HEADLIGHTS

July August 1970

HEADLIGHTS

The Magazine of Electric Railways

Volume 32 Number 7-8

EDITORIAL ADDRESS
P. O. Box 80
Church Street Station
New York, N. Y. 10008
Phone: 212 WO 2-0627

Editor .... Leo J. Ross
Managing Editor .... Jonathan D. Boyer
Associate Editors .... David L. Klepper
James C. Smith, Jr.
Jackson D. Jupp
Contributing Editor ...... Joseph H. Gould
Index Editor .... Lloyd E. Klos
Book Reviews .... Thomas W. Streeter
Frank S. Miklos

Date of Publication: July 1971

COVER PHOTO: Inward bound toward the City in May, 1967, a sliding door equipped SW-6 class Melbourne tramcar No. 944 on Route 64 is magnificently framed by some long needled trees as it speeds along the Dandenong Road reserved track shared also with Route 5. *Ward collection*

The two men responsible for this issue are the brothers Ward. Born in Melbourne in 1940, John O. is the senior. Having received his Bachelor of Arts at Melbourne University, John journeyed to Toronto to obtain his M.A. from Toronto University in 1964 and to work toward his Ph.D. during the next 3 years with a summer out to visit Europe and England and their trams and trains. Now a Lecturer in History at the University of Sydney, he is endeavoring to complete his degree amidst the clamor of 3 children. Brother Andrew was born some 4 years later. He too attended Melbourne University where he obtained a B.A. in Architecture and a Diploma of Town and Regional Planning. Having remained at home with his wife and child, he is now in private practice as an architect in a Melbourne suburb.

The Editors would also like to thank Howard R. Clark, Managing Editor of *Electric Traction*, the Journal of the Australian Electric Traction Association for assistance in providing several excellent photos and for the technical description of the W-7 class. Thanks too are also due to the Tramway Museum Society of Victoria Ltd. publishers of *Running Journal* whose December 1969 issue provided additional historical background on the development of the M&MTB.

PUBLISHED MONTHLY since 1939 by the Electric Railroaders' Association, Inc., 145 Greenwich Street, New York, New York 10006.

Applications for membership in the E. R. A. are supplied upon request. Dues are $5.00 per year plus a $1.00 initiation fee. *HEADLIGHTS* is sent free to members of the Association who are in good standing. Subscriptions to *HEADLIGHTS* for non-members are $6.00 per year. Industry subscriptions are $12.50 per year for three copies of the magazine each month; additional monthly copies cost $3.00 per year. Only public agencies and firms in the transportation field are eligible for industry subscriptions.

A view of the new median strip operation built as part of the complex split-level tram and road interchange at St. Kilda Junction. Although No. 958 is a post-War enclosed car, 40 to 50 year old W-2 class cars are quite common on this stretch of Routes 5 and 64 providing a quaint contrast between the old and what is hopefully to become the new standard for reserved track tram operation. *Ward collection*

Melbourne

Transportation Plan for 1985

THE FUTURE DEVELOPMENT OF MELBOURNE'S transportation network has been described in the *Melbourne Transportation Study, The Transportation Plan.* The Study, a plan for all forms of transportation in 1985, is a product of the Melbourne Transportation Study, the working group of the Melbourne Transportation Committee. Established in 1963, the Melbourne Transportation Committee includes the national Minister of Transport, the Minister for Local Government, and chairmen of the major land transport authorities. The MTC assigned a staff of six engineers from the various authorities to work with the two consulting firms that had been hired and to gain experience in all aspects of the study. On completion of the basic study, these engineers, together with other assigned staff, became the Melbourne Metropolitan Transportation Study which, in turn, was responsible for preparing the 1985 plan.

The Study found that the number of jobs, car-owning households and students attending schools and universities will be substantially increased, while the number of trips for business and shopping will also rise. Daily trips by residents of the design area in 1985 are expected to be two-and-a-half times greater than in 1964, with trips per person increasing from 1.56 to 2.05. The existing networks are not capable of handling the increasing volumes of traffic at a desirable standard of service.

Travel by private car is expected to show the greatest increase—about 203 percent—and is the reason additional road construction is so vital. A 74 percent increase in rail and a 23 percent increase in tram/bus travel also is predicted. However, because of the predominance of auto travel, public transport trips are expected to comprise only about 22 percent of all week-day trips, whereas 1964 public transport accounted for 38 percent of all daily trips.

Trips to the central city area are expected to show an increase of some 31 percent over 1964 figures; auto trips will rise by 53 percent, rail by 55 percent and tram/bus will remain approximately the same. Trips associated with worker travel to the city in 1985 are expected to rise by 34 percent over 1964. Private transport trips for work will increase by 55 percent, rail by 62 percent and tram/bus are expected to remain about the same. With the expansion of urban development, it is expected improved transport services will increase trip lengths for all modes, with the average journey by auto rising from 4.8 to 7.1 miles and train from 9.2 to 10.9 miles.

The total demand for parking in 1985 in the city area is expected to be 55,600 spaces, compared with 38,000 in 1968. In order to meet the demand of motorists who drive their cars to the local railway station and complete their journey by rail, the Committee recommended that more parking facilities be provided at many suburban stations. In 1964 nearly 13,000 cars were parked at railway stations each day, with about half of these parked in off-street facilities at 98 stations. By 1985 morning-peak commuters using the railways will require 25,000 car parking spaces at stations.

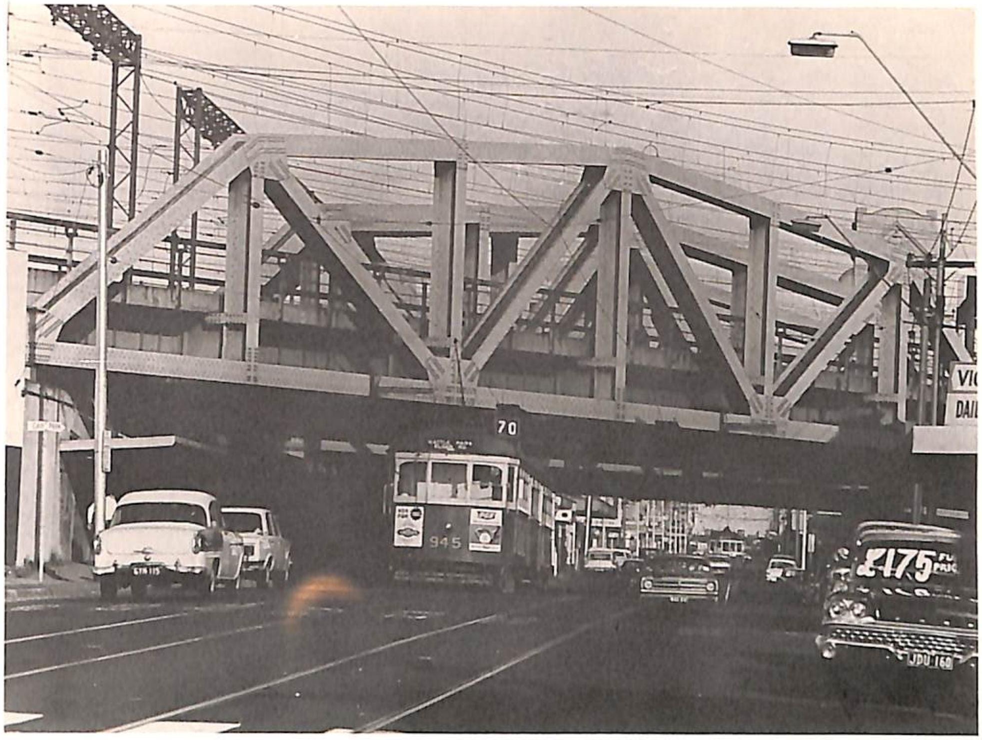
The report recognizes that "the motor car has brought mixed blessings to developed communities in the world." By 1985 it is expected that there will be 1.5 million motor vehicles (autos and trucks) on roads in the metropolitan area—2½ times the 1964 total. The total number of person trips each day — about 6,367,000 — will be three times the number of trips as formerly. The average distance travelled will also rise about 50 percent. The mileage travelled by private autos in the design area alone could reach 37.4 million vehicle miles a day. At the same time, the demand for street public transport—buses and trams—is expected to increase substantially, and the number of passenger miles travelled daily will rise from about 2½million in 1964 to 3½ million in 1985.

The Transportation Committee, realizing the importance of improved roads in the overall transport plan, has recommended the construction of 307 miles of freeways, 103 miles of new arterial roads, and 189 miles of widened arterial roads. The recommended plan not only makes provision for the expected trebling of the 1964 volume of vehicle traffic, but also additional means of handling this increased traffic and providing the higher standards of service required.

The public transport demand expected in 1985 necessitates improvement of Melbourne's suburban rail network and tram and bus services. The Committee attached great importance to the public transport proposals because, unless positive action is taken to improve these services, in terms of travel time and comfort, the requirements for additional road space will inevitably have to be substantially increased. Melbourne's existing comprehensive network of public transport is a valuable community asset which many other cities lack.

The suburban rail network, operated by Victorian Railways, is broad gauge (5'-3") and is mainly electrified. It comprises a multi-track system which radiates from the city and extends 26½ miles to the south and southeast suburbs. On many lines the system has considerable reserve capacity to handle more people. Other lines can be greatly expanded without enlarging rights-of-way except at the terminals.

The Committee recommended proper upgrading of all these services, providing faster, more comfortable, more frequent services, better parking facilities at points of modal

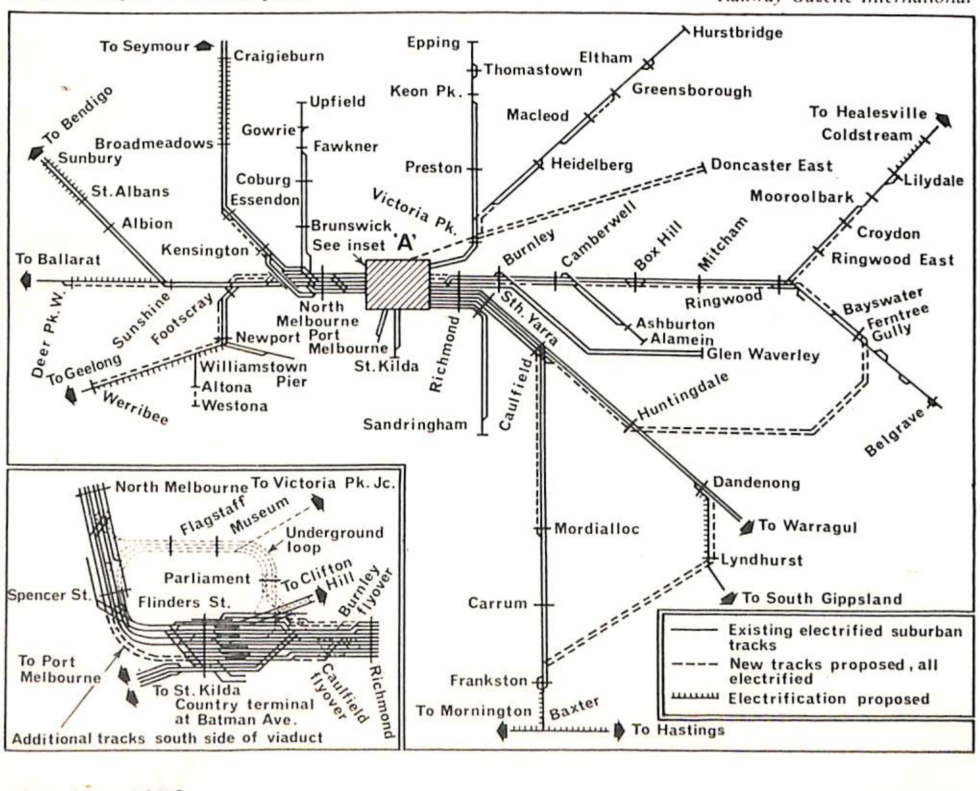


A sliding door car slips beneath the rail overbirdge at Richmond Station, one of the most important on the electrified railway network, while in the background a W-2 class car fights its way through the Swan Street traffic in 1968. Improved surface/rail transfers at stations like Richmond, the first station beyond Flinders Street the important Box Hill, Dandenong, Frankston and Sandringham electric railway line, are emphasized in the 1985 Study. *Ward collection*

inter-change, improved feeder bus services linking rail and tram networks with residential areas and the maintenance of a high standard of safety.

By 1985 the metropolitan rail system is expected to be handling 663,000 passengers a day compared with 381,679 in 1964. This big increase is expected to follow the predicted rise in population in the metropolitan area. The most important role played by the rail network is in handling peak commuter traffic. In 1964, two-thirds of the total passengers carried travelled during the morning and evening peak hours.

Schematic map of the Melbourne suburban railway network showing the three new routes and other changes proposed as part of the 1985 plan. *Railway Gazette International*



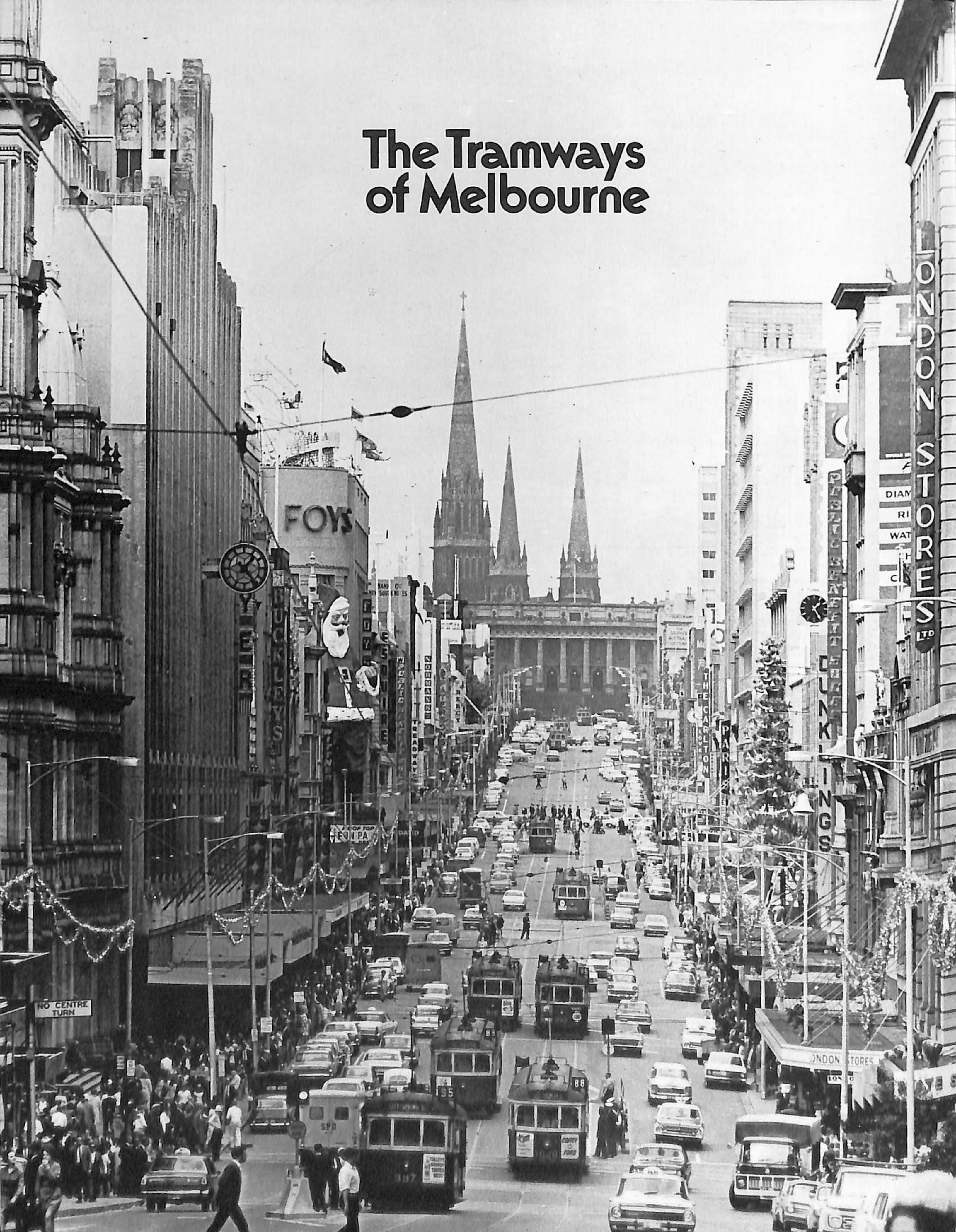
To carry out its 1985 traffic task effectively and to develop the necessary potential for further expansion beyond that date, the Committee recommended the construction of an underground loop terminal in the central city area and several new lines—East Doncaster to the City; Huntingdale to Ferntree Gully and Frankston to Dandenong.

