Bernd Rohrmann

A special essay about

trams

- The birth of trams
- Tram typology
- Three quasi-trams
- Trams in special cities

	Melbourne	
Mannheim	Ballarat	Bendigo
Dunedin	Christchurch	Hamburg
Berlin	Zuerich	Oslo
San Francisco	Wuppertal	Lisbon

- Do trams have a future?

May 2020

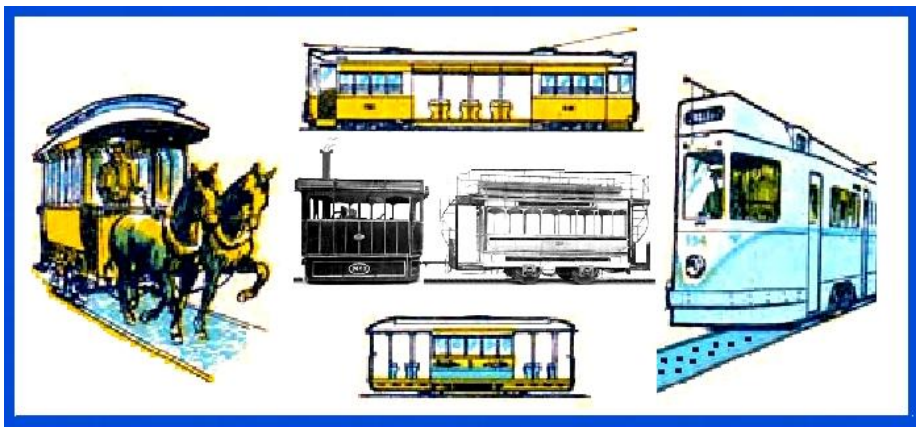
THE BIRTH OF TRAMS

Firstly, to be an 'orderly' author, let's clarify what a "tram" is! It seems to be quite clear, all over the world, that -

/// trams serve the transport of people within a city
/// a tram runs on rails
/// the power source of trams varies
/// each tram can be single, or have one or two attached wagons
/// a city's tram system usually has an intense service
/// tram companies are mostly owned by the city.

So, when were trams 'born'?

In terms of the requirement: The larger cities became, and the more the residents movability was essential, the less was the classical 'public transport', namely people carts drawn by horses, sufficient.
In terms of technology: Both the invention of passenger trains, from 1830 onwards, and of cars, from 1885 onwards, and then the creation of motor busses, from 1900 onwards, were essential.
The essential features were that trains run on tracks, and that cars and busses provided inner-city transportation.



The (quasi-)trams were for decades drawn by horses. The first transport devices to go beyond that were invented from 1840 onwards, using many different technology means.

TRAM TYPOLOGY

It seems that trams, compared to other transportation systems, such as horse wagons or ships, are very young - yet nevertheless, they are almost 150 years around, and over such a long time an enormous amount of inventions and advances has occurred.

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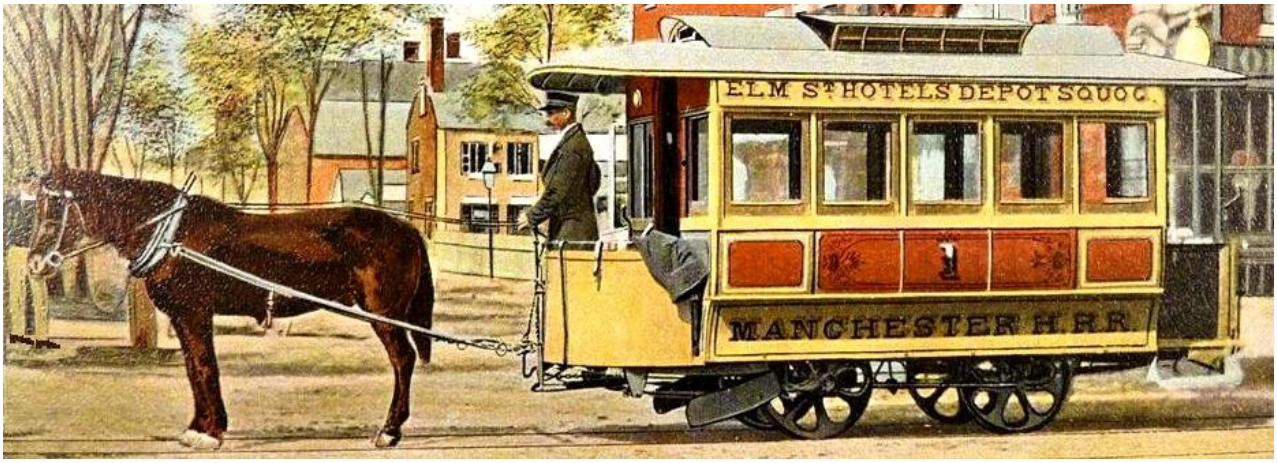
All this included more than improvements - many innovations actually created new types of trams, and many cities had an own approach.

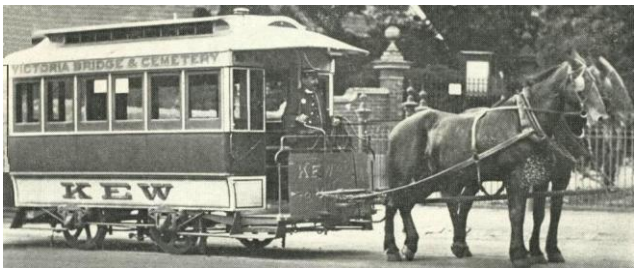
Therefore my essay will have a chapter of main tram types, and then a chapter about the efforts of a dozen distinctive cities.

Horse-drawn trams

This began 1807 (!) in Swansea in England. After a few decades, it was done in many countries, all over the world. The wagons were elaborate.



The first one in Australia was established in Sydney, 1861, followed by Adelaide and Melbourne.



To cope with the weight and the load of the wagon, between 1 and 4 horses were needed, standard was 2. The usual 'working time' was 3-5 hours, and the working life of a tram horse around 4 years.

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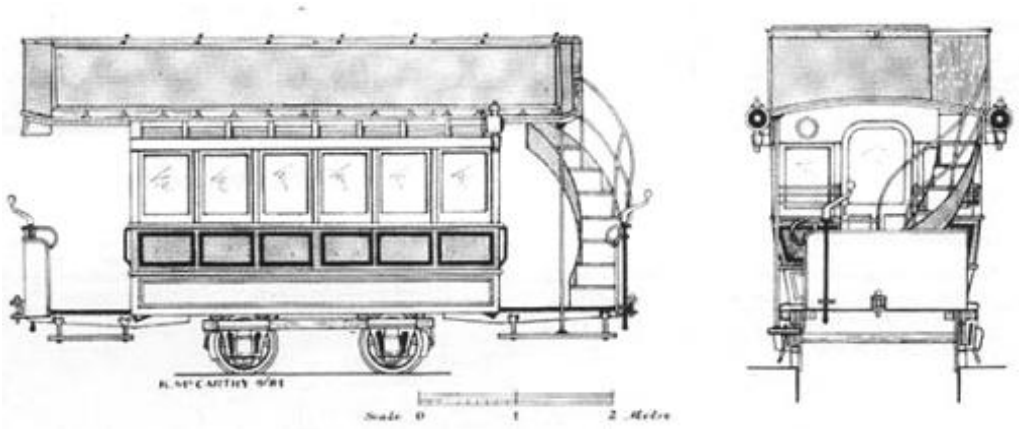
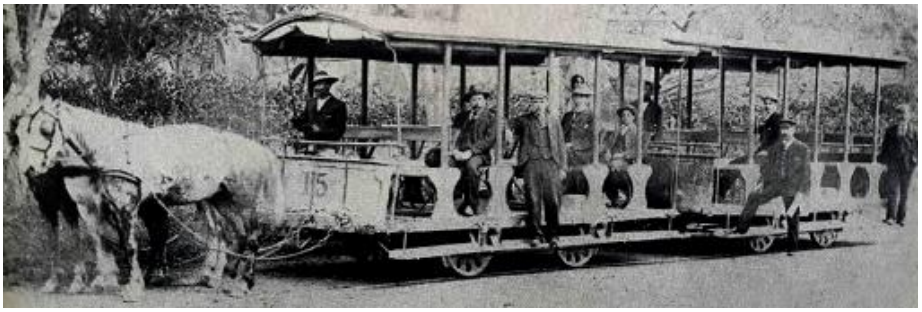
The wagons were often enlarged by having an "upper floor", which was likely to be open, rather than to have a roof.



