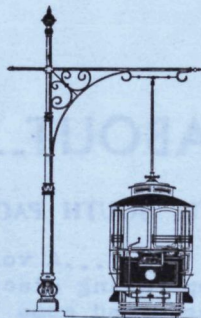


TROLLEY WIRE

Magazine of the
SOUTH PACIFIC ELECTRIC RAILWAY
and
**AUSTRALIAN ELECTRIC TRANSPORT
MUSEUM**

Registered at the G.P.O., Sydney, for
transmission by post as a periodical.



APRIL 1970



SPECIAL Bi-Centenary Celebrations ISSUE

40c

ABOUT....

The SOUTH PACIFIC ELECTRIC RAILWAY Co-operative Society Ltd.

...A volunteer organisation set up to create an operating electric transportation museum. To date it has acquired some twenty-four items of rolling stock from the Sydney and Brisbane tramways systems, built a depot and a substation at Loftus in the Royal National Park and has completed a quarter of a mile of track for electric operation.

The project began in the early 1950's, and work on the site at Loftus commenced in 1956. Construction and restoration proceeded as fast as the limitations of volunteer labour and finance would permit as the entire cost of the project had to be met by subscriptions and donations from members of the Society.

The years of concentrated effort were rewarded in 1964 when an electric tramcar moved under power on the Museum's tracks for the first time. The trams are operated for the benefit of visitors every Sunday and most public holidays from 10 am to 5 pm.

The AUSTRALIAN ELECTRIC TRANSPORT MUSEUM (S.A.) Inc.

...Formed in 1957 to preserve some of the forms of public transport which had served Adelaide for 50 years. Work commenced at the Museum's site at St. Kilda, some sixteen miles north of Adelaide, in late 1958 and work is now well advanced on the restoration of the seven trams, three trolleybuses and one industrial electric locomotive in the Museum's collection. It is hoped eventually to operate all these vehicles under their own power.

All construction and restoration work at the Museums has been carried out by volunteers and paid for by donations, as neither museum is in receipt of any Government or private financial grants.

Further information about these organisations can be obtained by writing to the Secretary at:-

SPER, Box 103, GPO, Sydney, NSW, 2001

AETM, Box 1468L, GPO, Adelaide, SA, 5001

FRONT COVER: A scene at the SPER Museum showing R-class car 1740 and O-class 1111 in the depot yard with P-class 1497 on the main line to the Princes Highway.

TROLLEY WIRE

New Series Vol. 11 No. 2
Issue No. 127

APRIL 1970

TROLLEY WIRE is published bi-monthly by the South Pacific Electric Railway Co-operative Society Limited, Box 103, G.P.O., Sydney, New South Wales, 2001

Editor: R. I. MERCHANT

Subscription rate (for non-members):
\$2.00 per annum, post paid.

1770 - 1970

Not only to go further than anyone had done before but as far as it is possible for a man to go.

-Capt. James Cook

A small step for one man but a giant step for mankind.

-Comdr. Neil Armstrong on stepping onto the moon.

* * * * *

TROLLEY WIRE

...The bi-monthly house magazine of the South Pacific Electric Railway and the Australian Electric Transport Museum. Normally its sixteen pages cover the activities of Australia's tramway museums, and give news from the four Australian tramways still operating, overseas tramway museums, brief historical articles, etc.

TROLLEY WIRE is available to non-members for \$2.00 per year (6 issues), post paid.

This Issue

...Presented as an enlarged special Bi-Centenary issue to commemorate the landing of Captain Cook on Australian shores in 1770. Instead of our usual content, we have prepared a pot-pourri of Australian "tramology" based on the notes of a lecture presented recently in Newcastle by Ken McCarthy.



A TRAMWAY MISCELLANY

TRAMS FOR ALL OCCASIONS.....OCCASIONALLY A TRAM

Since December 1853, -- when the first primitive horse drawn car ran along the rails from Goolwa, South Australia, -- Australia has experienced continual tramway operation. Although the zenith of tramway development passed in the late 1920's, four Australian cities still operate passenger tramway services, but these are only a shadow of a once almost nationwide industry. The rise and fall of tramways in Australia is therefore best expressed as....."Occasionally a Tram -- Trams for all Occasions -- Occasionally a Tram".....

Where do we draw the identification or classification line between railways and tramways? During January 1970, the closure took place of the Silverton Tramway Company's line from Broken Hill to Cockburn; nobody could dispute that this undertaking was a pure railway, yet in South Australia between 1853 and 1885, some 77 miles of railway in the Goolwa, Strathalbyn and Victor Harbour region was operated by horse traction, employing rolling stock (certainly after 1879) almost identical to the conventional Adelaide horse cars; this then was an example of a railway which could be identified as a tramway.

Those who pursue the study of railway transport history must make up their own minds what constitutes a tramway and a railway, but if one considers such undertakings as the Western Australia Public Works Dept. pier tramways along the W.A. coast which employed horse, steam and petrol hauled tramway type trailer cars, and the Bundamba, Belmont and Cairns lines in Queensland, where Kitson and Baldwin steam motors towed trailers (resembling those used in Sydney) to regular timetables, then the tramway nomenclature must apply. But it is reasonable to reject such operations as the former Sydney steam motors occasionally hauling ex Sydney "C" type tramcar trailers on the quarry sidings at Bombo in N.S.W. as a purely industrial railway undertaking ---- even by rejecting these industrial undertakings we can still arrive at an impressive vehicle roster for Australian tramways.

From 1853 to date no less than 6,407 individual vehicles have operated on Australian tramways. This total has been compiled by only counting once such cars which have seen service in more than one city as well as those passenger vehicles which underwent later conversion to non passenger service cars.

This total can be broken up into the following sections:-

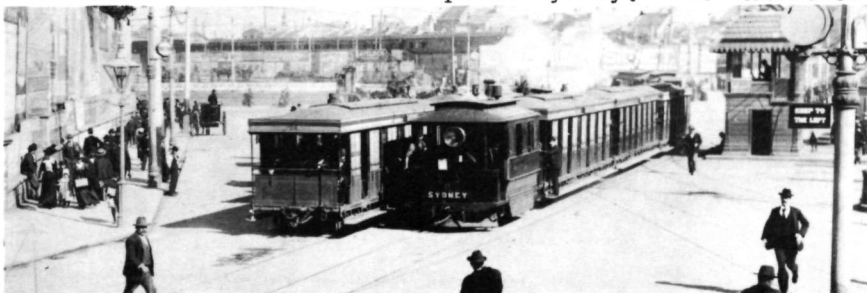
Electric passenger cars	4476	Steam motors.. . . .	169
Electric service cars - new.. . . .	158	Steam combination cars.	20
Battery cars.. . . .	13	Steam trailer cars.. . . .	438
Compressed air car.. . . .	1	Cable grip cars.. . . .	638
Horse cars.	228	Cable trailer cars.. . . .	660
Freight cars.. . . .	198	Petrol cars	8

It must be emphasised at this point that in some cases, such as the freight car and horse tram totals, the numbers given are conservative estimates.

