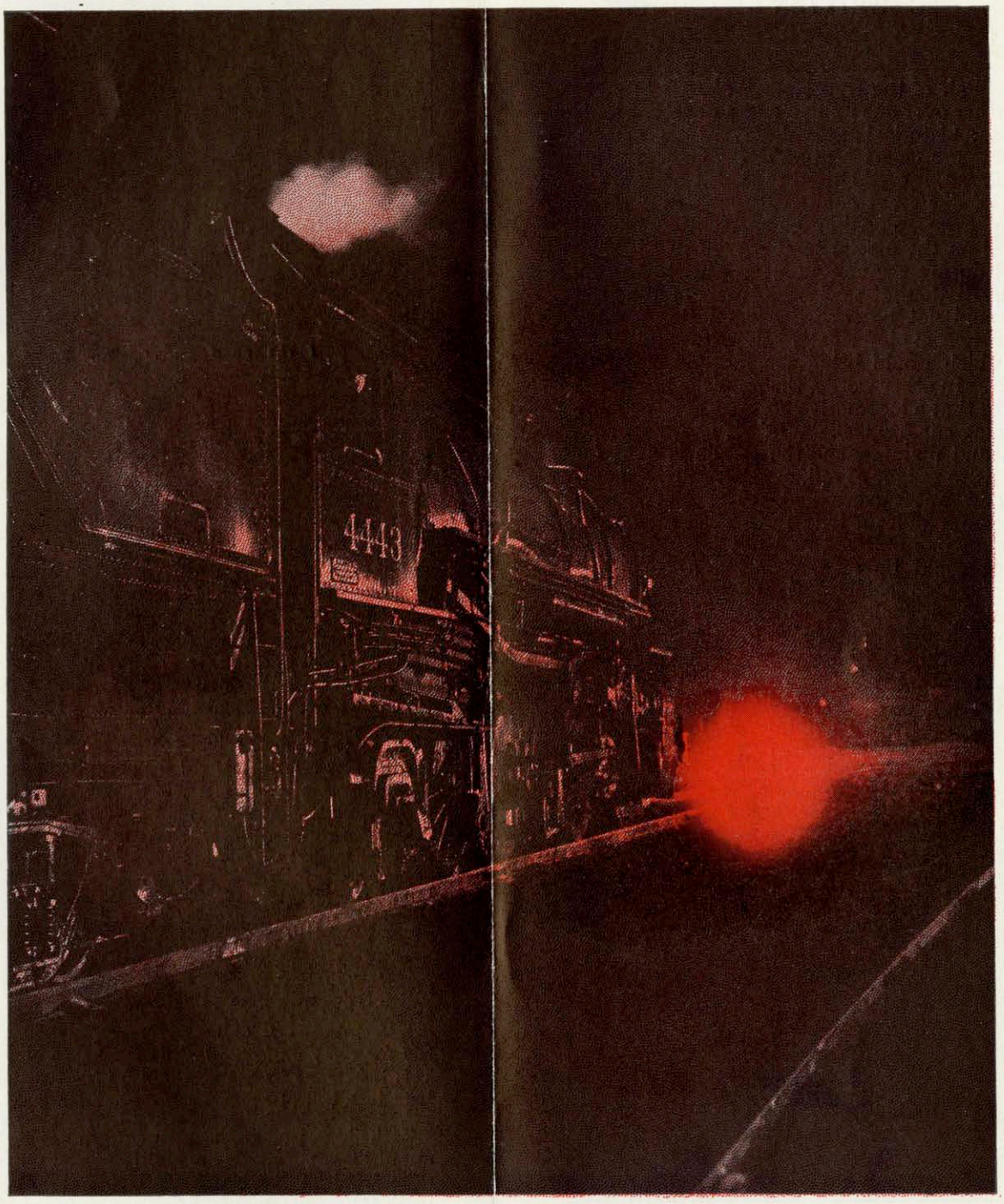



*THE RED FUSEE IS A SIGNAL TO STOP*

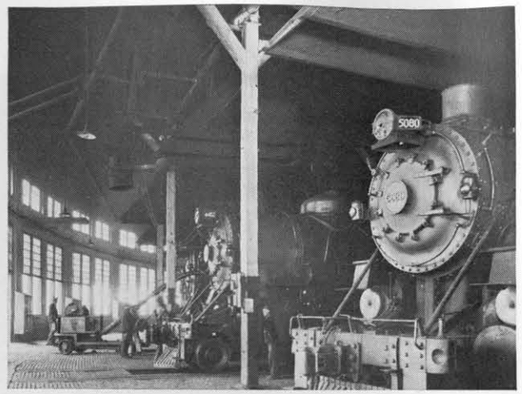
***At night, red-burning fusees, sometimes called flares, afford a splendid means of warning to railroad men***

## HOW THIS BOOKLET CAME TO BE WRITTEN

THE "Fair of the Iron Horse" of 1927 brought together over one million and a quarter people to see a historical pageant of great importance. It was more than a celebration of the achievements of one railroad, it crystallized the spirit back of the railroads of our great country. Some time afterwards, an associate editor of a scientific journal paid a call on the official in charge of public relations and during the conversation a wish was expressed by both that while the "Fair of the Iron Horse" could not be carried around the country that possibly some informative substitute might be evolved which would bring the railroad closer to the people. In other words, the public is interested in knowing that a locomotive costs $85,000 or more and a dining car $45,000. When it comes to construction and maintenance the public is avid for statistics as to weight of rail, cost per mile, amount of coal and water consumed. The matter was milled over for quite a long time, then a comprehensive plan was outlined and not infrequently a locomotive could be seen, carrying a couple of photographers to some outlying roundhouse or freight yard. Finally a series of articles was written which were published in the "*Scientific American*" during the greater part of three years. It was the favorable reaction of the public to these articles that suggested the publication in this condensed folder, of the mass of information collected.

***A picturesque operation is the placing in exact position of a new rail on the leveled cross ties***





***In the Round House, ready for service***

## RAILROADING TODAY

### RAILROAD CONSTRUCTION AND MAINTENANCE

WHO has not, at one time or another, gazed down the length of a straight-of-way of railroad track and found a fascination in watching the steel rails converge to a vanishing point in the distance? But how many of us know the story, equally fascinating, of how those rails were put there and how they are kept so straight and true.

Briefly to tell about railroad construction and maintenance, there is first to be considered the present or probable future need of a railroad as a means of transportation between two different points. When this has been determined a corps of field engineers or surveyors starts to map out the best and most economical route. From their observations they prepare plans so that the necessary right-of-way can be purchased. They also draw up plans and specifications for the use of the contractor who will do the work of grading.

As the work of preparing the finished grade of the road progresses, materials for the construction of the track are assembled at the job and then distributed to place. For the track structure of today, 22 creosote-treated ties are laid for every 39 feet, which is the length of a steel rail. This is followed by the distribution of the steel rails, joint fastenings, bolts, tie plates, spikes and rail anchors.

To build one mile of single track railroad, the following material is required: 204 tons of 130-pound (per yard) steel rails; 270 joint fastenings, which with abrasion tie plates weigh 141 pounds each; 5418 tie plates, weighing 16½ pounds each; 70 kegs of track spikes, weighing 200 pounds each; 15 kegs of track bolts, weighing 200 pounds each; 1650 rail anchors, weighing 2½ pounds each, or a total of 4125 pounds; 2979 treated cross ties, size 7″x9″x8½′; 3600 tons of stone ballast. This represents about 89 carloads of material, the cost of which is $23,000. Labor, supervision, accounting and freight charges add $17,000, so our mile costs $40,000.



After the distribution of material, the ties are evenly spaced and the tie plates placed on the top face of the ties, using a gauge, so that when the rail is placed on them, the inner or gauge side of the rail heads will be exactly 4′ 8½″ apart. This is the distance that has been adopted as standard on all railroads in this country.

Carloads of engine cinders are brought in and dumped on the track. The trackmen raise the rails on these cinders until there is a mat 12 to 18 inches thick, extending over the width of the roadbed. Time is now allowed for settlement of the cinders and then when the roadbed has become stabilized, the cinders are "cribbed out" or cleaned out and used to widen the banks of the roadway, and new ballast, of stone, gravel or crushed hard slag, is distributed. Stone ballast is generally used in heavy traffic, high-speed territories. It is necessary to have from six to twelve inches of ballast between the bottom of the ties and the cinder foundation. This takes from 2200 to 3000 cubic yards of ballast, or from 55 to 75 carloads per mile of single track railroad.

