PART I

HISTORICAL DEVELOPMENT

Chapter 1

PUBLIC TRANSPORTATION AND THE CITY

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The city is the hallmark of a civilization. History is full of exploits of battle, discovery, endurance, and victory over the hostility of nature that took place away from cities and urban places. Yet the true progress of humankind is measured by the felicity of the good life; the excitement of great adventures of the mind; the glow of creativity as expressed in music, poetry, and the graphic arts; the formulation of law to protect people from one another and from overly rapacious government; the fellowship of society; and the greater productivity possible from the sharing of talents and skills—such progress is apparently possible only in an urban place.

IN THE BEGINNING: THE CITY

Cities as permanent places of habitation are a product of the first great turning point reached by humankind: the agricultural revolution. Early human beings hunted and gathered locally available foodstuffs and other materials necessary for survival. Even a rich area was soon depleted of animals fit for food or of berries or other wild edibles, which meant that the human residents were forced to move on to other places not yet fully exploited in order to survive. When we learned how to plant crops and domesticate certain animals, we could exchange the role of nomads for that of urban dwellers.

The agricultural revolution by itself was not sufficient to cause the development of major urban centers. The growth, development, and shaping of cities in their modern form is closely related to the availability of transportation.

To begin with, in order to grow to any great size, an urban place requires an external transportation system to bring in necessary food and materials, because urban dwellers tend to be specialists in tasks other than raising food and gathering supplies. Since the beginning of larger-scale urbanization, urban residents necessarily have traded the fruits of their specialization for the surpluses of foodstuffs and supplies brought in from other areas. How large a population of specialists a city may support is, therefore, directly related to the size of the hinterland that an urban place may tap for its food and supplies.

In ancient times, before mechanical means of transportation or engineered transportation improvements were possible, land travel was difficult and slow. The capacity to move goods over land was limited by lack of carrying capacity. The use of pack animals bearing only small loads was common. Wheeled vehicles were scarce because they were expensive and troublesome to make; roads were rough and difficult to use if they existed at all. With capital always scarce, primitive societies simply could not afford to take the time and effort—nor were the skills available. To provide good land transportation. On the other hand, rivers, lakes, streams, and the oceans provided natural means of transportation that enabled large quantities of goods to be moved, in early times on simple rafts and later by means of more sophisticated vessels. Urban places located on waterways thus had the potential to grow because their available hinterland was larger than that of an urban location away from water. For example, a budding community located in a river basin, especially if it was downstream, was in an excellent position to grow; the closer to the mouth of a river, the larger the hinterland that might be tapped for food and other supplies necessary to support life. In an age without mechanical transportation, heavy materials could be moved easily downstream with only the current. Cities located at the mouth of a river at the sea had the potential of supporting a large population; they not only had access to the surplus of the entire river basin upstream, but could also trade with other seashore cities.

Because of the importance of water transportation to help supply cities with sustenance, even today most of the major cities of the world are located on waterways or on large lakes. With the advent of mechanization, nonwaterside locations also became attractive for modern urban locations, because railroads, highways, pipelines, and airplanes can move the supplies and foodstuffs necessary to support a large population. Water transportation is no longer a prerequisite for the growth of a large city, although the momentum of an early start has allowed water-oriented cities to continue growing, and most major U.S. cities are located on water.

THE GENESIS OF URBAN MASS TRANSPORTATION: THE AGE OF THE OMNIBUS

As long as an urban area was small in size, residents could make their way about on foot and goods could be carried or moved with relative ease by simple and even crude means of transport. With increased city size, however, getting about on foot became a different proposition, greatly limiting the size of internal markets for goods and services, and making difficult the process of gathering a labor force from throughout the whole of the community.

If a city grows large enough, limitations on the means of internal circulation of people, as well as goods, can have a decided dampening effect on urban growth and development. On the other hand, given good external and internal transportation, growth is affected not only by transportation, but by other economic, social, cultural, and geographic factors. Furthermore, over time, the means of internal transportation can actually help to shape the growth of an urban area.

The idea of providing a land-based public conveyance for passengers within an urban area can be dated back at least 300 years. In 1662, as a reflection of urban growth in the city, the eminent and practical French mathematician Pascal began to operate a horse-drawn wagon line carrying passengers in Paris. In the beginning the service was free of charge. Pascal's brainchild became popular and it was quite the rage for people of quality, as well as others of less elegant status, to utilize the new means of urban transportation. When a fare was finally charged, after the period of free operation, the public rebelled and patronage fell off so sharply that Pascal was forced to quit the transportation business.

With the industrial revolution of the eighteenth century came both the rapid growth of cities and the separation of home and workplace. Workers no longer possessed the tools of a trade that could be plied at home; they worked at machines in factories, both of which belonged to someone else. The need to travel regularly between home and factory made the now familiar peak-hour trip a common feature of urban life. As the leader in industrialization, London, by the early 1800s, was awash with a tidal wave of humanity at the beginning and end of each working day as tens of thousands of working people, from the highest position to the lowest, crowded the streets, walking back and forth to work.

The lure of the suburbs began to attract upper-middle-class London merchants by 1750. Business had to be conducted in the center of the city where the exchange of information was not only crucial but possible in the face-to-face contact that was mandatory in an age innocent of modern communication. You did not have to live in the city, however, if you could afford horses and a carriage. A religious revival in the Anglican church preached the need to take the children out and away from the noise and dirt of the city. With ample means to pay for the necessary transportation, the London upper middle class began to leave the city for the quiet, hearty, and fresh air of the areas lying 4 or 5 mi outside of it. The trend caught on, as more common people aped their wealthier fellow citizens. During the nineteenth century, as transport improved, the trickle of persons moving to the suburbs became a strong flow.

