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The Light Rail Option

A Future Transport System for Dublin

by

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THE LIGHT RAIL OPTION
A FUTURE TRANSPORT SYSTEM FOR DUBLIN

INTRODUCTION

Movement (walking, running driving, getting about) is one of the most essential requirements known to man. There are many modern forms of movement today. In broad terms there are two main forms of movement in the city. One, there is individual movement and two, there is mass movement.

Individual movement is walking, cycling or driving which can result in mass movement. Mass movement is group mass movement where numbers move in the same way at the same time.

In the city (a high density populated urban environment) there is the question of which form of movement should gain precedence over the other? What values are put on the movement, the environment and the people in a city?

Transport is the means and ways of moving. Car transport is individual mass movement and combines the movement of individuals at random, hence opening up the possibilities for transport problems. Train, tram, bus and airplane transport is group mass movement and is also termed public transport.

City Planners, Transport Authorities, Designers and Engineers are all involved in what is now the most common dilemma in cities around the world, congestion.

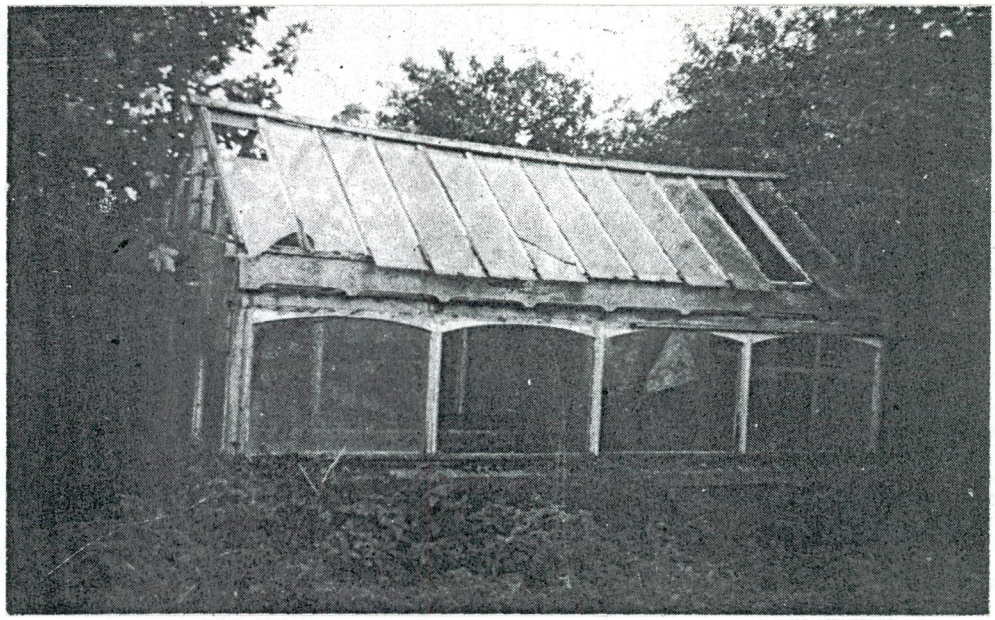
Unbearable pollution, congestion and living conditions have led to a situation where public transport is re-emerging with a new face. Public transport is gaining increasing importance with developments made on its entire image, function and philosophy. Light Rail is a public transport system which is reflecting this chance. This is a study of light rail and the questions it raises on movement in a city. It aims to show an optimistic way forward and a restructuring of the way we live our lives in the cities of the future.

In Ireland, principle (principal) cities and many tourist resorts boasted trams and light railway systems at the beginning of the century. The excitement of rail flourished for a few short decades with the young and old of Ireland and abroad enjoying narrow gauge rails and trams trundling past scenic coastal areas and passing through cities.

> To stand upon the railway station platform,
> early in this century, waiting for an express
> train to bear you away for a holiday was
> for a child, a very close approach to heaven.
> (22, P79)

Both trams and light railway systems of the past ran on narrow-gauge rails. Winding their way around mountains, lakes and city streets, these rails exhibited a flexibility unsurpassed by any other form of rail transport.

With the rapidly increasing use of the automobile at the beginning of the century offering the ultimate freedom of mobility to the masses, the tram became the "ugly duckling" of transport. It was slow in comparison to the new euphoric speeds to be enjoyed by motorists whose



The decaying image of a converted tram into a holiday home in Cork.

The enthusiasm during the rail age exhibited in the eyes of the children.

rising impatience exiled the old tram to the poorer districts of town. With its downmarket image, the tram was eventually banished from this fair isle. Blamed for the rising congestion in our cities, the tram has completely disappeared. Its few remains which can be observed disguised as holiday homes and cow-sheds on the Cork coastline leave little to remember.

Modern public transport in Ireland has been deteriorating since the introduction of the car. Dublin City-Centre has suffered most with its non-stop heavy traffic which creates a permanent smell of fumes and turns a normal conversation on the street into a deafening struggle to communicate. The influence of the car has completely eroded the original Medieval and Georgian street network structure of the city, introducing acre-wide roads and pavements regardless of the costs and losses involved.

Dublin city is now experiencing economic growth and rapid development. Its face is changing and improving with new and renovative developments, especially in the older parts where attention was badly needed. This can be seen in two lights: The original stone-setted streets are being relaid, paved and pedestrianised e.g The Temple Bar area, Henry Street, Abbey Street, etc., but at the same time there is a rise in the number of cars present and consequently severe congestion problems. This situation raises an important question: Is this the time to act, to revolutionise Dublin's public transport services and completely reorganise the way Dubliner's move around their city?

There has been a recent renaissance of tram transport. Throughout the world, new tram systems have been

installed in cities similar to Dublin. These new systems have developed into what is now called Light Rail.

Light Rail may be a solution to Dublin's transport problems and it may also help to rejuvenate its pessimistic image.

This thesis is an exploration of Light Rail and its effect on transport in modern cities. It aims to show Dublin as an example of a city that would benefit greatly from a new Light Rail system.

Chapter 1 introduces the new general concept of Light Rail, as opposed to the old light railway systems. The most important aspects of what is involved in a Light Rail system are explored in general, and an introduction to the new terminology for the reader is also included.

Chapter 2 traces the origins of Light Rail from the introduction of wooden trolleys on rails in the coal mines in the 1600s up to the modern-day tram. It involves the evolution from rail traction to electric rail traction in the tram and also the development of the "overhead wire system" which is still in use today.

Chapter 3 delves more deeply into the technology of Light Rail, and gives specific examples thereof. The logic behind this technology is explored and compared to that of the automobile industry. Most importantly, the benefits of Light Rail for the modern city are underlined.

Chapter 4 shows Dublin City as a place in need of a Light Rail system which would not only relieve city traffic

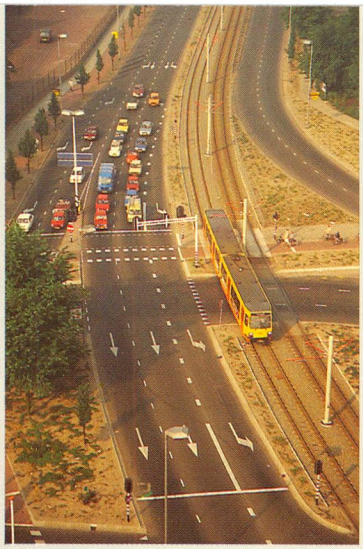
congestion but also preserve it's heritage, change its image and light the spark to a better quality way of life. Possible tram routes are traced and suggestions provided regarding the installation, functioning and general appearance of a Dublin Light Rail System.

Chapter 5 concentrates on the environmental issues surrounding today's transport solutions. The effects of auto pollution are mapped in both the immediate and the long term, and the relative merits of Light Rail with respect to the environment are explained in comparison.

Chapter 6 describes the general systems which service three different cities in mainland Europe, as it tells their success stories. This chapter illustrates the newly available technologically advanced systems.

This work will conclude in a brief, final summary of its main focal points.

Portland, U.S.A.



Utrecht, Holland.

London Docklands.

Karlsruhe, West Germany.

Grenoble, France.

Just some of the light rail systems around the world in action.

Bury Interchange, the northern terminus for Phase 1

METROLINK FUTURE PHASES

With the successful introduction of Phase 1 between Bury and Altrincham including the new City Centre Stations, further phases are already anticipated. Future Metrolink routes to serve Salford Quays, Oldham, Rochdale, Marple, Tameside, Chorlton, Didsbury and Trafford Park are now being studied in detail.

CHAPTER 1

WHAT IS LIGHT RAIL?

> A transport system that is fast, safe and clean. Vehicles with wide doors that make it easy to step on board. The Vehicle passes noiselessly and smoothly through the city, almost without being noticed. Transport to shops, school and work on comfortable uncrowded modern vehicles with a reliable and frequent service.
> (1. P9)

What could Michael Barry be describing? A space craft that flies close to the ground with wide doors and is hardly noticed? What he is describing is not science fiction but a relatively new mode of travel: light rail. Light rail is the specific term used to describe a certain type of rail-based urban transport system, a complete transformation of the old slow-coach trams that existed in Ireland and throughout the world a long time ago. The transformation has not only affected their function but also their appearance. Light rail is a new version of the tram system using new technology and what are called supertrams or LRVs.

Light rail is a flexible system that includes street-running and is very different from the old tram system in that street running is now predominantly "reserved". This means that the modern LRV does not share its passage with other road vehicles and thus frees itself from

normal public congestion.

Light rail is enclosed or segregated when travelling at high speed through suburbs. This further isolates the system from traffic congestion.

The system uses high-capacity vehicles which are lighter than ordinary heavy rail vehicles. The LRVs (Supertrams) are articulated (like long trucks) and have tapered ends to negotiate sharp curves in a city centre, which can be as tight as 15 metres radius. Movement or traction (movement on rails) is electric with overhead current collection. There are many wide doors on LRV's which allow passengers to enter and exit quickly. The vehicle interiors are attractive with comfortable high quality seating and low floors which, increasing ceiling height, allows elderly persons, Mothers with prams and wheelchair users easy access to the vehicles. The vehicles have a spacious feel to them eliminating any feelings of claustrophobia.

Light rail vehicles are comfortable and quiet due to the highly resilient steel wheels on steel rails. When accelerating the LRV moves off smoothly and quietly with its compact and powerful motors working away unnoticed. LRVs are capable of climbing relatively steep gradients accommodating for the different terrains in urban landscapes. Further information on the technology of the vehicles is included in Chapter 3. To add to the new LRV visual appeal, during the construction of a light rail system, city scapes become enhanced and rejuvenated with the addition of new street furniture and street paving. The key to light rail is simplicity. There is no heavy underground or over-ground construction as in

the case of undergrounds or elevated rail systems. It has a simple power source. Its simple to use for everyone. It even looks simple. Low-floor LRVs require at stops a simple platform little higher than a normal pavement. In the central area of a city the stops are usually at spacings in the 300 to 500 metre range. This lowers the average speed of the transport but is of great convenience to the passengers. Advances in the technology of electric traction caters for the frequent stops with fast acceleration and energy-saving devices.

How does the system work? What routes could it take? Light rail is known to encourage confidence in the public for public transport with a fast, frequent and comfortable service. It can have service intervals of 5 minutes or less at peak times and can also offer passenger capacity in the 5,000 to 20,000 per hour range. This is very impressive considering the quality of transport and reliability. The presence of the tracks alone inspire confidence in passengers. The system works very simply with low staff levels. The stops are unmanned and the tickets are sold at shop outlets or dispensed from self service machines. Bus feeder services enhance the service and increase the catchment area. A ploy used to reduce traffic congestion in the city centre is what are called "park and ride facilities". This involves special sub-urban car-parks beside light rail stops. Encouraging motorists to adapt light rail is something the system will do naturally by exhibiting the major advantages it has over other forms of transport. It is environmentally friendly, clean and non-polluting. It revitalises a city-centre with the introduction of pedestrianised streets and lower traffic levels by means of new traffic calming techniques. A

city centre without the fumes and dirt from traffic seems hard to imagine in the context of a city like Dublin, but this is possible only if more people leave their cars at home. With less pollution, less noise and Light rail, city centres become humanised, sociable, amiable environments. In the case of Dublin, a humanised centre would probably bring about a new sense of pride and a realisation that not all is lost.

A light rail system is very flexible in terms of what route it can take. For sub-urban travel at speeds of up to 90 km/hr. the track is completely segregated but can still run at the sides of roads, on parkland or along old railway formations and rights of way. In the city centre and central areas the track is flush paved and predominantly reserved. Routes can also run down pedestrian streets. As with any route there are intersections with normal traffic. This is managed using traffic lights with priority given to the passengers of LRVs. If there is very heavy traffic automatic barriers can be installed.

Apart from the vehicles, the routes and the stops there are a few more pieces of equipment for the light rail system to be integrated into a city.

Electrical substations are necessary and must be provided at intervals to feed power to the system. In environmentally sensitive areas such as the city centre these are buried completely and unobstrusively below ground. In other areas they are built to fit into the surrounding architecture discreetly.

Overhead wires are usually ugly and cluttered looking in

photographs of old trams. New lighter wires used are less obtrusive with the developments in synthetic support ropes reducing the need for heavy insulators. Buildings and streets are often being used to support overhead wires minimising the need for new supports.

Drivers of the LRVs use a system called "Line of Sight' driving to separate themselves from other LRVs. An automatic vehicle monitoring system allows regulation of the vehicles to any desired service pattern. The whole system to set up and run costs only a fraction of a heavy rail system such as a Metro/Dart or Underground system. Light rail systems are also efficient enough to be profitable, such as in Nantes in France.

This is a general description of Light rail but serves to introduce the subject. More practical examples are illustrated in Chapters 3 and 6.

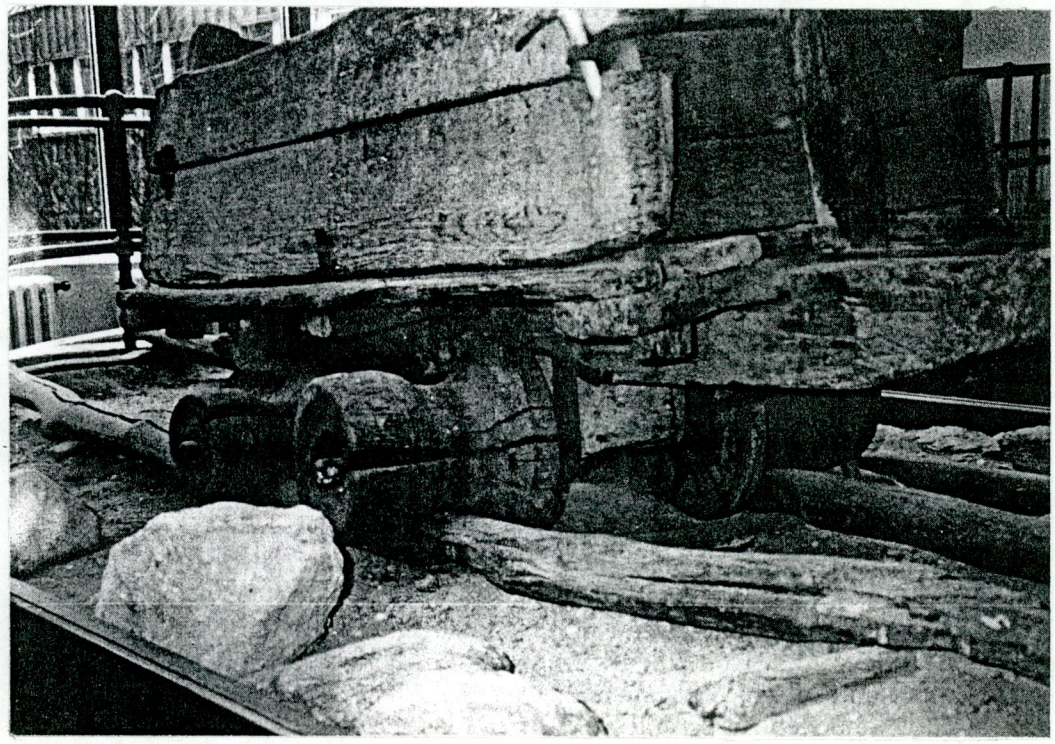
CHAPTER 2

THE RISE AND FALL OF THE TRAMS

The origins of transport using rails came from the medieval mines. Wagons and rails with wooden wheels ran on wooden rails to carry the very heavy loads. These came to be known as wagonways or tramways. There is evidence of these being in use in mines in Europe up to the 18th Century. The word *tram* supposedly came from the German traam meaning beam or the Swedish tramm for log. The obvious problem with the wood on wood system was wear. The development of iron plating laid over timber beams is recorded from the early 1700s. Iron wheels also being developed around this time. Transportation was still reserved for goods and heavy loads.

