

Historical Overview of U.S. Passenger Transportation

*Lester A. Hoel
Hamilton Professor of Civil Engineering
University of Virginia*



For the first 1800 years after Christ and the thousands of years preceding that period, the means by which people traveled remained essentially the same. By land, travel was either on foot or by transport modes that were powered by animals or humans. Depending on the country, the motive power might have been horse, mule, camel, elephant or oxen. For travel by sea, boats were powered either by wind or humans. Whether by land or sea, the trip was usually slow, costly, and dangerous. The absence of non-animal power sources that could be "harnessed" to do the work needed to move people placed severe limitations on the time required to make a trip. It also constrained the capacity of vehicles used for travel, and limited the infrastructure that was provided to serve as roadways and terminals. It is no wonder that continents and nations remained relatively isolated and societies grew, flourished and declined without the knowledge of others living on the same planet.

In the 300 year span between the time that Columbus discovered the new world, in 1492, and the year that a new nation was born with a Constitution and Bill of Rights, passed in 1791, little had changed in the way Columbus traveled to America, from the manner in which Thomas Jefferson traveled to France.

In 1790, the year of the first census, 4 million people lived in the United States, most along the Atlantic seacoast in villages or on farms. Bad roads and poor communications kept communities isolated. For example, two stage-coaches and 12 horses carried all the traffic between New York City and Boston. It took almost a month for news of the Declaration of Independence to travel from Philadelphia to Charleston, South Carolina. In fact, the technology of urban and intercity passenger transport didn't look much different to Americans than it did to their ancestors until we reached the dawn of the 19th Century AD. Then, in a period of less than 200 years, this nation underwent changes in its transportation systems that were truly

revolutionary, and the cataclysmic emergence of modern transportation was essential in changing world history.

Over the past 200 years, the evolution of a transportation mode typically has followed a sequence that included invention, demonstration, testing, evaluation, introduction into regular service, public acceptance, and ultimately the creation of totally new transportation services. The final stage typically influenced economic development, new land use patterns and the adaptation of life styles around the new mode. Improvements to the new mode were typically "incremental," essentially refinements on the basic characteristics of the existing technology. As other modes were introduced that had superior service qualities, the existing mode declined, losing market share, but not necessarily becoming extinct. The new mode would be accepted primarily because it was perceived by the public as providing an improvement in the level of service compared with existing travel options. If this condition was not met, there was little incentive for change, and any additional benefits of the new mode would likely never be realized.

While many so-called transportation "buffs" are fascinated with a particular mode and often remain strong advocates for their favorite technological fix, the traveling public has been more interested in the service characteristics themselves, which include travel time, cost, comfort, convenience, reliability, frequency, safety and security. Thus, to examine transportation history is to learn how the inventive genius, financial capability, and systems organization of the transportation industry in cooperation with state and federal government, combined to create

transportation networks that made possible new ways of travel for the American public.

It is helpful to view transportation within the context of the service it provides, including urban transportation, intercity travel by rail and highway, and international transportation. If we examine the history of transportation within this framework, then the changes that have occurred during the past 200 years in technology, networks and service can be linked to society's needs and the changing lifestyle of the nation.

Let us look at the transportation situation as it existed during the 19th century. At the dawn of the century, a significant change in transportation technology occurred. In 1769, James Watt a Scottish engineer patented a revolutionary steam engine design, and later formed a successful company that marketed the innovation for a variety of applications, including steamboats and railroads. Robert Fulton, a civil engineer and inventor, demonstrated the commercial feasibility of steamboat travel in the U.S. when on August 17, 1807, using a Watt engine, his new creation, often referred to as *Clermont*, but actually named, *North River Steamboat*, successfully traveled up the Hudson River from New York to Albany. In subsequent years, steamboat transportation flourished on major U.S. rivers and lakes providing passenger service to cities located on Long Island Sound, the Mississippi River, its tributaries, other rivers in the West, and the Great Lakes.

To augment the river system, a system of canals were constructed for the purpose of connecting rivers and lakes and opening the west.