For this a staircase was needed, usually mounted at the wagon's end.

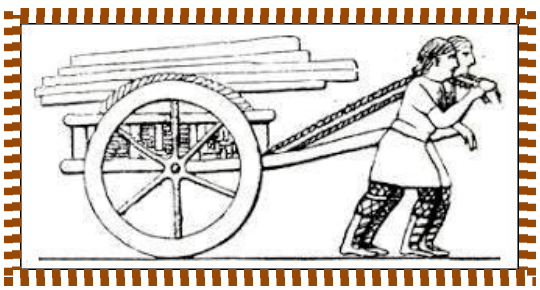


Finally, some horse tram companies set up two wagons.

Around 1930 almost all horse-drawn trams ended, for two reasons - the simply superior electric trams, and the considerable efforts to maintain large horse stables. A few were maintained just for tourists.

Excursus History of carts & wagons

While horse-drawn trams were a novelty, just 200 years ago, horses were certainly not! And even carts are in use for about 5000 years.



So I looked up all the historic cultures, starting with the Mesopotamia kingdoms. All had one-wheeled carts or two-wheeled wagons.

Below is a collage of 16 historic images, mostly drawn by horses.

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<tr>
<td>Sumer
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 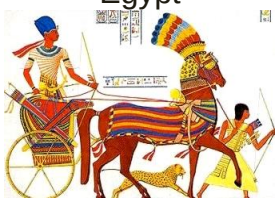 </td>
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 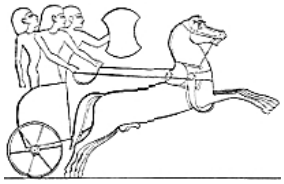 </td>
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 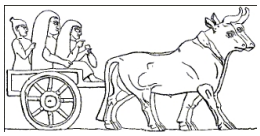 </td>
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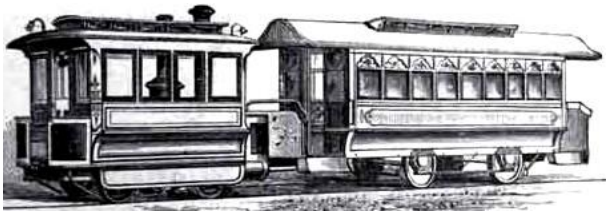
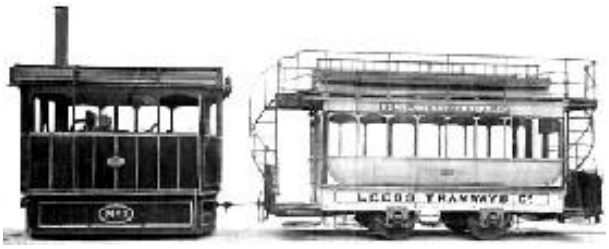
The first image, from the "Standard of Ur", is dated 2500 B.C., the one from Egypt is about 1000 years younger.
Actually carts had two purposes, from the very beginning - tools for transport and tools for war. Warriors on a cart drawn by a strong horse were a crucial force within antique armies.
As the last image shows, carts or wagons or carriages were so essential that they even appeared on coins!

Steam trams

The label "steam tram" means: A steam engine provides the power. There were two types, the engine built into a tram wagon, and a little locomotive draws the tram (like a mini-train). Oldest case (I think): A small train~tram connecting Cologne and Bonn (Germany), 1844. Below are six early examples for both types.



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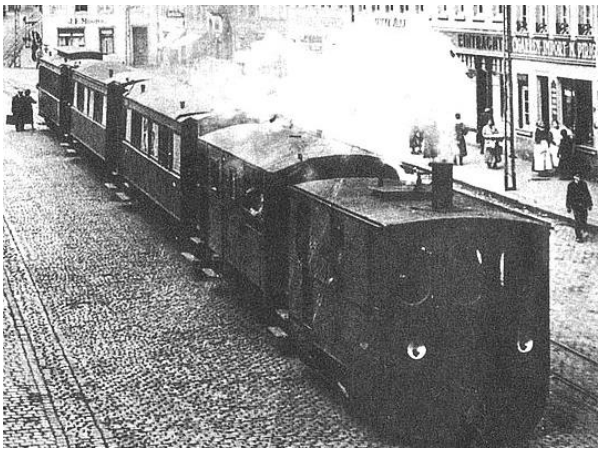
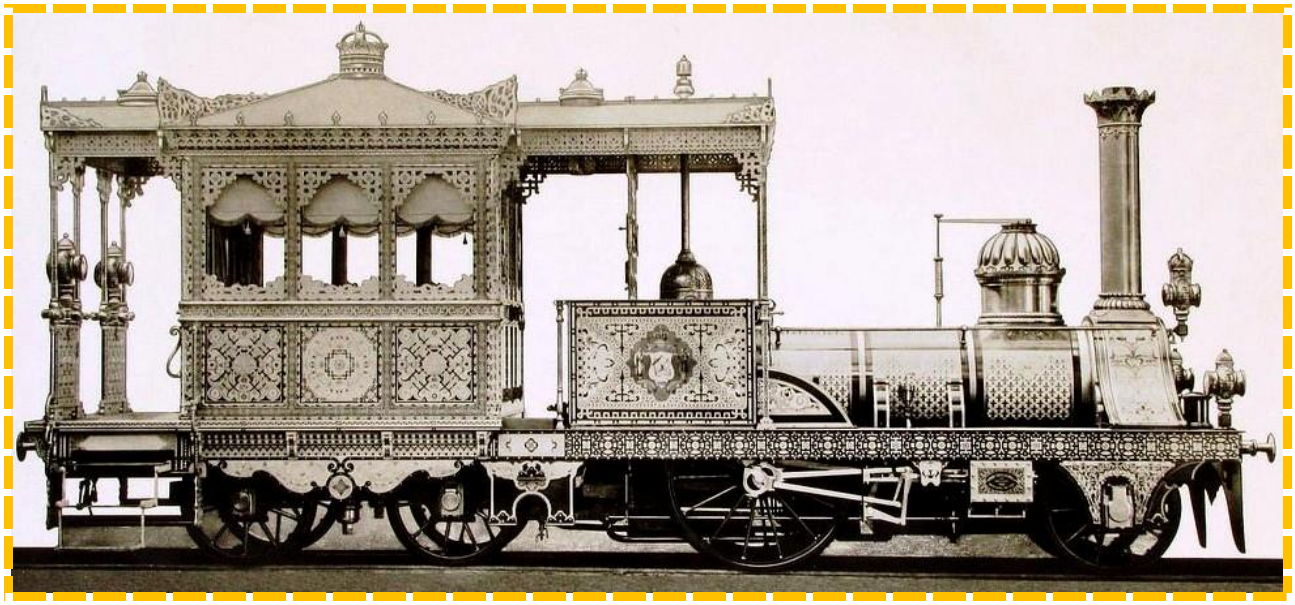
BENDIGO TRAMWAYS



Eventually in the 'home country' of the steam engine, England, unusual steam trams were designed, like this rather odd one, meant for some rich people in Egypt!



I think this beast is both - a piece of technology and a piece of sculpture!