Public transportation only became a reality in the 19th Century. Up until then transport for people was limited only to the noble and very rich. The first steam hauled train was operated by Richard Trevthick's steam locomotive in South Wales in 1804. The Stockton and Darlington railway opened in 1825. The railway age had begun. Early railways only ran between towns and cities. They greatly contributed to the economic growth and development of the victorian cities but were expensive to build with fixed rights of way and few halts.
(1, P18-20)

In the beginning of the Victorian age cities were small and compact. Their streets were mainly small and narrow



date, where?

Wooden wheels on wooden rails

and the solution at the time to provide mass public transport was the horse-drawn omnibus. It has been said that the word "omnibus" comes from the service developed by Monsieur Baudry in Nantes in 1800. In 1829 New York and London adopted horse-omnibus services which used large horse drawn coaches on a predetermined route, running at fixed times. At the end of the 18th Century there was an example of horse drawn vehicles running on a plateway where passengers were carried. This was the Oystermouth Tram road which ran between Oystermouth and Swansea in South Wales. The vehicles that were used were similar to stage coaches but could be driven from both ends.

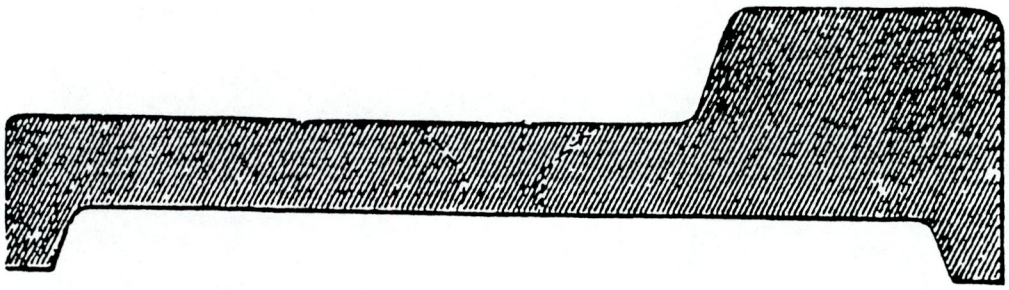
The first tram system opened in the United States. It was known as the New York and Harlem railroad which began service in 1832. The cars were built by John Stephenson and weighed 2.5 tons and could seat 30 people. This was a high increase in capacity over the horse omnibus. The line was 6.4 km long and provided a service every 15 minutes. The pavements and streets at that time in New York were either cobbled or just dirt. The transport of the horse-omnibus was uncomfortable over such terrain. It travelled at the very slow speed of 8km/hr. which is just slightly faster than walking pace. The tram system on the other hand, with it's iron wheels on iron rail offered a much smoother, comfortable and faster service. The reduction in friction meant that a team of horses could pull greater loads than before. The system was widely adopted and proved very popular and by the end of the 1850s there were horse-tramways in most principle cities centred in Eastern United States. The development of the tram in Europe was between 10 or 15 years behind that of the United States. An early European development

was in Vienna where there was an exhibition line in 1840. In France, Alphonse Laibat, who had worked with the New York and Harlem railroad, laid down a line in Parish in 1853. The line had grooved wrought Iron rails which were flush with the road surface.
(1, P18-P28).

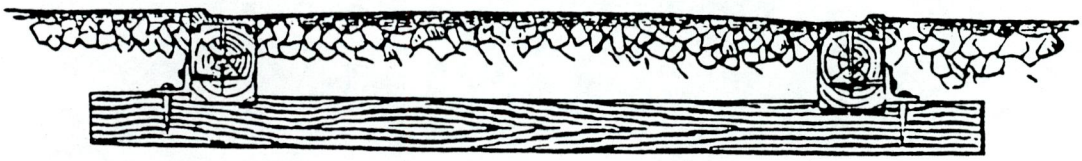
In Britain a horse tramway was installed in Birkenhead in 1860 by the energetic young American entrepreneur George F Train. He followed this with the opening of three more tramways in London the next year. Train used his own "steprail" which proved to be unpopular. The rail arrangement meant that the top of the rail was 16mm above the surface of the road. The resulting interference which the rail caused with the other horse-drawn traffic led to the closure of the London lines. Train suffered the same experience in Dublin when he laid down some trial track on one of the city Quays in 1867. Dublin Corporation are believed to have been the deciding body to insist on the tracks removal.

European cities tended, as a rule, to be more conservative than their American counterparts about the introduction of tramways but by 1877 most European medium sized cities had a tram system.

An example of British conservatisism came in 1870 when the Tramways Act specified that the tramway companies were responsible for maintaining the road surface and 450mm at each side of the track. This was in the context of wear caused by horses hooves. After the horses were removed from service and mechanical traction was introduced the Tramways Act did not change. Later on with the introduction of the motorbus, the path was



G. F. Train's tramway at Birkenhead. Section of rail.



G. F. Train's tramway at Birkenhead.

This rail was also used unsuccessfully along the Quays in Dublin.

provided free. Another part of the Tramways Act which restricted the tramways was that a municipal authority had the option of the compulsory purchase of a tramway after twenty-one years of operation, and every seven years thereafter. Naturally this was no encouragement for the tramway companies to improve and modernise their systems. By 1888 there were over 4,000km of tramways in the united States compared to over 1200km in regulated Britain.

Horse tramways were better than the horse omnibus with greater capacity and faster journeys. Horse tramways also had lower operating expenses and so could charge lower fares. Tramways that offered low fares opened up a new source of custom, the poorer social classes. The poor who had never enjoyed public transport could now jump on a tram and go to the shops. In some locations it became *the* form of transport for the poor giving it a down market image. This image aided the replacement of the tram by the motorbus. The irony of the situation is that the descendant of the tram the new LRVs are now considered to be the attractive face of urban mass transit and the bus in now the carrier of the down market image.

Horsedrawn trams did have their drawbacks. The main drawback was the cost of maintaining a fleet of horses. Hauling a tram was heavy work for a horse and thus an average working life of a horse was four years. One tramcar might require a fleet of up to eleven horses (five pairs to work in shifts plus a spare). This meant that there were a huge number of animals to feed and shelter. At that time an epidemic could wipe out a fleet of horses just like that and apart from the care of the

animals there was also the problem of the disposal of horse manure from the city streets. The horse manure could have been described as an environmental hazard at the time. This environmental problem spurred on many attempts to develop alternative forms of traction. In 1859 the first purpose built tramway vehicle to run on steam was put in to service in Philadelphia. It had a small steam engine and a passenger compartment together. Other subsequent steam tram systems used a small locomotive which hauled separate passenger trailers. Steam was noisy and dirty as well as dangerous. In 1883 a runaway engine killed seven people in Huddersfield. There was a steam engine narrow-gauge light railway system at Bray in Dublin. It had a very tall chimney to keep the smoke from covering the open exposed passenger carriage. The chimney failed to fulfil the purpose sending a billow of steam and smoke into the passenger carriage and consequently was closed down. Operating costs were almost as high as those of horse-trams. A few gas powered systems were developed in Europe. In Britain in 1877 a compressed air system was tried. More compressed air systems operated in the United States. The most successful air system was the Mekarski car in France. The Nantes tramway operated initially on a 6km long line in 1879. Speeds were slow - the average speed was 9 k m/hr. and it took 20 minutes to charge a car for 1 trip at a compressor station. All these systems were never widely adopted.

Thomas Davenport, a blacksmith from Vermont, built an electric motor with enough power to propel a small rail vehicle around a circular track in 1835. In St Peterburg a boat was propelled with a similar motor in 1839. Professor Charles Page propelled a vehicle to a speed of

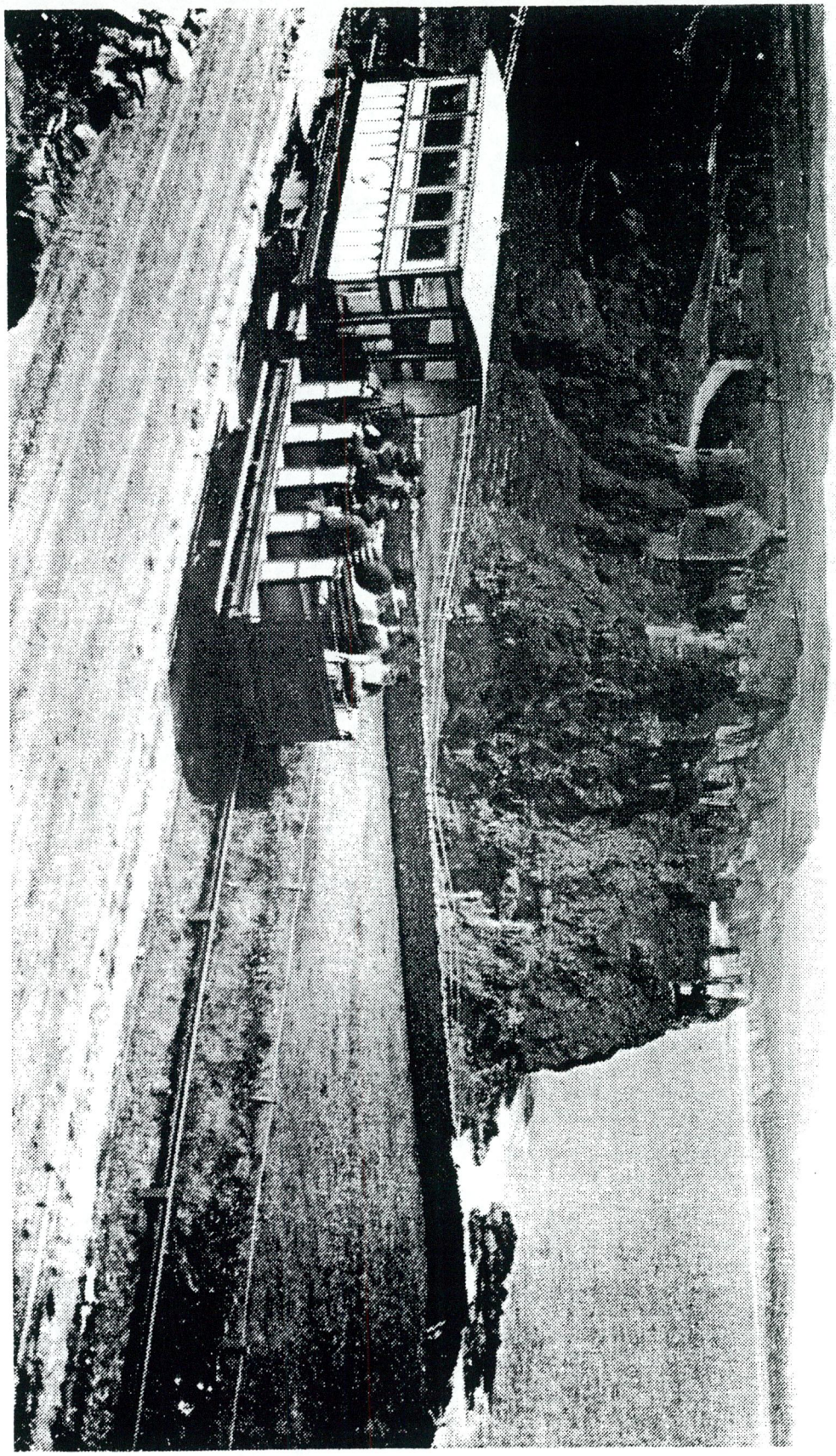
30km/hr using an electric motor near Washington in 1851. None of these motors were ever very efficient. The primary reason for this was that they used batteries which yielded little electrical power and were quite expensive. Michael Faraday discovered how to convert mechanical energy into electrical energy. In 1831 Faraday showed that it was possible to induce electric current into an electrical conductor by passing it through a magnetic field. This was the discovery which led to the development of the electrical generator. The following decade led to the introduction of the magnet and the dynamo for the production of electricity but it was not until the second half of the 19th Century that efficient large scale electricity generators were built. These were primarily built for the production of electricity for domestic and industrial use but not for electric traction. In 1872 the Belgian born Z T Gramme found that by feeding electricity to a dynamo it acted as a motor. This was the first principle in the development of a practical form of electric traction.

Siemens and Halske electrical company introduced the world's first electric locomotive at the Berlin Industrial Exhibition in 1879. It was a small locomotive which pulled three trailers carrying passengers around a 300mm long circuit at 7 km/h. The electric current was delivered to the 2 hp motor by a central third rail. Two years later Siemen was to follow this by opening the world's first electric tramway at Lichterfelde in the Berlin suburbs. It was made up of converted horse tram cars carrying 26 passengers with a top speed of 20km/hr. One major flaw in the design appeared when horses received electrical shocks from the rails at road crossings. The power was fed at a voltage of 180 volt

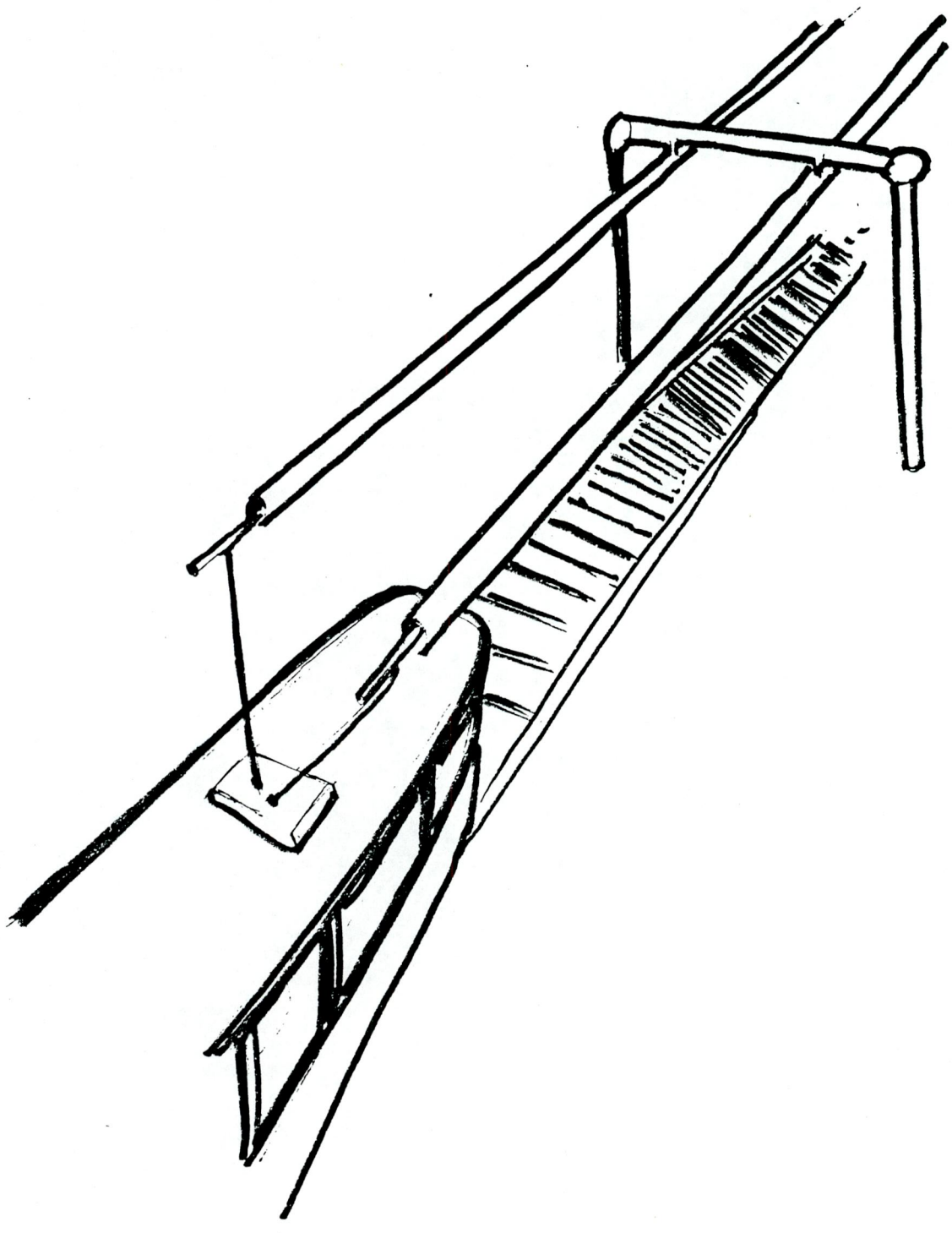
via the running rails! Hence there was a safety and also economical problem.

