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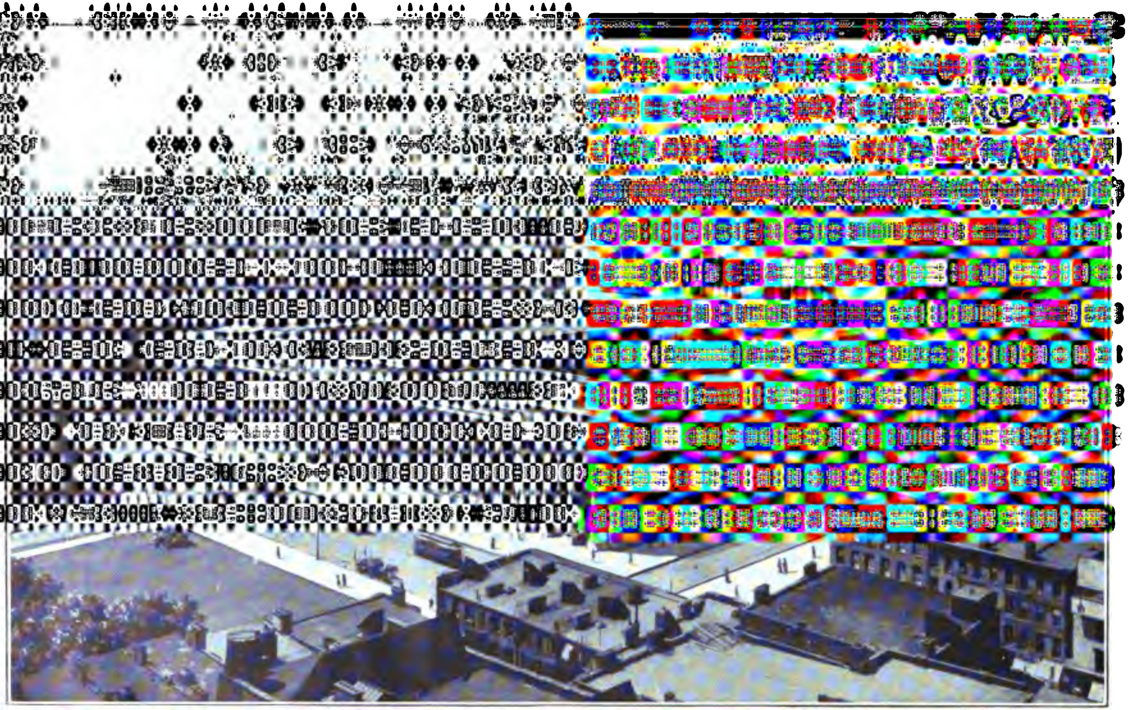

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GREAT AMERICAN INDUSTRIES

FOURTH BOOK

TRANSPORTATION

BY
W. F. ROCHELEAU

A. FLANAGAN COMPANY
CHICAGO

PREFACE

The last twenty years have been a period of organization in all large industries, and in no industry has this feature been perfected to such an extent as in transportation. The great railway and steamship systems cover the world with their activities, and their service has been brought to the highest degree of perfection attained in any line of industry. The general interest shown in transportation is the author's reason for adding this, the fourth book, to the series "Great American Industries."

The early history of each branch of the transportation industry is given in brief, that more space might be devoted to the later and more important developments. Our modern methods of transportation and communication have made "all the world kin"; therefore the scope of this volume differs from that of any of the others because, from the nature of the subject, the author found it necessary to give some account of the development of the different methods of transportation in other lands, so closely are they associated with the development of the same methods in the United States.

Because of the limitations of the work only the larger problems have been included. It was thought better to describe these to such an extent as to enable the reader to gain a clear idea of them, than to give less complete descriptions of a large number of topics. For this reason, descriptions of street car systems, elevated railroads and ferries connected with large cities have been omitted.

W. F. ROCHELEAU.

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GREAT AMERICAN INDUSTRIES

TRANSPORTATION

PRIMITIVE METHODS OF
TRAVEL AND TRANSPORTATION

Introduction

Since the time when, according to the biblical account, man was driven forth from the Garden of Eden, he has been a wanderer upon the face of the earth. In his early wanderings he was directed by curiosity and by desire for food. He was naked and without weapons, but he soon learned to use a stick and began to carry it with him. This was probably the first carrying done by the race. As soon as men began to roam any distance from home it became necessary to carry the children who were too young to walk, and the child in arms was the second burden that man learned to bear. Then were added clothing and food, and later the portable tent or shelter.

From these primitive beginnings the great systems of transportation have been developed. For many generations, we do not know how many centuries, man was his own beast of burden, and all early devices for carrying were for helping to hold the pack or other burden in a convenient position. The first devices were directly to assist the hand, and in our study of this subject we should always bear in mind that all artificial work goes back to man. Indeed, "all work is imitation of man's work. The primitive form of every moving device exists in the human body."

Travel and transportation are related to every art and to almost every activity of man, and every trade known to exist has done some work especially for the traveler and common carrier. Moreover, it is by means of travel and transportation that the people of one locality are made acquainted with the people and products of other localities. An interchange of products between people of different localities was one of the earliest results of this mutual acquaintance. Each tribe produced something that the others did not possess or that they could not produce so well, and the exchange was to the advantage of both parties to the trade.

Tribes dwelling in fertile river valleys could raise an abundance of grain, while those dwelling in the mountain and forest regions became skilful in making weapons and such implements and utensils as could be easily fashioned of wood. The forest tribes supplied those of the valley with implements and weapons, and in return secured supplies of grain. This arrangement is still found in the Congo region in the interior of Africa, where the Pygmies and people of a larger race exist side by side. One race constitutes the hunters and forest rangers while the other constitutes the farmers. The hunters supply the farmers with meat and other forest products for which in return they receive their supply of garden produce and other foods obtained from the soil.

Men's wants have increased as their acquaintance has been extended, so that now the most highly civilized nations draw upon the resources of the earth to supply their real and fancied needs. Scarcely any commodity exists where it is needed or where it is used up. To illustrate: the rubber of the Amazon region is taken in its raw state to the river ports by the natives who gather it from the trees. The raw rubber is shipped to the manufacturers in the United States, where it is made into boots, shoes and other articles. These in turn are taken to the wholesale dealers, from whence they are distributed to the retail dealers, who sell them to the final consumers. Thus the material of which our rubber shoes are made is transported at least four times before the finished product reaches the final consumer. This is only one of many illustrations that might be given to show how almost every commodity is handled and carried several times before it is placed in possession of those who use it.

Many localities possess much larger quantities of some commodities than they can use, and they exchange the surplus for money or other commodities. The United States raises more grain and meat than are necessary to support its own people; consequently it exports large quantities of these products to Europe, for which in return it receives money or manufactured goods. The Argentine Republic sends to Europe large quantities of wheat, wool and meat, and Australia is engaged in a similar trade with wool and meat. Thus these countries have built up an extensive commerce between themselves and the countries of Europe. Again, every neighborhood has its local distribution of goods from the store to the customer, and there are constant exchanges of articles between neighbors and friends, so that all over the earth there is a constant running to and fro of men and women whose combined travels in a single day, some ingenious calculator has estimated, exceed fifty times the distance of the earth to the sun.

These endless goings and carryings bind together the trades and occupations of each community, making the farmer, the merchant, the mechanic, the blacksmith all dependent upon each other. They join in commercial bonds the nations mutually dependent upon each other for supplies, and promote peaceful relations among the peoples of the earth. Transportation and commerce have always been the chief promoters of civilization, and in the twentieth century they have become so extensive that they girdle the earth with bands of steel in the form of railways and ocean cables, and bind the nations together in an inseparable union whose common purpose is to advance the general welfare of men.

Transportation differs from other highly organized industries in that all stages of it are found in the most highly organized systems of railways and steamship lines. In no better way can this be illustrated than in transportation by a large steamship carrying passengers and freight. The freight is loaded upon wagons by men and hauled to the dock, where it is unloaded and taken on board the ship by hand, or on trucks moved by men. Then it may be placed in the hold of the vessel by elevators or cranes operated by steam or electric power. Porters attend to the passengers' baggage, and the ship carries both freight and passengers to the destined port. When the destination is reached, the ship must be unloaded by men and the goods again loaded upon wagons and delivered to their owners.

Apply this illustration to handling freight on railways and in wholesale and retail stores, and you will be surprised to see how closely the early methods of carrying are still identified with the most modern methods of this great industry.

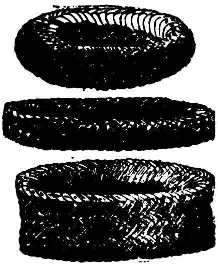
A FILIPINO WOMAN CARRYING WATER

TOTING AND CARRYING

Man was the first beast of burden, for he lived many years upon the earth before he began to domesticate animals. As soon as the family was organized, he placed the burden of carrying upon woman. In the early days of the race the women carried the burdens, made the fires, cooked the meals and set up or constructed whatever structure sheltered the family from sun and storm. Meanwhile, the men defended the camp from hostile tribes and hunted game for food. These early practices are still found among the native tribes in the interior of Africa and among some of the Indian tribes of North America.

In general, women prefer toting, that is, carrying their burdens on the head, and men prefer packing or carrying, that is, bearing the burden on the shoulders or back.

Men are still employed as carriers in all countries. They are necessary where other means of transportation have not been developed, and their employment is economical in regions so densely populated that labor is cheap and land can not be spared to raise fodder for pack animals, as in the densely populated portions of China and Japan. In these countries and among uncivilized tribes carrying has become a fine art. Each nation and tribe has developed its own peculiar methods and appliances, and one familiar with the subject can tell with a good degree of certainty, from the structure of the carrying device and the material of which it is made, the tribe or nation from which it comes.



HEAD BANDS
PUEBLO INDIANS

One of the necessities of life for which the earliest provision for carrying was made was water, and as far back as carrying devices can be traced, two sorts of vessels were used for this purpose; those made from skins of animals, and jars or jugs. The essential features of the modern pitcher originated in the early water jars of uncivilized peoples.

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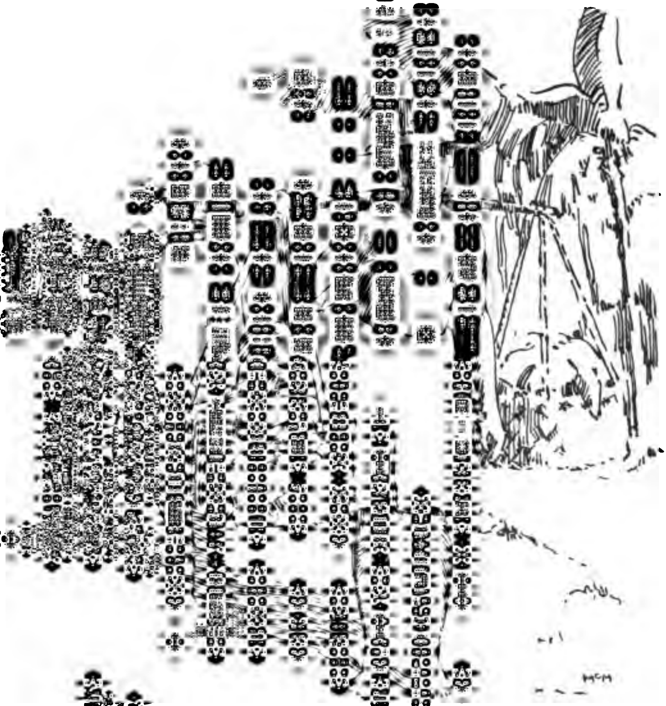

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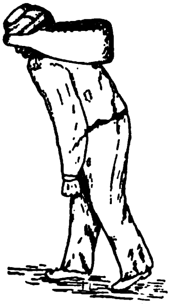
among people of the negro race the world over, and wherever they are found, toting negro women are frequently seen, whether in the wilds of Africa or in the cities of southern states. The negroes of Angola use a basket having a head pad on the bottom, and woven from light, strong material. In the basket is placed whatever the carrier is to tote. A load of from fifty to seventy-five pounds in weight is easily handled by these people.

Packing or carrying burdens on the back or shoulders is the method commonly employed on long marches and in caravans. The pack may be fitted to the back and tied together, or it may be placed in a receptacle constructed for the purpose. The pack is held in place by a head band, which passes over the forehead, by shoulder bands, or a breast band, or any two of these devices may be combined. The wide part of the band shown in the illustration passes over the forehead and the basket is held in place on the back, resting against the shoulders. The basket is used for holding whatever is to be carried. The carrier often holds a staff in one hand, while the other is left free. There are over 100,000 carriers in the Congo region, engaged in bringing the products of the forest to ports from whence they find their way to the channels of trade. Each man carries a load of seventy-five pounds, and he will travel twelve miles a day, which is equivalent to carrying one thousand pounds one mile.

A carrying device common in Northern Europe and sometimes seen in the United States and Canada is the yoke. This consists of a piece of wood hollowed out so as to fit over the shoulders, and having a space cut out in the middle for the neck. The yoke is usually about four feet long, and has cords with hooks attached to each end. The objects to be carried are attached to the hooks and the weight is sustained from the shoulders. This yoke was formerly used for gathering sap in the sugar orchards of New England and Northern New York. Its only advantage is that it keeps the object carried away from the limbs, so that one can walk more easily. A neck strap and a frame serve the same purpose, and they are commonly used by the women of Normandy. In the Philippine Islands and some other regions in the Far East, a simple shoulder pole is used in place of the yoke, for carrying packages, and sometimes a baby may be placed in one basket and merchandise in the other.

A FRAME USED IN PLACE OF A YOKE

The porter's knot, commonly used by the carriers in England, is a pad fitted to the shoulders and held in place by a band passing over the forehead. The head is protected by a stout leather cap. The pad serves as a resting place for the object to be carried, and it enables the carrier to take any sort of package, such as a box, bag, case or cask, that is not too



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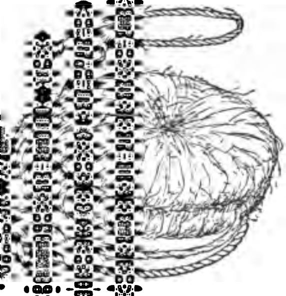

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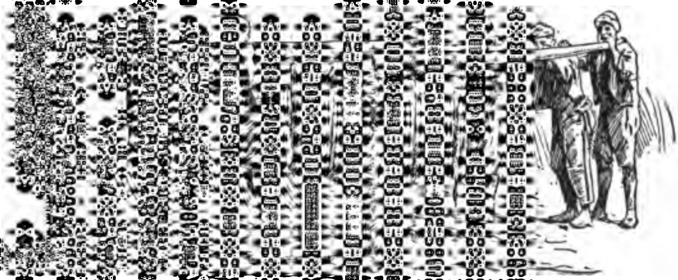

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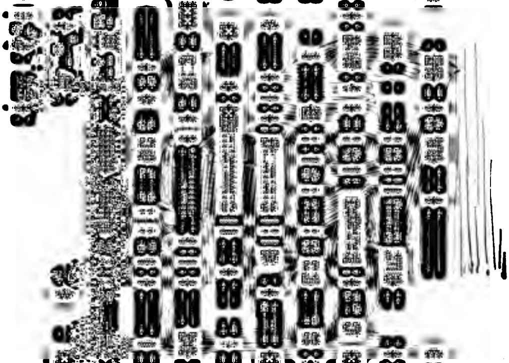

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instance, of the hundred million horses in the world, at least eighty millions are found within the temperate regions, and the elephant and the camel constitute the chief pack animals of the Tropics, because the climate of those regions is such that other pack animals can not be used there with profit.

A few elephants are employed in Burma, Ceylon, and some other countries of the Orient, where the heat is intense and where vegetation is abundant, but they can not be used in regions having a crowded population, because all of the land is required for the support of the people. An elephant will carry a load of from 1800 to 2500 pounds and thrive in a country where a horse can not live. Elephants are valuable in handling timber and other heavy objects, which they pick up with their trunks and carry to places directed by their drivers, where they carefully place the burdens in position. Under careful directions these huge animals will pile logs or timber as skilfully as the best workmen. They are also fitted with harness and used to haul heavy loads.

The camel has aptly been styled the "ship of the desert," for he is the only beast of burden that can endure the long marches across the barren wastes of Africa and Central Asia. His feet are adapted to walking in the sand; he is not affected by the heat, and if necessary he can go nearly two weeks without water and several days without food, subsisting upon the fat which is stored in the hump on his back. He can carry a load equal to that of three horses, and can travel with as great a degree of speed. Goods from the region of Soudan have for [illegible] ert to Cairo, [illegible] uthern coast [illegible] camels. On [illegible] plies for the [illegible] on regularly [illegible] arrival and [illegible] own several [illegible]

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Before the construction of the Trans-Siberian Railway, an extensive caravan trade was carried on between China and Russia in Europe. Tea was carried on the westward trip, and European goods on the return. Since these distant countries have been connected by railway, however, the caravan trade in Asia is carried on principally in the plateau of Turkestan, where the yak, a species of native ox, is used.

The llama is the native pack animal of South America, and is used in the mountainous regions where neither the horse nor the burro can be employed with profit. The llama belongs to the camel family and is especially adapted to mountain climbing. It can carry from fifty to two hundred pounds, is docile and easily managed, and it is very useful for carrying goods in the high altitudes of the Andes. In all other parts of South America the horse, the ox and the mule are used.

The burro is common in Mexico, Europe, western Asia and in the Rocky Mountain regions of the United States. These little animals are very surefooted and faithful, and with less care will perform relatively more service than the horse. For transportation in the mountains and for long distances over the country roads they are usually gathered in considerable numbers, forming pack trains. They travel in single file, each animal following the one ahead with but little direction from the drivers.

In some countries of Europe and in the Polar regions, the dog is used to carry packs and haul sledges and carts. In Holland, Belgium and Nor-

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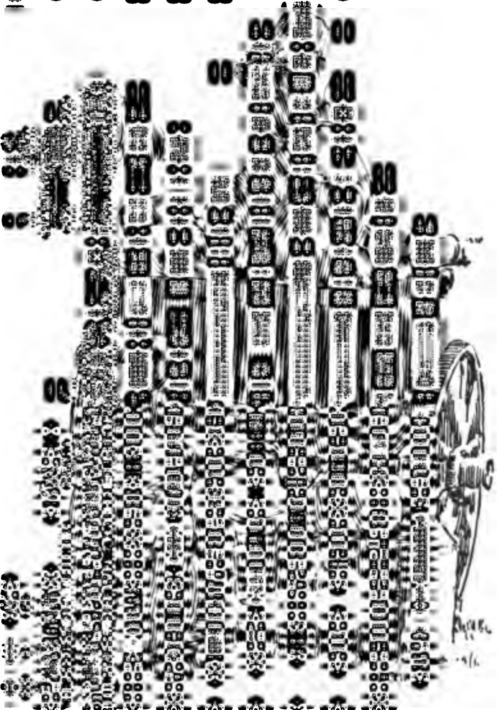

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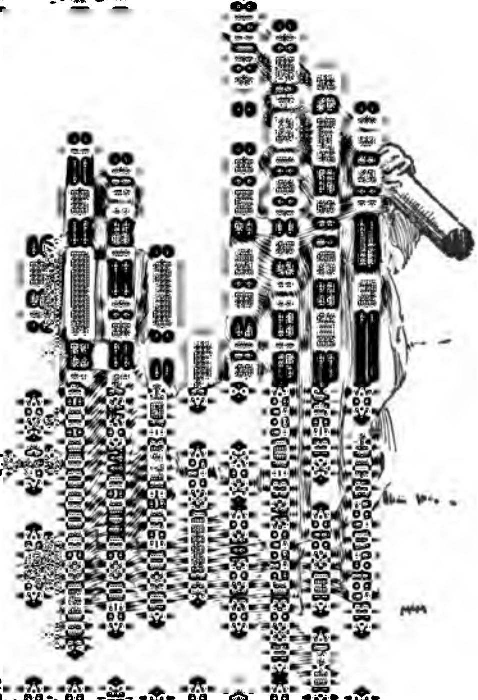

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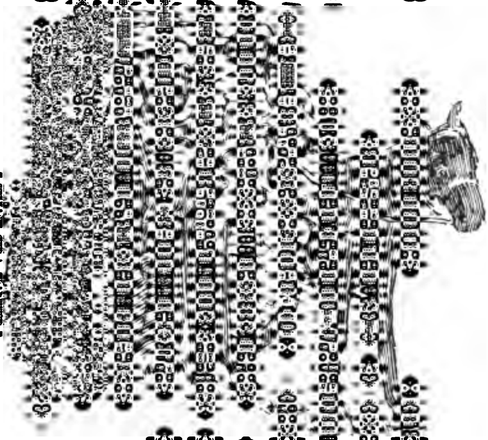