The above calculations commenced with the Goolwa lines of 1853, but a tram-like service operated in Newcastle, N.S.W. as early as 1827 when the Australian Agricultural Co. occasionally used primitive horse hauled cars to transport passengers on its short coal railway. From 1836, a convict powered, 4 mile line on the Tasman Peninsular in Tasmania furnished a reasonably comfortable ride between two ship passages in sheltered waters for those dignitaries visiting the notorious Port Arthur Gaol settlement. This arrangement, signs of which are still visible, avoided the need for a much longer single ship passage through stormy waters. So the history of tramway transport in Australia bridges a span of some 143 years.

GAUGE

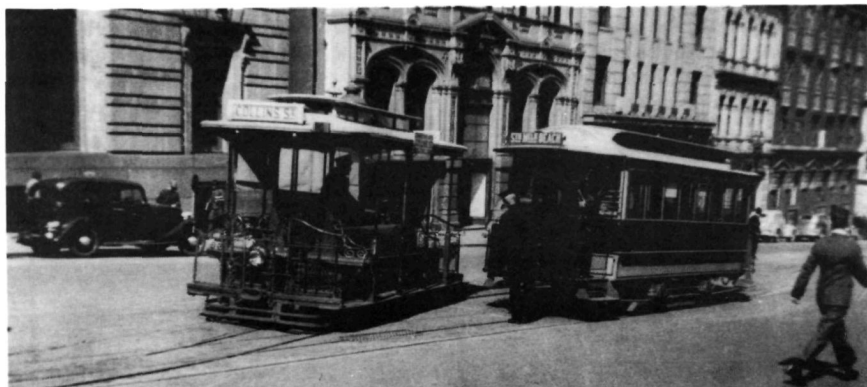
The standard railway and tramway track gauge of 4'8½" had its origins back in Pompeii, almost two thousand years ago. Some 612 route miles of Australian tramways were built to this ancient gauge, while a further 48 miles of cable construction can be added to this figure. It is this gauge which survives today in Melbourne, Adelaide, Ballarat and Bendigo and in the two working museum tramways at Loftus and Parramatta Park, N.S.W. and the short industrial line at Randwick Workshops in Sydney. The narrower



Sydney's Railway Square around the turn of the century. The old American term "street railway" would have been an apt description of the Sydney tramways during the steam era.

3'6" gauge was employed in 150 route miles of construction and the broad 5'3" gauge amounted to 97 miles. Of the 20 miles of 2 ft gauge laid down by the P.W.D. in Western Australia, all but $12\frac{1}{2}$ miles were later converted to 3'6" gauge. The total tramway mileage in Australia, therefore, amounted to approximately 920 route miles, about 75% of this total was in operation during the 1920's, at a time when Australia's population amounted to only 6 millions, over a land area of some 3 million square miles.

This multiplicity of gauges did not present the same difficulties as faced the Australian railways network as only at St. Kilda in Melbourne did the two different gauges cross and meet. Greater problems were faced between two modes of traction when they met on identical gauges. In Melbourne and Sydney electric rolling stock could only be operated with safety on the cable track if the cable loading gauge and track centres on curves were widened, although in Sydney some C-class cars on the electric system were built to reduced dimensions to work on cable trackage. The Lonsdale Street cable line in Melbourne was built to electric standards, but was not used as such. In N.S.W. the Cronulla, Morpeth and Kogarah tramways, and for part of its life, the Rockdale route, and the Fassifern to Toronto line operated on the standard gauge track built with check rail and back-to-back clearances of the coarser railway wheel standards while the other lines in the state to this same gauge were laid with the finer tramway wheel clearances and tolerances. This necessitated in wheel exchanges or tyre re-profiling for permanent rolling stock transfers between the systems. The small isolated South Australian tramway network in Port Adelaide posed a gauge problem when taken over by the standard gauged Municipal



Shunting a South Melbourne cable grip and trailer set in Market Street, the terminus of the southern lines after the electrification of Collins Street. Photographed in 1936 by the late Wal Jack.

Tramway Trust, the operators of the main Adelaide system. From 1879 to 1882, the Port Adelaide line was steam operated on the 5'3" track gauge. In the intervening period until taken over by the M.T.T. in August, 1913 horse traction worked the line, still on the broad gauge. Since the M.T.T. were still busy in the conversion of the Adelaide tramways from horse to electric operation at this time, broad gauge horse traction continued until late 1914, when the line closed for gauge conversion. March, 1915 witnessed horse cars again on the streets of Port Adelaide, this time on standard gauge tracks, a working which persisted until April, 1917, when electric trams appeared.

ISOLATED LINES

The Adelaide and Melbourne systems grew from a number of isolated private and council worked networks, while Perth and Fremantle had foreign owned track at the extremities of the main systems. There were several instances of isolated tramways being joined up.

In 1882, the isolated Newtown and Marrickville steam line in Sydney was joined to the expanding main system after working for 10 months in isolation. As recently as 1954 the Footscray isolated routes were physically connected to the Melbourne tramways. The Thebarton to Henley Beach section of the Adelaide to Grange horse tramway was electrified and worked as an isolated unit from the Adelaide system between December, 1909 and March, 1910, but was physically connected to Adelaide by the horse tram rails during this period. Similar situations existed in Sydney and Melbourne during the dual cable and electric operation period.

The Great Brisbane Flood of February, 1893 caused the Brisbane horse tramway system to be cut into two isolated parts. At 4 am on Monday, February 7th, the first span of the Victoria Bridge washed away to be followed progressively by the other spans as the Brisbane River ran amok with a flood which eventually left 8,000 people in a populated area of 20,000 homeless. Although the patched up bridge was reopened late in 1893, it was not until October, 1896 when the erection of half of the new Victoria Bridge was completed that the two isolated parts of the Brisbane horse tramways were permanently reunited.