In 1883 the Portrush to Bushmills line in Ireland was opened using the "Third Rail" system. Running along a scenic coastline, this was the first electric tram service to carry passengers in Britain and Ireland. The third rail ran along beside the main tram line but on the seaward side and elevated to a height of 430mm. The passengers boarded from the other side. Siemens supplied the electrical equipment. Part of the equipment was a hydroelectric generator at the Salmon leap falls on the River Bush near Walkmills. The line was 10km long with 60 level crossings. At a level crossing the power ran underground but after a cyclist was electrocuted in 1895 the Board of Trade insisted that an overhead system be installed. The line was basically a tourist line. In 1885 another third rail system opened between Bessbrook and Newry also in Ireland. At road crossing this system used an overhead wire instead of the third rail. The overhead wire was engaged by a contact strip on a fixed metal frame mounted on the tram roof. These systems were extremely popular in their day with many thousands going on holidays every year on the trains.

At the 1881 Paris Industrial Exhibition, Werner von Siemens exhibited an overhead current collector. The collector involved the use of two bronze tubes with slots cut out. The bronze tubes ran parallel above the trams. A sliding shuttle was drawn through each of the bronze tubes and the shuttles were connected by a flexible cable to the motors.



The Portrush to Bushmills "Third Rail System" was a very popular tourist attraction.



The Shuttle System

An innovative development of the troller was a trolley pole. This was an inexpensive and simpler method of current collection. It was developed by a Belgian called Charles Van Depoele in the United States. It consisted of a simple wooden pole mounted on the tram roof and pressed by a spring against the overhead wire. A small grooved wheel at the end of the pole ran under the overhead wire. Van Depoele demonstrated his trolley pole at the Toronto Industrial Exhibition in 1885. But when he took out a patent on the trolley pole method it was objected to by Frank J Sprague who had also developed a trolley pole.

Frank J Sprague has often been referred to as the "Father of Electric Traction". Sprague is responsible for a major advance in the development of the electric tram when he coupled together into a whole the technical advances at the time. Sprague who had worked with Thomas Edison up to 1884 formed his own company called "Sprague Electric Railway and Motor Company". He is probably most famous for putting an electric tram system in a town in Virginia called Richmond. Richmond was a typical American town with steep hills and muddy streets. Sprague faced many technical problems with under powered motors, overhead wires burning through and difficulty keeping the undercontact trolley to stay on the wire. Sprague evolved the swivelling trolley pole which turned on a roof mounted tripod and was fitted with an insulated trolley rope for retrieval. In February 1888 Sprague succeeded in opening the tram system, which was the largest in the United States at the time, with 40 cars running on the 20 km route. It, apart from being fully operational, was a success. The Richmond company's operating costs were reported as being only 40% of those

operating a system with horses. Richmond tram system became extremely popular and operators and promoters of trams flocked to see the new system. The modern day equivalent Grenoble light rail system is causing a similar reaction.
(1, P28-29).

After Sprague's success electric traction spread like a wave across the United States. Two years later one sixth of the United States tramways were electrified. America had no problems adopting the new transport as it became apparent that it was possible to make good profits. The electrified trams could offer lower fares which created for greater passenger demand. The trams being high capacity, very frequent and faster than before dealt very efficiently with the greater passenger demand. Sprague's success awarded him the work of more and more electric tram systems. Van Depoele ended up working for a leading rival company of Sprague in North America.

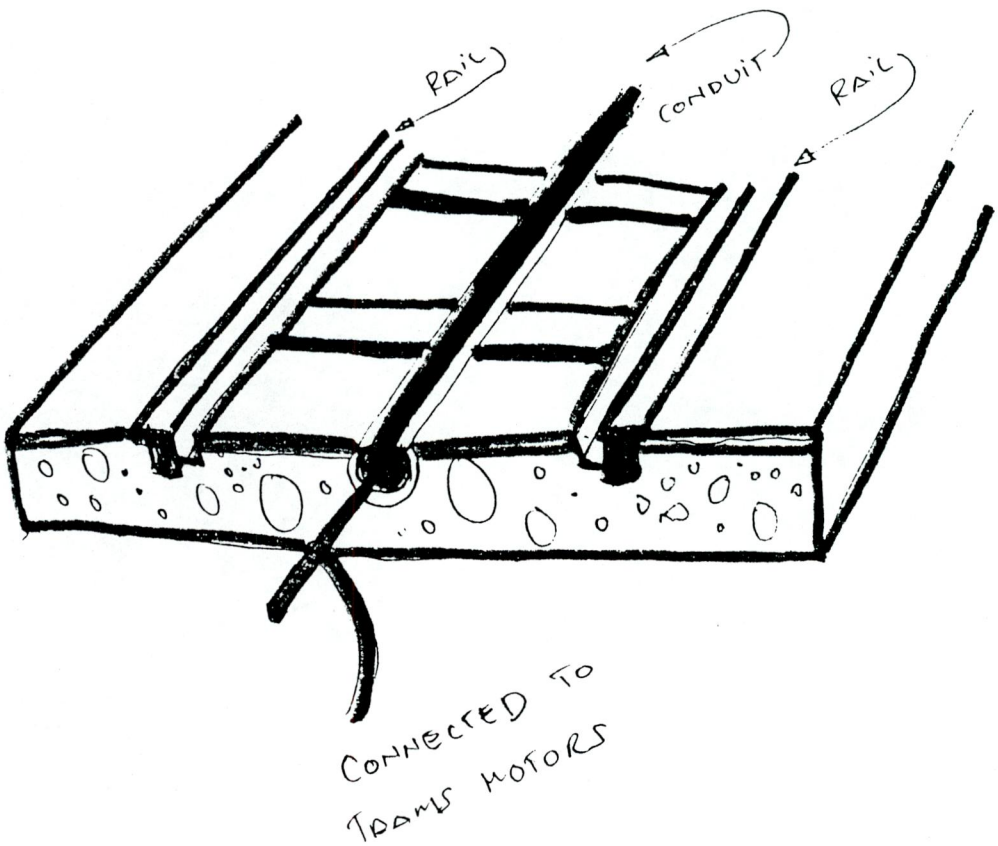
Europe's systems were always more stifled than America with regulations and statutes. Many alternative systems were tried in Europe while America adopted the overhead wire system. Americans had a more carefree approach to development. Europeans with their uncluttered streets disliked the overhead wire system. The New World had little time for the aesthetics of urban culture and overhead wiring was flung up on plain timber poles unashamedly. "In Europe there was objection to this 'visual Pollution'" (1, P28). Attempts were made to offer an aesthetic solution with ornate poles and supports being used to blend into the streetscapes. These in time became part of the urban heritage. Many cities banned overhead wires running through their

historical centres. Europe basically civilised their tram systems.

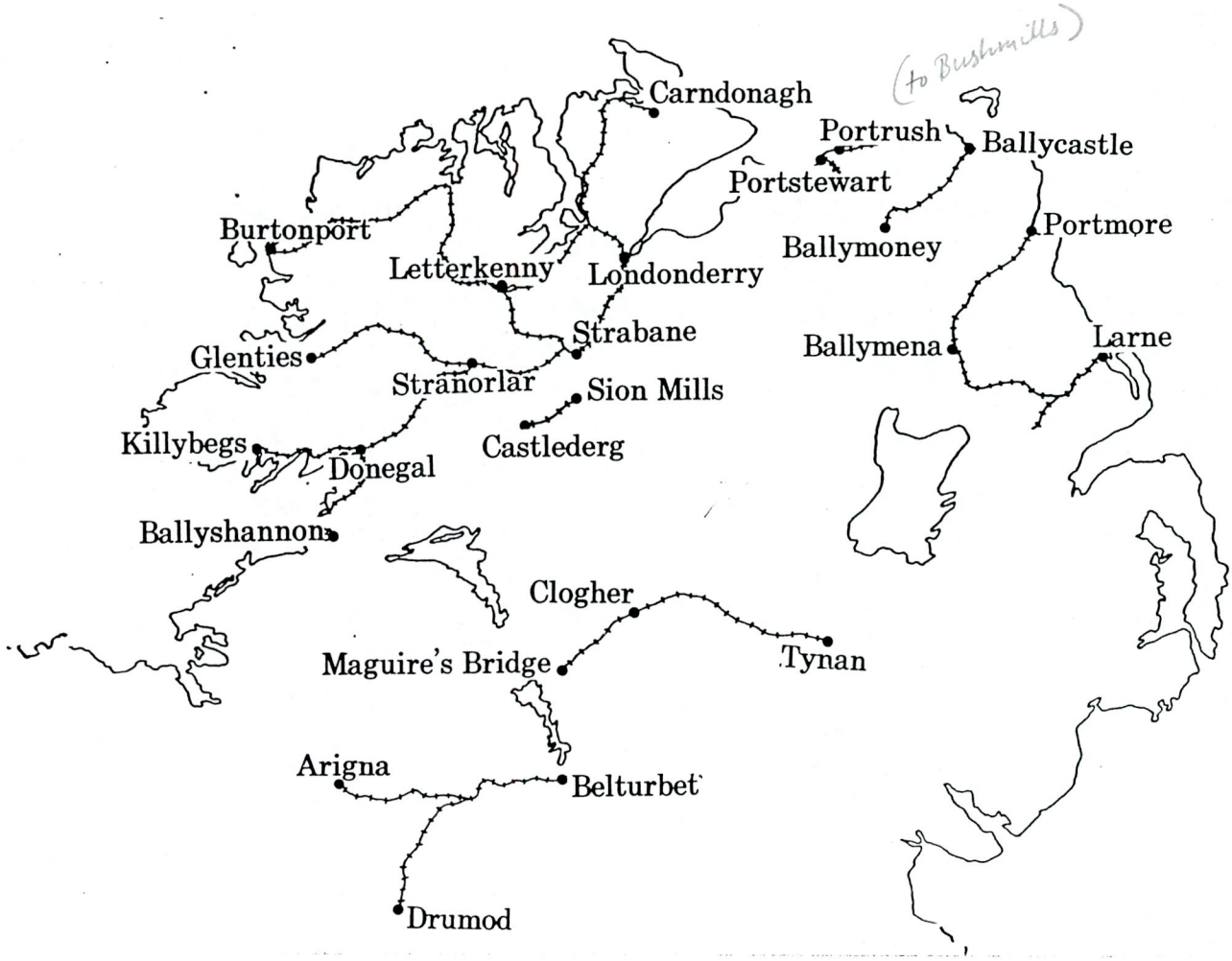
Europe with its negative reaction towards overhead wires tried many alternatives. Battery cars were one such alternative which were tried in cities such as Berlin, Vienna and Paris. Battery cars proved inefficient, heavy and emitted noxious fumes. Paris also had another system called the conduit system. In such a system a tube or conduit was laid below the road surface with a live conductor rail located within it. The conduit had a slot for the access of a plough which was pulled along the conductor rail by the vehicle. The disadvantages of the conduit system were the high costs involved to lay it down and the maintenance of it as quite frequently mud and water would get lodged in the conduit.
The Golden Age of tramways really came before World War 1. Tramways were built in cities all around the World. During the war the tram gained a very prominent position over other modes of transport especially over the then infantile motor car. The war though was to develop a rival to the tram that it could not challenge. Better manufacturing technology and more efficient designs improved the motor car and bus immensely during the war. So much so that after the war cars and buses began to appear on city streets.

> In Britain the number of passengers carried on trams peaked in the late 1920s when a total of 4.7 million passengers were carried. Thereafter in Britain trams were on the decline.
> (1, P36).

The Royal Commission on Transport (1929-31)