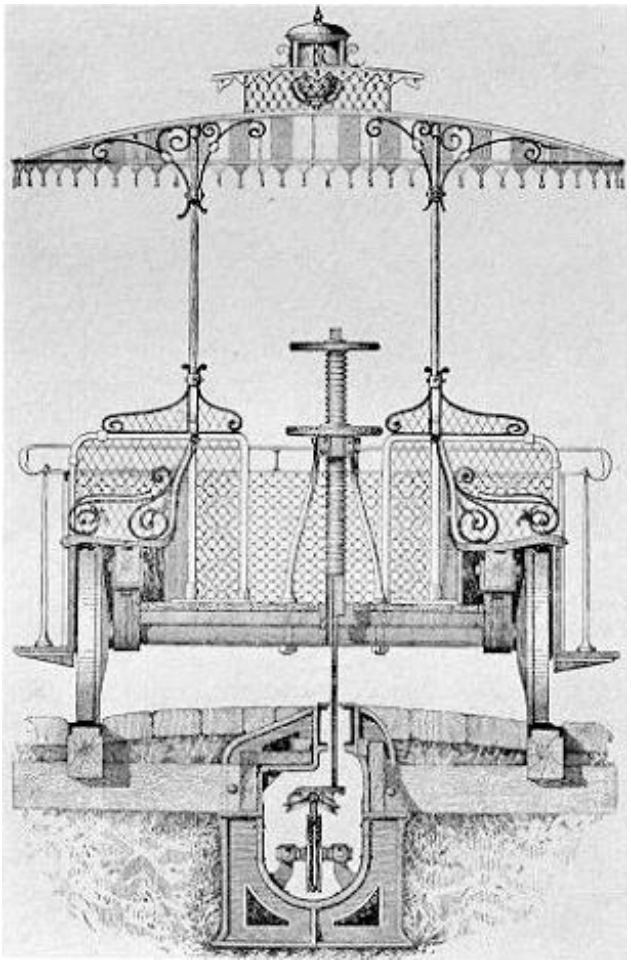
Cable-hauled trams

In 1840 engineers in England invented a new concept for moving passenger carriages, namely, to pull it along with a steel cable. This requested a fixed track in which the cable would move.

It took a while that this was fully realized - it was 1873 in San Francisco, and a few years later, 1881, it was done in Dunedin, New Zealand. Both cable car settings are still alive!

Cable-hauled trams are especially used in case of long steep tracks.

The following sketches show the design. Essential is the carriages grip of the rope.




Van Ness Ave. California
30
& Market Streets


9


NICHOLSON ST

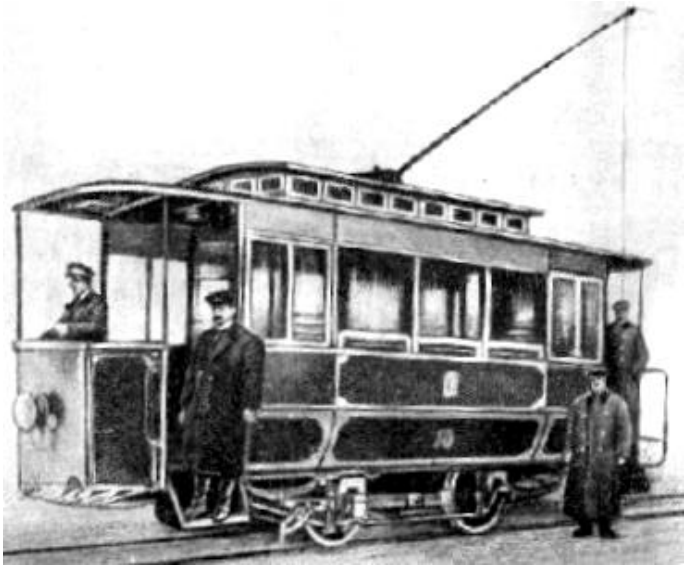
Gas & Petrol-driven trams

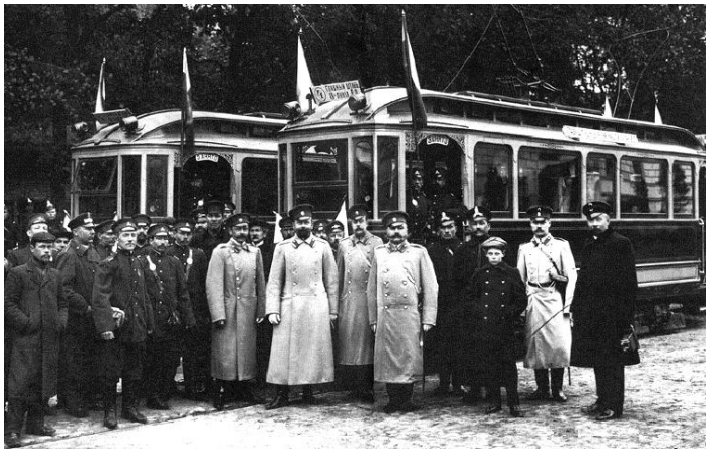
Engines using gas, and more so petrol motors (usually diesel), were explored in European countries, USA and Australia

There were abandoned soon regarding trams, yet became standard for railways and also buses.

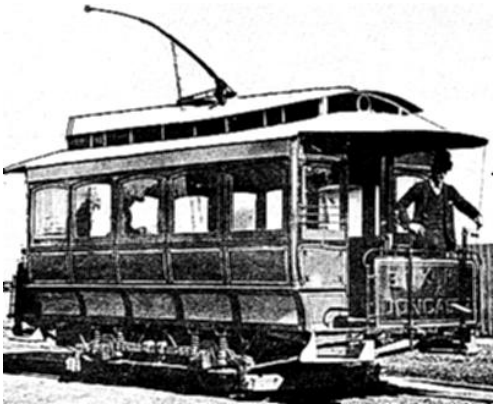
Electric trams

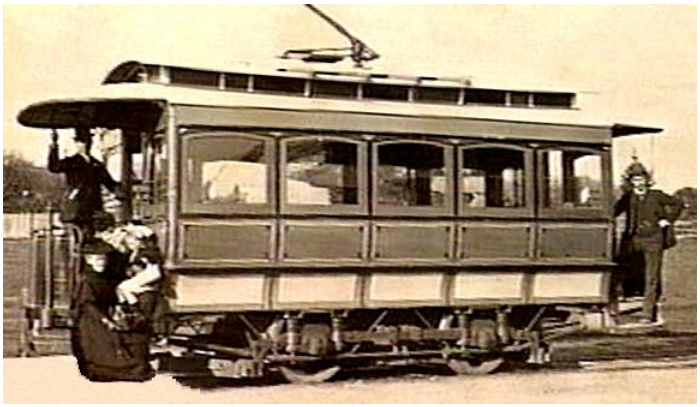
Nowadays almost all trams are electric trams. How did this come about? The crucial inventors were Fyodor Pirotsky (Russia) in 1880 & 1883 and Werner von Siemens (Germany) in 1881.

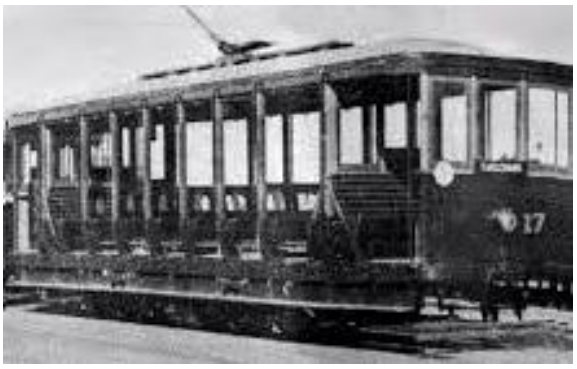




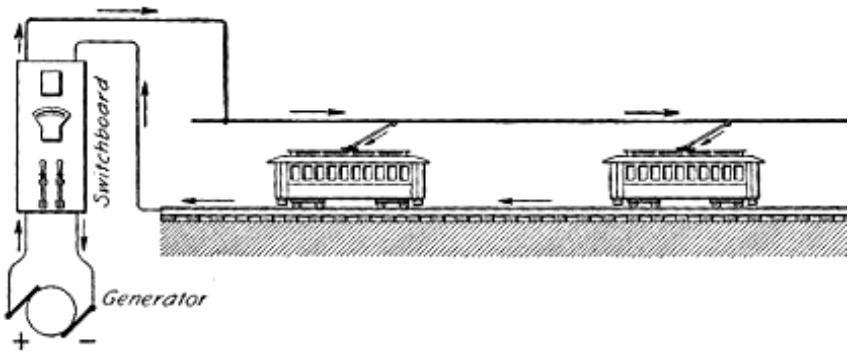
Here are examples of early electric trams from many countries.