Other recommended improvements include: increased service frequencies on peak services, with the addition of 73 extra trains, the laying of 33 miles of new express tracks mostly in existing rights-of-way; extension of electrified services over an additional 62 track miles; double-tracking of some 19 miles of single track lines, replacement of all out-of-date rolling stock, extension of automatic signalling, construction of new stations, substantial extension of car and bus parking facilities at suburban stations; and grade separation of 80 road-rail crossings.

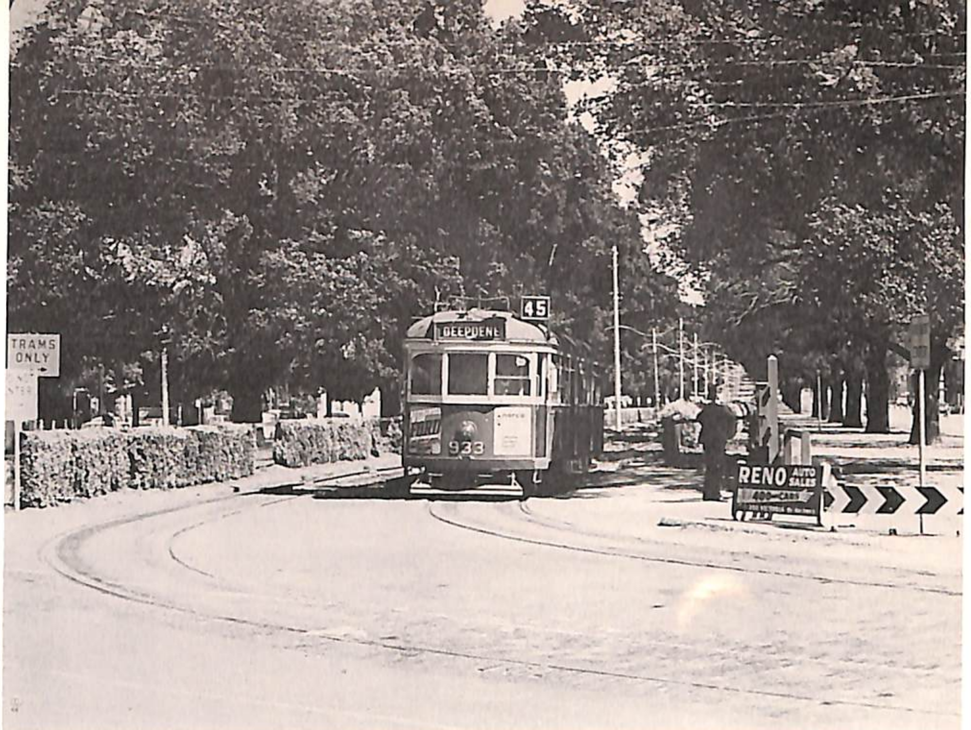
The big advantage of the loop to commuters will be the enormous savings in travel times. A person boarding a peak hour express from Mordialloc and wishing to go to the corner of Swanston and Latrobe Streets will take 35 minutes, saving 10 minutes compared with 1964 times; from Ringwood to the corner of William and Latrobe Streets, 25 minutes, saving 20 minutes; from Box Hill to Lonsdale-Elizabeth Streets, 20 minutes, saving 10 minutes, and from Broadmeadows to the corner of Spring-Collins Streets, 20 minutes, saving 20 minutes. The Committee report indicates that by 1985, 63 percent of city bound passengers will be using one of the three new underground station, which will mean that passenger congestion at Flinders Street-Princes Bridge will be eliminated and city bound passengers will be delivered closer to their destinations.

Continued on Page 20

The Tramways of Melbourne



LEFT: Christmas occurs during Melbourne's summer as the many shirtsleeved shoppers attest to in this view of Bourke Street with FOYS' Santa Claus looking on approvingly. At the top of the street in the background can be seen the City's Roman Catholic cathedral and the State government buildings. *Ward collection*



Deepdene-bound, an SW-6 class car on Route 45 is about to turn off the scenic and traffic-free Victoria Parade reservation. *Ward collection*

by John and Andrew Ward

AUSTRALIA TODAY has a total population of about 12 million, of which nearly 5 million are concentrated in the principle cities of Melbourne and Sydney. In marked contrast, the rest of the country, although about the size of the continental USA, supports a population of about 7 million, approximately one third of which is concentrated in the remaining state capitals. It is no surprise, therefore, that Melbourne and Sydney alone possess suburban railroad electrifications and that in the entire history of the nation only 11 street railway systems have existed, of which but four survive today. One, in Adelaide, South Australia, has dwindled to a largely off-street line. The two tiny provincial networks of Ballarat and Bendigo live on borrowed time, and although closure (abandonment) has been postponed again recently by the State Legislative Council (the upper house of the State of Victoria), the ruling political party has indicated closure to be its policy. Since most operative cars in these two cities (a number of which are single-trucked, including four Birneys) are over 50 years old and once ran in large cities like Melbourne and Adelaide, the systems present much of the aspect of museums, run for the benefit of the travelling public by the State Electricity Commission of Victoria.

Australia's only remaining large trolley system, the second largest in its history, is that of Melbourne, the capital of Victoria. With a population of nearly 2.5 million people, it stands 37th on the list of the world's metropolital areas by population. Its trolley system is largely intact today and with the exception of Brisbane's FM class, it operates the most modern tramcar fleet to have been built in the country, including Australia's only PCC car. Indeed, Melbourne is now the last city in the English-speaking world to rely primarily on the electric tram for street public transport; a state of affairs that the writers of this article hope will continue.

Melbourne was founded by the Yarra River in 1837, and tramway operation began with the first cable car service, the Richmond line, in 1885. Chosen for economy and cleanliness, not because of major hills, the cable operation was left-handed in keeping with the British tradition and Australia's rule of the road and set the pattern for today's tram operation. At its height in 1924, before the earliest conversions to electric operation, the cable system had reached a total of 45.983 route miles, making it one of the most extensive cable systems in the world. Horsecar extensions were added; and in 1906 the North Melbourne and Essendon Tramway and Lighting Company Ltd. began operation of the first electric portion of the present system, from Flamington Bridge to Essendon and Maribyrnong, now part of Routes 57 and 59. This early electric line used ten single-truck Brill closed motor cars, five cross-bench ("toast rack") open motor cars, and ten open trailers. This was not the very first electric operation in Melbourne. Two trams were employed on a 2½ mile line from Box Hill Station to Doncaster. This separate operation survived, however, only seven years (1889-1896)!

Prior to the establishment of a unified tramway system under the aegis of the Melbourne and Metropolitan Tramways Board, street railway service was provided or planned by seven different electric street railways and two cable systems. The largest was the cable system of the Melbourne Tramways Trust, which by 1919 operated 43.663 route miles of double-track cable tramway, with 539 grip cars, 485 four-wheel trailers, and 58 double-truck trailers. This system grew out of the original Richmond line. The Northcote City Council tramway was a second, independent operation, consisting of 2.320 route miles of double track, 12 grip cars, and 15 trailer cars.

The most progressive and dynamic of the six electric lines was the Prahran and Malvern Tramways Trust. First operations of this system took place in 1910 with 13 cars and two routes; by 1919 the system included 35.466 route miles and 96 trams with operations beyond Pahran and Malvern, including St. Kilda, Caulfield, Hawthorn, Kew, and Camberwell. The last six double-truck cars ordered by this system became the models for the subsequent standard W. class of the unified system, no doubt partially because the P&MTT's dynamic General Manager, Alexander Cameron, became head of the unified system.

Other electric systems included the Hawthorn Tramways Trust, with two routes comprising 11.105 route miles, 32 trams, and the site for "Wattle Park," a tramway park since developed to include a chalet, a golf course, tennis courts, picnic areas, etc.; the Melbourne, Brunswick, and Coburg Tramways Trust, the most technically advanced of the electric systems, with 7.055 route miles and 18 trams; the Fitzroy, Northcote, and Preston Tramways

An impressive vista looking south toward Port Ormond in 1969 sees car No. 869 running outbound along St. Kilda Esplenade whose white concrete center strip testifies that the M&MTB's newly relaid trackage has once again provided motorists with fine high quality paving at the tram riders expense. *Ward collection*

In a moody scene, one of the M&MTB's elderly W-2 class cars rumbles through the fog on the single track outer section of Route 70 prior to its recent double-tracking.
Ward collection

Trust, then in the process of building routes from the North Fitzroy cable terminus, but not open to traffic; the Footscray Tramways Trust, with three routes constructed but no power supply; and the North Melbourne Electric Tramway Co. that operated the first electrical line, 6.833 route miles, with the original 15 motors and 10 trailers.

The Victorian Railways also operated two electric tramways, both running to suburban railroad stations and built as extensions of electric suburban lines. The first, using the same 5-ft. 3-in. gauge as the Victorian Railways, was built in 1906 from St. Kilda Station to the beach suburb of Middle Brighton. The second was not opened until 1919 and was built to the 4-ft. 8½-in. tramway gauge, extending from Sandringham Station to Black Rock and Beaumaris. Both remained with the Railways and were not absorbed by the Melbourne and Metropolitan Tramways Board and both have been replaced by bus operations, the St. Kilda line in 1959 and the Sandringham line in 1956.

Eventually it became recognized that divided operations of Melbourne's tram system was not efficient, and on November 1, 1919, the Melbourne and Metropolitan Tramways Board came into being by Act of the State Parliament of Victoria. The M&MTB immediately took over the main cable tramway system, run by the Melbourne Tramways Trust and by August 1, 1922, the six electric systems and the two cable systems were under its ownership and operation. The cable systems used standardized equipment, but the electric cars comprised 216 units of 24 different types: 167 single-truck cars of 16 types and 49 double-truck cars of eight types. In addition to the problem of standardizing and replacing the electric car fleet, the new system had the problem of what to do with the cable car lines, which had been in operation for 30 years and now had well-worn rails and equipment. A number of different proposals were investigated, but the Board decided to develop a unified tramway system, replacing both the miscellaneous electric car fleet and the cable cars with standardized electric cars. However, to keep existing services operating, the Board built 24 single-truck electric cars for service before the standard tram was available, and a number of improvements were made to the cable car fleet and system. These improvements included replacement of pulleys on the Northcoat line, permitting standard cable cars to replace the smaller Northcoat cars, construction of 43 grip cars and 50 trailers, supplementing steam cable-haulage engines with large electric motors, and rail replaning and grinding.

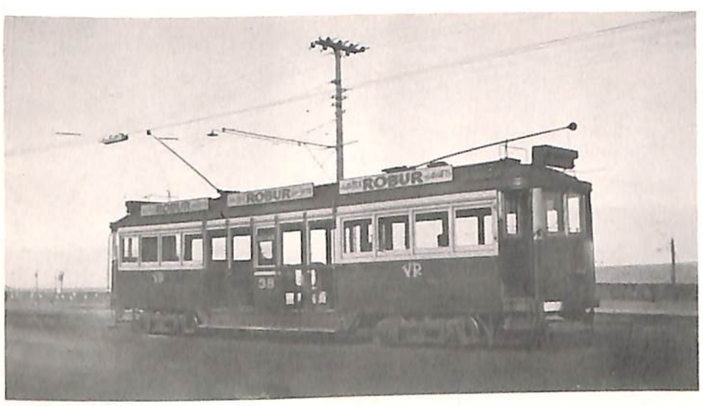
The first standard W class car based on the Prahran and Malvern double-truck cars and designed by the Board's staff, entered service in 1923. It consisted of two main closed sections (or "saloons") for non-smokers located over the trucks (or "bogies") and a dropped center section between. A separate full-width driver's cab was located at each end. The double-ended car was arched-roof and pre-

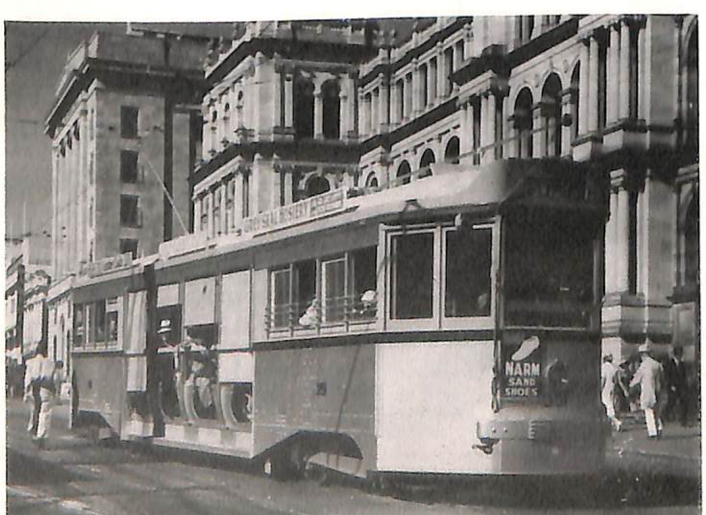
Continued on Page 8

Looking toward Port Phillip Bay we see a W-5 class car on the South Melbourne Beach route passing the park at St. Vincent Place South; soon it will join Victoria Avenue in the background which it will follow down to the seaside.
Ward collection

Elsewhere in Australia

LEFT: In the provincial city of Ballarat, one of the three other Australian tram systems besides Melbourne, eight venerable bogie and single-truck trams, each more than a half-century old, are lined up at a siding on one of the system's single track roadside routes while transporting rail and begonia enthusiasts. *Ward collection* **BELOW LEFT: The only Australian tram with rotary ventilators, 1937-build Hobart City Council No. 111 rolls along Liverpool Street with its bow collector held high on November 11, 1954. BELOW RIGHT: Bound for the picturesque destination Eaglehawk, maximum traction trucked Bendigo No. 25, a former M&MTB N class vehicle built in 1916, pauses at Mitchell Street in 1955, eight years after its arrival here.** *W John Webster photos*





ABOVE LEFT: Built for one of the Victorial Railways 5'-3" gauge tram feeder lines, VR No. 38 pauses at the outer terminal of one of the now-abandoned lines. LOWER LEFT: Even though constructed between 1935 and 1938, one of Brisbane's distinctive silver liveried vehicles, No. 351 sported plate frame maximum traction trucks as it rumbled through town. *E. Van Husen photos* **ABOVE: Acoupled set composed of No. 371-372 on Adelaide's still-operating, all-reserve track former steam railroad tramway between Glenelg Beach and Victoria Square, City with an appropriate and Australian-spelled warning posted in the foreground to protect the line crew.**

Ward collection

Continued from Page 6

sented a modern appearance. Longitudinal wooden seats were placed in the saloons, and transverse seats between three doorways on each side of the center semi-open section. The car had a steel-channel main frame, trucks similar to the US MCB-type, and four 40 HP motors. Nearly all cars built since have been variations on this design.

In 1925 the first major cable line, from Windsor to St. Kilda Beach, was converted to electric operation. That year also saw Melbourne's last horsecar operation, ironically to the zoo, now electric route 55. Subsequently, additional cable lines were converted, usually with buses providing interim service while the conversion work was underway. The original Richmond cable line was converted in 1927, and, after the South Melbourne line was converted in 1937 (with the Port Melbourne line permanently receiving buses), only the Bourke Street routes to Northcote and North Fitzroy remained. These were replaced by double-deck diesel buses on October 26, 1940, ending cable-car operation in Melbourne.

The Bourke Street lines were the first major Melbourne lines to use buses. Previously, they had been relegated to replacing certain very light electric and cable lines and for light suburban development lines, as well as interim cable-to-electric conversion operation. The Board would have preferred to defer the Bourke Street conversion until after the war, to conserve fuel, but the worn condition of the rope (cable) forced the issue.

Operation of the Bourke Street bus routes was judged unsuccessful, and work began for the reintroduction of trams, this time electric, in 1953. The Bourke Street route to Northcote began tram operation June 26, 1955, and the route to East Brunswick on April 8, 1956. Meanwhile, another new tram line had been opened, linking the isolated Footscray system to West Maribyrnong and the rest of the system, on May 2, 1954. The Board's maximum tram mileage existed then during 1956-7, with 142.692 route miles and 284.726 single-track miles, operated by 810 passenger cars and 8 works trams.