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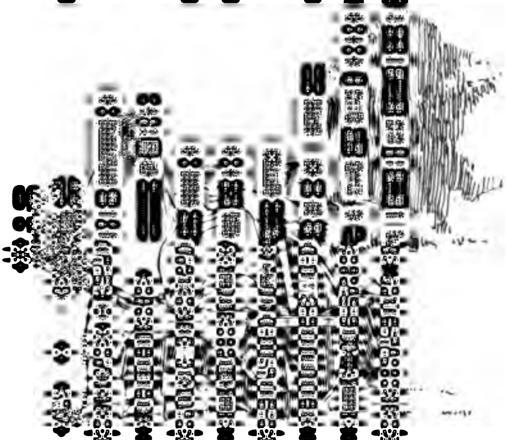

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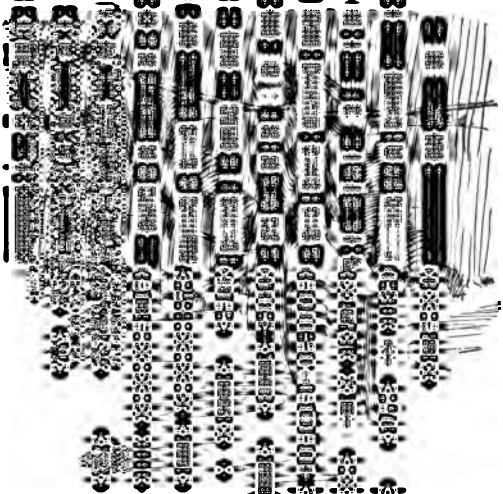

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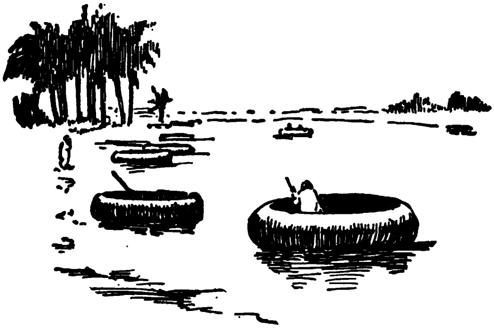
Some streams in the mountainous regions of India are occasionally crossed by bridges consisting of a single rope of rawhide. The rope is suspended so



CIRCULAR BOATS USED ON THE TIGRIS RIVER

that the end at which the passenger starts is higher than that on the opposite bank. The passenger places a short stick of wood having a groove which fits over the rope, upon the bridge, and grasping this with both hands slides across the stream as easily as a bird flies through the air. In Switzerland they have improved upon the rope bridge of India, by substituting the steel cable for the rawhide rope, and by using cars which are hauled across deep ravines and up the sides of mountains by steam

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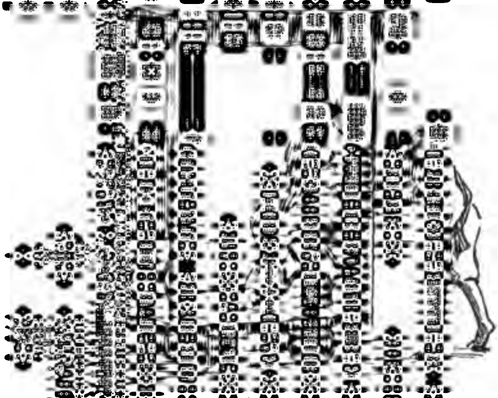

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When needed for use the skins are inflated with air, and two or three of these skins fastened together make a raft that will float a heavy load. The rafts are used only in going down-stream. When the journey is completed the air is expelled and the skins are folded into small space and carried back, to be inflated for another trip.

Mombassa has a very peculiar street railway. It consists of a light tramway on which run cars containing only a single passenger. Each car is pushed by a man.

ROADS AND CARRIAGES

The first roads were mere foot paths or trails over which men walked in single file. They began to be formed as soon as men began to travel; therefore their existence is as old as that of the human race. Roads of this sort were common long before beasts of burden were domesticated, for before the use of domesticated animals was known "mankind had walked over every habitable part of the world." By some it is supposed that these early trails were those formed by the animals in their wanderings, such as those made by the buffaloes in North America. Other authorities have considered these early trails to have been formed by man. Doubtless both of these suppositions are correct, some of the primitive roads being animal paths and others those formed by the frequent passage of men. These paths were usually the shortest practicable roads between the points which they connected. They avoided obstructions, often went around instead of over steep hills, and led to such places on streams as could be bridged or forded.

The first bridges consisted of trees felled across the streams or of stones upon which the traveler could walk from one bank to the other. Streams that could not be bridged in this manner or forded were impassable until the boat came into use.

With the domestication of the ox and other beasts of burden, more attention was given to the removal

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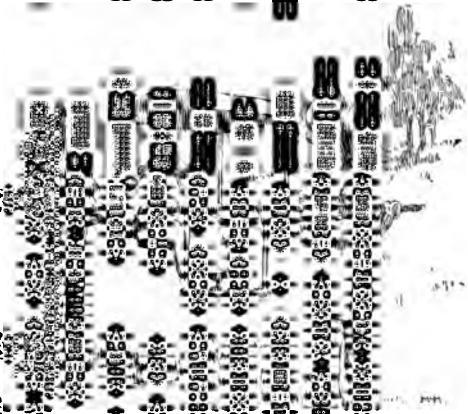

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[illegible], the build- [illegible] til the thir- [illegible] hivalry, the [illegible] urdens, and [illegible] ooked upon [illegible] rded one of [illegible] It directed that all trees and shrubs be cut down to a distance of two hundred feet, on either side of roads between market towns, to prevent concealment of robbers in them. The first toll for repairing roads was levied in 1346. For a time France was the leading nation in the construction of roads, but the French engineers finally adopted the English method invented by Macadam, and now throughout all European countries north of the Pyrenees excellent systems of highways are maintained. These roads are in charge of government engineers and are kept in the best state of repair. In their construction the highest degree of engineering skill has been employed; hence there are but few heavy grades, and the roadbed is of such material that it is always hard and is not affected by rain or snow. Roads of this sort connect all the hamlets and rural districts throughout the British Isles, France, Germany, Switzerland and Northern Italy. Upon them a horse can haul from three to four times as heavy a load as it can upon the average American road.

The early American colonists found the country threaded with Indian trails. Many of these were so well marked that traces of them may still be found in some localities. At first these trails were laid out by the Indians with reference to the location of their enemies and their hunting grounds, but after the coming of the white man they led to the nearest trading stations. The Jesuit Missionaries called these trails "roads of iron" because they were so difficult to follow. Nevertheless, in most cases their locations were wisely chosen, as later events have proven. Since these trails afforded the best means of travel into the interior, it was natural that the early settlers should follow them in their journeys of exploration and when in search of game.

As they became acquainted with the country, the settlers extended their journeys further and further. Thus it was that the Indian trails westward formed the first connections between the New England colonists and the streams and valleys of the Mississippi basin. The destination of each was a river or lake of the West. Some of these trails are still of great historic interest. The Old Connecticut Path extended westward from the vicinity of Boston to the Hudson river at Albany. The advantages of its location are seen in the fact that the Boston and Albany Railroad follows it very closely for nearly its entire length. It was over this trail that the New England colonists took their first journey westward, and the novel, "The Bay Path," by J. G. Holland, is founded upon incidents associated with the Old Connecticut Path. At an early date this was made a public highway by the General Court of Massachusetts. Another noted trail, which might be considered a continuation of the old Connecticut Path, though it had no real connection with it, was the Iroquois Trail, which was the main highway of this powerful Indian confederation, and extended from the Hudson River to the Niagara along the line now followed by the New York Central Railroad. The Lake Shore Trail is another of these paths; it is now followed by the Lake Shore and Michigan Southern Railway across Ohio.

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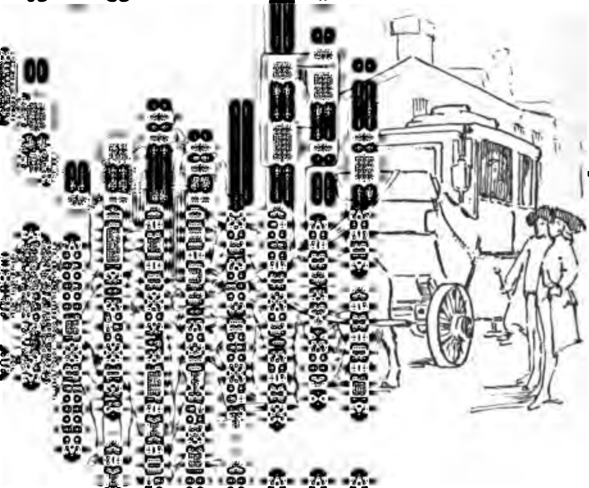

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the roads follow the meridians and section lines of the Government land survey. Roads running in the same direction are usually two miles apart and parallel. These roads are crossed by others running at right angles to them and the same distance apart, so that in the states of the prairie regions the roads resemble in plan the streets of a city. There are, of course, some modifications of this plan, due to local peculiarities, as the channel of a river and occasional steep bluffs. The easiest way around the bluff, and the best location for a bridge over the stream, in such cases determines the location of the road.

During the first century of colonization, travel was on foot, on horseback or on inland waters, and the roads were scarcely more than bridle paths; and even at the beginning of the Revolutionary War carriage roads were few and poor. The early carriage was the chaise, a sort of two-wheeled cart for carrying passengers. Later, the coach was introduced by the more wealthy colonists, and an enlargement of the private coach became the early stage coach. The first line of stage coaches in the Colonies was established in 1756 between Philadelphia and New York, and it required three days to make the journey.

Before the advent of railroads, transportation of agricultural produce in any quantity was practically impossible except for farmers located near centers of trade or near navigable bodies of water. Most of the large planters of the South owned sloops, in which they took their tobacco to the nearest sea-port and brought back such supplies as were needed. But the New England farmer had no such advantage; consequently his exports were few. The struggle for independence did not improve conditions.

When Washington went from Mount Vernon to New York to be inaugurated president of the United States, he was obliged to go on horseback, and it required seven days to make the journey. Five years later there was only one turnpike road or "pike" in the country. This extended from Philadelphia to Lancaster, Pennsylvania, a distance of sixty-six miles. It was constructed by a private company which received compensation for its investment by collecting tolls of those who traveled over the road. At this time mail routes existed between New York and Boston, New York and Philadelphia and other important centers. It took three days to go from Boston to New York, and two days to go from New York to Philadelphia. Roads near large cities were somewhat improved by 1800, but this improvement did not extend to the country.

During the War of 1812, a blockade virtually closed all our seaports, and the people were compelled to find some means of inland transportation between the chief centers of trade; and lines of freight wagons were soon established. These wagons were covered with canvas and hauled by horses or oxen. The necessities of the traffic soon developed lines of these wagons, which extended from Boston to Baltimore and thence as far south as Savannah, Georgia. They were taken across large streams on ferries, and trips from Boston to

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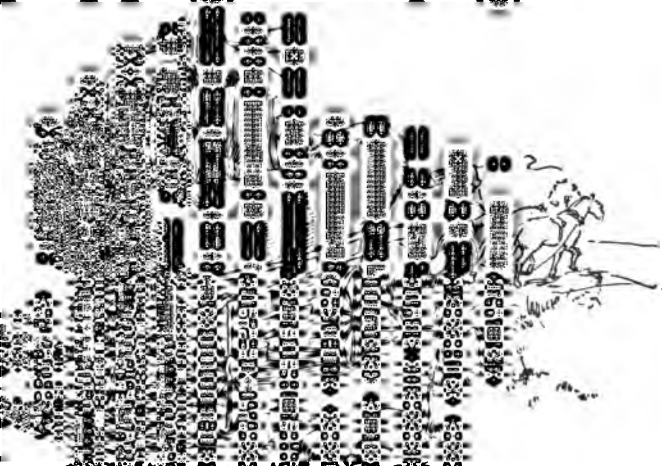

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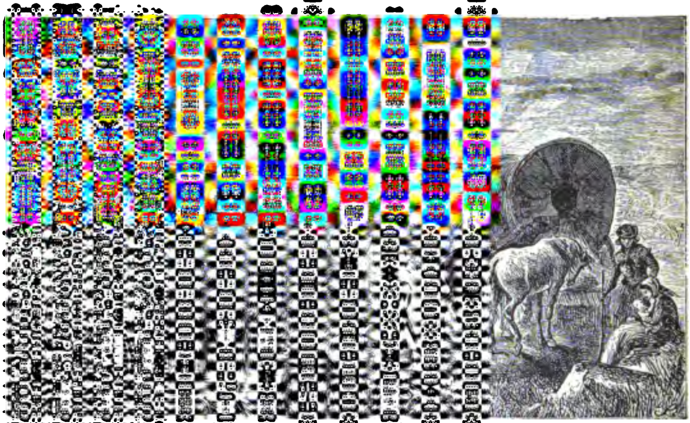

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[illegible] nt early recognized the importance of good roads for military as well as for transportation purposes, and lent some assistance to the construction of roads into the new states west of the Alleghanies, it was not until 1806 that any formal attempt at road building was made by the United States. In that year the great National Road, known also as the "Cumberland Road" and the "National Pike," was projected. As authorized by Congress, this road was to extend from Cumberland on the Potomac to the Ohio River. The project was afterward enlarged to extend the highway to connect with others leading to the Mississippi. The road was constructed in sections, appropriations being made from time to time. The last appropriation was made in 1838 and completed the road as far as Vandalia, Illinois, but by this time the rapid construction of railroads into the prairie states made further extension of the road unnecessary and the project was dropped. Other roads were projected at about the same time, but they were never completed. The Government constructs and maintains all roads in national parks, but aside from this it has no direct connection with either the construction or maintenance of public highways.

While the United States is ahead of some of the great countries of Europe in a number of the leading industries and in the construction of railroads, she is far behind those countries in the construction and maintenance of common roads, and we are accredited with having the poorest roads of any large civilized nation. The rapid development of new territory and the vast domain within our boundaries are two important reasons why we have not given more attention to perfecting our highways.

In considering the problem of road improvement, we must remember that the mileage of roads in the United States exceeds many times over the milage of all steam and electric railroads of the country. To put these roads in such condition as will make them compare favorably with the roads of Europe will require the expenditure of a larger sum than has been expended in the construction of railways, and people in rural communities are not willing to incur this burden of taxation. Another obstacle to securing permanent results is found in what may be called a lack of uniformity in policy throughout the country. With few exceptions the construction and maintenance of roads devolves upon the local authorities. In some states the county is the unit, and in others the township or a division of the township known as the "road district." There is little state supervision or state aid, and practically no supervision from the national government. However, the Department of Agriculture is rendering the most valuable advisory services possible.

Small communities can not undertake and carry forward successfully great enterprises, and local jealousies frequently prevent adjoining communities from uniting in an enterprise for their common good. Consequently permanent improvement of our highways makes but little progress. The use of graders and other road machines makes possible the construction of a better roadbed than formerly, but in many localities repairs will not last more than three years, and some sections must receive annual repair to keep them in suitable condition for heavy teams. Therefore, much of the money and labor expended upon our roads, instead of going into permanent improvements, is invested in repairs which at best can endure but a short time, and our tax for repairs never diminishes. In this way, hundreds of thousands of dollars are wasted yearly. So long as these conditions continue, but little can be hoped for in the way of permanent progress.

Until recently the value of good roads has not been realized by rural communities. Most of their residents have never known better conditions of transportation, and naturally they think present facilities as good as can be reasonably expected; therefore they have been slow in heeding the appeal for better roads. This appeal, which may be considered the beginning of the good roads campaign, began about 1890, as one of the results of the advent of the bicycle, and for the next few years a good roads propaganda was vigorously pushed by the American Wheelmen's Association. When the popularity of the bicycle began to wane, the automobile appeared, and this caused a still more strenuous demand for better roads. This demand became so general that Vermont, Massachusetts and some other states created state road commissions, and under their supervision permanent roadbeds are being constructed in their respective states.

Yet perhaps the strongest influence leading to better conditions has been that exerted by the farmers. The extensive demand for farm products, combined with improved methods of agriculture, have forced upon the farmers the necessity of securing prompt and frequent conveyance of their produce to market, and in many localities under old conditions the roads are practically impassable for weeks at a time in the Spring and Fall. Moreover, rural free delivery routes for the distribution of mail are established by the government only upon condition that good roads shall be maintained, and this is an added incentive to the appeal.

The Department of Agriculture at Washington maintains a division whose activities are devoted entirely to furthering the extension of good roads. This division or bureau is in charge of the ablest road engineers and experts in the country. It issues bulletins of instruction which are distributed free to any who may desire them, and it annually sends out a "good roads" train to different parts of the country. This train is equipped with the best appliances for road-making, and is in charge of experts. Notice of its coming is given several days in advance, and at one or more meetings, methods of road-making are explained, after which a short piece of road is built to shop how the methods can be applied. There is also a national good roads congress, with membership in every state. This organization holds annual meetings and its members use their influence in promoting a sentiment in favor of good roads in their respective states. The sentiment in favor of better roads is constantly growing, and the people are beginning to realize that the problem of good roads is the most important economic problem now confronting them.

We have said that on the roads of France and England a team can haul from two to three times as heavy a load as on the average American road. This means that the American farmer must keep at least twice as many horses or mules for hauling his produce to market as would be necessary if our roads were as good as those of Europe. Competent authorities estimate that bad roads cost the farmers fifteen dollars a year for each horse and mule in their service. If a tax of this amount were levied upon the draft animals of the country for three years in sucession, it would create a fund sufficient to reconstruct on a permanent foundation all the important roads in the country. Ever since the organization of the line of freight wagons during the war of 1812, the wagon has been one of the most important agencies in transportation. It is necessary to the farmer who must haul his produce directly to market or to some shipping point from which it can be forwarded. Again, this same produce in its final form for consumption must be loaded upon wagons and distributed to those who use it.

The farmer hauls his wheat to market and returns with a load of manufactured supplies. The wheat converted into flour is distributed into the homes of mechanics and mill operatives who make his clothing, farm implements and other articles necessary to the successful prosecution of his vocation. Railroad and steamship companies keep careful accounts of the freight and passengers carried, and from their records we are able to compile statistics showing the enormous traffic in which they are engaged. We are, however, unable to obtain such statistics of the millions of teams toiling on their weary ways on country roads and city streets with their burdens of freight, and we seldom stop to think that the tonnage moved by teams is greater than that moved by our railways and steamship lines combined. Someone has truly said, "The most important element which lies at the root and beginning of a nation's progress, and that which is indeed the greatest part of the foundation of a country's civilization is a system of good roads. Roads are the veins and arteries by means of which the circulation of the social body is carried on. Where they are clogged, the march of civilization is retarded."

The latest development in road transportation is seen in the perfection of the horseless carriage. The early history of this vehicle is given in connection with the development of the locomotive on page 151. Its advent as a practical conveyance dates from 1894, when a Frenchman produced a steam carriage which contained within a small compass an engine of sufficient power to move the vehicle over long distances at a high rate of speed; and since that year France has led in the perfection and manufacture of automobiles, but she has been closely followed by the United States.

During the decade from 1894 to 1904, the automobile came into very general use as a pleasure and sporting vehicle, and the racing mania experienced soon after the perfection of the bicycle was for about three years very strong among those possessing automobiles. Sober-minded men who were looking into the future were, however, giving their attention to the perfection of the automobile for general use. They realized that however popular it might become as a carriage of pleasure, its greatest field of usefulness would be in carrying freight, and they labored to perfect a carriage that would

A TRACTION ENGINE WITH WAGON TRAIN

take the place of the heavy dray hauled over the city streets by horses.

To be successful, such a carriage must be easily managed, durable and operated at an expense no greater than that required to keep and drive the number of horses necessary to do the same amount of work. After several attempts the problem was solved, and now horseless drays or "auto trucks" as they are generally called, are found in all large cities, and their number is rapidly increasing. Many of these trucks can carry a load three or four times as heavy as a two-horse team can haul over the same road. They run at a higher rate of speed and are not affected by the weather; neither do they become tired. It requires but little more expense to operate an auto truck than to keep a team that can not do more than one-half the work; consequently the horseless truck is rapidly coming into favor.

But the usefulness of this truck is not confined to cities. Some years before the auto truck was known, it was found that the traction engine could haul a train of wagons over a good country road, and in numerous localities lumber, grain and threshing machines were transported in this way. If the traction engine with its clumsy gear and heavy wheels could be used successfully on the country roads, the auto truck was certain of success, and now it is not only taking the place of the horse for hauling freight in many localities, but it is also entering fields where the horse can not be used, and carrying both passengers and freight.

In the hot and arid regions of New Mexico auto trucks are used to carry freight, and they are operated successfully where the heat is so great that draft animals can not be used except at night. In Nevada and California we find these trucks in use over desert roads and in mountains, where a train of these carriages transports in a day as much ore as could be packed by two hundred horses or mules. In Egypt the horseless carriage is replacing the camel in both freight and passenger traffic, and on some routes these trucks traverse long stretches of desert. The Belgium government is constructing roads along the Congo for the operation of these vehicles, and they are also coming into use in South Africa.