With the completion of construction, the work of the engineer is not finished. Wear and tear, increased by the constant demand for greater speed and heavier trainloads, need to be constantly remedied by replacements and repairs, which have to be made without interruption to traffic. This is the maintenance problem.

***"WASHING"***
***Hot water, oil and compressed air clean the engine***



***The engineer protected by interlocking systems gets his orders to leave the Washington Terminal***

A slight insight into the magnitude of this important work may be gained from the following statistics covering the seven-year period of 1922-1928, inclusive, for the railroads of the United States:

**Roadway and Structures**

| | |
|---|---|
| Additional track and track material | $843,981,000 |
| Heavier rail | 242,848,000 |
| Additional ballast | 85,879,000 |
| Shops and engine houses | 242,470,000 |
| All other improvements | 1,385,603,000 |
| Total | $2,800,781,000 |

The annual program of maintaining a railroad calls first for the renewal or replacement of rails that have become worn. New rail is generally laid "out of face"—that is, uninterruptedly, without patchwork—in stretches of from one to five miles on main line, high-speed tracks. Local conditions and the amount of rail to be laid determine the methods to be used.

Regular and frequent inspections are made of the tracks and their integral parts to detect any flaws in material or workmanship that may develop into safety hazards. The high standard of materials, workmanship, and inspection that is maintained on the railroads is reflected in the freedom from accidents due to defective tracks and other faults that can be avoided by proper attention to important details. In fact, on one major railroad there have been only 1.5

passengers injured in any manner whatsoever per 1,000,000 passenger miles traveled. On this same railroad there has not been a passenger killed in a train accident in over 14 years.

Bridges, buildings, signals, and other structures form a considerable part of the property of a railroad, the construction and maintenance of which call for close attention not only to utility but dignified appearance as well. Safety is the first element of consideration, so that no accident shall occur as a result of failure of these structures. "Safety above everything else" guides here as it does in every phase of railroad activity. All of these facilities, adequately supervised and maintained, provide for rapid and safe transportation. Railroad maintenance is a most fascinating subject because changing conditions never allow problems to remain permanently solved.

Fascinating as this phase of railroading is, probably the greatest appeal to young and old is the so-called "iron horse" or the locomotive.

## 'ROUND A ROUND HOUSE

Although we cannot say truthfully that a locomotive actually sleeps, it is true that a period of rest is beneficial. At the same time it allows a thorough cleaning and inspection of the machine before it again undertakes the responsibilities that accompany its long runs over the rails. Few of the inventions of men see harder service than the engines which haul our passenger trains on schedules that are seldom broken.

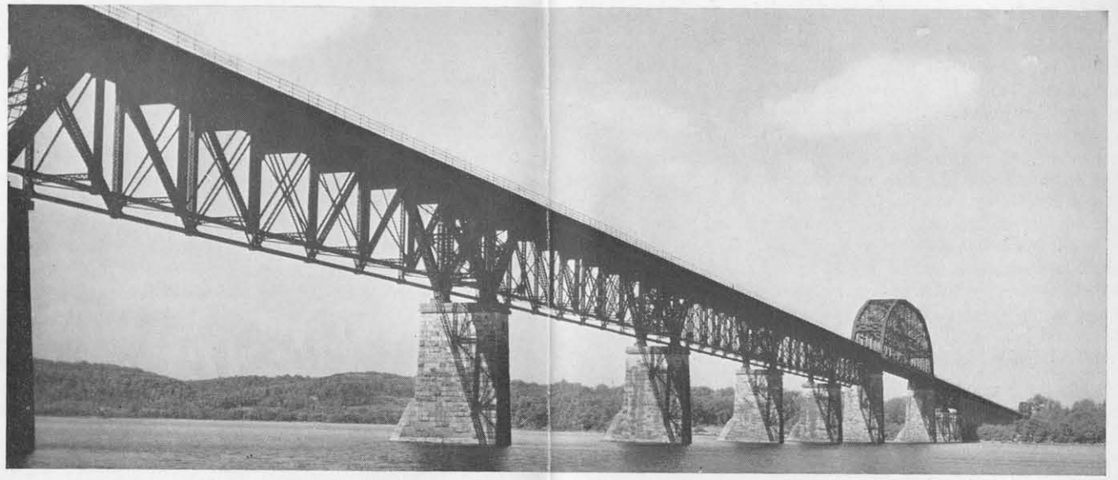
While locomotives are built nowadays on a progression system comparable to that of automobile mass production, still there is an individuality about them which is different from that of any other machine. Early in their careers they disclose variability as to steam distribution, acceleration and tractive effort. All of these little quirks have to be straightened out, so that there may be uniformity in the locomotives as they stand fully fueled, with steam up, on the "ready track."

The service period of a locomotive begins in its berth in the round house. Probably all have seen round houses from the outside, but few have inspected them. A round house should be visited only when "personally conducted" by someone who knows the ins and outs of railroading, for there are many pitfalls for the unfamiliar in the railroad yards. A roundhouse is a grooming shelter, circular in shape, where locomotives can be berthed for examination and firing up, and where minor repairs can be made. The shape of the building is such that the locomotives may be assigned to any designated berth and shifted to it with the aid of a turntable. The same turntable routes the locomotive to the "ready" tracks which lead to their daily tasks.

An elongated hood or "smoke jack" is located over each stall of the round house. This, in conjunction with electric motor-driven draft generators, permits the smoke and gases to be eliminated, so as to keep the round house less murky than it would be otherwise. The locomotives are fired up with the aid of oil under air pressure. When the steam pressure is high enough to permit operation the engine is run out by the hostler to the turntable, which is rotated so that the engine can be run, either to the "ready track," if already supplied with fuel, or to the coal tipple, where 8 to 12 tons of coal are run by gravity into the coal space of the tender. The coaling is accomplished with the aid of chutes and the amount of coal delivered is charged up against the locomotive and the run. While normally the locomotive

*The Capitol Limited in the picturesque Potomac River Valley*





*The Susquehanna River Bridge—More than a mile long*

backs beside the coal bridge to receive the fuel, means are provided at most terminals for coaling on any one of the multiple tracks.

The water is supplied to the tank in the tender with the aid of a movable spout. This tank supplies water to the boiler under the direction of the fireman. The tanks hold from 10,000 to 18,000 gallons and a run from New York to Washington would require about 25,000 gallons of water and 11 tons of coal for the engines of the "President" class. Additional water is taken up, while the train is in motion by scoop from track tanks.

All is now in readiness for the crew, the sand boxes having been filled at the time of taking coal. Sand is indispensable and is usually supplied at or adjacent to the coal-handling station. The sand, to be of any use, must be delivered to the sand dome of the locomotive in dry condition so that it will flow freely when needed. Varying with weather conditions, approximately two bushels of sand would be required for the trip mentioned. Sand is quite a substantial item. A trunk line may readily pay $50,000 a year for sand. The sand is used for starting, in order to give the driving wheels better adhesion to the rails. The sand is blown on the track with the aid of a compressed air jet controlled by the engineer in the cab.

The crew arrives and the engineer and fireman sign the book in the master mechanic's office. They look over their $80,000 beauty to see if everything is "O. K." The dispatcher's orders must now be obeyed and the engine slowly moves to the head of the assigned train and the coupling is completed. The engineer and the conductor compare their watches. The leaving time approaches. The tower man gets a signal from the dispatcher's office. A lever clicks, a disk or semaphore changes position. The conductor signals the engineer, who sands the tracks, opens the cylinder cocks, and pulls the lever which controls the throttle valve concealed in the dome of the locomotive. The stately machine is in motion over the steel rails and we sit back in our comfortable seats while the begoggled and begloved crew on the pulsating locomotive watch for anything that looks like danger.

There is plenty for the crew to do until the end of the run is reached. Then the locomotive pulls back the train into the yard. Here the engineer stops at the hostlers' quarters, delivers the locomotive to the shop forces, and gives an account of his stewardship in a written report.