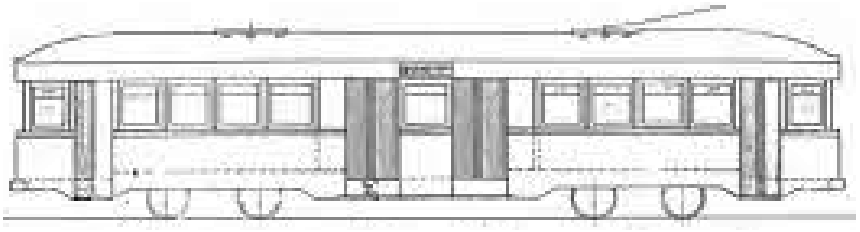




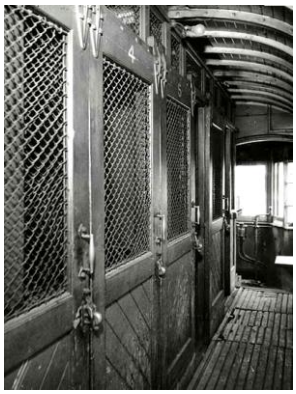
This sketch shows the technology: Electricity supply through 550-600V overhead wire, collected by the trams trolley pole, feeding the motor which sits on the axles.



Almost all current trams are "articulated" trams. It was invented for the Boston Elevated Railway in 1912. In this design, a tram will consists of several parts which are connected with flexible joints.
That is advantageous for narrow curves and enables more passengers.



Lastly, the weirdest use of trams - a prison tram! Built in Sydney 1909, it had 6 6-person cells + 2 women cells, and was used by prisons.

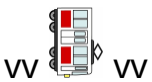


***A petulant comment**: One feature, disliked by me, are the advertisements on trams... This happened from the beginning, and is unfortunate very common nowadays, urghhhh. The reason: Endless budget trouble of public transport.*

Battery-powered trams

This was tried long time ago, around 1890, in various cities, including Bendigo/Australia. It was soon abandoned though - at that time batteries were not powerful enough.

I think nowadays one could try the modern 'e-car' batteries - but the electric power source is better anyway.

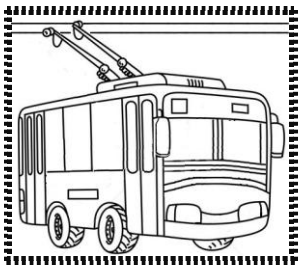


Finally, the double-deck concept

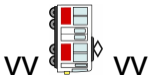
What you see her for a bus, was done for trams from the very beginning, even for horse-drawn trams.
The reason: This was less expensive than having a second wagon, in order to maximise the number of passenger per trip.

THREE QUASI-TRAMS

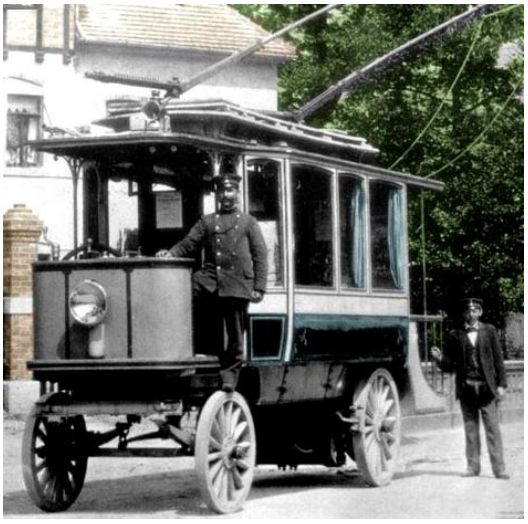
Trolley buses



In many cities tram systems have been discarded completely, in favour of buses. Yet some cities installed electric buses as basis for inner-city people service.
They are usually called trolley bus ("O-Bus" in Germany). Differently to electric trams, they need two trolleys, and two power lines are needed, because they cannot use metal wheels and rails for the electricity circuit.



Who invented the trolley bus? Again, Werner von Siemens (and/or his Siemens company), in 1882 - he called it "Electromote". The primeval electricity collection of the first model was soon replaced by clever trolleys.



Since then, many different types were developed, including buses with three axles, and double-floored ones.

Currently, about 300 trolley bus systems exist, and used in about 50 countries. They are indeed a true alternative to electric trams.

Rack rail trams

This is another special tram (if called a "tram" at all), the rack railways. Their feature is the "rack" rail, sitting in the middle between the main rails.

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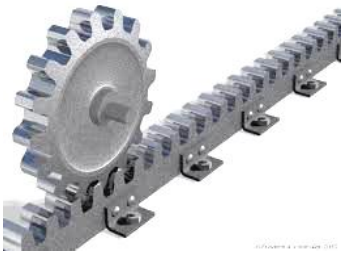

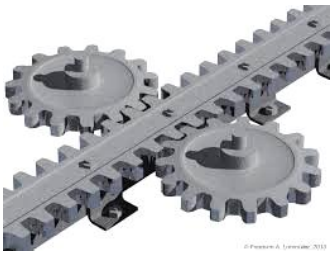

The rack rail systems differ considerably, for example, one or two cog wheels may be implemented..


At first locomotives were used, later electric trams were installed.

Rack railways are very much a Switzerland feature - mostly going up mountains, yet occasionally also installed within towns.

Suspension rail trams

These very unusual (quasi-)trams do not move on rails, they are hanging.

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They require large constructions, more than tracks (here: Dresden). The oldest, highly developed, and most famous one is in Wuppertal.

Hybrid modes of trams

If a tram track has to cope with a steep section, a cable tractor can be installed there. This happened first in the Sydney harbour.

A modern system, still in use, is in Trieste (Italy).

TRAMS IN SPECIAL CITIES

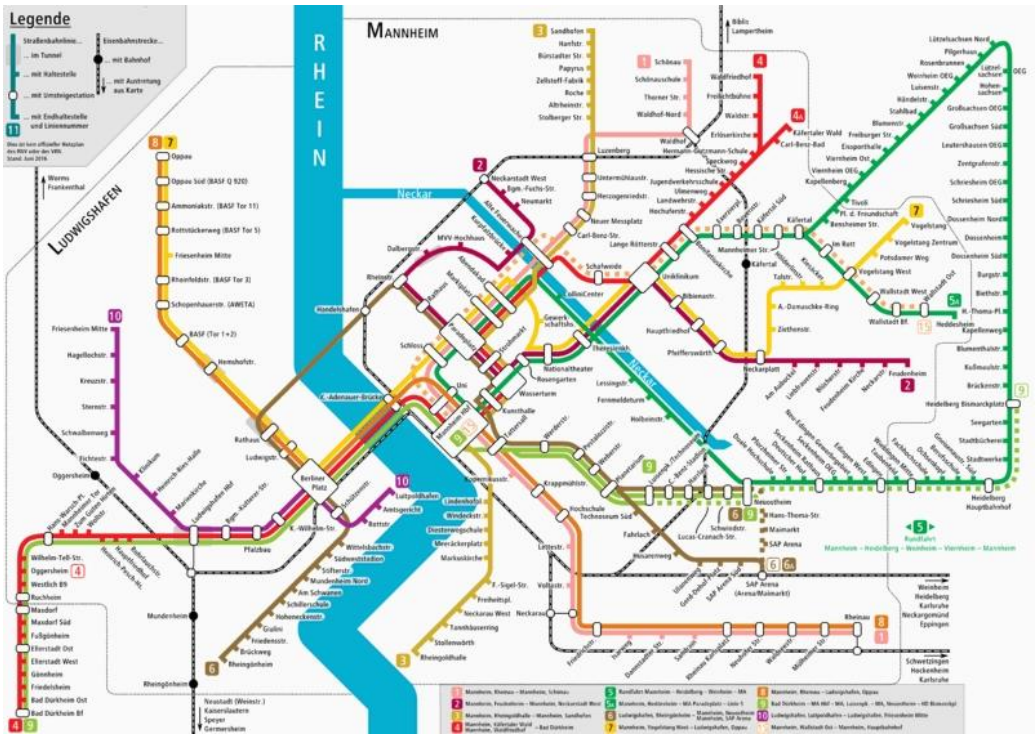
In this chapter, I will describe the tram situation in 13 cities - where I lived, or which I have visited when travelling.
None of my first places, all in Germany - Witzenhausen, Banteln, Alfeld, Bad Oeynhausen, Marburg, Hamburg - had trams, the first one was ...

Mannheim

This city is located at the river Rhein. It has electric trams since 1878.

Meanwhile they have installed modern trams - this one here just passes Mannheim's 'icon', the historic Water Tower.

The network is large, because Mannheim and Ludwigshafen (left of the Rhine) collaborate, and even links to Heidelberg (eastern) are included.

