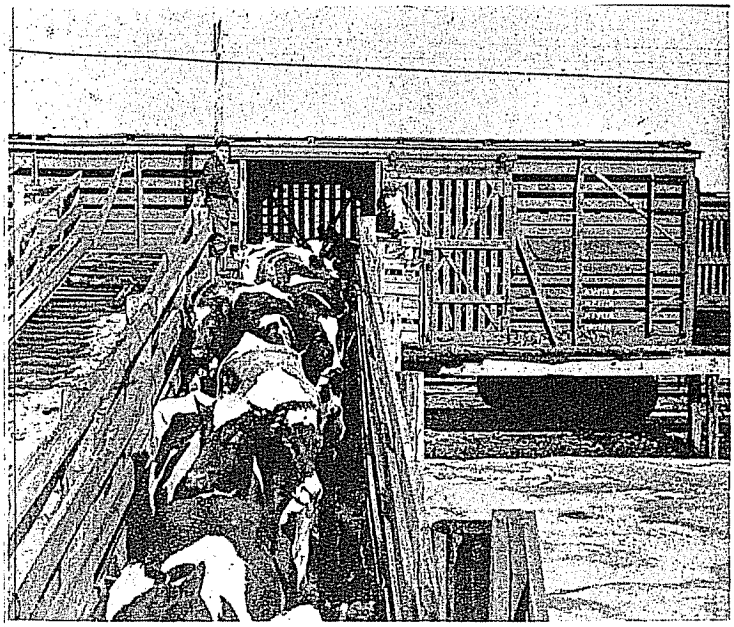


Much livestock is transported by railroads.

earlier patent. Its use on passenger trains became general before 1886.

In the "Burlington Railroad Trials" of that year, air brakes were tested on freight trains. As a result, further improvements were made. Within a few years, the automatic air brake was used on all freight trains. These brakes were further improved several times. The present-day "AB" air brake was adopted after laboratory experiments and road tests during 1929 to 1933.

Use of lightweight alloy steel freight cars in a train varied the weight of the train. There was need for brakes which would have braking power for heavily loaded cars, without too much braking power for empty, lightweight cars.

As a result, the air brake companies developed the AB "load compensating" air brakes. These new brakes are designed to equalize braking power on both loaded and empty cars. Following road tests by the Association of American Railroads, a considerable number of cars have been equipped with the new brake for further service experience.

Pioneer Inventors Add Safety

In early days, trainmen had to go between the cars to couple them with a simple "link and pin." This resulted in accidents; it was also slow.

The coupler invented by Colonel Ezra Miller in the 1860's was widely used on passenger cars. As early as 1869 the Master Car Builders' Association began a series of tests extending over many years. The problem was to find an automatic safety coupler which would work with other couplers already in use. One series of tests led, in 1887, to the approval of an automatic coupler invented by Major Eli H. Janney. From then on, the Janney coupler rapidly replaced other types.

Laboratory and field tests are still carried on by the Association of American Railroads.

Railroads Bring Modern Progress

Standardized equipment, new inventions, and constant improvement helped the railroads—and the Nation—to develop rapidly. Greater safety, comfort, and efficiency in operation were the result.

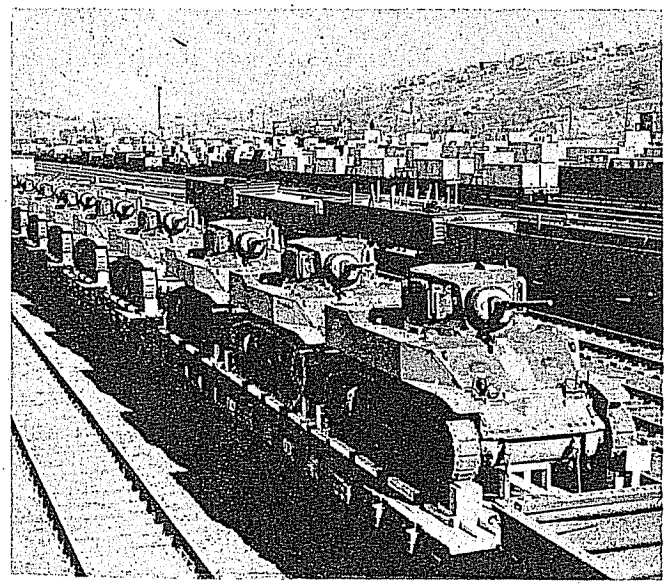
This fact was shown during World War II. The railroads had about one-third fewer locomotives, one-fourth fewer freight cars, and one-fourth fewer workers than they had during World War I. Yet, during World War II, they carried nearly double the amount of freight traffic and more than double the amount of passenger traffic.

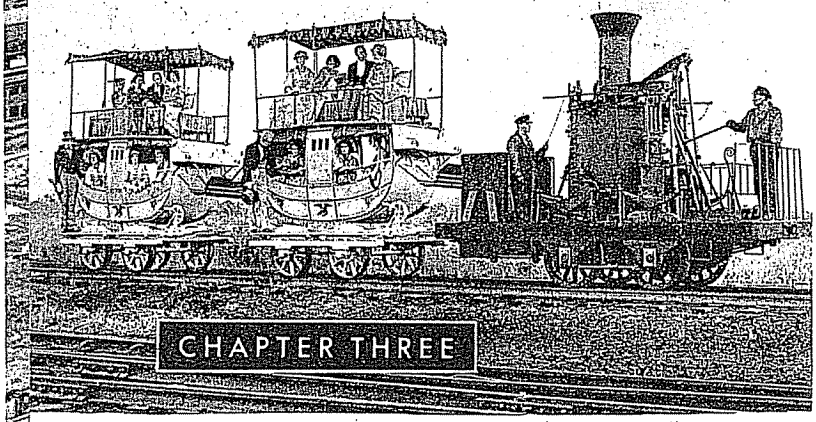
During World War I, the Federal Government operated the railroads at a cost to the treasury (and the taxpayers) of $2,000,000 a day. In World War II, the railroads were operated by their owners. This time, railroads *paid* the Government more than $3,000,000 a day in taxes. Much of this money helped to pay for the war effort.