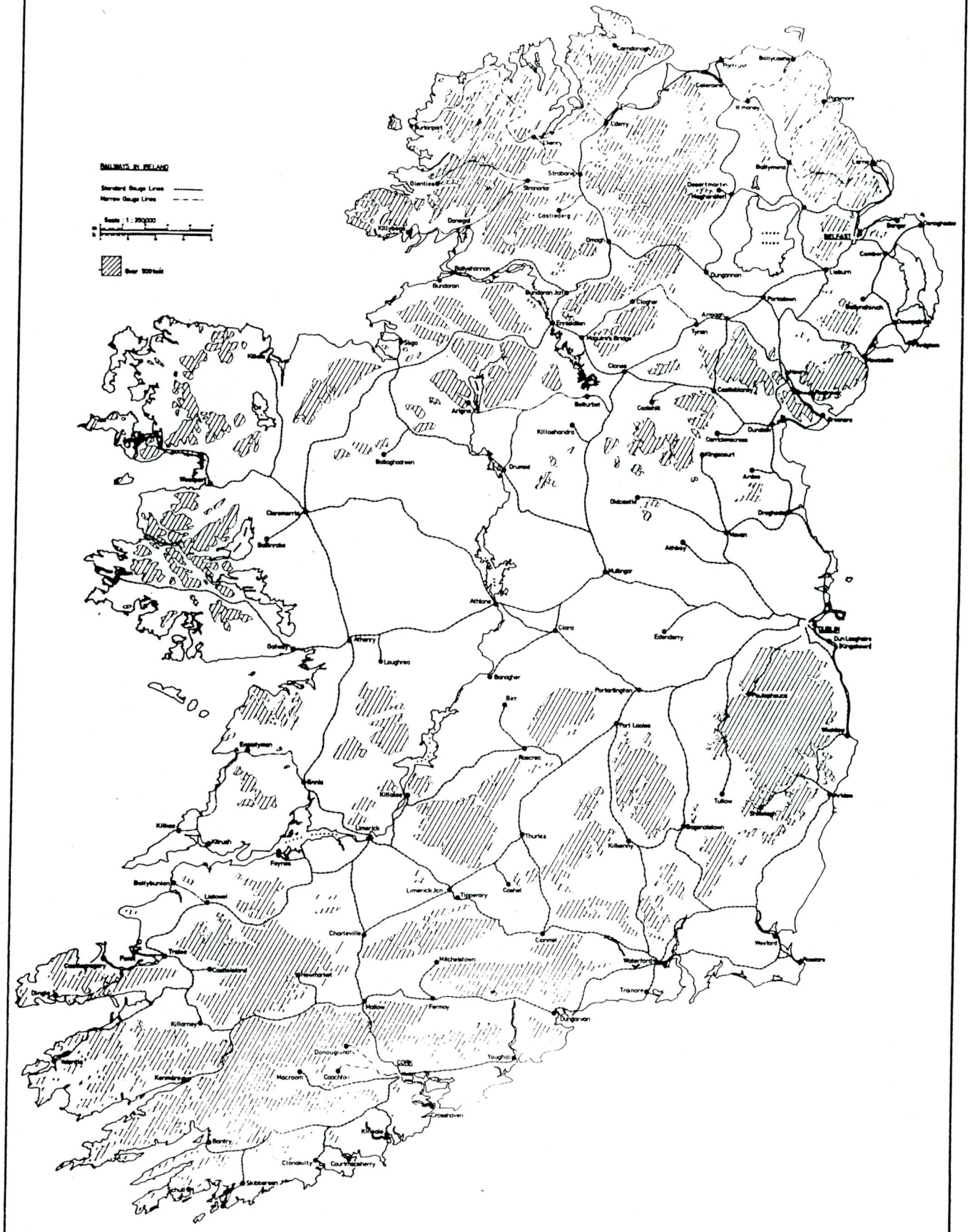


The Conduit System

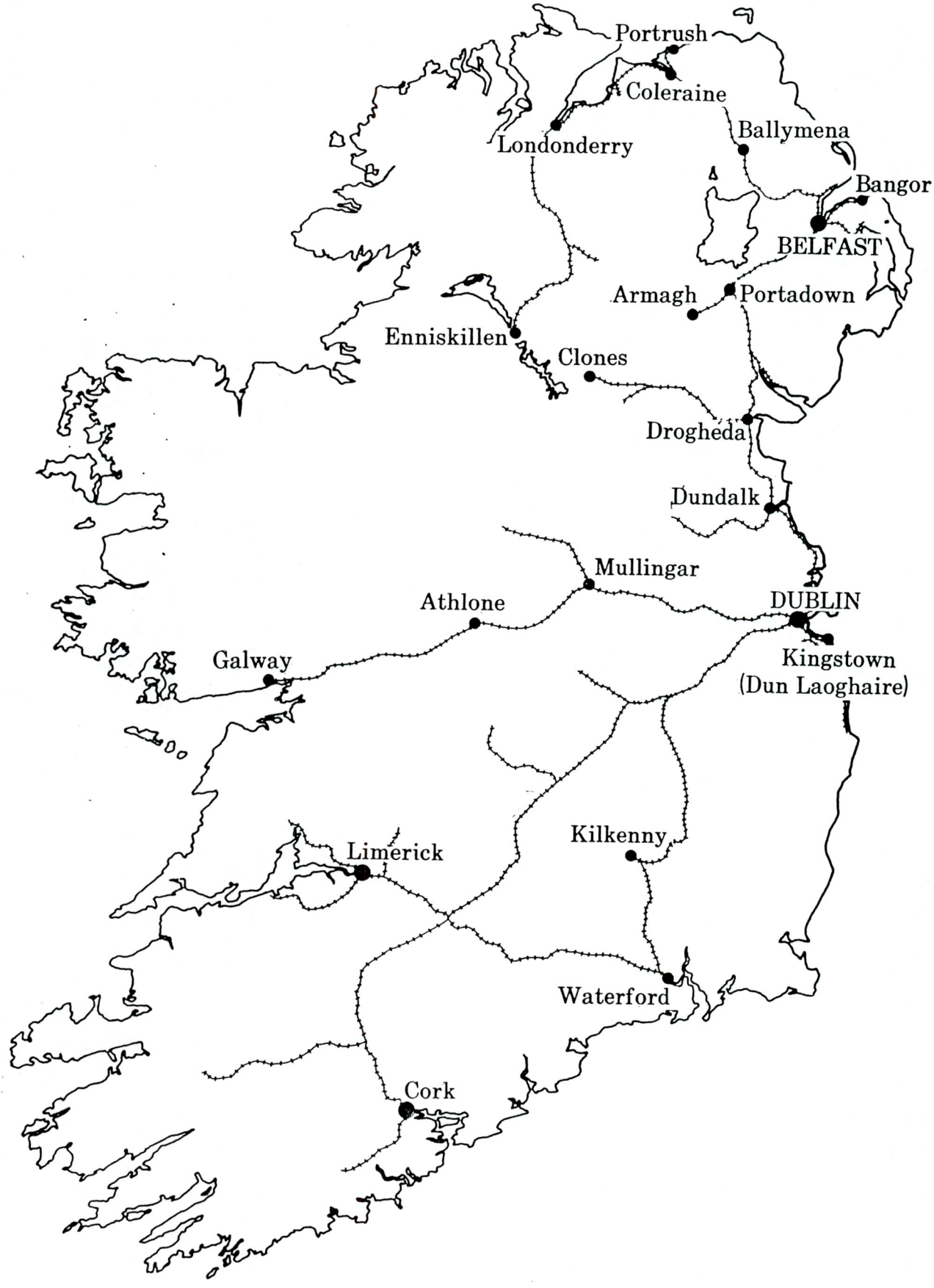


Narrow gauge lightrailway systems in Ireland

The heyday of the Irish railways 1914



The railways in Ireland 1855



> effectively wrote the death notice of the British tram when it stated "Tramways, if not an obsolete form of transport, are at all events in a stage of obsolescence, and cause much unnecessary congestion and considerable unnecessary danger to the public. We recommend therefore, (a) that no additional tramways should be constructed and (b) that though no definite tram limit can be laid down, they should gradually disappear and give place to other forms of transport. (1, P36).

There were many reasons for the decline of the tramways. Many had low fare regimes which carried a downmarket image. The low fares did not always accommodate for depreciation and proper maintenance and so many systems became even more downmarket. Some tramways never proved worthwhile because of their scale especially if they were small systems. Buses at first appeared fashionable with reliable engines running on cheap fuel with good capacity. They were completely flexible taking whatever route desired and all provided for free. With the introduction of the bus the tram was seen as a cause of congestion to the new vehicles. Trams were slow moving and inflexible. Trams were taken off the roads for cars and buses to create even thicker congestion on today's roads which never seem wide enough.

Not all tram systems failed to compete with the motorbus of the time. To compete some systems were modernised with new motors and cushioned seats. In Britain tramcars in London in 1931 with modern designs were called felthams. The tramcars had air and magnetic brakes, roller bearings, good acceleration, prefabricated bodywork and a separate drivers cab. Another feature

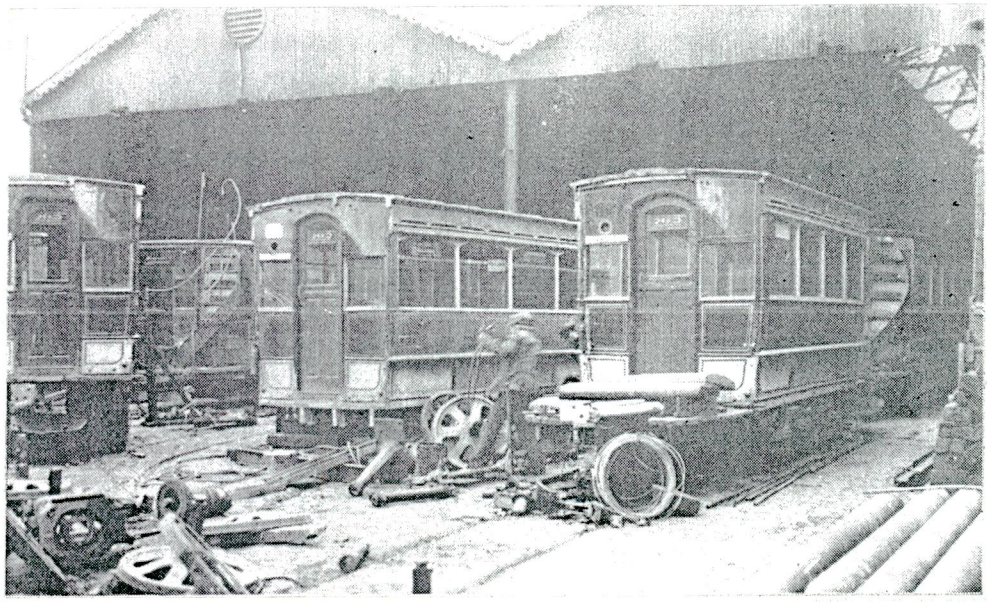
incorporated in the new systems in Britain during the 1930's reserved track was laid down either on the side or in the centre of the road. This concept was previously tried in France in 1904 and resulted in high speeds for better services. Unfortunately, after the war the closing of the trams could not be stopped. Wartime neglect and the nationalisation of the municipal electricity supply in 1948 led to a series of post war closures. The last city tramway to close in Britain was Glasgow in 1962. The last Dublin tram line to Dalkey closed in 1949. The last electric tram in Ireland closed in 1958 at the hill of Howth. While most tramways in Britain and France closed other countries retained their systems. These countries continued the development of the tram and came up with more new designs which can still be seen in service today.

In the 1930s very significant advances were made in tram design. In Switzerland at this time and advanced bogie and body design was developed and was adopted by Swiss cities which have provided an excellent service up to recent times. The most advanced tramcar to emerge from this era was researched and developed in North America by the "Electrical Railway Presidents Conference Committee". The car they developed was called the PCC and brought a new level of sophistication and comfort. They had streamlined metal bodies, pneumatically operated folding doors, improved smoother acceleration and breaking, high speed motors and improved suspension. They were much quieter than previous designs and more comfortable with better ventilation and seating. Despite this new level of sophistication and comfort it was not enough to prevent the rise of the motor car in North America. But if the PCC did not succeed in America it certainly did in

Dublin in the Tram era

date, wartime?

The Old Cork Tram



The sad decline of the tram in Cork

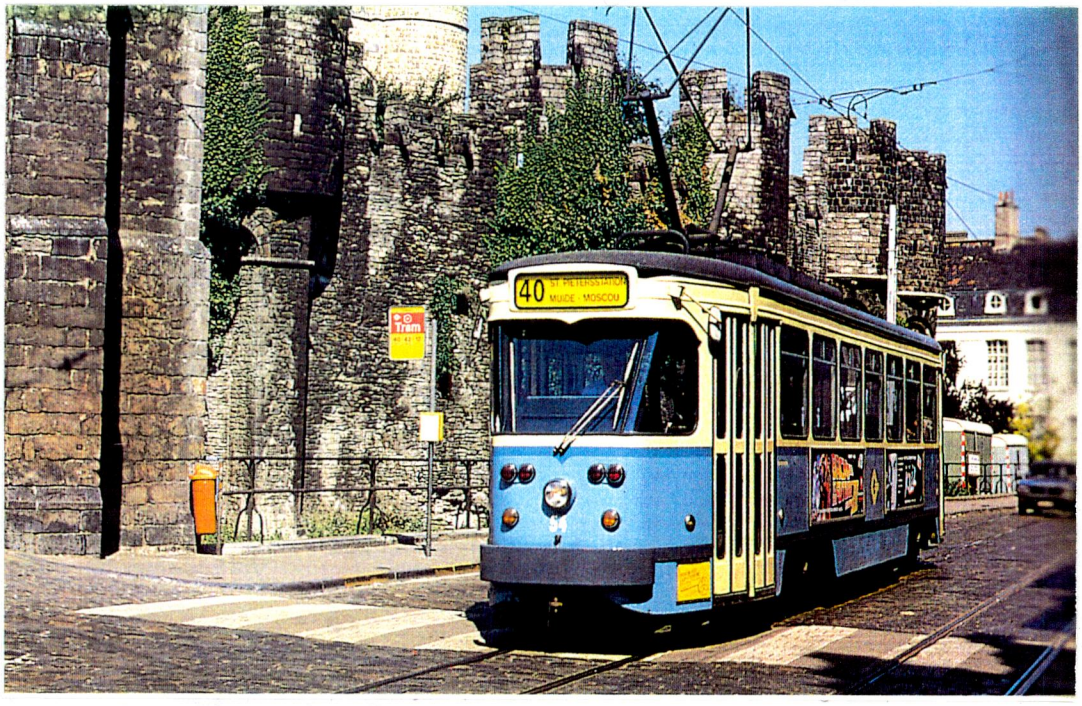
Eastern Europe. In 1947 the CKD Tatra in Czechoslovakia obtained a license to manufacture the PCC car. As production in North America dwindled, it expanded in Prague and PCC cars were sold out to most of Eastern Europe. To date an extraordinary total of 22,000 cars have been manufactured by Ckd. Trams were always popular in low car ownership countries such as those in Eastern Europe.

By 1970 the general opinion was that many cities in the Western World had totally abandoned street trams. Of course there were exceptions such as cities in Switzerland, Austria, West Germany, Italy, Belgium, the Netherlands and countries that were in the Eastern Block. Trams were looked upon as being out moded and inefficient. The countries that retained their trams were the ones to develop the rebirth of the tram (the birth of light rail). The principle country involved in the rebirth was Post-War Germany.

After the war Germany's cities needed to be reconstructed. At the time there was a national policy of encouraging domestic electricity production. Electric traction reduced the dependence on imported oil and so a conscious decision to retain the tram was made. As the cities were being reconstructed reservations for tram routes were laid along many of the new roads. This allowed high speed tramways to travel along side the roads. Labour in Germany was in short supply and was expensive. Old trams had a crew of four and proved uneconomical. Development of high capacity cars was needed. By the 1950's Duewag, a German Company produced a six axle articulated car. Capacity was 200 with a driver and conductor as crew. The passenger crew ratio

Above: The tourist eyecatcher, a reconverted tram in Bristol.

Below: The Tatra car to be seen throughout Czechoslovakia even today.



The infamous PCC cars Where?

was a productive 100:1. The greater productivity afforded by the higher capacity vehicles changed the economic situation and allowed successful competition with the bus. Light rail began to become a reality.

The history of trams and light rail reveal a lot about man's great achievements throughout the last two centuries but it also reveals a lot about the differing attitudes throughout the world on transport. Trams attracted enormous popularity but Western European countries made strong reservations about adopting them. Their heritage and background might be lost to this liberating transport and yet when the most liberating transport of all (the car) comes along they lose all their inhibitions. America, and most of Europe did away with their strong reservations and with open arms welcomed the automobile caring not for the unforeseen mess to which we now must face. On the other hand cities such as Prague in Czechoslovakia have retained their trams, their history and beauty with little or no detrimental effects from the car. To experience a traffic free city with no visual or physical pollution is incredible. To experience Dublin at rush hour with the noise and frenzy is also incredible. Which one would you prefer?

CHAPTER 3

LIGHT RAIL TECHNOLOGY

Every year a new car comes on the market boasting this new feature and another new technology. Every year more and more cars appear on the road. Each new car on the road presents the world with a worsening congestion problem. Light rail technology is advanced every year but the difference between it and that of the car is that Light Rail transport is problem solving while car transport is problem creating.

Light rail technology attempts to solve the problem of congestion in urban areas by getting down to the basics of the problem. The problem is space. How do we use our space? Which is more important, getting around and about the space or the space itself? In other words are roads more important than streets, parks or buildings? City planners in many cities in Europe are facing up to the fact that more new roads lead to even more new roads. They have now made better public transport a major priority for their future developments. In Holland, a country faced with a shortage of ground, the Government are heavily investing in new public transport while reducing any further road development. Light rail and heavy rail numbers are to rise significantly in the next ten years.

Light rails offers us a new technology that will make a

very noticeable impact on the changing faces of our modern cities. Light rail holds an optimistic view on the future of our cities. Light rail is about image, an attractive image of speed, efficiency, reliability and comfort.

The image of light rail is of course carried by the vehicle itself, the LRV. There are many fine examples of LRV design that have combined successfully a both functional and aesthetic solution with very attractive results. The following photographs highlight both the varied and attractive designs of LRVs. Much praise has been given to the GEC Alsthom LRV design in Grenoble, France. Michael Barry writes " Some observers consider that the external design of the GEC Alsthom LRV for Grenoble is the most aesthetically pleasing of these LRVs in service today" (1, P.97).

LRVs are not the same world-wide as no Light rail system is exactly the same. Different cities require more or less of what can be provided by a Light rail system. Some cities may want high floor LRVs because they want the system to link into an existing metro-system which have high platforms. Some cities have very narrow streets and other cities have large streets. One needs a narrow LRV and the other needs a large high capacity LRV. Nevertheless the new generation of light rail systems are adapting many of the same new technological advances.