Mass transportation finally came to the British capital in 1829, when an enterprising coach builder named George Shillibeer introduced the first modern omnibus. The omnibus was a high-wheeled wagonlike vehicle, with the entrance at the rear. Seats inside, for perhaps as many as 18 to 20 passengers, were arranged longitudinally along the walls so that the passengers sat facing one another. The rear

entrance, with a step down to the ground level, made it possible to enter and exit with relative ease compared to a stagecoach. Regular pickup and drop-off of passengers was provided and the vehicle was operated along a regular route from Paddington Green to the Bank. Although Shillibeer's company did not stay in business very long, the idea of the omnibus caught on; soon these vehicles crowded the streets of the great cities of the world, beginning with London and gaining popularity in Paris, New York, and elsewhere during the 1830s.

Omnibuses had few amenities for the passengers apart from what was usually a fancy and brightly painted exterior. There was, of course, no heat in cold weather and passengers had to be content with straw piled on the floor in which to snuggle their feet. If the vehicles lacked amenities, there was no lack of color and vigor in their operation. Omnibus drivers were known for their large vocabulary of profanity as they questioned the heritage and other habits of fellow drivers in mad dashes to the curb to pick up potential passengers. Accidents were common as the number of omnibuses grew along with the rise of other street traffic. Crowding was soon so bad in London that, to provide greater mass transportation capacity, the double-decked omnibus became a common feature, as a forerunner of the present-day, double-decker bus of London.

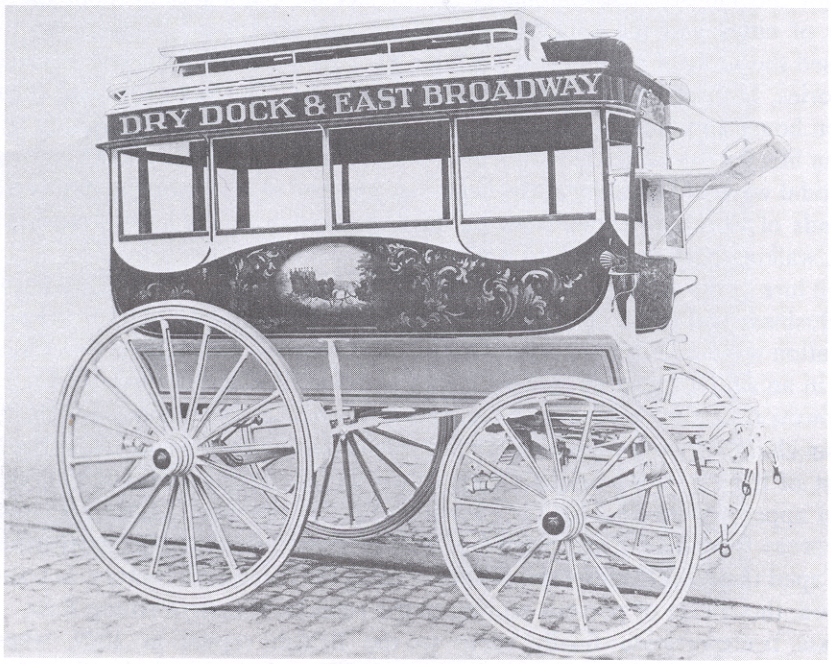

Figure 1-1 *Early omnibus. Used in New York City. (courtesy of American Public Transit Association)*

In several cities—particularly in Europe—the omnibus allowed people of modest income to live beyond walking distance from work. The possibilities of better climate and better housing on the outskirts of the city opened up for a great mass of population. At the same time, omnibuses were usually more expensive to ride than the streetcar that appeared on the scene a bit later. Because of the slow pace of urban population growth, omnibuses were not heavily used in the United States except in a few of the largest cities, but they were especially popular and long-lived in New York City. New York saw its first omnibus in 1831, when Abraham Brower began to operate a line along Broadway between the Battery and Bond Street.

Where it was utilized, the omnibus strengthened the central business district (CBD) of cities, helping to make the central area a focal point for internal travel. Because of their limited speed of about 3 mi/h (5 km/h), however, they could not be extended for long distances into relatively undeveloped areas and consequently had little influence on expanding city boundaries. The horse-drawn omnibus was in use in many cities throughout the world until the early 1900s; in those places where they were used so long, it was usually because of local restrictions against laying rail for horsecars in certain streets. As a result, omnibuses were often directly replaced by motor buses, as was the case on Fifth Avenue in New York.

The omnibus had the virtues of relatively low capital cost and inherent flexibility. Balanced against the advantages were the discomfort of operations on poor road surfaces, low speed, and very limited passenger capacity. As useful as it was, the omnibus was a mode of mass transportation with considerable limitations. It is small wonder, then, that its use was never as extensive — at least in the United States — as was its successor in time, the horsecar.

THE MASS TRANSIT REVOLUTION: THE AGE OF THE STREET RAILWAY, 1830-1920

HORSE-DRAWN STREETCARS

The streetcar as a mode of public transportation was introduced in New York City in November 1832 almost as an afterthought. A line of track had been laid along Fourth Avenue to bring the cars of the New York and Harlem Railroad into the heart of the city. Because city restrictions prohibited the use of steam locomotives in the streets of lower Manhattan, passenger cars were pulled by horses from Harlem into the downtown area. The enterprising promoters of the Harlem Railroad saw the potential for hauling local passengers in regular urban transit service, in addition to pulling the steam railroad coaches downtown. Lightweight cars were built to save money and to lighten the horses' loads, and the Fourth Avenue line became the world's first streetcar service.

