago.

There was no electric tram boom in the United Kingdom in the 1890s. The new technology was quickly available, mainly from the United States, but the constraints imposed by the 1870 Tramways Act delayed the electrification of urban systems in Britain for a decade. As the twenty-one-year leases given to horse tram companies came to an end, local authorities in the United Kingdom began to consider electrification but were uncertain how best to go about it. Many of them saw this as an opportunity to expand municipal influence and control. There was certainly no likelihood of a private enterprise free-for-all on the streets, as happened in most American cities.



Postcard advertising the Blackpool & Fleetwood Tramroad, opened in 1898. This privately run coastal line was originally separate to the Blackpool Corporation system along the promenade but the two were merged in 1920.

The four British cities that pioneered extensive electric tram networks before the turn of the century took contrasting approaches. The first to open were in Bristol (1895) and Dublin (1896/7), still part of the United Kingdom at this time. In both cases the initiative came entirely from private enterprise, although local authority approval was needed. The next pair, Glasgow and Liverpool (opened in 1898), were examples of early municipal drive, both ambitious city corporations determined to build and operate their own electric systems without any private company involvement. These expanding local authorities were keen to learn from experience overseas in both technical development and management, but only a handful of councils chose outside operators to run their trams under contract.



A smartly turned out crew on an American tram delivered to Bristol in 1898. This was the first British city to develop an extensive electric network.

At the close of the Victorian age municipal electric trams were introduced to towns as diverse and differing in size as Dover (1897), Bradford (1898), Southampton (1898), Sheffield (1899), Aberdeen (1899), Hull (1899), Norwich (1900) and Sunderland (1900). As the Edwardian age dawned in 1901, corporation tramways opened in the larger conurbations of Birmingham, Newcastle and Manchester. London's first electric service also

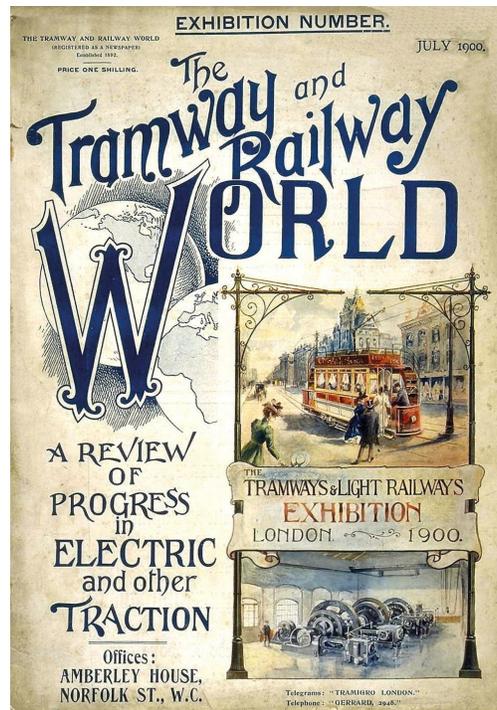
opened in 1901, run by the private London United Tramways in the western suburbs, which were then in Middlesex, beyond the control of the London County Council (LCC). The first LCC electric line, from Westminster to Tooting, was not opened until 1903.



One of the first electric cars introduced by Glasgow Corporation in 1898 is now on display in the city's Riverside Museum. These early single deck trams with a central entrance/exit and an open balcony at both ends were known to Glaswegians as 'room and kitchen' cars.

The largest and wealthiest city in the country was, rather surprisingly, one of the slowest to develop electric trams. Here the multiplicity of local authorities involved and sharp differences in attitude to this new mode of public transport led to delay and disagreement. The LCC, which from 1889 oversaw most of central London, gradually took over the fifteen private horse tramways in its area, but dithered over how to modernise them. There were concerns about overhead wires ruining the look of London's famous streets, and the LCC eventually decided to bury the power lines with a conduit system similar to those in Washington and New York. A wire free system was certainly attractive but it took much longer to build, cost twice as much and required constant cleaning and maintenance. It also meant creating 'change pits' at the LCC boundary when links were made with other systems in outer London and the suburbs. Through running required a unique transfer arrangement at each pit where the plough was jettisoned below and the trolley

pole was raised to the overhead wire. The procedure was reversed in the other direction: pole lowered and plough pushed under each tram.



Cover of the monthly journal *Tramway and Railway World*, July 1900. The big London exhibition featured in this issue encouraged many local authorities around the country to develop their own electric tramways.

No other local authority in the United Kingdom could afford the conduit system, though a few who were anxious to avoid wires experimented with stud-contact power supply. An electric cable buried below the tracks was connected at intervals to metal studs set flush with the road surface. Under each tram was a long collector shoe which picked up power from the studs electro-magnetically. Neither of the two commercial systems available proved reliable, and the last two stud-contact operators eventually put up wires instead in 1919 (Lincoln) and 1921 (Wolverhampton).



The Kingsway Subway linked the London County Council's northern and southern electric networks from 1908. This is the subway entrance below Waterloo Bridge on the Embankment, showing the unique LCC conduit system with a central slot rail, chosen to avoid using unsightly overhead power lines.

Between 1900 and 1913 tramway traffic throughout Britain trebled as electrification spread through all the big cities and most large towns. This was a rise from around one million to 3.3 million passengers per year. In 1904 there were nearly seven thousand electric trams in service; by 1910 this figure had nearly doubled. The new electric trams could take people farther, faster and at lower fares than anybody could remember. They gave everybody the opportunity to have an affordable ride to work, an evening out in town, or a cheap excursion to the countryside on Sundays and holidays.



The opening of a new electric tram system was a major civic event for any town. Here is the inaugural parade of Leicester Corporation Tramways in 1904.

Newspapers began referring to a new 'riding habit' which took off wherever electric trams appeared. A comment by the local paper in Keighley, Yorkshire, when the town's own electric service opened in 1904 is typical: 'Trams have ceased to be a luxury and are now a necessity of town life'. In the Edwardian years electric trams also had no real competition on the road.

There were very few motor cars, and these belonged to wealthy individuals who might previously have owned a horse-drawn carriage but rarely used public transport. Petrol engines were only developed some years after the electric motor, and reliable motor buses did not start to appear until around 1910. In the years just before the First World War, the electric tram still dominated the urban streets and was widely considered a modern marvel.

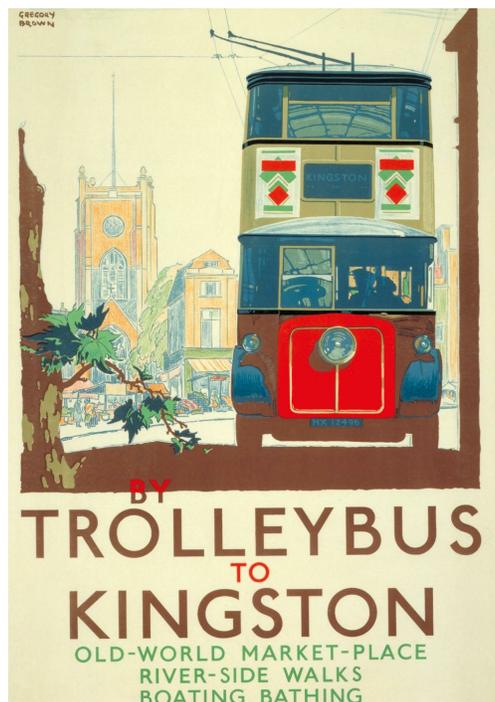


Trams in Lower Briggate, Leeds in 1908. This council-run system became the largest in Yorkshire and was not closed down until 1959, just months before the final English city closure in Sheffield in 1960.