The body design of LRVs is as the names suggests "light". On average the weight of a vehicle is around 30 to 40 tonnes. This may seem heavy but is much lighter than main line heavy rail vehicles. The recent Stadtbann 2000 prototypes have reduced the weight of a vehicle down to

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Fontaine La Poya
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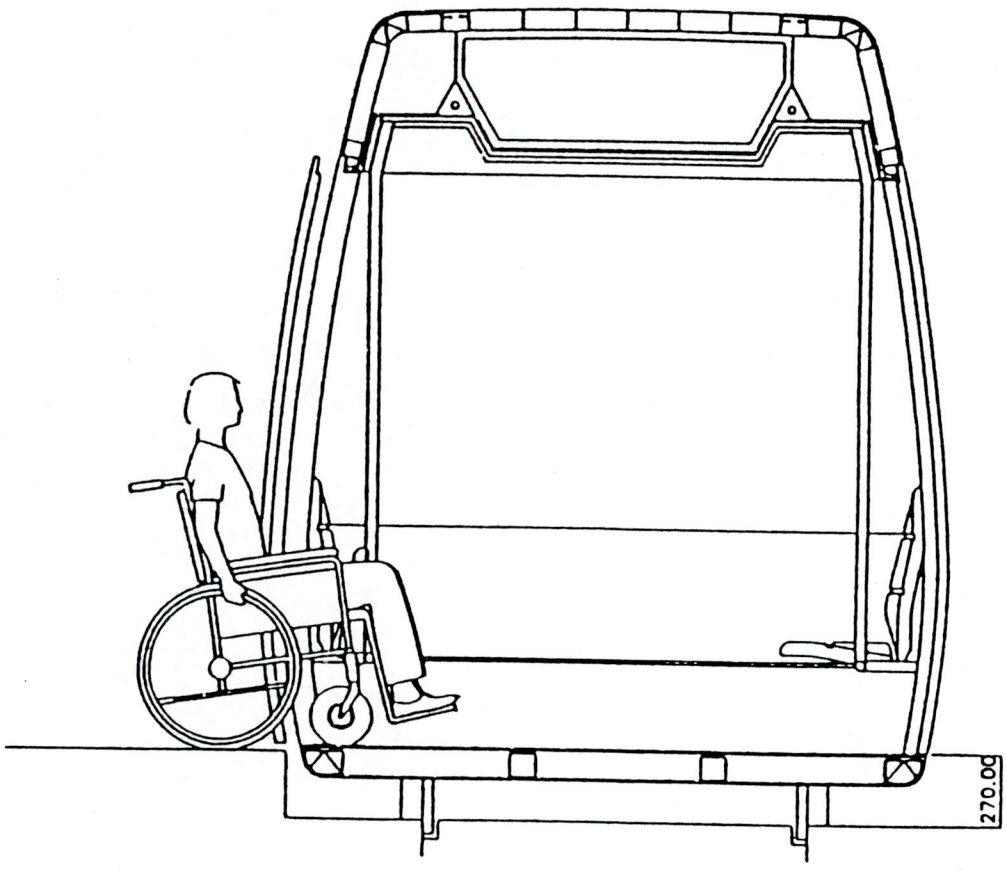
Two fine examples of the new face of public transport. The Fiat Turino 5030 low floor LRV and Kassels new complete low-floor LRV.

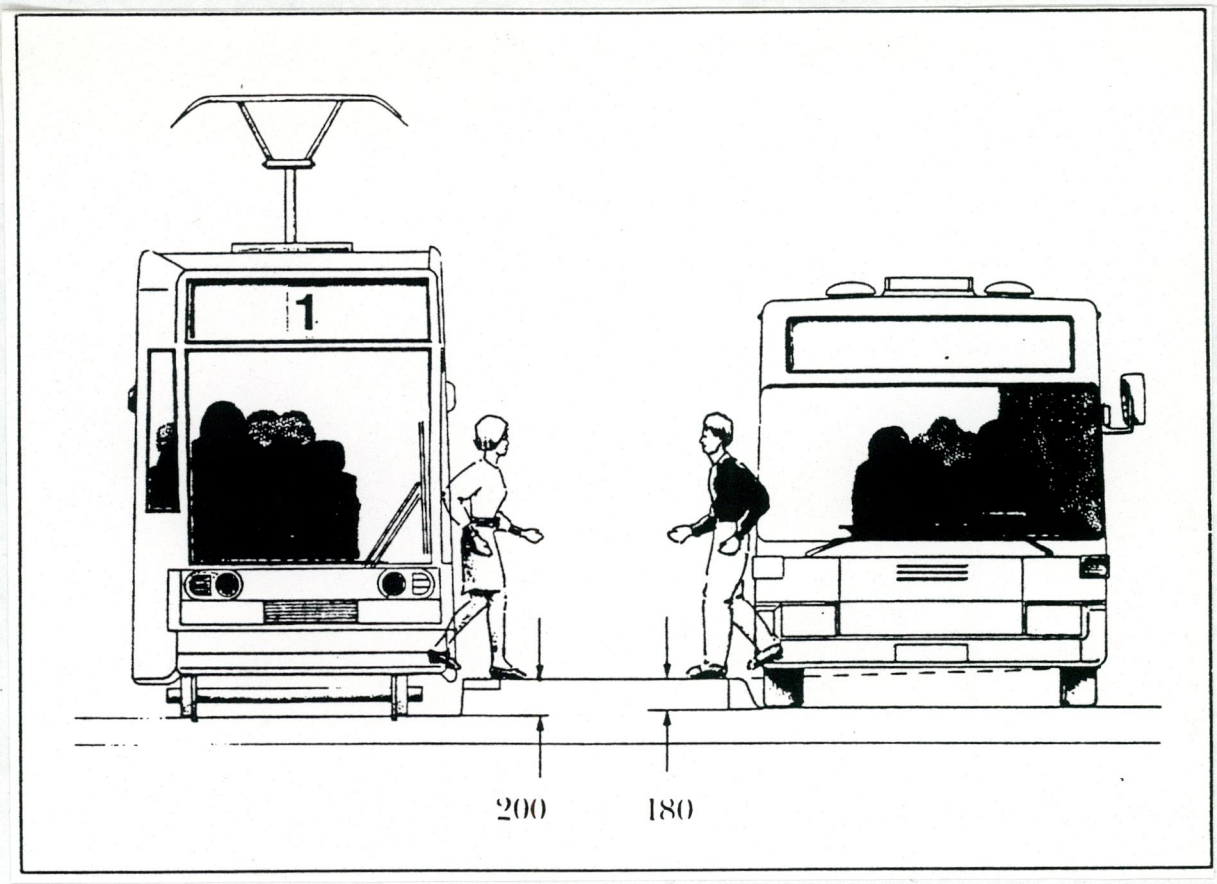
The interior of the Stadtbahn 2000 LRV.

20 tonnes using new lighter wheel sets. Lighter materials also aid weight loss in LRV construction. Usually the LRV is made of steel panels welded for the main shell. The stadtbann 2000 prototypes are bolted aluminium panels. This is a significant development as aluminium has been known to be an awkward material to use and, if damaged, to repair. Aluminium is also considered expensive if used in short production runs. Composite materials are used on the internal walls and roof linings combined with glass fibre insulation. LRV bodies are so designed to minimise travelling noise. As well as the glass fibre in the walls and under the floor the skirting around the vehicle which acts as a safety feature for pedestrians also acts as a noise trap if properly constructed. The insulation used also acts as a thermal insulation as well. As mentioned the vehicles have varying dimensions. These range between 2.1 metres to 2.65 metres wide and 20 metres to 30 metres long. In the development of the LRV, three generation types of vehicles have been categorised. First generation vehicles have a short low floor area, second generation vehicles have a medium low floor area and the third generation (some of which are still at the prototype stage) have a complete low floor. The third generation vehicles combine together the most up to date state-of-the-art technology. These vehicles have advanced three phase- traction systems, regenerative braking, tranverse mounted motors, fully automatic information systems and self monitory systems.

The first trams used DC as their power supply. DC motors were heavy and controlling them was inaccurate. In the sixties the development of a thyristor helped traction control to improve performance of the acceleration and



Light rail design concentrates on providing for the masses including those people with disabilities.



The design of the LRV to bus interchange procedure and the practice in reality.

The Stadtbahn 2000 and the Duewag mock-up are both conceptual light weight low-floor LRVs of the future.

The interior of the Fiat 5000 low-floor LRV.

velocity. Thyristors are small electrical components with properties similar to those of a semi conductor. The difference being that thyristors can handle high power levels. The use of thyristors for motor control is known as the Chopper method. DC chopper control was quickly developed with the introduction of GTO (Gate turn-off) thyristors. This further reduced the weight of a vehicle as well as making cost savings and ensuring reliability. GTO thyristor motor control makes completely smooth acceleration and braking possible.

The latest introduction to this field is AC (alternating current) traction. An AC motor is lighter, has fewer parts and simpler to repair than conventional DC motors. With the new advances in control technology AC traction motors use GTO devices controlled by microprocessors. The AC power supply can also be used for services such as lights, heating, doors etc. Using AC for these services involves the use of electro-static-invertors which replace heavy motor alternators used in DC supply. Electro-static-invertors are very light with no moving parts which again make the latest generation LRV even lighter.

> AC three phase equipment (voltage-source invertor) with combined regenerative and rheostatic brakes. Microcomputer propulsion control unit SiBasic. Independent axle drive by parallel arranged six pole induction motors with squirrel age" (16, P.15).

This is the description of the control and drive arrangement that Siemens give of their new Low-floor LRV in Bochum, Germany. Three phase is a high powered AC supply which can sometimes be found in domestic use but

The old and new trams of Kassel in Germany. Note the asymetrical design of the new LRV. This ensures that passengers exit and enter on the same side.

usually in Industry.

LRVs are not required to have as many brakes as heavy rail vehicles. For instance a heavy rail vehicle may have up to four different types of brakes. LRV brakes are made up of three lighter versions. The first is called dynamic braking. The power is turned off from the motor and put into generating mode. The motor produces electricity from the vehicles kinetic energy which is used differently according to the system used. Rheostatic braking feeds the energy through a series of resisters on the vehicle and it gets lost or used to heat the vehicle. Regenerative braking feeds the electricity into the electric overhead wire supply system and if another vehicle is close by it will receive it. This is again all made possible with the thyristor and microprocessor. Savings in energy costs of 30% have been claimed. The second form of braking on a LRV is used to slow the vehicle to a halt from around 10km/h. These are generally disc brakes which are either hydraulically or pneumatically controlled. The third form is the emergency braking for rapid deceleration. These brakes are called track brakes and use electromagnetic technology.

Transverse mounted motors are another development using the AC power supply. GTO DC chopper controlled motors were mounted longitudinally and involved expensive gears and overcrowding of the bogie. Tranverse mounted motors are smaller and in a more compact position. They require lighter spur gears and with fewer parts are easily repaired.

The use of microprocessors in Light-rail is becoming ever

more popular. Not only is it possible to have the motoring and breaking systems under the control of a logic system but information can be displayed to passengers via screens during transit. The vehicle can also self monitor itself for any failures or malfunctions and immediately alert the driver or maintenance personnel improving an even more reliable system.

The technology behind light rail helps it to compete with the car by offering a service with excellent reliability and a styling and comfort incomparable to a car. Passengers can be led by the sophisticated technological image of light rail which caters for all. Wide doors and low floors aid even the disabled to travel in comfort. Considerations like this open up the field of mobility not only for normal pedestrians but also for the elderly, disabled and Mothers with babies and prams. Using this as a feature attracts a bigger proportion of the population to take advantage of the new public transport. Newly installed light rail systems have always raised the numbers using public transport and will continue to do so.

CHAPTER 4

LIGHT RAIL IN DUBLIN, A DREAM OR A REALITY?

Many books and articles can be found on the destruction of Dublin. They deal with the de-centralisation of the city and how it's grandiose centre of years gone by has become a site of dereliction. Dublin is changing it's image in recent years and more and more worthy new developments are appearing. Pedestrianised streets are becoming familiar to Dubliners, and the centre seems livelier than ever. The one downside to this is the congestion of Dublin at peak hours. During the Christmas rush in 1991 there were many accidents involving road traffic and pedestrians. The resulting deaths and injuries highlighted the dangers of heavy congestion in Dublin. The last few years has seen a significant rise in car numbers.

> The recession of the 1980s dampened the demand for new cars but recent economic growth has again increased the demand witnessed by the fact that new vehicle registration exceeded 40,000 in 1990, compared to 28,000 in 1987. (11, P.2)

The problem in Dublin is that its street network cannot cope with the volume of traffic wishing to enter the city centre at peak periods. The road congestion problem adds to the poor service that the road based public transport provides which in turn encourages more people to use

private transport. On average only 25% of journeys are made by public transport while 58% are made by car.

In January of 1992 an article by Simon Perry declared that Dublin was on the verge of a traffic crisis which could result (if nothing is done) in a complete halt of traffic at peak times. Simon Perry, Professor of Civil Engineering at Trinity College, Dublin has carried out a three year survey on the congestion levels at peak times in the centre Dublin region.

Cars play a role in our culture and more than likely will continue to do so. They offer (providing there's enough road space) mobility, privacy, status and freedom of movement for millions of people throughout the world. The car is for many an essential part of life. Unfortunately, in todays heavily populated cities the car is the cause of much damage and destruction.

The city car is an inefficient user of space. With an average occupancy of 1.5 person it can not compete with a bus or LRV. A LRV with 150 passengers is the equivalent of 100 cars. Cars are energy inefficient and polluting. There is a high accident rate. For one city car 2 car parking spaces are required, police and traffic wardens are needed to ensure the car parks properly, hospitals and fire brigades are always on the ready for emergencies and millions of pounds are spent every year maintaining the roads. It is a very costly, wasteful form of movement. Dublin's centre is choked with cars every day. If the congestion caused by Dublin's cars have not caused enough damage the fuel emissions have. Irish cars are of poor quality and there have been no steps made to control the type of emissions while in Europe, in comparison,

compulsory catalytic converters are installed in every car.

Buses in Dublin are noisy, smelly, uncomfortable, unreliable and expensive. Congestion is their primary enemy and there's nothing they can do about it. Dublin buses are high powered in terms of acceleration and speed but are extremely noisy and polluting. Silencers used are not adequate and the fuel used being ten times cheaper is far dirtier than normal diesel used by cars.

Newer models on offer have improved interiors, wide doors and low floors. Engine manufacturers are in the process of developing methods to reduce fume emissions and at the same time improve the silencing of bus engines. Bus combined with Light Rail offer an excellent and extensive form of public transport. Bus services on their own do not command the same type of respect as rail transport and this is why even guided busways have poor customer perception.

The golden rule in rail-transport is to identify a need for a system before you identify the place. Dublin needs something to relieve the continuing congestion. L.R.T. has proven itself many times over throughout the world. There are now over 300 L.R.T. systems with more under construction and more planned.

"Increasingly wherever urban traffic congestion exists, some form of rail based mass-transit system is seen as the only really effective crowd puller" (13, P.20).

L.R.T. has proven itself to attract car owners to leave their cars behind and commute to work on a reliable and

punctual service. The "Docklands Light Railway" is a good example of this. The docklands of London had until recently been a derelict unfashionable place. In 1980 the new "Dockland Light railway" opened and was designed to carry 22,000 people daily by 1992. By 1990- not only was it carrying 34,000 people daily and being greatly expanded but the original plan for the Jubilee live has been reactivated to serve the same area such was the increased demand.

Even closer to home the DART another rail based mass transit system in Dublin has proved successful in getting car-owners off the road. In the Dart Corridor, which is served by both bus and Dart, 54% of journeys in the morning peak are made by public transport and 37% by car. Outside this corridor, where the sole form of transport is the bus, only 26% of journeys are made by public transport while 58% are by car.

"It is estimated that because of DART 6,000 to 8,000 cars are left at home each day by DART users. To put this in perspective, the Drumcondra road, one of Dublin's busiest arteries, had 3,800 cars per hour cross the Cordon point in a recent census" (11, P4).

The DART system as evidenced is successful in its own right but it offers a limited service and does not provide a free passage through the central core of the city and link railway stations in East and West. The free passage through the city centre is most important and a Light rail system provides a solution to this problem in Dublin. There are many cities similar to Dublin in size and population that have installed light rail systems with outstanding success.

The Docklands light railway is an automated guided transport system. The advantage is that passengers get to sit in the front where the driver usually is. The disadvantage is that it is restricted to a reserved track and cannot be used for street running.

The successful Dart system in Dublin.