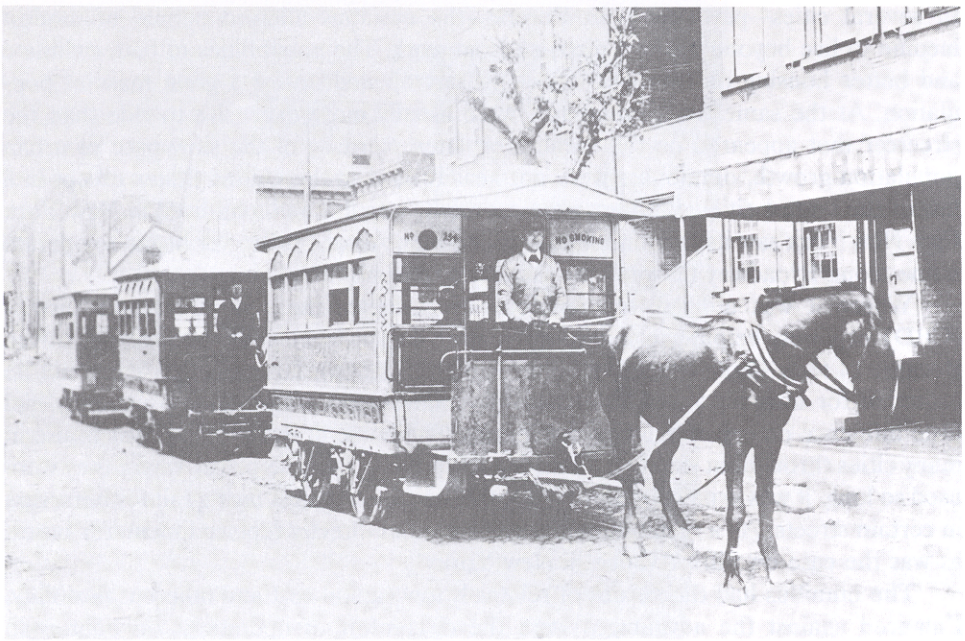

Figure 1-2 *Horsecar used in Philadelphia in 1880. Note "No Smoking" sign. (courtesy of American Public Transit Association)*

The horse-drawn streetcar had a number of advantages over the omnibus. Cars with metal wheels rolling on iron rails were easier to pull than the omnibuses on rough roads. Thus, horsecars could be larger than omnibuses and so carry higher payloads with the same number of horses. A horsecar could maintain a speed of about 4 mi/h (6.4 km/h), which is about 1 mi/h faster than was possible by the omnibus.

By the late 1840s, after a slow start outside New York City, the horse-drawn streetcar appeared in a number of other American cities. By the time of the Civil War and immediately thereafter, almost all American cities and towns of any size, or those with even a modest delusion of metropolitan grandeur, had horse- or mule-powered street railway companies. As with the omnibuses, there were many competitors in a business—urban public transit—which was later usually thought of as a natural monopoly. Typically, in a community of any size at all there was no single city transit company operating all the omnibuses or streetcars; in a large city, service on each street was usually offered by a separate firm having a franchise granting monopoly power to operate. The possibility of a multiplicity of transit operations in a town was often a fact. Philadelphia had 39 streetcar companies all operating at virtually the same time. The public was not generally well served in the broad civic sense by competition among several local horsecar companies. Each firm served only a limited area; longer trips required changing vehicles and paying separate fares each time a different company was used. Multiple companies with multiple fares discouraged long trips.

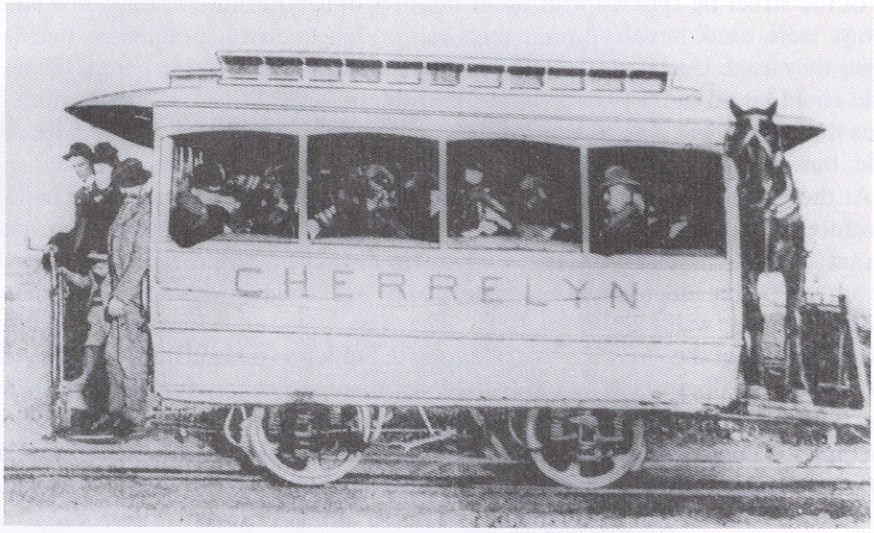

Figure 1-3 *Fifty-fifty. On this archaic line, in the outskirts of Denver, a horse pulled the car up hill and then rode down on the rear platform. He was on the job so long that his shoes wore grooves in the flooring. (courtesy of American Public Transit Association)*

Mergers between street railway companies began to take place during horsecar days. Later, as the transit industry moved toward mechanical means of transportation, the increased need for capital accelerated the merger process because larger, more stable companies fared better in the capital market.