The great World War II record of the railroads was the result of technical improvements in the whole railway industry, careful planning in coöperation with the Government, the coöperation of shippers, and the splendid efforts of all railroad people.

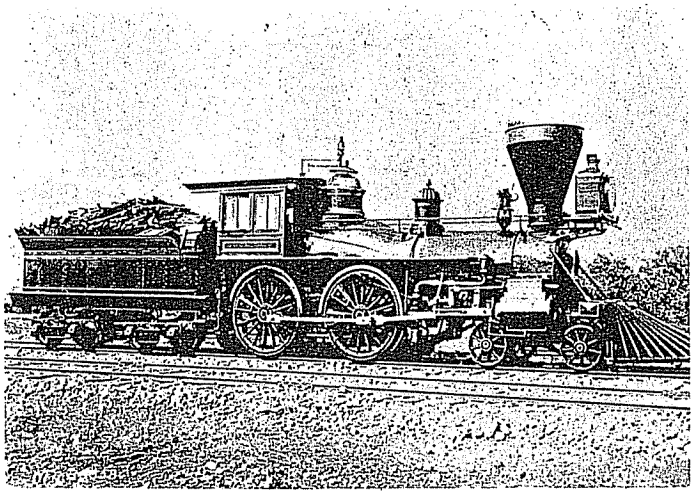
Railroad progress has developed steadily since pioneering days. Railroads will continue to play an important part in the future history of America.

In World War II, with fewer workers and less equipment, American railroads nearly doubled World War I records.





Locomotives and cars like these were used in the 1830's.



Ancestor of modern engines was the 4-4-0 of the 1860's.

MILLIONS OF HORSES

Locomotives Have Grown in Horsepower and Size. The 'Iron Horses' Work at Many Jobs.

PHINEAS DAVIS looked with pride at the locomotive he had built. At last, it was ready to be entered in the contest for the best railroad steam engine. A railroad in Baltimore was offering the prize. To Phineas, that prize was a fortune—$4,000!

Phineas Davis had come to York, Pennsylvania, as a poor boy. He found work in a watchmaker's shop. What really interested Phineas, though, was steam engines. Then, one day in 1831, he heard about the $4,000 prize. So he set to work to win it.

Phineas built an engine that would burn coal. It took weeks and weeks of hard work. Finally, it was finished, and Phineas named it the "York."

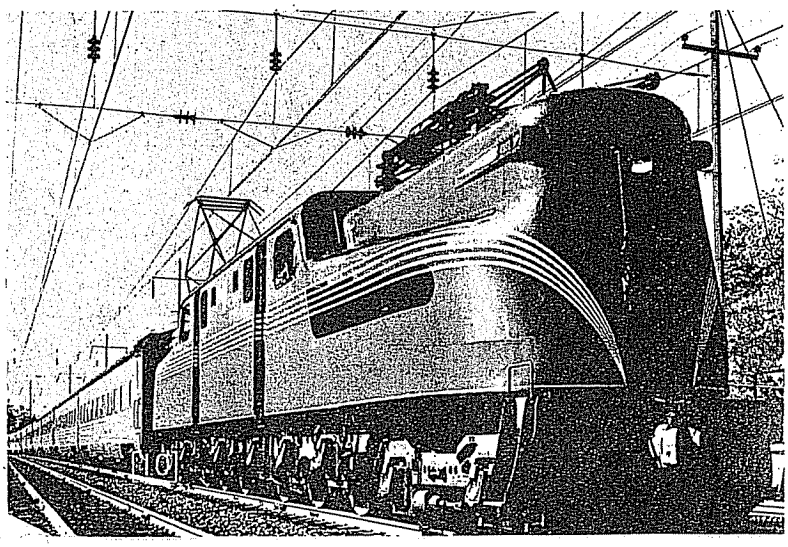
"I believe it's a pretty good engine," he said. "It may even get up enough steam to go fifteen miles an hour." He couldn't try it out. There were no railroad tracks in York. Phineas carefully took his engine apart, loaded the pieces into an oxcart, and hauled them the fifty miles to Baltimore.

Four other engines entered the contest. But Phineas Davis' engine was judged the best. On level track, it would even travel twenty miles an hour. Phineas won the $4,000. He also won a new job. He stayed in Baltimore to build engines for the young railroad which gave him the prize.

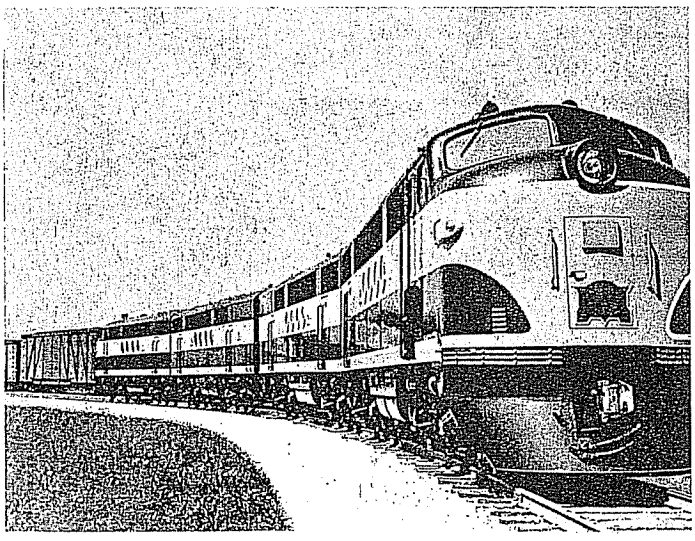
A year later, Phineas built the "Atlantic." In 1835, the "Atlantic" pulled the first railroad train ever to enter Washington, D. C.