> World-Wide, the overwhelming conclusion of all serious studies is that modern L.R.T. (Light Rail Transit) is the best solution for cities with the size and population distribution of Dublin. Master studies have already been carried out on Dublin which have come up with the possible routes for a Light Rail system. (14, P.20)

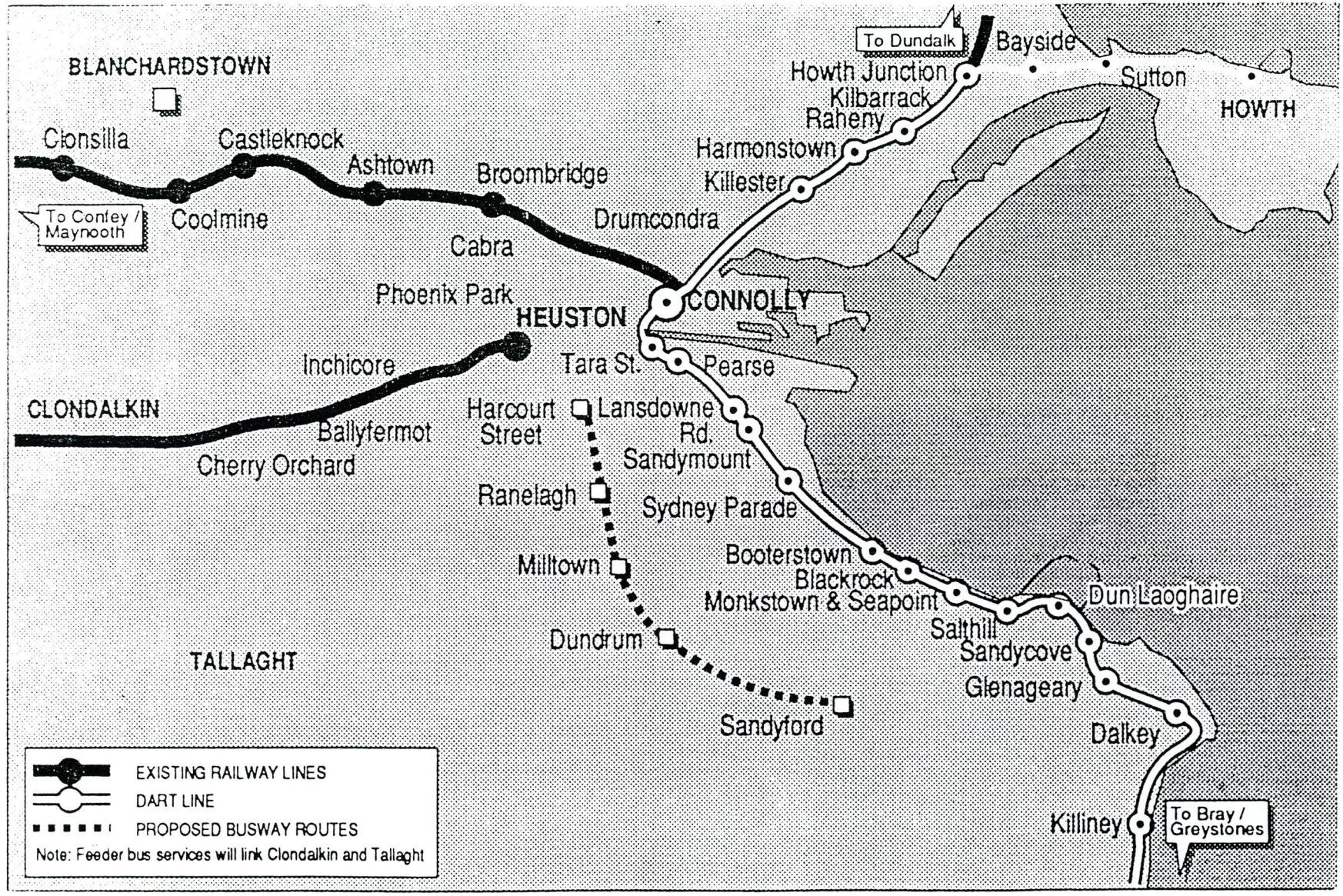
The routes chosen use existing derelict railway lines where possible to cut down on costs and isolating the system until necessary from other traffic. This is one of the most cost effective ways of choosing a route. The following map illustrates the possible L.R.T. routes proposed as a result of a study carried out by Students of Civil Engineering at Trinity College Dublin.

The aim of the route chosen is to pass through the high density areas and commercial areas with the minimum of environmental disturbance. Fortunately the routes have identified unused tracks which can link up to mainline rail routes for interchange also relieving congestion in Dublins two main train stations Connolly and Heuston. The interchange from the LRV to the mainline train could be as simple as getting off the LRV and crossing the platform to board the mainline train. No waiting in a train station and lugging luggage up long platforms. The planning of the routes also allows for further extensions when funds become available . Buses will continue to be used to enhance the service by covering routes not served by the Light Rail system. This may include some buses in the centre but with a difference. These could be free buses for the young and elderly running from shopping areas to other areas. One such bus exists in Dublin today. It is smaller and quieter than the conventional

bus with a more attractive appearance. When a public service is to be enhanced why not enhance every element of it? Normal feeder buses would also run to the Light rail stations.

At time of writing the old Harcourt Street line was opened with plans for a light rail line or if funds are not forthcoming a busway. The costs predicted for construction of a light rail system are £300 million. This is a beginning but it must be carried through into a full light rail system with a co-ordinated traffic management structure to succeed. Left as a busway with no further connections would be futile and without cause. The maps following show the full Light Rail systems in comparison to the Harcourt Street line.

With the introduction of a Light Rail system to Dublin new car parking facilities would be essential. These facilities are called "park and ride" facilities beside the Light rail station. It may include according to many multi-storey car-parking. The initial impression is high-rise multi-storey concrete structures but it could just as well be multi-storey basement parking. A "park and ride" system in Zurich, Switzerland uses parking meters which dispense (after payment of the parking fare) Light rail tickets. For those who use the Light rail system the parking is free. Dublin using the Zurich approach could entice motorists into using the Light Rail system but there is also another lesson to be learnt from the Swiss. Zurich does not have a ban on inner-city driving and therefore suffers from congestion even with a light rail system. In Dublin a ban limiting the hours of inner-city driving with no inner-city parking unless in already instated parking lots inflicting restraint on


BLANCHARDSTOWN
Clonsilla
Castleknock
Ashtown
Broombridge
To Conley / Maynooth
Coolmine
Cabra
Drumcondra
Phoenix Park
HEUSTON
CONNOLLY
Inchicore
Tara St.
Pearse
CLONDALKIN
Ballyfermot
Harcourt Street
Lansdowne Rd.
Cherry Orchard
Sandymount
Ranelagh
Sydney Parade
Milltown
Booterstown
Blackrock
Monkstown & Seapoint
Dun Laoghaire
Dundrum
Salthill
Sandycove
TALLAGHT
Glenageary
Sandyford
Dalkey
Killiney
To Bray / Greystones
To Dundalk
Howth Junction
Kilbarrack
Raheny
Harmonstown
Killester
Bayside
Sutton
HOWTH
EXISTING RAILWAY LINES
DART LINE
PROPOSED BUSWAY ROUTES
Note: Feeder bus services will link Clondalkin and Tallaght

motorists would benefit the overall success of a light rail system. The benefits of no inner-city street car parking are those of space. More space for pedestrians more space for the provision of bicycle lanes and more space for trade and leisure. Limiting the time for inner-city driving would rule out todays rush hours and peak traffic periods offering the alternative transport of light rail to handle the large numbers going to and from work.

The appearance of the power supply and the power supply sub-stations are often unpopular and can take from light rail system. Care must be taken when making these decisions. According to Simon Perry from Trinity College on the appearance of the power supply "modern technology will allow city centre sections to operate without direct power supply- thus obviating overhead cables" (14, P.43)

Power supply substations are often buried in environmentally sensitive areas but in Dublin another solution can be offered. Dublin's centre has a lot of run down derelict buildings which could if carefully done have their fronts re-built in the original Georgian style and have the power supply station in the interior. This would (if possible) solve the problem and give an original image to Dublins Light Rail system. The appearance of the track is similar except its more flexible and not really a problem. Use of various materials between the rails and outside the lines is common. If there is a lot of money polished granite and marble can be used to great effect, as can be seen in some continental schemes such as Grenoble and Nantes in France. The Manchester system still to be opened has used different types of cobblelock brick giving both

visual and textural effects. In Germany, some schemes have taken the "green" approach using grass between the lines. Apart from this approach appearing environmentally friendly it also reduces noise. In street-running lines cars may have a tendency to travel on them if they are not noticeably different from the road. In Dublin the green approach could easily be used offering a cost-effective and Irish-looking system. The reduction of noise using the grass would highlight the difference between the new system and the noisy buses at present. The presence of the grass would also keep pedestrians off the lines especially with our wet climate. This would help save the grass and also help save lives!

Fares are a critical factor in the success of a mass transport system and it must be recognised that public transport in Dublin has one of the lowest subventions in Europe. At approximately 20% it is "tiny" compared with figures as high as 80% in the Netherlands. "The share of EC structural funds in 1991 was dominated by roads with a massive £300 million compared to the £27 million for public transport" (13, P1). In mainland Europe many systems have very relaxed fare control measures as a result of their subventions on public transport. In Dublin the opposite approach would have to be taken to ensure its existence. Tickets for LRVs are usually sold in machines at every stop and in local shops and it has been suggested that these be transferable for use on the bus/train/LRV without undue penalties. Unifying the tickets would have to be stringent and regular with if possible on the spot penalties and fines. If at all possible measures should be taken to lower fares considerably, thus encouraging the Dublin motorist to

avail of the cleaner, safer, time saving and cheaper option. The emphasis on fares is crucial to public opinion and support, without which nothing would succeed.

As so often is the case public property becomes the attraction for vandals and crime. Protection is needed on a Light Rail system against this type of behaviour. Stations and stops should be well lighted at night and ticket machines and other equipment should be made as vandal proof as possible. Security cameras are used if the level of vandalism warrants such measures. Materials for surfaces, both on the LRVs and stations exist which aid easy removal of graffiti. In Amsterdam new colour schemes and a special transparent adhesive material was used to deter vandals. The new colours had the psychological effect of calming people and if vandals did spray or deface a wall the transparent material would be removed and replaced immediately. Strict measures have to be executed if a vandalism problem exists. Experience has shown that if immediate action is not taken the problem escalates radically. Dublin does have a vandalism problem and such measures would probably have to be taken. The solution is the discouragement of vandals by constant security maintenance and improvement. In areas of high vandalism CCTV (close circuit television) offers more comfort for passengers travelling late at night and can also reduce vandalism to equipment. The only problem with CCTV is the expense which has to balance with the costs of vandalism. This leads us nicely onto the costs of a Dublin Light Rail system.

COSTS:

PHASE 1:

Harcourt Street Line (Dundrum - Milltown- St Stephen's Green) - O'Connell Bridge - Broadstone Station - Cabra Junction with a spur to Connolly Station £95 million

PHASE 2: (a)

Tallaght - Milltown (or Heuston) £55 million

PHASE 2: (b)

O'Connell Street - Heuston £35 million

According to Simon Perry, "these approximate costs include all engineering works, full electrification and rolling stock" (13, P.19).

As can be seen the costs even for a small system are high but are not that high when put in comparison with heavy rail costs or even road development costs. The cost of an underground system would be ten times higher if not more. In the case of Dublin, in particular, financing a Light Rail project would be a problem which would need very careful consideration. Light Rail schemes have explored many new methods for raising transport finance and maybe, by using some of these ideas, Dublin could have a Light Rail system up and running. These ideas are being tried and tested throughout the world with the intended aim of lowering the cost for the tax payer.

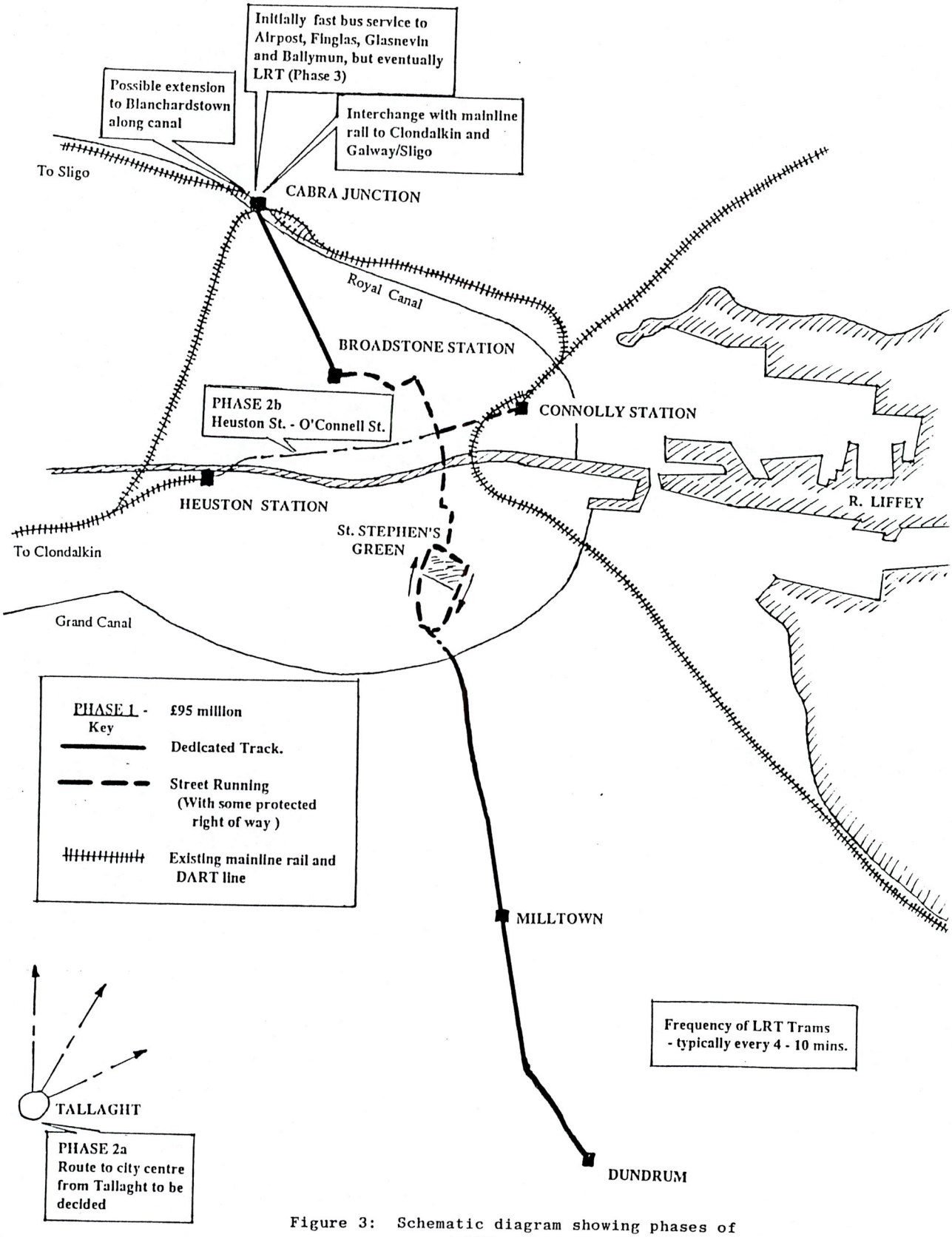


Figure 3: Schematic diagram showing phases of a proposed LRT system for Dublin.

This is of special interest to to an Irish Government which is continually getting deeper and deeper into debt. Of course, public funding is inevitable but to what extent is important.

Government funding is essential and forms usually the bulk of the finance. Raising this finance comes from all angles depending on the nature of the government. Government attitudes towards funding public transport differ depending on the importance a particular Government put on it. European Governments are increasing contributions towards Light Rail in a response to environmental issues. Roads, cars and traffic accidents are only now being recognised as costly expenses to the tax payer. This is why in Manchester, San Jose and Sacramento, California portions of their Light Rail schemes where financed with rediverted road funds.

Road developments in America are often cancelled and funds transferred for public transport. Another source of funding can come when bus services can be reduced due to a Light Rail development and the funding transferred. International funds are always readily available as well with the right approach.