During the period between 1800 and 1850, approximately 4,000 miles of canals were built, which provided connections between various waterways in the northeastern portion of the U.S. Perhaps the most well known is the Erie Canal completed in 1825, which was 363 miles long and connected the Hudson River at Albany N.Y. to Lake Erie in Buffalo. This huge project spawned a new construction industry as well as the profession of Civil Engineering. Techniques and expertise developed in building the Erie Canal were used throughout the world in canal building projects in the 19th Century, such as the Suez Canal completed in 1869 and the Panama Canal, which was begun by the French in 1882, completed by the Americans, and opened for traffic in 1914. Canals shortened travel compared with other circuitous routes either by water or by horse and wagon, but travel times on canals were still limited by the speed of mules that were used to tow the boats. Furthermore, boats were de-

layed if the canal contained locks, and often fighting ensued between boat crews traveling in opposite directions as to who had first priority in traveling through. Often queues stretched for miles on both sides of the lock of a heavily traveled canal.

During the canal era a new mode was slowly emerging. The use of rails as a road surface enabled horses to pull heavier loads and by 1830, the Baltimore and Ohio Railroad became the first to offer this service. The introduction of steam power technology in England opened a new era of transportation and the "iron horse" soon replaced "Dobbin" as the source of motive power. Americans were slow to accept this new technology because they were committed to canals and the nation was blessed with extensive power resources from water. But steam railroads were gradually introduced, first by the South Carolina Canal and Railroad Company in the late 1820's, using a steam locomotive made in the U.S. named "Best Friend of Charleston," and then by the B&O which began to experiment with steam when it acquired the "Tom Thumb" in 1830. Incidentally, the story that Tom Thumb lost a race to a horse and carriage because a power belt slipped remains a transportation myth even today.

By 1850, railroads had proven that they could provide superior service characteristics of time, cost, and reliability when compared with either canals or turnpikes. Consequently, funds to build roads for horse-drawn carriages or further investments in canals began to be diverted and railroads became the dominant intercity passenger mode as Americans entered the 20th Century.

Having established that railroads were more competitive than canals or roads, the next stage was a massive construction effort of track laying, bridge building, and station construction throughout the nation. In 1887 alone almost 13,000 miles of track were laid, and by 1900 a railroad network of 260,000 miles stretched between the coasts and borders of the U.S. Now the railroads not only duplicated canal routes, but they opened vast territories of the West, a period in U.S. history that could not have occurred without this new and powerful technology. Thus, rail transport not only provided a competitive service that diminished the market share of an existing mode, but, because of its technological advantage, it could offer new services heretofore unavailable, thus influencing economic development and land use patterns.

The scenario described for the canal-railroad era is similar for other major transportation developments of the 20th Century, where truly remarkable changes in transportation have occurred, namely the emergence and dominance of automobile and highway transportation and the air transport industry. These new modes essentially replaced rail and bus for urban and intercity passenger transport, and ocean going steamships for international passenger travel.

The story of flight is exciting because it can be personalized with stories of inventors and heroes whose actions truly shaped a new era in American transportation. Beginning with the Wright Brothers, who in 1903 proved that a self-powered heavier-than-air machine could fly, it was only 24 years later, in 1927, that a young pilot, Charles Lindbergh, would captivate the Nation by demonstrating the feasibility of transatlantic flight when he flew non-stop from New York to Paris in 33½ hours, a distance of more than 3,600 miles. A non-stop Pacific crossing, between Tokyo and the West coast, a distance of 4,883 miles, would first occur in 1931, but with much less fanfare — it pays to be first!

These events heralded the beginning of a new age in air travel, which was recognized for its military significance and then as the technology improved, as a carrier of domestic and international passengers. Air transport has a rich history, much of which has occurred during the lifetimes of many living today. It includes the pioneering period prior to World War I in which Europeans led in aircraft design and development, the use of airplanes in World War I for combat and reconnaissance, the postwar period which demonstrated the capabilities of air service for delivering mail and passengers, and the extensive use of air power in World War II.