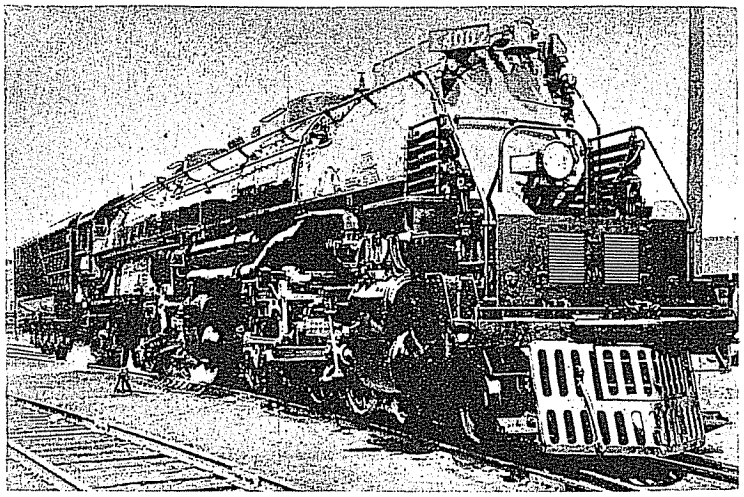
Phineas Davis was only one of many pioneers in

Some locomotives get electric power from overhead lines.

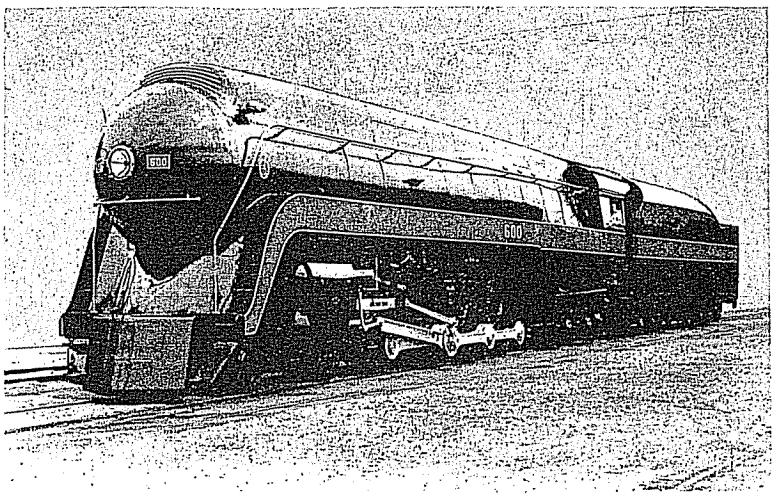


Diesel locomotives burn oil to make electric power.





Giant steam locomotives haul long, heavy freight trains.



Streamlined steam engines pull many passenger trains.

locomotive building. Peter Cooper had already proved the value of the steam engine with the famous "Tom Thumb." Matthias Baldwin, Horatio Allen, John B. Jervis, Richard Norris, and many others were in this pioneer group of locomotive builders and designers.

The early pioneers were followed by other inventors and designers. These men built larger and larger locomotives that were more and more powerful. Our country still excels in locomotive building.

Locomotives Come In Many Sizes

Today's locomotives are great power plants on wheels. They pull long passenger trains at high speeds. They haul mile-long freight trains.

Locomotives are designed to do many different kinds of jobs. For example, some are designed for passenger trains which travel from Chicago to the Pacific Coast, with very few stops. Smaller engines haul "local" trains which travel only short distances and make many stops on the way.

Some giant freight locomotives pull long trains of coal. Others may haul trains of fresh vegetables in refrigerator cars. Many kinds of freight are moved to their destinations at passenger train speeds.

On level land, the locomotive can keep up its speed and power without much trouble. In mountainous country, extra power must be available for long, steep grades.

In most cases, steam freight locomotives have smaller driving wheels than passenger engines. The smaller driving wheels give the locomotive greater tractive effort, or pulling power. Large driving wheels on the passenger engine give greater speed.

Tractive effort of a locomotive is governed, too, by the number of driving wheels. Some heavy freight haulers have 20 driving wheels, ten on each side. The number of locomotives has dropped steadily since 1926, but the average tractive effort of locomotives has gained greatly. (See graph on page 4.)

The cylinders of a locomotive are located ahead of the driving wheels on each side. Inside each cylinder is a piston. As steam pressure moves the piston in the cylinder, a piston rod, main rod, and side rods move, turning the wheels of the locomotive. Some locomotives have two separate sets of cylinders—one in front, one in the middle. They drive two sets of driving wheels.

Railroad people have names for the many types of locomotives. The streamlined steam passenger locomotive pictured above is a Northern type. Because it has four leading truck wheels, eight driving wheels, and four trailing truck wheels under the cab, it is called a 4-8-4. The big freight locomotive is a 4-8-8-4. It is the Mallet type, with two sets of cylinders and driving wheels. It also has a jointed frame to allow for movement around short curves.

Locomotives Do Other Jobs

The jobs performed by today's locomotives would have made Phineas Davis' eyes pop out. Of course, the chief job of the locomotive is to haul a train. Today's locomotive, however, must do many other things.

The modern locomotive is the source of power for all the comforts we expect on a train. The locomotive supplies steam heat and hot water for a whole train of passenger cars. Its steam drives many kinds of devices which open fire doors, run the stoker to feed the furnace, operate the reversing gears, oil the moving parts, pump water into the boiler, and do many other tasks. It builds up compressed air for the brake system.

Science Produces New Locomotives

In recent years, scientific research has produced new kinds of steam locomotives which use the turbine engine. Steam drives the vanes, or blades, of the turbine at great speeds. The whirling rotary power of the turbine is turned into tractive power.

In one type of turbine locomotive, the turbine force drives electric generators. The electricity produced drives electric motors near the wheels. The electric motors turn the locomotive wheels.

