

Besides being straight or nearly straight, tracks are built as level as possible. On most main lines throughout the country, roadbeds do not rise more than one foot in 100 feet of track. This rise is called a one per cent grade. Very few main lines have grades of more than 2.2 per cent. Even these are in mountainous country.

The Tracks Are the Railroad

Today's roadway (track and roadbed) is the product of modern science and engineering. It has been tested and improved, tested and improved a thousand times over.

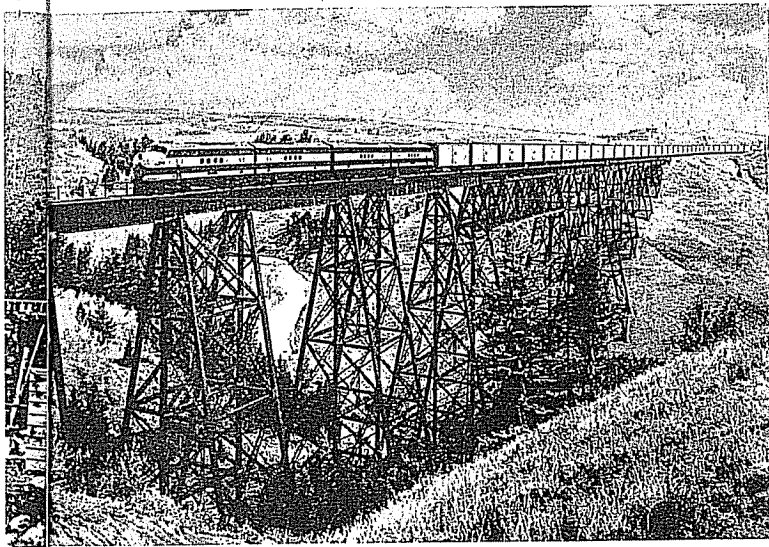
Chemistry has improved the strength, the life, and the safety of the materials. Chemists, for example, have rearranged the molecules of the steel in the track many, many times as they steadily improved the quality of the steel itself. Engineers have

roadbed have even resulted in changes in the design of locomotives.

One of the newer tools of science is the supersonic detector. This device sends out sound waves of higher pitch than any possible before. These sound waves are far beyond the range of the human ear. Supersonic detectors can be used to find flaws in steel track, locomotive axles, and many other kinds of equipment.

Today, more traffic is being carried on our steel rails, with greater safety and lower upkeep costs, than would have been thought possible only twenty years ago. Back of this record is more than a hundred years of scientific research. This research has been carried on in laboratories and out on the tracks by railroads and builders of railroad equipment.

The roadways for America's trains are among the finest in the world.

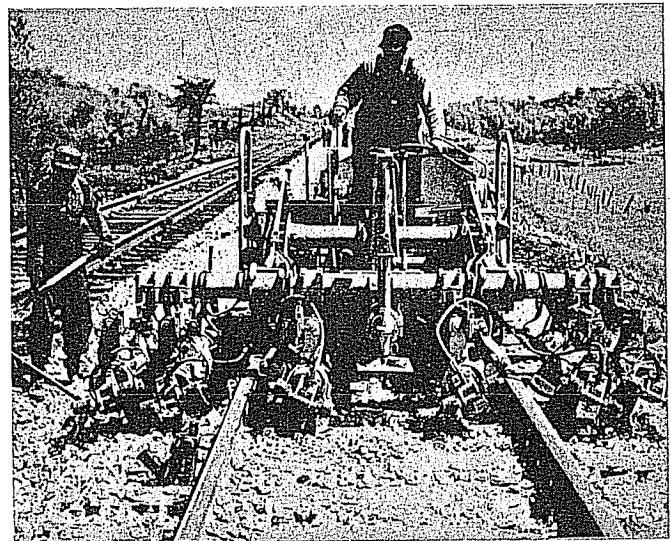


Modern steel bridges are vital links in railroad systems.

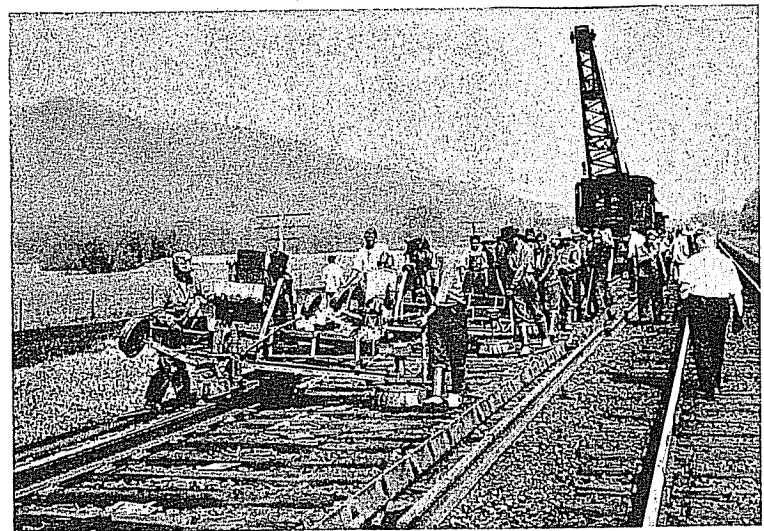
created machinery for laying track and keeping the whole roadway in good condition.