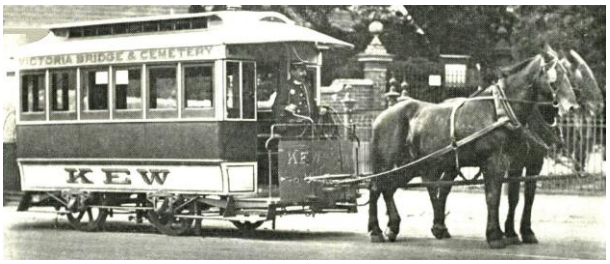


Melbourne

Above you see trams in front of Melbourne's iconic Flinders station.

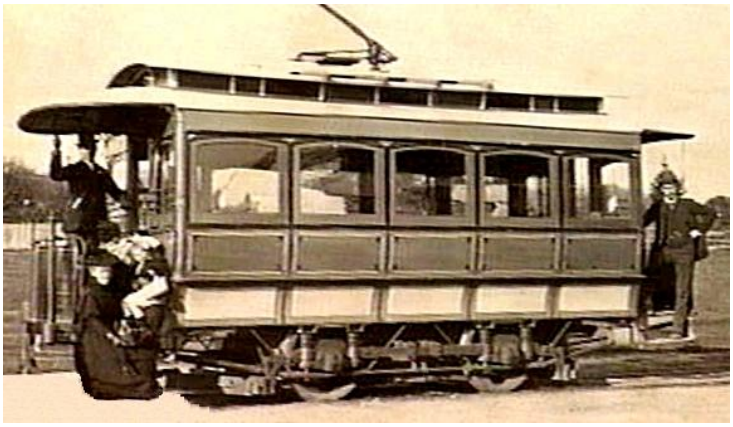
This will be the biggest of all city sections - because I live in Melbourne since 1995, and even more so because Melbournes tram system is the largest in the world, plus,"the trams are Melbourne's character".

It started 1884 with horse trams, in several suburbs. This ended 1923.



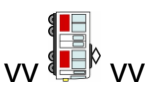
Then soon in 1885 cable-hauled trams were set up. This became a large network; one line lasted until 1940.

Next phase: The first electric tram was installed, in 1889. This lasted only 8 years - but in 1906 several ventures followed.



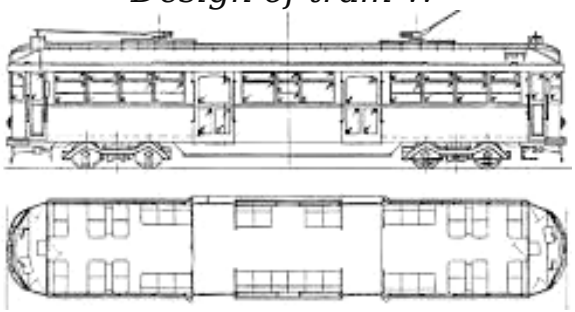
Then step by step horse trams and cable trams lines were converted into electric trams, the last ones in 1940 - from then electric trams were completely dominating.

In 1923 a new tram type was introduced - the "W" class, painted in a green-and-yellow design - eventually becoming iconic.



Some of the "W" trams are still in service. An extra-long one was also created, but didn't make it, had trouble in tight curves.

Design of tram W



756 W trams were built, until 1956.

Only in 1980 new trams were installed, including class B and D and E.

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Technical data of Melbourne's main trams

Tram	length	width	height	motor	seats
W	14,1	2.7	3.2	four 30 W	52
B	23,6	2.6	3.7	two 195 W	76
E	33.4	2.7	3.7	six 84 W	64

An unusual sign for how much trams mean for Melbourne: In 1978 the project "Melbourne Art Trams began, and 36 trams were painted by all sorts of artists. This program is still running.

Another unusual feature is the "Restaurant Tram". It offers dinner and wine and drinks while running through Melbourne. And it's a W tram!

This great opportunity is currently on hold - but both Melbourne fans and tram fans hope that it will come back to life.

Finally - the tram system of Melbourne is the largest in the world. The data regarding the network size of the "top 5" are obvious:
Melbourne 250km, Moscow 208 km, St Petersburg 205 k, Cologne 198 km, Berlin 194 km.

Melbourne has 493 trams. The service is organized via 24 routes, with altogether 1763 stops (see map below). Passengers in 2018: 205 million.

Please consider though that Melbourne has 2 further transport facilities:

<> buses: about 50 bus companies, about 300 routes'
<> regional railways: inner-city circle and 7 lines to surroundings (map below). These have even more passengers than the trams.
The management of these three systems is connected.

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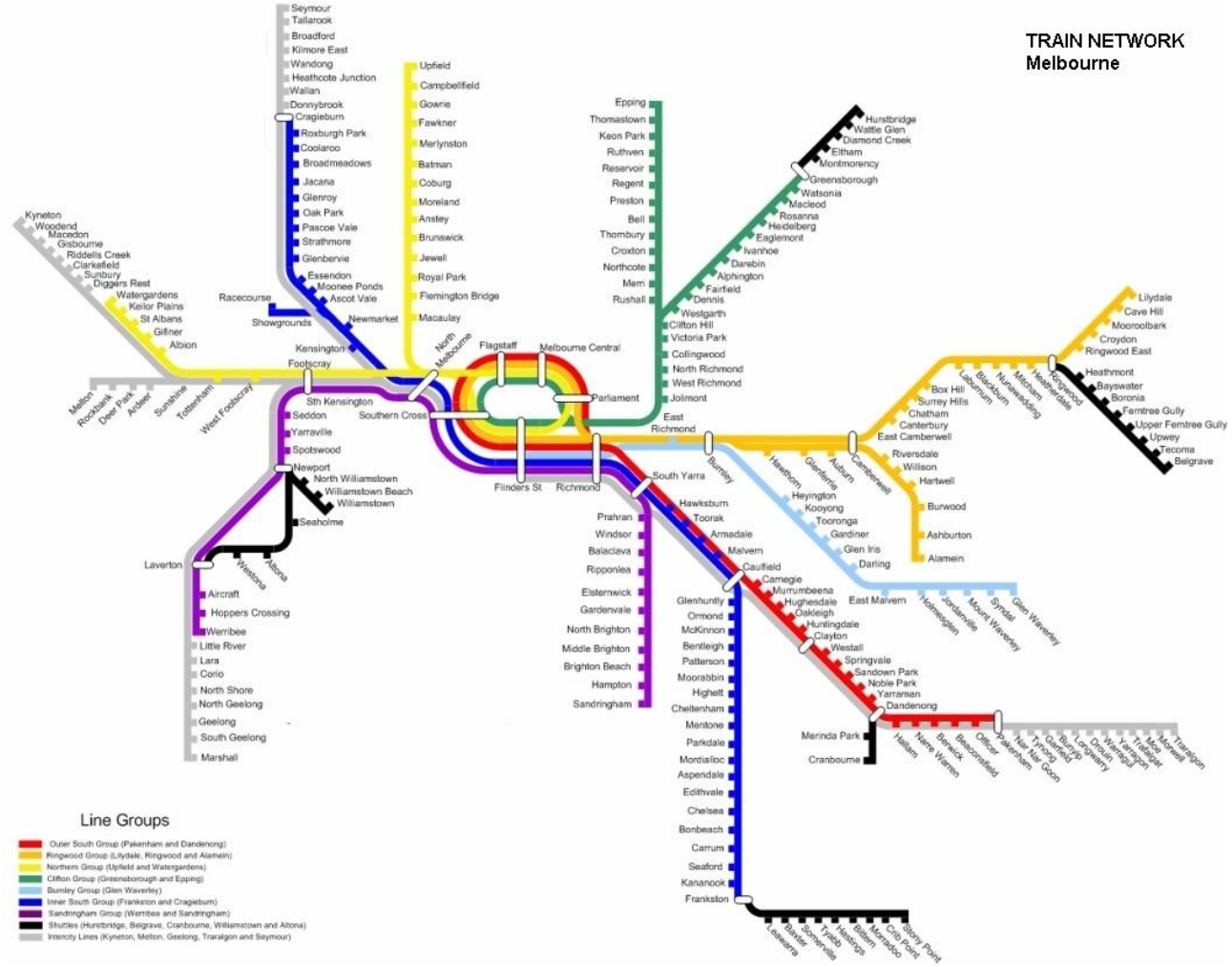
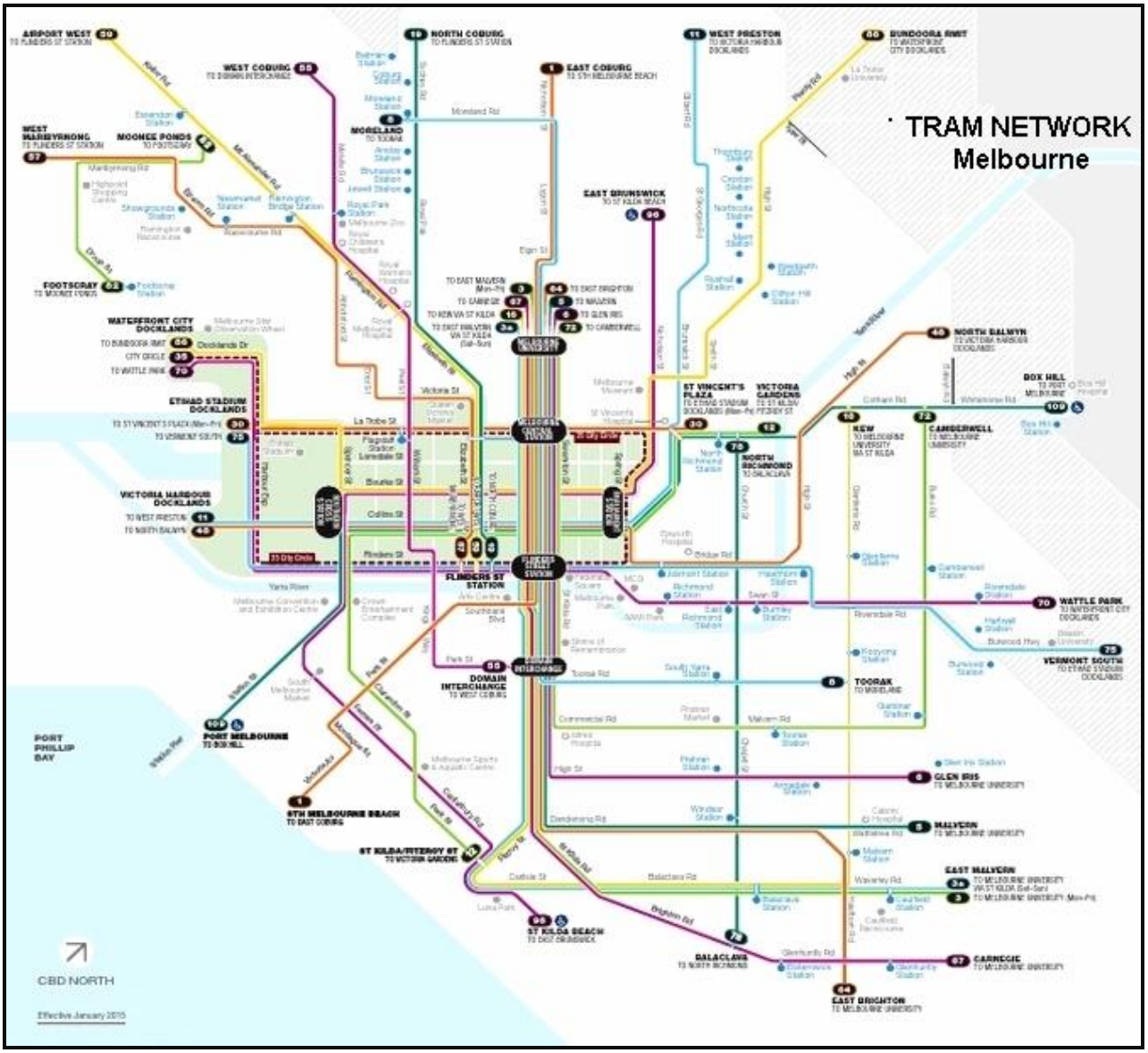