The dream of many locomotive designers is the gas turbine, operated by hot gases from the burning of coal or oil. The gas turbine operates only at great temperatures—1200 to 1400 degrees Fahrenheit. Modern developments in metals and the burning of fuel make this type of engine a promising possibility. A number of gas turbine locomotives are now in service.

Electric locomotives are used for heavy trains, both passenger and freight, and for switching purposes where tracks are electrified. Electric locomotives pick up speed rapidly. They make no smoke. They can run backward or forward with equal ease. An electric locomotive is also ready for instant service. There is no fire to build or steam to generate before it starts its run.

The electric locomotive gets its power from overhead lines, or from a "third rail." The electric power station may be some distance away.

The Diesel-electric uses the internal combustion engine for its power. This engine is somewhat similar to the engine in an automobile. However, it burns fuel oil instead of gasoline.

The Diesel engine drives generators. The electricity from these generators, in turn, drives electric motors which are geared to the wheels.

It costs more to build a Diesel-electric locomotive than a steam engine of the same size. However, the Diesel-electric burns less fuel than the steam engine. It can also be run long distances without stopping for fuel or repairs. On western railroads, for example, the Diesel-electric usually travels from Chicago to the Pacific Coast and back again. Little or no time is lost for refueling or repairs.

The Diesel-electric is used to pull many streamlined passenger trains. These trains first appeared in 1934. Today, more and more Diesel-electrics are being used to haul heavy freight trains, too.

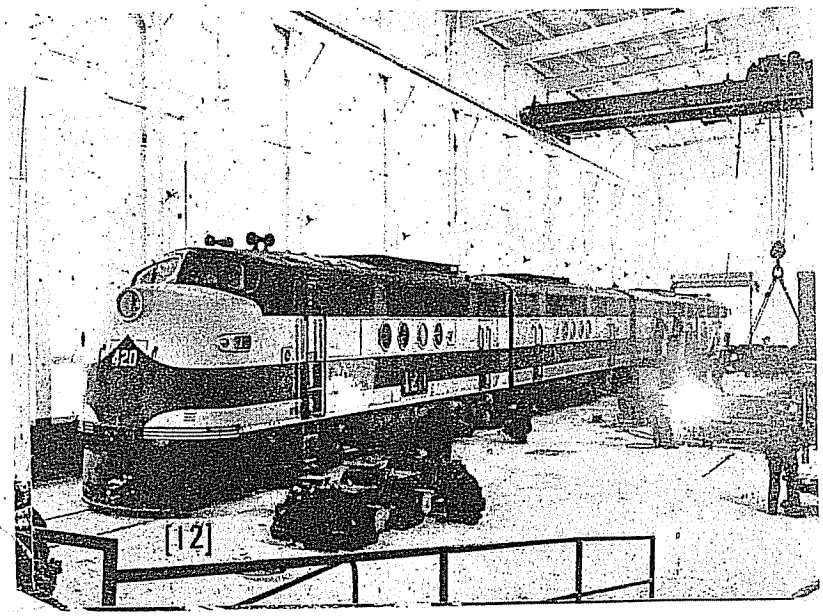
Research Brings Steady Improvements

All these developments in locomotives have been brought about through constant research by railroads, locomotive manufacturing companies, fuel companies, electric equipment manufacturers, steel manufacturers, and others. Most people see only the new streamlined locomotives as the products of this research. However, most of the important improvements in locomotives have been made gradually. Improved use of fuels, greater power, metals of greater strength, greater safety, greater ease of operation—these are just a few of the "unseen developments" in locomotives.

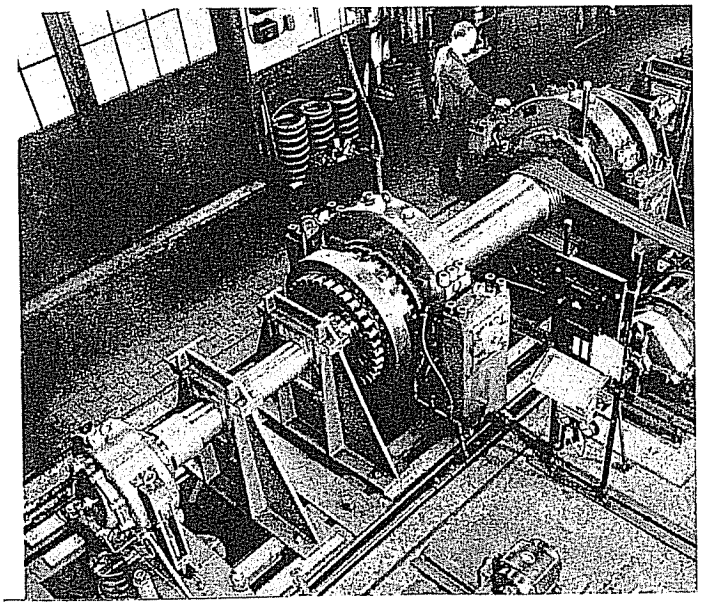
The most powerful locomotive of less than half a century ago developed 1,258 horsepower on five driving axles. Some of today's steam locomotives develop that much horsepower on *each* driving axle.