Roadway workers now have track-laying machines, powered spike hammers, ballast tampers, ballast cleaning machines, and many other devices to help them. Hidden flaws in the rails cannot escape notice, either. "Detector cars" traveling over the rails discover these defects by noting the way the rails carry electricity. Defective rails are marked automatically with a daub of paint. Track workmen then replace the defective rails.

With modern tools, railroad research men have been able to run tests they never could make before. For example, tests on bridges may make it possible for trains to cross without reducing speed. With this change, train schedules could be speeded up and thousands of dollars saved. Tests on track and



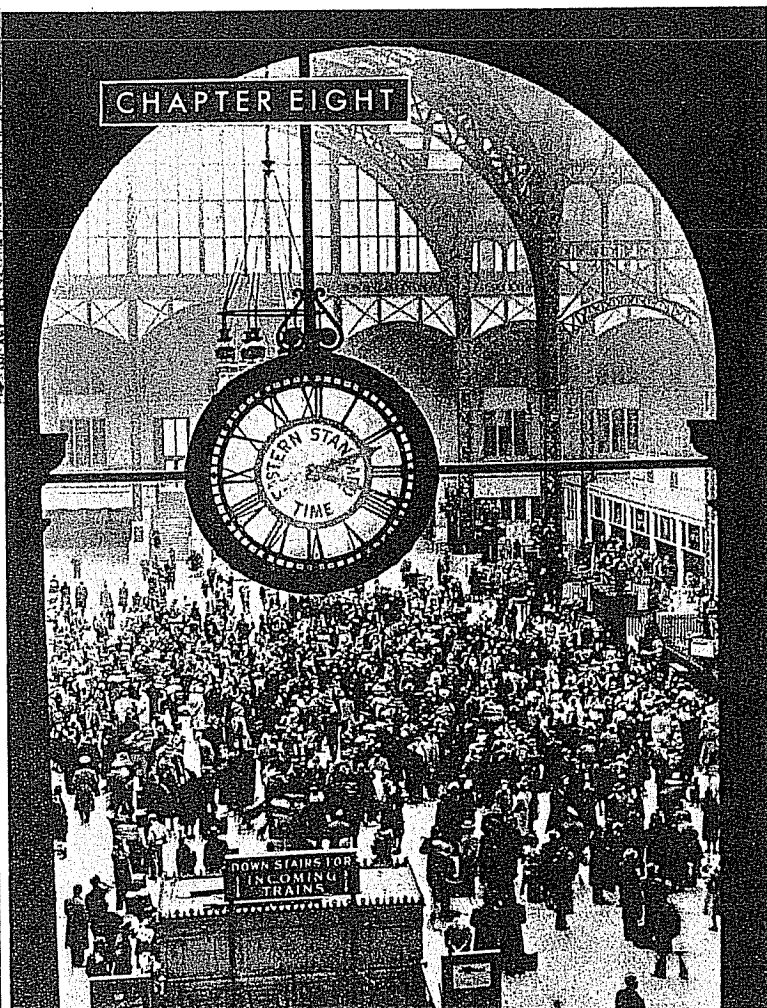
This 12-tool ballast tamper packs ballast around ties.



Adzing machines smooth off cross-ties as tracks are laid.

PEOPLE AND SCIENTIFIC METHODS

*Planning and Research Bring
Greater Efficiency in Railroad
Buying, Selling, Accounting,
Scheduling, and Operations.*



[26]

EVERY few seconds a train starts on its run somewhere in the United States. The train may be a local freight, starting a run to the next town. Or, a streamlined passenger train may be starting a run across two-thirds of the continent.

The railroads of the United States operate many thousands of trains daily. From previous chapters, you already have some idea of the work needed to put one train and its cargo of freight or passengers on the road. Multiply that work by thousands. Then, if you try to add together all the people, tools and equipment, supplies, time, and money needed for this work, your head will be in a whirl.

Yet, trains everywhere move with precision, and the whole vast railroad system runs smoothly and without confusion, in an orderly and efficient operation.

Time Governs Most Railroad Operations

Almost every operation of the railroads is governed by time. Trains depart, arrive, move, meet, and pass on definite time schedules. Cars are cleaned, supplied with equipment, loaded, coupled into trains on definite time schedules.

Stations, ticket offices, baggage rooms, mail and express offices, and a great number of other offices and operations are governed by time. Even track repairs and many shop repairs are run on time schedules, so that train operation will not be delayed.

Visit a passenger station in New York, Chicago, or some other great city. Trains are arriving and leaving all through the day and night. In the morning and evening, special commuter trains are run on fast schedules—every few minutes during the heavy rush hours—to carry people to and from work in the city. These commuters, as well as thousands of other people, govern their daily activities by railroad time.

To meet these time schedules and to keep all their activities running smoothly, the railroads have built up complete and exact systems. Selling, scheduling, buying supplies, accounting, and planning are an important part of railroading.

Railroads Sell Their Services

Railroads are a business, of course. To get money to operate their business, the railroads must sell their services. Passenger and freight agents are the salesmen.

Passenger agents, however, do more than sell tickets to people in stations or ticket offices. They

Thousands board or leave trains daily at city terminals.

sell the railroads' services in connection with conventions, special tours, traveling sports and theatrical organizations, and the like.

Freight agents work with manufacturers and others who may ship freight. Industrial agents cooperate with new industries in establishing their plants along the tracks of their particular systems.