Abandonments since have been few. The major one was the replacement of the three Footscray local lines, but not the link to West Maribyrnong, with one-man buses on March 10, 1962. Also, the Point Ormond shuttle tram was replaced on October 22, 1960 by an extension of the Clifton Hill to Point Ormond bus line. The Board's bus operations have further increased by taking over private operations and route extensions; but a committee appointed by the State Parliament in 1963 recommended the retention of most tram lines, as well as purchase of 910 new cars and possibly a tram subway. (Also recommended were 2,540 new buses, new electric trains, extensions to the suburban electric railway system, an underground city railway, and an intricate road network.)

The track of the Melbourne tram system can be described as excellent. Much of the street trackage has been relaid in mass concrete during the last decade, and many lesser track projects have been carried out, including temporary and permanent relocations in connection with bridge widening, traffic-flow improvements, the installation of resilient crossings at a number of important downtown intersections to reduce noise, etc. The last single-track portion of the system on route 70 to Wattle Park, has just been double-tracked. The construction of a complex, split-level, freeway-style interchange at St. Kilda Junction, an important tramway and road intersection, has led to the construction of 1,000 yards of median-strip reserved tramway, closely integrated with the road construction involved.

At present, some 27 tram routes are operated, of which 8 form through-routed pairs (Nos. 1, 10-12, 15, and 55). All other services terminate in the city, except for routes 69, 79, and 82, which are the only "crosstown" lines. These routes make up slightly less than 125 miles of tramway route, to which may be added approximately one additional mile not used in revenue service. The basic routes are supplemented by numerous cutback and special rush hour and other services. At the present time, some 653 trams are required for service, including the necessary maintenance margin, with another 45 cars stored surplus. This compares to only 277 buses, of which 33 are in storage.

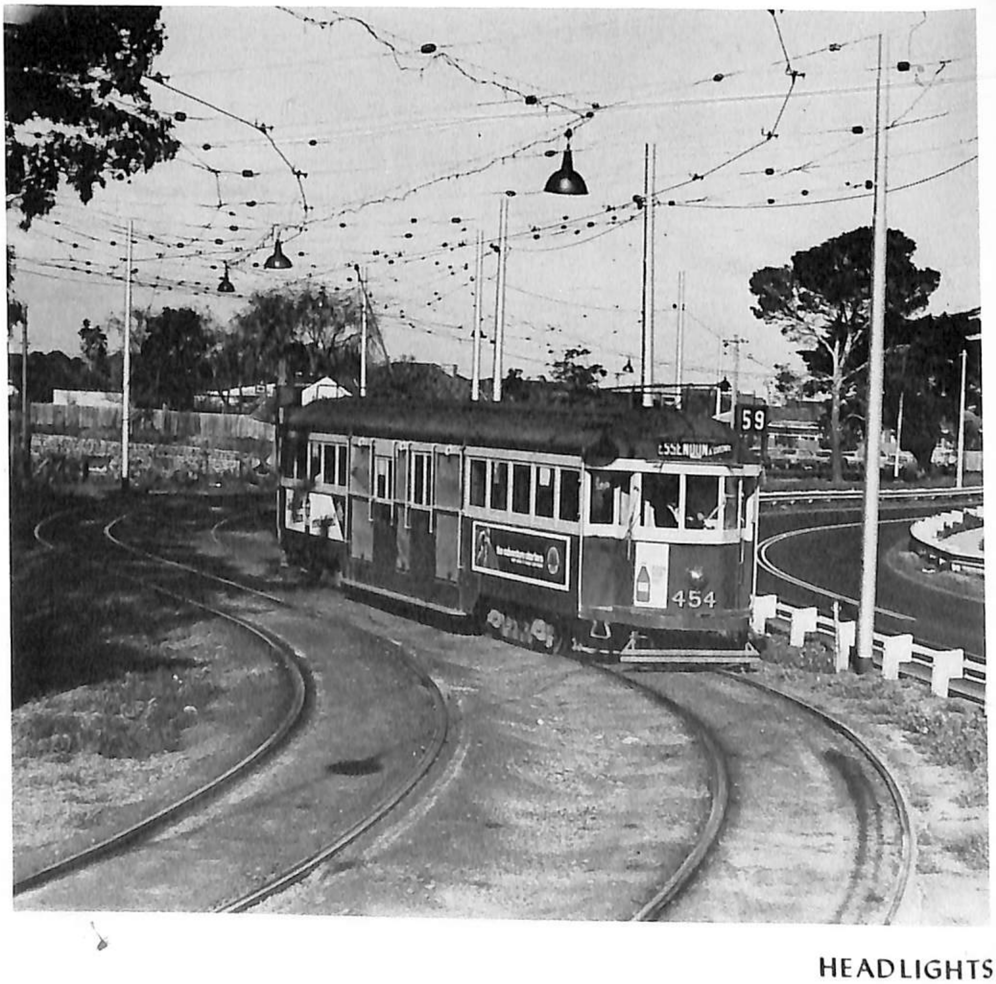
The downtown area of the "city" is a well-defined triangle, with streets arranged in a grid pattern. Seven routes terminate in the north-south tramway streets (Spencer, Williams, Elizabeth, and Swanston Streets with the Elizabeth St. routes terminating in front of Flinders St. Station). Since that station is one of the world's busiest, it and the tram terminus create a massive passenger movement. The east-west tramway streets are Flinders, Collins, Bourke, and Latrobe; Flinders handling through-routed cars, Bourke handling both through-routed cars and cars terminating, and the other two only terminating cars. Safety zones have been constructed downtown, with the result that the trams are able to move through the crowded downtown streets with relative ease. The operation of buses downtown has been restricted, but two privately operated routes clutter already overcrowded Swanston Street, and the Board operates some buses down Flinders Street.

Melbourne's worst traffic congestion is created in the few narrow outlet roads that connect the central city area with the inner, middle, and outer suburbs, and in certain suburban arterial streets that carry heavy retail shopping activity. The outer termini of the car lines are usually located between six and eight miles from the center of the city, with route 70 having its outer terminus at the eight-mile distance. (The act setting up the Board empowered it to operate service up to 10 miles from the city center.) All termini require double-end trams as there are no loops.

Suburban housing developments have expanded far beyond the tram termini, and connecting bus services are usually infrequent and in the hands of private operators. But in one area, North Baldwin, along High Street and Doncaster Road, outer suburban buses, operated by the Board, run express to the center of the city over tram routes. Elsewhere, competition between private buses and the trams has been restricted, but not completely, especially in the south-east of the city. Here, in the spacious tree-lined triple carriageway of St. Kilda Road, private bus lines operate express into the city, attracting customers from the slower local trams. Reserved or subway operation for the eight tram routes operating on St. Kilda Road would right this situation and provide more efficient and economical service.

On July 17, 1970 a W-2 class car on Route 59, bound for Essendon Aerodrome, whose quaint title has proven too much for the M&MTB's destination sign painters, with its canvas blinds drawn on the offside, squeals around the tight reverse curves on the temporary track deviation caused by the construction of the freeway to the new international Tallamarine Airport.

Ward collection



One-of-a-kind No. 980 speeds along the Mount Alexander Road track reservation used by Routes 51, 52 and 59 as part of an Australian Electric Traction Association convention. *H. R. Clark photo*

posed of members who coopt their successors on a permanent basis. Because of its financial autonomy the Board does not have ready access to State loan funds and is expected to balance its budget annually. For many years a very profitable undertaking (for a lengthy period it even contributed to the financing of the City Fire Department and other services), it has sustained an annual loss since the early 1960s, despite the highest local fares in Australia. The 1970 loss amounted to $1,824,-676, considerably less than that of the New South Wales Government Transport bus operation in Sydney and is largely made up of concession fares to pensioners and students, and unremunerative "development" bus routes.

In 1970, the tramway system carried approximately 111,000,000 yearly, as compared with 22,000,000 for the Board's buses and 142,-000,000 for the 176 route miles of the extensive electrified suburban railroad system. Tramways compete with electric railway lines in certain districts and with buses in others. The Melbourne Transport Master Plan, prepared by the Transportation Study Group to cover developments to 1985 attempts to use surgery on all operations to correct this haphazard situation; but its activities are limited by the accuracy of its land-use projections and lack of finances. Meanwhile, the Board remains firmly convinced that Melbourne must rely increasingly upon its light railway network. It points out that trams may cost 17½ percent more per mile to run than buses, but earn 53½ percent more revenue per mile. Nonetheless, its recent application for a loan from the State Government to purchase 100 European articulated design trams has been turned down. The recently retiring Board Chairman, Major-General R.J. Risson, had been criticized in the newspapers for pro-tram policies. But the former Deputy Chairman, Mr. R. J. Kirby, who is now Chairman, has been quoted as saying that "people who believe we can solve all our problems by switching from one form of transport to another are living in a fool's paradise." Indeed, the new Chairman has indicated that fixed rail vehicles will maintain their place in Melbourne's transport system for many more years to come. Mr. Kirby is taking an aggressive approach to stating the case for public aid for transport, and the future of the Melbourne system is hopeful, if not completely assured.

The trams serve every class of urban area, from the prestigious residential suburb of Toorak (Route 8) to factories, endless rows of shops, and humbler dwellings in the northern and western areas of the city, where the trams are more heavily patronized, headways are shorter, and the more modern cars are employed. Patronage is lightest in the eastern and southeastern suburbs, and here the base weekday headway averages three trams an hour, with longer headways late at night and on Sundays.

With the relaying of most track in concrete, redundant connecting curves and crossovers have been eliminated, reducing the flexibility of the system in suburban areas. Consequently, the operation of chartered trams for school and other services, once a feature of Melbourne's operations, has been reduced.

Overall operating speeds are not spectacular. Loading is rapid because of the trams' many wide doors and two-man operation, but stops are closely spaced and maximum speeds are low. Reserve track on certain routes (particularly 82, 59, 5-64, 55-56, 42-48) and near-reserve conditions on certain other routes (9A, 10, 11) helps, especially during rush hours. A typical Route 70 car will complete its 7½ mile run in 35 to 40 minutes, but the last run of the night can turn in a 25 minute performance. The reason is that Melbourne is unique in Australia in using Bundy Clocks, two or three of which exist on each route, which must have a key turned in them at the correct schedule time. Intended to prevent bunching up during rush hours, they slow down operations during periods of infrequent service by requiring a tram arriving at one early to wait until its scheduled time to depart. Operating times and headways are still better than in rival Sydney, which is mostly served by small, one-man operated diesel buses.

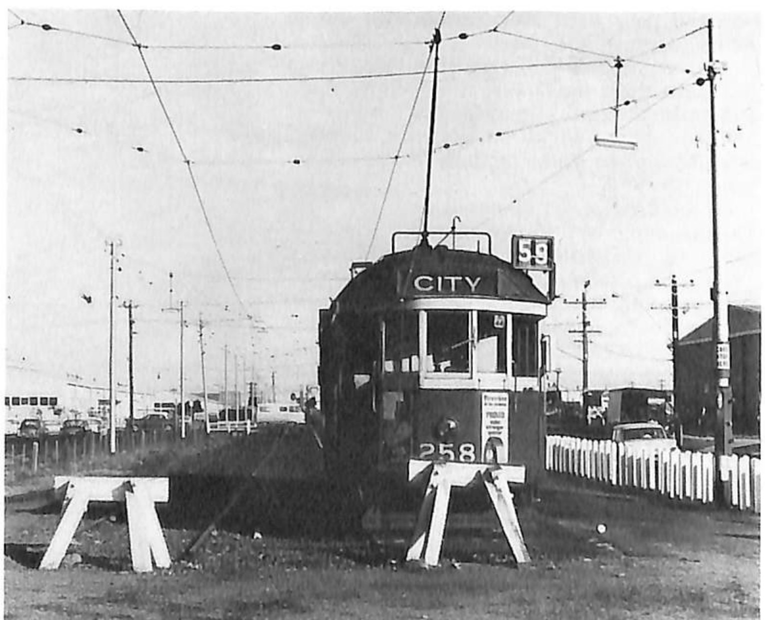
Power for the Board's operations is produced from brown coal by the State Electricity Commission. Whenever the SEC's employees are on strike (a fairly regular event) the trams are reduced to a crawl or halted altogether.

To the average American fare collection and ticketing are primitive in the extreme. The English system of sectional fares is in use, whereby the patron gives the roving conductor 10, 15, 20, 25, 30, or 35 Australian cents (less for children and pensioners) according to the number of sections or zones travelled ($1.00 Australian = $1.12 U.S.). The average route consists of eight sections. The conductor must issue a receipt for every fare collected and must punch it on the number indicating the section at which the passenger boarded. The tickets are small and the conductors often inexperienced, making the whole procedure wasteful and time consuming; but it does allow the Board to keep a rigorous check on its staff. But not on the customers, because the conductor, particularly, in peak hours, is too harried to keep a mental note of who has paid and who has not, and the number of fares uncollected would astound an American operator. This loss in revenue can be added to the cost of two-man operation to indicate the need for modernizing the fare-collection system. The limited prepayment introduced in 1969 and the ticket-sellers at certain City (downtown) safety zones, who help ease congestion on the cars, are only minor variations on an archaic theme. In addition, the basic tramcar design, with two or three doors in the dropped center section in use in each direction, does not permit smooth passenger flow. As a result, the far ends of each saloon are under-utilized, because of the difficulty of exit in rush hour.

The present Tramways Board is responsible to the Victorian State Government, but in all matters of finance and administration policy it is an entirely autonomous body, com-

Although most air traveler's don't make use of the fact, Essendon Aerodrome is served by the M&MTB's tram route 59 whose quaint terminus with its neat little bumper posts is seen here. Like New York's La Guardia Airport which was also served by trams, Essendon has been superseded as an international field, in this case by the new Tullamarine Airport.

Ward collection



Originally equipped with maximum traction trucks and other mechanical equipment from older cars and designated CW-5, No. 684, a W-5 since its conversion in 1956, rolls north through Royal Park headed for West Coburg.
H. R. Clark photo

The Cars That Move Melbourne

All cars currently in revenue service are of the bogie (double-truck) drop-center saloon (enclosed body) type, constructed in the Board's own workshops in Preston, which also handled maintenance and rebuilding. All these cars are noted for their passenger carrying capacity; they seat over fifty and can provide room for 100 standees. Even mothers with baby carriages are regularly allowed on the trams in off-peak periods. Each tram is between 45 and 48 feet long, weighs approximately 17 tons, and is equipped with four 40-horsepower motors. Top speed, on the level, fully loaded is slightly over 30 MPH.

The oldest representatives still serviceable are the L class, originally ordered by the Prahran and Malvern Tramways Trust, but delivered to the Board in 1921. Although their curved sides, interior timber panelling, and glazed Trust monograms on the saloon doors (between the dropped center section and the compartment at each end) are quaint links with the past, these cars can still provide an excellent ride and have been modernized with upholstered seating and lined ceilings. Still in regular use until a year ago, their capacity of 170 made them the largest cars to have operated in Melbourne, except for the now retired 5-ft. 3-in. gauge Victorian Railways numbers 50 and 51, which had a capacity of 200 passengers.

Of the drop-center standard cars, the earliest remaining are the W2 series, some of which were originally built as W and W1 trams. These have a rather unusual version of uphostered seating; the longitudinal benches in the end "saloon" compartments have foam rubber pads attached to the original wooden surfaces. They have also been equipped with sliding carbon shoes, replacing the original trolley wheels, and lined or painted ceilings, instead of the original dark stained finish. These modifications do not compensate on a winter morning for the six open central doors, only three of which can be closed off by canvas blinds. These trams were all constructed between 1923 and 1931, numbered 219-241, 419-431, 433-438, 470-475, 477-609, 623-653. The decline in patronage on the system as a whole, and particularly in the better residential areas south and southeast of the city, has allowed the retirement of many of the older, wooden-framed, W2 trams.

Between 1930 and 1935 two modified versions of the W2 class appeared. These cars had better trucks, in an attempt to improve on the W2s' "basic" riding qualities, and larger wheels (33 inch instead of 25 inch or 28 inch). The W3's (654-669) retained longitudinal seating in the saloons, with transverse seating throughout, upholstered in the saloons. Both types are in semi-permanent storage as non-standard equipment.