THROUGH WAR AND PEACE

The Edwardian decade (1901–10) is often considered the golden age of the UK electric tram. At the start of the First World War in 1914, passenger numbers were still rising and although few completely new tram systems were planned, further extensions were still under way and demand was booming. Some of the underlying threats to the tram's dominance were already becoming apparent but most of the local authorities and private companies that had invested heavily in trams chose to ignore them.

Nobody could have foreseen the social and economic upheaval brought about by the war, but the financial implications of tramway management policy set by many local councils before the conflict was soon clear. The cheap fares policy maintained nearly everywhere kept driving up passenger numbers but took little account of the need for renewals and essential reinvestment. Alternative vehicles like the motor bus and the 'trackless' electric tram (soon to be known as the trolleybus) emerged just before the war, but neither had yet taken over from trams anywhere.



A poster featuring one of the new 'Diddler' trolleybuses introduced to replace trams in London's south-west suburbs in 1931. Trolleybus no.1 can now be seen at the London Transport Museum's Depot in Acton.

The successful mechanisation of London's buses was soon to supplement the capital's electric tram and underground railway services. Petrol engines looked more promising than battery electric or steam power for buses, but early attempts to develop regular services with motor vehicles were unsuccessful. Eventually, in 1910, the London General Omnibus Company (LGOC), came up with a winner, the bus equivalent of Henry Ford's recently launched Model T motor car. This was the famous B-type, London's first reliable motor bus and ideal for cheap and efficient mass-production. The LGOC was able to replace its entire horse bus fleet with new B-types in just eighteen months. Outside London, motor buses were soon being used on feeder links to tram services in cities like Liverpool and Sheffield, but more regularly on outer and country routes that could not support tram traffic.

Early versions of the trolleybus, essentially a cross between a tram and a bus, were also being marketed as a cheap alternative system to towns with a readymade power supply, which many local authorities had built in the early 1900s. Without the need to install and maintain trackwork, trolleybuses simply require twin overhead wires to provide positive supply and negative return for the electric current from the power station. Infrastructure costs are therefore considerably lower.



Competitors on the streets in 1910 on display together in the London Transport Museum a century later: a B-type motor bus (left) and a West Ham Corporation tram (right). Trams often had twice the capacity of early motor buses and were more reliable, but buses were more flexible and cheaper to run.

They are also more flexible than trams as each vehicle can be steered to the kerb and around obstacles in the street just like a bus, although trolleybuses do normally require a turning circle at the end of a route. The first two passenger trolleybus routes in the United Kingdom were launched on the same day in 1911 by long-term city rivals and neighbours Bradford and Leeds. However, these and a handful of other ‘trackless’ systems opened at this time were still essentially experimental and the trolleybus did not evolve into a fully fledged competitor to the tram until the 1930s.

Soon after the declaration of war in 1914 many local authorities prepared one of their decorated trams as a mobile recruiting office, encouraging men to join their local ‘Pals Battalion’. In Glasgow, the military recruiting campaign promoted for the city by James Dalrymple, the tramways manager, was so effective that he soon had problems staffing his own operations. This led to a radical solution to wartime staff shortages on the trams, first adopted in Glasgow but soon copied across the country.

In March 1915 Glasgow became the first city to employ female tram conductors; six months later there were over eight hundred women in uniform in the city and some were being trained as drivers. By 1918, the last year of the war, some 80 per cent of municipal tram conductors in the United Kingdom were female. Both management and men accepted this changing role in the workplace as a temporary necessity, but only 'for the duration'. Most of the women lost their home front jobs on the trams when the men returned in 1919, and only a few non-unionised private companies continued to employ female uniformed staff in the 1920s.



The first two trolleybus routes in the United Kingdom were opened on the same day, 20 June 1911, by rival neighbours Leeds and Bradford. Both systems were supplied by the Rail-less Electric Traction Company. This scene shows the inaugural Leeds vehicles outside the Town Hall.

Both civilian casualties and damage were modest in the First World War compared to the Blitz attacks of the Second World War, but the tramways did take direct hits in air raids by Zeppelins and later bomber aircraft. The common experience of travelling by tram during the war was not fear, disruption or injury in a raid but exasperation at the increasingly unpleasant journey conditions. Maintaining and repairing the trams in wartime was difficult, and services became less reliable and often overcrowded. The first system closure came in 1917 when the Sheerness & District Tramway in Kent found it was unable to source spares for its German-made Siemens electrical equipment.



A Scarborough tram dressed as a naval gun raising funds for the war effort during the shell shortage of 1915. The slogan refers to the shock bombardment of east coast towns by the German fleet in December 1914, the first attack on British civilians.

Yet it was not until the late 1920s that tram numbers began to decline from their maximum figure of some fourteen thousand cars across the United Kingdom, and total passenger numbers dropped for the first time. However, the overall financial position of most tramways was already starting to look quite serious. The increase in passenger numbers during the war was sustained, giving twice the revenue income in 1920 over 1914, but wholesale prices had trebled in the same period so trams were running at a loss. Councils felt obliged to keep their fares low and to expand services to the new suburbs built in the 1920s, particularly on the edge of big cities like Birmingham, Leeds and Liverpool.



Wartime operation in Doncaster with a female inspector and driver, and a very young male conductor below military age, c.1918. None of them would have been appointed to these uniformed posts before the war, and the women all lost their jobs when the men returned to their posts in 1919.

Most electric tram systems were now twenty to twenty-five years old. Local authorities had to decide whether to modernise their existing trams and equipment or replace them with cheaper motor buses or trolleybuses. There was no obvious single way forward, and across the country councils took different experimental paths. Birmingham was the first to experiment by replacing a complete tram route with trolleybuses in 1922, but it never expanded trolleybus operations across the city. Two years later Keighley, in Yorkshire, was the first local authority to replace its entire electric tramway system with trolleybuses.



A Dudley, Stourbridge & District single-deck tram built in 1919 restored for operation at the Black Country Living Museum. The museum line is on the narrow 3-foot 6-inch gauge track

used on all the original electric tramways in the West Midlands.

The largest early conversion was in Wolverhampton, completed in 1928, which briefly had the most extensive trackless system in the world. Collaboration with local vehicle builders Guy Motors soon gave it a large, advanced double-deck trolleybus design. This was developed in parallel to Guy's latest six-wheel motor buses, and could rival the capacity of trams.



A tram jam in Manchester, c.1920. There are eight trams in this view of Deansgate, blocking the street in both directions.