Many railroads have offices over the entire country—outside their operating areas. The agents in these offices give out information and sell the services of their particular roads to passengers and industries, too.

Scheduling Is an Exact Operation

Neither freight nor passenger services could be sold if the railroads failed to deliver the service. Thus, cars and trains must be available to meet the needs of the railroads' customers.

Most trains are run according to timetables. These timetables list the arrival and departure times of each train at all its stops along the way. On busy railroads, the timetables of passenger and freight trains must be worked out very carefully.

Passenger trains, for example, frequently leave or arrive at a station where trains of other railroads are arriving and departing. They cannot all arrive and depart at the same time. The schedules of all these trains must be planned so that they will not conflict.

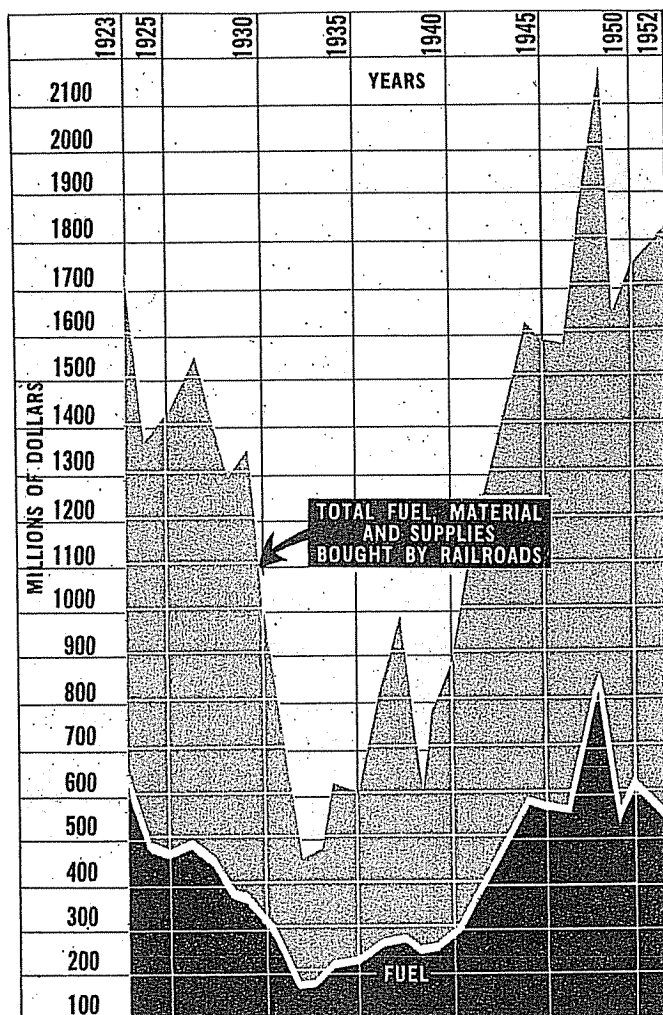
Frequently, too, a passenger train may include cars from other railroads. The schedules of the two railroads must be planned together.

Railroads must have some idea in advance as to the number of passenger and freight cars they will need. For example, large numbers of cars to carry wheat must be sent to the wheat-growing regions at harvest time.

Railroads Are Buyers, Too

Railroads are among America's best customers. In 1952, for example, the railroads spent more than $1\frac{3}{4}$ billion dollars for fuel, materials and supplies alone. Add to that the money spent for wages, taxes, new equipment (such as locomotives, cars, etc.), and for additions and improvements to shops, stations, roadways, and signals, and the bill soars to more than eight billion dollars for that year. (See the graph on this page, the table on page 28, and the graphs on page 31.)

The railroads' regular "shopping list" includes more than 100,000 items. A detailed study of railroad purchases showed that railroads bought materials in no fewer than 12,174 cities and towns in the United States. Purchases were made in more than



In most years, railroads are billion-dollar customers.

85 per cent of the counties in the United States.

The Pullman System, now owned by the railroads, gives us a good example of the number of supplies needed on just one part of a train. In a recent year, the Pullman Company purchased 226,968 sheets, 461,315 pillow slips, 1,705,231 hand towels, 12,251 head rest covers, 13,511 table cloths, 28,668 napkins, 17,248 dish towels, and 27,756 glass towels, plus several thousand miscellaneous items. The Pullman Company keeps a stock of some 10 million linen pieces. You would do the same if, in an average year, *your* overnight guests equalled almost one-fifth of the country's population.

The Activities Are Tied into a System

Railroad executives have the job of tying together, or coördinating, all railroad activities into a smooth-working system. They must have many

facts about railroad operations at their finger tips. Is it any wonder that most railroad presidents have grown up in the business, step by step?

Imagine the office work necessary to run a large railroad! Here is just a partial list of railway office work:

Preparing and selling tickets; collecting freight charges; handling money in thousands of different activities; making payments; purchasing equipment, materials, and supplies; keeping dining car and restaurant records; keeping track of freight cars; collecting and paying rentals for equipment shared with other railroads; keeping the time of all employees.

But that's only a start. We'll add another partial list:

Making and quoting freight rates and passenger fares; preparing and making changes in timetables; paying taxes; keeping a record of stockholders and bondholders; analyzing operating costs; designing bridges, buildings, and equipment; preparing deeds, contracts, and other legal documents; preparing many daily, weekly, monthly, and annual reports; and writing thousands of letters to government agencies, other departments, other railroads, and the public.