In India we find the motor car in increasing numbers in both city and country, and even in conservative Turkey these cars are making regular trips carrying both passengers and freight. In South America they are crowding the donkey from the country roads and carrying men and goods to inland cities and towns, and even in far-off Java American automobiles are found carrying mails and freight on country roads.

From these accounts we see that the sphere of the horseless carriage is not confined to the highly civilized countries of Europe and America, but that within a decade from the time of its perfection it has found its way into all corners of the earth. Today there are thousands of motor cars scattered throughout the world, carrying hundreds of thousands of passengers and hundreds of thousands of tons of freight. By the use of the horseless carriage waste places can be brought in contact with centers of life and trade, and many resources which hitherto have been inaccessible will reach the world's markets and be turned into useful commodities.

WATERWAYS

INTRODUCTION

In all ages the sea has been the highway of nations, and long before the invention of the steam engine the science of navigation had reached a good degree of perfection. Men had sailed around Africa, discovered America, and circumnavigated the globe. They also had learned to use the compass and other instruments of navigation with such skill as to give them confidence in venturing into unknown seas and in exploring the remotest parts of the earth, though their ships, compared with those of the twentieth century, were very crude affairs. Lakes and rivers were likewise the most convenient highways for inland peoples living upon or near them, and since the beginning of history no tribe has been found occupying land near a navigable body of water that did not have some sort of a vessel in which they could float upon its surface.

The simplest boat was the log, and doubtless it was first used without modification, much after the manner of the log drivers in the lumber regions of the present day. Presumably the next step consisted in fastening two or more logs together to form a raft. In time men learned to make the dugout, a sort of canoe fashioned from a large log by shaping its ends and cutting out the inside so that the canoe when finished would carry several persons.

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and need to be handled with care, otherwise the canoe may suddenly "turn turtle" and give its occupants a cold bath for which they are not prepared.

From the dugout and the bark canoe to the mammoth ship of today is indeed a far cry, yet it was in these structures that transportation on the water had its beginnings, and all boats of the early ages were modifications and enlargements of the canoe, as are the boats still in use by barbarous and partially civilized peoples. While it would be interesting to trace this connection and to show the successive steps leading from the canoe of the savage to a modern ocean liner, there are matters of greater importance demanding our attention, and we must leave this phase of the subject and turn to a discussion of the problem of modern transportation on the water. The subject naturally divides itself into transportation upon the ocean and transportation upon the inland bodies of water. In both divisions we find natural waterways and those which have been constructed by man.

Transportation Upon the Ocean

SAILING VESSELS

Development of navigation and the improvement of ships are so closely related that we must discuss them together. The earliest sea-faring nations were naturally those whose countries bordered upon some large body of water. Therefore we find our interest in early navigation centering about those

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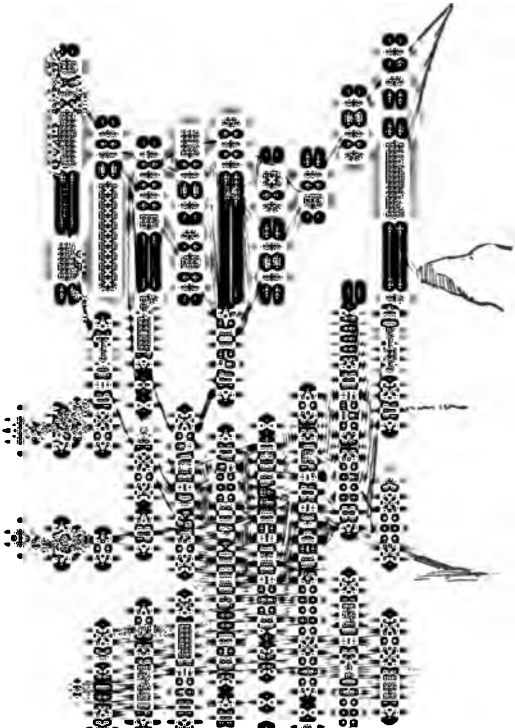

... se of the sea as ... time of their ... re found in all ports of the Mediterranean. The Greeks and Romans used ships in war long before they made any extensive use of them in commerce. Their early war ships were large boats propelled by oars, the largest being constructed with two or three banks of oars, one rising above the other. Their merchant ships were patterned after the war ships. In the course of time sails were added to the oars and both were used in propelling the ship. Compared with the ship of today these old structures of the Greeks and Romans were clumsy and slow, but they were nevertheless powerful in their time. It was with ships of this construction that the Greeks won the battle of Salamis, 480 B. C., and compelled the Persian army under Xerxes to give up their attempted conquest of Europe.

Just when sails were first used is unknown, but it is probable that men began to use the wind in driving their ships long before the days of written history. We know that the ancient Egyptians used boats with sails because pictures of such boats appear on their monuments, and in 1906 Professor Petrie discovered the model of an Egyptian sailing vessel of a period about 3000 B. C. The model is of a vessel rigged for rowing up the Nile and sailing down. It is the earliest record we have of the use of sails. The earliest account of a large ship is found in the Bible (Genesis VI, 14 to 16) where Noah is given instructions for building the ark. However strange it may seem, the relative proportions of length, breadth and depth for the ark given in these instructions are practically the same as

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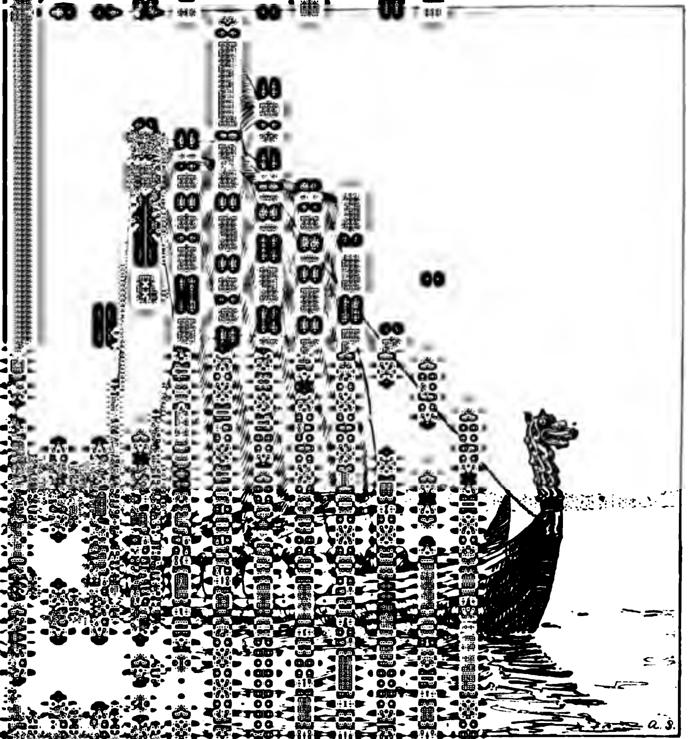

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Empire navigation was neglected for several centuries. Commerce has always been the chief factor in the development of navigation upon the sea, but it required many centuries before the allurements of the great wealth to be gained through trade led men to brave the dangers of the open ocean, and for more than a thousand years after the beginning of the Christian Era, transportation on the sea was confined to the Mediterranean and the coast waters of western Europe. The Norsemen were the first nation to become interested in navigating the open ocean, and history tells us that they visited the shores of North America nearly five hunrded years before Columbus made his first voyage of discovery. The ships of these hardy sailors were low, long and narrow, and used both sails and oars. For many years the Norsemen's claim to the discovery of America was not accredited because men did not believe that such vessels could cross the ocean. These doubts, however, were dispelled when the World's Fair was held in Chicago in 1893. In that year a Viking ship, shown in the illustration, in size and form an exact pattern of those used by the old Norsemen, was built and in it Captain Andersen and his crew made a successful voyage across the Atlantic and by way of the St. Lawrence River and the Great Lakes to Chicago.

The next historic ships to attract our attention are those in which Columbus made his celebrated voyage of discovery. These ships are worthy of more notice because they represented the degree of perfection in ship-building which Spain, the leading

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trade sprang up between some of these cities and the countries of eastern Asia. The chief cities engaged in this trade were Genoa, Venice and Florence. In Asia this traffic passed over inland routes to Constantinople; thence by way of the sea to Venice and other Mediterranean cities, but about the time that Columbus began to advocate his theory that the earth was round and that Cipango or Japan could be reached by sailing westward, the Seljuk Turks captured Constantinople and closed all trade routes in Europe. This compelled Venice and other Mediterranean cities to seek an outlet either by way of the Red Sea or other overland routes far to the south of Constantinople. While these new routes were possible, dangers from robbers and from storms on the Red Sea made them nearly impracticable; therefore the necessity of finding an all-water route to India and other countries of the East was forced upon these cities if they were to retain the trade to which all of their wealth was due.

The necessity for such a route was the strongest incentive to navigation known in the fifteenth century. It was in an attempt to find this route that Diaz was driven by a storm around the Cape of Good Hope in 1486. Had he kept on his way, this navigator might have had the honor of discovering the long desired passage, but when captain and crew found that Africa was on the wrong side of them, they became panic striken, put their ship about and returned to Portugal. A few years later Vasco da Gama reached India by rounding the Cape, and soon after European ships began a profitable trade with

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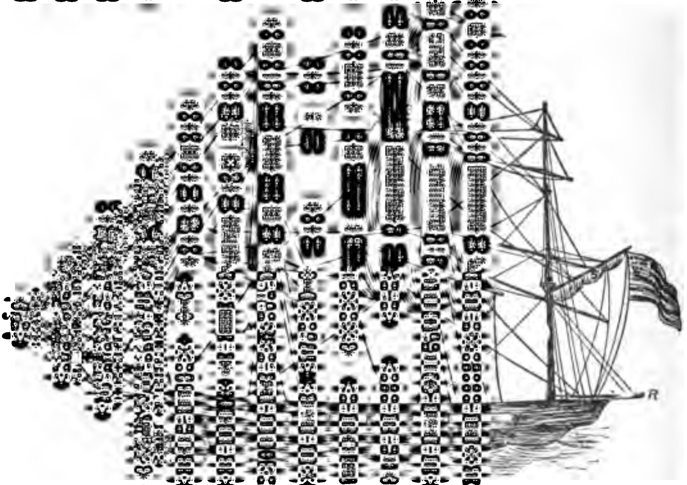

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... the high seas, ... her prestige and ... e and England. ... d in America a ... them and the ... eeded manufactured products and in return were able to supply the Old World with raw material, but for many years the traffic was limited and irregular.

With the growth of the colonies and the increase in trade the attention of the colonists was directed to ship-building, and in the course of a century they reached such a degree of skill in this art that American ships became famous the world over. Strength, speed or good sailing qualities, and space for storing cargo are the three great requisites of the good ship, and in these respects American ships excelled those of other nations. These ships were longer in proportion to their width and had lower hulls than the European vessels of the same capacity. Moreover, their sails were so constructed that every foot of canvas caught the breeze. Their rudders were greatly improved and the ships could sail closer to the wind than their European competitors. They could also be turned in shorter space and more quickly. The schooners built upon Chesapeake Bay became especially famous under the name of "Baltimore Clippers." In the war of 1812 more than two hundred of these ships became privateers and preyed upon British commerce and not one of them was captured.

The American war ships of that day were also superior to those in England, as is shown by the brilliant career of our navy in the struggle which has not inappropriately been called the second war for independence. The war of 1812 was only one of numerous wars which occurred during the first fifteen years of the nineteenth century, and

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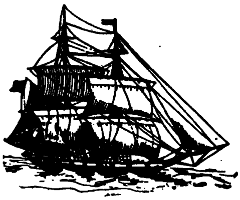
For many years ships were operated on this plan and were generally known as merchant carriers, but after peace was established throughout Europe and America, opportunities for trade increased so rapidly that regular lines of ships known as packet ships, were early established between American and European cities. The first of these lines, known as the "Black Ball" line was established between New York and Liverpool in 1816. Its success was such that other lines soon followed and Boston and Philadelphia were given as good shipping privileges. The average time for the round trip for these ships between New York and Liverpool was about sixty-three days or a little over two months, but within five years a sufficient number of lines had been established to give New York weekly sailings for Liverpool. The packet ships carried freight, mail and passengers, though their accommodations for passengers were meager and the number of passengers was small. In those days no one took a sea voyage for pleasure. Only those went abroad who were compelled to do so by neces-



A BRIG

sity, and as one writer puts it, "Their departure was the cause for prayers, tears and the making of wills."

However, with the thorough establishment of line traffic between America and Europe the ships were improved in size and speed and the best of them made ample provisions for passengers. With the increase of accomodation and the lessening of time there was proportionate increase of travel, and long before ocean steamers became strong competitors of these vessels they were doing a good passenger business. Furthermore, the demand for ships which would engage in trade between American ports and the far East was such as to call for the building of a larger ship, and this was met by the construction of the square-rigged ship, especially adapted to long voyages. Soon after these ships had entered upon their career the discovery of gold in California turned the attention of the American people to the Pacific coast, and a valuable carrying trade sprang up between Boston and New York and San Francisco. At first all of this was accomodated by sailing vessels which went around Cape Horn. Some of these ships made remarkable progress, one completing the voyage from New York to San Francisco in seventy-six days and another a return voyage in eighty-four days. By 1850 the sailing vessels had been perfected to such a degree that the time from New York to Liverpool averaged less than twenty days, while that from Liverpool to New York was thirty-three days, the difference in time being caused by the head winds which all west bound ships encounter.

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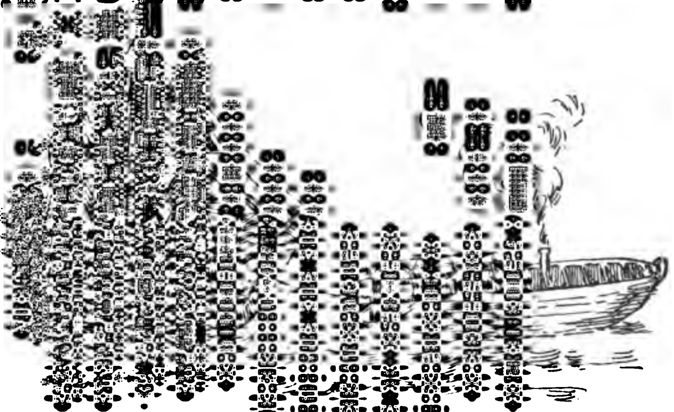

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perfected. Another American, John Fitch, is, next to Fulton, perhaps, entitled to the greatest credit for his efforts. In 1786 Fitch constructed a boat propelled by paddles that were operated by an engine. One of his boats made regular trips on the Delaware River for some time, and attained a speed of seven and a half miles an hour, but his device was too complicated to make it commercially successful.

It seems that Fulton had been studying the problem of steam navigation for a number of years before he began the construction of the "Clermont," his first boat. During a part of this time he was in Paris and there he met Robert R. Livingston who was then ambassador of the United States to the French Court. Mr. Livingston had also given considerable attention to the problem of steam navigation and so thoroughly believed in its possibilities that in 1798 he secured from the legislature of New York the exclusive right and privilege of navigating the waters within the state "with all kinds of boats which might be propelled by the force of fire or steam; provided that within one year he built such a boat whose rate of progress should not be less than four miles an hour."

Mr. Livingston was unable to meet the demands of this concession within the limited time given and he received the extension of his privilege. In 1806 he returned to New York with Fulton who had secured an engine manufactured in England. They at once began the construction of the "Clermont," which for that time was a boat of very considerable

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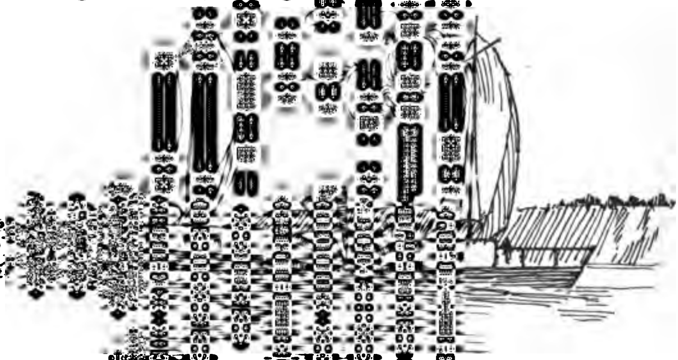

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while many others expected some dire calamity would befall those who risked their lives upon the strange craft. So, when the eventful morning arrived, the wharves, piers and housetops, in fact every point from which a view of the river could be obtained, was filled with spectators. When everything was ready the engine was set in motion and the boat moved steadily from the wharf and turned up the river, much to the astonishment of those who expected the project to fail.

All the way along the route the "Clermont" was hailed with the greatest enthusiasm. She made the trip, a distance of one hundred fifty miles, in thirty-two hours, and on the return voyage reached New York in thirty hours, going in the face of a head wind both ways, so that the trip was made without the aid of sails. The voyage of the "Clermont" may be considered to mark an important epoch in the history of commerce and of transportation. It was the beginning of a new era in which men were raised above their dependence upon the wind for navigating not only inland waters but the high seas as well.

Mr. John Stevens of New Jersey, was at work upon a steamboat at the same time that Fulton was engaged upon the "Clermont," and he completed his invention a short time after Fulton's first voyage. Being deprived of the privilege of navigating the waters of New York, Stevens conceived the bold idea of taking his boat to the Delaware by sea, and this was the first steamer to navigate the ocean. Although Stevens cannot be considered the original inventor of the steamboat, he certainly should be accredited with giving birth to the idea that the steamer could be successfully used upon the ocean.

In 1811 Fulton and Livingston began the construction of boats at Pittsburgh, and the following year the first steamer was sent down the Ohio. Its strange appearance, the noise of its engines, and for that time the great speed of this boat, struck terror to the hearts of many of the settlers along the banks of the river, for they had never heard of a steamboat and did not know that such a thing had been invented. Fulton and Livingston increased their fleet upon the Hudson and placed boats upon other waters in New York, while Stevens operated upon the Delaware and the Connecticut. In 1818 the first steamer on the Great Lakes appeared on Lake Erie. In 1812 the "Comet" appeared on the Clyde in Scotland, and this was the first steamer in Europe. In 1819, as we have already seen, the "Savannah" traveled across the ocean to Russia, by way of England, and was the first steamer to cross the Atlantic, although she used both steam and sails for propelling power. Within the next twenty years steamers multiplied until they operated upon all navigable waters of the civilized world. The day of steam navigation was fully established and the day of the sailing vessel was on its decline.

For thirty years after Fulton's invention the paddle wheel was used exclusively for propelling steamers. While this device was satisfactory on rivers and other bodies of still water, it was not well suited to the ocean because the rolling of the vessel often caused one wheel to be entirely out of the water while the other was too deeply immersed for effective service. Between 1840 and 1845 John Ericsson, the inventor of the "Monitor," perfected the screw propeller, which rapidly came into use and is now almost universally employed in operating both large and small boats. With the advent of the screw propeller the success of steam navigation upon the ocean was assured and men began to give their attention to the construction of steamships which rapidly replaced the sailing packets, and by 1870 the latter were practically confined to the irregular traffic of ports not located on general transportation routes.

Since the introduction of the propeller the improvement in the steamship has consisted in the improvement of the marine engine, whereby greater power is obtained for the quantity of fuel consumed, the adoption of steel in the place of wood as a material of construction; and in certain passenger ships, increase in speed and the adoption of plans and devices which contribute to the safety and comfort of the passengers. At the beginning of the twentieth century the art of ship-building had been brought to such a degree of perfection as to make the best passenger ships floating palaces, whose equipment and conveniences are not excelled by the most luxurious hotels of Europe or America. But before describing one of these ships it will be of interest to notice some of the steps by which present conditions have been reached.

One of the most important of these steps was the organization of the steamship lines between American and European ports. We have seen that lines of packet ships were doing a prosperous business before the steamers entered the field of ocean traffic; but with all the skill used in their construction and navigation these vessels were at the mercy of the winds, and regularity of arrival and departure could never be assured. A voyage which under favorable conditions would require twenty days might, by adverse winds be prolonged to sixty, eighty or even one hundred days, to the disappointment and often the serious inconvenience of the passengers and the merchants who were waiting for their cargoes.

While the first steamers required as much and sometimes more time to cross the Atlantic than the best sailing vessels under favorable conditions, they were not dependent upon the winds, and the same boat made the voyage both going and coming in practically the same number of days, thus assuring regularity in arrival and departure. With the assurance of regularity, mails, passengers who were able to pay the price, and high class freight sought transportation by steamer. This assured a sufficient amount of regular business to warrant establishing lines of steamers between Liverpool and New York, also between Liverpool and Philadelphia and Boston, and these lines were soon extended to other cities.