What now becomes of the locomotive? In the early days the engineer and the fireman did the cleaning, but as business increased, engines became larger; a group known as "wipers" was engaged to go over the machinery, jackets and tanks, and finally six or eight men had to spend several hours to "wipe" a large locomotive. Now, however, a new plan has been introduced. This process, using what is known as the "locomotive wash rack" rapidly removes the accumulation of oil, dirt and dust by a mixed stream of air, oil and water, played at high pressure on the parts to be cleaned.

When the engine comes in from the run, the ashes are dumped at the cinder pit of the inbound tracks. Six men now inspect the locomotive and it is then ready to go to the roundhouse for another preparatory period. At the scheduled time it will be tuned up and fired, ready for the next long run.

But, so far as safety is concerned, careful grooming of the locomotive would be unavailing, unless proper signals are installed and kept in good working order, for signals are the "eyes and ears of the railroad."

## THE RAILROAD'S EYES AND EARS

The modern complex art of railway signaling, in which the swift, sure power of electricity is taking a more and more prominent role, had its beginnings in the necessity for avoiding confusion and collisions in passenger and freight traffic and in the desirability of giving certain trains precedence over others. One of the first major developments, applicable on a large scale, was the manual block signal system, the chief principles of which are still in use. The lines of the railroads are divided into sections, or blocks, each section protected by signals, and the operators, located in strategically placed stations, control the necessary signals by hand through the manipulation of levers. Such signals are usually of the semaphore type and are operated in three positions: Horizontal means STOP; Diagonal conveys the message, CAUTION; Vertical—the way is CLEAR.

While the manual block system provides protection, it is supplemented and improved by the next step in the evolution of train operation by signals—the automatic block signaling system. Such things as broken rails, unclosed switches and other accidental hazards are detected automatically by the electric devices of this system, which is super-imposed on the manual block system, permitting closer train movements since trains following one another are spaced by the automatic signals, the latter having as a controlling medium a track relay energized only when rails are unbroken, switches closed and the block unoccupied by a train, engine or car. Trains moving in the opposite direction, however, are protected by the manual block system, although the automatic system acts as a check on the former, giving double assurance of safety.

In large passenger terminals a great many signals are concentrated in a comparatively small area, and the result is a highly evolved pattern of switches, tracks and signals which appear hopelessly interwoven and baffling to one unacquainted with the mechanical intricacy of the terminal. A good example of this is Union Station at Washington, D. C. The Washington Terminal Company covers a ground area of 18 acres, including 60 miles of track, and an interlocking network of signals and switches requiring the use of over a million feet of electric wiring. The track arrangement entering from the north consists of three double-track lines converging at the New York Avenue interlocking plant and diverging into ten parallel tracks which run through to the point where they again diverge to 32 station tracks at the K Street interlocking plant.

*The Dispatcher's Office, Baltimore. The telephone plays an important part in this work. On the "train sheet" is recorded the time trains pass telegraph offices*



Another and most recent development in signaling is the color-position-light signal and its increasing use is attributed to its several important advantages over the semaphore. These signals are controlled by continuous track circuits, that is, electrical connections, with the tracks so arranged that the passing of a locomotive or car over a signal zone automatically and instantly sets the lights.

Supplementing the signals for general operation are the hand, flag and lamp signals. For instance, there is the picturesque sign language of the lantern or flag. When the trainman swings his lantern across the track, it means "stop." Held horizontally at arm's length when the train is moving, the lantern says to the engineer, "reduce speed;" or in the same position when the train is standing, sends the message, "ready to leave." Raised and lowered vertically, the word is flashed to "proceed." Swung vertically in a circle at half-arm's length across the track when the train is standing, the signal is to "back." But when the train is running and the lantern is swung in a circle at arm's length across the track, the code of the railroad tells the engineer that "the train has parted." If the trainman swings his lantern horizontally above his head when the train is standing, the engineer is told to "apply the air brakes." When the lantern is held at arm's length above the head while the train is standing, the message to the engineer means "release the air brakes." The flag or the hand, used in these ways, conveys the same messages as the lantern. Another signal recognized by all engineers is an informal but very familiar and urgent one, and it is not necessary to be a railroad man to give it. When the engineer sees someone waving any object violently on or near the track, it means to "stop."

These signs are for the eye, but there is another means of communication in railroad signaldom which appeals to a different sense. There has been developed an ingenious system of sound signals, using the locomotive's vociferous whistle. To the uninitiated, these blasts are unintelligible. Apparently they are sounded at random, but in reality every series of whistles has a meaning, and to these shrill messages every railroad man within earshot listens subconsciously and understands them.



*The operators in the Dispatcher's Office at Tower K, Washington Terminal, giving orders to the levermen who operate the switches and signals, all interlocked*

For the benefit of those who have listened to the language of the locomotive and felt curious to understand what it says, these are the messages that come from its steel throat:

One short: Apply brakes, stop.
Two long: Release brakes, proceed.
One long, three shorts: Flagman protect rear of train.
Three shorts, one long: Flagman protect front of train.
Four long: Flagman may return from west or south as case may be.
Four long, two shorts: Flagman may return from west or south, under certain conditions.
Five long: Flagman may return from east or north, as case may be.
Five long, two shorts: Flagman may return from east or north, under certain conditions.
Three long: When running, train parted; to be repeated until answered by the trainman's signal.
Two shorts: Answer to any signal not otherwise provided for.
Three shorts: When train is standing, back.
Four shorts: Call for signals.
One long, two shorts: To call the attention of yard engines, extra trains, or trains of the same class or inferior right to signals displayed for a following section. Also to be given when passing track or bridge gangs.
Two long, two shorts: Approaching public crossings at grade.
One long, continuous whistle: Approaching stations, junctions, and railroad crossings at grade.
One short, one long: Inspect train line for leak.
Succession of short sounds: Alarm for persons or live stock on the track.
Two shorts, one long: Answer to flagman's stop signal.

The ringing of the locomotive's bell, which sounds a warning in the yards and on the right-of-way, might also be called part of the signal system.

The torpedo plays a loud and efficient part in sound signaling. The explosion of two torpedoes is a sharp warning to reduce speed and look out for a train ahead or an obstruction. The explosion of one torpedo will indicate the same as two, although the use of two is required. Trains move with caution after torpedo explosions until a signal is received that the way is cleared. At night, fusees are sometimes used as signals. When the conductor wishes to get in touch with the engineer to notify him to stop, to start, to reduce or increase speed, as the case may be, he pulls the bell-cord and passengers hear the familiar "psst-psst" of the signal.



Still another group of signals to be assimilated by the railroad man is that which takes in the numerous flag and light displays on the rear-end of a train or the front of a locomotive, or the rear of the tender or caboose. Each color, light or flag has a different meaning.

All of these carefully worked-out signaling systems and methods have been gradually built up and perfected along with the development of the railroad and all the trainmen know the signals by heart. They are interwoven with the operation of the trains, the safety of the people and the protection of goods, and they bring us next to the important question of "Time" and the responsibilities of the train dispatcher.

## TIME AND THE RAILROAD DISPATCHER

On the railroad, "Time," it might be said, is a benevolent master. The hands of the clock daily control the movements of thousands of trains. Time tables are consulted by millions of people scattered in cities, towns and hamlets everywhere. The commodities of the nation are moved and delivered on a time basis. From the last stroke of twelve of one year to the last stroke of twelve of the next, time is master—and "waits for no man."

It is perhaps, not too much to say that the whole complex structure of railroad organization would collapse without the aid of the vital, co-ordinating force, symbolized in the clock. Suppose, we'll say, that by some freak of nature, all our watches and clocks should become oddly magnetized and run in crazy fashion. This phenomenon would probably not seriously disrupt the normal processes of most of the industries, but the operation of the railroad would turn into great confusion. Trains would run, for they are guided and guarded by ingenious signal devices, but they would come into terminals behind schedules, miss connections, disappoint passengers, inconvenience shippers, and generally create havoc in the well-ordered transportation processes of the country.