The cars providing most of the current service divide broadly into two types: sliding door and non-sliding door. The non-sliding door W5 series (1935, 720-849, with a few cars later converted to sliding door SW5) have transverse upholstered seating, rounded fronts, steel frames, and improved trucks and motors, with better acceleration, higher speed, and smoother riding than the W2 and W3 trams.

Car No. 899, a sliding door SW-6 class vehicle on the East Malvern-City route, turns off Waverly Road to pass under the Dandenong railway while one of the blue Harris Trains passes overhead in a 1969 view that is dated by the tram route number which has been changed from 4D to 3.
Ward collection

The SW6 class (1939-1954, 850-1000), together with the W7 class described elsewhere, with sliding doors, represent the ultimate Board design. The old-fashioned division between the dropped-center portion and the saloons at each end has been partially eliminated by the removal of the interior bulkheads. Steel-framed windows with eye-level "tip-ins", lined ceilings, plastic stanchions, and modernized drivers' cabin windows combine with the driver's operated sliding doors to give the tram-car a modern look and a comfortable ride. Some cars in this group have buzzers instead of bells for notification of the driver, resilient wheels, and helical gears.

Construction of conventional trams in the Post-War period may seem surprising in view of the development of the far more advanced PCC car design by 1936. Actually, the M&MTB had become interested in the PCC design as early as 1938 as the result of a visit of H.H. Bell, then Chairman of the Board, to America at which time he had begun negotiations to have a complete car imported and to either build others locally or to adapt their features to new cars. However, the Customs Department refused to permit a sample car to enter the country duty-free and the Second World War caused the negotiations to be broken off.

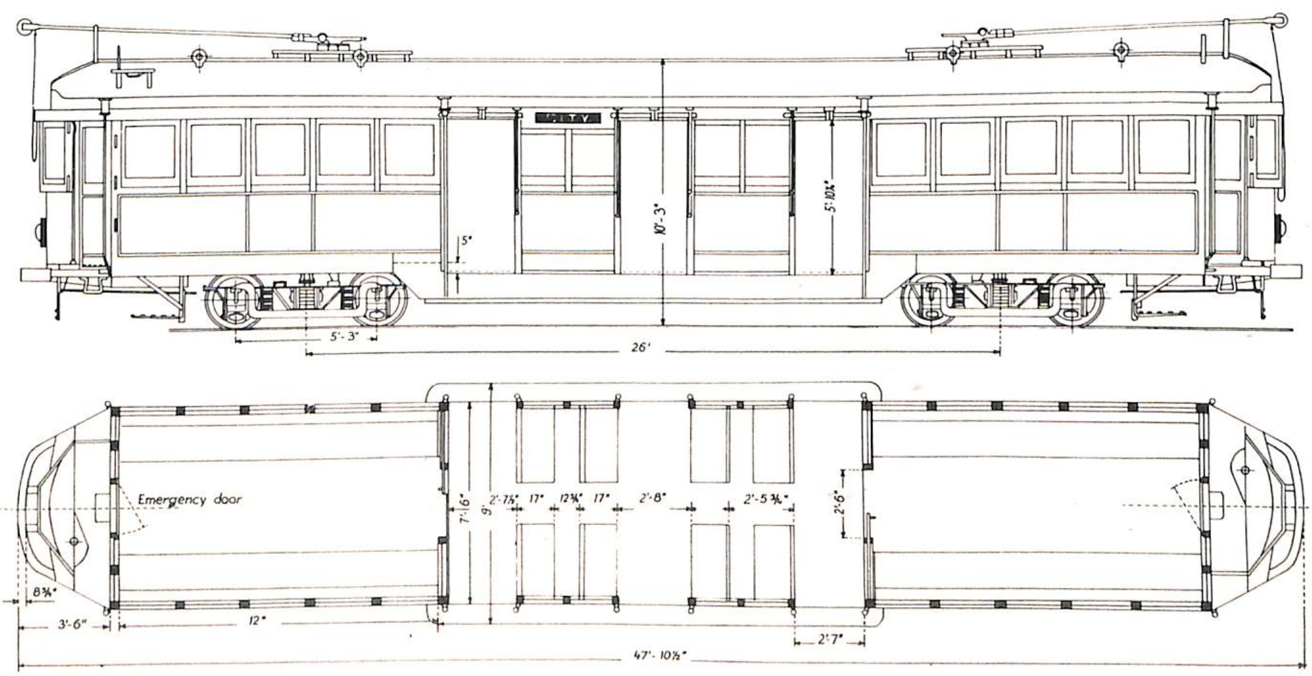
The negotiations were resumed in 1946, with three top staff members being sent overseas to study this and other transit matters. As

One of the M&MTB's typical standard W-2 class cars in its Hawthorn green and cream livery trundles past the ubiquitous inner suburban terrace while bound for South Melbourne Beach, its No. 1 MCB trucks highly visible in this view.
Ward collection

Melbourne's class 'w' car

Series 219-418
Built 1923-1927

As built in 1923-27 and portrayed here, the original M&MTB standard car had 3 equally-spaced doors with drop center seats arranged in pairs facing the center of the car. From 1928-33, these cars were converted to the W-2 configuration with a narrow center door and back-to-back seating in the drop center.
L. Reznicek drawing



THE TRAMWAY MUSEUM SOCIETY OF VICTORIA LTD.

Registered office;332 Flinders St Melbourne.

Statement concerning the July-August 1970 issue of "Headlights", the official publication of the Electric Railroaders Association U.S.A. (which was recieved in Melbourne in Nov. 1971), as authorised by the museum Board of the Tramway Museum Society Of Victoria ltd.

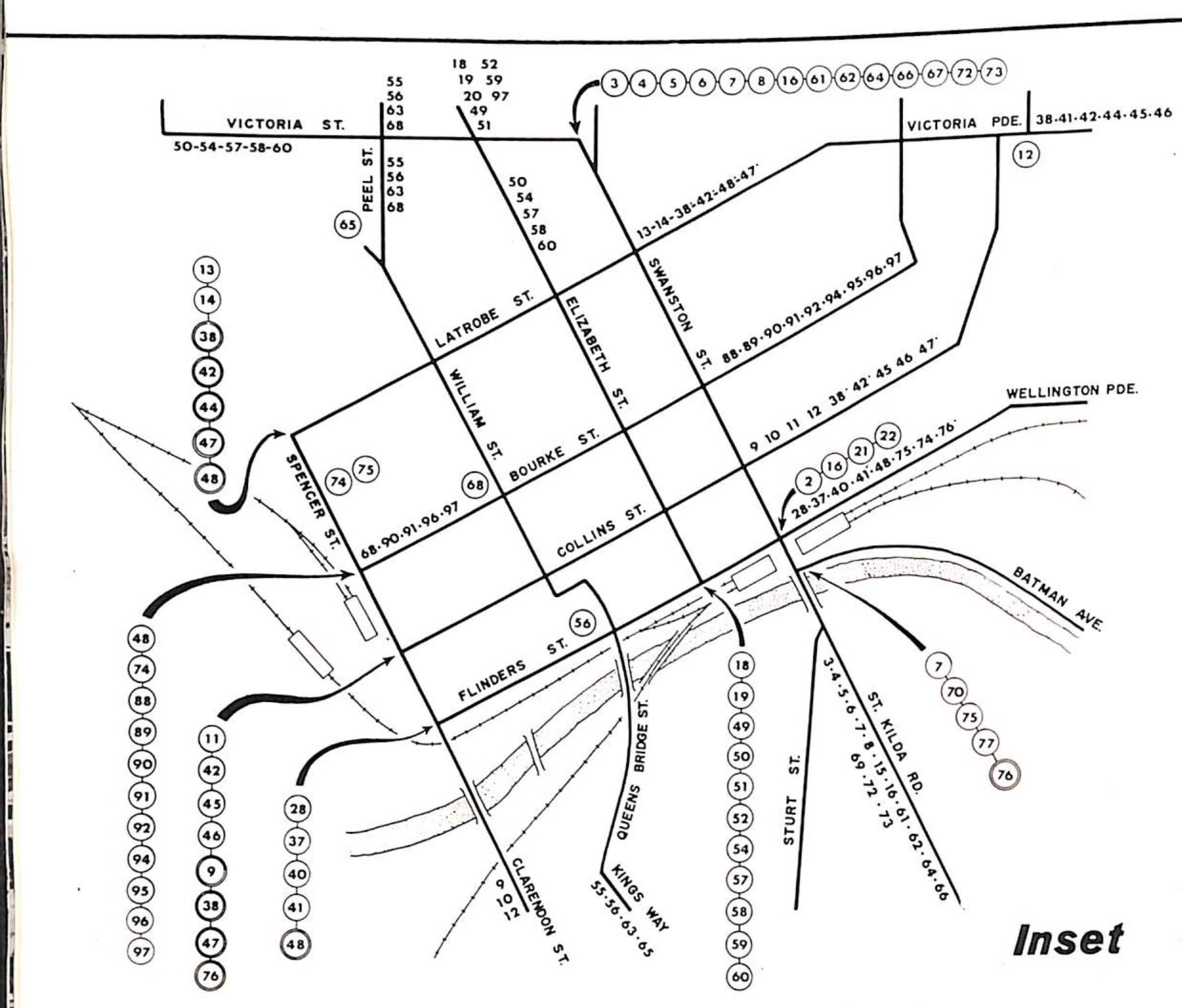
\- - - - - -

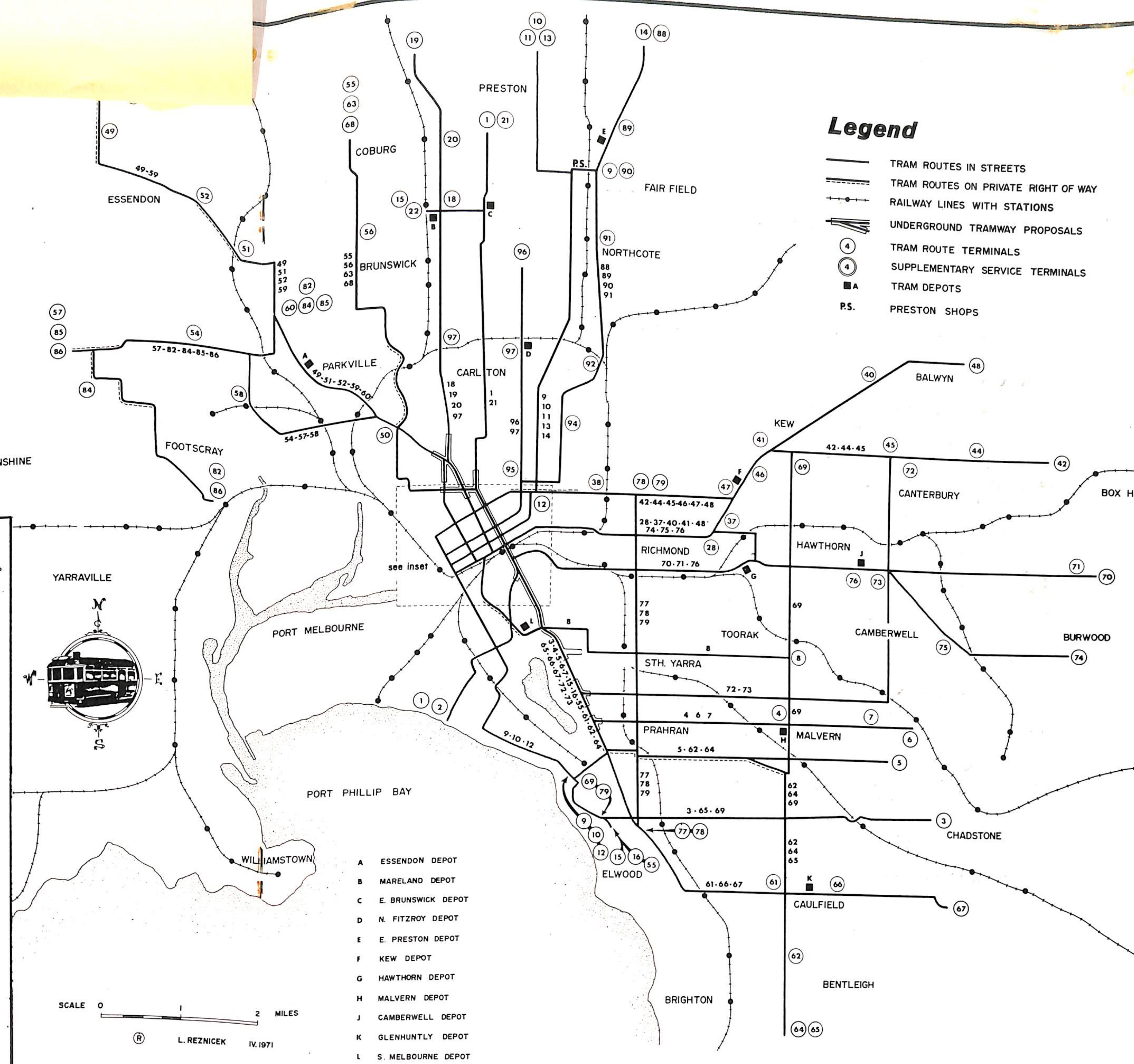
The full 24 pages of this issue is devoted to the tramways of Melbourne. The format is very nice and the intentions good, but there are, unfortunately, many errors. The first section, "Transportation Plan for 1985" is basically sound, and needs little correction. "The Tramways Of Melbourne" is interesting but contains a large quantity of errors in the text. The map of Melbourne is basically sound, but there are many small errors and the route numbers and suburban names are poor to useless. The car roster is partly alright, but there are many errors in details, classes are shown in the wrong sections, and the last section should not be included in a MMTB roster. "The W7 Tram" section is sound, with only minor mistakes. Photograph captions are fair, but there are many small errors and one or two of greater importance.

The editorial remarks on page 2 attribute "additional historical information" to the December 1969 issue of Running Journal and acknowledge this society accordingly. However, there has been no communication whatever from the E.R.A. to the Tramway Museum Society of Victoriaand any data used has not been verified as being used correctly. "The Tramways of Melbourne" section is credited to John and Andrew Ward, but the former has advised that the text is almost unrecorisable by him and has been completely re-written and considerably enlarged from that submitted.

Corrections to the text and captions, as compiled by this Society cover four pages of foolscap (and for this reason are unable to be supplied here) and together with a corrected map and roster may be perused by arrangement with the Secretary.