The first and most celebrated of all these lines was the Cunard, named from its founder, Sir Samuel Cunard. Recognizing the superiority of the steamship for mail service, in 1838 the British government advertised for bids for fortnightly mail service between Liverpool and Halifax. The bid of the Cunard Company was accepted and on July 4th, 1840, the "Brittania," a wooden paddle wheel steamer, sailed under this contract from Liverpool to Boston by way of Halifax, and entered Boston in fourteen days and eight hours from the time of her departure from Liverpool. The "Brittania" was the first steamer to sail under regular government contract for carrying the mails across the Atlantic and her first voyage was the beginning of that regular communication between America and Europe which, regardless of sunshine or storm, summer or winter, has continued to the present day, increasing in frequency and efficiency as the years have gone by. In 1850 the Inman Line was established between Philadelphia and Liverpool; also the Collins Line, an American enterprise, between New York and Liverpool. After a heroic struggle of eight years this line, notwithstanding its excellent service, was compelled to suspend because it could not compete with the British lines which received substantial aid known as "subsidies" from the government.

In due time the packet lines were changed to steamship lines, and a few of these are still in existence and with the Cunard line control the trans-Atlantic trade. The most prominent of these are the Hamburg-American Line, formerly the Hamburg-American Packet Company, the White Star Line, and the North German-Lloyd Line. Be-

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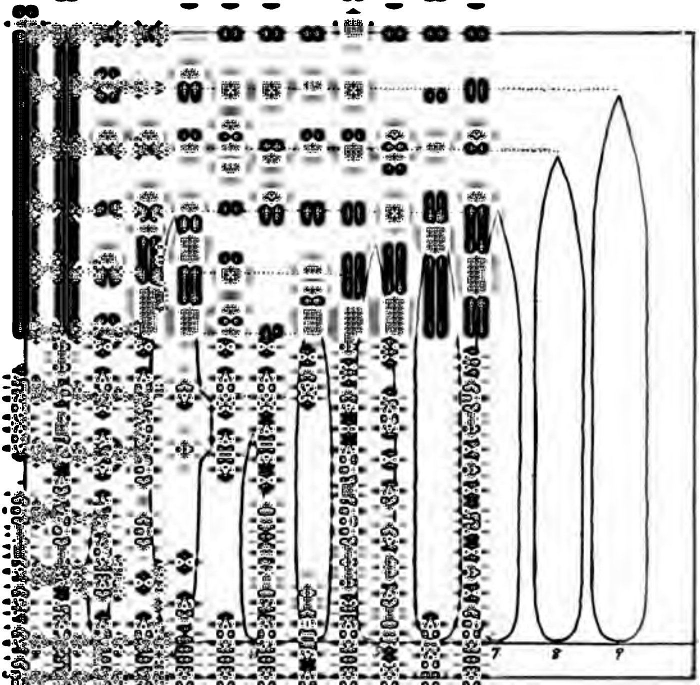

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8. Mauretania
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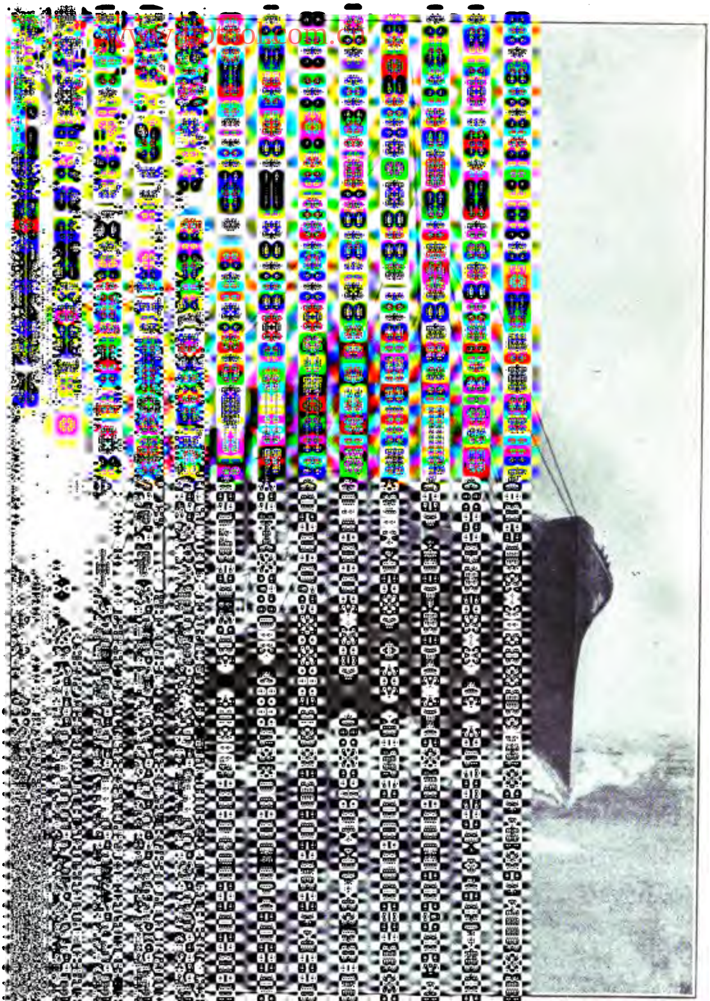
long and had a speed of eight and a half knots, or eight and a half nautical miles an hour. Increase in size and speed were gradual, even after the introduction of the screw propeller. The "Asia" in 1850 was two hundred seventy-five feet long and had a speed of twelve and a half knots, and the "Persia" built five years later had a length of three hundred seventy-five feet and a speed of nearly fourteen knots an hour. The first record-breaking ship for size was the "Great Eastern" built in 1858. This ship was 692 feet long, 83 feet wide and 58 feet deep, and had a displacement of 28,000 tons. She was driven by paddle wheels and propellers and had four engines which collectively exerted ten thousand horse power. This magnificent ship rendered distinguished service in laying the trans-Atlantic submarine cable, but commerically she was a failure, simply because she was in advance of the times, and traffic between Great Britain and the United States was not large enough to make the operation of so great a ship profitable. Today much larger ships pay their owners heavy dividends.

The next step in advancement was the perfection of the steamship with the screw propeller, and the "China" of 1862 was the forerunner of the so-called "ocean grey hound" of the twentieth century. The "China" had a length of 337 feet, being about fifty feet shorter than the "Northwest" and "Northland," the largest passenger steamers now plying on the Great Lakes. Ships of this pattern continued to increase in size until they attained a length of 525 feet and a speed of nearly twenty miles an hour. The twin screw or double propeller was then introduced in place of the single screw, and this led to the construction of still larger and swifter vessels. The "City of Paris" and "City of New York," built in 1889, were 560 feet long and had a speed of nearly twenty-one miles. Following these came in rapid succession the "Lucania," 620 feet, the "Kaiser Wilhelm der Grosse," 694, the "Celtic" and "Oceanic," 700 feet, the "Deutschland," a little larger and the first ship to cross the Atlantic at an average speed of twenty-seven and a half knots, and the "Kaiser William the Second."

Then came the mammoth ships "Lusitania" and "Mauretania" of the Cunard Line, with a length of 790 feet and an average speed of twenty-five and seven-tenths miles. With these ships it was supposed that the limit of size had been reached, but the White Star Line has under construction two ships, the "Olympic" and the "Titanic," 890 feet in length, 92 feet in breadth and 64 feet in depth and having an extreme height of 105 feet and a displacement of 60,000 tons. The "Olympic" is expected to be ready for service in 1911. While these ships exceed the Cunarders in size, they will not equal them in speed. The "Olympic" will have four funnels twenty-eight feet in diameter, and when she is thirty-five feet in the water the roof of her pilot house will be seventy feet above the surface of the sea. These ships and the "Lusitania" and "Mauretania" are driven by four screw propellers and have both the old style engine and the steam turbine, which operates on the same principle as the water turbine and possesses several advantages over the engine having cylinders, piston rods and cranks.

To one who is not acquainted with a large steamship, the size and equipment of these vessels is almost beyond comprehension. A brief description of the "Lusitania" and "Mauretania" which are identical in size and plan, will give some idea of the immensity of these ships. They are 790 feet in length, 88 feet wide, 80 feet deep to the boat deck, and when fully loaded draw thirty-seven feet six inches of water, that is, they sink in the water to this depth, and displace 45,000 tons, a quantity of water sufficient to fill a channel thirty feet wide, six feet deep and nearly a mile and a half long. The height to the top of the funnels is 155 feet, an altitude greater than that of many church spires, and the height to the mast heads is 216 feet. The ships are driven by engines which develop 68,000 horse power each. The amount of coal required for a voyage across the Atlantic is 6,600 tons, a quantity which would require twenty-two trains of thirty trucks each of the English coal cars. If these two ships were placed end to end under Brooklyn bridge, they would fill the entire space between the piers. If either one of them were placed alongside the Capitol at Washington it would extend nearly a hundred feet beyond the building and an average height would rise considerably above the roof of all portions of the structure except the dome. If placed in front of the Auditorium Hotels in Chicago, which extend over two blocks, one of these ships would be considerably longer than the space occupied by these buildings. If one of the smoke stacks were laid in a horizontal position two railway trains could pass through it abreast on double tracks. Their accomodations are for 500 first class passengers, 500 second class passengers and 1300 third class passengers each, and each ship carries a crew of between eight and nine hundred. Forty oxen, eighty sheep, sixty lambs, ten calves and one hundred thirty pigs beside two thousand chickens and in addition turkeys, ducks, pigeons, grouse and quail and a large quantity of fish, are required to supply the passengers and crew of one of these ships on a single voyage.

These ships are luxuriosly appointed and supplied with every device and convenience which modern science and ingenuity can contrive for the safety and comfort of their passengers. They contain numerous passenger and freight elevators operated by electricity, each stateroom has telephone communication with all parts of the ship, and for safety provisions the ship contains one hundred seventy five water tight compartments which make it impossible for the vessel to sink, the most perfect wireless telegraph apparatus that can be devised and a submarine signal device which warns of danger on approach of land. Their average time in crossing the Atlantic is about five days, and the shortest time made was by the "Mauretania" in September, 1909, when she covered the distance of 2800 miles between Queenstown and New York in



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four days ten hours and fifty-one minutes.

Some ships, like the "Cedric," combine freight and passenger traffic and run at a lower rate of speed, requiring from seven to ten days for their passage instead of about five days as for the boats that carry only passengers. They have a lower passenger tariff, excellent accommodations and are very popular with that class of travel which does not require haste. But whatever the line of patronage, ship owners have found that both freight and passengers can be carried more cheaply and with a greater degree of safety in the large ship, and such is the extent of traffic between Europe and the United States that during most of the year all steamship lines are crowded to their fullest capacity.

OCEAN ROUTES

Having given our attention to the development of the sailing vessel and the steamer, let us now consider for a moment the routes over which most of these vessels regularly travel, for however strange it may seem to the landsman, the ocean routes between leading ports of the world are as definitely marked by the mariner as are the great trunk lines of railway across the continent. There is, however, this difference; the mariner does not follow his path so closely as the railway train must of necessity follow the track, but within the range of certain limits as shown upon the map, ships bound from the European ports to the United States traverse the Atlantic between certain boundaries, and those going from America to European ports follow as closely another line of travel.

These routes move north and south with the seasons, being farther north in winter than in summer. A glance at the map shows at once that the northern routes are the more desirable because they are shorter, but during the summer it is unsafe for vessels to venture too far northward because of the liability of encountering icebergs, and a collision with one of these monsters of the northern seas would mean destruction to the ship. To illustrate this more clearly: vessels from Montreal to Liverpool shorten their routes by passing out of the Gulf of Saint Lawrence north of Newfoundland, and in Spring and Autumn they follow this course, but during the Summer months they pass to the south of that island.

Ocean routes on main lines of travel are fixed by international agreement, and in a great measure in the north Atlantic and other bodies of water carrying a heavy traffic they serve the same purpose as double tracks on a line of railway. As all trains move in a given direction upon one track and all those moving in the opposite direction are upon the other track, so all ships sailing from the European to American ports are required to keep within certain degrees of latitude, while those sailing from America to Europe are required to keep within certain other boundaries, and these eastward and westward routes are so far apart as practically to remove all danger from collisions between ships sailing in opposite directions.

A commercial map shows that steamship routes can be divided into two classes; those leading across the ocean and those leading along the coast. The latter are followed by vessels engaged in what is called "coastwise" trade, that is, in transporting passengers and freight between ports of the same country and located on the same body of water. Familiar routes of this sort are those between Portland, Maine, and Boston and New York, and between New York and Savannah and New Orleans. There are many of these coastwise routes along the Atlantic seaboard of the United States. Ships engaged in coastwise trade usually carry both passengers and freight, and unless rough weather is encountered, trips upon them are very pleasant. Coastwise traffic is common to all countries bordering upon the sea, and we find routes of this class in all parts of the world.

Measured by their amount of traffic the most important ocean routes are the north Atlantic routes between the United States and Europe. To these the coastwise routes in both Europe and America act as feeders, the coastwise vessels bringing freight for trans-shipment to ports where the trans-Atlantic steamers land, and also carrying goods from these ports to their destinations along the coast. Other important routes from Europe westward lead to Colon on the coast of Panama, Pernambuco, Rio de Janeiro and Buenos Ayres in South America, thence around Cape Horn to New Zealand and Australia. The important routes eastward from Europe lead through the Mediterranean Sea, Suez Canal and Red

Sea to the Indian Ocean. From this outlet the routes diverge, some leading to Australian ports and others to the ports of India, China and Japan. There is also an important route between the ports of Great Britain and those along the western coast of Africa to Cape Town.

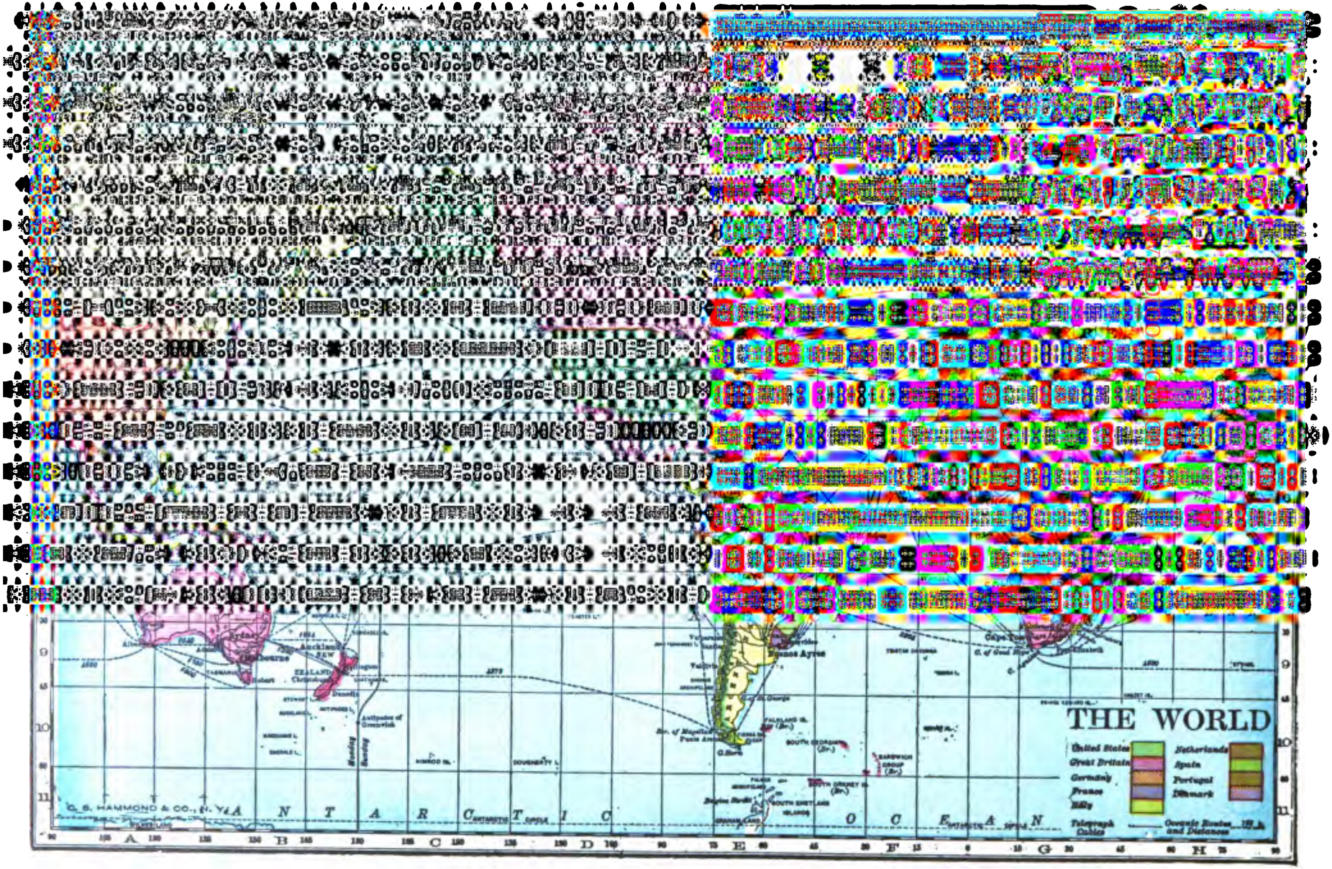
The chief routes on the Pacific are those between San Francisco, Seattle, Vancouver and a few other ports of the United States and Canada and the leading commercial cities of Japan, China, the Philippine Islands and New Zealand and Australia. Some vessels make all of these ports while other lines ply directly between American ports and those of New Zealand and Australia. In the study of these routes we see that the position of Hawaii is peculiar. This little island territory is located at the crossroads of the Pacific, and Honolulu is consequently a port of call for nearly all vessels traversing routes which center there. So far as possible, ships between American ports and China and Japan take the northern route because it is shorter. The distances across the Pacific, however, are so great, exceeding 6000 miles, that only the largest ships can carry enough coal for the voyage, and for those which need to take on supplies, Honolulu is a convenient coaling station.

Local routes along the shores of different countries and across the many gulfs, bays and straits which indent their coasts are so numerous that a detailed description of them does not come within the scope of this work, but a word should be said about the routes of sailing vessels because they vary so widely from the routes of steamships. The steamship seeks the shortest practical route between ports, but the object of the navigator of a sailing vessel is to seek the path of the most favorable winds, and this path often takes him a long distance from the most direct route to the port for which he is bound. A sailing vessel bound from Boston to a port on the English Channel, for instance, would follow practically the same path as steamships in that direction, but on its return the sailing vessel must go far to the south along the coast of Africa until it reaches the zone of the Trade Winds, by which it will be steadily driven westward. Should the vessel attempt to return by the same route it traversed in going to Europe it would constantly encounter head winds, that is, winds blowing in an opposite direction from that in which the vessel is sailing, and the time required to traverse this shorter route would probably exceed by some days if not weeks the time necessary for the return voyage by way of the tropics.

OCEAN SHIP CANALS

Some ocean routes have been changed, others have been created and still others have been greatly benefited by the construction of ship canals. These works are of such magnitude and require the expenditure of so much money that they are usually undertaken by the government of the country across whose territory they extend. The Suez Canal across the Isthmus of Suez and connecting the Mediterranean with the Red Sea, is the greatest ship canal that has yet been built. It is one hundred miles long, thirty-one feet deep, one hundred eight feet wide at the bottom and four hundred feet wide at the surface. This canal was begun in 1859 and was completed in 1869. It is a sea level canal and has no locks. It is lighted by electric lights throughout its entire length, so that ships can make the passage by night as well as by day. The completion of the Suez Canal changed the ocean routes between Europe and India and China and Japan. Previous to the construction of this canal all vessels bound for Asia were compelled to go around the Cape of Good Hope. By going through the canal a distance of over 4800 miles is saved between England and Calcutta. Over 4000 ships pass through this canal each year.

The Kaiser Wilhelm or Keil Canal crosses the peninsula of Jutland, and enables ships to enter and leave the Baltic Sea without incurring the dangers of the long passage around this peninsula. It is sixty-one miles long and has a depth of twenty-nine and a half feet. The Manchester ship canal was constructed to enable sea-going vessels to dispose of their cargoes at Manchester instead of Liverpool. It is thirty-five and a half miles long and twenty-six feet deep. The Cronstadt and St. Petersburg Canal connects St. Petersburg with the Baltic. The Corinth Canal across Greece connects the Gulf of Corinth with the Gulf of Ægina and saves vessels entering or leaving ports on the Adriatic Sea about one hundred seventy-five miles. The canal is four miles long and twenty-six and a quarter feet deep.


THE WORLD
United States
Great Britain
Germany
France
Italy
Netherlands
Spain
Portugal
Denmark
Telegraph Cables
Oceanic Routes and Distances
A N T A R C T I C O C E A N
C. S. HAMMOND & CO., N.Y.