The design of a passenger car gives us another example of this office work. Before a car is built, 500 to 900 drawings are made. Then, the companies supplying special parts for the cars make another 300 to 500 drawings. From these drawings, hundreds of blueprints are made. Some railroads build cars in their own shops. Other railroads order cars from car manufacturers. Most of the new passenger cars now cost about \$150,000 each.

Science Aids the System

Many of the railroads' research projects are aimed at improving the methods used in office work. A new ticket machine prints a ticket, then records the facts about the sale for the accounting department. New printer telegraph machines and other machines are speeding up messages between offices. Many office records are recorded on microfilm to reduce file space.

Every new method and every new machine is closely studied by the railroads. Whenever these methods or machines prove useful and efficient, they are put to work.

In addition to coördinating all the activities of their own people and trains, the railroads work together to serve the Nation. The railroads' outstanding record during World War II is an example of this cooperation.

Fuel, Material and Supplies

Purchased by Principal Railroads in 1952

Fuel:

Bituminous coal.....	\$ 191,265,000
Anthracite coal.....	4,481,000
Fuel oil—Residual.....	64,205,000
Fuel oil—Diesel.....	281,796,000
Gasoline.....	9,601,000
All other (coke, wood, fuel for illumination).....	7,311,000
Total fuel.....	\$ 538,659,000

Forest Products:

Cross ties (treated and untreated).....	\$ 101,314,000
Switch and Bridge ties (treated and untreated) and timber.....	28,076,000
Lumber (equipment, rough and finished).....	36,874,000
Other forest products.....	10,702,000
Total forest products.....	\$ 176,966,000

Iron and Steel Products:

Steel rail (new and second hand, except scrap).....	\$ 77,676,000
Wheels, axles and tires.....	56,438,000
Frogs, switches and crossings, and parts of same.....	30,712,000
Track fastenings, track bolts, spikes, etc.....	73,865,000
Iron bridges, turntables and structural steel, all kinds	8,230,000
Bar iron and steel, spring steel, tool steel, unfabricated rolled shapes, wire netting and chain, except light coil; boiler, firebox, tank, and sheet iron and steel, all kinds.....	46,247,000
Forgings and pressed steel parts for locomotives.....	2,986,000
Car forgings, iron and steel, and fabricated or shaped steel, for passenger and freight cars.....	40,213,000
Flues and tubes for locomotives and stationary boilers.....	3,168,000
Bolts, nuts, washers, rivets, lag screws, pins and studs.....	11,272,000
Springs, helical and elliptical, all kinds for locomotives and cars.....	4,368,000
Locomotive and car castings, beams, couplers, frames, and car roofs.....	74,591,000
Track and roadway tools, all kinds, including hand and power operated tools, miscellaneous roadway material and fencing. Motor, hand, push and trailer cars, and parts for same.....	17,318,000
Machinery and repair parts.....	26,314,000
Pipe, iron and steel, and fittings, all kinds.....	9,223,000
Hardware, all kinds, including nails.....	8,351,000
Hand and small machine tools, such as drills, taps, reamers, dies, chasers, including air tools and parts.....	14,452,000
All other iron and steel products, including pig iron	7,641,000
Total iron and steel products.....	\$ 513,060,000

Miscellaneous:

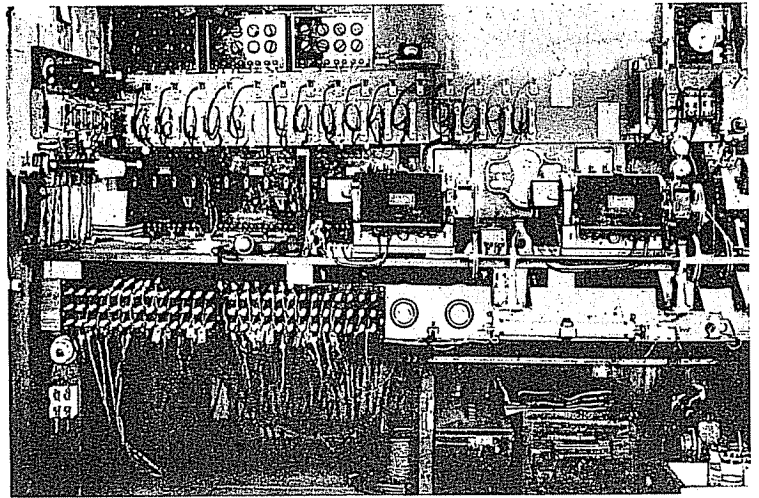
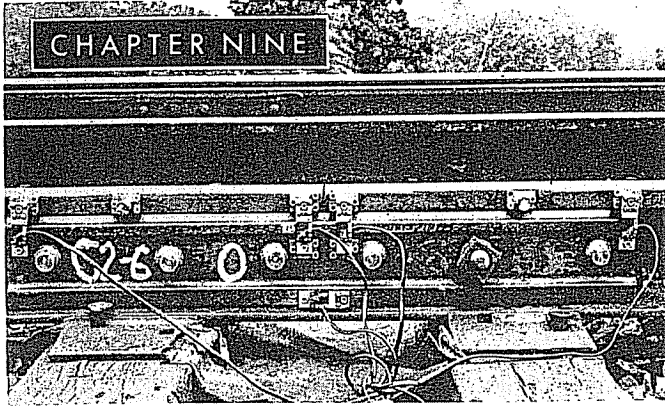
Cement, lime, plaster, building brick and other building materials.....	\$ 9,708,000
Lubricating oils and grease; illuminating oils; boiler compound; waste.....	40,952,000
Non-ferrous metal and non-ferrous metal products	42,967,000
Ballast.....	29,623,000
Electrical materials including electrical material for Diesel locomotives.....	54,325,000
Stationery and printing.....	33,529,000
Commissary supplies for dining cars and restaurants.....	43,980,000
Rubber and leather goods.....	10,813,000
Glass, drugs, chemicals, including chemicals for timber treatment; painters' supplies.....	49,256,000
Arch brick for locomotives.....	2,585,000
Passenger car trimmings.....	15,315,000
Locomotive, train and station supplies.....	27,855,000
Interlocking and signal material.....	54,221,000
Telegraph, telephone and radio material.....	16,365,000
Air brake material.....	23,253,000
Standard and special mechanical appliances for locomotives.....	9,489,000
Automotive equipment and supplies, including diesel material not elsewhere classified.....	84,422,000
All other miscellaneous purchases.....	40,404,000
Total miscellaneous purchases.....	\$ 589,065,000