With so much at stake, it is small wonder that the railroads have developed precision and uniformity in their timepieces to such a degree that people have come to regard the railroad as synonymous with time accuracy. The factory

worker looks at his watch, the housewife checks her clock, as the fast limiteds fly past city, town and countryside. The city motorist, driving to work in the morning past the railroad station, glances at the clock tower to check his watch, even though he does not catch a train. The railroad agent and ticket clerk receive scores of telephone calls inquiring about the time.

An examination of the machinery by which this split-second accuracy and rigid uniformity of time are brought about, doubtless will interest the layman. On the Baltimore and Ohio, a special department handles the job—the "Time Service Department." Accuracy is achieved by this department through a system of standard clocks located in the office of every train dispatcher, and in every terminal where train and engine crews are required to register and begin their work. It is the task of certain designated employees of the Company to keep the standard clocks accurate. At noon daily, they receive the correct time by wire from the Federal Government. Should the standard clock be as much as ten seconds fast or slow, it is corrected.

Uniformity of time over the railroad system is brought about by rules that require men in many branches of the railroad to compare their watches with one of the standard clocks at certain specified times. These men include supervising officers, such as road foremen of engines and trainmasters; members of train crews, such as engineers, firemen, conductors and flagmen; employees in the Maintenance Department, such as signalmen, supervisors of track and track foremen. All these men have something to do with the running of trains and each man must have what is known as

***The hand or flag is moved the same as lantern. Here, the signal is "Stop"***



***Trainman signaling "Stop" with flag***

a standard railroad watch, the product of any one of a designated group of watchmakers, well-known for making time-pieces of enduring accuracy. To insure the safe operation of trains, each railroad man's watch must tick in unison as the fine craftmanship of the most skillful manufacturers of watches of our day can make possible.

As a further guarantee of uniformity, employees in the branches of service mentioned must take their watches once each month to an official watch inspector for comparison, and twice each year (April and October) for thorough inspection. For this purpose, the Baltimore and Ohio has 136 official watch inspectors, all of whom are practical jewelers and watchmakers. Their work has been examined and certified by the Horological Institute of America, a body sponsored by the Bureau of Standards of the United States Government. These inspectors are located accessibly in the cities and towns along the line of road and, with their cooperation, inspection service is kept at maximum efficiency.

While the main tracks of the trunk line railroads of the country are well protected by modern signaling devices, there are still many miles of single track where trains are permitted to run from block to block with time accuracy—and that means time-piece accuracy—as their principal safeguard. In emergencies, or on the occasion of violent storms, the signal systems of even the most highly developed main lines may be thrown out of order, and here, again, the unfailing watches in the hands of engineer, conductor and flagman, are the basis of safe operation.

Most of us at one time or another, have seen the engineer and conductor of a passenger train stand beside the steaming



locomotive at a terminal comparing their watches at the start of a long run. This is a check that takes place hundreds of times a day on the quarter-million miles of American railroads. The running of trains nowadays, however, is more than the mere job of getting them from one terminal to another on time. Regularity and smoothness of operation all the way are also considered important factors in good railroading. This is why we may often see conductors and flagmen looking at their watches as they pass familiar landmarks, such as towers and stations along the line, even when passing them at high speed, in order to check the regularity of the run and smoothness of the speed maintained.

## HOW TRAINS ARE MOVED

Now we come to another part of the story. Who guides the engineer along the many steel lanes of the railroad, through the dense centers of traffic in the big cities, in and out of busy railroad terminals—always on time? Unlike the motorist, who not only operates his machine, but also has a choice of the roads he wishes to follow, the engineer controls only the speed of the locomotive, not the route. It is not his job to "steer." He must follow orders, which are conveyed to him by the highly efficient devices of the modern railroad signaling system. Silently, day and night along his route, lights flash, semaphore arms move, switches turn, controlled by an invisible hand guiding the trains to their destinations. Trace that guiding force to its origin and you will find the railroad train dispatcher sitting at a table in his office, probably poring over his "train sheet."

A superficial glance at the things required of a train dispatcher will convince you that his job is not a simple one. Upon his shoulders rests the responsibility for moving many


***Buying the Ticket***



***Clerk is "working" the run and checking up***

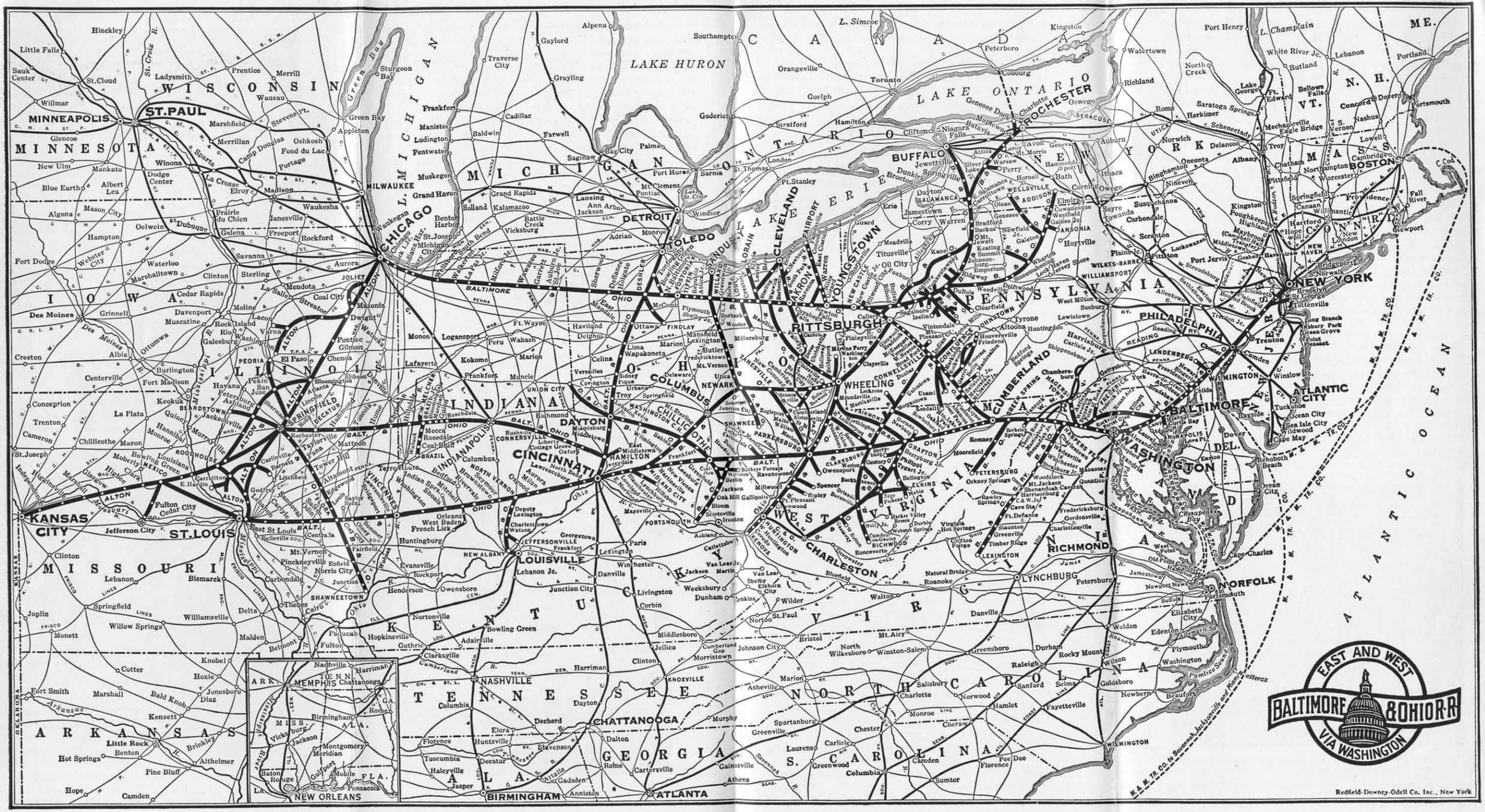
trains daily in a precise and orderly manner with safety and promptness. In unforeseen emergencies he must decide quickly what to do to forestall costly blockades and to avoid confusion. It is essential that he possess qualities of steadiness, sobriety and reliability, together with initiative and capacity for passing rapid, sure judgment on any given situation.