Horsecars required a larger capital investment than did omnibuses because track had to be laid. Horsecars, depending on size, ranged in cost from about $600 to $1000. Over time the horses, as with the omnibus, were the most expensive part of the investment. Horses cost about $200 each and were kept in service for about 5 years. Because one or two horses per car could be worked for only about 5 h/day, three to six horses were required to provide 15 h of service. On steep grades, additional horses were often required.

Because tracks were constructed in public streets, franchises were usually necessary so that the public thoroughfare could be used for private enterprise. The franchise bore with it certain responsibilities, such as payment of an annual franchise tax. It was common to demand that the street railway pave the area around its tracks and clear snow from the paved track area in winter. If that were the only cleared portion of the street, as was commonly the case, wagons and buggies soon cluttered up the streetcar right-of-way. In some cases, the street railway company was required to pave the entire street from curb to curb, which could be a substantial financial burden and, in later years, this requirement aided and abetted the buses and automobiles that competed with the street railways. Another requirement was that, in the summer, the unpaved

part of the street be sprayed with water in order to control dust. Later, when electric railways were used, streetcar companies were often required to maintain the public bridges they used. Under most franchises in the United States, the fare imposed on the public could be no more than 5 cents. The nickel fare proved to be lucrative in most places during the last 30 years of the nineteenth century, when prices were relatively stable, but became a problem later.

At the horsecar's operating speed, one could travel 2 mi in a half-hour commute. Therefore, it was possible for the nineteenth-century horsecar commuter to find a pleasant area to live, several miles from his downtown work location, where the benefits of better or cheaper housing could be enjoyed without the burden of inordinately long walks or travel time. Thus, the horsecar helped to stimulate the outward growth of the city. Although the growth tended to be relatively compact, often there were a few long fingers of growth along major streets out into underdeveloped areas. The street railways added to the importance of the established downtown area by helping to make it the most accessible place in the city and, therefore, the prime location for most economic, social, and cultural activities.

CABLE CARS

Despite its many advantages over the omnibus, street railway managers kept seeking improvements to the horse-drawn streetcar. Many attempts were made to find a means of mechanical power that could replace the horse. A major breakthrough in motive power was the successful operation of cable cars in San Francisco in 1873. Invented by Andrew Hallidie in 1869, the ingenious part of the cable car was a grip that allowed a cable, running continuously in a slot between the tracks and beneath the street, to be grasped and released so that cars could start and stop. The cable was powered by giant steam engines and the cable car, therefore, had great potential for mass movement.

The cable railway was first used to climb San Francisco's formidable hills; the areas on Nob Hill, Russian Hill, and to the north and west of Market Street were immediately opened for urban development. But the cable car was not merely a street railway vehicle for a city with steep hills. The passenger-carrying capacity of a cable railway system was substantial because of the power available, and cities without the problems of hill-climbing soon adopted the new type of urban transportation. Indeed, Chicago, a city not known for hills, had the largest cable car operation in the United States. Grip cars pulling up to three trailers, and traveling at close headways, provided the capacity to move thousands of people into a central location. The importance of downtown Chicago as a great and vibrant business district and major place of employment was actually made possible by the cable car, long before the familiar elevated railway loop (the Loop) was built in the central business district.

What made the cable car attractive, particularly in large cities, was that it had a much lower operating cost than the horse-powered railway. If the cable railway provided relief from operating cost, nevertheless, the formidable (for that day) capital

Figure 1-4 *Cable car. California Street, San Francisco cable car in 1974 and still going strong. (courtesy of Harre W. Demoro Collection)*

investment required—probably a minimum of $100,000 per route-mile and perhaps much more—meant that the cable car was practical only where there were large numbers of people to move.

Because of its relatively high speed, the cable car helped draw city development out along its routes. Of course, the need for a dense traffic level meant that most cable lines were located in well-built-up sections of a city, usually as a replacement for busy horsecar lines. The development attributable to cable traction would have been even greater had the cable car not so soon been superseded by another and better form of mass transportation.

Electric Streetcars

For many years, people fascinated with electricity had been attempting to devise some method of electrically propelling a vehicle along rails. Early experiments using battery-powered cars had not been particularly successful. It was not until dynamo-generated current was perfected in the late 1860s and the transmission of power over a relatively great distance through wires became possible that electrically propelled transportation was at all practical.

A number of pioneers experimented with electric locomotives or electric railway cars with more or less success during the early 1880s. In 1883, Charles Van Depoele operated an experimental electric line in Chicago, and on the heels of that success operated a service at the Toronto Exposition in 1885. The spring-loaded pole pressing on the bottom of the wire, with the return circuit made through the running rails, was perfected by Van Depoele. The early electric cars were crude and undependable. Most were nothing more than converted horsecars, with the motor placed on the platform next to the driver, now dubbed a motorman. The rheostatic control was rough, and a chain drive was used to power the wheels of the car. Vibration was a major problem, and the weight of the motor often caused the platform of the car to buckle.

In 1888, however, the state of the art was greatly improved when Frank J. Sprague electrified a portion of the horsecar lines in Richmond, Virginia, and brought together all the elements, which he and others had devised, that were necessary for the successful operation of electrically powered streetcars. Sprague used Van DePoele's idea of overhead wire with a bottom-contact, spring-loaded trolley pole to collect the current, the return circuit through the rails. Sprague also devised an improved control system so that the cars were easier to operate. He also developed a means of suspending the electric motors so that there would be a minimum of wear and tear on the motors and gears from vibration, and the operation of the cars would be relatively smooth and trouble free. After a few more years of development, the electric streetcar was ready to take its place as the preeminent means of urban transportation for the next 30 years.