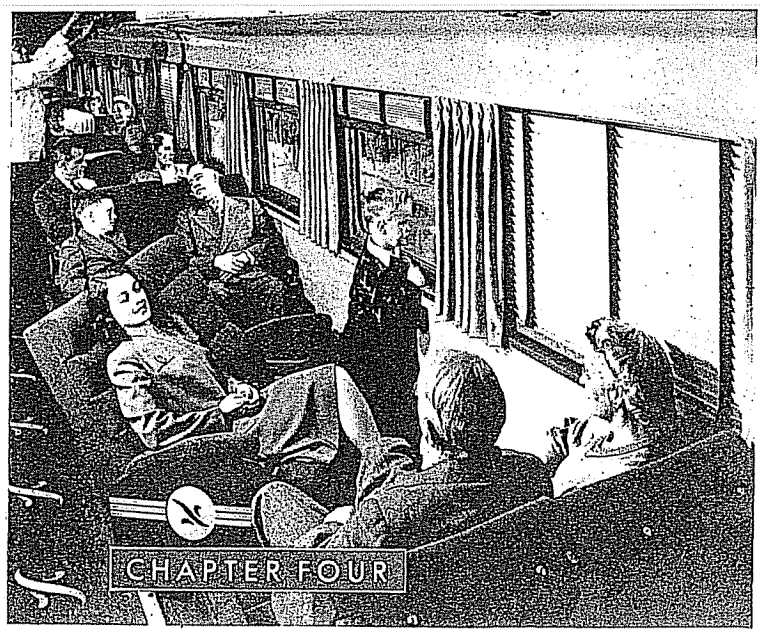
To produce one pound of steam, the modern steam locomotive burns only about half as much coal as the locomotive of forty years ago. It gets nearly twice as much work out of that pound of steam after the steam is made. Average speeds and average loads of trains have been increased. Operating efficiency has helped to keep down hauling costs.

Workmen overhaul a big locomotive in the shop.

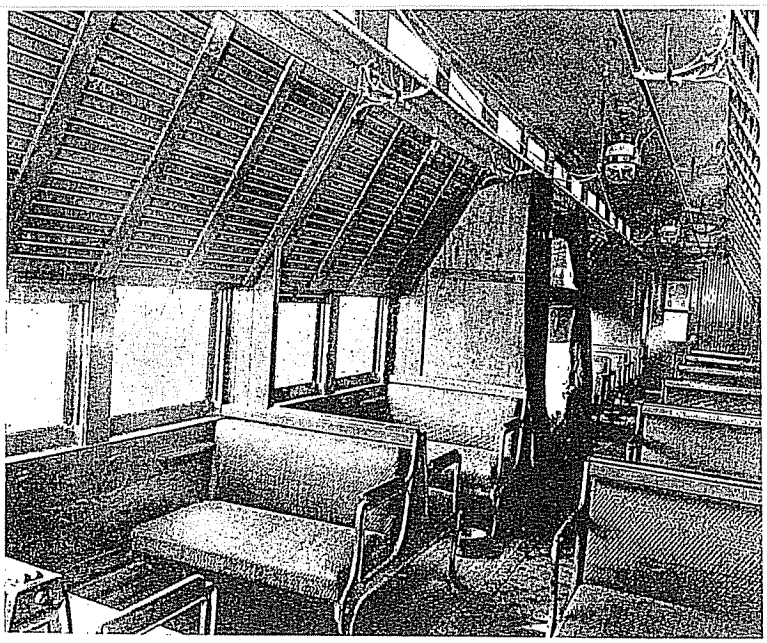


This machine tests axles at high speed under heavy load.





Roomy, reclining seats in new coaches give real comfort.



Early Pullman cars were then "the height of comfort."

ALL THE COMFORTS OF HOME

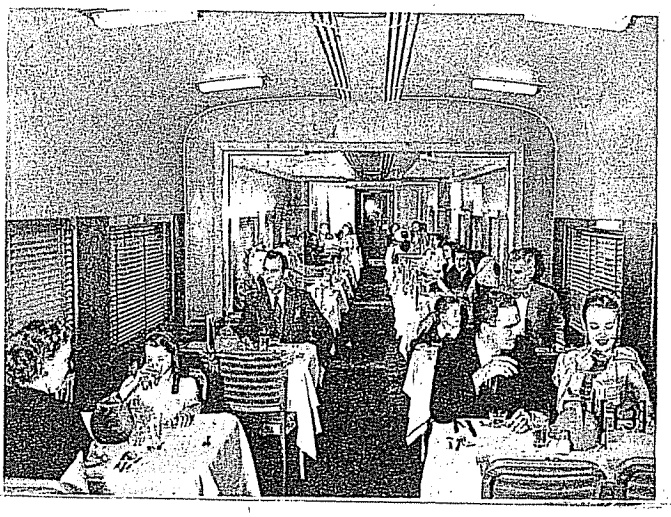
Science and Skillful Designing Have Made Railroad Passenger Cars the Finest in the World.

GEORGE M. PULLMAN tossed and turned in his hard, springless bunk. He just couldn't sleep. He was riding in a "sleeping car" in the early 1850's.