Assigned to each dispatcher's office is a certain part of the railroad, and all trains entering or leaving that section are subject to his orders. Also subordinate to him are the operators in the towers and telegraph offices located in the territory under his care.

Supplementing the telegraph in dispatching, the telephone has come to be commonly used, so much so that it has long ceased to be a novelty. With the receiver at his ear, instead of his hand upon the key, the dispatcher keeps in constant touch with operators and towermen.

When the dispatcher desires to talk with an operator at a certain location, he "selects" that station by turning the proper key in a cabinet directly in front of him. A bell rings on the operator's end and he quickly answers. Frequently the dispatcher is in touch with several stations at one time, which is made necessary when orders are issued to trains at different locations.

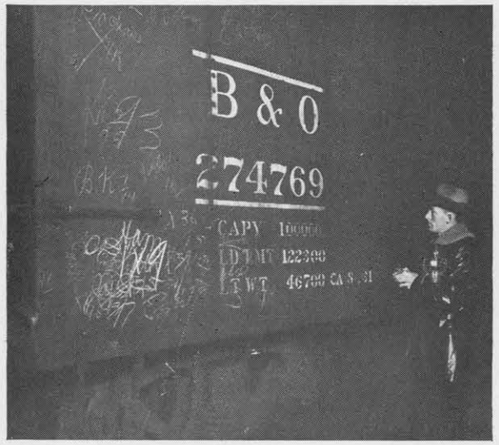
In his important and responsible work, the dispatcher functions hand in hand with time. The standard clock in his office is his most valuable ally. He uses it constantly in directing and following the movement of trains. He uses the minutes and seconds in planning the routes of trains. And time is also vital to him in making the quick decisions that are always necessary.


WISCONSIN
MINNESOTA
IOWA
ILLINOIS
MICHIGAN
INDIANA
OHIO
KENTUCKY
TENNESSEE
MISSOURI
ARKANSAS
ONTARIO
NEW YORK
PENNSYLVANIA
WEST VIRGINIA
VIRGINIA
MARYLAND
DEL.
N. J.
CONN.
MASS.
VT.
N. H.
ME.
MINNEAPOLIS
ST. PAUL
CHICAGO
MILWAUKEE
DETROIT
TOLEDO
CLEVELAND
BUFFALO
ROCHESTER
SYRACUSE
BOSTON
NEW YORK
PHILADELPHIA
PITTSBURGH
BALTIMORE
WASHINGTON
WILMINGTON
ATLANTIC CITY
NORFOLK
RICHMOND
LYNCHBURG
CHARLESTON
WHEELING
COLUMBUS
CINCINNATI
DAYTON
INDIANAPOLIS
LOUISVILLE
NASHVILLE
CHATTANOOGA
ATLANTA
BIRMINGHAM
KANSAS CITY
ST. LOUIS
MEMPHIS
NEW ORLEANS
LAKE HURON
LAKE ONTARIO
L. Simcoe
L. Champlain
ATLANTIC OCEAN
EAST AND WEST
BALTIMORE & OHIO R.R.
VIA WASHINGTON
M. & M. Tr. Co. to Savannah, Jacksonville and Miami
Redfield-Downey-Odell Co. Inc., New York

Now, specifically, just what does the train dispatcher do? For one thing, he compiles daily an elaborate train sheet, which is the dispatcher's record of the movement of trains in his territory. Operators in the telegraph offices and towers out on the line keep him informed as to the time of trains passing those points and he carefully makes note of this information on the train sheet. In the case of freight trains, he must ascertain and record the total number of loaded and empty cars in each train and the total "tonnage". These facts, studied in relation to each other, enable him to tell which trains to side-track and which to let through, in short, to chart the course of trains through his section.

How does the dispatcher know which train shall precede others? In this he is guided largely by definite operating rules which specify the precedence of trains, and it follows that in order to give the passenger train a clear track, the freight train would be diverted or side-tracked at the proper time to enable the passenger train to pass without delay. The same is true of freight trains of different classes. For instance, a freight train which carries stock or perishable shipments is considered fast freight and would be given preference in right of way over a train handling ordinary freight.

When there are many freight trains moving upon the railroad, the dispatcher's job becomes even more exacting. He must be familiar with the class and capabilities of the engines pulling the trains and, as previously mentioned, must ascertain how many cars, loaded and empty, make up each train, together with the total tonnage. If a freight train consists of 100 loaded cars, for instance, and the gross weight of each car is 50 tons, the total tonnage of that train would be figured at 5000 tons. Passenger trains, of course, have precedence over the freights and this ever-recurring problem




***This man in a railroad yard is recording the number and coded classification and destination of a car, as it is to be transferred to another line and the owning line will receive compensation. The code is printed in book form***



of getting the freight trains out of the way becomes more difficult with each increase in the number of trains handled.

Another interesting chapter in railroading of today and maybe more interesting in these pages, because the public sees only a portion of it, is what might be termed the birth, life and death of a railroad ticket.

## THE RAILROAD TICKET—ITS BIRTH, LIFE AND DEATH

Every railroad traveler has heard the trite, courteous and important request of the conductor as he enters a car and starts to check up his passengers—"All tickets, please." But the ordinary person gives little thought to the origin of his ticket and what happens after the conductor has collected it. Yet the railroads have developed a science of ticketing their passengers that never fails to account for the revenue that each ticket represents to the carriers.

Long before the passenger ever thought of his trip, the ticket that he buys has been prepared for him. For the purpose of having tickets readily available, there is a ticket supply department in the general offices of every railroad, with an adequate staff to prepare in advance the thousands of tickets of many different kinds. Not only must there be plenty of tickets always on hand, but the thousands of agents in the stations all along the line must be supplied with sufficient to take care of demands.

Beyond supplying, selling and collecting tickets is their accounting. To take care of this, there is the auditor of passenger receipts, with a large force, to assemble, sort, classify, record and indicate both the mileage and the revenue involved in each and every ticket. A ticket is handled, on the average, 15 times.

The accounting is not as easy as it looks. If a passenger buys a ticket from Washington to New York, or from Baltimore to Chicago, for example, over the Baltimore and Ohio, it is a simple proposition. There are only to be considered the point of origin and the destination. However, should a passenger intend to go, for instance, from Baltimore to San Francisco, or to Los Angeles, Portland or Seattle, his part of purchasing the ticket and handing it over to the conductor still is simple, but the work of the railroad necessarily becomes complex. The line in question ends in the west at St. Louis, Springfield and Chicago, and beyond these points the ticket becomes a joint one with whatever railroad the passenger uses to continue his journey.

To take care of transfer to another railroad, a separate form is used for each line operating. To simplify the process and handle the interline business economically, there was adopted what is known as a "multi-form" ticket, which in many instances resulted in the discarding of as many as ten or more of the old individual forms, thereby bringing about a very substantial reduction in the number of tickets which agents were required to carry.



As the railroad ticket developed, so did its various kinds. The simplest is the local ticket, but its progeny are many, including the one-way, the round-trip, the excursion, the commutation, the printed destination, the clergy, the conductor's cash fare receipt, the interline one-way and round-trip, and the interchangeable scrip coupon book.

Upon receipt in the office of the ticket supply clerk the tickets are filed in cases awaiting requisitions from the agents along the line. When printed, all tickets are consecutively numbered so as to be readily identified in the records.

This might be called the infantile period of the ticket's existence, for the ticket has not yet begun to move, but it does begin to move when the agents' requisitions come in. Then it steps into passive life, being taken from the ticket supply case where it has reposed and sent to the agent, who stores it in his selling case subject to call.

Now the ticket has "gone to school" and the big experiments of its life are before it. It is ready to be sold to the first customer. Suppose it be an interline ticket. The prospective passenger steps up to the little station, say, at Nappanee, Indiana, and expresses a desire to go to Boston, Massachusetts. The agent takes the ticket from the case where it has been resting, stamps the date on the back, receives the proper amount and the ticket changes hands. It leaves home—for a while. Although the issuing line may not reach Boston, the interline ticket will take care of the passenger to that point, and the passenger will not have to worry about procuring other tickets.

Next the ticket begins its active life. Under its new owner (who really seems to think a lot of it for he carefully puts it safely away), its adventures begin.