By 1940, propeller-driven aircraft had reached the peak of its performance and although these planes were still in service in the 1950's, with the development of the first jet engine by a British designer, Frank Whittle in 1938, a new era in air transportation was soon to begin. In 1958, Boeing delivered the first American built commercial jet to Pan Am, and air speeds were suddenly increased from 360 to 570 miles per hour. Flight times coast to coast were reduced to less than 6 hours and international passenger travel was soon to shift from large ocean-going vessels to the new Boeing 747's introduced in 1970. Both domestic and international travel was to see a major shift from sea and rail to air transportation.

Just as our nation has been shaped by the intercity transportation systems which have been created in the past two centuries, so have its urban areas been influenced and molded by improvements in transportation services. Initially, water transportation played a key role and the location of urban places with access to harbors, rivers, lakes, and streams had higher potential than those land areas without easy access to water. Urban transportation has a significantly different function than does intercity transport, since it serves as an integral part of the infrastructure of the city itself and has impacts on land use and the quality of life. Expansion of city boundaries was made possible as travel speeds increased since the maximum time allotted for a journey to work trip has remained essentially constant. In addition to travel factors such as cost, time, and convenience, urban transport modes are favored if they are quiet, non-polluting and unobtrusive. Thus, it is no surprise that horse-drawn streetcars and carriages, which existed in cities by the 1830's, were soon replaced first by cable cars in the 1870's and later by electrically powered vehicles, which first appeared in the late 1880's. In addition to increased speed and lower costs, the reduction in animal pollution of the city streets with its odor and potential for causing illness and death, was considered to be a major improvement in the quality of city life. Early marketing of the automobile would also emphasize the non-polluting features of this new horseless carriage.

The introduction of the electric streetcar, later called the "trolley car," revolutionized urban transportation. Frank Sprague, who had worked with Thomas Edison at Menlo Park, is credited with creating this new mode, when in 1884 he created the Sprague Electric Railway and Motor Company and in 1888 electrified a 12-mile horsecar line in Richmond, Virginia, that demonstrated the use of electricity to propel a mass transit vehicle on rails. Sprague was not the inventor of the "electric street railway," but he was the first person to successfully assemble the various elements necessary for the system to function: an overhead wire to collect electricity, an improved control system to facilitate car operation, and a vibration-free suspension system for the motors.

The "streetcar" became the dominant mode of urban transportation for the next forty years, reaching a peak ridership in 1926 of 17.2 billion and connecting cities with interurban service. Thirty years after Sprague's demonstration in

Richmond, there were approximately 45,000 miles of street railway and 18,000 miles of inter-urban electric in the United States. The streetcar made possible the "starlike" pattern of cities and generated added traffic from amusement parks and residential communities located along and at the end of the lines. Large urban areas required greater capacity and speed than was possible by the electric streetcar, which was constrained by mixing and cross traffic. Thus was created the rail rapid transit systems, both elevated and underground. The first was opened in London in 1863 and later rail rapid service appeared in larger U.S. cities, New York, Chicago, Philadelphia, Boston, and Cleveland. After a hiatus of about 50 years a renewed interest in rapid rail transit was followed in the 1970's and 80's by the introduction of rapid transit systems in San Francisco, Washington D.C., Baltimore, Atlanta, Miami, and Buffalo.

When TRB's predecessor, the Highway Research Board (HRB) was formed in 1920, another mode of transportation was emerging, spawned by the inventiveness of people like Henry Ford, who developed and mass produced a motor car that could be purchased at a price most Americans could afford. In 1901 there were only 8,000 registered automobiles in the U.S. but by 1920, more people traveled by private automobile than by rail transportation. However, the nation's roads were not capable of servicing this new way of travel, in fact roads were of such poor quality that for many years the League of American Wheelmen, who represented bicycle interests, had themselves been lobbying for good roads. Thus, it fell to the states and the federal government to form a partnership and begin a program of highway development that would enable this "horseless carriage" to traverse the nation at will. In 1893 the Federal government had established the U.S. Office of Road Inquiry, within the Department of Agriculture, with an appropriation of \$10,000. The office was charged with the task of investigating and disseminating information, but it wasn't until 1916 that the first Federal Aid Road Act was passed, which provided federal support for roads and gave State highway departments the authority to initiate projects, thus setting the stage for a long-term effort by states to organize, design and build a nation-wide highway system. The story of America's Highways was told in a book published by the Federal Highway Administration for the U.S. Bicentennial in 1976. This easy-to read volume traces the development of highway transportation in the U.S. from its origins to the active years of high-

way building that culminated with the now completed Interstate Highway system. The book also chronicles the influence of other modes on highways and describes the careers of those who led the effort.