Grand Total \$1,817,750,000

Source: Reports of the carriers to the Bureau of Railway Economics, Association of American Railroads.

RAILROADS BUILD FOR TOMORROW

Continued Development of Railroads Will Help Build a Greater and Even Stronger America.



Tests of track under actual operation bring steady railway improvements. Wires (left) lead to sensitive instruments (right).

RAILROADS played an important part in the development of the United States. They helped to build many great American cities. They tied agriculture and industry together so that each could better support the other. They united all parts of our vast country.

Railroads are no longer in their early stages of growth. But railroads have shown that they can still grow in usefulness and efficiency. Railroad people are never satisfied with something because it works well. They are always searching for ways to make the railroads even better.

Railroads Make Safety Progress

Railroad progress in safety is a good example of the railroads' record of steady improvement.

Railroad safety has been the subject of systematic, scientific study for many years. Great sums have been spent on improved roadway and equipment developed by engineering and invention. Education in safe thinking and safe practices among railroad men goes on constantly.

As a result, railroad operation, in so far as the traveling public is concerned, is more than three times as safe as it was 35 years ago, and twice as safe as it was 25 years ago.

For each passenger fatality occurring through collision, derailment, or other train accident, since 1941, the railroads performed the equivalent of carrying a passenger 238,000 times across the continent. On the basis of railroad safety records for

the past 12 years, Martha Wilson—the girl in Chapter One—could ride back and forth across our nation, one round trip a week, for the rest of her life, and until the year 4240, without fear of ending her travels through a passenger fatality.

Yet, the railroads continue to work as hard on safety as ever. They know that no new gadgets, or combination of gadgets, will make railroads perfectly safe. But they know, also, that there can be further improvement—and they are at work to make such improvement.

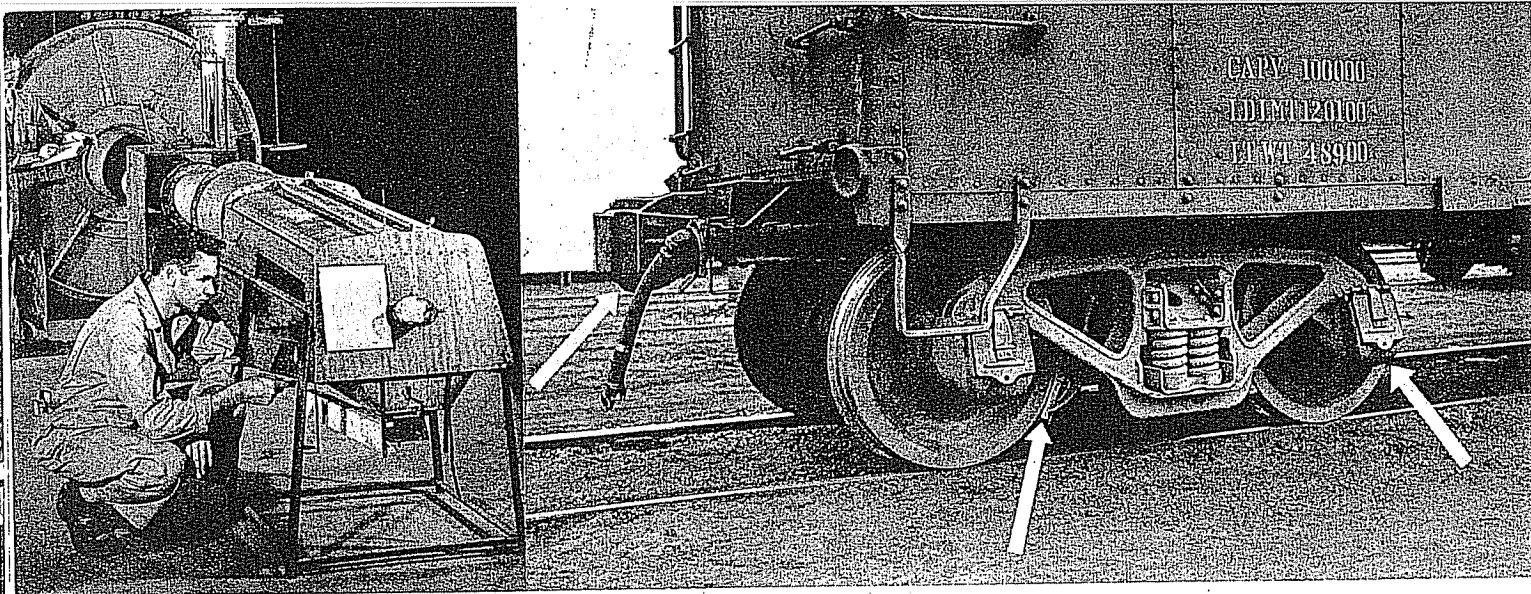
Railroads are putting a new and safer type of rail into the track. This rail is improved through the joint researches of the steel companies and the Association of American Railroads.