Most of the smaller tram systems chose motor bus replacement, persuaded by the dramatic progress in bus design at this time. By contrast the typical new tramcar of the time was a little more comfortable for both passengers and crew but essentially very similar to its pre-1914 predecessor. Little effort had been made to bring the tram up to date and practically no research was being done in Britain to improve construction methods, design or technical operation.

The main exception to this traditional approach was at the Underground Group of companies in London, which was already in the vanguard of bus and Tube train development, often adopting innovative mass production techniques from the American motor industry in Detroit. Its experiments with new prototype trams in the late 1920s led to the creation of a radically modern all-steel body design for trams, and London's first operational trolleybuses, which both entered service in 1931. The luxurious Feltham cars, named after the west London suburb where they and the early trolleybuses

were built, were the most advanced trams in the country at the time, and said to be the fastest in Europe, but they appeared just as the whole future of tramways in Britain was being called into question.

A Royal Commission Report in 1931 came down strongly in favour of the motor or trolleybus as the public transport of the future. Their considered view was that tramways 'if not an obsolete form of transport are at all events in a state of obsolescence and cause much unnecessary congestion and considerable danger to the public'. They therefore recommended that no additional tramways should be constructed and that they should gradually disappear and give place to other forms of transport. The Commission's view probably reflected public perceptions at the time, where trams were widely considered to be old fashioned, a threat to road safety and the major cause of traffic congestion in towns. This did not translate into national policy but the official disparagement of trams and recommendations for replacement firmly set the tone for a decade of tramway decline across the country.



Wolverhampton Corporation replaced its entire tram network with trolleybuses between 1924 and 1928. By the time these locally built Sunbeam trolleys were delivered in 1933, the town had briefly become the largest trolleybus operator in the world.

Developments in London were, as usual, rather different to every other city in the country. In July 1933 a new public corporation, London Transport, was created to run all public transport services in the city except the suburban

routes of the main line railways. At last London's public transport could be co-ordinated by a single authority. A few months later an ambitious five-year New Works Programme was announced which included new Tube lines and the replacement of the capital's tramway system, then the largest in the world, with trolleybuses. Most of the new vehicles were built by AEC, the main supplier of London's buses, and were large enough to replace the trams on a one-for-one basis. Between 1935 and 1940 well over half London's huge tram system disappeared and the trolleybus network grew from just 18 route miles to 255. Being able to use the same electrical distribution system as the trams right across the city, and shared power generation with the Underground, was a great advantage.



The Kingsway Subway in London was enlarged to take double-deck trams in 1931. This is the underground tram station at Holborn. The subway closed in 1952 but most of it survives almost intact and the northern ramp in Southampton Row still has conduit tram track in place.

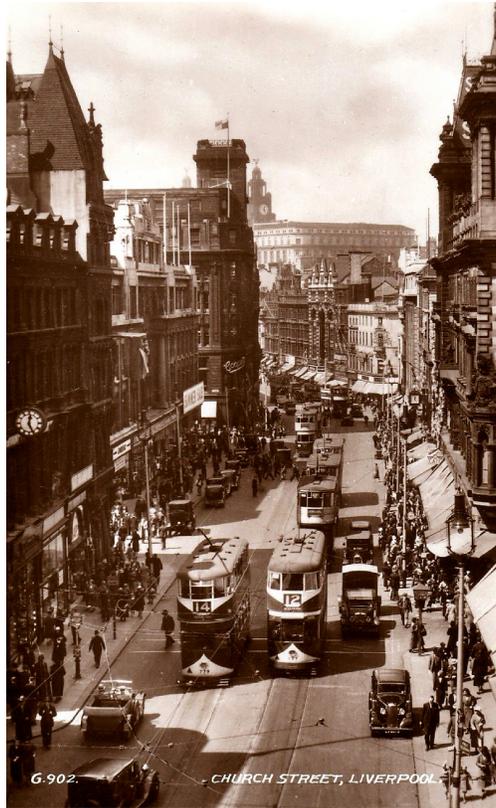
By the mid-1930s it was not only the smaller urban tramway systems that had been replaced. Trams had been succeeded by trolleybuses in Bournemouth, Nottingham and Portsmouth by 1936. The company-run Bristol network, the urban electric pioneer, was purchased by the council in 1937 and the first bus replacements followed in 1938. There were route closures in Belfast, Birmingham, Cardiff, Leicester, Manchester, Newcastle and Plymouth. A handful of systems including Aberdeen, Leeds, Sheffield

and Sunderland continued to invest in modern trams while trimming back their networks.



An experimental metal-bodied Feltham car with centre doors built for London's Metropolitan Electric Tramways in 1930. Tram development was abandoned soon afterwards in favour of trolleybuses. This car was sold on to Sunderland in 1950 and now runs at the National Tramway Museum, Crich.

The only British cities that continued to plan for the expansion of their tramway systems in the 1930s *and* built modern tramcars to run on them were the two municipal pioneers of the 1890s, Liverpool and Glasgow. Both corporations had the skills, facilities and experience to design and build their own new trams with the latest technical and design features, and began to do so after 1935. On a smaller scale, another system which bucked the trend for tram replacement with an impressively modern streamlined fleet in the 1930s was Blackpool, destined to be the only survivor by the early 1960s.



Trams still outnumber cars in this 1939 view of Liverpool's main shopping street, looking west towards the Liver building. The city did not start tram replacement until the 1950s, passing its latest streamliners on to Glasgow. Final closure came in 1957.

FROM BLITZ TO CLOSURE

By the outbreak of the Second World War in September 1939, the number of trams operating in Britain had dropped to around seven thousand, roughly half the peak figure reached in the 1920s. During the 1930s trams had been eliminated from more than fifty towns across the country, and replaced by motor buses or trolleybuses. Trams had been condemned in some larger urban areas such as London, Birmingham and Manchester but none of the big cities had completed their replacement programmes. The war held up the abandonment process for a time, but when it started again it was to affect systems which had had been largely immune, such as Liverpool, Leeds, Sheffield and Glasgow.

It is hard to know what might have happened if the war had not taken place, but it seems likely that the end would simply have come sooner for Britain's trams. As it was, conversion work continued at a reduced pace for the first year of the war, but was halted in most areas when mass bombing raids by the Luftwaffe began in the autumn of 1940. Bomb damage was extensive in some cities but both the tramways operating staff and the systems were incredibly resilient. It became a matter of pride to repair bomb damage wherever possible and keep the trams running as a vital wartime service and an important morale booster for the civilian population. Working on the trams in cities experiencing heavy aerial bombardment was as dangerous and difficult as any Home Front occupation, and again it was war work shared by men and women.



Trolleybus 1521 made the final passenger journey for London Transport on the night of 5/6 May 1962. A few days earlier it demonstrated one of the common problems with trolleybuses: dewirement at a busy road junction. Here an inspector is using the bamboo pole kept underneath the bus to push the booms back on the wires. More than fifty years later 1521 is still running at the East Anglian Transport Museum.