After the train is in motion, the ticket is shown to the train conductor (and, perhaps, as well as to the Pullman conductor) and the passenger announces his intention of stopping over in Washington, D. C. The train conductor then punches the Nappanee to New York portion of the ticket, indicating that he has honored it to the end of his run, and written on the back of the coupon "Off at Wash., D. C."

Distinctive ticket punches are furnished to the division superintendents by the ticket supply clerk, and the division superintendents give them to the conductors on their respective divisions. Each punch, different from any other, tells an interesting story to the uninitiated. If the destination shown on a ticket be a point on the parent line, the last conductor examining the ticket and honoring it to destination would retain it and send it along with other collected tickets and his reports to the auditor of passenger receipts.

Conductors distinguish passengers in the coaches who have already turned in their tickets from those just boarding the train by issuing small train checks which are of different colors to signify various destinations or travel zones.

Reverting to the interline ticket to Boston, the various conductors en route, after examining the ticket, report to



***Reports and waybills for freight auditor come by train and are sorted***

the auditor of passenger receipts that they "have honored but not lifted" it, this report being made on a special form. On the next to last lap of the passenger's journey the train conductor takes up the Nappanee to New York coupon of the ticket, sending it to the auditor of passenger receipts, while the passenger retains the larger portion of the ticket that is good on the foreign line for the remainder of the trip to Boston. This part of the ticket is taken up by the conductor on the last foreign line and forwarded to his auditor for final disposition.

After the receipt of the Nappanee-New York coupon of the ticket by the auditor, it is checked against the report of the agent who issued the ticket at Nappanee. Then, along with others, the coupon is placed in a metal box for lodgment with the custodian of records. About two months usually elapse from the time the ticket is lifted until it is permanently filed away.

Under the regulations of the Interstate Commerce Commission, used tickets may be destroyed at the option of the carrier after completion of the audit, with some exceptions. The used local tickets, however, are held by the Baltimore and Ohio for a period of six months after the audit, and home interline and foreign interline tickets are held for a period of three years after the audit, as the tickets are needed for reference purposes.

A macerating machine puts an end to the useful life of the railroad ticket. It again becomes pulp, whence it came.

### Accounting For The Tickets

As interesting as the life of a railroad ticket are some of the operations in connection with its collection by the conductor and the accounting through the auditor's office. Cash fares collected by conductors from passengers who have not provided themselves with tickets beforehand are

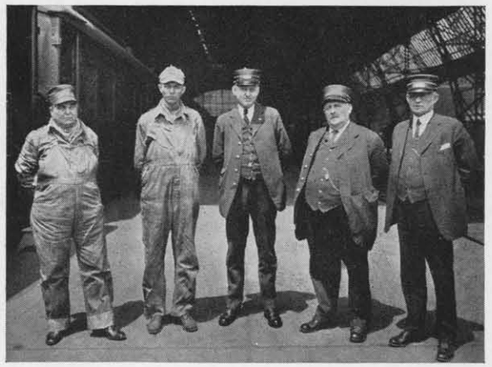
reported by the conductors on a special form. A separate form is also made of scrip coupons honored. The conductors forward these reports to the auditor, with a report of tickets "honored but not lifted," together with lifted tickets or coupons reading to destinations on their respective runs. This enables the auditor to keep a complete check of the earnings of the various passenger trains.

When coach fares are collected the conductors issue duplicate receipts, one to the passenger and the duplicate portion for the auditor. The cash so collected is deposited by the conductor with the agent at the end of his run. This cash so given to the station agent is deposited by him with his other station receipts in a local bank, subject to the check of the railroad's treasurer.

After the conductor has examined and punched all tickets and coupons, local and interline, collecting those terminating on his run, he assembles his reports and arranges the tickets and coupons he has collected, separating coach from Pullman passengers for statistical and rating purposes, and puts them all in a large envelope addressed to the auditor. The envelope is then forwarded by train mail.

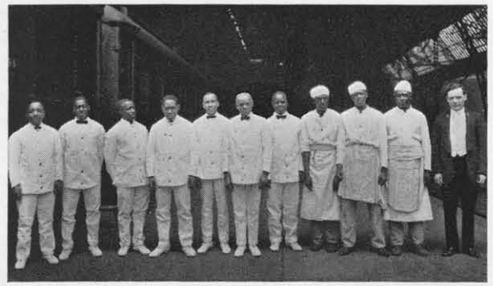
These envelopes, filled with tickets, coupons, and so on, which have been collected, and the various reports of the conductors, are found each morning piled high on the mail table in the office of the auditor of passenger receipts. The mail clerk sorts the envelopes according to divisions of the road as represented by the territory covered by the run of each conductor.

The train earnings bureau next receives the envelopes, and from the contents the clerks "work" the revenue and earnings of each train by divisions. After the train earnings clerks have completed their records, the local and home interline tickets are assorted into selling station order and filed in the ticket cases. At the end of each month these filed tickets are checked against the agents' ticket reports, and the fares, at which time the tickets are reported, are checked against the authorized tariffs so as to insure proper accounting. Tickets issued by other railroads are assorted



*Train Crew*





*Dining Car Crew*

by the names of the companies issuing them and are checked against the reports rendered by their respective companies.

Having shown what happens to a railroad ticket, we pass on to a kindred subject—the wanderings of a freight car.

## PEREGRINATIONS OF A FREIGHT CAR

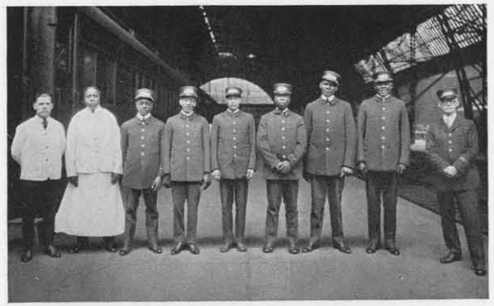
As soon as a freight car starts on its peregrinations, agents and agencies of the road begin to make records of its travels, so as to render proper charges for shipments. While the actual operation of a freight car in transit is important, equally so is the accuracy of the detailed records of its movement. Upon these records depends the main source of a railroad's life—the revenue which, through the treasury of the company, buys the cars, the motive power that hauls them, and quantities of supplies. Most important of all, these revenues provide the pay rolls for the men who maintain the tracks, men who make records, men who watch over the freight in transit and protect it from robbery, men who are in the signal towers, men who truck the platform freight and those who work in the shops to repair locomotives and cars when a wheel has gone flat or some part broken, and other men and many women who form the big "railroad family."

Before freight is loaded, the transportation department has seen to it that the proper type of car is available and that it is in good physical condition. The car is examined as to its roof and sides, and to make sure that the doors fit snugly when closed, so that the contents will not be damaged by dampness or wet weather while on the road.

The car is then placed alongside the loading platform of the freight shed, and is cleaned and made ready for its consignment of goods. After being weighed, freight is loaded into the car, particular care being taken to pack it so that it will not be tossed around in the car and that the available space is used as far as possible. The car is then closed and sealed.

The merchandise has been brought to the freight station by drays and trucks, with an order from the shipper, and on this order should be given complete information as to the name of the consignee, destination, description of the shipment and whether the shipper wants to specify the railroads





*Sleeping Car Crew*

over which the shipment will move. In the freight station the orders are taken up and a receipt is given to the drayman for the shipper.

The shipping orders are sent to the freight office for making up the waybills, which show the name of the consignee, destination, full routing and so on. Should the shipper fail to specify the roads over which his shipment is to move after leaving the original line, the originating railroad will accept and forward to destination in accordance with tariffs in effect at the time. The waybills accompany the shipments to their respective destinations.

The car is next pulled out from the loading platform track and forms one unit of the freight train. At strategic points "classification" yards help to simplify the making-up of through trains in order to route them economically. The train finds itself on its way to Chicago, passing over several operating divisions, and there are as many operating train crews as there are divisions. The waybills pertaining to our car are passed along from conductor to conductor, usually through the medium of the yard master at each divisional or terminal point.