Automatic signal systems, owned and operated by the railroads, provide the most complete and effective system of traffic control in the transportation world. A program of improving freight cars from a safety standpoint was started before the war and is being carried forward.

Through the years, the trend of the railroad accident rate has been steadily downward. The railroads are doing their best to keep it so.

Railroads Have Many Problems

Railroads have good reasons for their efforts to steadily improve railroad operations and service. Railroads are "manufacturers," privately owned and operated. However, instead of manufacturing furniture, or books, or mining machinery, railroads



Locomotive fire boxes (left), freight car couplers, brakes, and journal boxes (right) are objects of continuous research.

manufacture *transportation*. They also manufacture much of their equipment. Railroad shops are a big industry in themselves. Railroads, like any business, want to make a fair profit on their product—*transportation*.

Railroads are the great common carriers of the United States. They not only carry people but haul things—anything for anybody, at any time, going anywhere. This is done at rates which are regulated by the federal and state governments, and which are published and known to all interested persons.

When payment to the railroads for carrying persons and goods is not enough to meet expenses, the railroads cannot simply raise prices. Railroads must ask permission of the Government to raise or lower their prices, or rates. Their request goes to the Interstate Commerce Commission. This agency of the Government is in charge of railroad regulation. The I.C.C. must make a complete study of the railroads' request. This study may take much time.

Railroads must also compete with other kinds of transportation—trucks, buses, ships on inland waterways, and airplanes. Railroad men point out that railroads pay for their own roadways, signals, stations, and upkeep. On the other hand, their com-

petitors, railroad men say, are helped by the Government in many ways. The Government builds and takes care of many highways, canals, river channels, and airports at little or no cost to the transportation systems using these facilities, but at the expense of the taxpayers.

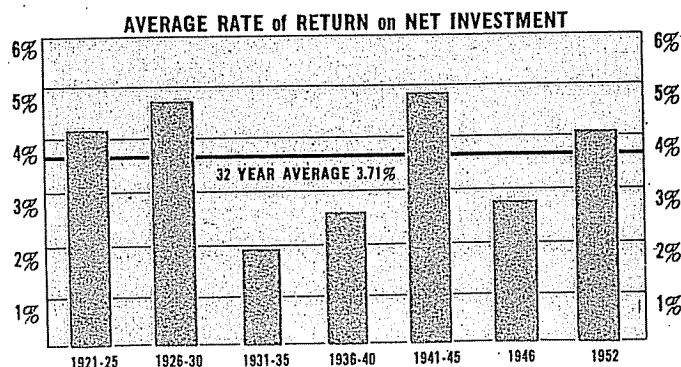
Railroads, however, pay both taxes *and* all the costs of building and taking care of their roadways and equipment. Their tax money is a major factor in supporting schools and paying teachers' salaries.

Railroads Must Make Profits

Throughout their history, railroads have steadily improved their services. However, costs to the public have come down and wages for railroad workers have gone up. Since 1921, the average weekly wage paid employees has more than doubled. Taxes in 1952 were more than four times greater than in 1921. Yet, the average charge for carrying a ton of freight one mile is 1.43 cents, an increase of only a slight fraction. In 1952, the average charge for carrying a passenger one mile was 2.66 cents—nearly one-half a cent *less* than in 1921.

Almost all industry in the United States has been paid for by private capital. Private citizens, banks, and insurance companies lend money to industries. Industries use this money to build their businesses. If a business makes money, the investors share in the profits.

Railroads were built almost entirely by private capital, too. The Government did help lower the cost of building some pioneer rail lines by granting sections of land along the proposed routes. However, of the total railway mileage in the United States today, only about 8 per cent received federal grants of land as an aid to construction. This method of encouraging the building of railroads through un-



settled regions increased land values and land sales. Federal and state governments and the country at large benefited from these increased land values.

The land grants were not gifts. In return for the grants, the railroads carried government troops and property at half price and the mail for four-fifths of standard rates. These rates repaid the Government many times over for the lands granted. The 131 million acres of land received by the railroads were valued at about \$125,000,000, or less than one dollar an acre, at the time the grants were made.

The land-grant arrangement was repealed by Congress, effective October 1, 1946. Up to that time, the railroads had paid over \$1,250,000,000 to the Government in cheaper rates alone. That amount was ten times as much as the estimated value of the lands at the time they were granted to the railroads. The railroads also helped change millions of acres of unused public land into productive, taxable land.