The inner ring (see above map) is around Melbourne's CBD district, where also 8 tram routes are.

By the way -- the first railway line, established 1854 run to Sandridge. This was an early landing place for passenger ships; it's now called Port Melbourne.



Ballarat

This country town in Victoria/Australia, wealthy because of the "gold area", established a significant tram network from 1887 onwards - yet in 1997 it was closed down completely, in favour of buses.

Only few trams remained, running to please the tourists.

vv vv

However, many historic trams were saved and put into the new Ballarat Tramway Museum.

Bendigo

This country town, also in Victoria/Australia, does not have a pleasant tram history. Namely:
1890-1890: Battery-operated tram, failed.
1892-1902: Steam tram, was unsuccessful.
1903-1972: Electric trams, worked okay, yet became too expensive.

So the council decided to end the provision of trams, even though the fleet had been modernized.

However:
Already in 1972 a "tourist tram" concept was realized, and turned out to be successful.

Later, even a restaurant tram, named "The Colonial Tramcar Restaurant", was installed (similar to Melbourne), and it is highly accepted.

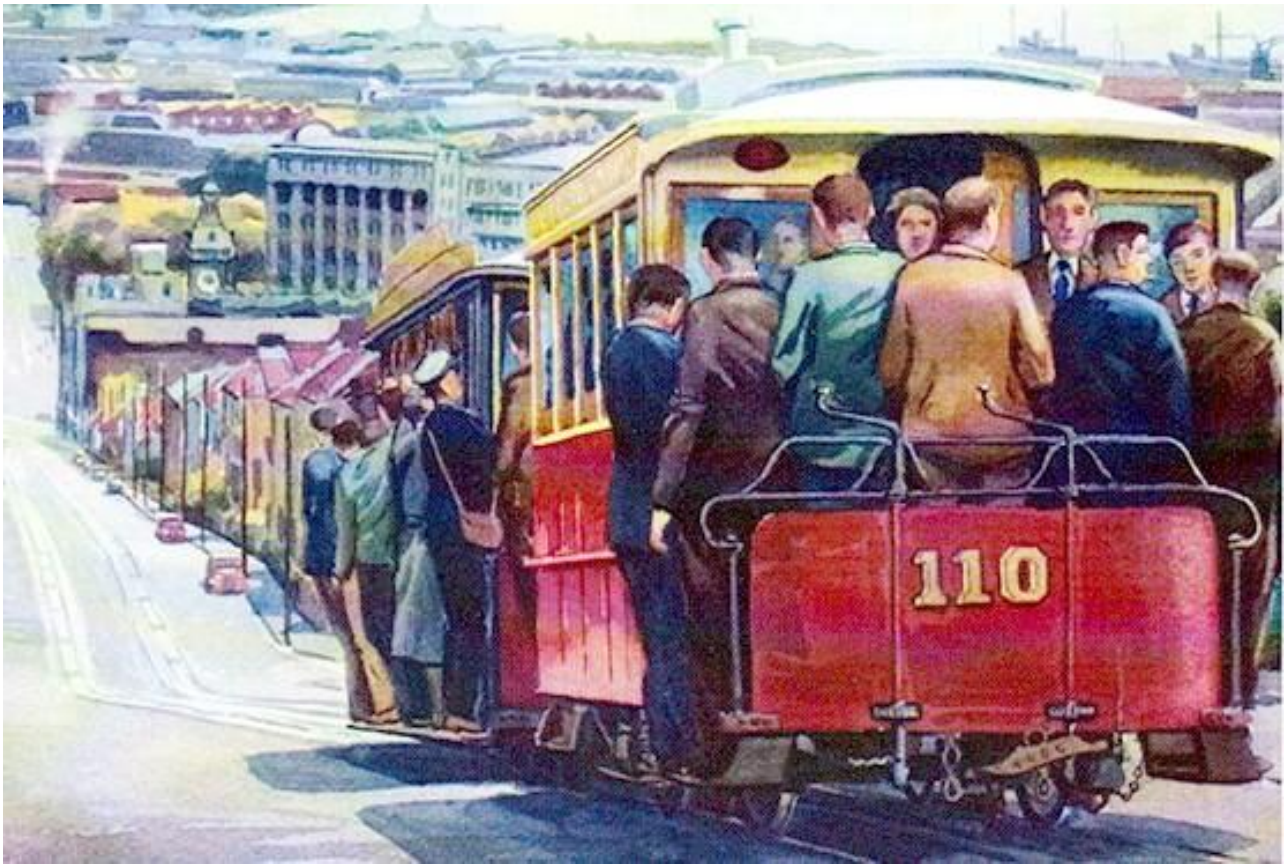
vv vv

Since 2008 it was debated in Bendigo to re-install one tram line, but the advocates did not (yet?) succeed.