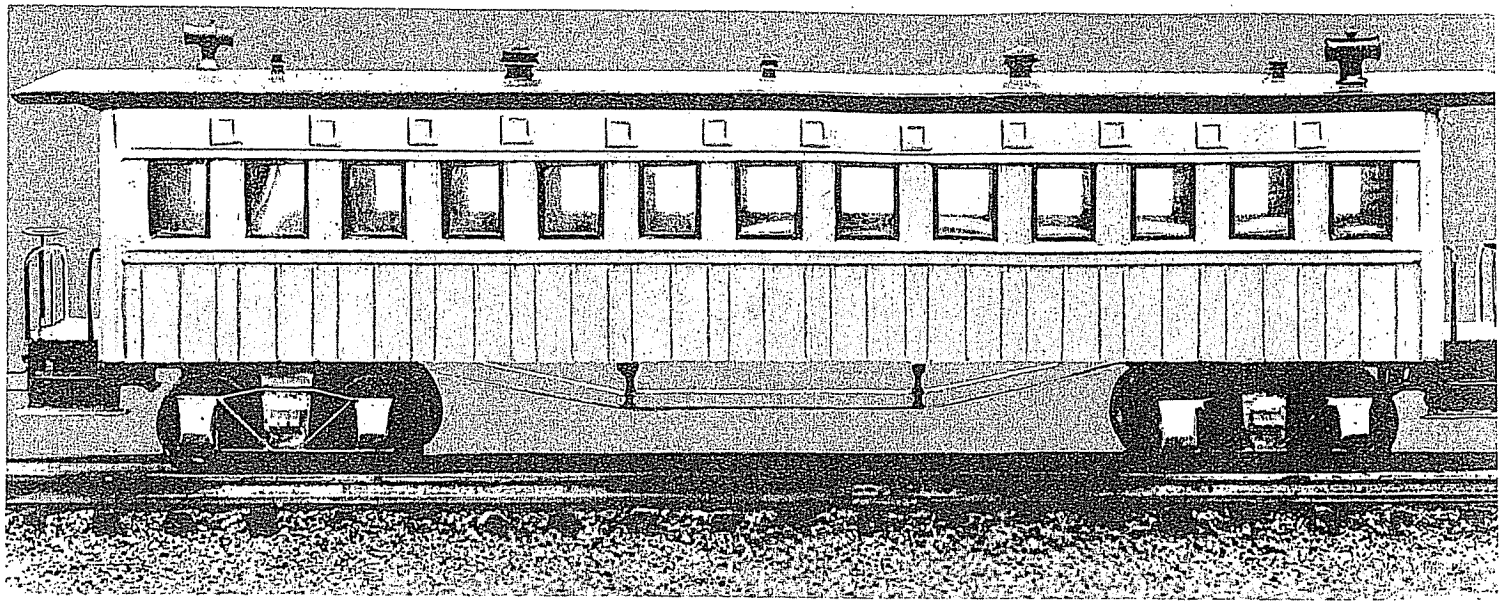
The car was simply a day coach fitted with hard bunks. The car jerked, the candlelight flickered, and the cold wind whistled through the cracks around the windows. The coarse blanket did not ease his discomfort.

George Pullman found himself thinking that night about a car which would give passengers real comfort. Finally, in 1864, Pullman was able to build his first real sleeping car. By that time, he was a successful Chicago contractor. Pullman spent all his money building the sleeping car he had dreamed about. He called it the "Pioneer." The car and Mr. Pullman both became famous in 1865 when the car was first used in President Lincoln's funeral train.

Within three years, Pullman had a number of cars in operation on three railroad lines. Pullman steadily added improvements to his cars—steel un-



RIGHT—*"Fancy" dining cars such as this one (above) were used in the 1880's. In modern dining cars (below) passengers dine in surroundings as smart as any restaurant.*



In 1860, this coach was the last word in travel comfort. Enclosed vestibules and other improvements were unheard of.

derframes, enclosed vestibules, and hot water heat.

Pullman cars were the first with raised roofs and overhead ventilation. The design of Pullman's cars affected the design of other passenger cars for many years.

Modern Luxury Comes at Low Cost

Look at a modern streamlined train. Its outside surface is smooth and gleaming. Climb aboard. The cars are air-conditioned, soundproof, brightly lighted, and beautifully decorated.

Sit down in one of these comfortable-looking seats. Deep and soft, aren't they? Months of research produced them. Press the button on the arm of the chair. You may sit up straight or lie back and rest. Most coaches have some kind of footrest so that you may stretch out to sleep.

The train has a public address system. You may hear recorded music (from a wire recorder) or a radio broadcast. Programs may be stopped for a moment for announcements concerning meals or other train services, about points of interest along the way, or for a station stop.

Look around a bit. New arrangements for storing luggage, better fluorescent lighting, new materials for seats and curtains are just a few of the developments on the newer cars.

You May Ride Right Under the Sky

A few years ago, the vice president of a locomotive-building company rode through the Rocky Mountains in a freight train pulled by one of his locomotives. He sat in the cupola of the caboose.

"What a wonderful view you have up here," he said to the crew. "We ought to give passengers this view."

The result of the vice president's idea was the dome car. It is a car with some of its seats "on top of the car" under a glass roof. Passengers can see easily in any direction. Some of these cars are now in use, and more are being built.

Comfort Is Streamlined in Sleepers

Walk into the sleeping cars of this new streamlined train. Just push the car door handle with your finger. It opens the rest of the way itself.

More and more private rooms are being built into these sleeping cars. Single private rooms used to take much more of the car space than berths. Most of the new roomette cars, however, will carry almost as many passengers as the old Pullman car. Some will carry even more.

Many amazing space-saving ideas are worked into these cars. In the roomettes, the bed is made up before you board the train. At bedtime, you just pull the bed down from the wall. The rooms contain toilets, washstands, space for clothing and luggage, and personal controls for air conditioning, heat, light, and ventilation.

Larger bedrooms and drawing rooms have space for two or more passengers. Some of them even have private shower baths. The walls between some of these rooms can be folded back to make a complete home on rails for a family.

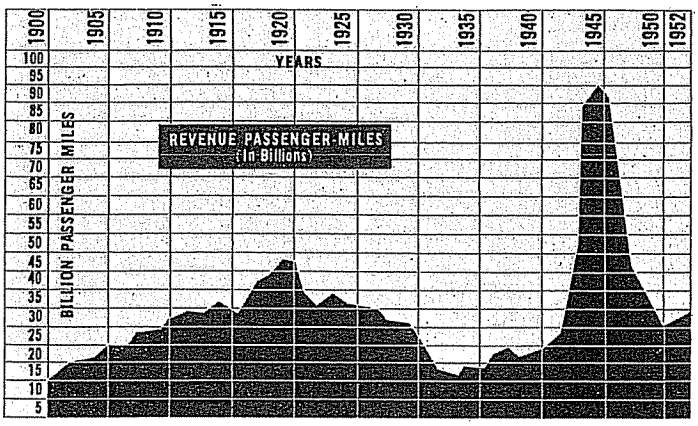
Let's Have A Meal on the Road

Railroad dining cars have always been famous for their delicious meals. New decorations, equipment, and design add to the service and surroundings.

Notice the roominess of the new diners, for instance. On some trains, the whole car is a dining room. The kitchen is in the next car. An "electric eye" opens the door between the two cars.