The electric streetcar precipitated a revolution in urban public transportation. Within 2 years of the completion of Sprague's electrification project in Richmond, better than 1200 mi (1900 km) of electric street railways were in operation in the United States. From a cost viewpoint, the electric railway car was far superior to both the cable car and the horse-powered street railway. It cost a great deal less to install track and the overhead wire and power distribution system for an electric railway than it did to put in the costly and complex cable system. Capital costs were lower than for the cable railway and operating costs lower than for the horse railway.

The electric railway car could operate at an average speed of at least 10 mi/h (16 km/h). This permitted street railways to be extended even farther from the central business districts than either horsecar or cable car lines. Within a few years, the electric streetcar played an important role in shaping the city it served as the population oriented itself to the location of the expanding street railway system. Many streetcar companies were also in the real estate business, and city development was often by design of the companies. Electric traction promoters would buy large tracts of land in promising outlying territory and then extend the streetcar line to the land that they owned. The transit company stood to profit from people buying its land, building or buying houses, and becoming regular streetcar customers.

The coming of the electric streetcar also had an impact on the structure of the transit industry. The multiplicity of street railway operations that were common during the horsecar days were no longer practical. Generally, there were wholesale mergers as dispersed companies pulled together to form a "Union Traction Company." The

larger company was better able to attract capital for the purposes of electrification than were separate, small, independent horse-railway companies. Unfortunately, many small companies not only were overcapitalized, but much of the capital was in the form of debt. When mergers were consummated, the surviving company had embraced the capital structure of the absorbed firms and was usually burdened by capitalization that often greatly exceeded the value of the assets.

Figure 1-5 *CBD in transportation transition. Los Angeles at the turn of the century. Horse, electric, and gasoline vehicles vie for the right-of-way. (courtesy of Southern California Rapid Transit District)*

The shaky financial situation in the transit industry was widespread, although it did not include the entire industry. Nevertheless, as long as prices and costs were stable—as they were for most of the last 30 years of the nineteenth century—and patronage continued to grow, the transit industry could function as a safe, stable, and seemingly profitable institution. At the same time, overcapitalized transit firms were on the edge of financial disaster if prices in general should rise or if patronage should fall.

By the time of World War I, the electric streetcar had had a major impact on the growth and structure of cities and had opened up the outlying suburban areas to the middle and upper middle classes as well as to less affluent Americans. The huge influx of immigrants from abroad and from rural areas of the nation into U.S. cities had

helped swell urban growth, and the development of the urban area was often channeled along the streetcar lines. Like the arms of a starfish, streetcar lines projected from the central business district out as much as 5 mi (8 km) or more. The electric streetcar provided the basic transportation for American cities before the coming of the auto age. Typically, service was good, fares were relatively cheap, and the streetcar was a part of everyday life for citizens of all classes, occupations, ages, and economic levels. It is fair to say that the streetcar was the most decisive factor in shaping U.S. cities until the automobile.

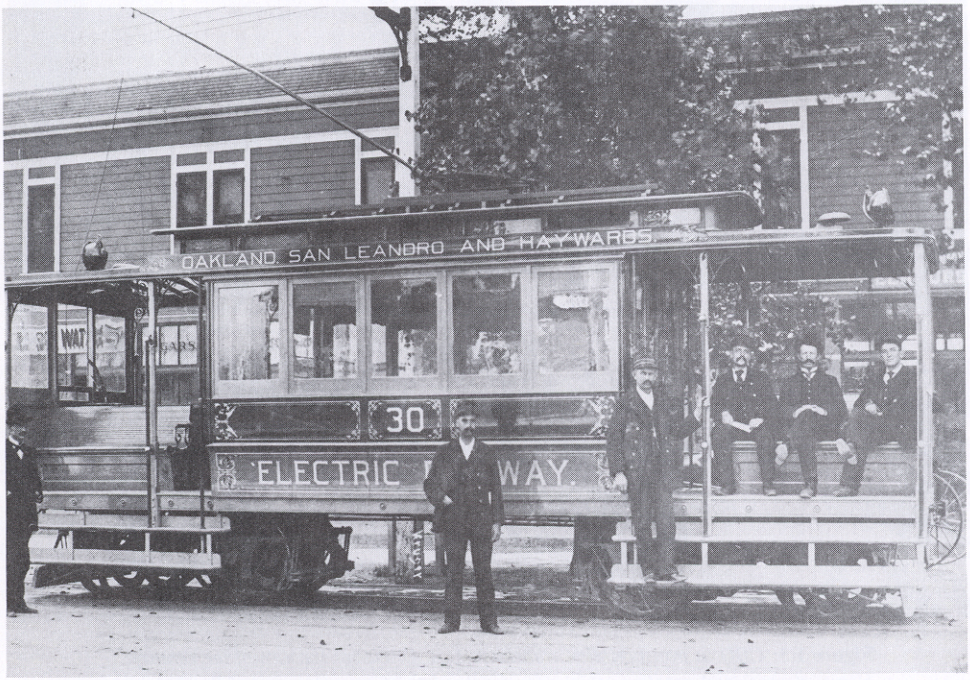

Figure 1-6 *Early streetcar (California type). Oakland, California, about 1895. (courtesy of Harre W. Demoro Collection)*

For the first two decades of the twentieth century, all large U.S. cities depended on streetcars. The central focal point was, of course, the bustling downtown. Strip shopping streets developed along the streetcar's radial arteries, and often local shopping centers formed where several streetcar lines intersected. Housing, to be convenient and marketable, had to be within no more than two or three blocks of the streetcar line. Large factories or major employment centers of any kind had to locate where there was either the existence or potential of streetcar service. The public-transit-oriented city was relatively compact and population was relatively concentrated. Lesser densities were possible out along the suburban and interurban electric lines or

the commuter railroads, but even there homes tended to cluster. The classic suburb had developed.