Melbourne: A Great Tram Network





Car Roster of the Melbourne and Metropolitan Tramway Board

	Class	Car Numbers	Quantity Built	Quantity Active	Date Built	Builder	Type	Capacity Seated	Capacity Standing	Weight (lbs. U.S.)	Overall Length	Truck Centers
1	W7	1001 - 1040	40	40	1954	P	EDC	48	102	39,600	46'-6"	28'-0"
	W6	970 - 979 981 - 1000	60	60	1947-54	P	EDC	52	98	38,900	46'-6"	28'-0"
	PCC	980	1	1	1950	P	ESS	48	102	38,125	46'-6"	28'-0"
2	SW6	890 - 969	80	80	1944-47	P	EDC	52	98	38,500	46'-6"	28'-0"
	SW6	850 - 889	40	40	1939-43	P	EDC	48	102	37,950	46'-6"	28'-0"
	SW5	785,787 840 - 849	12	12	1939-40	P	EDC	52	98	37,860	46'-6"	28'-0"
	W5	720 - 839	120	121	1935-39	P	ODC	52	98	34,300- 35,400	46'-6"	28'-0"
3	CW5	681 - 685	5	0	1935	P	MDC	48	102	32,100	46'-6"	27'-0"
	W4	670 - 674	5	5	1933-35	P	ODC	48	102	36,800	46'-0"	27'-6"
	W3	654 - 669	16	15	1930-34	P	ODC	52	98	35,200	47'-0"	28'-0"
	SW2	275,426, 432,436, 478,644	6	6	1924-27	J,H	EDC	48 or 52	97 or 93	38,100	48'-0"	26'-0"
4	W2	219 - 248 249 - 278 279 - 328 329 - 338 339 - 358 359 - 368 369 - 398 399 - 418	30 30 50 10 20 10 30 20	21 20 23 9 14 8 28 17	1923 1924-25 1924-26 1924-26 1925-26 1925-26 1926-27 1926-27	H J A A H H,P J P	ODC	52	98	36,300 to 37,700	48'-0"	26'-0"
		419 - 438 470 - 479	30	21	1926-27	P						
		439 - 458 480 - 494 495 - 524 525 - 609 624 - 653	20 15 30 85 30 410	18 13 28 84 29 333	1927 1928-29 1927-29 1927-30 1930-31	P P J P P						
5	In Storage:											
	Y1	610 - 613	4	4	1930	P	FCE	53	75	39,700	45'-0"	22'-0"
	Y	469	1	1	1927	P	FCE	53	75	37,000	45'-6"	24'-0"
	L	101 - 106	6	6	1921	J	ODC	52	118	39,260	45'-6"	24'-6"
	VR	52,53	2	2	1943	V	EDC	48	102	39,900	45'-0"	26'-0"
6	Presented to Australian Electric Traction Association:											
	X	217 218	1 1	1 0	1923-24 1923-24	B S	STB STB	33 33	50 50	18,400 19,100	28'-0" 28'-0"	– –
	S	154 - 165 166 - 171	12 6	1 0	1916 1920-22	D C	STO STO	36 36	74 74	29,300 29,300	35'-0" 35'-0"	– –

	Class	Car Numbers	Traction Motors Horsepower	Traction Motors Type	Controllers	Trucks Type	Trucks Wheelbase	Wheel Size	Air Compressor	Notes
1	W7	1001 - 1040	4 @ 40	GE247AX2	RC2	No. 15	5'-2"	28"	DH16	
	W6	970 - 979 981 - 1000	4 @ 40	GE247AX2	RC2	No. 15	5'-2"	28"	DH16	A
	PCC	980	4 @ 55	GE1220E	GEPCC	St.Louis B3	6'-3"	25"	CP25	B
2	SW6	890 - 969	4 @ 40	GE247AX2	RC2	No. 15	5'-2"	28"	DH16	C
	SW6	850 - 889	4 @ 40	GE247AX2	RC2	No. 15	5'-2"	28"	DH16	D
	SW5	785,787 840 - 849	4 @ 40	GE247AX2	RC2	No. 15	5'-2"	28"	DH16	E
	W5	720 - 839	4 @ 40	GE247AX2	Q2CK1, RC1,2, PCM	No. 15	5'-2"	28"	DH16	F
3	CW5	681 - 685	2 @ 65	GE201	NA	Brill 22E	4'-0"	NA	NA	G
	W4	670 - 674	4 @ 40	MV101AZ	K35JJ	No. 9C	5'-9"	33"	DH16	H
	W3	654 - 669	4 @ 40	MV101AZ	K35JJ	No. 9B	5'-9"	33"	CP27 DH16	I
	SW2	275,426, 432,436, 478,644	4 @ 40	MV101A, MV101AN, GE247, GE268A, BTH265D	K35JJ, RC1	No. 1B	5'-3"	See Note	CP27 DH16	J
4	W2	219 - 653	4 @ 40	MV101A, MV101AN, MV101AR, MV101AX, GE247A, GE247AX, GE247AX2 GE288A, BTH2650, BTH265P	K35JJ RC2	No. 1A, No. 1B	5'-3"	See Note	CP27 DH16	K
5	Y1	610 - 613	4 @ 40	GE247AX2	K35JJ	No. 15	5'-2"	28"	CP27	L
	Y	469	4 @ 40	MV101A	K35JJ	No. 1C	5'-3"	26½"	CP27	M
	L	101 - 106	4 @ 40	GE247A	K35AA2 K35JJ	Brill 77E	5'-1½"	28"	DH6	N
	VR	52,53	4 @ 40	GE247AX2	K35JR	No. 15	5'-2"	28"	CP27	O
6	X	217	2 @ 25	GE264	NA	Brill 79E1	8'-0"	NA	NA	P
		218	2 @ 35	WH510	NA	No. 4	8'-0"	NA	NA	
	S	154 - 165	2 @ 55	GE241	NA	Brill 21E	9'-0"	NA	NA	Q
		166 - 171	2 @ 55	GE241	NA	Brill 21E	9'-0"	NA	NA	

A – Dash canopies omitted beginning with No. 970.

B – Trucks and electrical equipment imported from U.S. Has hand operated accelerator.

C – Austerity design with bus type seats.

D – No. 850 had public address system.

E – No. 840 modified 1949 to test interior layout for PCC's.

F – No. 740-41, 750-51 had automatic acceleration equipment. No. 740-41 also had 4 WH 1426 50 hp motors. No. 785, 787, 803, 813 retired.

G – New bodies to use electrical apparatus, trucks, brakes, etc. of the 39 C,D,E,N and P classes (34 cancelled). Converted to W-5 class in 1956.

H – First cars with transverse seating in saloons.

I – No. 654 retired.

J – No. 644 rebuilt after collision to SW 2b class 1952 as prototype for system-wide modernization scheme never carried out. Included upholstered seating throughout, steel framed windows and sheathing, removal of saloon bulkheads.

K – No. 219-418 built as W class 1923-27 converted 1928-33. Had three equal sized doors and facing seats in dropped center. Original weight was 37,200 to 38,300 lbs. No. 419-438, 470-479 (30 cars) built as W1 class with open dropped center. No. 426, 432, 436, 478 converted to SW 2 class 1938, remainder to W2 class in 1936-37. No. 422 originally numbered 364.

L – Ten additional cars cancelled. Now in storage.

M – Built as Tourist Car. Now in storage.

N – Designed and ordered by P & MTT, completed by M & MTB. Had 3 and 2 seating in drop center (56 seats, 104 standing) became 2 and 2 in 1934. No. 106 formerly equipped with PC (automatic acceleration) control. All cars now in storage.

O – Built for Victorian Railways. Now in storage.

P – Originally had 2 trolley poles, bow collectors tested in 1924. No. 217 preserved at Malvern depot.

Q – No. 164 preserved at Malvern depot.

BUILDER
P = M&MTB Preston Shops
H = M&MTB Holden Street Shops
J = James Moore
A = Holden's Body Builders, Adelaide
V = Victorian Railways Newport Shops
B = J.G. Brill Company (USA)
S = St. Louis Car Company (USA)
D = Duncan & Fraser
C = M&MTB Coburg Depot

TYPE
EDC = Fully enclosed, drop center, saloon
ESS = Fully enclosed, straight sill, saloon
ODC = Open, drop center, saloon
MDC = Maximum traction truck, drop center saloon
FCE = Bogie, front & center entrance saloon
STB = Single truck, Birney safety car
SOC = Single truck, open combination
NA = Not available

a result, it was decided to import one set of St. Louis B-3 trucks and electrical equipment to be applied to a standard M&MTB tram body and to enter into a licensing agreement for either partial or complete construction of PCC cars or equipment in Australia.

Beginning in January 1949, Preston Workshops began construction of an SW6 frame modified for the PCC equipment. These modifications included raising the drop center floor to be level with the saloon floor (to accommodate the additional control gear), modifying the step arrangement, placing the necessary ducting under the floor to supply air to the force-ventilated motors, redesigning the wind-shields and incorporating the number boxes within the end roof canopies, making the center seating longitudinal and upholstered, and modifying the lighting and ventilation. In addition, in contrast to normal PCC practice, No. 980's accelerator is directly advanced by means of a hand operated linkage (like a conventional controller) instead of by means of a pilot motor at a rate usually selected by a foot pedal. Besides being simpler and cheaper, this arrangement causes it to be more nearly like Melbourne's other trams to drive.

Originally 980 was assigned to Malvern Depot where it operated on Route 69 Kew - St. Kilda Beach, a crosstown route selected to avoid possible rear-end collisions by older cars whose inferior braking cannot match that of a PCC with its dynamic, drum and track brakes. It is currently assigned to East Preston Depot where it operates on Route 96, City (inner terminal designation for all lines serving downtown Melbourne) — North Fitzroy. Because it is the only Melbourne tram that can exceed 31 mph, it resembles a wild stallion when lined up behind a string of other, slower cars. Internally and externally experimental, it is far more advanced than the W7 series, although built earlier. Undoubtedly, if sufficient funds had been available, and perhaps if Customs hadn't been so unbending, the W7 series would have been constructed along similar lines and the image of trams in Melbourne would have been substantially higher.

Like Blackpool, Melbourne too has its illuminated trams. Here one decorated to celebrate the 150th anniversary of a bank's opening (not the car's construction), pauses before entering single track on Route 70 Wattle Park.
Ward collection

Number 980 was not the only Melbourne tram to present something of a U.S. flavor. Cars of the Y and Y1 classes, numbers 469 and 610-613, built in 1927 and 1930, bogie front-and-center door cars, with arched side windows, riveted steel exteriors, air-operated folding doors, and eye-level windows, suggest the Peter Witt cars of U.S. fame. Their original purpose was to serve as one-man tourist cars (for sightseeing) but they were never used for that purpose and never operated as one-man cars, except for a brief period when in all-night service. All now are stored out-of-service, as non-standard, despite numbers 610-613 having received upholstered seats and resilient wheels shortly before withdrawal. United States influence also was evident in the Board's two 1923 Brill and St. Louis single-truck one-man Birney safety cars, 217 and 218, now retired. Number 217 has been restored by the Tramway Museum Society of Victoria and resides in Malvern Depot with S-class 164, a 1916 Melbourne Brunswick and Coburg single-truck closed car.

Over the years the Board has employed a wide variety of service vehicles, including two reciprocating rail grinders, track - cleaner - scrubber cars (two purchased second-hand from Sydney in 1961, upon that system's closure) a 2,000 gallon capacity track-cleaning bogie tank car, a vacuum cleaner car, a utility freight car converted from a 1906 single-truck toast rack V-class car, a spare freight car converted from a 1906 single-truck closed U-class car, and a flat car used for carrying brake blocks and sleepers (ties). Most of these cars remain in service, and one of the freight cars has been converted into an advertising or billboard car, although its principal duty remains transporting Board equipment from one depot to another.

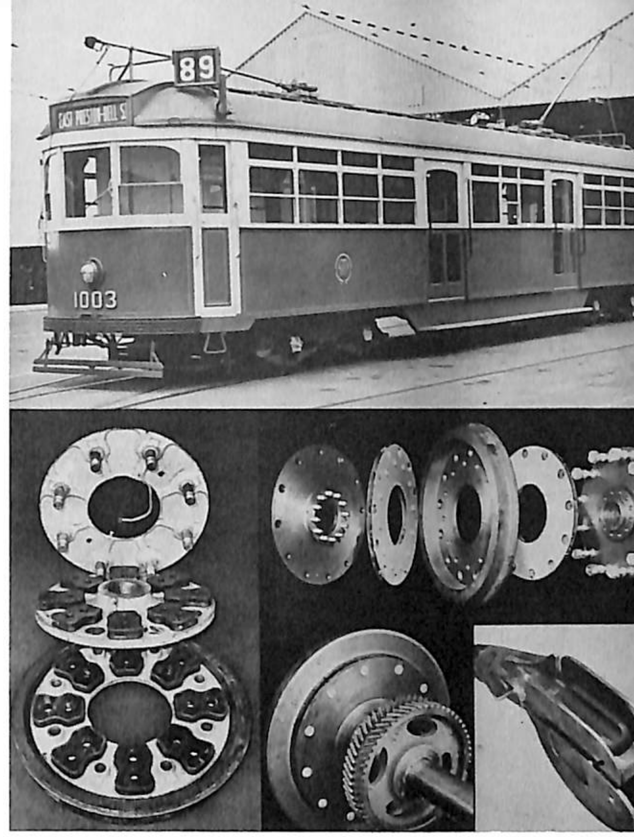
In another glimpse of what used to be, X-2 class No. 678 makes its way to the Ballarat Road terminus of the now closed Footscray tram network. Now scrapped, these 1934-built cars were similar in appearance to the Y-1 class bogie cars although in this case using a single Brill 21E truck.

The W-7 Tram Zenith of it's Type

Designed and built at the Melbourne and Metropolitan Tramway Board's Preston shops, located at Miller Street in Preston, Victoria, the forty W-7 class trams represent the high water mark in the development of the standard Melbourne car. Acquired for the conversion of the Bourke Street-Northcote and Bourke Street-East Brunswick routes to electric traction, these cars, numbered from 1001 to 1040 were put into service between March 1955 and August 1956.

In external appearance, the W7 tram is not easily distinguished from its predecessors, the SW6 cars numbered from 850 to 969 and the

W6's numbered from 970 to 1000 (except No. 980, the Board's only P.C.C. type tram.) The superior comfort of the W7 to the W6's is, however, quite obvious to the passenger. The ventilation is better, smoking compartment seats are upholstered and the vehicle is much quieter in operation. Noise reducing features include resilient wheels, double helical gears, carbon insert trolley shoes and body insulation. Because of the success of most of these features, they have been or are being fitted to many of the remaining cars.



The whole is equal to the sum of its parts. In June 1955, shortly after its completion, a representative of the highest stage of development of the Board's W classes, W-7 No. 1003, poses outside Preston Depot modeling the gold lining that formerly enhanced the green and cream M&MTB livery. Below that are some of the parts which make it up; on the left a partially disassembled National O type resilient wheel contrasts with the standard PCC-type on the right, below that are the helical gears for quieter running and a closeup of the carbon shoe insert used on these cars.

M&MTB photo, Herbert G. Frank collection

GENERAL DESIGN:

The W7 car has a double ended, drop center body mounted on two equal wheeled bogies. Built to the same general design of the SW6 class, with straight and simple lines, the body consists of two saloons separated from a center smoking compartment by loading platforms with two doorways in each side at the platforms. There is an enclosed motorman's compartment at each end. Seating is provided for 48 passengers, 18 in each saloon and 12 in the smoking compartment. The normal "crush" load is 150 passengers, as with most other Melbourne cars.

A combination of transverse and longitudinal seats is provided in the saloons. To permit freer circulation in the smoking compartment, which is the portion of the tramcar most favored by short distance riders, the transverse wooden seats of previous types have been replaced with longitudinal upholstered seats.

The seating throughout is fitted with latex rubber cushions and backs covered with either light colored blue-grey or green leather.

Body Construction:

The all steel framework of the body is fabricated in sections to simplify construction and to permit quick replacement of portions which may be damaged in collisions. The light but strong sections are assembled and riveted and/or welded together to form a complete unit integral with the underframe. Commercial rolled steel sections are used throughout. Saloon side frames are sheathed with 14 gauge mild steel stress panels below the waist rail and 14 gauge pier panels above. Smoking compartment side frames are sheathed with 16 gauge mild steel stress panels. The main drop centre girders have webs of 12 gauge mild steel. Roof carlines and centre bulkhead pieces are pressed from tee sections; bulkhead carlines are pressed from angles.

In typical conventional streetcar fashion, the roof consists of 2-½ in. x ⅜ in. oregon boards covered with cotton duck and supported on hardwood roofsticks furred to steel carlines. The ceiling is ⅛ in. tempered "Masonite" glued to wooden frames and mounted in three long sections with a clean, smooth appearance, all screws being hidden. Tongue and groove hardwood 6 in. x ⅞ in. forms the flooring. Tasmanian mountain ash is used for the end bulkheads and the flush panelled escape doors.

Bulkheads:

To protect passengers in the saloons and smoking compartments and to provide for the breaks in floor level at saloon entrances, bulkheads are constructed on both sides of the doorways. These bulkheads have steel panels from floor to about waist level. Stanchions extending to the ceiling and braced to the sides at cant rail level are sheathed with "Doverite" over the "grab" length. The saloon bulkheads have safety glass panels between the main glass lines.

Windows:

All side windows are metal framed. Saloon windows and smoking compartment centre windows are half-drop type with hopper type standee windows above. Louvre sun blinds, sliding in extruded brass channels fixed to the pillars, are fitted to the saloon windows.