What a pleasant place the dining car is! Soft dinner music comes from hidden loud-speakers. New design of tables and storage space reduces crowding. Coffee shop cars with lunch counters, and even cafeteria cars are also being added to the de luxe trains of some railroads.

The kitchens are being improved, too. An amazing amount of equipment to save space, time, and labor is crammed into these kitchens. Automatic refrigerators keep foods fresh. Other automatic devices do everything from keeping plates warm to disposing of the garbage.



One passenger carried one mile is a "passenger-mile." This graph shows the effect of World War II on travel.

Technical Improvements Bring Comforts

Not all cars and trains have all the new improvements, of course. Making new improvements takes time and millions of dollars. Besides, many new scientific devices are not out in the open where you can see them.

Research in lightweight metals and smoother riding devices has added greatly to passenger comfort and safety. In many cases, this research has increased speed and reduced weight by the use of new metals and alloys.

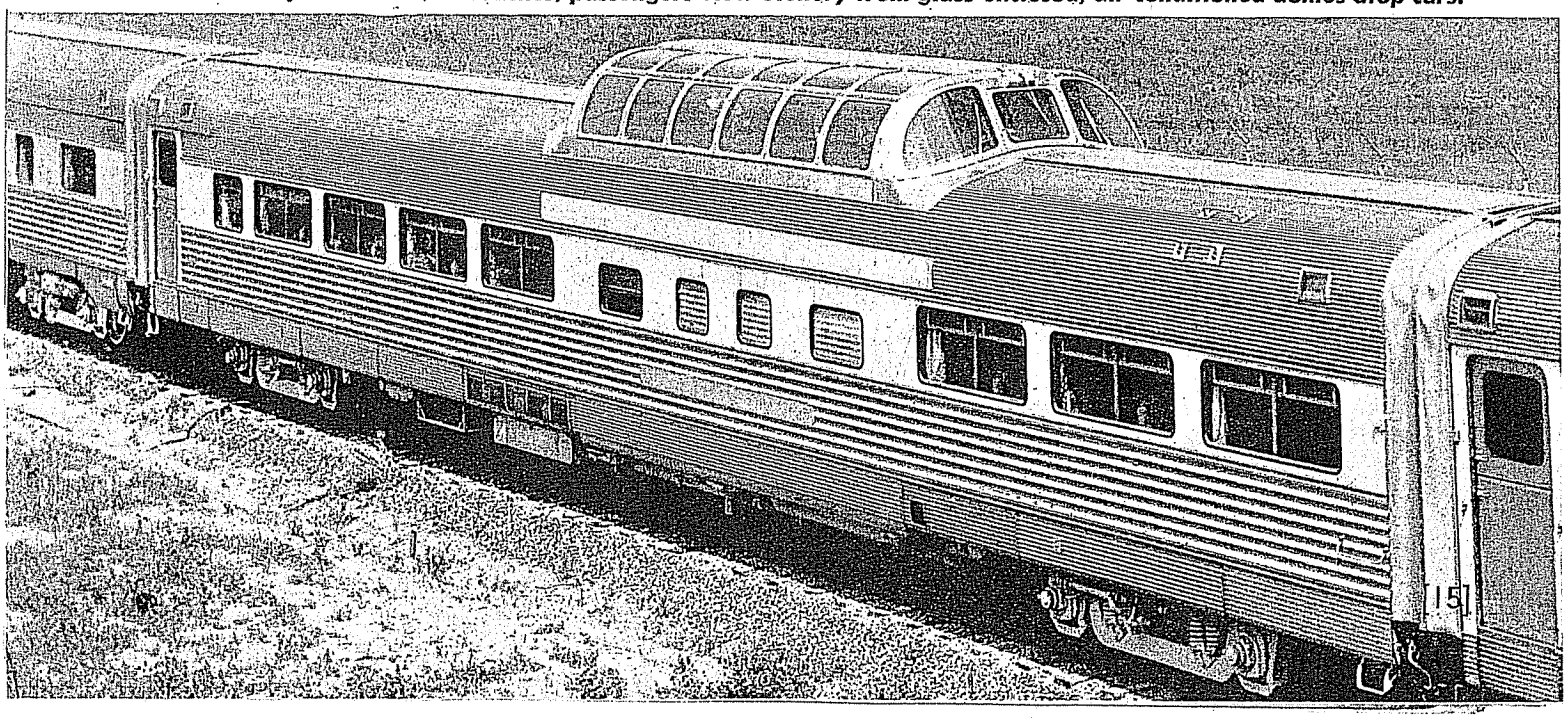
New type springs under cars give a "softer" ride. Roller bearings, better shock absorbers, improved brakes, and other developments in the trucks add to smoother running. New style cars do not sway or rock as much as older cars. New tight-lock couplers and cushioning devices mean smoother starts and stops.

Another modern development is the radiotelephone. On some trains, you may telephone or send a telegram while the train speeds along the rails.

A new center for railroad research is the Central Research Laboratory of the Association of American Railroads at Illinois Institute of Technology in Chicago. This million-dollar laboratory is headquarters for engineering, mechanical, sanitation, and other important research.

The railroads have hundreds of scientific research projects under way today to improve your travel future. In your tomorrows, the railroads will be there with fast, comfortable, safe, and attractive cars to take you from one place to another.

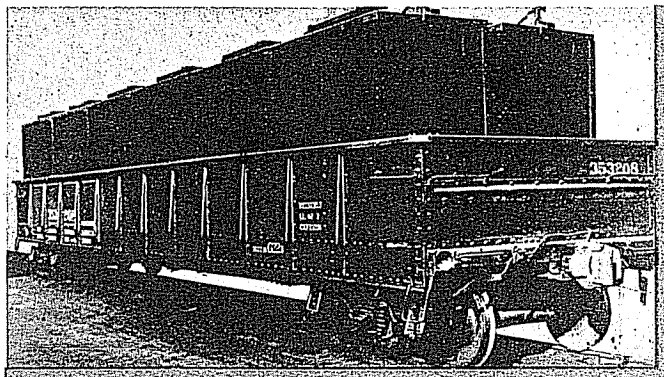
In some of today's streamlined coaches, passengers view scenery from glass-enclosed, air-conditioned domes atop cars.