The isolation of tramway routes due to major constructional works were fairly commonplace at a period when motor omnibuses were unavailable to provide a replacement service, but the work of reconstructing the Charing Cross bridge in Bendigo provided us with a recent example during 1965 when the Eaglehawk tramway was isolated from the main Bendigo section. From time to time temporary track was used to bridge the gap to enable rolling stock to be exchanged for routine maintenance.

OPENING BRIDGES

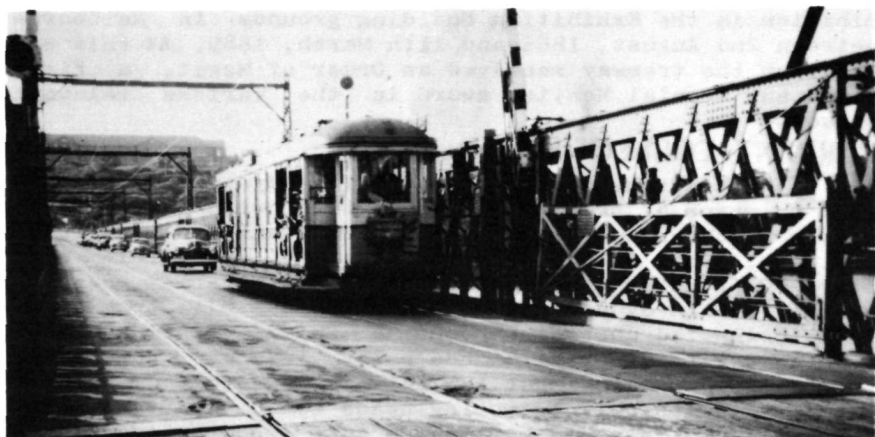
Swing span bridges over which tramlines were laid also caused intermittent isolation of otherwise connected lines, especially during hot weather. At two locations in New South Wales tram lines crossed opening, swing span, bridges. The structure at Glebe Island seemed to function to its designed purpose although routine maintenance sometimes caused termination of the tram service on each side of the swing span. At times, tram crews were directed to walk across the traffic gap with their passengers to take up running on the connecting vehicle. At Glebe Island the trams beyond the bridge were not physically isolated from the rest of the system due to other connecting lines, but beyond Gladesville Bridge, the other swing span, the long Ryde line was isolated from time to time. The Gladesville Bridge displayed the propensity to jam. On many occasions the roadway would be usable but the tram tracks would fail to align causing a well tried emergency routine to operate beyond the delinquent span.

The Jervois Bridge at Port Adelaide was of similar construction to the Glebe Island Bridge but displayed similar habits to the Gladesville span. This structure was traversed by the Semaphore and Largs trams between 1917 and 1935. In Newcastle N.S.W. the most unusual opening span of all was traversed by the Carrington Trams. Until the major creeks in the flat Newcastle area were excavated and lined during the late 1920's, local flooding occurred during most wet weather periods. To relieve this situation dredges sometimes ventured up Throsby Creek, requiring the special span of the Carrington Bridge to be unfastened and floated out of position.

One very unusual structure could be seen in the Brickworks' Siding, Sutherland. Trams entering the brickyard had to pass through a lifted draw bridge span of a skip way; thus the steam tram took the place of shipping in a more conventional situation.

TURNTABLES

Because Australian cable tramways all employed grip car and trailer sets, turntable terminals were not required as in San Francisco. The first St. Leonards Park terminal on the North Sydney cable line (1886-1893) did employ a turntable, however, which had the dual purpose of exchanging the trams between the down and up tracks, and diverting them to the Ridge Street Depot. Some other turntables come to mind: in Newcastle a turntable stood in the Perkin Street depot yard, to turn the single ended steam combination cars, from 1887 until 1893 when the City track was extended to a triangular terminal at Parnell Place. The turntable was then transferred to Glebe in 1894 where it remained until the scrapping of the combination steam cars in 1896. The same turntable is believed to have



"0" 857 approaches the Gladesville Bridge swing span on 19th March, 1950, the last day of service on the Drummoyne to Gladesville section of the Ryde line.

started its career at Bridge Street Yard in Sydney to enable similar steam cars to be terminated there. These trams worked to terminals such as Coogee, where balloon loops simplified the turning procedure, and to the Railway Station and Randwick Workshops where triangular loops were laid in. To equalise wheel wear, turntables were employed at Baulkham Hills depot in N.S.W., and at the rear of Elwood Depot on the St. Kilda to Brighton line in Victoria where this 5'3" gauge 'table was the last one in use in Australia.

A combination traverser-turntable contrivance was reputed to stand in the White Bay powerhouse yard in Sydney to enable ash trams from the Robert Street siding to travel under the bins but it is doubtful whether this was ever constructed.

ONE TRAM ONLY

Much has been written about the single electric car which worked the Leonora to Gwalia tramway between 1907 and 1916, but there were two other "single tram" lines in Australia. The Box Hill to Doncaster pioneer electricline operated with a single electric tram between 1889 and late 1890 when a second vehicle joined the "fleet". The standard gauge, 1 mile, horse tramway on St. Helena Island in Moreton Bay, Queensland, was served by a single car from 1900 to 1935 and the body of this same tram is reputed to be still standing on the island.

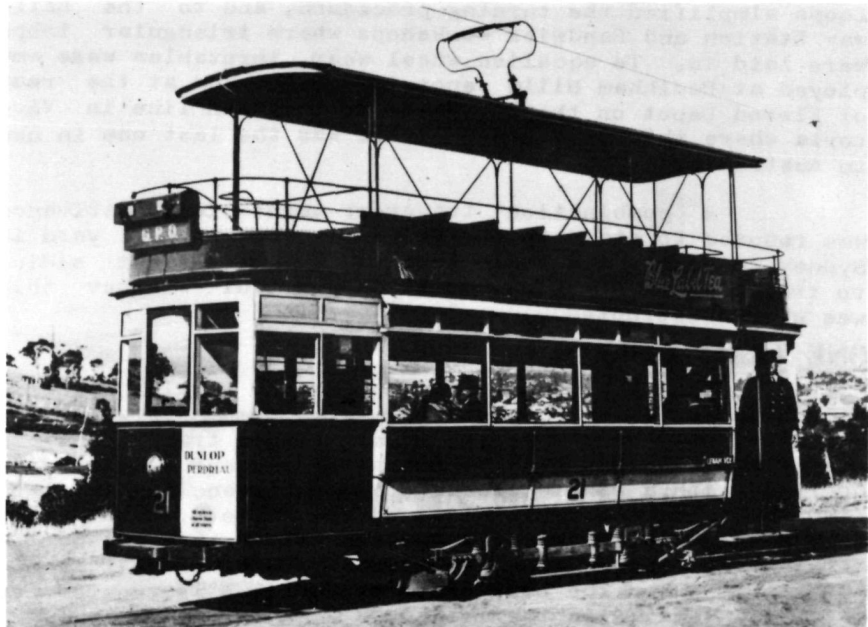
The original car and machinery of the Box Hill tramway had been constructed, displayed and operated by