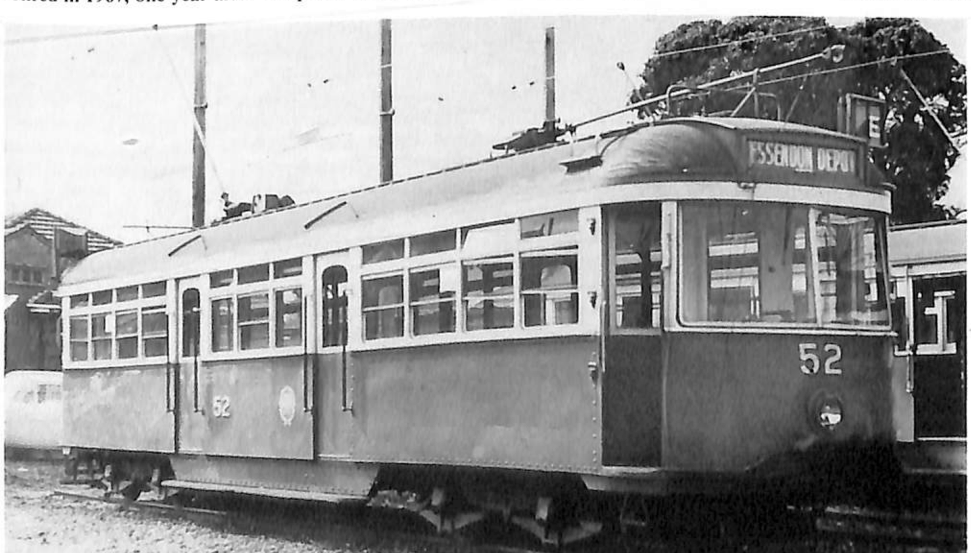
Doors:

Sliding doors designed to counter the capricious changes of the Melbourne climate are fitted to the 3 ft. 5 in. wide entrances at the loading platforms. Built from Tasmanian mountain ash and glazed with 3/16 in. safety glass, the doors have their leading edges "softened" with sponge rubber as a safety measure. Each door runs on two sheaves with ball-bearing races fitted at the top edge on a loose round track rod supported in a mild steel trough. Gun-metal guides run between step treads to keep the bottom of the door in position; guide rollers are attached to the lower trailing edge of the door and to a pillar at waist level.

The doors are driven by compressed air engines operated by means of valves in the motorman's compartments in conjunction with conductor's valves located in the advertisement panel on each side of the smoking compartment. The doors on the near side only are operated by the motorman; the off side doors are opened or closed by the conductor. The long stroke, differential piston type door engines are fixed to the cant rails behind the advertisement panels. They have been designed for quick opening and closing, with a cushioning action towards the finish to each stroke, and operate at the normal air brake pressure of 60 to 70 lbs. per sq. inch. In operation, constant air brake pressure is applied to the front end of the door engine cylinder. To open and close the door, air pressure is applied and exhausted at the rear end of the cylinders.

Continuing its home craftsmen tradition, the door engines, as well as the operating valves, track runners and the door fittings were designed and manufactured at the Board's Workshops, Preston.

Built by Victorian Railways for its St. Kilda-Brighton line in 1924, No. 52-54 came to the M&MTB in 1959, but their narrow doorways restrict 52 and 53 to cross-suburban Route 82 Moonee Ponds-Footscray, with 54 having been retired in 1967, one year after this photo of 52 was taken at Essendon Depot. *Ward collection*



Finish:

The interior of the saloons up to window level is lined with 3/16 in. "Masonite" painted to match the upholstery. Modern shades of light grey and green have been chosen to improve the appearance. The pillar facing strips and moldings are of blackwood finished in natural color, while the ceiling is finished in semi-gloss ivory enamel.

The saloon floors are covered with 5-ply Malthoid, cemented down and finished with paving paint, while the smoking compartment floor has 3-ply Malthoid finished as above and fitted with hardwood wearing slats. Cast aluminum alloy anti-slip tread plates are fitted to the steps.

The Board's standard colors for exterior finish are green and cream enamel decorated with gold lining, with the monograms and numbers in gold, shaded black. The roof is of stone color and the trucks are sprayed with black bituminous paint. Exterior grab rails are "Doverite" covered.

Motorman's Compartment:

The motorman's compartment is totally enclosed and is fitted with hinged doors on both sides with an emergency door between the compartment and saloon. The centre window of the windscreen is fixed and fitted with an air operated windscreen wiper. The side windows on the windscreen are fitted with half drop sashes. A rear vision mirror is placed on the left-hand corner pillar, enabling the motorman to see the car entrances and stepboard.

Ventilation:

Although half-drop and hopper windows in saloons and smoking compartments may be opened as required, the ventilation seemed inadequate in the humid weather. Accordingly a perforated grille ventilator is provided in the ceiling, running the full length of the tramcar and connecting with the clerestory roof.

Sound Insulation:

Sound insulating material consisting of two layers of ⅞ in. hair felt encased in aluminium sheet has been attached to the underside of the flooring, above each of the tracks. The material is expected to withstand vibration, dust and mud and is non-inflammable. A single layer of hair felt has also been cemented on the inside of the steel sheet side panels. The effect of this sound insulation is a marked reduction to the sound level in the saloons.

Two trams were, in addition, provided with sound insulated ceilings consisting of perforated "Masonite" backed by a ⅞ in. layer of hair felt. This experimental treatment caused some improvement, particularly when the tramcars were relatively empty, but was not sufficient to justify the expenditure.

Lighting:

In the ceiling twelve lamps in specially designed fittings provided with polished stainless steel reflectors and 8 in. diameter flashed opal bowls, made with a hole in the centre for the removal of the lamp without disturbance of the fittings, ensure direct vertical lighting.

All horizontal and angular lighting is diffused, protecting the passengers from direct glare, and at the same time permitting efficient reflection from the light colored ceiling.

Signalling and Destination Signs:

The conductor's signalling system consists of an electric buzzer working from the 600 volt supply and operated by leather "cords" along each side of the ceiling.

L class No. 104, designed for the Prahran and Malvern Tramways Trust and completed for the M&MTB in 1921, displays its Brill 79E trucks and extra width to good advantage as it short turns at St. Kilda Junction in November 1967 under the watchful eye of the point controller's box on the right, before reconstruction of this important intersection had begun.
Ward Collection

One of the high-floored W-3 class cars is seen outside the University of Melbourne in Swanston Street in a view that reveals its 33-inch wheels and its English style trucks with their leaf springs under the axle boxes and the use of four truck-mounted brake cylinders.
Ward collection

The destination and route number mechanisms are of the Board's own design and manufacture. They are equipped with white cloth curtains on which the destination names and route numbers appear in white on a black background. At night the curtains are illuminated from behind.

Trucks:

The trucks follow the lines of the Board's recent design having steel H-section side frames supported on long semi-elliptic springs rigidly attached to the axle boxes, and joined to the side frame by a pin on one end and with a sliding shoe and rubber pad on the other end. The bolster is a box section built up of mild steel plate, electrically welded and supported on helical springs carried on a spring plank swung on links 12-5/16 in. long.

Wheels:

The wheels are 28 in. diameter, mounted on 4⅛ in. -4½ in. diameter axles, with axle boxes of the standard railway journal type. To improve the riding qualities of the trucks it was decided to follow American practice and fit resilient wheels, thus reducing the unsprung weight. By the use of rubber, wear on track work, particularly at points and crossings, is reduced and impact loading on the truck frame is lessened with reduction of noise and an improvement of passenger comfort. There is noticeable softening in the riding quality of the vehicle; the acceleration steps are smoothed out and harsh feel of the external brake shoes is greatly reduced.

Two distinct designs have been used for the resilient wheel on the new trucks. One is that manufactured by Industrial Steels Ltd. of Sydney, and is known as the "National" design "O" wheels. The centrifugally cast tire fits on the outside of the outer cheek plate and these are bolted through the holes in the hub plate to the inner cheek plate. The hub and cheek plates are separated by two sets of eight rubber blocks, having a Durometer hardness of 65-70, one set on each side of the hub plate. The rubber is kept in compression.

The second type was designed incorporating the principles developed for the PCC tramcar and built at the Board's Workshops, Preston. The rolled steel tire is separated by two rubber sandwiches from the cast steel inner and outer cheek plates. A rubber sandwich consists of ⅞ in. thick rubber disc bonded on both sides to spigoted 10 s.w.g. steel sheet The rubber has a Durometer hardness of 40-45. Under a passenger crush load of 10 tons the deflection of the centre of the wheel is 5/32 in. The maximum travel possible before the wheel becomes solid is 11/32 in. In both designs the main load is taken by rubber in

Built in 1926, two years after Melbourne's two Birneys, No. 454, the doyen of the ten cars in the now-retired X-1 class, sits at the Port Ormond terminus of the now abandoned Port Ormond shuttle route in 1954. Although of M&MTB style body design, the car had many U.S. attributes; some like the Brill 21-E special trucks were visible, while other, like fareboxes and pneumatic deadman equipment were not outwardly apparent.
W. John Webster

Although this photo is of a Bendigo Birney, Melbourne's X class cars No. 217-218 were similar with minor detail variations (No. 217 had no destination sign boxes). *Donald Warner*

No. 980, the pride of the M&MTB's fleet, its one-and- only PCC, glides along one of the usually badly congested inner suburban shopping streets bound for its City terminus at the corner of Bourke and Spencer Streets about to pass a branch of FOYS. While the wheels, trucks and traction equipment are of PCC design, the end styling is more reminiscent of the Master Unit designs of the late 1920's. *Ward collection*

shear, being so placed as to absorb shocks—vertical, lateral and rotational.

When running, the rubber sandwiches become hot for two reasons: heat is transmitted from the rim which is subjected to brake shoe friction, and heat is developed through the hysteresis of the rubber loading cycle. The type of rubber in both cases and the bond used in the sandwiches were selected with all requirements in view.

Brake Gear:

The truck brake gear is of the clasp type, equalized throughout and is hung on hanger links fitted with parallel case hardened pins. Braking is applied through a radial brake beam.

The truck leverage is 6.334 to 1, and the foundation brake gear leverage on the car body 2.114 to 1, giving a total overall leverage of 13.39 to 1. The brakes are operated by compressed air applied by means of a self-lapping type of motorman's brake valve. With this type of valve, the pressure corresponds to the position in which the handle is placed. Any desired pressure up to the maximum can be obtained and held in the brake cylinder. A relay valve is provided to give speedy operation of the brake.

The brake equipment consists of a W.H.D. H. 16 compressor, 8 in. x 12 in. brake cylinder, a 60 in. x 16 in. air reservoir, W.H. type "W" self-lapping motor-man's valve, and a W. H. type "E" relay valve. All the motors, gears, control and brake equipment are manufactured in Australia.

Motors:

The cars are equipped with four 40 h.p. General Electric 247 AX2 motors with 15/58 gear ratio. Double helical hear wheels and pinions have been used instead of straight spur gears used hitherto. The new teeth ensure gradual smooth engagement and so greatly reduce the gear noise, particularly evident with worn spur gears. The new gears are centrifugally cast and the teeth flame hardened. Lubrication is accomplished by the use of gear shield grease pats having the viscosity of 30-40 penetration is accomplished by the ened. Lubrication is accomplished by the use of gear shield grease pats having the viscosity of 30-40 penetration bitumen. This traction equipment is capable of average rates of acceleration and retardation of 3 m.p.h.p.s. from 0 to 12 m.p.h., of 2.12 m.p.h.p.s. from 0 to 15 m.p.h. with a seated load on level tangent track without discomfort. The free running speed is 32 m.p.h. with full wheels, 29.6 m.p.h. with worn wheels (25 in. dia.) and the schedule speed is 12 m.p.h. with six stops of six seconds each per mile.

Current Collection:

The cars are provided with carbon insert shoes, which slide along the trolley wire. The carbon contact is an insert approximately 2⅞ ins. long by 1⅛ ins. wide by 13/16 in. thick and fits into a gunmetal guide, which is secured by a lock screw to the tilting head of the trolley shoe. When in motion the tilting head remains parallel to the trolley wire irrespective of the height of it. The carbon inserts have a life of approximately 800 miles before a replacement. The trolley shoe reduces arcing and results in negligible wear to the trolley wire.

Control Equipment:

The electrical control equipment is of the remote contactor control type, arranged for series parallel operation with 7 series and 7 parallel resistance steppings. The master controller has an aluminium case enclosing the control drum, line breaker switch and reverser. The contactors are of magnetic type, arranged in two boxes with 5 units in each. The line breaker is also of magnetic type, fitted with adjustable over-load device and operates in series with the contactors. The resistors are of the General Electric Co.'s light weight edge strip unbreakable type. All electrical equipment with the exception of resistors is designed and manufactured by the Board.

Dimensions:

Length over bumpers: 46 ft. 6 ins.
Length over saloon corner posts: 40 ft. 1 in.
Width of car over pillars, 8 ft.
Width of car over footboards: 9 ft.
Height, rail to footboards (tare): 1 ft 2 ins.

Height, footboard to loading platform floor: 1 ft. 1⅛ ins.
Height, loading platform to saloon floor: 6 ins.
Truck centres: 28 ft.
Truck wheel base: 5 ft. 2 ins.
Size of wheels: 28 ins.
Seating capacity: 48.
Crush load capacity: 150
Weight (tare): 18 tons 8 cwt. (41,216 lbs.)

The furthest extent of the tram system is the outer, eastern end of Route 70 Wattle Park, some 8 miles from the City, seen here prior to its recent double-tracking. The vehicles which have just looped (passed) include No. 923 an SW-6 and No. 517 a venerable 1928-built W-2. To the left is Wattle Park, owned and operated by the M&MTB in the manner of early American electric trolley amustment parks, with some of 517's stripped brethern being provided there for children to play on. *Ward collection*

Continued from Page 3

The plan makes provision for a total of 24,825 auto parking spaces at suburban railway stations by 1985, and recommends that as far as practicable these should be at off-street locations. In 1964 an estimated 164,000 rail passengers a day were using bus services to reach suburban railway stations and it is predicted that by 1985 this number will rise to about 264,000 a day. Modal interchange facilities will be constructed at major points.

An extensive tram and bus public transport service, operated by the Melbourne and Metropolitan Tramways Board, covers about 200 miles of tram routes and 222 miles of bus service, comprising 31 routes in the metropolitan area. In 1964 the tram/bus networks were catering for 888,000 person trips a day and by 1985 it is expected to rise to 1,093,000 trips; an increase of 23 percent. Average passenger trip lengths are expected to rise from 3.0 miles to 3.5 miles; and person miles travelled from 2.4 million to 3.5 million miles a day—an increase of 46 percent over 1964.

The committee's comments regarding the tram system were extremely enlightened as follows:

> 'The committee concluded that the (tramway) system cannot be lightly scrapped. Loadings at present require a fleet of some 690 tramcars. These vehicles are housed and serviced in nine fully equipped depots located strategically around the area served by the tram fleet, and workshops covering a total area of 22 acres are used for maintenance and overhaul. The electric power to run the system is supplied through some 27 rectified substations and a comprehensive electrical distribution system (both overhead and underground) is installed. The majority of tram tracks are in excellent condition as are other parts of the system. However, the trams themselves, although well maintained, are generally obsolete in design, and becoming increasingly expensive to maintain in good operational condition. The tram car as a public transport vehicle is ideal for moving big loads for distances up to 7 or 8 miles . . . while the modern bus as an alternative vehicle to the tram is a more flexible unit in traffic and enables fare collection and passenger handling from the footpath, factors such as road width, traffic volume, kerbside parking and traffic delays would still militate against any substantial improvement in bus headways and speeds by comparison with trams which, unit for unit, have a 50 percent greater passenger carrying capacity [and would have even more if larger auticulated cars were purchased.] In the opinion of the committee, it would be quite unrealistic to scrap the tramways network and it is recommended that trams should continue to operate as a part of the system of street public transport.'

While the tram car is regarded by the committee as an efficient vehicle for shifting big loads for distances up to about eight miles, it is impeded in its task where it has to share the existing road space with other traffic. In Europe and elsewhere, where trams are being retained, the Committee pointed out, the congestion problem has been overcome by putting trams underground in the inner city areas and elsewhere by giving trams their own reserved tracks as already done at St. Kilda Junction, Kingsway, Victoria Parade and other areas in Melbourne. Up to 1985 and beyond, the Committee believes trams will play an important role in street public transport services. In the longer term it considers that continued operation of trams must ultimately depend on providing separate rights-of-way for trams cannot be provided, continuing studies will determine if tram services should be replaced by buses.

The recommended plan provides for 746 additional route miles to be added to the existing street public transport network of 1,328 miles by 1985, including nine separate extensions to the tram system. By 1985 trams are expected to be carrying 120,000 passengers to and from the city in the morning and evening peak hours, compared with 90,000 in 1964.