But the greatest of all ocean canals when completed will be the Panama Canal, extending across the Isthmus of Panama and connecting the Atlantic with the Pacific ocean. Active work on this canal was begun by the United States government in the summer of 1906. When completed the canal will be fifty miles long, and will extend from deep water in the Caribbean Sea to deep water in the Pacific Ocean. It will have a summit elevation of eighty-five feet above the sea, to which level ships will be carried by a series of three locks on the Atlantic side and two on the Pacific side. The width of the canal varies from five hundred to a thousand feet. The sections one thousand feet wide will be used as waiting basins for ships waiting their turns to pass through the locks. It is expected that the Panama Canal will be open in 1915, and the entire cost of the project is estimated at $375,000,000.

The opening of this waterway will have a greater effect upon the ocean routes of the world than did the opening of the Suez Canal. It will shorten water passage between New York and San Francisco from 13,700 miles to 4650 miles, or over 9,000 miles. It will also greatly lessen the distance between the Atlantic ports of the United States and the Orient and make our communication with China, Japan and the Philippine Islands much more inexpensive and convenient than at present. The opening of this canal will also confer a great benefit upon the commercial world, for it will shorten by some thousands of miles the passages of the vessels from

European ports to Australia and the islands of the southern Pacific.

ORGANIZATION

We have already seen that in the early part of the nineteenth century the merchant and the ship owner were often combined in the same person, and that the merchant was accustomed to load his ship with merchandise and sail for a foreign port where the cargo was sold and another cargo bought, to be sold at home or, in some instances, at an intermediate port where another change of cargo might be effected before the ship returned to the point of its departure. When traffic was small and irregular this was the only profitable way in which the ship could be used. Communication was equally slow and uncertain, and it required from two months to a year to send a letter to Europe and receive a reply. This lack of communication was a great drawback to commercial relations between merchants in different countries. Regular and systematic trade could not be established until there was in each country practically an equal demand for the goods of the other; means for regulating transportation and such facilities for communication between the countries have made the delivery of materials at frequent and regular intervals reasonable and certain.

The demand for goods preceded the development of transportation and mail facilities, and when enterprising ship-owners provided these means they found the trade awaiting them. We have already referred to the formation of some of the trans-Atlantic steamship lines as one of the most important steps in the perfection of the ocean-carrying trade. We now wish to show the extent and degree of perfection to which these organizations have been developed. The steamship companies, like the railway companies, have organized lines into systems so that now a few companies practically control the passenger and express-freight business between the United States and Europe, and likewise the European traffic between the different ports on that continent and the ports of Northern Africa and Western Asia. The carrying trade of the Pacific has also been organized in a similar manner and is controlled by a few companies.

Means for securing freight and also for distributing it are equally important to all great lines of transportation. If the trans-Atlantic line can control the coastwise trade at each of its terminals, it is not only sure of regular traffic but also of all the profits arising from that traffic. In Europe these lines own and control steamers engaged in coastwise traffic, but in the United States only American vessels can engage in traffic of this sort, so that their control on this side of the water is secured by contract with the owners. In this way the great trans-Atlantic lines have built up systems which contain a complete organization for collecting, carrying and distributing freight.

Some of these great lines have also reached out for the world's traffic. One of the most noted in this respect is the Hamburg-American line which in addition to its trans-Atlantic trade dominates the city of Hamburg, Germany, sends steamers to Mexico, Panama, Venezuela and other South American countries, carries on an extensive coastwise trade in Europe as far north as Spitzbergen, has a line of steamers extending along the west coast of Africa as far as the Congo, and in Asia connects with the ports of Arabia on the Persian Gulf, with Ceylon, Calcutta and the Straits settlements, with the ports of China, Japan and Siberia, and also sends its steamers from there across the Pacific to Portland, Oregon. This line has in all a total of fifty-seven routes traversed by its steamers and covering practically the commercial world. The North German-Lloyd line is another whose interests are nearly if not quite as extensive.

Some of the systems have been formed by the consolidation of competing lines, because they were continually cutting rates and conducting their business at a loss, or because the weaker lines were unable alone to compete with the great systems built up by the Hamburg-American and other strong companies. The International Mercantile Marine, the largest steamship company in the world, was formed under these influences and by the consolidation of the American line, the Inman line, the Red Star line and several others of less importance. The chief object of these organizations was to maintain rates so that freight could be carried at a profit.

But these organizations in some instances have been extended to include great railway systems in the United States. Sometimes the initiatory step was taken by the railway, sometimes by the steamship company. To illustrate: some years ago the Pennsylvania Railway considered that its business interests would be advanced by securing a controlling interest in some steamship line, and the necessary connection was made. However, it did not prove so fortunate as the projectors of the enterprise anticipated, and after some years the arrangement was materially changed. Many railway lines have trade alliances with steamship companies. Among these are the Illinois Central which has important steamship connections at New Orleans, the Louisville and Nashville Railway which has similar connections at Pensacola. Most of these alliances occur in the smaller ports which are frequented by the steamers of comparatively few lines. In such ports as New York and Boston where ships of all lines enter, each line of ships and of railway is able to obtain all the traffic it needs without these alliances.

On the Pacific coast we find alliances between the trans-continental lines of railway and the steamship lines plying between the ports of the United States and those of the Orient. When the Great Northern Railway was completed the Great Northern Steamship Company was organized and constructed two of the largest and finest ships ever engaged in carrying freight and passengers. These ships were to ply between Seattle and China and Japan. In 1907 one of them was wrecked and never replaced; the other continues to make regular voyages. The projectors of the enterprise admit that it has not been attended with profit. The other steamship lines having trade affiliations with the great railway systems on this coast are the Pacific Mail Steamship Company and a Japanese line.

The combinations of the great railway and steamship companies form connecting links around the world by various routes and make the transportation of freight and passengers quick, safe and regular. Through these systems we can truthfully say that the world's trade has been organized, and in connection with the telegraph and the ocean cable it is now possible at any moment for the merchant to know the condition of markets in any part of the world in which he is interested, and to govern his shipment of goods in accordance with that information.

But we must not let the services of these great systems, however extensive they may be, cause us to overlook the no less important if less conspicuous services rendered by the single ship known as the "tramp steamer." These steamers are owned and operated as single vessels and are entirely independent of line traffic and of schedules. They load wherever they can find cargoes and depart for whatever ports their cargoes are designated, and they do the bulk of the carrying trade between ports having irregular traffic, and shipping such commodities as are carried in cargo lots and can not stand a high rate of tariff. Most of the cargoes coming to these steamers consist of raw material such as sugar before it is refined, jute, cotton, grain and the like.

These steamers may be operated by the owner or they may be leased by him to some individual or firm in need of their services. It is the business of the owner to see that his ship is provided with cargo and in contracting for a lading he not only looks at the present opportunity but also at the prospect of a return cargo from the port to which the one in sight is to be carried. If the ship must return empty or sail to another distant port for lading, the owner can not make so favorable rates as he can when assured of a cargo at the port to which the ship is bound. In all ports where freight is shipped, there are men called "ship brokers" whose business it is to bring the shipper and the ship-owner together, and through these agents most of the cargoes are obtained. The broker receives a commission on the freight secured.

The telegraph and the ocean cable are in frequent use in directing the courses of these steamers. A steamer loaded with cotton at Galveston and bound for Liverpool will probably find no cargo for her return trip. On reaching Liverpool she may be ordered to San Francisco for a cargo of wheat, and to provide ballast, that is, a sufficient loading to keep her from rolling, she may carry a cargo of coal at a very low rate, the owner making his profit on the cargo of wheat. Since Great Britain imports in bulk much more freight than she exports, the carrying of coal as ballast is one of the important reasons why this country has exported so much coal. Ships provided with other cargo can not afford to take the coal at the rates which could be paid for carrying it, but they are very glad to take it at almost any rate as ballast.

When our ship leaves San Francisco the destination of the wheat may not be known. In that case the captain is directed to sail to a certain point and when he reaches there he will be informed of the destination of his cargo. Cork, Ireland, is a favorite reporting station for steamers looking for such instructions. When one of these steamers leaves its home port there is no certainty of the time of its return, and it may sail around the world before again entering the harbor from which it first departed. There are thousands of these independent steamers and they are found in all navigable waters. Their service in the carrying trade is of great importance and without the tramp steamer water transportation would suffer many inconveniences, and probably some of it would be impracticable.

Some large firms and some firms which ship commodities calling for vessels of a peculiar construction prefer to own their ships, so we have private lines of steamers. Most conspicuous among these, perhaps, are the tank steamers of the Standard Oil Company, so called because the hulls are practically converted into huge tanks for carrying petroleum products. The steamers of the National Fruit Company are constructed for the purpose of carrying fruit from the West Indies to the Southern ports of the United States and for accomodating passenger trade between these points. The United States Steel Company also has its ore ships on the Great Lakes, constructed for carrying ore and coal.

Every convenience for handling freight easily and quickly is provided on the docks and on board the ships, for the ship is earning revenue only when she is on the move and it is important that her stay at the dock be as short as possible. Freight is classified as package freight and cargo freight. The former class includes manufactured goods and such other commodities as are handled in packages or cases. Coal, grain, cotton and lumber are good illustrations of cargo freight. Proportionately less capital is required for transportation upon the water than upon the land because nature has provided the highway, and freight rates by boat are usually less than those by rail. Passenger rates, however, vary widely in this respect. Where the steamer service is regarded as a luxury, as upon the Great Lakes in the United States, the rates are proportionately high. When the steamship and the railway come into competition the steamer rate is usually a little lower than the railway, but the time is longer, so that what the passenger gains in one way he may lose in the other. On long trips two forms of ticket are sold: those providing transportation, state-room and meals, and those providing transportation only. With the second form of ticket the passenger pays extra for his berth and meals. The difference in expense in the two plans is usually slight, and when the first form of ticket can be purchased, it saves time and inconvenience for the passenger to provide himself with it.

NAVIGATION

Navigation is the art of determining the position of the ship in the open sea by observation of the heavenly bodies and also of computing the best course to be steered in pursuit of the voyage, and the distance to be traveled. Before leaving port every ship should be provided with navigators' charts of the body of water over which she is to sail, a compass, a sextant, a nautical almanac for the current year, a lead line for measuring the depth of water, and a log line, which is an apparatus for determining the distance which the ship travels in a given time. Position of the ship is determined by two methods, known as "dead reckoning" and "observation." All courses are reckoned from the north and south line of the compass, called the meridian. Large ships usually have more than one compass. One of these, called the standard compass, is situated above the deck as far as possible away from local influences because the presence of iron affects the workings of the magnetic needle and causes it to vary from pointing due north and south. The ship is navigated by the standard compass.

Keeping the ship on her course and ascertaining her position from day to day are the most important duties of the navigator, and every ship master must be familiar with the solution of all problems which may arise in connection with these duties. Records of the distance traveled each day and of every change in the direction of the course are kept, and by comparing these records with navigators' tables which give the necessary reckonings for all latitudes, the ship's position can be quite correctly determined. When this has been done, the course to the port for which the vessel is bound can be easily computed. This method of keeping the ship on her course is known as "dead reckoning," and it usually answers all purposes for short voyages.

The method of reckoning by observation consists in measuring the positions of certain heavenly bodies, as the sun, moon or some star. The altitude of the body above the horizon is ascertained by an instrument called the sextant, and the ship's position is then found by comparing this distance with tables in the nautical almanac or some other work on navigation. The longitude is determined by ascertaining when the sun is directly overhead, that is, on the meridian. At that moment it is noon on the ship and this time is compared with the time indicated by the ship's chronometer, which is a clock that keeps accurate time and is set by the time at Greenwich, England, which is the standard time for all navigators.

Since the difference of fifteen degrees in longitude causes a difference of one hour in time, the longitude of the ship is easily ascertained. If the ship is sailing westward from the standard meridian her local time will be slower, and if eastward, faster than the time indicated by the chronometer. Supposing a ship bound from Liverpool to New York has been on her course three days and the captain ascertains the noon hour. On comparing this time with his chronometer he finds that the chronometer indicates 1:30 P. M. Greenwich time; therefore his ship is one and a half times fifteen degrees west of the standard meridian and her longitude is 22 degrees and 30 minutes west.

The ship's crew varies in number according to the size of the vessel and the kind of traffic in which she is engaged. Ships carrying passengers require a much larger crew than those which handle freight only. However, most of the extra number on the passenger ship are engaged in looking after the wants of the passengers and their duties are similar to those of the employees of a large hotel.

The regular crew is engaged in navigating the ship, and consists of a captain, a first mate, a second mate, a purser, an engineer and one or more assistant engineers and as many seamen, stokers and other helpers as the size of the ship may make necessary. On large ships the number of officers may also be increased. The captain is the commander-in-chief, and his word is law. The mates are his assistants and take turns with him in navigating the ship. The purser is the treasurer and cashier. He keeps the books and receives and pays out all the money handled during the voyage.

The crew is divided into watches of four or six hours each. While one watch is on duty the others are at rest. The captain or one of the mates has command of the watch. In case of an emergency it is the duty of the officer in charge to call the captain who at once takes command of the ship. Besides the man at the wheel who steers the ship, there is always a man on the lookout who keeps watch for approaching vessels and other objects which should be avoided. Nothing is left to chance and every minute of the day and night when the ship is on her course the utmost vigilance is maintained to avoid accidents.

When one is facing the forward end of the ship the right hand side is "starboard" and the left hand, "port." On the starboard side the ship carries a green light at night, and on her port side a red light. Both of these lights are so enclosed that they can not be seen from the opposite side or from behind. A steamer carries a strong white light at her foremast head which can be seen from all points except from behind. A sailing vessel does not carry a white light at her foremast head, so that a sailing vessel can be distinguished from a steamer at night. The officer navigating the ship during the night watches looks most closely for the red and green lights.

The rule of the road is that ships approaching each other from opposite directions shall turn to the right and keep far enough from each other to avoid any danger of collision. When two vessels approach from such directions that their paths cross, the one having the other on the starboard or right hand side is to turn to the right and let the other keep on her course. A steam vessel must always keep out of the way of sailing vessels, a vessel at anchor or one disabled, as well as a vessel having another in tow. Steamers also have a uniform code of whistle signals. One blast means that the ship is turning to the right, two blasts that she is turning to the left, three blasts that she is backing, and a series of short blasts means "Look out" or "Get out of the way." These rules are universal and are recognized the world over. Any navigator not following them except in narrow harbors and rivers where sometimes it is impossible to comply with the rules, is subject to arrest and prosecution, and is held responsible for any damage which may be caused by his violation of the rule.

While a century ago an ocean voyage was an object of dread, the science of navigation and the art of ship-building have now been brought to such a degree of perfection that an ocean voyage constitutes one of the most desirable forms of recreation, and the passenger on an ocean liner is subject to as little or possibly less danger than when engaged in his daily vocation.

GOVERNMENT AIDS

In the open ocean ships incur but little danger, but along the shore and at the entrance to harbors many dangers are encountered. Consequently all governments bordering on the sea erect and maintain systems of signals to warn vessels of these dangers. These signals consist of lighthouses, lightships and storm signals.

Lighthouses are the most conspicuous and interesting of all these signals. Ever since men began to sail ships, lights have been placed on shore to guide them. At first these were nothing but fires kindled on head points. Later, harbor beacons were erected, and in the days of the Greeks and Romans some of these were pretentious structures. Two of them, the Colossus of Rhodes and Pharos of Alexandria, are classed among the seven wonders of the ancient world. The former was a bronze statue of the sun god, Helios, that bestrode the entrance to

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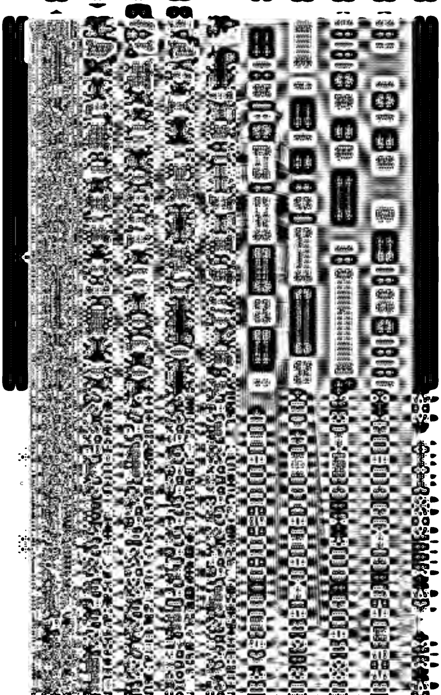

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the fury of the waves and the pressure of ice. These conditions call for structures of the greatest strength and the lighthouses erected in such places are usually in the form of the frustrum of a cone, and for the first twenty or thirty feet are of solid stone masonry. Above this the tower is constructed, and contains rooms for storing supplies and the living rooms for the keeper. At the top of the tower is the light chamber in which the lantern is placed. In most lighthouses this chamber is circular and has a row of windows extending around it so that the light can be seen from all directions. The height of the tower depends upon the location of the lighthouse and the distance at which the light needs to be seen. Lighthouses built upon bluffs are naturally lower than those built upon hidden rocks. The Eddystone lighthouse, one of the most famous in the world, is seventy-seven feet high. Bell Rock, off the coast of Scotland, is one hundred seven feet high. Minot Ledge, off the entrance to Boston Harbor, and the most famous lighthouse of the United States, is eighty-eight feet in height, and Spectacle Reef in Lake Huron is ninety-three feet. During the winter this lighthouse is subjected to great pressure from floating ice.

Like the tower on which it stands, the style of the light must be adapted to the purpose which it is to serve. Some lights are stationary and some revolving. The apparatus of a revolving light is delicate and complicated and its invention was one of the most useful scientific achievements of the nineteenth century. The lantern of a revolving light may contain three, four or six sides or faces. Each side is composed of a lens which is made up of a central convex lens around which are arranged rings of glass in which the glass is so shaped that a cross section forms a triangular prism. The angles in each ring vary so that the entire lens when complete refracts the rays of light passing through it to a common point. This lantern is mounted upon a frame which is supported upon trucks that revolve upon a track, the entire apparatus being so delicate that the least possible resistance is given to the motion of the lantern.

The motive power is usually a weight which operates a system of gearing. In the center of the lantern is the lamp. This usually consists of a large vessel for holding oil and having a burner with one or more circular wicks. In case more than one wick is used, they are arranged in concentric circles in order to produce a solid flame. The fuel for the lamp is a high grade of mineral oil. One of these lanterns complete may weigh several thousand pounds and contain from a few hundred to 3,000 pieces of glass. Its light can be seen, provided the altitude is sufficient, for more than twenty miles.

The number of flashes in a revolving light is equal to the number of faces in the lantern. A lantern with three faces would give but three flashes in one revolution; if of four faces it would give four flashes and so on. The different lights are distinguished by the number of flashes and the colors of the lights. For instance, a red glass may be placed in

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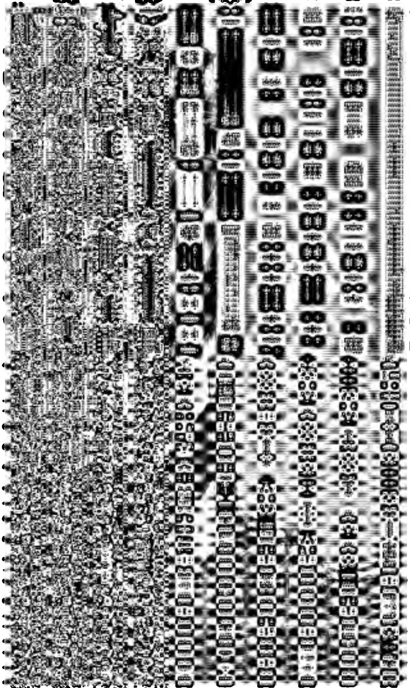
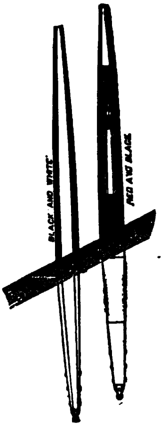


... FLORIDA

some another. Perhaps the most striking arrangement of this sort is found in the lighthouse off Saint Augustine, Florida, which is decorated with circular stripes, giving it the appearance of a huge barber pole.

From the harbor beacons of long ago to the modern lighthouse is a long stride, but present conditions have been reached only through centuries of the most careful and systematic study of the problem of warning ships at sea. "Now in place of the sturdy bonfire of oak or the huge iron cage filled with coals, there is only a single lamp whose rays are gathered by the combination of the lenses, into a compact bundle of unwasted light and doubled and redoubled by means of magnifying lenses, until they dart to the farthest horizon in a strong beam of steady light."