the Thomson Houston Electric Company at the Centennial Exhibition in the Exhibition Building grounds in Melbourne between 2nd August, 1888 and 11th March, 1889. At this exhibition the tramway received an Order of Merit, a First Place and Special Mention award in the various relevant classes.

CURRENT COLLECTION

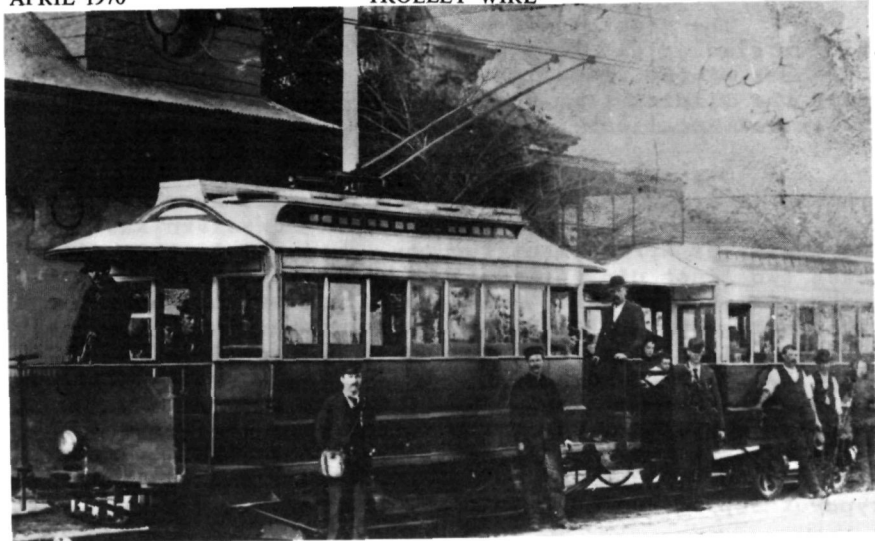
Most Australian electric tramways collected current by means of trolley poles fitted with fixed axis wheels or shoes under-running on a centrally located trolley wire. This method permitted the use of simple open overhead frogs at junctions. The 1890 Waverley experimental line in Sydney and possibly the Box Hill tramway of 1889, collected current through a swivel trolley wheel mounted on the end of a bamboo pole. This was successful on small undertakings but the only sophisticated network to persist with swivel trolley heads was Launceston, where the trolley wire could be located away from the track centres, but manually operated bladed overhead frogs were a necessity at junctions.

When the Waverley undertaking was transferred to North Sydney in 1893 poles with fixed trolley heads replaced the bamboo ones on each car. These new poles were mounted on the edge of the tram roofs, however, to permit



Hobart double deck car 21 at Lenah Valley terminus during the nineteen thirties.

Photo by the late Mrs. E. King



The twin trolley poles are clearly seen in this photo of Saywell's two saloon cars at the Brighton-le-Sands terminus.

erection of roadside mounted trolley wire with a saving in span poles. This system worked satisfactorily until 1901 when the need for the introduction of balloon loops or triangles and the relocation of the track into the centre of the road caused the poles to be replaced back in the centre of the car. For a time prior to the changeover, the normally single pole fitted cars carried two poles, one side mounted, one centrally mounted.

The London branch of the German company of Siemens Brothers won the contract for the construction of the Hobart electric tramways and it is not surprising that they adopted the sliding bow form of current collection as an engineer in the German headquarters, Walter Reichel, had perfected the device two years earlier. The Hobart system opened on 23rd September, 1893, having been beaten by the North Sydney line by some three days to being the first "permanent" electric tramway in Australia. The Hobart undertaking retained the bow form of collection until closure in 1960.

Bow collectors won a trial in Melbourne between 1924 and 1930 while in Adelaide both bow collectors and pantographs were examined during the 1930's. During the late 1930's Brisbane also altered the overhead on one route for dual trolley pole and bow collector operation, but there is no record of bow collector trials having taken place.

The problems of providing an overhead wire crossing for sliding electric train collectors and the wheels and shoes of the trams in Melbourne was reversed in Hobart where the sliding tram bows crossed the trolley bus wires at several locations.

Saywell's private Rockdale to Brighton-le-Sands tramway in Sydney collected power from twin overhead wires from 1900 to 1914 and the Leonora line in Western Australia had a similar arrangement for its entire electric life. These two lines did not function on the twin wire trolley bus system but on a DC, 3 wire principle which enabled two DC lighting dynamos of 250 volts to feed into the twin overhead wires as well as the track to provide a 500 volt potential. This was possible by feeding a common wire at earth potential into the track from the two dynamos and a positive current of 250 volts in one wire and another 250 volts of negative polarity into the other wire. Contemporary technical journals of that period indicate that this type of supply was used in these two cases.

Remote track point changers actuated by "power-on and power-off" arrangements on the overhead wire were used on many of the larger mainland systems as well as at Hobart. Sydney is believed to have had one similar device at the Cleveland Street Junction until the arrival of the O-class cars in 1908, which operated coupled with both cars with a pole on the wire. The difficulty in coasting two vehicles of a coupled set under the overhead switch contactor caused the removal of the device.

Coupled cars were naturally used on the steam and cable systems although during the early years of operation the North Sydney cable line worked single grip cars during slack periods.. The N.S.W. steam motors were known to haul up to 4 or 5 trailers in normal service and consists of up to 8 trailers could be seen in shunting moves at Broken Hill. On the electric undertakings Perth, Kalgoorlie, Adelaide, Sydney, Newcastle, North Sydney, Manly, Enfield and Rockdale worked coupled motor cars while in addition Fremantle, Perth, Kalgoorlie, Melbourne, Geelong, Ballarat, Bendigo, Sydney, Rockdale, North Sydney, Manly and Newcastle operated electric motor-trailer sets.