Remarkably, some cities which suffered Blitz attacks were still able to carry out their modernisation programmes while the war continued. Hull, which had converted the northern part of its tram network to trolleybus operation in 1937, ended its southern operation by 1942 despite earlier Blitz attacks and sold many of its remaining tramcars for further service in Leeds. In Bristol, tram operation continued on two surviving routes until 1941 when a German bomb cut the main power supply, and services ended prematurely. Plymouth was down to one tram route when the war started but this was still running through the devastated city centre six years later and was the last tram system in the West Country to close in September 1945.



Sheffield city centre, December 1940, with a tram and a department store engulfed in a firestorm created by German incendiary bombs after one of the heaviest Blitz attacks on the city in the Second World War.

In the five years after the war most of the towns and cities that had begun tram replacement in the 1930s finished the job. Trams disappeared from Bolton and Salford in 1947, Bury, Blackburn, Leicester, Manchester and Southampton in 1949, then Cardiff, Newcastle and Bradford the following year. In London replacement of the remaining trams only started in 1950 because priority was given to completing the Central line Tube extensions postponed in 1939, which were opened in 1947–9. It was decided not to extend the trolleybus system, already the largest in the world, but to use new diesel buses to phase out the trams in a two-year programme.



The upper deck of a rundown Bolton tram photographed soon after the war and just before the town's system was replaced by buses in 1947.

A special 'tramatorium' was set up in Woolwich to which London's trams made their final journey to be broken up and burned. The last week of operation was announced on the side of every car and all passengers were issued with special 'Last Tram Week' souvenir tickets. The final night, 5/6 July 1952, became a big public event with crowds lining the streets and the last car unable to reach New Cross depot until the early hours of the morning. A sentimental, but beautifully filmed short documentary, *The Elephant Will Never Forget*, was made by British Transport Films to capture the final days of London's trams, and was shown in cinemas after the closure.



Last Tram Week in London, July 1952, when each tram announced its own fate and every passenger was issued with a special souvenir ticket. Tram 100, seen here at Eltham, had been in service since 1928 but would now be scrapped and burned at the 'tramatorium' in Woolwich within six months.

In the austerity years after the war there were still a handful of large tramway systems in the United Kingdom, mostly run by local authorities, that were determined to carry on and even expand and modernise. Leeds, Sheffield, Glasgow, Edinburgh, Aberdeen, Blackpool and Sunderland all held out for a while but nearly everyone and everything had turned against trams by the 1950s.



A post-war Sheffield tram and a Belfast trolleybus from the second largest UK system, both operating a long way from their original homes at the East Anglian Transport Museum in 2015.

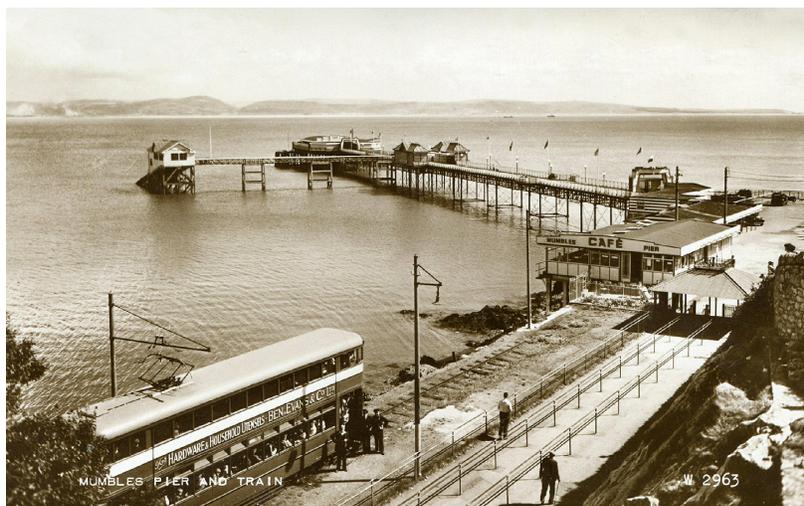
Town planners preparing schemes for post-war reconstruction of bomb-battered town centres and New Towns never included tramways in their proposals. There was a blinkered assumption that trams could not be accommodated in new street layouts that were designed for the bus and the private car, with gyratory systems and underpasses. The result was more destruction of city centres by local council planners and politicians than by the Luftwaffe, and a general failure to create improved and better-laid-out urban environments. Towns and cities became dominated rather than liberated by new urban highways and inner ring roads.

Rising costs hit the remaining tramways hard and were an almost insuperable problem after the war. By the late 1940s the price of rails was about 60 per cent higher than before the war and electricity costs were up by around 50 per cent. Electricity was also now beyond local authority control, part of a newly nationalised industry that could no longer subsidise local operations. Passenger numbers were at an all-time peak in towns everywhere before the sudden boom in car ownership from the mid-1950s, but the electric tram could not provide cheap and efficient public transport where it was needed. A new tram might cost up to £10,000, while a new bus could be supplied at less than half that price. Both operating and maintenance costs were rising all round, and even the larger remaining operators reported heavy

losses. Liverpool and Glasgow showed deficits of around £500k and £200k respectively on their tramway accounts in 1950/51.

With persuasive arguments about cost, flexibility and street congestion all stacked against them, even the big tramway stalwarts had to throw in the towel. Liverpool started conversions and closures in 1949, Aberdeen in 1951, Sunderland and Edinburgh in 1952, Dundee in 1955. By 1958, there were only just over one thousand trams still running in Britain and Ireland. The last electric tramway in Ireland, the Hill of Howth near Dublin, succumbed in 1959. In January 1960 the historic Swansea & Mumbles Railway closed, successor to the Oystermouth Railway & Tramroad Company that had run the first passenger service and was now the last in South Wales. The final three big city operations were already preparing for closure. The last Leeds tram ran in 1959, the final Sheffield car in 1960 and two years later, in September 1962, Glasgow gave up its last trams.

In the ten years since the end of London's trams, system closures had become increasingly large and emotional public events. Glasgow, which had identified with its trams more than any other British city, had only taken the reluctant and unpopular decision to abandon its whole system in 1955. The final send-off was almost a week-long drawn out affair, culminating in a ceremonial parade of 20 trams which moved slowly through the city like a funeral cortege, watched by an estimated crowd of 250,000 people who braved the rain to pay their final respects.



The historic Swansea & Mumbles Railway, successor to the Oystermouth Tramroad, was the last tramway to close in South Wales in January 1960. This postcard view of the Mumbles

terminus c.1950 shows one of the giant electric cars introduced in 1927. Only a short section of one tram survives in Swansea Museum.

This left Blackpool as the only remaining street-running electric tramway in mainland Britain for the next thirty years. It too was about to be cut back to the seafront promenade and the inter-urban line to Fleetwood. On the Isle of Man the Douglas horse trams, the Manx Electric Railway and the Snaefell Mountain Railway continued seasonal operations, as did the cable-worked Great Orme Tramway in North Wales and Volk's Electric Railway in Brighton. None of them, apart from Blackpool, provide a regular public transport service, although they have all become part of the heritage leisure industry, with its mixture of popular entertainment and nostalgia for lost times.