THE MASS TRANSPORTATION AGE: FERRIES, COMMUTER RAILROADS, INTERURBANS, AND RAPID TRANSIT

FERRIES

In discussing transportation by omnibus and by rail in the early days of the development of modern cities, one must not forget the ferryboat and its role in urbanization. A number of American cities were faced with water barriers; urbanization across those barriers would have been impossible without the ferry. Early nineteenth century engineering knowledge and available structural materials were so limited that it was not possible to construct bridges across, for instance, the Hudson and the East rivers in New York, the Delaware River in Philadelphia, or Boston Bay and San Francisco Bay. The ferry provided a means of crossing water barriers quickly and at relatively low cost. Thus, the ferry made possible the expansion of urbanization from an original core city to many other adjacent areas. Like the street railway, it permitted persons of ordinary means the opportunity to find good housing at reasonable cost and, perhaps, a more favorable environment than were available in the major city center. The ferry, along with the other modes of public transportation, allowed cities to develop horizontally at a time when engineering skill and the quality of materials precluded vertical development of high-rise housing.

COMMUTER RAILROADS

Commuter rail service had its inception when enterprising nineteenth-century railroad management noted that it was possible to pick up additional passengers on trains already being operated if those trains entered the city in the morning hours coinciding with the beginning of work and departed at the end of the workday. Obviously, if a railroad was already operating a long-distance passenger train into the city, the extra cost of stopping at the outskirts was virtually nil; the revenue collected from the passengers was almost all profit. In the nineteenth century, railroads encouraged this kind of traffic. Some involved themselves in land development schemes, much like the early street railway companies, in order to encourage suburban development. In any event, to be attractive to the would-be suburban passenger, the railroads typically cut, or commuted, a part of the fare. Thus developed the name *commuter* for the regular, shuttling passenger on the railways and, indeed, for all who traveled back and forth regularly.

Eventually, in some places, the commuter or suburban railroad operations became very large in scope as cities expanded. The development of Long Island beyond Queens

and Brooklyn is an example; its growth was due to the substantial commuter operations of the Long Island Rail Road. Across the Hudson in New Jersey, a large number of suburbs and cities formed along the lines of railroads aimed at the great metropolis and joined to it by ferries. The commuter railroad was like the ferry in that middle-class people had access to better housing and a better family environment than were available in the major city center. In Boston, Philadelphia, Chicago, and along the peninsula in San Francisco, commuter rail service fostered a great outward spread of population. It should be noted, however, that the pattern of development was different from that influenced by the streetcar. Because of the economics and operating nature of the steam locomotives originally used as the motive power in commuter rail operations, growth was not along a solid corridor adjacent to the railroad, but, rather, resembled beads spaced on a string. It was uneconomical to start and stop steam locomotives much more often than about every 2 or 3 mi; the stops therefore tended to be so spaced. Housing would develop around the railway stations. In many cases, these communities along the railway remained enclaves of suburbanization in otherwise rural areas and did not grow together until well after the coming of the automobile age.

INTERURBANS

In the Midwest, in particular, there was another variation of the growth pattern caused by the commuter railroad. In the late 1890s, interurban electric railway lines were developed linking smaller cities, often 50 mi (80 km) or more distant, with a larger regional city. The interurban cars, while closely related in technology to the local streetcar, were larger and more comfortable and capable of relatively high speeds. The economics and technology of the interurban were such that stops could be efficiently spaced at intervals as short as a quarter of a mile apart where necessary. A beads-on-string type of development, similar to the commuter railroads took place in the outskirts of many cities served by interurbans; but because the separate clusters of housing were closer together, the process of growing together into a long suburban arm of development was more likely to take place. Los Angeles was greatly affected by the building of interurban electric railways as an integral part of real estate development. The spread-out nature of Los Angeles was largely caused by the Pacific Electric Railway and its thousand-plus miles of track.

RAIL RAPID TRANSIT

In some places the growth of a city and its population was so great that it became evident more than a century ago that some means of fast transportation utilizing other than the street surface was necessary. Street traffic had reached such formidable proportions in London by the 1850s that mobility was seriously threatened, and it was obvious that some new form of fast transportation had to be developed on a grade-separated right-of-way. The British response was the 1863 opening of the Metropolitan Railway's steam-powered underground line in London from Farringdon Street in

the city to Bishop's Road, Paddington. Shortly thereafter, in 1868, the first elevated railway was opened in New York City. As with the earlier London subway, the New York elevated trains were propelled by steam locomotives.

With the coming of electrification after 1888, and Prank Sprague's invention of multiple-unit train control in the 1890s, rail rapid transit became even more popular for handling large crowds with a swiftness denied the surface modes. With electrification, unlucky pedestrians need not worry about hot ashes falling on them from an elevated railway, and Londoners traveling on their underground railway system did not have to worry about suffocating or bearing on their clothes and faces the environmental pollution of steam locomotives. By the first decade of the twentieth century, a network of electric elevated railways covered parts of Brooklyn and Manhattan. Chicago enjoyed the services of several steam-powered elevated railways in the 1890s; with the coming of electrification, the systems were greatly extended and linked together in the famous downtown Loop. The first American subway was a streetcar subway in Boston, opened in 1898, and soon followed by a subway built for trains. New York's first subway was opened in 1904, and construction of additional subways proceeded rapidly for the next 35 years. Philadelphia's first subway opened in 1907, and Chicago began using its first underground railway not long before World War II. Cleveland started construction of a rail rapid transit system in the 1920s; delayed by the Great Depression and World War II, it was finally opened in the 1950s. Toronto opened its first line in 1954, Montreal in 1966. The San Francisco Bay area built its system in the 1960s and 1970s as an antidote to the automobile. In the 1970s, Washington, Baltimore, Atlanta, Miami, and Buffalo joined the ranks of cities with subways and rail rapid transit. The 1980s saw Los Angeles begin the long process of subway construction.