The number of bus routes will be increased and the length of route miles will increase by 64 percent. The buses will serve an area of 850 miles, or nearly double the area in 1964. The new bus routes will provide a greatly improved service in suburban areas and as feeder service to the fixed rail system, operating on closely coordinated timetables. The street public transport system is designed to form a grid pattern over the whole area, spaced at varying distances from half to one mile, and more than 80 percent of all people in the design area will reside within 10 minutes' walk of a tram or bus service.

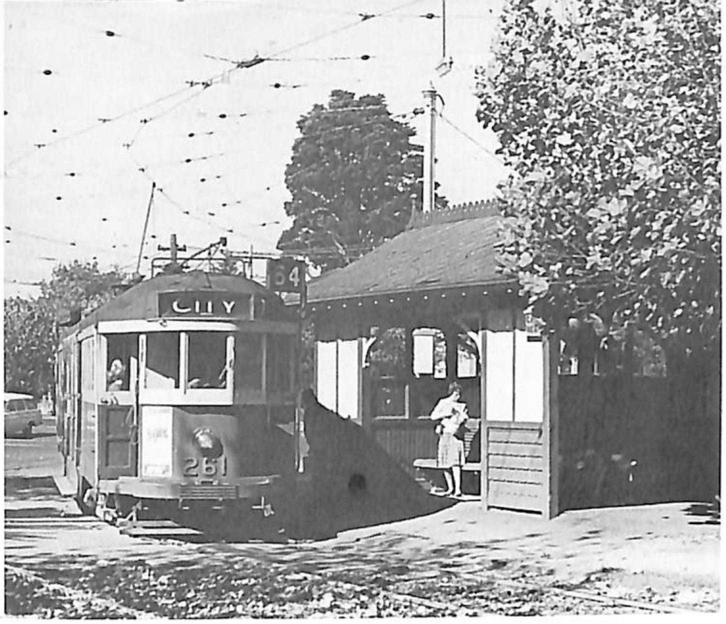
To provide rapid transit to rail stations for people living in outer suburbs, a number of new express bus routes will be incorporated into the public transport system. Two of these will be from Sunbury to Essendon and Keysborough to Oakleigh. Additional services will use the Tullamarine Freeway to the city and another from Altona via the Westgate Bridge to the city.

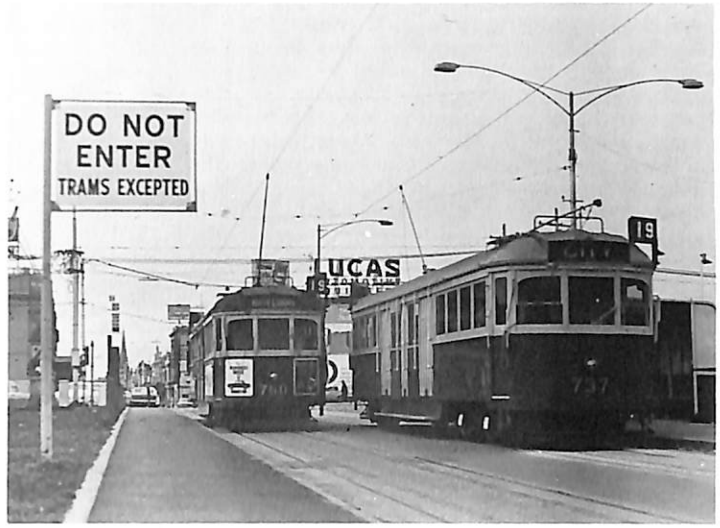
To ensure higher standards of passenger comfort and achieve the improved schedule speeds a substantial programme of replacement of vehicles will be required as well as an expansion of their numbers. This will involve the expenditure of some $55,000,000 (Aus.) for 910 new trams (an increase of approximately 220 over the current fleet size), $50,000,000 (Aus.) for 2,540 new buses and $8,000,000 (Aus.) for new bus depots.

The Metropolitan Transport Committee's plan is based on an assessment of transportation requirements for the design year, or alternatively, for the year in which the population reaches about 3.7 million, at the levels of service described in the report for each mode of transport. Implementation of the proposals will be made over a number of years and follow a series of administrative procedures.

The routes of the proposed freeways, the arterial network and the rail lines will have to be safeguarded by incorporating them as reservations in the metropolitan planning scheme. This will require the Melbourne and Metropolitan Board of Works, as the planning authority, to draw up an amending planning scheme showing the reservations. By law this scheme must be placed on public exhibition to allow citizens the opportunity of examining what is proposed and lodging any objections they may have.

After considering objections the Board will submit the amending scheme with objections to the Minister for Local Government. The Minister then refers the matter to the Town and Country Planning Board for report before final submission to the Governor-in-Council. When the process of public examination and the hearing of objections has taken place, final decision as to reservations will be made, and the reservations approved will become a permanent part of the Metropolitan Planning





LEFT: A Route 64 East-Brighton-City car pauses at an attractive shelter to pick up passengers at the Hawthorne Road intersection where Route 64 joins Dandenong Road. RIGHT: A freshly shopped W-5 with its glossy coat of Hawthorn green and cream paint, shaded lettering and white painted journal box covers, passes a less preposing member of the same class No. 760 which is about to leave the Royal Parade tram reservation and enter Sydney Road whose congestion is obvious in the background. Strong emphasis on expanding reserved tram tracks is made in the 1985 Study. *Ward collection photos*

Scheme. Reservations for public purposes, such as these, carry the right of compensation under the Town and Country Planning Act.

In producing the Transportation Plan for 1985, the Committee has of necessity made a number of predictions into the future. For this reason, the Committee believes that the plan must be a matter of continuing study and assessment if it is to retain its relationship to conditions and needs within the Melbourne area and still remain flexible.

In addition to its transportation implications, the detailed investigations carried out have resulted in producing a vast amount of information of considerable value, not only to the authorities responsible for implementing the transportation plan directly, but particularly to municipal councils which will have a big part to play in Melbourne's Transportation Plan for 1968.

The costs for the entire group of recommendations is $2,616,000,000 (Aus.) as submarized below:

	Million $
RAIL	
Underground rail loop	80
New lines of new alignments	60
Extension of electrification along existing lines	8
Route capacity improvements on existing lines	42
New stations on existing lines	2
Additional suburban trains	35
Modal interchange	14
	242
STREET PUBLIC TRANSPORT	
New Vehicles	105
Bus depots	8
	113
HIGHWAYS	
Freeways	1,675
Major divided arterial roads	64
New arterials	28
Widening arterials and bridges	359
Grade separation (rail/road)	95
	2,221
PARKING	
(CBD parking financed by M.C.C. and private enterprise)	40
TOTAL COST	$2,616

A glimpse of the goals of the Melbourne and Metropolitan Tramway Board has been given in a paper by D.J. Lees, the M & MTB's Planning Engineer, reproduced in abridged form in the November 1970 *Modern Tramway*. Based on a survey conducted in 1962-63, updated with 1969 headways, the paper indicated that for trips of up to 30 minute travel time, the area served by trams averaging 10 miles per hour is greater than that served by the railway service. If the tram services were speeded up to an average of 15 miles per hour, this advantage would be extended to journeys of up to 55 minutes. For travel times in excess of this, the advantages of the suburban railway are beyond dispute. This data is summarized in the following table:

Areas Enclosed Within
Travel-Time Contours
From Central
Business District of Melbourne

Travel Time (Minutes)	Railway and Walking (Square Miles)	Tram at 10 MPH and Walking (Square Miles)	Tram at 15 MPH and Walking (Square Miles)
20	3	5	8.5
30	14.5	16	30
40	39	35	60
60	144	82	115

The ultimate aim of any public transport undertaking should be to give the greatest possible service to each individual passenger within the limitation of resources available. The desires of individual users may be summarized as follows: (i) a door-to-door service (an almost impossible goal for every passenger); (ii) a through journey without changing vehicles; (iii) minimum waiting time at stations and (iv) a fast but comfortable service. The first requirement dictates that routes should be as close together as possible and that stops should be as frequent as practicable. In densely populated areas the aim should be to space stops at about six per mile (about 270 metres apart.)

Using Route 6 City-Glen Iris as a representative example, less than 50 percent of the passengers on the High Street portion of this route travel to or from the Central Business District. A service with about three-quarters of these stops eliminated (as a normal suburban railway) would greatly increase the walking time for most passengers.

Changes of mode, or even between vehicles during a journey—particularly a comparatively short one — are undesirable from several aspects. They are time consuming, cause annoyance to passengers (particularly in bad weather), are difficult to synchronise and create problems with ticket transfers. To meet this requirement, routes should ideally be distributive, that is, branch into a number of closely-spaced routes as they extend from the central area.

Waiting for a vehicle is particularly frustrating to passengers in a hurry. To provide headways between vehicles compatible with the overall journey times, it is considered that the peak headway between vehicles should be of the order of 20 seconds. This is at present approached by trams in Swanston Street, the M & MTB's busiest tram route on which the peak loadings exceed 5,000 passengers per hour in one direction, whereas a 90-second headway appears to be approaching the absolute limit for heavy railway operation.

Passengers desire a fast but reasonably comfortable journey. As the time at stops must be kept to a minimum it is essential that the vehicle starts as soon as passengers have boarded and before some have reached their seats, and likewise that passengers who intend to alight have reached the exit before the vehicle stops. Acceleration and braking rates must therefore be acceptable to standing passengers, and rates of change of acceleration must also be acceptable. Service rates in the order of 6 feet per second per second (4.1 miles per hour per second) appear to be the upper limit from the passengers' point of view, though emergency rates as high as 9 fpsps (6.1 mphps) may be acceptable. Tramway facilities can readily be designed to meet these requirements, provided that the routes are segregated from other traffic.

There are four ways of segregating public transport from other street traffic: (i) street reservations; (ii) cuttings (with tunnels or bridges at crossings); (iii) overhead structures and (iv) tunnels. Where the width of the street permits, street reservations such as on Kingsway offer an obvious solution. They are, however, subject to many problems at grade intersections, and further, many wide streets do not offer the patronage that narrower (and more congested) streets have to offer. Melbourne is fortunate in having a number of wide streets within the inner areas. Where public transport is placed in cuttings deep enough to pass beneath cross traffic, it is also possible to channel through motor traffic alongside at the same grade. Tunnels become essential however at public transport junctions, for grade crossings on a high capital cost scheme would be unacceptable. It is generally on aesthetic grounds that overhead structures above streets are rejected. They have considerable merit from the public transport operator's point of view, but generally require at least one traffic lane in the street below for supporting columns and, if they are not parallel to the traffic lanes, they may interfere with more than one lane. They do not eliminate problems of noise.

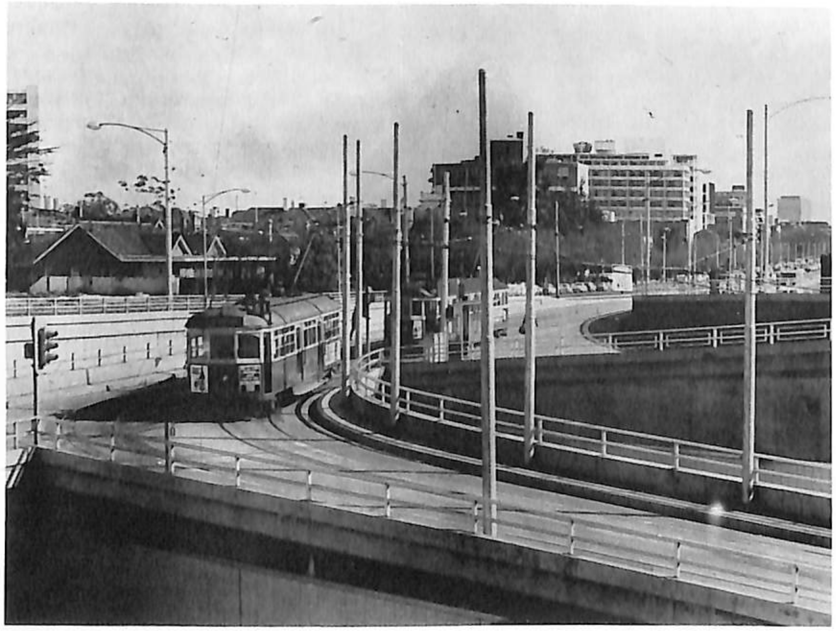
In many instances—particularly within the Central Business District of Melbourne—the demand for road space exceeds that which is available. Plans for rationing road space to the more essential users are unlikely to offer more than a temporary relief to the problem. As the requisition of property within CBD for the purpose of street widening is out of the question, road space can only be increased by the creation of additional levels. Mass passenger transport is the obvious choice of traffic for the new levels.

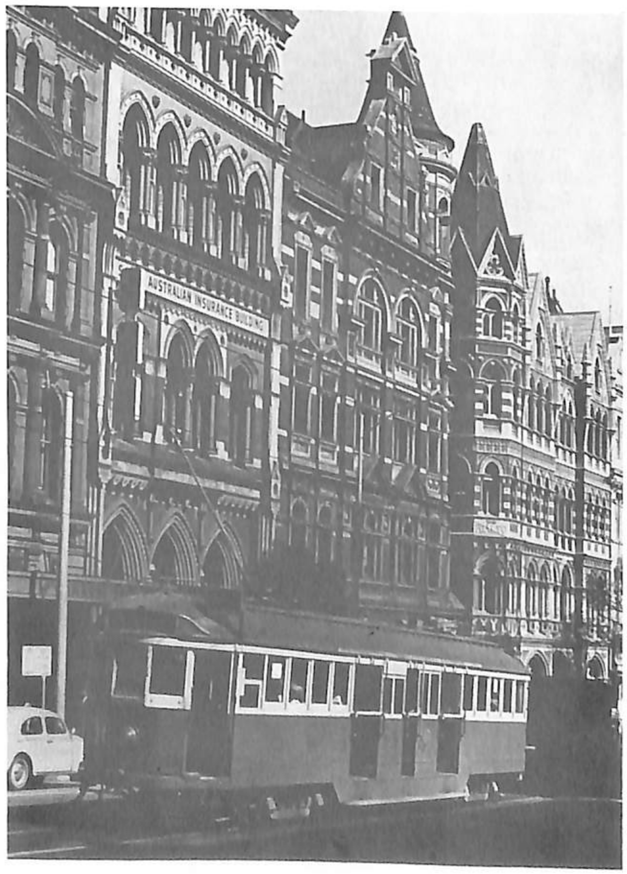
It was therefore decided to confine further investigation to underground routes. Present loadings and predictions for 1985 indicate that the tram network feeding into Swanston Street represents the greatest concentration of travel within the inner suburban areas, and work to date has been concentrated on underground proposals along this street. It would be convenient to channel traffic from the south, south-east, north and north-west tramway routes into this scheme thus serving a considerable portion of the inner suburban areas. The subway would also conveniently serve both Flinders Street Railway Station (the city's busiest station) and the proposed underground railway station in La Trobe Street at Swanston Street.

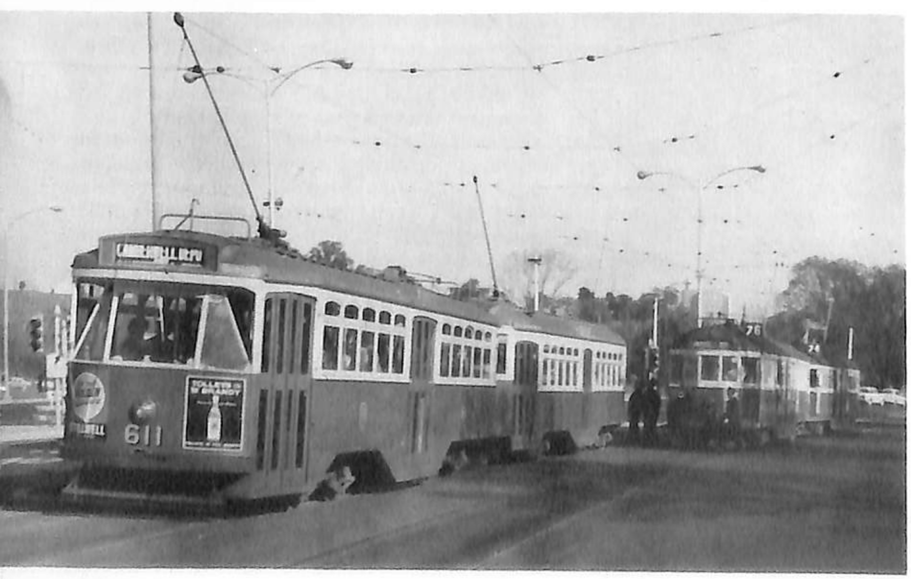
There were a number of fundamental considerations which were relevant to the preliminary design of the subway system. The layout of the suburban railway network is such as to adequately serve areas beyond the existing tram termini, and any major route extensions beyond existing tram routes may be considered unlikely. An electric "guided" mode of transport is assumed because air pollution could not be tolerated in the tunnels, and because tunnel clearances must be kept to an economic minimum. The cross-section of the vehicles should be sufficient for four or even five people seated transversely, leaving an adequate longitudinal gangway with sufficient headroom for standing passengers. It is unlikely that journey lengths would justify the use of doubledeck vehicles with their slower rates of loading.