For thirty years, between 1962 and 1992, the only street-running trams in Britain were on the Blackpool system. This shot taken in 1985 shows one of the English Electric 'railcoaches' built in the 1930s near the northern terminus in Fleetwood.

Six months before the demise of Glasgow's trams, London Transport closed down its electric trolleybus system in May 1962. At the time there were still more than twenty urban trolleybus operations in British towns. All of these had partly or wholly replaced local tram systems between the 1920s and the 1940s, though as a hybrid vehicle they had never been an entirely convincing alternative to the tram or appeared demonstrably superior to the

cheap and flexible diesel bus. Most operators had modernised their systems over time, and Bournemouth had yet to order its most up-to-date trolleybuses, which would be the last to go into service in the United Kingdom in 1965. But the apparent good health of the remaining systems in the early 1960s was deceptive and within a decade they were gone. Appropriately enough, the last British system to close in 1972 was Bradford, one of the first cities to open a trolleybus route in 1911.



A gathering of preserved Bradford vehicles at the Trolleybus Museum in Sandtoft to mark the fortieth anniversary of the last system closure in the UK.

LIGHT RAIL RENAISSANCE

While trams disappeared completely from Britain's local government and town planning agenda in the 1960s, many cities in Continental Europe continued to rely on trams as a key public transport mode alongside buses and trolleybuses. This was particularly true of the communist Eastern Bloc countries aligned with the Soviet Union, where there was no real private car market and public transport was the only available option for almost the entire population.

In Western Europe some cities such as Lisbon and Milan continued to run antiquated traditional trams of pre-war design which have since acquired a heritage tourism appeal alongside more modern rolling stock. In Austria, Belgium, the Netherlands, Switzerland and West Germany there was considerable investment in tramway modernisation from the 1970s and 80s. Cities in France, Italy and Spain, where public transport had declined in the 1950s and 60s, as well as Nordic cities in Sweden and Norway, also began to reintroduce urban trams.



A new Spanish-built CAF Urbos tram on the long-awaited Birmingham city centre extension of the Midland Metro down Corporation Street, 2017. This street presence and access to both New Street station and the main shopping areas brought an immediate boost to light rail ridership.

France has led the way in a light rail renaissance with more than twenty completely new urban systems opening in cities and towns across the country in the last twenty-five years. In Ireland, where the last traditional electric tramway closed in 1959, a modern light rail system for Dublin called Luas (Speed), opened in 2004 and is being extended. The latest European country to join the tram renaissance is Luxembourg, where a new light rail operation called Luxtram launches in 2018.

Farther afield, Melbourne, Australia, which has had trams since the 1880s, now trumps St Petersburg in Russia with the world's largest tramway network, featuring both heritage and modern rolling stock. The former British colony of Hong Kong has retained its UK-style double-deck trams after its return to Chinese control in 1997, while mainland China has opened a series of new light rail systems in its rapidly growing cities in the twenty-first century.



Four generations of electric trams in Vienna, from pre-1914 (second from right) to the latest ultra-low floor design in 2006 (far left).The Austrian capital now has the largest tram system in Europe.

Even the automobile-obsessed United States began to take a new interest in this apparently outmoded system of transport which had almost disappeared

from US cities. In 1972 American urban planners coined the term *light rail* to describe new tram and streetcar transformations that were then being planned in Europe and North America. It became a generic name covering a range of rail-based urban public transport systems from street line operations to exclusive rights of way above or alongside roads and railway lines. Edmonton in Alberta, Canada, was the first city in North America to open a new light rail network in 1978, soon followed by San Diego in the United States. Since that time more than twenty North American cities have joined the light rail revival in addition to the handful of cities that never completely abandoned the trolley. Gradually, light rail systems are being re-adopted as a means of freeing up congested and polluted cities that have become dominated by the automobile.



A CAF Urbos tram on the new light rail system in Besançon, France in 2015. More than twenty completely new tram networks have opened in France since the 1990s and more are planned.

Back in 1960s Britain there was an almost universal belief that trams or any related form of electric street transport belonged to the past, to be nostalgically remembered perhaps but only seen in a museum context. Oil was cheap and there were few concerns at the time about air pollution or other environmental impacts from petrol or diesel emissions despite the boom in car ownership. Cost was all, and from a financial perspective electric public transport on town roads was no longer considered sustainable. Diesel

buses seemed the only logical answer to provide reduced and economical public transport services in urban areas.



UK-style double-deck trams still run in the former British colony of Hong Kong, returned to Chinese control in 1997. Mainland China has opened a series of brand new light rail systems in its rapidly growing cities in the twenty-first century.

The argument that electricity was a reliable, home-produced power source while imported oil might be vulnerable also carried little weight before the first oil crisis of 1973/4. Favouring oil soon sealed the fate of the trolleybus as well as the tram, particularly after the closure of the large London network in 1962. There were then twenty-two other British trolleybus systems still operating, but these were progressively shut down over the next decade. The last to go were Belfast and Reading (1968), Bournemouth and Cardiff (1969), Walsall (1970), Tees-side (1971) and finally Bradford (1972).

There have been a number of proposals since to reintroduce trolleybuses, including a major scheme for Leeds, which was only finally rejected by the Department for Transport (DfT) in 2016. There is now little likelihood that this form of transport will be back on British city streets in the foreseeable future. However, growing concern about the serious health risks from high levels of air pollution on city streets caused by petrol and diesel emissions has led to the introduction of both hybrid diesel-electric and battery-powered all-electric buses in the twenty-first century.



Few completely new trolleybus systems have opened around the world in the twenty-first century but most existing networks have been re-equipped with modern vehicles. This articulated low-floor trolleybus was supplied to Vancouver, Canada in 2009.

After closing all but one of its traditional street tramways, the United Kingdom was not initially involved in any novel developments in urban light rail. The first example of progressive public transport planning came in the 1970s when a proposal from the new Tyne & Wear Passenger Transport Executive was accepted for the principal metropolitan areas of the north-east. The plans involved modernising the run-down local rail services round Newcastle, Gateshead and Sunderland to create a joined-up rapid-transit network linked by new tunnels and bridges over the rivers.

The Tyne & Wear Metro, which opened in 1980, is an electrified system combining elements of light rail, heavy underground metro and suburban rail lines, but with no street running. Thirty-five years later nearly forty million passenger journeys were being made annually and patronage is still growing. But despite its undoubted success and subsequent extension, the Tyne & Wear Metro was not adopted as a model for urban transport planning in any other part of the United Kingdom.



A Tyne & Wear Metro train in Sunderland, 2003. The Wearmouth road bridge on the left carried Sunderland Corporation trams over the river until 1954.

When plans were drawn up in the early 1980s to redevelop the run-down derelict former docklands of east London, it was realised that a new public transport system was essential to enable both the commercial and residential regeneration of the area. There was strong pressure from government to explore cheaper alternatives to an extension of the new Jubilee Tube line. Light rail was chosen as it appeared to be the most cost-effective solution.