Railroads, like any other business, try to make a profit on the money invested in their buildings and other equipment. Expenses (supplies, equipment, wages) and taxes are up. Rates and fares are only a little higher than they were a few years ago. Thus, railroad profits have been very small. Some rail-

roads have operated at a loss in recent years.

Most industries operate at a profit of 6 per cent or more on their total investment in land, buildings, equipment, supplies, and capital. Even in war years, railroads averaged less than 5 per cent return on their investment. In the years since the war, the return averaged less than 4 per cent.

Despite slim profits, railroads have spent an average of a billion dollars each year since 1946 on their equipment, additions and betterments.

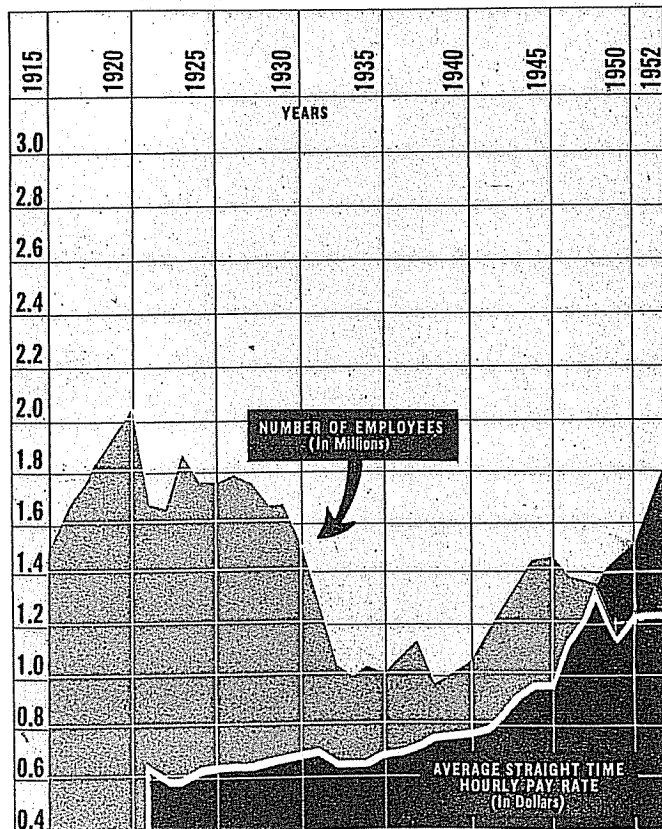
The Railroads' Future Is Our Future

The railroads have faith in their own future. Railroad men know that the future prosperity of the Nation will be tied closely to the prosperity of the railroads. Hauling cargoes over rails is still the most efficient mass land transportation known to man.

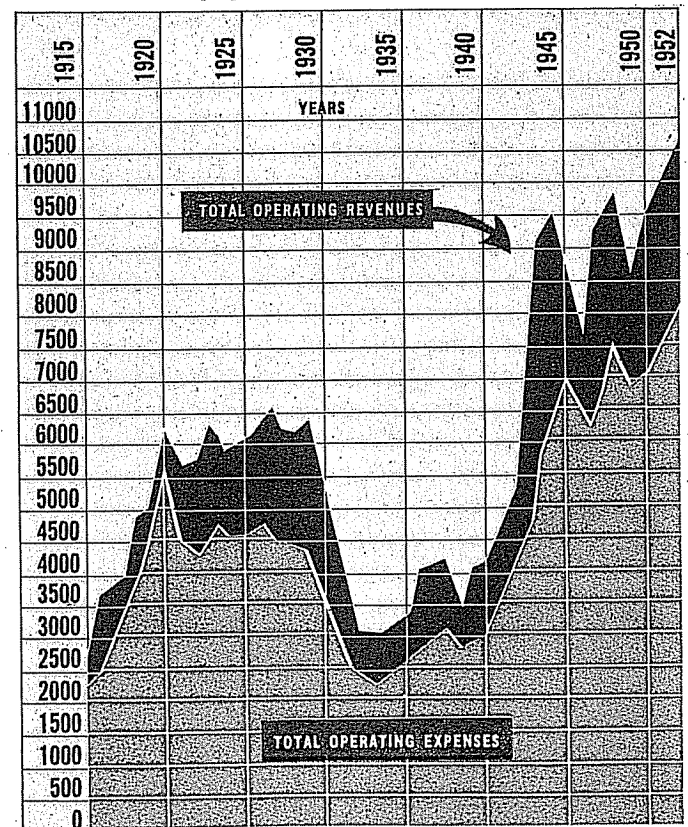
American railroads have proved that our privately owned and privately operated railroads are the most efficient in the world. Scientific progress has helped to give them that leadership.

As railroads tackle their problems, they are using all the tools of science to improve their operation and service. As the railroads of tomorrow prosper, they will help our Nation prosper, too.

The number of railroad employees is lower than it was in the 1920's. Average straight time hourly pay has doubled.



Out of the difference between revenues and expenses must come taxes and payments for use of the money invested.