Apart from Government funding transport authorities now adopt new organisational methods which can reduce overall costs. One particular example of this is not particularly original but still used. This example is where the public transport authority builds and owns the infrastructure - the track, traction supply and overhead wire etc. of a Light Rail system but then leases the infrastructure to an operator. This system was used as

far back as 1807 when Benjamin French paid £20 for the right to run a horse drawn passenger carriage on the line laid down between Oystermouth and Swansea. Modern leasing costs are considerably more.

A new organisational method which transport bodies are now using is called a turnkey contract. Here the transport body lets the contract of a new system to a consortium of equipment manufacturers and civil engineers. It can also include property developers. As railway equipment manufacturers are merging into supra-national conglomerates they have the capability to produce most of the equipment for a Light Rail system complete. With the turnkey system they are allowed to offer their products in a co-ordinated manner. This package deal of skills and the strengths of consortium partners can result in a new Light Rail system at lower costs. Some turnkey leasing deals also end up with better services included such as on-going maintenance services and facilities.

New public transport developments such as Light Rail invariably result in increased property values both private and commercial in the vicinity. A perhaps known example of this can be seen with property near the underground. Rents and property values are almost doubled. In Dublin it has been estimated that with the introduction of the DART system in 1984 a total of £40 million was added to the value of properties along and rear of the line. This increase in value is entirely due to the expenditure of Irish Rail and is of great financial benefit to the property owners. Tax systems have been developed in the US which can harness some of this gain for the benefit of public transport. The term

used is called value recapture.

As property values rise in the vicinity of a Light Rail so does the value of the line increase. Light Rail lines cut through the heart of a city and it's suburbs. The whole length of a Light Rail system has a full right of way offering great opportunities for many service routes including electricity and telecom. Light Rail systems can take advantage of this and make it a commercial reality.

Apart from charging for rail space new concepts have been developed to charge for road space which after all is provided free for no apparent reason. Garret Fitzgerald, former Irish Prime Minister, in a Dail speech had this to say about charging for road space:

> The reason public transport has declined is that the private sector is subsidised to an enormous extent. Road space is given free to private motorists, usually one person in a car, at a time when that road space has enormous value. They get it free. With that enormous subsidy from the community to them, naturally the facility is over used. If champagne were free it would be over-drunk. If a valuable product is made available free of charge people will use it and abuse it to the point of the grossest economic distortion (1, P221).

There are many concepts for road pricing and these have differing objectives. There are two main objectives, one is to reduce traffic congestion and the other is to raise revenue. A mix of both is also another option.

To reduce congestion traffic management is absolutely necessary. This can be done by imposing time limits on motorists on certain roads or streets in a city centre. Penalties are imposed if motorists do not obey these time limits. Another system to reduce congestion can involve charging motorists to enter the city centre especially at peak times. Taxes can also be charged to motorists for environmental costs to society caused by traffic congestion and traffic pollution. This would mean high capacity car engines would be taxed more heavily than low capacity. This might bring about the introduction of more energy efficient cars. In Dublin cars are almost 30 years out of date. In mainland Europe tests are rigorously carried out on all cars to maintain the quality of vehicles on the road. In Europe and the United States all cars are fitted with catalytic converters. All the methods mentioned can be used to raise finance for better public transport systems and a cleaner environment for all. Dublin could use these systems to fund their own Light Rail system as well as improve their environmental problems. A Light Rail system should be installed in Dublin as soon as possible to avoid worsening congestion problems in the future.

Light rail on its own would not solve the problem of congestion. It would make it more solvable. To build a Light rail system now would involve a complete upheaval of life in Dublin. The re-opening of the Harcourt line is only a beginning to the revolution that is needed to solve Dublin's transport problems. More emphasis is needed on traffic management and the provision of proper transport services to those more deprived areas in Dublin. More respect is needed for our cities social

space and environment. A complete pedestrianisation of the inner city centre in Dublin and the creation of substitute social centres in Dublin with pedestrianisation and good transport services are suggested steps for an optimistic future.

CHAPTER 5

THE ENVIRONMENT AND LIGHT RAIL

Dublin is filthy! Tourists from all over the world complain about the filth! A few years ago smog problems in the centre got so bad that action *had* to be taken! smokeless fuel is now the city's fuel to prevent the smog problem worsening. With traffic congestion numbers rising in Dublin a petrochemical smog rests permanently above the city. The principle villain responsible for the smog is the car. The following are the immediate and long term effects of road traffic.

> According to the American Lung Association, the US National Health bill attributable to air pollution has risen to $40 billion per year (1, P.62).

The chemicals emitted into the atmosphere from road traffic are now having obvious effects on our health. During combustion carbon monoxide, hydrocarbons, nitrogen oxides, sulphur dioxide and lead are all the chemicals that can have immediate effects in our health. Carbon Monoxide (CO) reduces the oxygen carrying efficiency in blood which can affect those with coronary artery disease. CO contributes to petrochemical smog.

Hydrocarbons (HC) have immediate effects on the eyes and throat. They result from the incomplete combustion of carbon based fuels. Benzine, a form of Hydrocarbon has been associated with the development of Leukaemia. HC also adds to petrochemical smog.

Nitrogen Oxides (NOx) are produced from both petrol and diesel engines. They make up the elements of petrochemical smog. NOx has detrimental effects on aquatic ecosystems such as rivers and lakes. Forests throughout Europe have suffered substantial damage due to acid rain. NOx can cause respiratory diseases and some evidence suggests the risk of cancer from the exposure of NOx.

Sulphur Dioxide (SO_2) is more associated with the burning of fossil fuels than from car emissions. Car emissions of SO_2 are small but significant. SO_2 also causes acid rain and respiratory diseases.

Lead is a fuel additive in petrol but if retained in the body in large concentrations can cause sever brain damage especially to children. There can also be damage to the nervous system, the liver and kidneys. Lead is now slowly disappearing from the petrol tank. Unleaded petrol is available and new regulations have reduced lead emissions in Britain from 7,500 tonnes in 1980 to 3,100 tonnes in 1988.

The long term effects of road traffic is the ever-growing greenhouse effect. Carbon Dioxide (Co_2) occurs naturally but it is also produced by the combustion of petrol and diesel. CO_2 is colourless and odourless and is harmless to man normally. (It is dangerous in confined spaces). CO_2 acts in a heat retentive way. Increases of CO_2 on a global scale produce a noticeable greenhouse effect. If Global warming accelerates with the greenhouse effect the sea level will rise wit the melting of glaciers and flood coastal areas. There will be a complete change in the

world' ecosystem and man may face extinction.

Figures show that transport is the third larger source of CO_2 in Britain. CO_2 contributes around 50% of the total greenhouse effect.

There are also other effects due to road pollution apart from the above mentioned. In Dublin many buildings of a prestigious nature have been covered with scaffolding for months. When the scaffolding has come down they stand out from their severely blackened neighbours as freshly scrubbed buildings. Acid rain, even mild acid rain, can cause sever blackening of building sand damage to blockwork. Damage to historic buildings and statues present a serious danger to our heritage. Every year millions are spent in restoration and preservation revealing another expense due to road traffic.

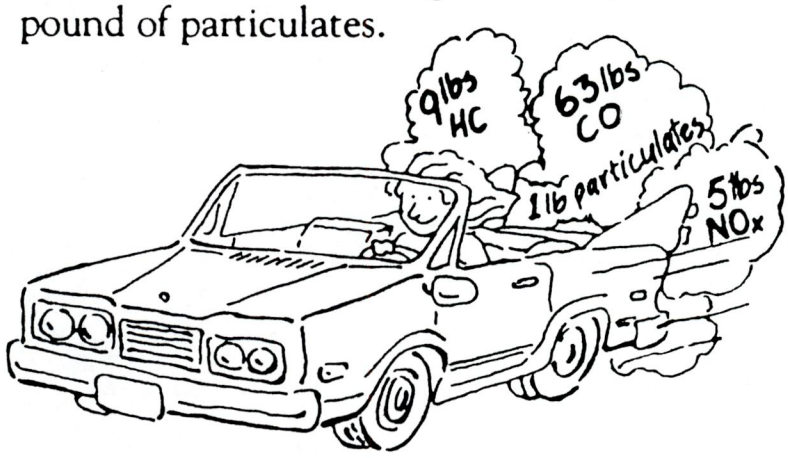
Probably the most immediately recognisable environmental effect to be encountered from road traffic is noise. To give an indication of just how loud buses and lorries are the average noise in a working office is 65 dBA, the average noise level of a bus or lorry is 90 dBA. Because the dBA unit is a logarithmic unit an increase of 10 dBA means the noise has become twice as loud. Therefore a lorry is 9 times louder than a normal conversation. A LRV is 5 dBA quieter than cars and 15 dBA less than trucks or buses. Another interesting point about noise is the variety of noises acceptable. Surveys have found that in the case of rail noise which is characterised by short periods of noise followed by longer periods of silence people have a greater tolerance to it compared to the continuous levels of road traffic noise.

Cars require a lot of space. In Light Rail terms this is wasted space. It has been reported that in some U.S. cities up to one third of urban land is taken up by car parks or garage space. Cars are very inefficient users of space. The following posters are very to the point.

A LRV is over 25 times more energy efficient per passenger kilometre than a car. Roads are visually unpleasant especially elevated roads. Multi-storey car parks can not be described as picturesque. Demolishing old buildings for a new wider road is a crime. Light Rail is so flexible it passes through the heart of a city with noticeably little disruption. An if all this wasn't enough public transport has proven itself over and over again that it is safer than road travel. In 1989 5,373 people were killed in road accidents in Britain. This seems to be taken as a fact of life. Figures from the Berne transport authority, SVB for 1990 show that there were 60% more accidents per million passenger journeys for the bus in comparison to the rate for the tram.

Think Clean Air

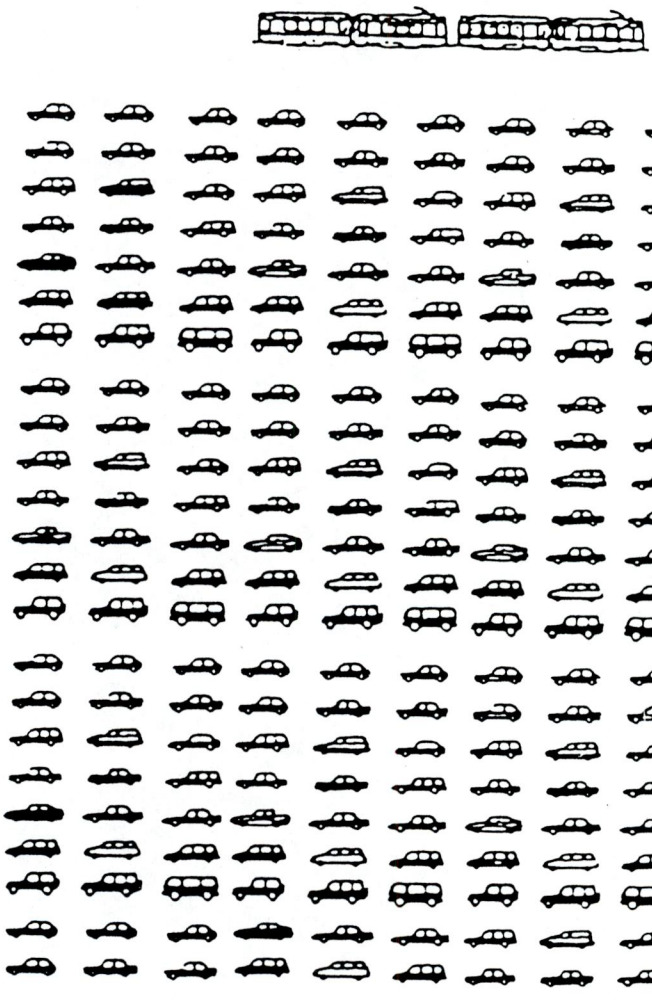
When just one commuter leaves the car in the garage and uses Tri-Met for a year, our lungs and planet are spared nine pounds of hydrocarbons, 63 pounds of carbon monoxide, five pounds of nitrogen oxides, and one pound of particulates.



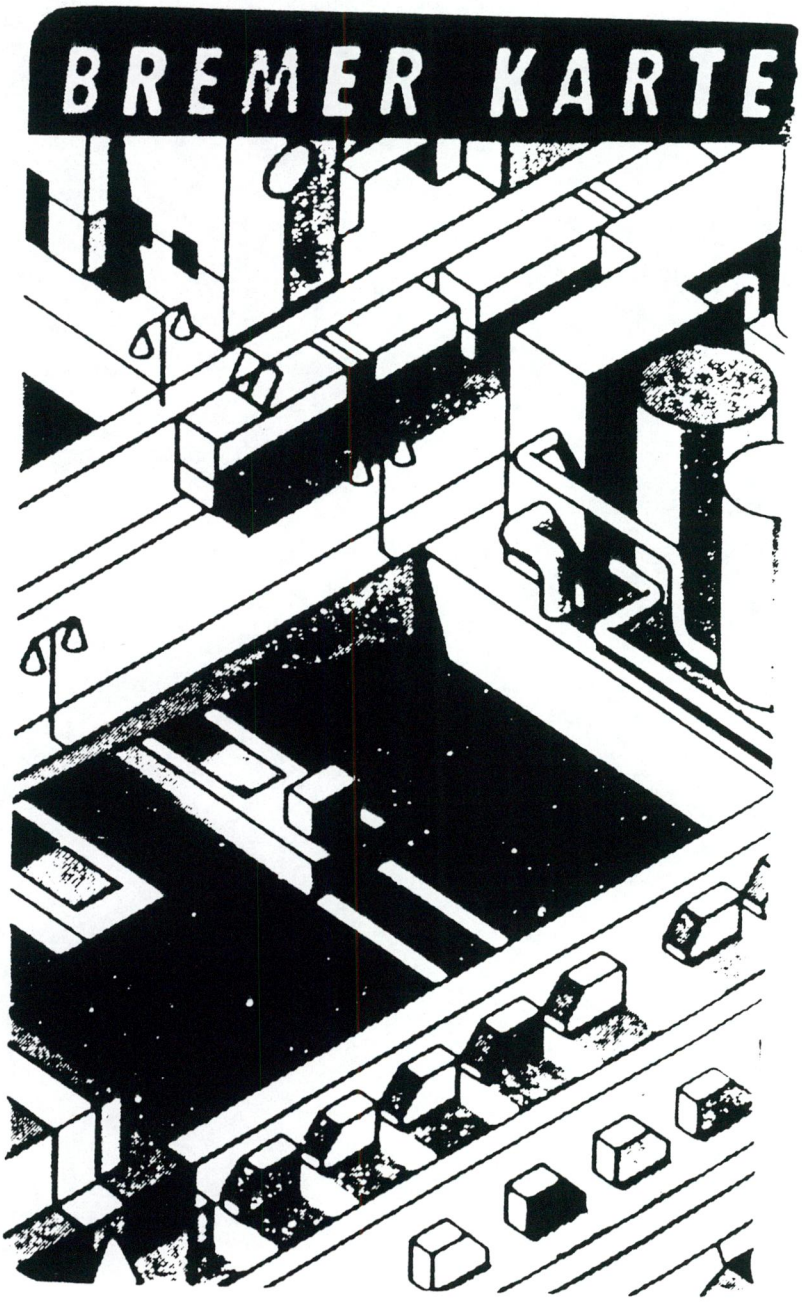
Each weekday Tri-Met keeps 100,000 tailpipes off our roads—**that's enough cars to fill I-5 from Portland to Eugene and back!**

TRI-MET

300 Personen fahren zur Arbeit



Belegungsgrad Auto: 1,2 Personen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CHAPTER 6

TAKING EXAMPLE FROM OTHERS

In 1883 the first electric tram in these Islands passed along the scenic coastline between Portrush and Bushmills in County Antrim. The technology of the electric tram reached Ireland within two years of the world's first electric tramway. Now twenty years after the emergence of Light Rail Ireland seems blind to the influence it is having on cities around the world. To open your eyes a little here are three examples of new Light Rail systems in Grenoble, Nantes and Manchester. It must also be pointed out that there are more than 300 Light Rail systems operating world wide with new projects being developed as we speak.