In 1982 construction of the Docklands Light Railway (DLR) was authorised, designed as a stand-alone rapid transit system to link the isolated Isle of Dogs, where a new business hub was planned at Canary Wharf, with the City and wider area of east and south-east London. Through re-using the trackbed of some disused freight lines linked by new elevated sections featuring tight curves and steep gradients, the DLR would become the updated equivalent of a traditional tramway, though without any street running. It could use articulated passenger cars based on the modern trams used in German cities but with no drivers. The latest computer technology enabled remote, fully automated train control to be adopted.

A complete initial network was built in just five years, opening in 1987. It was constructed within a tight budget of £77m, at a time when the estimated cost of a Tube extension to Docklands was £325m. In fact the cost savings of the DLR soon proved largely illusory. It was notoriously unreliable in the early years and required expensive reconstruction and upgrading of the control systems. Above all, the DLR alone was clearly inadequate to serve

the new fast-growing business centre created at Canary Wharf. The Jubilee line extension, finally completed in 1999 at much greater expense, was still found to be essential for Docklands. After a bumpy early ride the DLR became, in the early twenty-first century, one of the fastest growing and most reliable rail systems in the country. In the long run it has been a great success and become a crucial part of London's developing passenger transport network.



The Docklands Light Railway (DLR) in east London, 2009. The O2 dome at North Greenwich in the centre and the towers of Canary Wharf beyond followed on from the opening of the DLR in 1987, which kickstarted the redevelopment of this run-down part of the capital.

An underground rail proposal for Manchester similar to the Tyne & Wear Metro had been rejected by the Government in the late 1970s as far too costly. But Manchester lacked rail access into and across the busy city centre, where public transport relied on buses. Manchester Metrolink was devised in the 1980s as a scheme to develop a more efficient and cost-effective city transport system using modern trams. The plan was to progressively convert some of Manchester's suburban commuter lines to light rail operation and combine these with new street tramways across the city centre. Modern trams, but not trains, could be run over the linked systems, with services conveniently extended well beyond the main railway stations.

Metrolink Phase One was opened by the Queen on 17 July 1992, becoming the United Kingdom's first modern street-running light rail system. With the sole exception of Blackpool, this was also the first time in thirty years that trams had been allowed to share road space with other traffic. More

significantly, it marked the preliminary stage in a comprehensive public transport plan that could integrate light rail, heavy rail and bus services across an extensive urban area.

By the time Metrolink celebrated its twenty-fifth birthday in 2017 the network had grown into seven linked and radiating lines, including a second city crossing. It has developed into the largest and most successful light rail system in the United Kingdom, covering over 50 route miles and carrying 53 million passengers a year. Just as the London Underground has long been seen as a symbol of the capital, the Metrolink trams have taken on this accolade for Greater Manchester, underlining the region's rapidly revived economy since the 1990s.

The other light rail networks which followed Metrolink have had varying fortunes. Sheffield Supertram, the second system to be completed in 1994/5, was built to high design and engineering standards, successfully overcoming the challenge of the city's severe gradients. However, Supertram soon faced financial problems in competition with newly deregulated bus services. This was resolved by bus company Stagecoach taking over the operating contract for Supertram, but it has constrained the expansion and growth of the network. Extended services to Rotherham are being trialled in 2018, using new tram/train units designed for use on both national rail and tram lines, which have different safety and control systems. Tram/train operation has long been used in Germany but this is the first dual procedure in the United Kingdom.

Midland Metro, a scheme for a new-generation tramway network across the West Midlands conurbation, was first proposed in the late 1980s. In contrast to Manchester Metrolink, its implementation has been painfully slow and its benefits to the area have so far been very limited. Line One, designed to provide a new suburban tram service over a long-disused railway route between Birmingham and Wolverhampton, opened in 1999. Annual passenger figures never rose above five million, well below the predicted numbers.



First and second generation Manchester Metrolink trams at Salford Quays, 2010. On the left is one of the original Italian-built T68 units, all now replaced by a fleet of Bombardier Flexity Swift trams built in Austria (right).

However, the eventual completion in 2016 of the long-delayed short extension across Birmingham city centre was a major milestone. This at last provided interchange with the rebuilt New Street station and direct access to the new Grand Central retail complex. It also put a fleet of sleek new trams prominently on the city streets for the first time, giving them much greater visibility. Having flatlined for fifteen years, passenger figures suddenly improved dramatically in 2017. An extensive Metro expansion package has now been agreed, and the tram network is expected to triple in size over the next decade. Perhaps light rail in the West Midlands can now begin to match the impressive development and progress of Greater Manchester. The Midland Metro needs to live up to its name and provide fast local connections by the time the High Speed 2 rail line arrives in Birmingham, scheduled for 2026.

Croydon Tramlink was designed to improve access to the town's major office and shopping centre, already the largest in south London but facing growing problems of traffic congestion. Although Croydon had fast rail links with central London, most journeys in the suburbs were made by car and not public transport. Tramlink provides rapid and convenient east-west access through the town centre and across south London to Wimbledon, with Tube and rail connections. London's first suburban light rail network opened in May 2000. Within weeks the trams were carrying fifty to sixty thousand

riders a day, increasing by 2–3 per cent each month. Up to 25 per cent of riders surveyed said that they had previously used cars for their journey, more than double the modal shift that planners had predicted in three years.



A Stagecoach Supertram at the Cathedral stop in Sheffield city centre. The original light rail system completed in 1995 is being extended over National Rail tracks to Rotherham using new tram/train units that can work with both the different operating and safety systems.

Tramlink has had exactly the impact on local travel in outer London that had been hoped for, but much faster. The system has remained extremely well used, doubling its passenger figures in fifteen years, but it has not been extended and no further light rail schemes are now proposed for the capital. Transport for London's future plans have shifted from trams to more Underground services, with all-electric buses on the streets. There will be no more rails in the road, although this would be much cheaper than new Tubes.

Construction work on Nottingham Express Transit (NET) began in 2000 just as Croydon Tramlink opened. NET was the first new tramway to be authorised by the Labour government elected in 1997, which was determined to improve local transport around the country. Ambitious targets were set to reduce car use in urban areas and under the Transport Act 2000 all passenger transport authorities were required to produce a plan which would address environmental and access needs. At the time there were up to twenty-five new light rail schemes in preparation around the country.



Interchange between Tramlink and National Rail at East Croydon station, south London, 2016. On the right is one of the original Bombardier trams used since Tramlink opened in 2000. In the centre is one of the newly delivered Stadler trams which meet the demand for a more frequent service.

By the time the first phase of NET opened four years later in March 2004, all but one of the other new tram schemes had been turned down, cancelled or abandoned. There had been a policy shift at the Department for Transport (DfT) from support for new tramways to dismissing them nearly everywhere in favour of buses. This was largely because of cost and an apparent failure to offer value for money under government scrutiny. NET became not only the first new tramway to open in England in the first decade of the twenty-first century, but also the last.

NET Line One opened in 2004 and provided some ninety million passenger journeys over the next ten years, exceeding the most optimistic predictions. Its instant success supported the case for a southern and western extension to begin construction in 2012, doubling the size of the system when it opened in 2015. Trams now provide the backbone to local public transport services across Nottingham with which bus and national rail services are closely integrated.