SPAR BUOYS

The lighthouse service also has charge of the entrances to all harbors and the marking of points of danger on which lighthouses can not be erected. On some of these lightships are stationed. These consist of vessels constructed especially for the purpose and at night carrying lights at their mast heads. They are supplied with stores for the keepers and materials for keeping the lights in order. Buoys are used for marking sunken rocks and for indicating channels which vessels should follow in entering and leaving harbors. The larger buoys [illegible] ms, conical and [illegible] n as the "nun" [illegible] ndrical as the [illegible] es or spars are [illegible] milar purposes, [illegible] here the bottom [illegible] can not readily [illegible]

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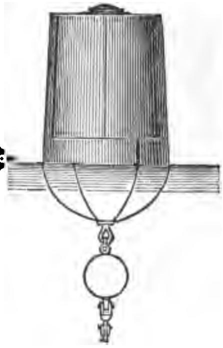

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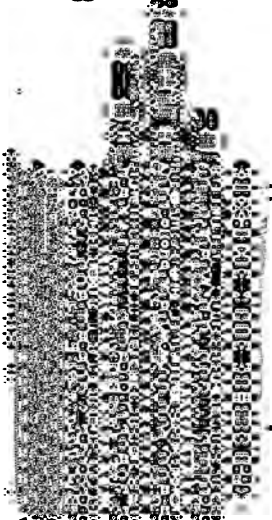

that ships about to leave harbor are forewarned of the approach of a severe storm and can remain at anchor until it is over, or ships at sea, seeing these signals, can take warning and run to shelter before the storm breaks.

The Life Saving Service of the United States maintains stations at dangerous points along the coasts and on the Great Lakes. Each station is provided with lifeboats which are so constructed that they can be operated in the roughest of water without sinking; and with other appliances necessary to save life and property from wrecked vessels. One or two men are always on watch in the tower of the life-saving station, and along the Atlantic coast those stations which are particularly dangerous are patrolled at night by men connected with two adjoining stations. Each man walks the beach until he meets the other, when they turn about and each returns to his station. In this way careful watch is kept for any vessels which may be driven upon the rocks or placed in distress during a storm.

When the vessel is observed, immediate aid is given. If possible, the lifeboat is launched and rowed at once to the wreck. If the condition of the weather is such that this is impracticable, a small canon with a ball having a line attached to it is fired at the ship. This throws the ball over the ship and carries the line which contains a card of instructions directing those on board the vessel to pull the line in. To this is attached a heavier line which may be attached to a hawser on board the

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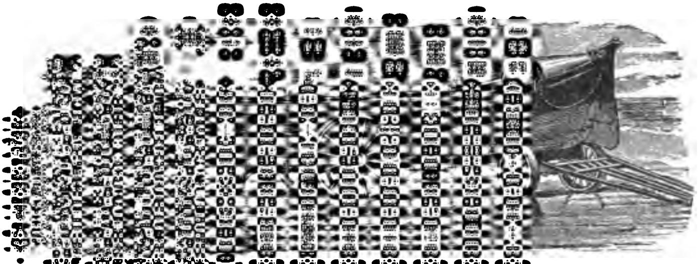

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of the lighthouse tender, which leaves supplies and usually a small library. These libraries can be exchanged at each visit of the tender, so that the keepers are supplied with a fair amount of entertaining reading. A very high order of discipline is maintained in the service, and whatever happens, the keeper is expected to care for his light even at the peril of his life.

SUMMARY

In 1909 there were 24,309 American vessels engaged in ocean trade, exclusive of the fishing vessels, which number 1379. Of the vessels engaged in regular transportation 1600 were employed in foreign and 22,709 in coastwise traffic. By far the greater part of our traffic is carried in foreign ships. For the fiscal year ending July 1st, 1910, this traffic amounted to the enormous sum of $3,302,821,000. The imports amounted to $1,557,854,854, and the exports to $1,744,966,203. This traffic radiates from and accumulates in great trade centers, the most important of which in the United States is New York. Other important ports connected with the trans-Atlantic trade are Boston, Philadelphia and Baltimore. Some idea of the traffic in New York may be obtained from the following statistics of the harbor: The harbor of Greater New York contains 444 miles of frontage, and of this 125 miles is available for shipping purposes, but this is not enough to accommodate the present traffic, and the National Government and the City of New York have combined to convert Jamaica Bay into a harbor. When this work is completed, it will give an additional harbor having twenty-five square miles of anchorage, and one hundred fifty miles additional water front. The Government is certainly justified in making any expenditure necessary to protect and promote our foreign trade.

INLAND WATERWAYS

IN THE OLD WORLD

Inland waters include lakes, navigable rivers and canals. Navigation of inland waters doubtless preceded navigation of the sea, because it was simpler and boats of a more primitive structure could be used upon the smooth waters of lakes and rivers more successfully than upon the ocean.

Rivers have always exerted an important influence on the progress of mankind, and as far back as we can trace written history we find the most civilized nations dwelling in the valleys of great rivers. The Egyptians had the Nile, the Babylonians and the Caldeans had the Tiber and the Euphrates, while the valleys of the great rivers of China have from the remotest time been the dwelling places of those untold millions of people who originated and have maintained the peculiar civilization of the Orient. Every great river is a natural highway from the interior of the country through which it flows, to the ocean. It affords a cheap and convenient mode of transportation, and is one of the most valuable of national assets.

The rivers of the Old World, especially valuable for navigation, are, in Asia, the Yangtse and Hoang Ho in China, the Amur in China and Manchuria, the Mekong and the Irawadi in Farther India, and the Ganges and Indus in British India. In Europe all the rivers large enough to float a boat or barge have been pressed into service, and a list of the navigable streams of that continent would embrace all of its rivers worthy of mention, but the Rhine, the Rhone, the Seine, the Danube, the Elbe and the Volga are the most important of European inland waterways. The interior of Africa is a plateau, and with the exception of the Nile, her rivers are navigable only a short distance from the sea, because of the nearness of the fall line to the coast. Above the fall line the Congo is navigable for more than a thousand miles for large steamers. In South America the chief navigable streams are the Amazon, which steamers can follow for more than two thousand miles, the La Plata, the Oronoco, and a number of the tributaries of the Amazon. The South American streams flowing into the Pacific are practically mountain torrents and are useless for the purpose of transportation or navigation. The navigable rivers of North America are found in the United States and Canada.

While a detailed description of all these rivers and their methods of transportation might be of interest, we must confine ourselves to those of the greatest commercial importance. In Asia the chief rivers for transportation are the Yangtse and the Ganges. The former affords the only means which the Chinese far inland have of transporting their products to the coast and their goods from the coast cities and foreign lands. While the wants of the Chinese are few compared with those of Americans and Europeans, yet some interchange of products is necessary, and the large number of people living in

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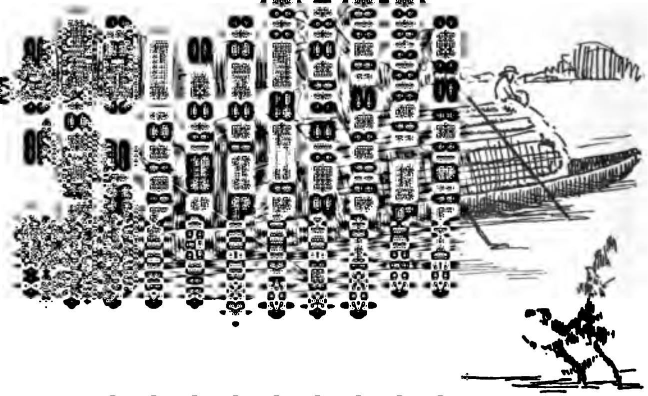

...OUTH AMERICA

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Valley find ready access to the Atlantic, whence they are taken by steamships to various European ports.

Germany, France, Belgium and Holland have the most complete systems of inland waterways of any countries in the world. Each of these countries has provided all transportation facilities possible in its rivers, and in addition has constructed canals connecting the principal rivers, and in some instances connecting the rivers of one country with those of another. Russia has also made great use of her rivers, and with connecting canals they form a network of waterways joining many cities and towns and serving the most valuable agricultural portions of Russia in Europe.

Government work on these waterways has consisted in straightening crooked canals, removing obstructions, and where necessary, in deepening the channels of the streams, a process generally known as "canalizing." The canals forming a part of these systems of waterways in each country are also government works. The extent to which these countries have engaged in the construction of canals is shown by the following table, giving the waterway mileage from each country:

Country	Miles
Russia	12,000
Great Britain	3,900
France	3,000
Austria-Hungary	2,750
Germany	2,700

In addition to this, Belgium, with an area somewhat less than that of Maryland, has over 1500 miles of canals, and this mileage will soon be materially increased by completion of works now under construction.

Government control of all means of transportation including railways is much more complete in European countries than it is in the United States. Because of this the railways cooperate with the waterways instead of attempting by competition to drive them out of business as the railways are often charged with doing in this country. Most of the traffic on the European canals is carried in barges drawing from six to seven feet of water. The barges are towed by steamers or by locomotives which run upon a track along the bank. Along some canals in Germany electric locomotives have been substituted for those operated by steam. This method of transportation is convenient and cheap, but it is somewhat slow. Nevertheless it finds favor with the people. It is estimated that one-fourth of all the traffic in France, not including that carried in wagons, is carried on her waterways, and in Germany, Belgium and Holland the proportion is but little less. Because of the numerous sea ports in Great Britain and her many lines of railway, less attention has been paid to the construction of canals and to canalizing the rivers in this country than in the countries on the continent. Nevertheless, the British Isles are well provided with waterways and transportation is ample, convenient and cheap.

The United States and Canada

RIVERS

The United States has the most extensive system of waterways of any civilized nation. According to the report of the Inland Waterways Commission of 1908, there are within the country 25,000 miles of navigated rivers and at least an equal amount which are navigable or which might be made so by improvement. These rivers are distributed as follows:

Section	Number of Streams	Total Mileage
Tributary to Atlantic Ocean....	142	5,311
Tributary to Gulf of Mexico, exclusive of Mississippi River and tributaries...............	52	5,261
Mississippi River and tributaries	54	13,869
Flowing into Canada............	1	180
Tributary to Pacific Ocean......	38	1,605
Total	287	26,226

Owing to the proximity of the fall line to the coast, the rivers of the Atlantic group are not navigable for any great distance. They are also separated by such barriers as make connection between them impracticable except by sea. The broad estuary of the Delaware enables ocean-going ships to ascend that river as far as Philadelphia, and to this fact is owing much of Philadelphia's commercial prosperity. Large river steamers can ascend the Hudson to Albany, and this is the only river of the Atlantic group that is of much national importance commercially. By means of the Champlain Canal, Lake Champlain and the Richelieu River, connection by water is made between New York City and the Saint Lawrence River, but the route is not of great commercial importance.

The Gulf group consists of the streams flowing into the Gulf of Mexico, and besides the Mississippi and its tributaries includes a number of shorter streams, such as the Mobile, Alabama and Tombigby, that are of considerable local importance. Their combined mileage exceeds 1200 miles. The fall line here is far inland and in consequence steamers can ascend these rivers to a much greater distance than they can those of the Atlantic group. The Mississippi and its tributaries form a network of inland waterways about 16,000 miles in extent, and are of sufficient importance to warrant special notice.

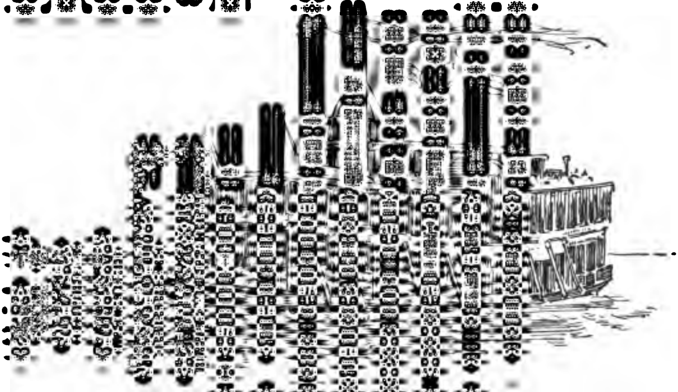
The Mississippi, from its mouth to the head of Cass Lake, Minnesota, has a length of 2430 miles. When considered as a waterway, the river is divided into the Upper Mississippi, extending from Cass Lake to Saint Louis, and the Lower Mississippi, extending from Saint Louis to the mouth. From Cass Lake to Cape Gerardeau the improvement of the river is in charge of the Mississippi River Improvement Association. Below that point it is in charge of the Mississippi River Commission, which endeavors to maintain a channel at least nine feet deep at low water, and two hundred fifty feet wide, between Saint Louis and New Orleans. The channel is constantly changing and is very treacherous, and it requires constant oversight and frequent dredging to keep it up to the required standard. Notwithstanding the care exercised by the Commission and by the river pilots, large boats are occasionally wrecked.

Below New Orleans the channel is deeper and ocean steamers drawing thirty feet of water can ascend the river to that city. The river deposits a great quantity of sediment at its mouth, and for many years it was impossible for the Government to keep a channel deep enough for the navigation of ocean-going steamers. In 1874, Captain James B. Eads, a government engineer, conceived the idea of making the river dredge its own channel by confining the current between artificial embankments called jetties, and thus securing a velocity of current that would carry the sediment far out to sea, instead of allowing it to be deposited at the mouth of the river. The Mississippi discharges into the gulf through several channels, generally known as "passes." Captain Eads selected the south pass for his experiment and on each side of this constructed embankments, 11,800 feet long on the east side and 7800 feet long on the west. This daring project was not favored by most engineers, but the experiment was successful even beyond the expectations of those who advocated it, and since the completion of the jetties, New Orleans has practically been a sea port.

From the time of its discovery by the French in

1672, until the completion of railway lines from the Atlantic seaboard to the great prairie region, the Mississippi afforded the only means of an outlet for the people and products of the great valley through which it flows, and the chief cities along its banks, Saint Louis, Memphis, Natchez and others, started as trading posts of the early French settlers. That their sites were wisely chosen is shown by the present thriving condition of the cities. Saint Louis, next to Chicago, is the largest center of inland commerce in the country, and ranks as one of the largest and wealthiest of our cities. The peculiar location of this trading post in reference to the Mississippi and its tributaries gave it a prestige shared by no other post along the river. From here boats could depart for the Upper Mississippi or Lower Mississippi, the Missouri, the Ohio and all tributaries to the south, and the Illinois. Likewise, boats from all these rivers made Saint Louis their center of exchange. Before the day of railroads, the trading post had become a city whose traffic was of such importance that when railway lines were built they readily sought the patronage which this great trade center offered. In this way the city continued to grow until it has reached its present size and importance.

In their passage up and down the river, the early French traders used the Indian canoes, but after the Revolutionary War the English settlers began to use flat boats which were large barges with flat bottoms and so constructed that they would carry heavy loads of freight. The crew used poles to keep the boat in the current and to push it away from snags. They [illegible] rent by day, [illegible] they reached [illegible] disposed of, [illegible] they could, [illegible] to propel a [illegible] ent. It was [illegible] boat expedi- [illegible] commercial [illegible]



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[illegible] essful opera- [illegible] ilroad in the [illegible] placed upon [illegible] Fulton's in- [illegible] dson, steam- [illegible] oped slowly, [illegible] barges from [illegible] Before the [illegible] rous packet lines of steamers were plying between St. Paul and St. Louis and between St. Louis and New Orleans and intervening points. It was on one of these lines that Mark Twain served as a pilot, and upon the experiences he gained in this occupation, he based some of his most humorous and at the same time life-illuminating sketches.

The Mississippi steamers of this period carried freight and passengers, and races between boats of competing lines were frequent. Although these contests were attended with great danger, both passengers and crew usually entered into the spirit of the race, and each boat was willing to run any risk to win. The type of steamers used was similar to that employed at the present time. The bottom was shallow or nearly flat, so that the boat would draw but a few feet of water, usually not more than six or seven, while the smaller boats drew much less than this. The paddle wheels were placed at the side, or one large paddle wheel was used at the stern. Freight was carried on the lower deck, and accommodations for passengers were on the upper deck. Before anything better was known, these steamers were considered comfortable and even luxurious, but compared with the passenger steamers now in use on the Great Lakes, their accommodations and equipment were very meager.

At present there are lines of boats between Saint Paul and Saint Louis and between Saint Louis and the important cities along the river to the south, and on the Ohio and Tennessee and other navigable tributaries, but there are no regular lines between

St. Louis and New Orleans. A canal is now in the process of construction between Saint Paul and Minneapolis, and when this is completed it is expected that it will increase the traffic on the Upper Mississippi to quite an extent, since wheat and flour can then be loaded on the boats direct from the elevators and mills in Minneapolis, and this will lead to shipping by boat a portion of these commodities now shipped by rail.

In the extreme upper portion of the navigable part of the river, known as the Cass Lake Region, conditions today are similar to those which existed on the lower part of the river between 1830 and 1840. The waterway affords the only means of transportation to the inhabitants of this newly settled region, and those located any distance from the river must haul their supplies back and forth over poorly constructed roads. Thus in our own country we find a river whose main channel extends through regions occupied by white men for more than a century before the breaking out of the Revolutionary War, and through other regions which were not opened to settlement until the first decade of the twentieth century.

While the Mississippi is still an important artery of trade and in the congested season when farm crops are moving relieves the railroads, its relative importance in transportation is much less than it was before the Civil War, and what is true of the Mississippi is equally true of nearly all the rivers of the country. This falling off in water transportation is due almost entirely to the extension of railway lines into all sections of the states which otherwise would find a natural trade outlet through this magnificent system of waterways. The railway has the advantage over the waterway in that it can be extended to any point where traffic will warrant, while the waterway must remain in a fixed channel, to some point on which the farmer must haul his products. If this haul is for any considerable distance, the extra expense often exceeds the difference between rail and water rates for freight; besides, transportation by rail is quicker than by boat. For these reasons the railway has taken a large part of the traffic from the river steamers.

The annual traffic on the Lower Mississippi amounts to about 6,560,000 tons; that between Saint Louis and Saint Paul to about 4,100,000 tons, and that from Minneapolis to Cass Lake to about 1,600,000 tons. The estimates in the Cass Lake and Upper Mississippi divisions include the logs floated down the river, so that the tonnage carried by boats is considerably less than the total amount given. Passenger traffic on the Mississippi and its tributaries is confined almost entirely to tourists, and limited to the spring and summer months, whereas, in former times the traffic was so large that at certain seasons of the year the boats had difficulty in accommodating it.

The Ohio is not only the most important navigable tributary of the Mississippi, but it is the most important commercial river of the country. From Pittsburgh to Cairo, Illinois, its length is 967 miles. The river is formed at the site of the great coal and iron industries at Pittsburgh, flows through a prosperous agricultural and manufacturing region, and has numerous navigable tributaries. For these reasons it carries a larger tonnage of freight than any other stream in the country of equal length. Its freight consists chiefly of coal, which it receives from the Pennsylvania and West Virginia coal fields and takes to Cincinnati and Cairo, thence to Saint Louis and as far as New Orleans. The next item of importance is iron; then follow manufactured goods and general merchandise. Most of the freight is carried in barges towed by steamers. The passenger traffic is so small that it is scarcely worthy of consideration; yet the river flows through a beautiful valley, and a trip up or down the stream is very enjoyable. The great distributing points along the river are Cincinnati, Louisville, Paducah and Cairo.

The Tennessee and Cumberland are two important tributaries from the south. The former has a navigable length of 652 miles, and the latter of 518 miles. These two streams with their combined navigable tributaries, furnish Kentucky, Tennessee and northern Alabama with a system of waterways having a length of over 1800 miles navigable for steamers, and more than a thousand miles additional open to barges and rafts, and they constitute a convenient and cheap means of transportation for all cities and towns on or near their banks.

The navigable length of the Missouri river from its mouth to Fort Benton, Montana, is 2285 miles. Although it is the second longest navigable river of the United States, the traffic upon it is of slight importance and seems to be on the decline. Before the construction of railways into South Dakota and Montana, the Missouri furnished a convenient outlet for traffic, but transportation by the railway lines is so much more direct than by the river that the water route has practically been abandoned.

The Illinois river is navigable for steamers to La Salle, from which point connection with Lake Michigan is made by the Illinois and Michigan Canal. However, this is so little used that it may be considered as abandoned. The Chicago Drainage Canal, connecting Lake Michigan with the Desplaines river at Lockport, is planned for a ship canal, provided a deep waterway from the Great Lakes to the gulf is completed. Until this is done, the importance of the Illinois river as a navigable stream will be slight.

Of the rivers flowing into the Pacific, the Columbia, Willamette, San Joaquin and Sacramento are the most important. Of these the Columbia is the largest and the Willamette has the largest traffic. The San Joaquin and Sacramento are of considerable importance in the transportation of farm products, and there are many other small streams in Oregon, Washington and California which are important to local interests, but none of these rivers has the importance of the Mississippi or the Ohio. The scenery on the Columbia and Willamette is remarkable for its beauty and grandeur, and boats are run upon these rivers for the accommodation of tourists. The Columbia and its tributaries contain 800 miles of navigable water, and doubtless it will eventually be developed into one of the great waterways of the country.