When the train pulls into a receiving yard at Chicago, the road engine is taken off and a switch engine takes its place. Then the train is split up, the switch engine "drilling" out the cars, shoving those for the freight house on one track, those for track delivery on another, and those for industrial or private sidings on another. Through this process our car is spotted on the freight house delivery track. It is put in its place as soon as possible after arrival, generally by 7.00 A. M. The waybills are turned over to the agent, who prepares the notices of arrival, expense bills and delivery receipts. Notices are sent the consignees who sign the delivery slips when they or their representatives send for their freight.

In unloading our car, the freight for delivery in Chicago is taken out first and then the freight for other points is either transferred to another car or moved by drays to the connecting line serving as a medium through which the shipment is moving toward its destination. It might be, however, that there would be a large consignment for Milwaukee, Wisconsin, the transfer of which might entail considerable

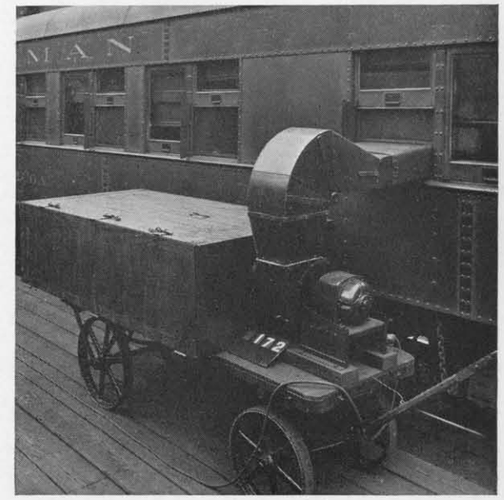


expense and time. In this event, the freight would be left in our car which would go on to Milwaukee over another road, or "foreign line," filled up by the freight agent with shipments received from other points for Milwaukee. If room permitted, all freight that could be packed into the car for points beyond Milwaukee would also be stored in this car. Should a similar condition prevail upon arrival of a car at Milwaukee, it might, eventually, be found on the Pacific Coast, for it is not unusual to see eastern road cars in all parts of the country. If the car was loaded with all Chicago consignments, it would have been emptied there and put in shape for re-loading.

The first clearing-house for the records where the location of any car, on the line and off the line of road, belonging to the Company or hired from another company, can be ascertained at any time, is the car service department. With the records of cars moving over all lines of the railroad, thousands of miles apart, or on sidings waiting for loading, the department serves the shipper by being informed where consignments are located. To be able to accomplish this service the department has the experience of years plus modern accounting devices, as well as a system of forms that were not just "blue-printed" in advance for the purpose, as one would plan a building, but are economical forms that have been made from practical study over a long period of time.

The records are made from freight train reports and show the movement of cars not only over the "home" railroad, but the various lines over which cars belonging to the home railroad may be in transit, as well as foreign line cars moving over the home road.

Transfers are checked at junction points or in the yards as illustrated. The cabalistic chalk marks on the cars have




*Pre-Cooling Sleeping Cars*

a meaning all their own. For example, the "93" and "BK7/14" on the freight car illustrated on page 23 indicate that this particular car was moved by Train 93, and was classified on July 14th, destined for Youngstown, Ohio.

While the outside of a railroad's general office building is quiet and serene, the inside is buzzing with fascinating activities. Of course, the life inside depends on the loaded cars outside. Thus the peregrinations of any freight car, moving at any time, whether full or empty, can always be traced in the records kept at headquarters. The car maybe on the Canadian Pacific or Canadian National bound for "home" with a load of dressed lumber; delivering coal to the Great Lakes; down in Florida being loaded with fruit, or in Kansas, but wherever it be its location is recorded. The cars are kept moving as promptly as possible, but the business of their movement and the accounting thereof is difficult to master. Ask any railroad man!

## AIR CONDITIONED TRAINS

Aside from the many ramifications of railroading, more recently, has come a great boon to the railroad traveler, especially during the hot, summer months, with the advent of air-conditioned trains.

Probably the best way to tell the story of air conditioning on the Baltimore and Ohio would be, first, to relate its history, then describe what it means, and finally give an account of how the apparatus works.

While commercially available a number of years before the Baltimore and Ohio adopted air conditioning to the small confines of a railroad car, the railroad's mechanical and electrical engineers, in 1920, began to look into its possibilities. They made studies and many experiments to overcome the obstacles in their way to success.

*Women need no longer "bootleg" smokes, for a comfortable compartment with real chairs is provided for their use*



*In the Air-Conditioned Lounge Car*

Finally, in 1929, they fitted up a Baltimore and Ohio passenger coach and tested the air-conditioning apparatus which they had installed on it during that summer, and discovered that smoke, dust, soot and other foreign matter could be removed from the air of the car, and next, that they could control its temperature. From these investigations they learned sufficient to equip the dining car "Martha Washington," which was put in regular service on April 23, 1930. This was the first time in railroad history that an air-conditioned car was operated.

So successful was the innovation installed in the "Martha Washington" that on May 24, 1931, two complete trains, the "Columbian, operating daily between Washington and New York and stopping at Baltimore, Wilmington and Philadelphia, were air-conditioned throughout and placed in service. They were the first air-conditioned trains in the world, followed later in the summer by other similarly equipped trains.

On April 20, 1932, the Baltimore and Ohio increased the use of air-conditioning on its trains by again inaugurating the first completely air-conditioned long-distance sleeping-car train, the "National Limited," operating daily in both directions between New York, Cincinnati, Louisville and St. Louis. This train is made up entirely of air-conditioned cars, the principal innovation on it being the application of air-conditioning to sleeping cars, which had presented the major problem of circulating the conditioned air to rooms, compartments and sections. After two years of study and experimentation, Baltimore and Ohio engineers finally worked out the successful method which has been incorporated on its trains. This insures the same control of atmospheric conditions in sleepers as it had previously obtained in its dining cars, parlor cars and coaches.

The "Capitol Limited," New York-Chicago train, was likewise equipped and started its first air-conditioned run on May 22, 1932.



Air conditioning the equipment of railroad trains means that the air is first cleaned—dust, smoke, fumes, cinders, etc., are removed—and then this pure air is cooled and dehumidified to the proper degree and circulated.

Should the thermometer outside register 100 degrees, inside each car of these trains the temperature can be made fifteen or more degrees cooler, if desired, or whatever might be the proper degree of comfort. This is thermostatically regulated.

Each car in these specially equipped trains has its own air-conditioning unit so that any car may be taken from a train without interfering with the mechanical and electrical devices that control the air-tempered, soothing, comfortable effect in the other cars of the train.

The windows of the cars are kept shut purposely, first, so that the air-conditioning apparatus may function properly and, secondly, this practice greatly reduces the noise from outside. Compared to the ordinary train, the interior of the air-conditioned trains is noticeably quiet, which has a pleasant and restful effect on travelers. Altogether, the comfort provided by these trains on hot, humid, muggy days makes summer travel a real pleasure.

The air-conditioning apparatus is operated by a specially designed combination belt and gear drive from the axle of the car. This generator is of sufficient capacity at all times to furnish the necessary power for operating the air-conditioning equipment and simultaneously provides the additional current to the storage battery, so that the equipment can be run for pre-cooling before a car leaves the station, and whether the car is in motion or standing still.

The machinery for compressing the refrigerant is located under the car and is driven from flexible belts under the car. The air is circulated inside the car, being drawn from the


*This is not a "diner" or a "broiler," but it is a real lunch counter, where beverages, fruit and sandwiches can be obtained*



*In the Diner*

car into the air-conditioning unit under the ceiling at one end of the car. Here it passes over fin-surface cooling coils containing the refrigerant, "freon." Heat and moisture are removed by these coils, and since the coils are always saturated with moisture, any dust and dirt in the air are also removed. This air, after being cleaned and dehumidified, is then forced through an air duct on one side of the car through openings in the upper deck into the car. On the vestibule ceiling of the car is a fresh-air intake, controlled by a damper. This fresh air is filtered for the removal of dust and dirt before it is mixed with the returning air from the car to be again cooled and forced back into the body of the car.