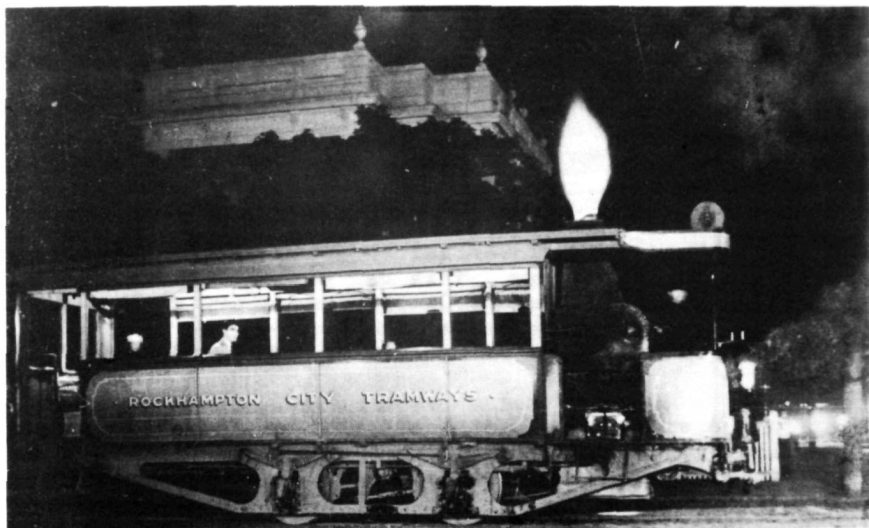
BELT LINES

The steam tramway which operated in Rockhampton, Queensland between 1909 and 1939 employed 9 double ended combination motor cars and 6 trailers. This network was constructed with a circular belt line around the city area with three lines branching to the suburbs, where all terminals were furnished with tight radius balloon loops. These successful Queensland steam cars were powered by underfloor steam engines, built by Purrey of Bordeaux, in France, which transmitted power to the wheels by a chain drive. The water tanks and other auxiliaries stood under

the cross benches while the compact engine was located behind the driver on the front platform. So compact were the cars that the driver had to fire and stoke the firebox from the roadway!

The only other Australian tramway set out like Rockhampton to the American pattern was the system at Broken Hill, N.S.W.. This too consisted of a large circular belt from which extended five branches to the suburbs. The fortunes of this tramway rose and fell with the prosperity of the mines, so for much of the period from 1902 to 1926 not all the track was in service, while periods of drought caused tramway traffic to be curtailed as the precious water was diverted to more pressing needs than steam tram boilers.

At Broken Hill the proposition of the "tail wagging the dog" existed..... The tramway superintendent exercised control over the isolated N.S.W.G.R. line between that city and the Darling River at Menindee from 1919 until joined to the main line to Sydney in 1927. It is believed that the Broken Hill steam motors powered the construction trains on the railway and were also used from time to time to assist the three Baldwin locos on water trains during the drought periods. It is perhaps worth mentioning here that the Silverton Tramway Company workshops at Railwaytown in Broken Hill were responsible for the major boiler overhauls of the N.S.W.G.T. steam motors in that city.



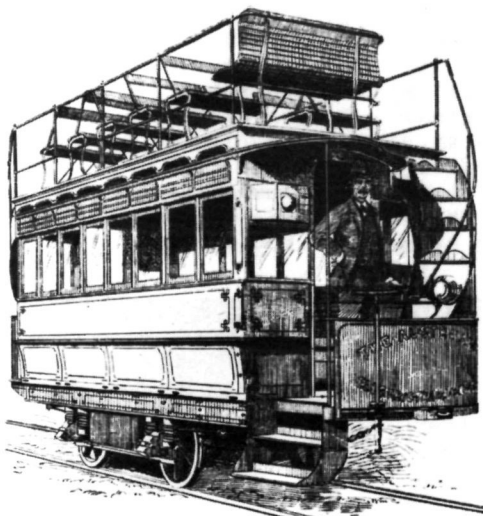
A rare photograph showing one of Rockhampton's steam trams at night.

From Hugh Ballment collection

BATTERY POWER

Self contained electric trams powered by batteries proved anything but successful in Australia. Nine battery cars opened the Bendigo to Eaglehawk tramway in 1890 in the most optimistic venture of its kind in Australia, but because of financial and technical difficulties, the line closed three months later. Not until 1892 was the route reopened with steam traction, using motors similar to those employed by the N.S.W.G.T.

On 1st June, 1888, a four wheel double deck battery car with transverse seats on the upper deck worked successfully on an official trial from Sydney to Botany and return with a load of dignitaries. This $5\frac{1}{2}$ ton tram was propelled by a single motor driving the wheels through gears. Banks of accumulators built to the "Julien" design



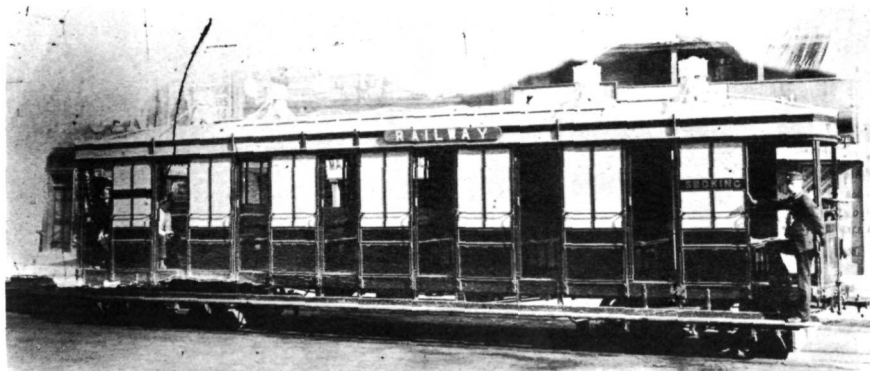
The Australian Tramway Company's accumulator car which was tried in Sydney.

and located under the lower saloon seats provided the necessary electrical energy. This car was on loan from the Australian Electric Tramway Company and apart from a later trial, believed carried out on the Kogarah to Sans Souci steam line in N.S.W., nothing further was heard of this vehicle.