Rail rapid transit was feasible only where the population was very large and dense and where street crowding was so overwhelming that there was no choice but to move to some high-capacity, rapid means of public transportation. Generally, rail rapid transit systems were built only in the developed parts of a city and, therefore, their impact on spreading growth was relatively modest. On the other hand, some of the earliest of New York's elevated railways were built out from the most highly developed parts of the city into almost farmlike lands well in advance of housing and commercial construction, and thus strongly influenced growth in the Bronx, Brooklyn, and Queens. Locations around the rapid transit stations were often choice spots for high-density development of apartment buildings, factories, or mercantile establishments. In the London area, however, beginning in the teens and especially the twenties of the century, the underground rapid transit railway system was extended far into the suburbs on the north side of the Thames. Today people may travel as far as 35 mi (56 km) by "underground" — mostly running on the surface, however—to find their way eventually into downtown London. The Bay Area Rapid Transit District system in the San Francisco area resembles the London system in its ability to shape and stimulate growth well out into the suburbs, as well as serving as a backbone of public transportation in the more densely populated parts of Oakland, Berkeley, and San

Francisco. Likewise, the Washington Metropolitan Area Transit Authority rapid transit lines extend for many miles out into the suburbs of Maryland and Virginia. These far-ranging rapid transit systems resemble the interurban electric railways of an earlier era and function much like commuter railroads.

MASS TRANSPORTATION IN THE HIGHWAY AGE: THE MOTOR BUS AND TROLLEYBUS, 1920 TO THE PRESENT

With the construction of subways in many parts of the world in the 1920s, the first great age of public transportation came to an end. Insofar as urban growth and development were concerned, the major transportation force of the next 70 years—especially in the United States — was the private automobile. The rapidly rising costs of the World War I period forced the overcapitalized transit systems to the wall. Even though patronage broke all records, the franchise-regulated fare of a nickel limited revenues while debt capital still demanded payment of bond interest. There was not enough revenue in many places to pay operating costs and capital obligations. By 1918 half of the street railway mileage in the United States was in bankruptcy. Even with financial reorganization, many of the nation's transit firms were unable to meet the challenge of the automobile age. This does not, of course, mean that development of new forms of transit was at an end.

In the 1930s, members of the transit industry allied to produce a new type of streetcar. The PCC (Electric Railway Presidents' Conference Committee) car was the superb result, the end product of the first systems engineering effort in U.S. history (see Chap. 5). As good as it was, the PCC car could not turn the tide in the United States against the move away from fixed-facility surface transportation with its burden of track and overhead wire maintenance cost.

MOTOR BUSES

The motor bus and the trolleybus are the major transit innovations of the mid-twentieth-century move away from the street railway. The motor bus is an obvious offshoot of the development of the automobile and the truck. The first regular use of buses by an existing transit firm took place in New York in 1905 when the Fifth Avenue Coach Company replaced some of its omnibuses with imported motor buses. In 1912, Cleveland Railways began to use buses as feeders to its streetcar lines. These vehicles were often crude and uncomfortable and suffered from the same uncertainties as the early automobile. Other cities began to see early, crude buses — often nothing more than a passenger body fastened to a truck chassis — offer service in less densely populated areas.

What was needed for the real development of the motor bus was a conveyance that was easy to get into and use. The Fageol brothers provided such a vehicle in the

early 1920s with the construction of front-engine buses that were designed from the ground up to be motor carriers of passengers. These buses had relatively low entrance steps, doors that could be operated by the driver, and—except for the engine location—were very much like smaller versions of the buses of today.

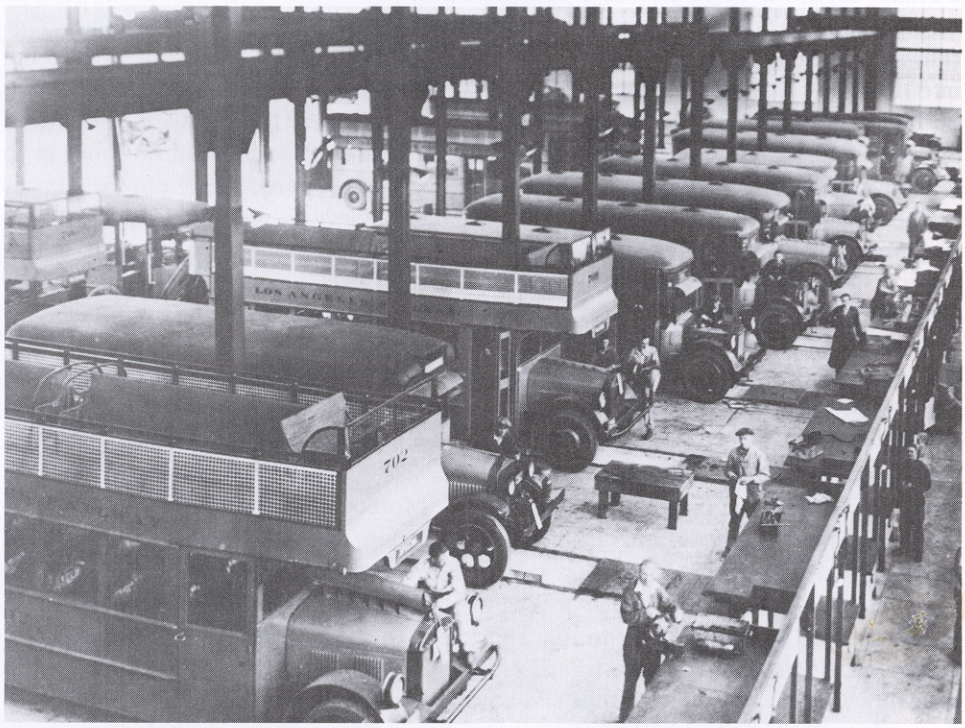

Figure 1-7 *Early buses—the streetcar killers. (courtesy of California Department of Transportation)*