GRENOBLE: (France)

The Grenoble Light Rail system opened in 1987. It is without doubt one of the most attractive systems in the world. Its overall design is totally comprehensive introducing high levels of sophistication to every aspect of the system. The following photographs show just some of it's remarkable features. It was the first system to introduce low floor LRVs which were designed by GEC Alsthom. The LRVs glide smoothly and quietly through the streets. Irish visitors to Grenoble cannot compare the performance of the low-floor LRVs to their own DART trains. The LRVs in Grenoble with a noise level of 75 dbA is significantly lower than other road traffic. Apart from the performance of the vehicles and their exemplary styling the Grenoble system has high quality

Grenoble, probably the most impressive example of light rail at work. Traffic is excluded from the city centre using remote control bollards which when required can disappear underground.

street furniture designed by top French Architects, very attractive rails and pathways using top quality materials and a well planned route.

Introducing the system was expensive and difficult due to the narrow streets and old buildings but now the city is completely transformed into by what the French term a model city. Leading architects are based in Grenoble which is beside Mt Blanc the venue for the next winter Olympics. The old architecture is well preserved and well-planned. French modern architecture continues to rise in a city where not only is there a Light Rail system but a very space-age looking Sky-lift for crossing a river.

The Light Rail system is a great success with 15% of passengers being ex-car users who never used a bus. The system found that demand surpassed their prediction and in 1991 they introduced three more new LRVs. There are currently 88,000 journeys daily.

> As can be seen in Grenoble, a well designed street running Light Rail system, in conjunction with pedestrianisation and attention to improvement of the streetscape can greatly add to the quality of city life (1, P47).

NANTES: (France)

Nantes has a long history associated with trams. In 1826 a horse drawn tram system was opened in Nantes. The last electric tram ran in Nantes in 1958 27 years later a new Light Rail system opened in 1985. The 10.6km line is laid entirely on reserved right of way principally at the side or in the middle of wide boulevards through the city. There are 28 high floor articulated LRVs but the stops are only pavement high so internal steps were included. New low-floor vehicles are being ordered and the existing vehicles being retro-fitted with low floor centre section.

The system was intended by the French Government to set the standards for all other light rail developments but with the rapid development of Light Rail technology it has been surpassed by Grenoble.

The notable features are its well designed shelters and steps and its neat black unobtrusive overhead wiring arrangements. It typifies a well integrated system in to city centre with substantial tree growth and cultivation. The following photographs show Light Rail integration with a city. The system is another success with 19.5 million passenger journeys in 1989.

The profitable simple Nantes approach. Note the simple overhead wire system.

MANCHESTER:

Due to open at the end of 1991 it was delayed by a problem in the construction of a bridge. It is now due to open in 1992. Everything is finished, the track, the platforms and the trams. When it does open it will be the first classic Light Rail system in Britain.

The system called the metrolink is 30.1 km and takes over two existing British rail suburban rail services. There is a 2.5 km street running section through the centre of the city.

A design-build-operate-maintain contract with a radical blend of public and private finance was used to get Manchester's metrolink project underway. Publications were made available to the public to gain a response to the project. Even though the system will use high floor LRVs special design considerations were made on the platforms. The platforms are a special high platform which allows the elderly and people with disabilities easy access. In pre-metrolink publications it was pointed out that the system was going to encourage everyone to travel on public transport in comfort. Artistic impressions of the metrolink were also made available. Witnesses of the Manchester metrolink have all agreed that it has transformed the city's image.

To give an idea of the construction that was undertaken in Manchester inner city centre here is a small description: A double track was laid through the centre which was laid on a concrete track bed set into the roadway. The rails were encased by a polymer which was

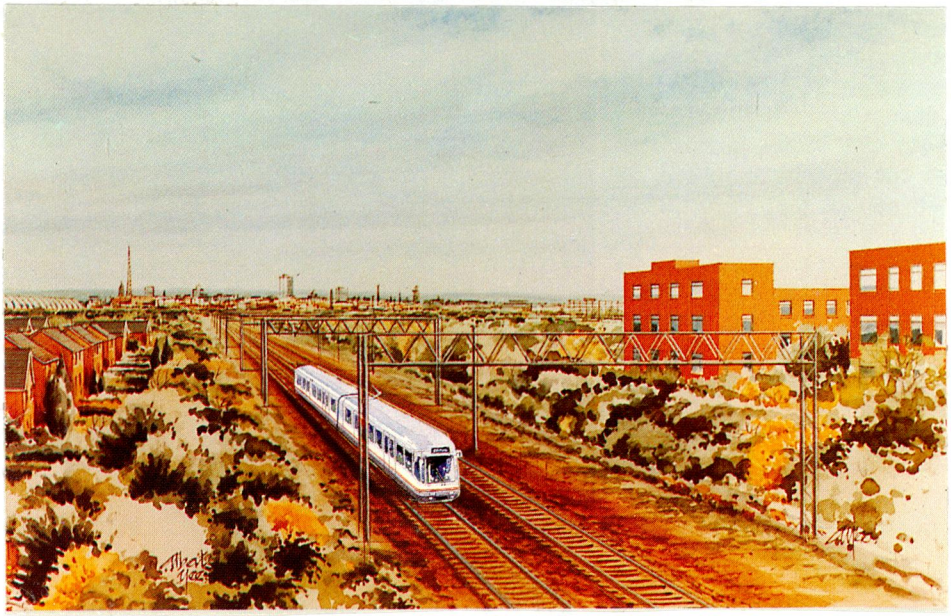
The proposed new image of Manchester.

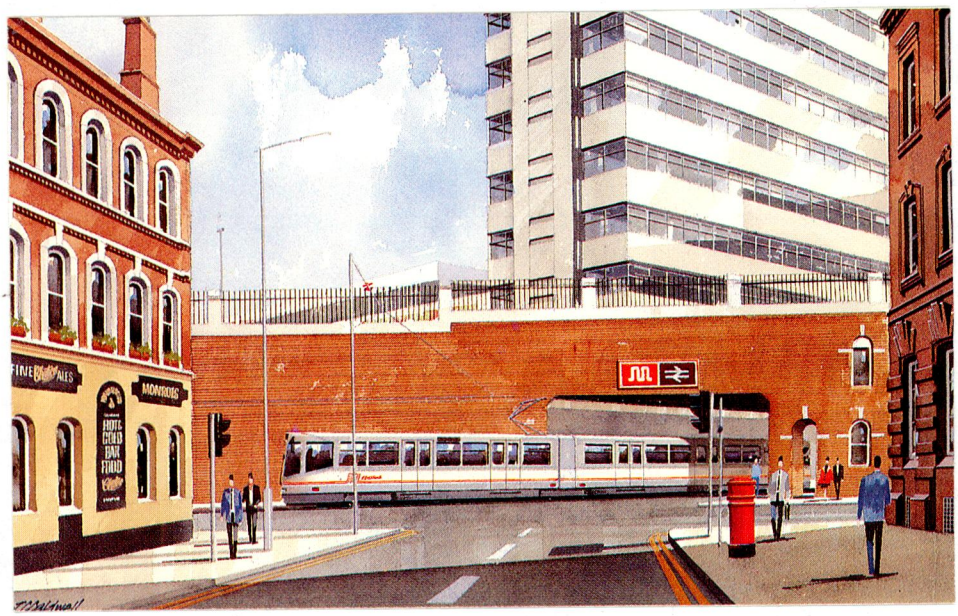
poured around the rail. The polymer controls noise and vibrations. It also insulates the rail which carries traction currents back to the new sub-stations.

Collection of any stray currents was achieved by a welded mesh in the track bed, which is separately connected to the substations where currents are continuously monitored.

This is the type of work that Dublin's city centre would have to undertake if it goes ahead with a Light Rail system.

In Britain, Light Rail construction is underway, with over 50 schemes at various stages, from the purely conceptual, to work in progress. The ever-proliferating amount of schemes shows that Light Rail has filled a real gap in transportation, that between the bus and the metro. Only a decade old Light rail has now emerged as the preferred mass transit solution for medium sized cities around the world.





The flexibility of Manchester Light Rail System.

nge" underneath Manchester Piccadilly Rail roviding a direct service to Victoria Station.

w on-street stations will be built at Piccadilly Market Street/High Street and St. Peter's iving easy access to the region's business, al and recreational centres. New Metrolink will also be built at Piccadilly and Victoria and at G-Mex.

isting stations between Bury and Altrincham ges and the City Centre will be refurbished specification making them more accessible ctive. This will improve the service offered to ng rail customers and encourage greater use stem.

million passenger journeys are made each these routes, this should increase to ten hen Metrolink is introduced.

Network diagram above shows how the

Metrolink's routes through the City Centre.

Profiled platforms will give level access to the front doors of trains

TRANSPORT FOR EVERYONE

he whole system accessible to everyone is a The new station platforms will have gently amps to make boarding easier for the elderly, with children and pushchairs or passengers using wheelchairs.

The existing stations will be refurbished additional ramps or lifts to make th accessible.

THE STATIONS

ept of Metrolink is that it should enhance the ent which it is designed to serve. The will be designed in sympathy with their ngs – simple, functional but elegant.

new stations in the City Centre will allow rs easy access to the Metrolink vehicles. stations have been designed to complement the best of Manchester's architecture bo new. Some will have high platforms prov access to all doors. Those in the busiest like Market Street and St. Peter's Square, special new profiled design to give level acc front door of the train and easy access fro of the platform.

CONCLUSION

Light Rail continues to develop with new and innovative approaches to transport problems. As a people mover system through the cities it is very effective and positive. It has a restraining element to it but its aim is to offer greater freedom and quality in urban life. By restraining, that is to say to reduce the over-indulgence that the car industry provides for the masses. It is important to realise that as with everything, being over-excessive leads to unforeseen problems. Over-use of the car in now exhibiting problems which in 1899 were completely unforeseen.

Dublin is suffering as a place of human life and energy. It does not offer a good quality of life. On a recent journey to the North side of the city on the DART system I passed one depressing housing estate after another. The noise of Industry and traffic was ever-present. The landscapes and parks were bleak and grey. There was a decrepid, joyless feeling and a smell of filth and dirt. The suburbs of Dublin offer very little to the quality of everyday life. The city centre is trying to revive itself. The people know that it has something to offer. Its a place to meet, to socialise, shop, educate, entertain, sight-see and most of all to enjoy life. The suburbs just by the mere words do not and could not offer what a city centre can. Dublin city centre is fighting a losing battle with it's traffic. It is a pity if a city with such potential would completely die. Dublin is not the only city in the modern day world suffering in the same way. Its a modern urban day reality which affects cities throughout the world. Cities which have chosen

Light Rail have improved their chances for change. The 20th Century society has lost sight of the importance of the city centre in our lives. Light Rail brings about a new awareness to the quality of life that can be achieved in the Urban scene. I believe the introduction of a Light Rail system in Dublin would not only reduce traffic congestion in the city centre and improve the environmental conditions we live in but also improve the quality of life for people in the suburbs. Light Rail is something to be enjoyed. It allows people to do things at their own pace, fast or slow.

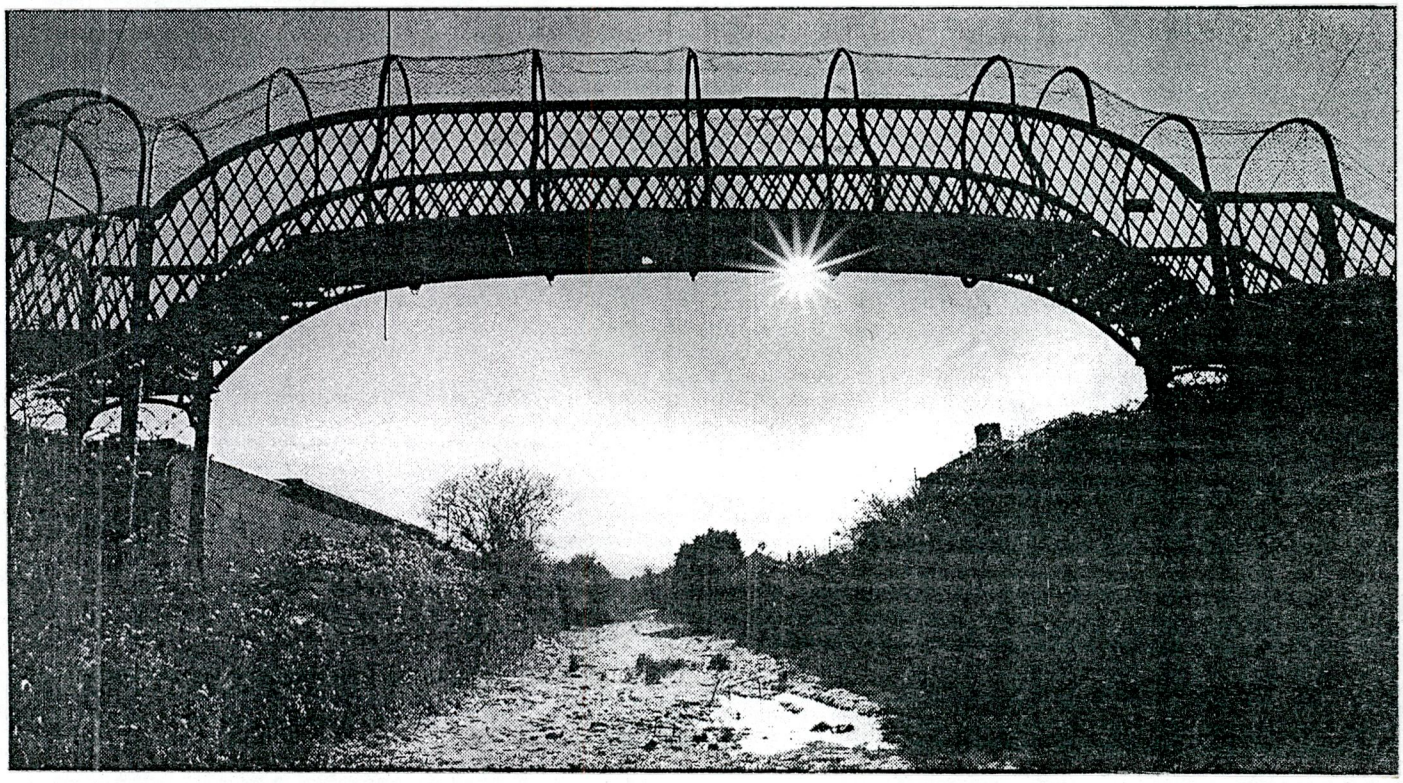
With the recent opening of the Harcourt Street line it seems plans are already made for light rail, although a preliminary busway is to run on the line before there is a complete go ahead for light rail. The decision to open the Harcourt Street line must be welcomed but the development should not stop there. In the choice of the location of future lines very careful consideration should be given to the viability of such lines. If a line is badly situated it is very expensive to remove and relocate. The suburban areas with high density populations are prime targets for a successful line. A route to the airport is another choice to be made in Dublin this route would clear away a lot of congestion problems both at the airport and the city centre, as seen in many other cities using Light Rail systems.

Light Rail has to be seen as not only another tram system but a means of structuring the way we move about a city. Dublin city centre is relatively small containing many fine streets. Road traffic spoils the beauty, the space and the image of such streets. With Light Rail a new lists of priorities can be laid down and enforced to

change this. Road traffic can be banned during daylight hours in the city centre and priority given to the pedestrian. The pedestrian has too little importance in our traffic ruled cities. The pedestrian is the appreciator, the observer, and the life of any city street. Road traffic infringes on the freedom of pedestrians. Light rail does not, has not and will not. As you know trams (LRVs) use a line of sight driving system and give priority to pedestrians.

Offering a pedestrian complete freedom to walk safely in the city centre is an attractive attribute to any city. Making the city attractive is important for not only the citizens but for tourists as well. Tourism is an essential ingredient to any cities life-style. Unfortunately Dublin has received some bad press over the years from dissatisfied visitors. Light Rail would boost tourism in Dublin. The city could even make it a selling point as so many other cities have done.

Light rail makes clear the importance of the movement of every citizen which as yet road transport fails to do and it is not until Dublin experiences light rail will it see the importance and respect to which every citizen deserves. As an option for a future transport system it is a must.



The old Harcourt Street Line, the Light Rail Line of the future. Hopefully in a few years this dull picture will change into a colourful spectacle of movement.

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