A similar but not identical double deck battery car, this time with knifeboard seats on the upper deck, won a trial from the Melbourne Tramway and Omnibus Company when it operated along the Toorak Road cable line in September 1888. This car next appeared in Ballarat on the then horse worked lines during the following month. Again these two trials proved successful but failed to develop into a practical application. On 9th January, 1889 yet

another battery car received a trial with the Adelaide and Hindmarsh (horse) Tramway Company. What is believed to be the Melbourne mechanism (which could have been the Sydney machinery with minor alterations) was set up under an Adelaide horse car for the trial. The tram worked with satisfaction on the straight track but continually stalled on the curves; so the battery form of electric traction did not succeed in Adelaide. When used in Adelaide the single underfloor motor drove a countershaft through a rope drive, which in turn transmitted power to the wheels through a sprocket and chain.

The last experiment into battery traction took place again in Sydney, when a car built to a design resembling the then standard 70 seat cross bench steam trail cars and in fact numbered 197 in the steam roster, made a successful trial trip to Coogee on 2nd May 1894. This car, powered by two motors, one located in each of its maximum-traction bogies, received power from banks of "Plante" type accumulators located under the cross seats. This tram, the most successful of all Australian cars of this type, remained in electric service for 13 months, after which time the electrical gear was removed and the car was sent to work as a steam trailer on the East Maitland to Morpeth line.



The most successful accumulator car was Sydney 197 which operated during 1894 and 1895.

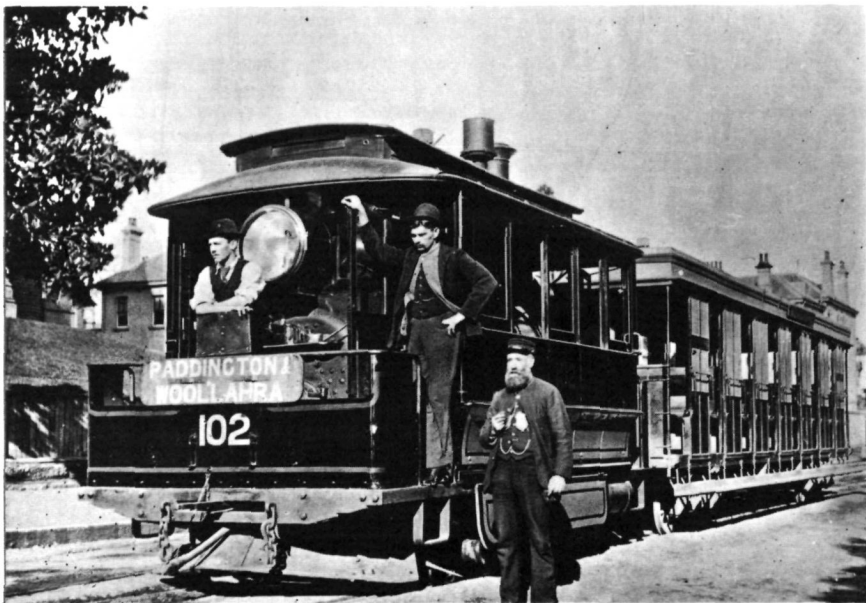
TRAMS ON RAILWAY LINES

At Cairns, Bundamba and Belmont, in Queensland, tramway stock operated on what was in fact railway track, but at Morpeth in N.S.W. an unusual reason caused a similar operation. During a financial depression of the early 1890's the N.S.W.G.R. achieved some economy by operating standard steam trams and trailers on the East Maitland to Morpeth railway. This operation, introduced on 1st August, 1893 lasted until July 1913 and at its peak, 2 motors, 2

trailers and 2 coupling trucks were in use. On Sundays, however, conventional steam trains worked the service.

Between 29th August, 1910 and 28th May, 1911 the N.S.W.G.T. operated the three mile Fassifern to Toronto railway. During this time the light rails and earthworks, built by the Excelsior Land and Building Company in 1891, were upgraded for full size Government railway working. Two steam motors and three cars were used at Toronto to provide the eight weekday, eleven Saturday and five Sunday return trips. One of these trailers was borrowed from Morpeth where a conventional end platform suburban railway coach was provided in the interim period. To handle the heavy Sunday traffic during the 1910-11 summer, the entire Morpeth tramway fleet was transferred each Sunday to Toronto.

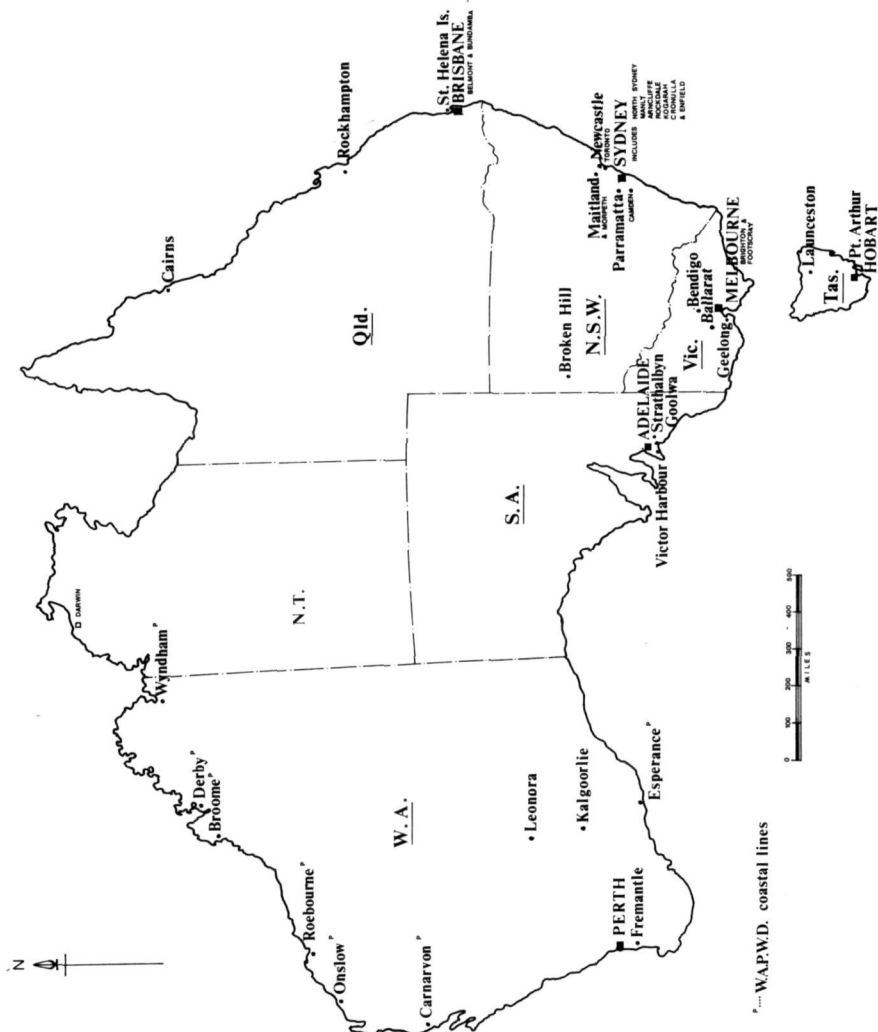
Two other N.S.W. tram lines were converted to full railway operation. The Camden line opened with two steam motors and two tramway trailer cars in 1882 but in 1884 conventional locomotives took over this service. The Castle Hill tramway was replaced with a railway beyond the Woollen Mills terminus at Northmead in January 1923 but this was short lived and succumbed to the depression and bus competition some ten years later.