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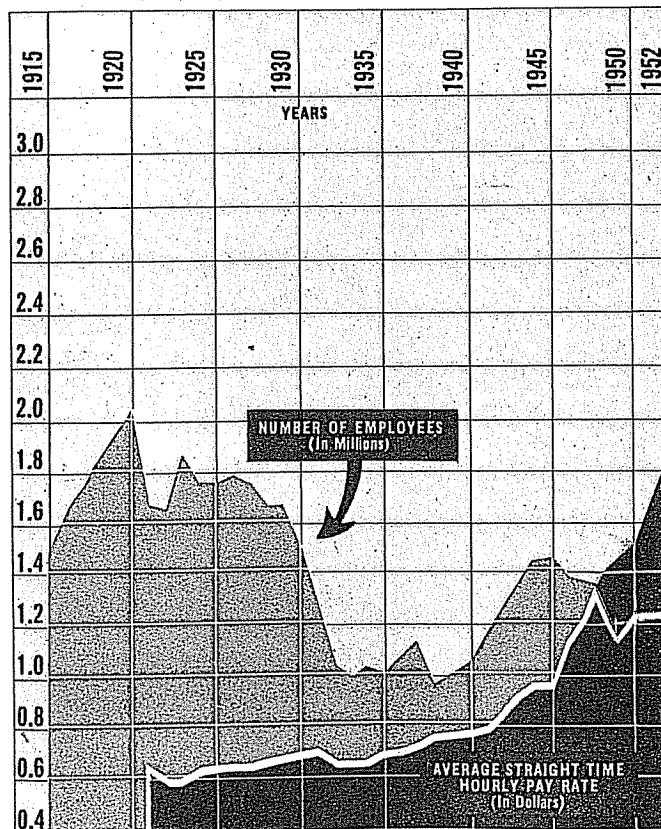
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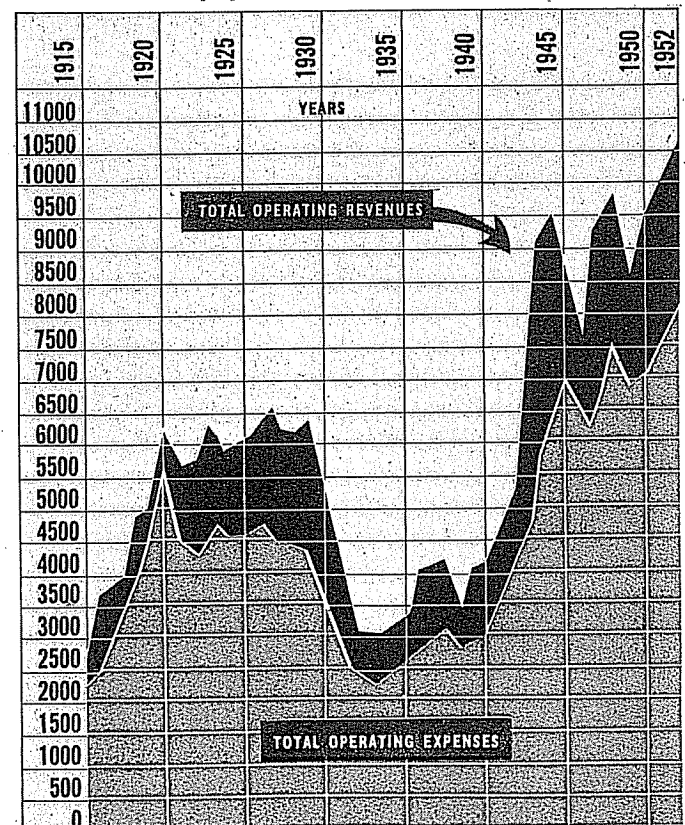
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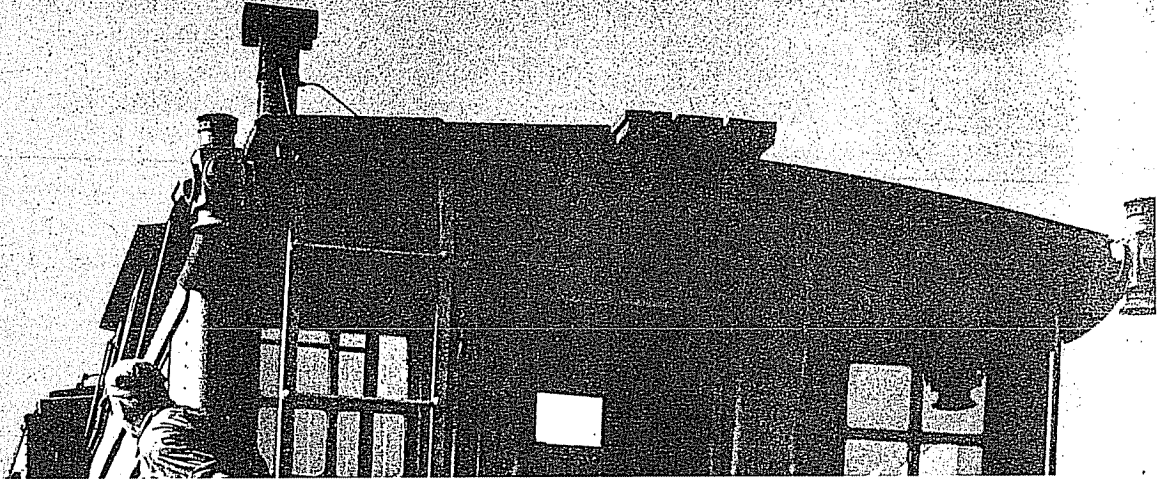


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RAILROAD STORY



RAILROAD STORY