One such man was Thomas McDonald, whose interest in highway engineering began as an undergraduate student with a thesis, written in 1904, on the highway needs of farmers and the force required to pull a wagon over different types of roads. His career began as an assistant professor of Civil Engineering at Iowa State, then Chief Engineer of the Iowa State Highway Commission, and in 1919 President Woodrow Wilson appointed him Chief of the Bureau of Public Roads, a post he held under seven Presidents until his retirement in 1953. McDonald's career spanned the building of millions of miles of hard surfaced roads in the U.S. and at the time of his death in 1957, the Interstate Era had just begun.

The highway research program, in which HRB would play an important role, involved the development of new theories and methods to be applied in planning, design, construction, operation, safety and maintenance. In 1956, Congress authorized the construction of a 42,500 mile system of Interstate and Defense Highways. The Interstate Highway System, now completed, has changed the face of this nation and has profoundly affected the reshaping of metropolitan areas and land use. It has also influenced the viability of passenger rail transportation and the centrality of urban public transportation.

By the time HRB had reached the 50 year mark, in 1970, air transportation had become a decisive force in both the domestic and international passenger transportation market. Now there were four modes — air, water, rail, and highway — that were well established. No longer would it be possible to consider one mode without understanding the impact on the others. In this climate, the concept of a new and expanded role emerged for the Highway Research Board, which was reconstituted as the Transportation Research Board in 1974.

What are the future research challenges for the TRB and the transportation community? We have seen profound changes in travel in the short span of two centuries when, for example, a trip between Philadelphia and Pittsburgh took 12 days by coach in 1800, 7 days by canal and rail in 1840, 8 hours by rail in 1910, 5 hours by auto in 1950, and 50 minutes by jet today.

In March 1995, the TRB and the National Science and Technology Council sponsored a Forum on Future Directions in Transportation

R&D. Research challenges in transportation for the 21st century were presented by industry, state and local government, stakeholders, and the research community. The research agenda proposed is in areas of, physical infrastructure, information infrastructure, next-generation vehicles and transportation system development.

Having placed transportation's rich history within the context of urban and international developments, speculation on its future would be the topic of a separate paper. Factors that will affect transportation include economic growth, demographics, energy availability, impacts on the environment, regulation, technology and communications. If the past is prologue then the future will be filled with change, challenge, and opportunity. If we do not know from where we have come, then how will we understand why we are here or where we are headed in the future.

REFERENCES

1. Brian J. Cudahy, *A Century of Service: The Story of Public Transportation in North America*, Passenger Transport, American Public Transit Association, 1982
2. William H. Ewen, *Days of the Steamboats*, Mystic Seaport Museum, Second Edition, 1988
3. George E. Gray and Lester A. Hoel (editors), *Public Transportation*, Prentice Hall, Englewood Cliffs, N.J. Second Edition, 1992
4. Allan E. Lee, *American Transportation: It's History and Museums*, Hildesigns Press, Charlottesville, Virginia, 1993
5. Leonard S. Reich, "From the Spirit of St. Louis to the SST: Charles Lindbergh, Technology, and Environment" *Technology and Culture*, Vol 36 April 1995
6. John F. Stover, *American Railroads* The University of Chicago Press, Midway Reprint, 1976
7. George Rogers Taylor, *The Transportation Revolution, 1815-1860*. Harper Torchbooks, Harper & Row Publishers, New York, 1968
8. U.S. Department of Transportation, Federal Highway Administration, *America's Highways: 1776-1976* Washington, D.C. 1976