CANALS

The oldest canal in the United States is the Chesapeake and Ohio, extending from Cumberland, Maryland, along the Maryland side of the Potomac river to Washington, D. C. It is 185 miles long and is used wholly for transporting coal from the mines above Cumberland. The history of this canal is of special interest. It was projected by George Washington in 1784, and the Potomac Company, of which Washington was made president, was organized to finance the enterprise and to construct the waterway. Moreover, the preliminary meetings in the interests of this canal constituted the initiatory steps which led to calling the convention that framed the Constitution of the United States in 1787. Work on the canal was pushed vigorously until 1789, when Washington resigned the presidency of the company to assume his duties as president of the United States. Shortly after this the work was abandoned, and nothing further was done until 1822.

In 1825 an agreement was reached between the legislatures of Virginia, Maryland and Pennsylvania and the Government of the United States, whereby the Chesapeake and Ohio canal was incorporated, and the United States, the City of Washington and the State of Maryland subscribed for shares of the stock. By this act the United States inaugurated its policy toward the development of inland waterways, a policy for which due credit should be given to the wisdom and foresight of George Washington.

Between 1800 and 1810 several canals were projected, and one of these, connecting the Hudson river with Lake Champlain, was constructed and is still in use, but most of these projects, like numerous others which followed, were merely schemes for speculating in stocks. Several routes were proposed for canals connecting Lake Ontario with the Hudson, but none of them was brought to perfection until after the completion of the Erie canal.

With the settlement of Ohio and the territory to the west of the Alleghany mountains, the great demand seemed to be for a waterway that would connect Lake Erie with the Hudson. To understand the importance of such a waterway, we must remember that there was not at that time, even a wagon road connecting the settlements west of the Alleghanies with Philadelphia, New York or other centers of trade. To meet this demand, the Erie Canal was projected and constructed by the state of New York. This canal, at the time a work of unusual magnitude, was begun in 1817, and opened to traffic in October, 1825. The ceremony of dedicating the canal to public traffic occurred in the city of New York. A procession of boats started from Buffalo for New York, and the ceremony occurred when these boats reached their destination. On this occasion DeWitt Clinton, governor of the State of New York, and to whose foresight and energy the canal was largely due, poured into the harbor two kegs of water from Lake Erie, and solemnized his act with these words:

"This solemnity at this place, on the first arrival of vessels from Lake Erie, is intended to indicate and commemorate the navigable communication which has been accomplished between our Mediterranean Seas and the Atlantic Ocean in about eight years, to the extent of more than four hundred twenty-five miles, by the public spirit and energy of the people of the State of New York, and may the God of the heaven and the earth smile propitiously on this work and render it subservient to the best interests of the human race."

The Erie Canal is 363 miles long, making it the longest canal in the world. When first constructed it was four feet deep and forty feet wide, and contained seventy-two locks. Its completion joined the Great Lakes to the Atlantic, and its importance as a waterway is illustrated by the fact that it reduced the cost of freight between Buffalo and New York City from one hundred dollars to ten dollars a ton. In the opening of the Erie Canal New York was placed in direct connection with the Great Lakes and the vast fertile country beyond. This connection at once gave it that prestige as a commercial center which has since made it the metropolis of America and the second city of the world in population. The completion of the canal turned the tide of western trade from Philadelphia and Boston to New York, and the prestige which these cities lost at that time they have never been able to regain.

The traffic upon the canal increased so rapidly that it was soon found inadequate to the demands made upon it, and in 1835 work on its enlargement was commenced. This work, however, was not completed until 1862. The enlarged canal has a capacity for boats of two hundred forty tons burden, and at that time it was supposed that larger boats could not be operated with success because the only motive power known for canal boats was animal power. The boats were hauled by horses or mules following a tow path.

Now, with the perfection of steam and gasoline engines, other motive power can be applied successfully, and this has led to a project for again enlarging the Erie Canal and all those connected with it as feeders. When this enlargement is completed, the canal will be able to carry boats drawing eight feet of water and of 1000 tons burden. Engineers claim that this work of enlargement exceeds in magnitude the work of constructing the Panama Canal, but in expense it will probably be somewhat less, the estimated cost being some over $100,000,000. When enlarged according to the present plans, the Erie Canal will furnish the cheapest route by which commodities can be transported from the Great Lakes to the seaboard, and it will doubtless increase the carrying trade upon the Great Lakes, as well as the export trade at New York. The locks on the new canal will be 310 feet long, 28 feet wide and 11 feet deep.

The time between the completion of the Erie Canal and 1840 was a period of canal building. The people of Ohio needed water communication between

Lake Erie and the Ohio river. As early as 1812 they began a series of movements which resulted in the Ohio Canal System, although construction did not actually begin until 1825. Two great canals of this state are the Miami and Erie Canal, extending from Toledo to Cincinnati and having a length of 244 miles, and the Ohio and Erie Canal, generally called the Ohio Canal, extending from Cleveland to Portsmouth on the Ohio river and having a length of 309 miles. These canals and a number of short feeders are still in use. Ohio has 595 miles of active canals besides a few miles that have been abandoned.

The canals in Pennsylvania, Delaware and New Jersey, are used almost exclusively for carrying coal. The Albemarle Sound Canal connects Chesapeake Bay with Albemarle Sound, and the Dismal Swamp Canal in Virginia and North Carolina, is a deepened channel through the shallow waters of this swamp. Both of these canals shorten the routes between the points which they connect.

Illinois has two commercial canals, although one of them is under the control of the United States government. These are the Illinois and Michigan Canal, as already stated, connecting Lake Michigan with the Illinois River at La Salle, and the Illinois and Mississippi or Hennepin Canal, connecting the Mississippi river at the mouth of Rock river with the Illinois river near Spring Valley. This canal is about 95 miles long, and was completed in 1907. Its chief use will be for carrying coal from the mines in the vicinity of Spring Valley to the Mississippi.

The Illinois and Michigan Canal was constructed for the purpose of general transportation, and is now but little used.

According to the report of the United States Inland Waterways Commission for 1908, there were in operation in the country 1994 miles of canals exclusive of those connected with the Great Lakes and the Hennepin Canal previously mentioned. Of these, 1,359 miles are owned and operated by states and 635 miles are owned and operated by corporations and are known as private canals. In 1908 the state canals carried 3,761,429 tons of freight, and the private canals carried 2,997,000 tons.

Originally, all boats on canals in the United States were moved by horses or mules traveling along a tow path, but since the invention of the gasoline engine and its application to boats, it is rapidly coming into use for moving boats on large canals. A gasoline motor boat can be operated without the services of a skilled engineer required for operating a steam engine, and can take a much larger load and this at a greater speed than can be moved by a team of horses or mules. In this improvement in motive power we see a tendency to increase canal traffic by providing the canal with means for more successfully competing with the railways.

Canal traffic is slow, but it is inexpensive, and for the handling of those commodities which must be moved in carload lots, such as coal, grain and lumber, it is a very convenient mode of transportation for localities through which the canals pass and also for the great trade centers which these waterways connect. The present tendency in the United States is to grant the canals more liberal patronage and to increase their traffic, because along the main lines of travel the railways are unable in the congested seasons to handle expeditiously the freight which is offered them, and more especially because it is believed that the support of the canal traffic will have a tendency to keep railroad freight rates down to their present limit.

THE GREAT LAKES

The Great Lakes have a combined area of 94,650 square miles, or an area a little less than that of the state of Oregon and a little more than the combined areas of Illinois and Indiana. If compared with the countries of Europe, they are nearly equal to England, Scotland and Wales combined, and about six-sevenths of the size of Italy. Lake Superior is a little smaller than Maine and a little larger than South Carolina. Lake Huron is a little smaller than West Virginia. Lake Michigan equals the area of Maryland, Massachusetts and Delaware combined. Lake Erie is about the size of New Hampshire or Vermont, and Lake Ontario is a little smaller than New Jersey. The distance from Duluth at the head of Lake Superior, to Buffalo at the foot of Lake Erie, including the connecting rivers, is 1030 miles; to Kingston at the foot of Lake Ontario, 1245 miles, while the distance from Duluth to Belle Isle is some over 2300 miles. Excepting Lake Michigan, about one-half of the area of the Great Lakes belongs to Canada and one-half to the United States.

In size equal to an empire, and occupying practically the geographical center of the most fertile region of North America, the Great Lakes with the magnificent river which carries their water to the sea, are of untold commercial value and they constitute one of the most important factors in the carrying trade of the United States and Canada. The first vessel larger than a canoe to float upon their waters above Niagara was the "Griffin," a sailing vessel constructed by La Salle in 1679. On completion she sailed for Saint Ignace and Mackinaw, which ports she reached without accident. There she was laden with furs and started upon her return voyage, but nothing further was ever learned of her. From the time of the "Griffin" it was more than seventy-five years before another sailing vessel operated upon the lake above the Niagara. The French and Indian traders preferred to trust their furs and other merchandise to batteaus, a sort of flat bottomed boat propelled by oars, and canoes, to risking them in such clumsy sailing craft as they were able to construct.

During the long struggle between the French and English for possession of the territory, trade with the Indians fell off. For a time after the Revolutionary War trade revived, and during this period the American Fur Company was organized. In this organization John Jacob Astor was one of the leading spirits, and a portion of the old building in which he had his office at Mackinac is still preserved in the Astor House. However, the British continued to keep the Indians in an unfriendly and at times a hostile attitude, so that traffic again lessened, and it was not until after the War of 1812, when British outposts had been abandoned and the Indians had been convinced that the United States was in possession of the territory, that any traffic worthy of mention was developed. This traffic began on Lakes Erie and Ontario and gradually extended to the western lakes. The opening of the Erie Canal was a great stimulus to lake traffic, and after 1825 the number of sailing vessels rapidly increased. The first steamer, "Walk-in-the-Water," operated on Lake Erie in 1818, but for the next twenty-five years the great bulk of the trade was carried in sailing vessels.

In the decade between 1830 and 1840, thousands of settlers entered the country around the Great Lakes. Farms were occupied, towns built and commercial relations developed with a rapidity that astonished the country at large and even the settlers themselves. A large part of this traffic passed over Lakes Erie, Huron and Michigan. It is estimated that in 1828, 5,000 people left Buffalo in a single day for the lake country. The traffic increased so rapidly that boats could not be built fast enough to accommodate it. The first steamer reached Sault Saint Marie in 1827, and the first steamer entered Chicago Harbor in 1832. The "Walk-in-the-Water" could carry from forty to fifty pasengers, and it took her thirteen days to make the trip from Buffalo to Detroit and back. The fare was eighteen dollars.

Extracts from a "Traveler's Guide," published by one Davison yearly between 1825 and 1840, give some insight into conditions of travel upon the lakes during those years. In 1825 this guide advertises another steamer on Lake Erie, named the "Superior." At this time a line of boats left Buffalo for Detroit every other day. The time had been somewhat shortened and the fare reduced to fifteen dollars. In 1834, it would seem from this guide that the time of boats between Buffalo and Detroit had been reduced to forty hours. In 1837 a full trip on Lakes Huron and Michigan was outlined. Mackinac and Green Bay were mentioned about 1830, as "military posts occasionally visited by steamers in the summer."

With the settlement of what was then the West, traffic on the lakes became regular and several lines of packet boats, sailing regularly from Buffalo, were established. The two-masted schooner was the earliest type of these lake freighters, but as the trade increased vessels of large size were built, until in type, size and appearance they came to resemble the merchant ships on the ocean. At first all vessels were constructed of wood, but with the increase in size, iron arches and steel bands for the purpose of strengthening the frame, were introduced. This gradually led to the building of iron ships, the first of which on the lakes was constructed in 1855. From that date iron and steel began to supplant wood as building material, and now all large ships and most small ones are built of steel. The early vessels were constructed to suit their trade. At first this was confined almost entirely to lumber and package freight and passengers, for which some of the larger sailing vessels provided accommodations.

With the development of the ore, coal and grain trade came the demand for a different style of ship, and the result is the modern freighter, which can be described as a huge trough with rooms above the deck at the bow and stern. The objects sought in the construction of ships of this style are strength, speed and the largest possible capacity. These boats ordinarily are from five hundred to six hundred feet long, about fifty feet wide, and when loaded draw from twenty to twenty-one feet of water. The hold is a vast chamber in which the cargo is carried. The deck is low, slightly oval, and contains numerous openings known as "hatchways." Through these the cargo is loaded and unloaded. The space at the stern is devoted to the engine, boilers, storage for coal and the rooms occupied by the crew. The bow is built high in order that it may meet and part the waves encountered in rough weather. Here are located the rooms for the officers and the apartments for guests.

In appearance the modern freighter on the Great Lakes is long, low and ugly, but for adaption to its purpose it has no equal. The capacity of one of these ships is from 9000 to 12,000 tons, or from 300,000 to 400,000 bushels of grain, and when under full load, without a tow, it will make from twelve to fourteen miles an hour. However, the ore boats often take one or two other boats of similar build and capacity in tow, because the extra time consumed in the voyage is more than compensated for by the great quantity of ore carried by the "consorts," as these ships are called.

The bulk of freight carried on the lakes consists of iron ore, coal, lumber, grain, flour, package freight and copper. In importance these commodities range in the order given. It is to the discovery and development of the extensive ore deposits on the shores of Lake Superior near Duluth, and in northern Michigan and Wisconsin that the enormous traffic on the lakes is due. The ore is in the form of decayed rock, and most of it can be mined with the steam shovel, which loads the car in a few minutes. The cars are hauled to the ore chutes in Duluth or Superior, where they are run upon tracks elevated over bins, into which the ore is dumped through an opening made in the bottom of the car by dropping panels or doors. An entire train can be emptied almost instantly. So perfect are the arrangements for mining and hauling that the ore is deposited in the chutes at an expense of about eight cents per ton. The bins have slanting bottoms and each bin is provided with a spout hung with a hinge joint so that it can be raised or lowered. When an ore steamer comes to the dock for loading, her hatches are open. These spouts are pulled down so that their contents will be emptied into the hold, the gates are opened and the ore shoots through the spouts into the hold of the vessel like an avalanche.

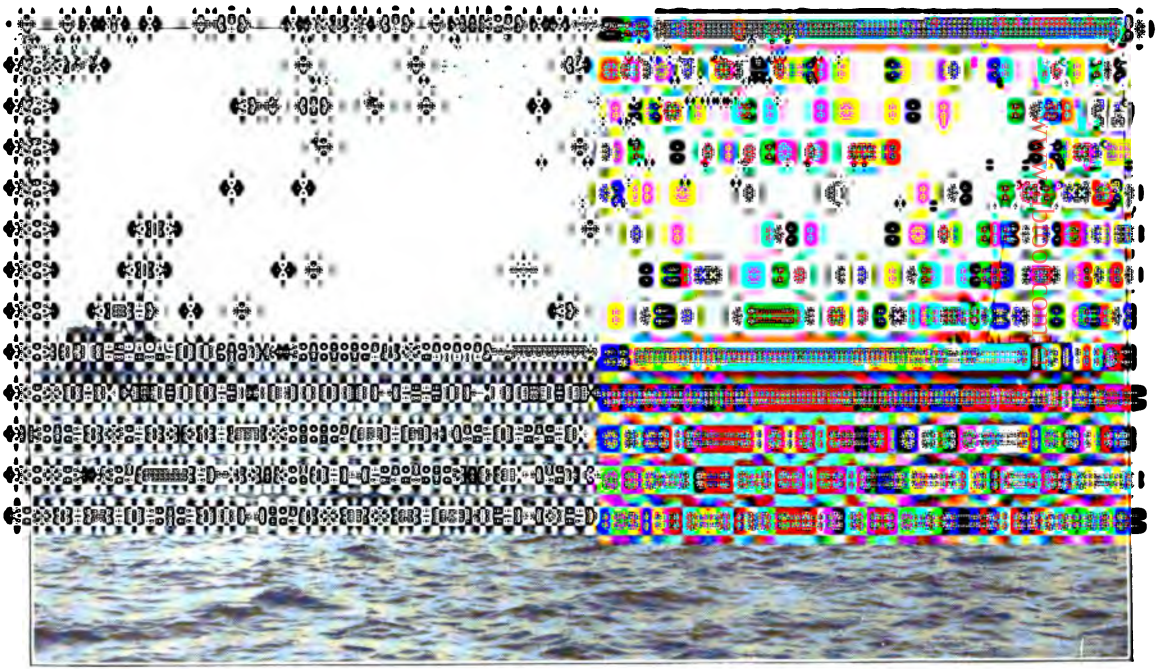
The rapidity with which one of these ships is loaded is almost beyond comprehension. The following records taken from the annual report of 1909 of the Lake Carriers' Association illustrate the efficiency of the methods used: On October 10th of that year the steamer "William E. Corey" loaded 10,111 gross tons of ore (2240 pounds to the ton) in thirty-nine minutes; on July 10th two cargoes of ore, aggregating 19,999 tons, were removed from two steamers in eleven hours, the time consumed on one being four hours fifteen minutes, and that for the other being five hours forty-five minutes. The unloading was done by huge buckets operated by electric power. These buckets are in the form of clam shells. They descend into the hold of the boat open, and when filled with ore they close. Buckets of the largest size have a capacity of fifteen tons, others a capacity of about ten tons. Several of these are operated at the same time upon the cargo. The ore is deposited either on a dump on the dock or into an electric carrier which transports it to the point desired. From one to two thousand tons can be removed from a ship in an hour, the quantity depending somewhat on the conveniences for depositing the ore and the number of buckets that can be employed at a time.

Nowhere else in the world are such conveniences found for handling freight in large quantities as at the docks on the Great Lakes, especially at Duluth, Superior and Two Harbors on Lake Superior, and at Cleveland, Ashtabula, Connaught, Erie and Buffalo on Lake Erie. These devices have been erected at enormous expense, in which the Lake Shore and Michigan Southern Railroad, the Pennsylvania

Railroad, large coal companies and the United States Steel Corporation have all been interested.

The conveniences for handling coal are equally efficient with those for handling ore. At some of these docks large chutes which can be directed to the hatchways of the vessel are so placed that cars loaded with coal can be clamped to elevators, hoisted to the required height and then overturned, dumping the entire contents into the chute, which immediately transfers the coal to the ship. As fast as one car is emptied it is replaced by another, until the complete load is taken on board. The enormous outlay necessary to provide these appliances is warranted, because it shortens the time of loading and unloading, and the amount of revenue derived from the ships depends upon the number of trips they can make during the navigation season, which lasts about eight months. For this reason the freighters plan to be in port only a few hours at the longest, and if a ship enters the dock empty, she may receive her load and depart in less than an hour.

Ore can be carried from Duluth or Superior to any of the Lake Erie ports or to Buffalo at such a rate that the entire expense of mining, loading on board ship, transporting and handling does not exceed eighty-five cents per ton, and it is the cheapness with which this ore can be handled in the coal region where fuel is abundant and inexpensive, that has been largely responsible for making the United States the leading country in the world in the production of iron and steel. The ships that carry ore down the lakes carry coal up, although much more



THE LARGEST ORE BOAT ON THE GREAT LAKES IN 1910
CAPACITY 14,000 TONS

ore than coal is transported and some of these vessels necessarily return empty.

In the foregoing paragraphs we have briefly indicated the extensive traffic in ore and coal. While this may be surprising to those not acquainted with it, what perhaps is still more astonishing is the fact that the traffic is growing faster than ships can be built to supply it. The ship yards at Detroit, Cleveland, Chicago and other points on the lakes are considered to be the best equipped and most efficient in the world, and they turn out ships faster than any other yards. In 1902, forty vessels, thirty-two of which were bulk freighters, were built and launched upon the lakes. In 1903, fifty were built, forty-two of which were bulk freighters. In 1904 the number fell to thirteen. In 1905 it rose to twenty-nine. In 1906 it was forty-seven and in 1907, fifty-six, while there were thirty-two ships on the stocks contracted for delivery in 1910. Nearly all of these are constructed for carrying freight.

The traffic over the Great Lakes is almost beyond comprehension. In 1907 the freight carried amounted to over 83,000,000 tons. Allowing thirty-six feet to a car, which is the length of the ordinary box car, and twenty tons for a carload, it would require a train extending one and a fifth times around the earth at the equator, or ten solid trains extending from New York to San Francisco to carry this freight. Moreover, the traffic is rapidly increasing. The lake authorities estimated that the trade for 1910 would amount to 100,000,000 tons, a little more than one-half of this tonnage being iron ore and about one-fourth coal, of which the yearly tonnage is about 16,000,000. Next in importance is lumber, and notwithstanding the rapid decline of the lumber industry in northern Michigan and Wisconsin, about 1,500,000,000 board feet of lumber are brought down the lakes each year. Allowing 20,000 feet per house, this is a quantity sufficient to build a city as large as Cleveland or Buffalo. The grain trade is also of great importance. About 200,000,000 bushels of grain are carried each year, one-half of this being wheat; and in addition to this there are about 11,000,000 barrels of flour transported, the total making enough bread stuff to feed every man, woman and child in the world for more than two weeks.