Edinburgh is the only other UK city to build and open a new tramway in the twenty-first century. Unfortunately the project has been the mirror image of Nottingham's success story. A big infrastructure project is rarely trouble free, but the saga of Edinburgh Trams has been particularly fraught, mainly,

it appears, through poor contract specification and project management. The delays, disruption and spiralling costs of this project are still being investigated by a public inquiry in Scotland which, at the time of writing, has still not reported its findings more than three years after the truncated tramway opened. It will be a case study in how a public/private partnership can go badly wrong, cost more than twice the original estimate and end up with a project half the size of the original scheme.



One of the Alstom Citadis units added to the original Nottingham Express Transit (NET) fleet when the tram system was doubled in size with extensions in 2015. It is seen leaving the new bridge over the railway station where there is now direct interchange with National Rail trains.

The tramway that finally opened in 2014 between Edinburgh Airport and the city centre carried nearly five million passengers in its first year, well ahead of target. However, it is quite a limited service, mainly providing a convenient airport link for travellers and visitors. Edinburgh Trams will only meet its original purpose of providing a useful everyday service for city residents and commuters if it is extended out to Leith as originally intended. Edinburgh City Council remains determined to achieve this, but the project is a political hot potato in Scotland and it is not clear how the extension will be funded given the disastrous handling of the initial scheme.

Light rail has had a rather modest roller coaster ride in the United Kingdom over the last twenty-five years. There are now just nine systems in

operation, six of them opened since 1992. Some extensions are in the pipeline but no completely new tram systems are planned for the near future. This does not compare well with developments in the cities of Continental Europe or even the United States.

Tramways are expensive, long-term capital projects and a single poorly managed scheme that runs drastically over budget can have a damaging impact on public and political perception. Getting a tram system built on time with minimal inconvenience is critical. But it is also now evident that once a system is up and running, the vast majority of passengers much prefer trams to buses. Light rail is far more popular with the public and a lot more effective at attracting people out of their cars in towns and cities. Trams can deliver the practical benefits of easy access, high capacity, no emissions, comfort, speed and reliability. They offer superior, highly efficient and pollution free public transport and are a positive, civilising asset to any town or urban area. Forget the fantasy of driverless electric cars: modern electric trams already offer the best mass city transport today and the most environmentally friendly solution for the future.



Edinburgh Trams, opened in 2014, has the longest light rail units in Britain. Each of the Spanish-built CAF articulated units is the length of three buses, as demonstrated here on Princes Street in a view from the Scott Monument.

FURTHER READING

BOOKS

- Buckley, R.J. *A History of Tramways from Horse to Rapid Transit*. David & Charles, 1975.
- Green, Oliver. *Rails in the Road, A History of Tramways in Britain and Ireland*. Pen & Sword Books, 2016.
- Klapper, Charles. *The Golden Age of Tramways*. Routledge & Kegan Paul, 1961.
- Lockwood, Stephen. *A–Z of British Trolleybuses*. Crowood Press, 2017.
- Lumb, Geoff. *British Trolleybuses 1911–1972*. Ian Allan Publishing, 1995.
- Millington, James. *UK Light Rail and Tram Museum Guide 2016*. Train Crazy Publishing, 2016.
- Murray, Alan. *British Trolleybus Centenary 1911–2011*. Trolleybooks, 2011.
- Owen, Nicholas. *History of the British Trolleybus*. David & Charles, 1974.
- Patton, Brian. *The Development of the Modern Tram*. Adam Gordon, 2006.
- Price, J.H. *A Source Book of Trams*. Ward Lock, 1980.
- Pritchard, Robert & Yearsley, Alan. *UK Metro & Light Rail Systems*. Platform 5 Publishing, 2017.
- Reed, John. *London Tramways*. Capital Transport, 1997.
- Rush, R.W. *Horse Trams of the British Isles*. Oakwood Press, 2004.
- Schwandl, Robert. *Tram Atlas Britain & Ireland*. Robert Schwandl Verlag, 2015.
- Taplin, Michael and Russell, Michael. *Trams in Western Europe*. Capital Transport, 2002.
- Turner, Keith. *Directory of British Tramways, volumes 1–3*. Tempus/History Press, 2007–10.

JOURNALS, SOCIETIES AND WEBSITES

- Tramways & Urban Transit*, monthly journal of the Light Rail Transit Association (LRTA). Website: www.lrta.org
- Tramway & Light Railway Society (TLRS)*
Website: www.tramwayinfo.com

British Trolleybus Society: www.britishtrolley.org.uk
Website: www.britishtramsonline.co.uk

PLACES TO VISIT

The museums listed here all have at least two preserved trams and/or trolleybuses. The largest museum collections are held at Crich (trams) and Sandtoft (trolleybuses), each with over fifty vehicles. Of the working collections only the East Anglian Transport Museum and the Black Country Living Museum currently have both trams and trolleybuses in operation. They will soon be joined by Beamish, where a trolleybus circuit is planned for its 1950s town development.

Most museum vehicles will normally be seen on static display but some may be undergoing restoration, out on loan or unavailable to view. Those museums marked with an asterisk * usually have vehicles in operation during opening hours and offer visitor rides on site. Some are run by volunteers and many have seasonal operation only. Please check the websites or phone in advance of a visit for information about opening times, access, special events and operations.



The Trolleybus Museum at Sandtoft, Lincolnshire, which has the largest collection of trolleybuses in the United Kingdom. The three vehicles nearest the camera formerly ran on the Reading, Glasgow and Manchester trolleybus systems.

MUSEUMS

*Beamish, the Living Museum of the North**, Beamish, County Durham
DH9 0RG. Telephone: 01913 704000. Website: www.beamish.org.uk

*Black Country Living Museum**, Tipton Road, Dudley DY1 4SQ.
Telephone: 01215 579643. Website: www.bclm.co.uk

Bradford Industrial Museum, Moorside Mills, Moorside Road, Eccleshill,
Bradford BD2 3HP. Telephone: 01274 435900.
Website: www.bradfordmuseums.org

*East Anglian Transport Museum**, Chapel Road, Carlton Colville, Lowestoft
NR33 8BL. Telephone: 01502 518459.

Website: www.eatransportmuseum.co.uk

Grampian Transport Museum, Montgarrie Road, Alford, Aberdeenshire
AB33 8AE. Telephone: 01975 562292. Website: www.gtm.org.uk

Greater Manchester Museum of Transport, Boyle Street, Cheetham,
Manchester M8 8UW. Telephone: 0161 205 2122.

Website: www.gmts.co.uk

Ipswich Transport Museum, Old Trolleybus Depot, Cobham Road, Ipswich
IP3 9JD. Telephone: 01473 715666.

Website: www.ipswichtransportmuseum.co.uk

London Transport Museum, Covent Garden Piazza, London WC2E 7BB.
Telephone: 0207 379 6344 Website: www.ltmuseum.co.uk

Milestones Museum, Leisure Park, Churchill Way West, Basingstoke
RG22 6PG. Telephone: 01256 639550.