Dunedin

This city in New Zealand, the southern island, was the second place to install the cable tram technology, after San Francisco, in 1881. It operated until 1957.

This was done because the Dunedin center sits high above the ocean and the harbour facilities.



Three lines were created. One of them was reported as the steepest tram line in the world.

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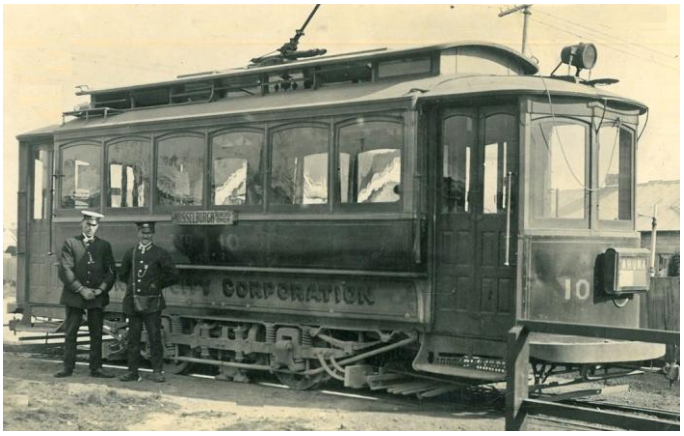


In Dunedin was a "pull curve" system developed, in order to pull the tram through a curve within the route.

Dunedin always was and still is a great place for architecture and art and music - yet it is also proud of its cable tram history.

Christchurch

This is the main city of New Zealand's southern island. It got its first tram line in 1882. The network grew fast, linked to the increasing importance of Christchurch.

Yet it all ended in 1954, when buses took over.

vv vv

The first tram services used horse-drawn or steam-engine trams, but in 1905 electric trams were installed on all routes.

40 years after the end of the tram system, in 1995, Christchurch installed a heritage tram, running on a central city loop. And this service finally even survived the terrible earthquake in 2011!

vv vv

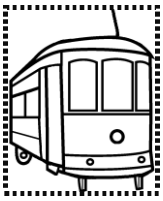
Hamburg

When moving in 1961 to Hamburg (the second-largest city in Germany), as a rather poor student, I hoped of course that trams would enable cheap moving through this large city... But that couldn't happen - Hamburg's tram system was closed down in 1978, after 85 years.

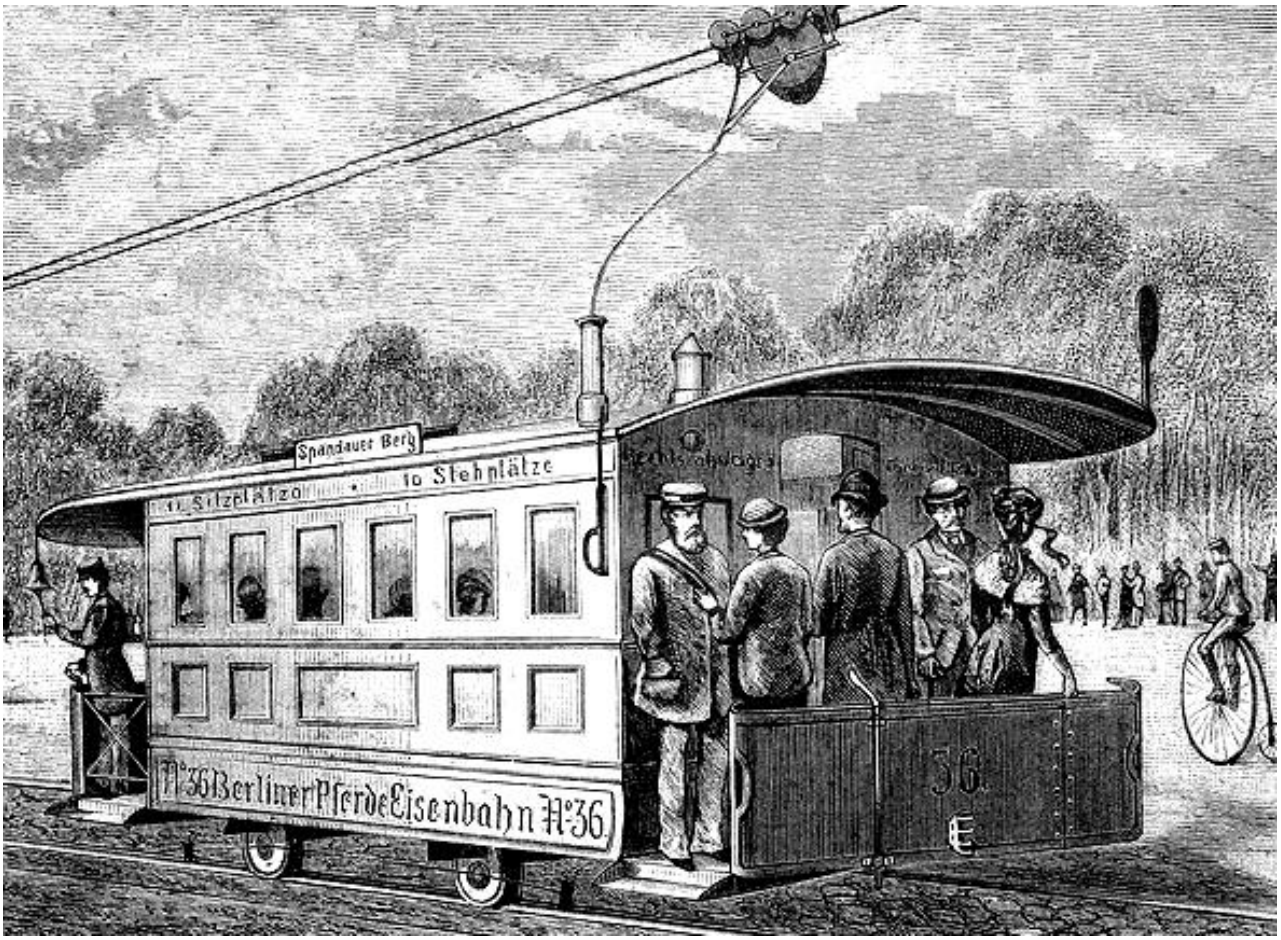
Hamburg's tram story has the usual sequence: Horse-trams 1855 to 1922 (!), steam-powered trams only briefly, 1878 to 1897, and in 1894 the first electric tram started. In 1955 there were 19 routes.

What's left: Models of Hamburg's trams... What has to be considered though: Hamburg has a network of city railways, a significant subway system, and ferries in the large harbour.

Berlin



Berlin, Germany's capital, has a 'grand' history regarding trams. Really?



Yes it was Berlin were the first proper electric tram was made 1881. The real inventor had actually been Fyodor Pirotsky in St Petersburg/Russia in 1880 - but it was Werner von Siemens (after discussion with Pirotsky) who designed a functional one (*as outlined in* "*tram typology*" *above*).

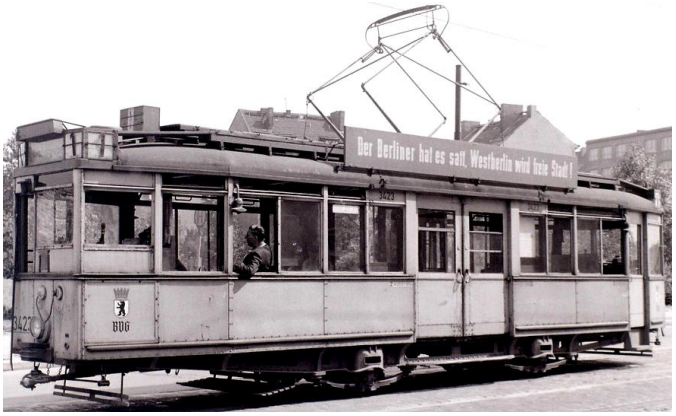
In 1883 its power source was changed to an overhead system.

The first tram in Berlin was, 1865, a horse-drawn one, the first horse tram in Germany.

After the restructuring and considerable enlargements of Berlin in 1920, step by step modernized trams were installed

After WW2, when Berlin was divided (until 1989) in two half's, West-Berlin and East-Berlin, and these belonged to different (and inimical) countries, two different tram systems were established.