### Pre-Cooling Sleeping Cars

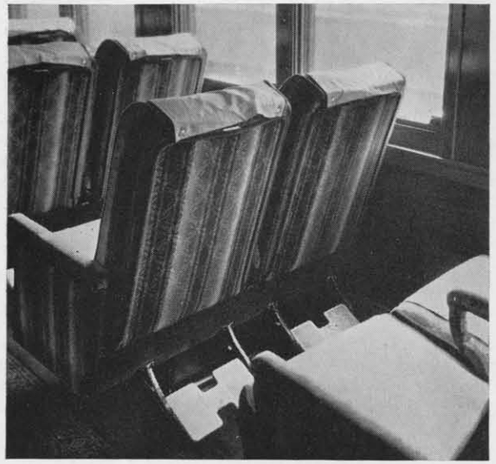
In addition to air-conditioning and air-cooling solid trains, the Baltimore and Ohio, in the last two years, has introduced and developed another feature of summer travel, the pre-cooling of sleeping cars for comfortable night travel.

The pre-cooling arrangement consists of small enclosed trucks in the interior of which are placed 1700 pounds of ice. A tube connects the ice compartment of the truck with the aisles of the Pullman sleeping car and when the motor, with which the truck is equipped, is set in motion, air is pumped through the iced compartment.

This is done prior to the cars being put at the disposal of passengers, so that on hot, humid nights, those taking the "night trains" find the air of the sleeping car cooled in comparison with the outside temperature and can sleep comfortably. This arrangement is in use at all principal terminals of the railroad, and there are now 72 pre-cooling machines in use throughout the system.

Other major innovations on the Baltimore and Ohio during the past several years have advanced travel comfort to a superior degree. The individual seat coach has become the standard coach on trains of the Baltimore and Ohio. It is a great improvement over the old style, double-seat coach in vogue for so many years on all of the railroads.

The reclining-seat car offers over-night comfort for those who do not care to use the sleeping car. By means of cranks each seat can be inclined independently. The arm rests are of sponge-rubber composition, soft and comfortable. The



*The foot rests are adjusted to the proper angle so that when the seats are in a reclining position the posture is most rest-producing*

middle arm-rests are collapsible and disappearing so they can be removed if desired to permit children to lie down. Foot-rests are also provided, adjusted to the proper angle so that when the seats are in a reclining position, the posture of the occupant is conducive to rest. Thermostatic control is provided on each side of the car to insure even temperature throughout, and, in addition, there are ceiling and window ventilators. Decorations are plain, the car being finished in living-room style. In addition to ceiling lights, small individual night-lights are furnished so that those who wish to read may do so. There are separate smoking rooms for men and women, with comfortable arm chairs. A novelty of these cars is the lunch room at one end, where simple refreshments can be obtained at all times during the night, with a watchful attendant on hand to supply the various needs.

There is also the individual bed-room car, used on overnight trains for the greater convenience of those who desire more comfort and privacy. These bed-rooms are equipped with full-length beds, instead of berths, hot and cold running water, toilet, electric fan, large mirror, thermos bottle, folding table and other special conveniences, all within the private room.

A later comfort-innovation is the private-section sleeping car, containing ten regular sections and four private sections. In the private sections, the beds are slightly recessed to allow standing position in the berths while dressing and undressing. Immediately adjoining are private washroom and toilet.

The trucks underneath all passenger cars have been made uniformly six-wheeled and they have also been "rubber-heeled," rubber shock absorbers having been put in between all metal parts. This decreases the noise as well as makes for smoother riding.

With the same attention to little things, locomotive engineers are trained to take great care in handling their trains to



avoid jolting. Huge locomotives are directed so well that trains of steel passenger cars are started and stopped so imperceptibly that the passengers hardly know the cars are moving. Longer locomotive runs have been established so that not so many stops as formerly have to be made to change engines on through runs.

If space permitted, many other more or less important improvements to passenger service could be enumerated here —but, the dining car is always an attraction if not a necessity.

## THE RAILROAD REFECTORY

The Baltimore and Ohio has lent itself to establishing on its principal trains the colonial type dining car (most of which have been air-conditioned). This type of car has a very home-like appearance, with an atmosphere of refinement. Without sacrificing elegance and hospitality, the management has striven to keep its high standard and make its dining car service everything that might rightfully be required of transportation catering.

One of the major parts of a dining car is the kitchen. Rarely does the public ever see this sanctum of the chef. Like the engine cab's interior, the kitchen is private. Yet, as there would be no locomotion without the engine, there would be no meals without the kitchen, which is a dynamo of activity and energy.

On one side of the little kitchen are the ovens; above it, the flat stove for frying and boiling. Next to it is the 36-inch broiler for steaks, chops, etc. Adjoining the broiler is the steam table, on which roasts are kept savory and juicy. Then there is the soup tureen. Next is the coffee urn from which is drawn the beverage whose excellence is celebrated.

Across the narrow aisle from the frying, the steaming, the broiling, the boiling and the roasting, stand the refrigerators where meats, fish and vegetables are kept fresh. At one end of the kitchen are the warming cupboards containing the platters and all service dishes. Every square inch of space is utilized. The food for the diners is passed from the kitchen through two small apertures to the waiters in the pantry.

There is practically nothing in the way of food that cannot be prepared in the pantry and kitchen, with their complete facilities, that is prepared in the largest hotels.

The chefs on the dining cars are experts. Any one of them could write a book of master recipes for any kind of meal. Under the chef are two assistants, one of whom is called the second cook, whose duties are to prepare certain foods; the other, the third cook, who takes care of cleaning the utensils, dishes, etc., and keeping everything spick and span and in order in the kitchen. The second and third cooks are serving apprenticeships to become chefs some day. In addition, a traveling chef makes the rounds further to inculcate other niceties of cuisine and help standardize methods in preparing the meals on the railroad.

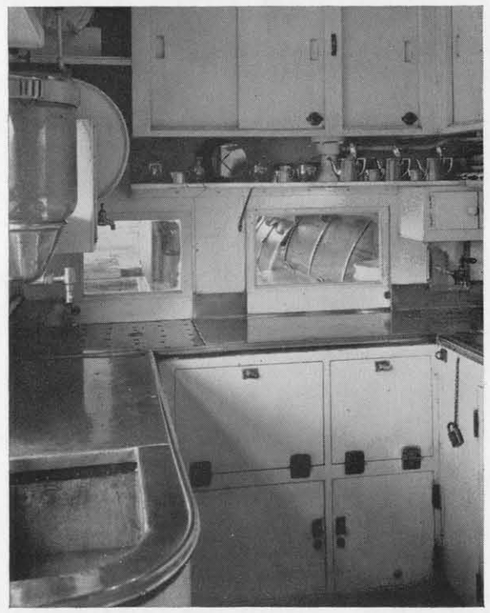
Extreme care is exercised in the selection of the stewards and waiters, and even in greater degree in purchasing food. Expert buyers do the "marketing" to supply the cars. All cars are stocked two or three times a month with dry groceries and bottled goods, while perishable food is put on every day at Baltimore, Chicago, Cincinnati, Pittsburgh and Wheeling.



Although stewards are held responsible for their men and supplies in equipment and food and much depends on the skill of the chefs, another principal element in successful dining car operation are the waiters. Their attentive, polite and courteous manner does much toward inviting a "guest" to come again, because he leaves the dining car with appetite appeased and with pleasant recollections. Coming into closest contact with the public, the waiters are especially trained in decorum under all circumstances. Upon them, as well as the stewards, the management relies as "host" for the Company.

## FINALLY!

There are many other things of fascinating interest about a railroad, but it would require volumes to hold their stories. Considering that the steam railroad has been in existence but a little more than a century, which is but a small span of years compared with the many centuries of slow animal-propulsion upon which man depended for transportation, the present state of efficiency, reliability, safety and comfort provided by the modern railroad is really marvelous. While other means of inland transport have come into public favor during recent years, it must be remembered that the railroads of the country not only are responsible for the quick settling of a people across a continent and unifying them, but even when faced with competition on land, on sea, in air, they still haul 75 per cent. of the nation's natural resources and industrial products. Like Tennyson's "Brook," they'll "go on forever."



*A Glimpse of a Dining Car "Kitchen"*





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# Railroading after a Century of Progress

EAST AND WEST
BALTIMORE & OHIO R.R.
VIA WASHINGTON

*Warm in Winter*

# Railroading after a Century of Progress

EAST AND WEST
BALTIMORE & OHIO R.R.
VIA WASHINGTON

*Cool in Summer*