Website: www.hampshireculturaltrust.org.uk/milestones-museum

National Tramway Museum, Crich*, Crich Tramway Village, near Matlock,
Derbyshire DE4 5DP. Telephone: 01773 854321.

Email: enquiry@tramway.co.uk

Riverside Museum, Glasgow, 100 Pointhouse Place, Glasgow G3 8RS.
Telephone: 0141 287 2720.

Website: www.glasgowlife.org.uk

Streetlife Museum of Transport, High Street, Hull HU1 1PS.

Telephone: 01482 300300. Email: museums@hcandl.co.uk

*Summerlee Museum of Scottish Industrial Life**, Heritage Way, Coatbridge,
North Lanarkshire ML5 1QD. Telephone: 01236 638460.

Website: www.culturenl.co.uk/summerlee



Restored Liverpool and Birkenhead electric cars running on the Wirral Heritage Tramway at the Mersey ferry terminal in Birkenhead, 2010. This is close to the site of Train's original horse-drawn street railway opened in 1860.

Swansea Museum, Victoria Road, The Maritime Quarter, Swansea SA1 1SN.

Telephone: 01792 653763. Website: www.swanseamuseum.co.uk

*The Trolleybus Museum**, Belton Road, Sandtoft, Doncaster, North Lincolnshire DN8 5SX. Telephone: 01724 711391.

Website: www.sandtoft.org.uk

Ulster Folk & Transport Museum, Cultra, Holywood BT18 OEU.

Telephone: 02890 428428. Website: www.nmni.com

HERITAGE TRAMWAYS

These are seasonal operations only. Please check operating days before visiting.

Douglas Bay Horse Tramway, Isle of Man*. Telephone: 07624 412374.

Website: www.douglashorsetramway.net

Great Orme Tramway, Llandudno*, Victoria Station, Church Walks, Llandudno LL30 2NB. Telephone: 01492 677877.

Website: www.greatormetramway.co.uk

Heaton Park Tramway, Manchester*. Telephone: 0161 740 1919

Website: www.heatonparktramway.org.uk



The famous Blackpool tramway has been fully modernised and upgraded in the twenty-first century. This is the first day of operation with a new fleet of Bombardier Flexity Swift trams on 4 April 2012. The much-loved heritage trams have been retained to provide a supplementary service.

*Manx Electric and Snaefell Mountain Railways, IOM**.

Website: www.manselectricrailway.co.uk

*Seaton Tramway, Devon**, Harbour Road, Seaton, Devon EX12 2NQ.

Telephone: 01297 20375. Website: www.tram.co.uk

*Volk's Electric Railway, Brighton**, Arch 285, Madeira Drive, Brighton, East Sussex BN2 1EN. Telephone: 01273 292718.

Website: www.volkselectricrailway.co.uk

*Wirral Tramway & Transport Museum**, 1 Taylor Street, Birkenhead, Merseyside CH41 1BG. Telephone: 0151 647 2128.

Website: www.mtps.co.uk

UK LIGHT RAIL SYSTEMS

These are all modern light rail systems with a regular public service operation. Blackpool is the only one that also operates heritage vehicles at certain times. Check websites for current service details.

Blackpool Tramway: www.blackpooltransport.com

Docklands Light Railway, London: www.tfl.gov.uk/modes/dlr

Edinburgh Trams: www.edinburghtrams.com

London Tramlink: www.tfl.gov.uk/trams

Manchester Metrolink: www.metrolink.co.uk

Midland Metro: www.nxbus.co.uk/the-metro

Nottingham Express Transit: www.thetram.net

Stagecoach Supertram, Sheffield: www.supertram.net

Tyne & Wear Metro: www.nexus.org.uk/metro

ABOUT THE AUTHOR

Oliver Green is a museums consultant and historian. Former Head Curator of the London Transport Museum, he is the author of several books on transport and design history, including *The Tube* and *Discovering London's Railway Stations* for Shire. Oliver is a Fellow of the Royal Society of Arts.

Shire Publications, an imprint of Osprey
Publishing Ltd
c/o Bloomsbury Publishing Plc
PO Box 883, Oxford, OX1 9PL, UK

Or

c/o Bloomsbury Publishing Inc.
1385 Broadway, 5th Floor, New York, NY 10018, USA

E-mail: shire@bloomsbury.com
www.shirebooks.co.uk

SHIRE is a trademark of Osprey Publishing Ltd, a division of Bloomsbury Publishing Plc.

First published in Great Britain in 2018

This electronic edition published in 2017 by Bloomsbury Publishing Plc.
© 2018 Oliver Green

All rights reserved. No part of this publication may be used or reproduced in any form, without prior written permission, except in the case of brief quotations embodied in critical articles and reviews. Enquiries should be addressed to the Publishers.

Every attempt has been made by the Publishers to secure the appropriate permissions for materials reproduced in this book. If there has been any oversight we will be happy to rectify the situation and a written submission should be made to the Publishers.

A CIP catalogue record for this book is available from the British Library.

Shire Library no. 842.

PB ISBN: 978 1 78442 248 6
ePub ISBN: 978 1 78442 249 3

ePDF ISBN: 978 1 78442 250 9
XML ISBN: 978 1 78442 251 6

Oliver Green has asserted his right under the Copyright, Designs and Patents Act, 1988, to be identified as the author of this book.

Shire Publications supports the Woodland Trust, the UK's leading woodland conservation charity. Between 2014 and 2018 our donations are being spent on their Centenary Woods project in the UK.

COVER IMAGE

Front cover: A Blackpool tram built in 1926 back in service after restoration at the National Tramway Museum at Crich. **Back cover:** This symbol appeared on the front and back of every London Transport trolleybus to distinguish it from a motor bus.

TITLE PAGE IMAGE

Seeing Glasgow by Tram and Bus. The city guidebook produced for the Empire Exhibition in 1938 featured one of Glasgow's sleek new Coronation cars on the cover.

CONTENTS PAGE IMAGE

A Manchester horsecar built in the 1880s and recently restored for use on the Heaton Park Tramway. It is the only working example of the Eades reversible design, featuring a revolving body which can be reversed at the terminus rather than walking the horses round for the return journey. The tram is visiting Beamish Museum here, with an extra trace horse attached to help the main pair on hills. It is currently on display at the Bury Transport Museum.

ACKNOWLEDGEMENTS

Images are acknowledged as follows: Alamy, **front cover** and pages **12** (lower), and **30**; Billy69150/Wikimedia Commons, page **48** (lower); Getty Images, page **18**; Glen Bowman/Flickr, page **24**; John O'Neill/Wikimedia Commons, page **16**; © TfL from the London Transport Museum, back cover and pages **8**, **10** (top), **10** (lower), **26** (top), **28**, **36** (top), and **38**; Martin Ortner/Wikimedia Commons, page **48** (top); Paul Jarman, page **3**; Rept0n1x/Wikimedia Commons, page **55**; Steve Morgan/Wikimedia

Commons, page **50**; Swansea Museum, page **5**; Trolleybus Museum Sandtoft, page **45** and **60**. All other images are from the author's own collection.