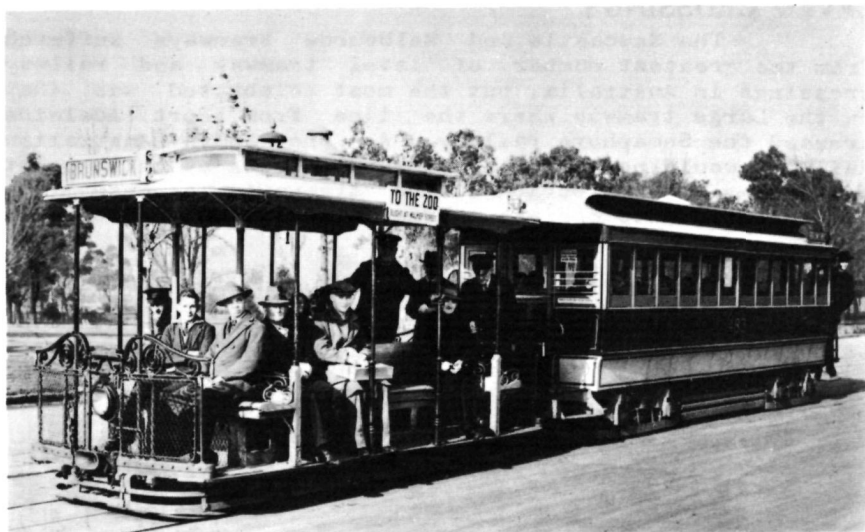
Baldwin built steam motor 102 and its 70 seat trailer are typical of suburban steam tramway working in Sydney in the 1890's. Here the crew pose with their charge while working the shortlived Woollahra branch.

LEVEL CROSSINGS

The Newcastle and Melbourne tramways suffered from the greatest number of level tramway and railway crossings in Australia, but the most celebrated was that on the Largs tramway where the line from Port Adelaide crossed the Semaphore railway. As the South Australian Railways would not allow a tramway crossing at this point without manned protection at the tramway's expense, the M.T.T. decided to operate a tram in isolation, on the line



Map showing location of the Australian tramways discussed in this issue



A Melbourne cable grip car and bogie trailer outward bound for the northern suburb of Brunswick.

beyond the crossing, for the opening of the route in 1917. When the M.T.T. later tried to force a through service, the railway gangers dumped sleepers in the tram's path. Finally the M.T.T. surrendered, and on agreeing to finance the manning of the crossing and the installation of safety devices, the S.A.R. gave its approval to the through service.

The insulating devices and crossing frogs on the overhead wiring where the 4'8½" gauge Melbourne tramways cross the 5'3" gauge electric railways have always been an intriguing arrangement, but several trams have been withdrawn for major workshop overhaul from time to time when the switching gear has failed to turn the 1,500 volt railway current down to the required 600 volts for the tram's passage.

The standard gauge Broken Hill tramways crossed several 3'6" gauge railways both of Silverton Tramway and local mine ownership, but in Sydney there were three places where 2ft gauge tracks crossed the tramlines. In 1924, a skipway was laid across The Spit route during sewer main construction; a similar railway crossed the Botany line, at Botany pier; while the narrow gauge blacksmith shop line crossed the standard gauge tracks in Randwick Workshops.

Sometimes it was possible to view one isolated tramway from another operated by the same authority. The Abbotsford line could be seen from Cabarita terminus while

the North Sydney tramway actually crossed the Millers Point line of the main Sydney network, but one line, located on the Harbour Bridge approaches, stood 100 feet or so above the other. The Manly and North Sydney systems reached Middle Harbour on each side of The Spit where connection was afforded by a special tramcar punt. From December, 1910 to January, 1912 rolling stock transfers were made on the deck of the vehicular ferry but between 1912 and the closure of the Manly lines in 1939 the special tramcar ferry performed the task.

The private Sydney Ferries steam tramway crossed the N.S.W.G.T. Castle Hill line on the level at the Church and George Streets corner in Parramatta without any physical connections. On those rare occasions that stock transfers were undertaken, the task necessitated in the derailment, jacking and slewing of the vehicles from one track to the other.

ROLLINGSTOCK TRANSFERS

The transfer of rolling stock between systems posed problems. Early transfers such as from Sydney to Newtown and to Enfield were carried out on low slung horse drawn road wagons but physical connections were later laid between railway and tramway lines in N.S.W., at St. Kilda in Victoria and at Perth in Western Australia. In N.S.W. these railway-tramway connections enabled many transfers of steam stock to be carried out under their own power; while steam motors could frequently be seen hauling elec-



Transferring Ballarat 25 to Bendigo on 6th October, 1960. The low loader is coming out of the depot onto Wendouree Parade.