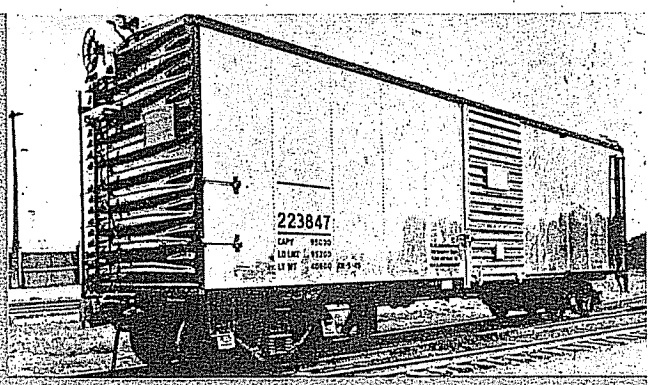
RAILROAD FREIGHT

Freight Service Is the Backbone of American Commerce. To Mee Our Daily Needs, "We Live Out of Freight Cars."

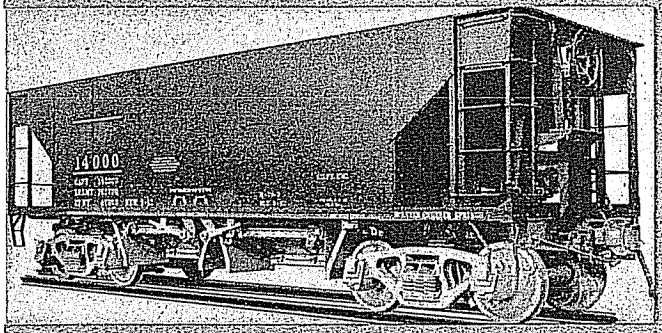
CHAPTER FIVE



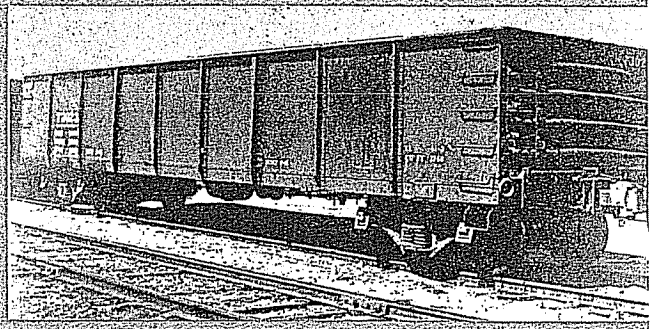
Container cars carry bulk freight in steel "boxes."



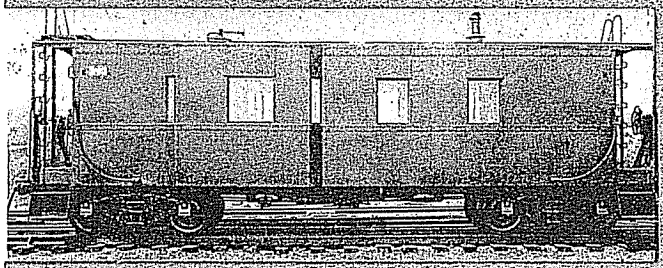
Boxcars are all-purpose freight cars.



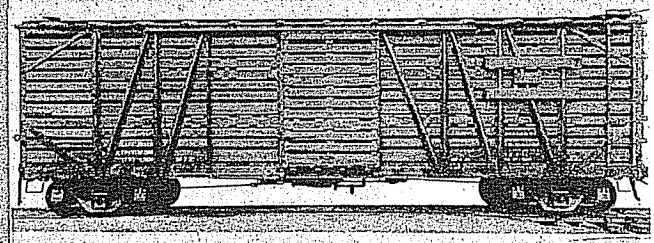
Loads of hopper cars are dropped from bottom.



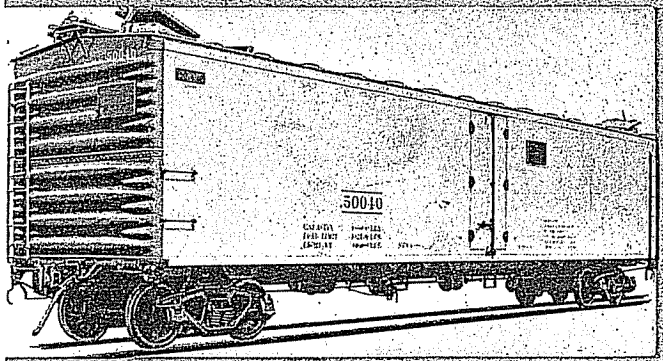
Gondola cars carry coal, sand, and gravel.



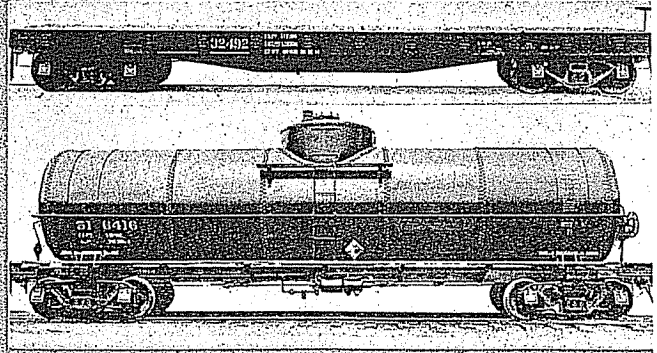
On a run, freight train crews live in cabooses.



Stock cars like this carry livestock to market.



Railroad men call refrigerator cars "reefers."



TOP—A flatcar. BOTTOM—A Tank Car.