Though it has been assumed that the vehicles will be supported on steel-tired wheels, the possibility of rubber (solid or pneumatic) tires or support from some form of air cushion, has not been ruled out. For the type of service envisaged, it is not considered that the monorail principle would have any advantages over the conventional flanged steel wheel. The design at this stage does not limit the type of track construction, so that a wide range of steel rail fastening systems are possible, or concrete tracks suitable for rubber-tired vehicles could be used. However, a type of track that can readily be cleaned, possibly by hosing down with water is considered desirable. Stone ballast is not recommended because of the difficulty of cleaning. Initial work has been based on a cross section of 16 feet (5.28 metres) diameter.

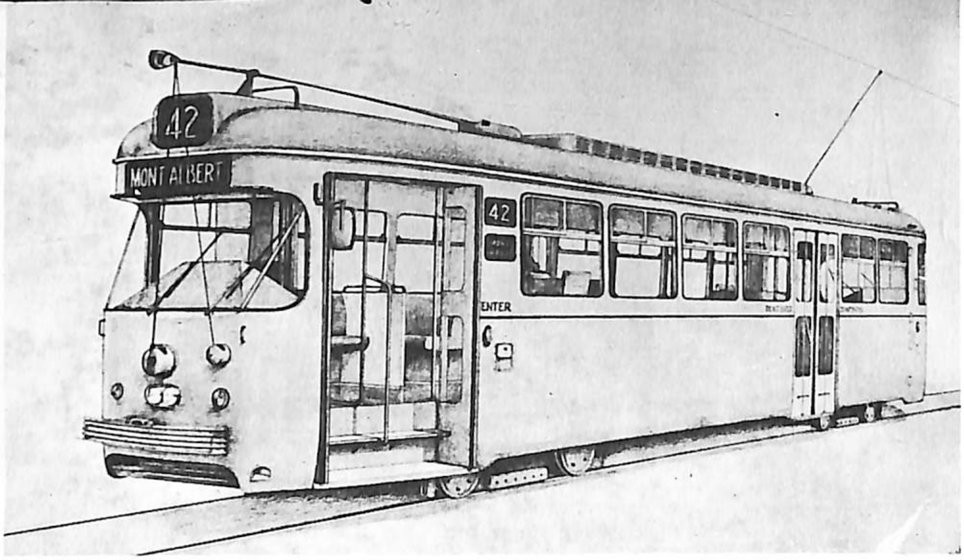
Curvature—in the vertical as well as in the horizontal plane—is critical, as it must be a compromise between route restrictions due to buildings and other authorities' services and vehicle speed. Vertical curves are based on a







UPPER LEFT: Closely followed by an older car on the now-renumbered 4B service, No. 917 starts down the ramp that leads to the Wellington Street bypass at St. Kilda Jct. on trackage that although paved, is reserved for trams. ABOVE: Blending well into its appropriate architectural backdrop, elderly W-2 class No. 637 rumbles down Collins Street in a 1968 scene that with new cars the M&MTB hopes will not be repeated in 1978. LOWER LEFT: Led by No. 469, its Y class precursor, No. 611, a Y-1 built in 1930 for study of possible one-man operation, passes two older cars. Looking somewhat like its U.S. contemporaries with their Peter Witt door arrangement and modernistic end treatment, the differences in window and door height are quite noticeable as is the contrast between 611's No. 15 trucks with their leaf springs and the drop equallizer MCB style of the No. 1C trucks under 469. When new, at least one Y-1 sported spoked wheels.
Ward collection



An artist's rendering of the proposed new trams for Melbourne shows this interesting design, embodying the standard PCC car Peter Witt door arrangement combined with Duwag doors, windows and general styling and the typical European location of the resistors on the car roof. Obviously laid out for front entrance, one-man operation, it has been estimated that 120-125 of these cars could handle the entire night and Sunday service with annual savings on the order of $500,000. *M&MTB rendering*

desirable maximum acceleration of 2 feet per second per second and an absolute maximum of 3 fpsps. They are designed as Euler Spirals. Horizontal curves are based on an absolute minimum of 330 feet (100 metres) radius where possible without encroaching beyond the title lines of private property. Practice here differs from normal railway practice in that optimum curve design is such as to suit vehicles with high rates of acceleration and braking. It has been found that the equiangular spiral is preferable to the circular arc in many locations, as it permits the radius to vary to suit the changing speed of the vehicles. Transition curves are designed as Euler Spirals, and are used for the transition from and to tangent (straight) tracks, except at turnouts A point of interest is that the tunnel route should be desinged to suit the pathway of the vehicle body, not its trucks, and then the track is located to suit.

Gradients for regions of acceleration and retardation are designed as "momentum grades" to give the greatest assistance by both conserving power and obtaining greater performance from the vehicles. For this reason, most of the stopping places are designed to be at the top of humps—and as near the surface as possible. The design is such that the gradients at stopping places are limited to 1 in 50 (2 per cent) and approaches to all stopping places are designed to be uphill. Where power is necessary to climb gradients, they are limited to 1 in 20 (5 per cent). The existing tram services operate on adverse gradient as steep as 1 in 12 (8.5 per cent).

Certain ruling principles were recognized in the design of special trackwork. Converging junctions, for example, should be sited immediately after stopping places—definitely not before, because of the danger of collision between vehicles which may already be using their service braking to make a scheduled stop. Diverging junctions should be immediately after a stop, so that the driver may "set" the junction as he starts off. Crossings at grade are considered to be most undesirable. Reversing of vehicles must take place on sidings or branch lines with lighter traffic, which are entered by facing points, returning to the main line via trailing points. This is regarded as essential to prevent delay to other vehicles on the main line.

Signalling has received only preliminary investigation. It is considered that conventional railway signalling systems, as well as being costly, would be unduly restrictive on route capacity. Maximum speeds will be much lower than on modern heavy railway suburban services, where maximum speeds well in excess of 60 miles per hour are common; furthermore, the proposed subway vehicles would have quick-acting service and emergency brakes. It is also assumed that tunnels will always be illuminated. Indications are that a green-amber system may be adequate, with red aspects at converging junctions only.

This is a factor which could be critical even at the design stage. The Melbourne Metropolitan Transportation Study predicted that tram loading in Swanston Street would pose a serious problem by 1985, when the peak hour volume would increase 10,500 passengers in one direction, compared by the 1964 figure of 4,750. The study added that, while trams, if free running, could be expected to handle the volume of traffic very efficiently, the limitations are imposed by cross-street traffic, and the need to regulate the flow by means of traffic signals.

A study of the capacity of services operated by trams of the PCC type on private right-of-way gives the following figures:

Single Track Capacities
Passengers Per Hour Per Direction

Length of Stopping Place	Single Car (4-Axle)	Articulated Car (6-Axle)	Coupled Pair of Four-Axle Cars
Total Number of Passengers Limited To 150% of Seated Capacity			
100 Feet	10,000	10,000	12,000
150 Feet	14,000	15,000	-
210 Feet	16,000	19,000	20,000
Total Number of Passengers Limited To 200% of Seated Capacity			
100 Feet	13,000	13,000	16,000
150 Feet	18,000	20,000	-
210 Feet	21,000	25,000	27,000

Since 1985 is, however, only 15 years hence, the question must be asked as to the measures to be adopted when the Swanston Street Subway scheme reaches saturation. The solution, no doubt, would be to develop alternative routes to draw off patronage as the load increases. A factor that should be taken into consideration is that high-density redevelopment of inner-suburban residential areas will taper off as a limited maximum population density is reached. Values quoted for the maximum are generally in the range from 100,000 to 150,000 per square mile (160-240 per acre), which is well beyond the present densities.

The proposal is for a double-track subway from points beyond the Haymarket Junction along Elizabeth, Victoria, Swanston Streets and St. Kilda Road to a point south of Nolan Street, with junctions at Queensberry Street to the North Melbourne route, at Victoria Street to the North Coburg route, at Batman Avenue to the Camberwell routes and at Nolan Street to the South Melbourne routes.

Stopping places are planned for City Road, Flinders Street, Collins Street, Bourke Street, La Trobe Street (above the proposed underground railway station), Franklin Street, Victoria Market, Queensberry Street and the Haymarket. This subway system would connect directly with more than 500 stopping places on the existing surface tram routes.

The route selected will offer no abnormal problems or interference with other authorities' underground services, except for certain storm water drains and local sewers which may require relocation in Swanston Street.

Crossing the Yarra River poses some interesting problems as the proposed route passes partly through and partly under a layer of tertiary basalt that rests on strata of silt and gravel—the present river course is above the basalt, while the layers of silt and gravel fill up the former river course. A possible method of construction is to use the submerged tunnel principle, the tunnel being designed to act as a beam to bridge areas of low bearing capacity. The route is located upstream for Princes Bridge to facilitate construction and to avoid interference with the bridge foundations.

Passenger access to the stations has not yet received detailed investigations. In principle it is proposed that direct access be provided between either platform and each of the four street corners above, and that provision be made for ramps and/or stairways both moving and fixed.

Tunnel ventilation has been studied in detail. As all of the electrical energy consumed within the tunnel is converted into heat, its removal could become a problem. To date it is anticipated that ventilation resulting from moving vehicles will be adequate to prevent an uncomfortable rise in the mean tunnel temperature. It may later be necessary to adopt forced ventilation.

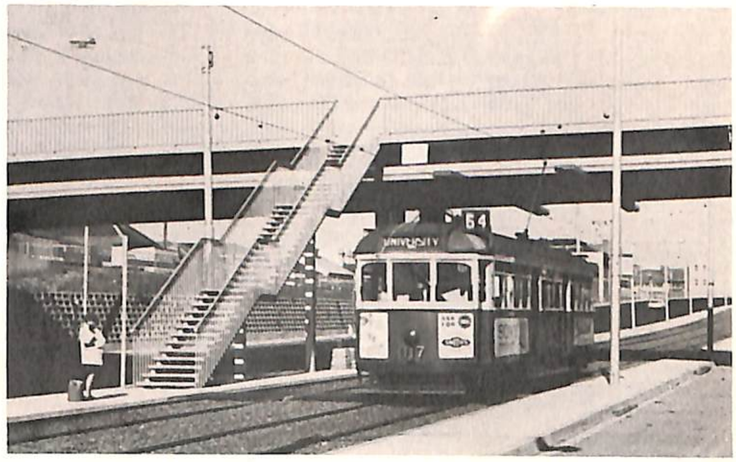
Estimate of costs are excluded from this article as they include a number of items that would be the responsibility of other authorities. In determining the value of such a proposal in terms of finance, one must include for such items as the increase in adjacent property values, the capitalized value of other benefits such as the elimination of pùblic transport from the street surface, and also the use to which such tunnels may be put in an emergency.

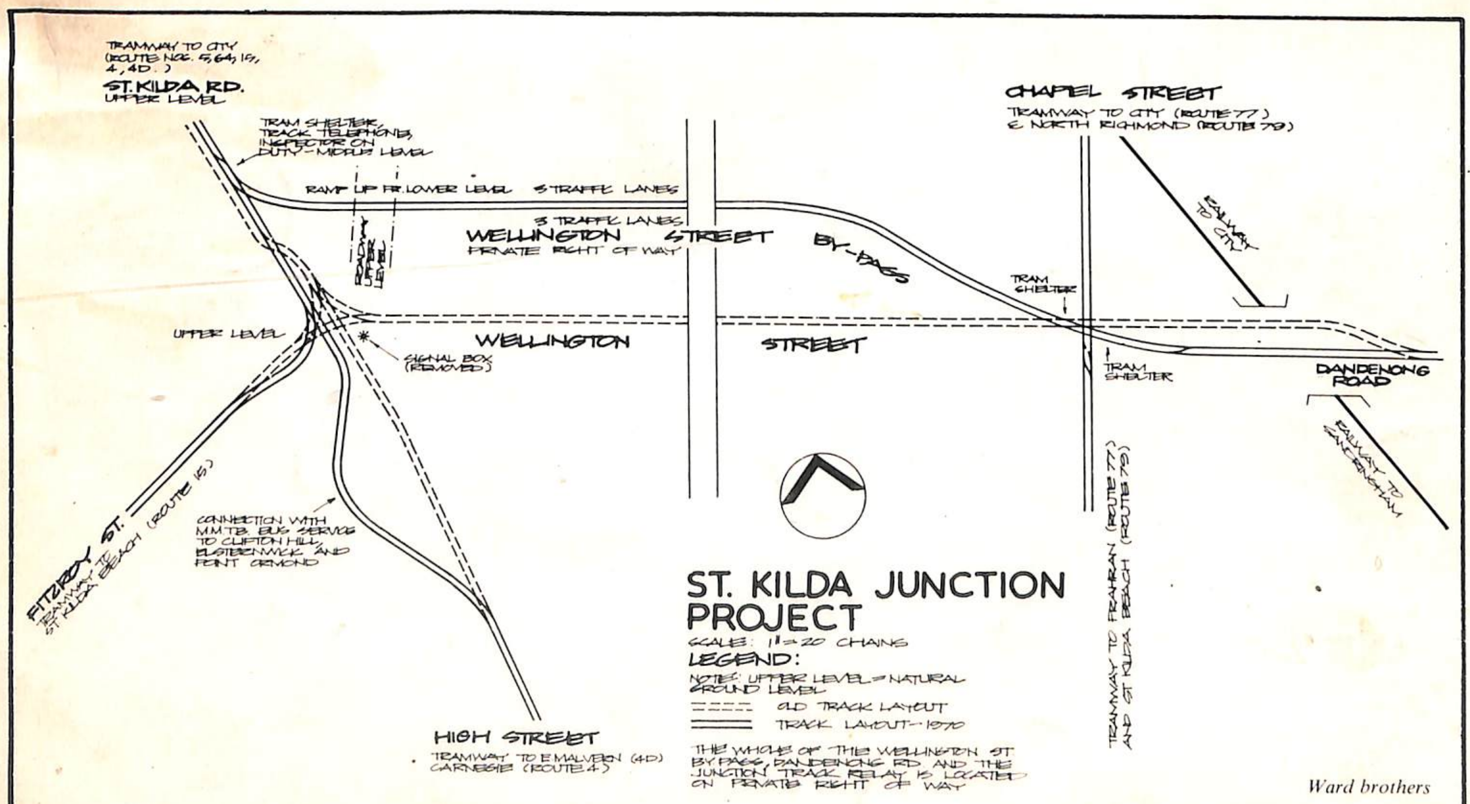
This proposal could contribute greatly to life within the Central Business District and the surrounding suburban areas. It is modern in that it is a transport form now receiving considerable attention from overseas, particularly in Germany and Central Europe, where it is sometimes referred to as "semi-metro" or "light rapid-transit". It is particularly suitable for routes that are unlikely to be lengthened to an extent at which conventional suburban railway operation becomes necessary.

It will provide opportunity for people to make journeys in comfort and expeditiously over most of this inner area by the use of one mode of transport and will limit walking to comparatively short distances. It will also ease what are becoming, if they are not already, the serious problems of inner metropolitan areas namely noise, air pollution and traffic congestion.

The St. Kilda Jct. project represented an important improvement for the M&MTB. LEFT: Here two of the Board's old but well-maintained W-2 class cars, both headed in the same direction but caught as they were moving on parallel courses, pick their way through the construction site on temporary trackage. *Ward collection.* BELOW LEFT: In another construction view, City-bound W-5 No. 838 rumbles along temporary trackage located on an incomplete highway structure while in the left foreground can be noted some of the permanent trackage. *H.R. Clark photo* BELOW: Headed for downtown W-6 No. 917 speeds beneath the Upton Road overbridge whose impressively modern architecture serves to prove that even in Australia trams can be moved to up-to-date, congestion-free rights of way to the benefit of both tram and road users.

A.W. Perry photo





Ward brothers