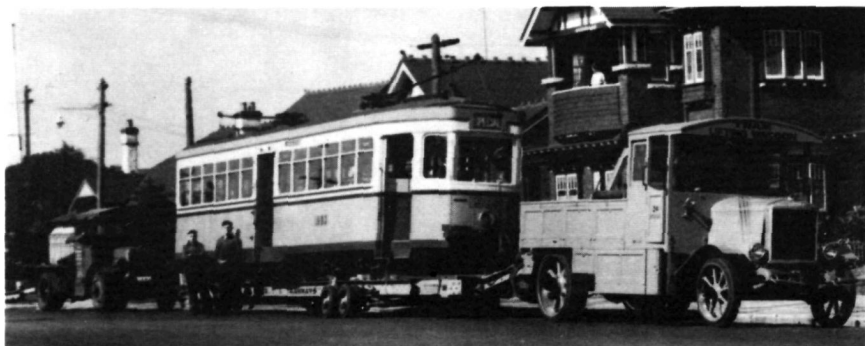
Photo by the late Wal Jack

tric tramcars along the railway lines on Sunday mornings during transfer duty periods. Prior to the connection of the Newcastle and Sydney based railway systems the Newcastle trams were delivered from Sydney by sea and as the Broken Hill railway did not connect with the main state system until after the closure of the street tramways such transfers from Sydney had to follow a 1,500 mile sea and rail route rather than the later 700 miles direct rail journey.

Except for the rare transfers of stock between the two Parramatta lines as mentioned earlier, new vehicles to the Sydney Ferries Parramatta steam tramway arrived by lighter up Parramatta River to the tramway wharf at Redbank while the delivery of three former Kogarah steam motors in 1937 was carried out by jacking and slewing between the railway and tramway tracks at Wunderlich siding at Camellia.

The Adelaide to Port Adelaide tramway transfers were made by road as were the Melbourne deliveries to Footscray prior to the physical connection of 1954, but until 1950 a "Sentinel" steam lorry was the prime mover of the road trailer at Footscray. More recent transfers between Melbourne, Geelong, Ballarat and Bendigo were also by road trailer. The most recent transfer between Ballarat and Bendigo, when Bendigo bogie car 1 was exchanged for Ballarat single truck trams 19 and 25, took place on a Yellow Express low loader semi-trailer during the three day period of 4th to 6th October, 1960.

With the closure of the isolated steam suburban tramways in N.S.W. by 1937, the policy of tram transfer changed from rail to road haulage. To facilitate this a long road trailer known as "The Lizard" was purchased by the Sydney tramways, onto which an electric tram could be driven under its own power. The use of this trailer gradually diminished with the closures of the isolated tram-



Moving a Sydney tram by road. R1-class car 1983 on "the Lizard".



Brisbane horse car 8, outside the old Light Street Depot. This car is typical of those operated in Adelaide, and on other horse tram systems.

ways at Enfield, Rockdale and North Sydney in 1948, 1949 and 1958 respectively. After November, 1952 the "Lizard" was forced to have its condemned solid rubber road tyres replaced by pneumatics like any other road user. This alteration was both costly and complicated and not until August 1954 did the "Lizard" again return to its regular duty. In the meantime, the private haulage firm of Pittmans handled the delivery of new rolling stock with a special road trailer, but the hiring fee is believed to have been too uneconomical to have this vehicle employed on the routine transfer of tramway rolling stock between the systems.

The retention of the Adelaide to Glenelg tramway after the closure of the street tramways in 1958, meant that the remaining city tram depot was isolated from the main workshops at Hackney. This isolation has been overcome by transferring the "H" cars due for repair over the two railless miles on a road jinker.

HORSE TRAMS

Of all the various forms of traction used on the Australian tramways the major types lasted as follows:

Steam	1879 to 1943	64 years
Horse	1853 to 1955	102 years
Cable	1885 to 1940	55 years
Electric	1889 to date	81 years

Although the horse traction period has been dated from the opening of the Strathalbyn railway in 1853 to the closure of the Victor Harbour line in 1955 its real heyday lasted from 1878 when the first Adelaide street line opened to 1917 when the Port Adelaide tramway gave way to electric power, a period of 39 years.

That animal traction lasted so long into a period of mechanical innovation is strange as this form of traction was plagued with three major problems: the possibility of animal sickness was ever present; a high number of horses per tramcar had to be kept and fed, even during slack periods, and the disposal of manure was a major problem. The horse operating companies generally quietened complaints of residents living adjacent to their stables by suggesting that the piles of manure had medicinal qualities!

THE FUTURE

What of the future? The long expected closure of the Ballarat and Bendigo systems in Victoria has yet to take place, the single interurban line in Adelaide still receives regular amintenance and as recently as December, 1966 new elaborate terminal facilities in Victoria Square, in conjunction with a road diversion scheme, were opened for the trams.

A new metropolitan transport scheme for Melbourne, released late last year, provides, amongst other things, a planned expenditure of \$55,000,000 for the purchase of 910 new trams. This then seems to guarantee the retention of at least one tramway system in Australia during the distant future with the possibility of the diversion of the inner city tracks into tunnels. After witnessing the removal of the North Sydney trams from their underground city access in 1958 and the rerouting of replacing buses into the already crowded streets, one finds it hard to look forward to the Melbourne proposals with optimistic certainty.

How long the single Sydney R-class car 1979 will continue its task of shunting the single flat top trailer on the quarter mile of track in Randwick Workshops is uncertain, but the electric feeding arrangements for this undertaking from Waterloo substation had to undergo considerable change to allow car 1979 to continue running. With the removal of the connecting track between the substation and the workshops, the direct earth connection was lost. Complaints from other utility undertakings due to the danger of electrolysis is believed to have caused the erection of a negative feeder along the transmission route.

Of the museums, the electric operation at Loftus and the steam working at Parramatta Park are well established and in the not too distant future it is hoped that the museums at Melbourne, Adelaide, Brisbane and Perth, and perhaps Hobart will also achieve running status.

When one reviews all these odd arrangements and difficulties associated with tramways over the last 143 years one not only marvels at their longevity, but in this day and age when the toil of overcoming difficulties is no longer considered a virtue, one wonders how tramways in Australia were ever established at all.



The closest points trams came to Captain Cook's landing place at Kurnell were La Perouse and Cronulla.

ABOVE: Steam motor 124A is seen on a trial run in Curranulla (now Cronulla) Street, Cronulla, on 1st June, 1911, twelve days before the official opening.

BELOW: "P" 1711, "O" 1431 and "P" 1591 at the La Perouse terminus on 27th December, 1949. Kurnell is in the background.



BACK PAGE: Sydney's last tram ran on 25th February, 1961. R1 car 1961 made the last run with R1's 1995 and 2035. Car 1961 is seen at Railway Square on its last run but one, to Maroubra.