In 1945 Berlin was widely destroyed, thus for some years old trams had to be re-installed.

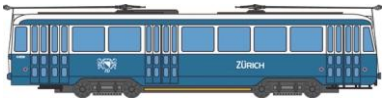


Meanwhile, after the re-unification of the two Germanys in 1989, Berlin has been made the capital city again. Trams are obviously a core part of public transport, linked with the railway system and the underground "U" train system. Increasingly modern trams get installed.

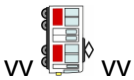
Currently Berlin has the fifth-largest tram system (after Melbourne, St Petersburg, Moscow, Cologne) - 22 lines, and 194 km net size.

Berlin also had a large trolley bus system but it was closed 1974. (As out lined in ch. 1, the inventor was - yes, Werner von Siemens, in Berlin!)

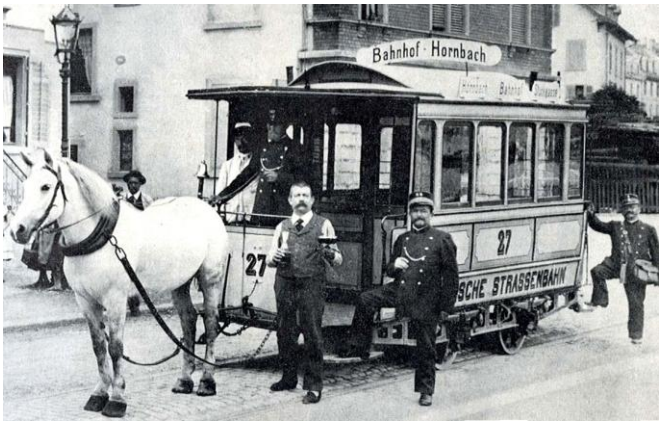
Zuerich



The city of Zuerich in Switzerland is rated as giving very high value to trams, beside city trains, trolley buses, funiculars and rack railways.



First were horse-drawn trams, 1886, then electric trams, 1888. Many of these connected central Zuerich with suburbs, and even surrounding villages.



The city of Zuerich founded a central tram authority ("StStZ", later renamed "VBZ") which by 1931 owned all ex-private tram companies.

vv vv

Since 1970 all Zuerich trams have the same blue-and-white appearance.

A few tram lines are underground, using city trains facilities.

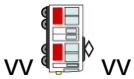
Furthermore, Zurich has a cargo tram, for transporting heavy goods.

Finally -- there is even a restaurant tram, called "Fondue Tram", loved!

Oslo

In Oslo the first trams were also horse-drawn ones, from 1875 to 1900. The first electric tram line opened in 1894.

In 2002 a serious discussion happened, with arguments to skip all tram lines and replace them by buses - but the decision was in favour of trams.



The plan is no to install a very modern and very large tram.

San Francisco

Firstly, San Francisco is (in my view at least) the most attractive USA city. Secondly, only there is a fully maintained cable tram!

At first there were several horse-drawn trams (called "horse cars") in S.F., from 1861 to 1913.

Yet then a modern technology was reasoned, the cable car -- and done.

vv vv

In 1873 the first one was realized. (*The technology of the cable trams is explained above in the chapter "tram typology"*).

At the end of a line, the tram gets turned around on a turntable.

Of originally 23 tracks, 3 are maintained, between the city center and a harbour area called Fisherman's Wharf. That's still serving commuters - yet the many millions of customers each year are actually visitors!

Here you see the track position and the power station for the cables.

S.F. had also 'normal' trams, called "streetcar". Here is the oldest one, nr 578, from 1892, now a memorial.
After the massive earthquake in 1906, this type of trams more and more replaced the oldish cable cars.

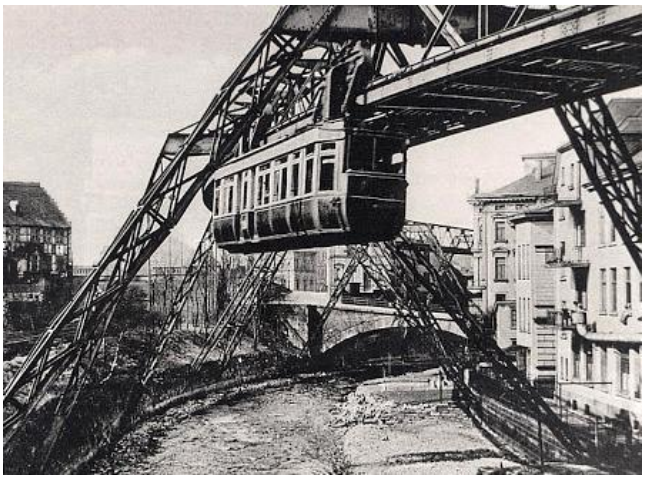
Today two of their lines are still operated.

By the way - since 1935 S.F. also has trolley buses, currently 15 lines.

Yes they are convenient - yet nothing compared to the iconic cable cars!

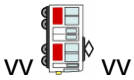
Wuppertal

What an unusual 'tram' - this one here is the only one not on the ground!



The (quasi-)trams in Wuppertal/Germany, named "Schwebebahn", i.e., Suspension Railway do not move on rails, they are hanging in a large steel construction.
The ingenious conception behind it: A tram route which runs above the river Wupper, rather than on a road.

The construction began in 1897, and the first track was available in 1901 - with emperor Wilhelm II. as honouree guest!



The track is 13 km long, and runs about 12 m above the river.

Suspender, wheel and motor are all above the cabin. The platforms for passenger access are high up, usually reached with elevators.

The "Schwebebahn" is still in use, was repeatedly modernized, and has about 25 million customer per year. That includes many visitors - this highly developed unique (quasi-)tram is certainly famous. It's even presented on stamps!

Lisbon

The last one of my "tram cities" is Lisbon, the capital of Portugal, for two reasons - the yellow trams there are undoubtedly special, and they were my most recent travel target, just a few month ago!

Lisbon's first trams, in 1873, were horse-drawn. In 1901 electric trams took over. They were - and still are - slimmer than trams elsewhere because of the narrow streets, and quite good in steep areas.

Around 2000 was a heavy debate about maintaining versus abandon the trams - yet in 2017 Lisbon's mayor decided to keep and to improve them - which certainly pleased the countless visitors!
Also, Lisbon installed modern trams for areas outside the historic city.

DO TRAMS HAVE A FUTURE?

From 1881 to 2020, trams have a substantial history of 140 years. And they have become better and better - in efficiency, in safety, in comfort.

Yet critical viewpoints flourish as well - trams are too complex, old-fashioned, inflexible, same-for-all, blocking progress.
Some even say: their time is gone, thus trams should be abandoned.

In fact, many cities have decided against maintaining tram networks, e.g., Buenos Aires, Hamburg, Jakarta, New York, Sydney, Vancouver.

So -- do trams have future?

Well, I'll try to make a cool list of viewpoints (and putting aside that me, the Melbournian, is of course biased).

vv vv

Con's

- Trams are inflexible because they are bound to their track.
- They are powered by electricity, which may collapse.
- If bad weather damages the wires, trams are stuck.
- Bus lines can adapt to new settlements, trams can't.
- Tram lines are difficult to set up in historic & tight villages.
- If a tram has a breakdown, it blocks a track completely.
- Overly crowded trams are uncomfortable for passengers.
- They are slower than cars (except of traffic jam situations).
- It's possible to meet 'disliked' or drunk people.
- Trams provide the impression of being behind with progress.

Pro's

- Modern trams are comfortable and safe.
- Large streets can handle both, car traffic and tram traffic.
- Trams are equivalent to about 50 cars, space-wise.
- Articulated trams can carry up to 500 passengers.
- Altogether, trams are cheaper to run than trains.
- Tram lines can be built within cities, railways can't.
- Differently to buses, trams cannot accidently run into sideways.
- Trams are not always punctual - yet still better than buses.
- A city's tram network is rigid yet firm and easy to know.
- In ecological terms, trams are far better than buses, let alone cars.

My conclusion, looking carefully through all these "con" & "pro" points:

Yes -- trams do have future!

This applies more to large than to small & narrow municipalities. Surely it is "*yes*" in the city with the world's biggest tram network - *Melbourne*!

That's it .. I appreciate your interest & patience with such a long essay.. bye for now!