Over the years, bus design and reliability improved greatly, and by the late 1930s all the elements of the modern motor bus, with the exception of air conditioning and air suspension systems, were brought together in a single vehicle. By 1939, the motor bus that was to become typical was powered by a large, powerful diesel engine mounted at the rear and driving the vehicle through an automatic transmission. Buses by that time were produced up to a length of 40 ft (12 m) with a capacity of more than 50 seated passengers. Some gasoline-powered—and, later, propane-powered buses—continued to be produced into the 1950s, but the diesel soon became the standard.

The great advantage of the motor bus is, of course, its flexibility, since it can go anywhere there is a decently paved street. Happily, the motor bus does not require any sort of overhead power distribution or the installation and maintenance of rails in the street as did the streetcar, and is thus a truly independent vehicle. Better yet, the cost

of the street surface that the motor bus uses is shared with all the other vehicles that operate on that street. The advantage of not having to pay the entire cost of the streets they use is marred for the transit bus by having to share that surface with all other motor vehicles; the bus wallowing in automobile traffic is a typical modern sight. As a result, service is often slow and undependable.

Small buses began to make inroads on streetcar operations in the 1920s. The street railway companies, sometimes burdened with motor bus competition, but often going into the motor bus business themselves when they recognized its advantages for service on lightly traveled lines, soon adopted the bus as a regular part of their operations. Starting in the 1920s, shuttle streetcar lines and light-traffic suburban lines began to be converted into bus operations. With the advent of the large diesel-powered buses in the late 1930s, even major streetcar lines with heavy patronage soon fell to the conquering modern relative of the omnibus.

TROLLEYBUSES

Another twentieth-century innovation is the trolleybus, a combination of both the electric streetcar and the bus. Equipped with twin trolley poles to gather electricity from overhead wires, the trolleybus enjoys the quiet power of electric traction. At the same time, because it travels on rubber tires like a bus, there is no need for the expensive business of laying track in the street. Moreover, the trolleybus, because it is free to move at some distance from under the center line of its wires, can easily get around obstacIes in the street that would block conventional rail-bound streetcars. Many conversions from streetcar to bus operations in the United States enjoyed an interim period of a switchover to the trolleybus. The reason behind this intermediate move was the advantage to the transit property of being able to continue to utilize its major investment in power stations and power distribution equipment for several more years after the abandonment of the street railway. When the necessity for repairs or modernization of the power distribution system became substantial enough, the trolleybuses were typically replaced with motor buses.

It is very difficult to find evidence that either the motor bus or electric trolleybus had any part in shaping the growth of modern American cities because recent urban growth came at the same time as the whirlwind upsurge in use of the private automobile. It is the automobile that has been the prime factor in shaping and developing recent urban growth, so whatever impact the bus or trolleybus may have had is virtually invisible. Coupled with the allure of government-insured mortgages, subsidized highway travel, and employer subsidized parking for employees, the automobile was formidable competition. It was no contest in the scattered, thinly developed suburbs, where transit foundered in a feckless effort to serve places with insufficient density to support conventional transit services.

Figure 1-8 *Downtown Chicago, Dearborn and Randolph Streets, 1910—congestion! (courtesy of Federal Highway Administration)*

Figure 1-9 *Downtown congestion. Same location 56 years later. (courtesy of Federal Highway Administration)*

SUMMARY

There is much being written about the possible virtues and growth-shaping possibilities of new and exotic forms of urban mass transportation. Regardless of what may actually happen, it is unlikely that in the foreseeable future any of the new means of public transportation now under development will have any greater impact on urban growth than did the streetcar in the United States.

The story of public transportation in the twentieth century will be covered in the next chapter, land use and transportation are addressed in Chap. 12, and prospects for the future are discussed in Part VI. As we will see, all over the world increased attention has been directed to upgrading and improving mass transportation. As a result of environmental pollution often caused by automobile exhausts and stunning levels of automotive congestion, it is likely that over the next half-century mass transit will once again become a potent force for shaping cities as well as serving them.

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EXERCISES

1-1 Why are urban places or cities important in economic, social, and cultural life?
1-2 Why was the agricultural revolution critical in the development of urban places?
1-3 What role did water transportation play in the growth of urban places?
1-4 What role did the horse-drawn omnibus play in urban development in the nineteenth century?
1-5 What part was played by the horse railway in urban growth? Why were franchises required and what was required of the franchise holder?
1-6What was the impact of the cable car on American cities?
1-7 How did the electric street railway revolutionize urban growth patterns in the late nineteenth and early twentieth centuries?
1-8 How did ferry boats, commuter railways, and electric interurban railways affect American cities?
1-9 Where was rapid transit first introduced in the United States? What job does it do that other modes cannot perform?
1-10 Why were the motor bus and trolleybus developed? What is their unique contribution?