The chief reason for this enormous traffic is that transportation by the lakes is much cheaper than that by rail. For instance, a bushel of wheat can be carried by boat from Duluth to Buffalo at a cost of two cents, while if carried by rail it would cost over five cents. Multiply this difference by the number of bushels of grain transported in a year and you see at once the enormous saving which is made. It costs $2.50 per thousand feet to move lumber from northern Michigan and Wisconsin to Buffalo by boat, while to move it the same distance by train costs $5.00 per thousand feet. Traffic authorities, by making comparisons similar to these, estimate that the saving in freight alone, due to transportation upon the lakes, amounts to over $500,000,000 per year. Since this saving reduces the cost of the commodity to the consumer, we can assume that this amount is saved to the people of the country rather than to any trust or transportation company.

Passenger traffic upon the lakes is of considerable importance, although not so large as it would be were the people of the country better acquainted with the vast inland seas. The annual traffic amounts to about 16,000,000 passengers. Of course by far the larger part of these are excursionists who make short trips from large cities, such as Chicago, Buffalo, Cleveland and Detroit. The other portion of the traffic consists almost entirely of tourists who prefer trips by the lakes instead of by rail.

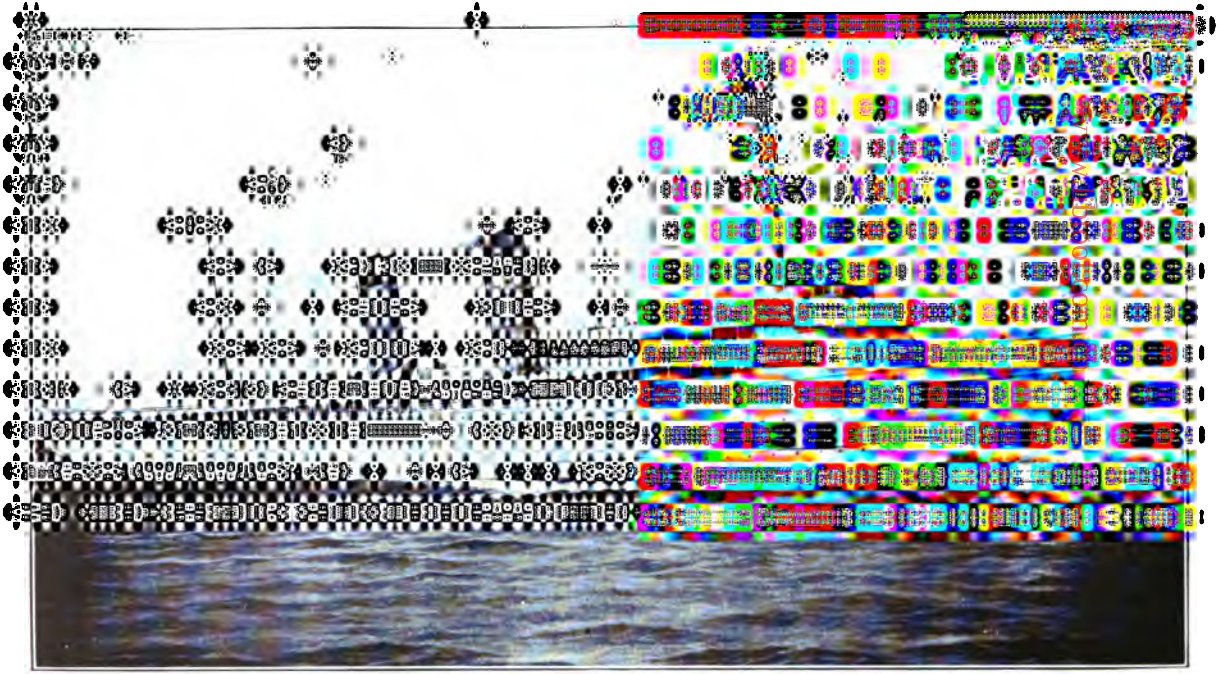
For the accommodation of these two lines of traffic, special classes of steamers are constructed. The excursion boat is planned for day travel and contains but few if any sleeping rooms or staterooms, and a small dining-room or none, the entire space being devoted to the accommodation of passengers on short trips. Most of these boats have rooms fitted up for dancing, and other forms of amusement are frequently provided. The largest excursion boats can carry from 2500 to 3000 passengers. They have a speed of about fifteen or sixteen miles an hour, though some of them exceed this, and trips upon them are pleasurable and restful. Boats of this class ply between Chicago and various ports on the eastern shore of Lake Michigan, between Detroit and Cleveland and other large ports on Lake Erie.

For the passengers who desire long trips, such as a journey from Chicago to Buffalo or Buffalo to

Duluth, passenger ships, resembling in structure and style the great trans-Atlantic liners, are provided. Some of these carry both freight and passengers, but there are others, especially those of the Great Northern Steamship Company, which are devoted entirely to carrying passengers. Upon these boats one may find as much comfort and luxury as is found upon the average high-class ocean liner. However, this difference between the lake and the ocean passenger steamers must be noted: upon the ocean boat provisions are made for two and sometimes for three classes of passengers; upon the lake boat second and third class passengers are unknown. The distinctions on these boats would not be tolerated by the public, and any company attempting to make them would probably receive but slight patronage.

A trip upon one of these floating palaces of the Great Lakes is one of the most enjoyable in the world, and considering the pleasure and advantages gained from it, can be regarded as remarkably inexpensive. Some of the routes most favored by tourists are those between Buffalo and other ports on the lower lakes and Duluth; between these same ports and Mackinac Island; also between Mackinac Island and the Soo; from Mackinac Island to Collingwood and return, through Georgian Bay and its thousands of islands, and from Chicago to various ports on Lake Michigan, Mackinac Island, Buffalo and intervening ports, and also to Duluth and other ports on Lake Superior.

One following any of these routes, unless previously acquainted with the lakes, is in a continual state



PASSENGER STEAMER, GREAT LAKES

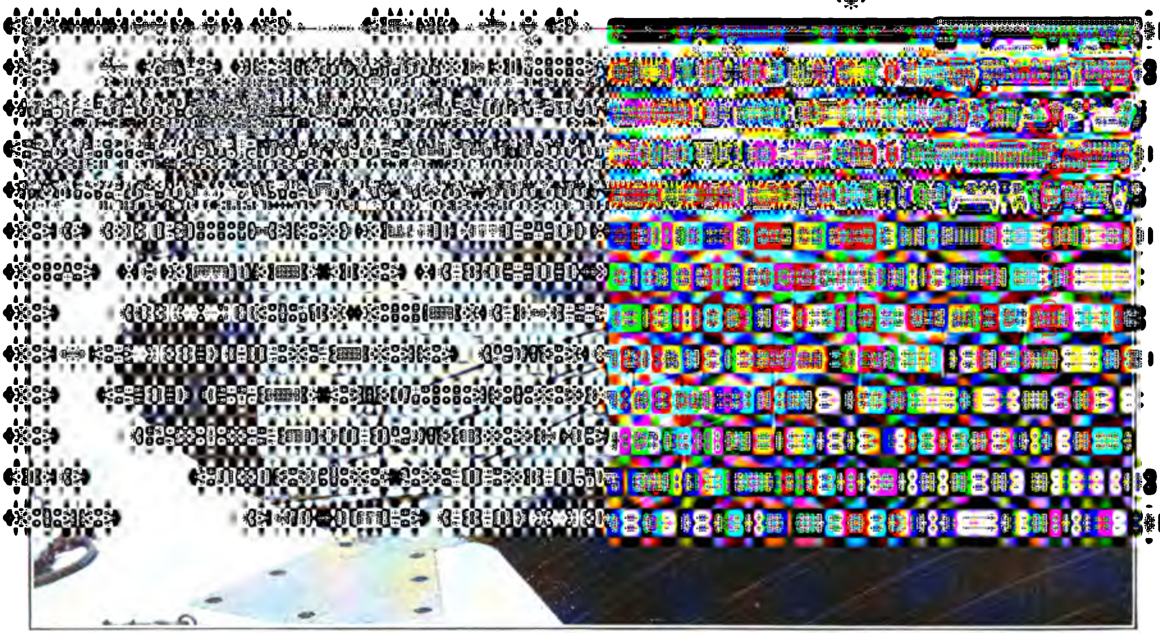
of surprise at the beauty of their scenery, the enormous traffic seen upon their waters, and the thriving and prosperous cities upon their shores. In addition to the trips already mentioned, connection through the Welland Canal can be made with Lake Ontario, and from there with steamers which descend the Saint Lawrence river as far as Montreal, where connection with other steamers going to Quebec and to the head of navigation on the Saguenay river, can also be made. Thus we have provided an inland waterway leading from the heart of the continent to the broad Atlantic. Since ocean steamers ascend the Saint Lawrence as far as Montreal, one can, if he so desires, travel all the way from Duluth or Chicago to any port in Europe by water.

A favorite pastime of tourists on the Saint Lawrence is shooting the rapids in that river. Several of these cataracts or rapids are found between Kingston and Montreal, and the passenger boats running upon the river are of sufficiently light draft to admit of their going down the rapids in safety, provided they are under the management of a skilful pilot. The channel is tortuous and the current very swift, and in order to pass through the rapids without accident, the boat must be kept in the channel and with the current. While the ride is somewhat exciting, it is not dangerous, because, owing to the skill of the pilots, accidents seldom occur.

Because of their great size, and also because their waters belong to two nations, the United States and Canada, the Great Lakes are subject to the same international laws and regulations as govern navigation upon the ocean. The governments of the United States and of Canada have each expended large sums of money in developing the waterway from Duluth to Montreal. These expenditures consist in the building of canals, the improvement of harbors by constructing extended breakwaters, as that at the entrance of the harbor in Chicago, by the erection of lighthouses and placing of lightships and buoys, and the establishment of life saving stations at all necessary points.

The canals at Sault Sainte Marie, or the Soo, are especially worthy of notice. They consist entirely of locks, which enable boats to make the descent of twenty feet between Lake Superior and the St. Mary's river below the rapids. These are the largest canal locks in the world. There are two on the American side and one on the Canadian side. The older lock is not now sufficient to accommodate the large steamers, being only eighty feet wide and sixteen feet deep, so another larger canal, eight hundred feet long, one hundred feet wide and having a depth of twenty-two feet of water on the sills, was constructed, and opened to traffic in 1896. This is known as the "Poe Lock," from the name of the engineer who superintended its construction.

The Canadian lock is sixty feet wide and nine hundred feet long, and is supposed to have the same depth as the Poe Lock, although it will admit ships drawing six or eight inches more water, and because of this it is becoming the favorite for some of the largest ships passing down the lake. The machinery for operating these locks is worked by water power,



THE POE LOCK, SAULT SAINTE, MARIE
THE VIEW SHOWS THE LOCK EMPTY AND REVEALS THE OPENINGS IN THE BOTTOM
THROUGH WHICH THE LOCK IS FILLED AND EMPTIED

and the great ships with their thousands of tons of freight are handled as easily as a boy would move his toy express wagon over a sidewalk. Such is the traffic through the Poe Lock that during the open season, which usually lasts about eight months, there is an average of one boat in the lock for every fourteen minutes of the day and night.

The Canadian government built, in 1833, the Welland Canal, which connects Lake Erie with Lake Ontario and enables boats to descend by lockage the bluff over which the cataract of Niagara is precipitated. This canal is twenty-seven miles long and contains twenty-five locks, the total rise of the lockage being three hundred twenty-seven feet. It will take boats drawing twenty feet of water. In addition to this, the Canadian government has also constructed canals around each of the rapids in the Saint Lawrence river, between Kingston and Montreal, so that there is now a fourteen foot waterway from the Great Lakes to the head of ocean navigation on the Saint Lawrence river. These canals are already inadequate to the demand made upon them, and doubtless in the near future they will be enlarged and deepened so that ships drawing twenty feet of water can pass through them. When this is done, for transportation purposes, the Great Lakes will become an arm of the sea, for vessels will pass directly to and from their ports to ports in Europe. Lines of steamers were once established for this traffic, but owing to the fact that they have to be lightened in going through the canals along the river, the traffic was found unprofitable and the project abandoned.

This brief sketch of the Great Lakes and their traffic gives some idea of their present importance as a trade and transportation center, and one is naturally led to inquire, "What of their importance in the future?" If interested in answering this question, take a pair of dividers, adjust them to the scale of a map representing the United States and Canada so that they will make a circle having a radius of five hundred miles. Place one leg of the dividers on the dot representing the city of Buffalo and construct the circle. Within this circumference resides sixty per cent. of the population of the United States and Canada, including twelve great commercial and manufacturing centers of these countries. Beyond this area lie the great wheat and corn regions of the United States and the still greater undeveloped grain region of western Canada. In 1909, 70,000,000 bushels of grain were shipped from the ports on Thunder Bay, and the development of western Canada is scarcely begun.

When the great trunk lines of railway now in progress of construction to the Pacific coast are completed and their numerous branches extended so as to bring this vast region within easy means of transportation, millions of acres which are now wild land will be devoted to the raising of wheat. As the population of a country increases, there is a proportionate increase in demand for all commodities, and even if in the course of time the apparently inexhaustible supply of iron ore in the Lake Superior region should fail, before that day comes the demands for package freight, coal, grain and other commodities will have so increased that the traffic upon the Great Lakes will doubtless be larger from these sources alone than it is at the present time with these and the added tonnage received from the iron regions. Within the area adjacent to the Great Lakes is the richest agricultural region of the world and its development is yet far from consummated. With the advance of scientific methods in agriculture and the perfection of processes in manufacture, the future of this region is of the brightest. No American can look upon these vast inland seas and contemplate their beauty, grandeur and value without a feeling of pride in this magnificent national possession.

RAILWAYS

EARLY HISTORY

A railway journey in a first-class coach or a palace car is of such common occurrence that we seldom think of the time when there were no railroads, or how the people of today, who live in regions so far from a railroad that they are deprived of its use, travel from one place to another. Although the railroad is so common, it has not been known for a very long time in its present form. In fact, at the beginning of the twentieth century there were men still living who were born before there was a steam railroad in the United States, and this pattern of road was introduced in England where it originated, only a few years before it found its way to our own country.

This does not mean, however, that no attempt had been previously made to construct tracks over which carriages could be hauled to greater advantage than on ordinary roads, and some of these roadways are of such ancient date that we do not know when they were built. The old Romans, who, in their time were the best builders that the world had known, made use of roads which were built of stone; and the famous orator, Wendell Phillips, used to tell us in his lecture, "The Lost Arts," that the ancient Egyptians used a sort of railway upon which to haul the huge blocks of stone used in building the pyramids and their magnificent temples. Only small, detached portions of the roadways constructed by the Romans and Egyptians have been found, so that we know but little of their extent, and practically nothing of their mode of operation. They stand today as silent witnesses of the genius of a distant past, and while they may have some interest as objects of curiosity, we must leave them for the more important study of the railroads of the present day.

The modern railway had its beginning in England, and originated in a road constructed for hauling wagons from a coal mine. At first it was merely an improvement on the common wagon road. Cross pieces called ties were laid on the road bed and timbers which served as rails were spiked to them. The ties were covered with earth or gravel, to give the horse a good path upon which to walk. This sort of railway was in use in the coal mines in New Castle-upon-the-Tyne in England as early as 1672. The advantages over the common road were so great that other mines adopted the device and these coal roads became known as tramways.

Wooden rails were used for about forty years before iron rails were substituted. It was found that with iron rails a horse could haul four times as much as he could upon an ordinary road, and within a few years these tramways were perfected to such an extent that the load was increased until a horse could draw forty times as much upon them as upon the common road. The first iron rails bore little resemblance to those now in use, but they are of interest because they show how great enterprises may grow from small beginnings. The rails were made of cast iron, and were only five feet long. They were spiked to the timbers which before their introduction had served as rails. The rail had a raised lip on the outer edge to keep the carriage on the track.

Some of the mines opening upon the hill sides placed pulleys in the mine, over which ropes passed, each end of the rope being attached to a car. By this arrangement the loaded cars running down the incline would haul up the empty cars on another track. The arrangement worked so well that it has been continued to the present time, and with the use of the steel cable instead of the rope, heavy loads are easily moved.

The perfection of the tramway led the miners to seek for some motive power that would be stronger and swifter than horses. The steam engine had been brought to a good degree of perfection, and those interested in tramways naturally looked to it for such power as they desired. Stationary engines were first employed and moved the cars by means of ropes, one end of which was attached to the car and the other to a cylinder or drum. The car was hauled by winding the rope around the drum. Two objections to this device soon developed; it was expensive, and it could be used only for moving cars very short distances. What was wanted was an engine that would move on the track with the cars, and attempts to supply this need led to the invention of the steam locomotive.

Strange as it may seem, inventors attempted to move wagons over a common road by steam power some time before they attempted to use engines in moving cars upon the railway. The steam wagon, then, was the forerunner of the locomotive. The first steam carriage of which we have any record was invented by a Frenchman named Cugnot, in 1769 and 1770, and a strange looking affair it was, as you may judge from the illustration.

In 1804, Oliver Evans, of Philadelphia, built a flat bottomed boat to use in dredging out the Philadelphia docks. When the boat was completed, he mounted it on wheels and drove it by its own engine to the river banks; then used the engine to turn paddle wheels and move the boat to its destination. Evans named this strange combination the Oructor Amphibolos. It was the first road locomotive known in America. The following year, Evans obtained a patent for a steam wagon, but we do not know that he ever made any practical use of his invention. Other inventions followed. Several successful steam wagons were placed in operation in England, and made regular trips for a number of years before the locomotive came into use on railways. It will be seen that these steam wagons were the forerunners of the automobile as well as the locomotive.

The first railroad locomotive was invented by James Trevithick, a Cornish mechanic, in 1802. It had a fly wheel on the crank and the draft was secured by means of a bellows. Trevithick's invention was not a commercial success, but his plan was improved upon by another mechanic, who succeeded in building an engine that would run ten miles an hour.

In 1812, one John Stevens of Hoboken, New Jersey, published a pamphlet in which he predicted that trains of carriages would be drawn on railways at a speed of twenty or thirty miles an hour, and that the speed might possibly be increased to forty or fifty miles an hour. Stevens was certainly a prophet, for at the time his pamphlet was issued there was not a successful locomotive in existence.

The first successful locomotive was constructed by George Stephenson, an English engineer, but his success was reached only after several years spent in experimenting. In 1829, in competition for a prize offered by the directors of the Stockton and Darlington Railroad, for a locomotive which would best meet their requirements, Stephenson built the "Rocket," which was the first successful locomotive. This engine weighed only four and one-half tons, but it was able to travel from sixteen to twenty miles an hour and haul a heavy load. The construction of the Rocket may be said to mark the beginning of a new era in transportation. From that time the success of the steam railway was assured.

Railroads connecting most of the important cities in England were soon constructed, and France, Germany and other countries on the continent of Europe followed England's example. Originally intended for hauling freight, these roads soon extended their service to carrying passengers, and thus, in a few years, between 1830 and 1840, was laid the foundation of the great railway systems of Europe.

RAILWAYS IN THE UNITED STATES

The first railroad in the United States was built from the granite quarries in Quincy, Massachusetts, to the Coast, in 1826. Its first use was for transporting the stones for the Bunker Hill Monument, so that noble structure commemorates, not only a celebrated battle in the Revolutionary War, but also the introduction into the country of a means of transportation which has exerted a far-reaching influence upon all phases of American life. This road was only four miles long. The ties were of stone, and upon them wooden rails were placed, and upon these wrought iron plates were fastened. The cars were hauled by horses. This little road is of special interest in the history of American Railways, both because it was the first railroad built in the United States, and because upon it were used the first switch and the first turntable in the world. These devices were invented by Mr. Gridley Bryant, the projector of the road. Bryant also constructed the first eight-wheeled car ever used.

The next year a second road was built. This led from the coal mines of Mauch Chunk, Pennsylvania, to the Lehigh River, and, including sidings, or turnouts as they were then called, was thirteen miles long. The same year the Delaware and Hudson River Canal Company commenced a road leading from their mines in Honesdale to the terminus of their canal. Three locomotives and the rails for this road were purchased in England, and one of these locomotives reached New York in 1829. This

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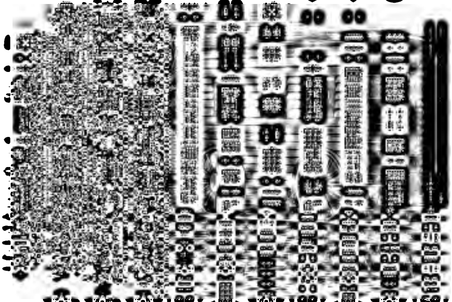

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the first passenger train in the United States. On these early trains there were no conductors. The engineer collected the fare, and the fireman handled the baggage and freight.

The charters of other roads followed rapidly, and in the next twenty years numerous pioneer lines were constructed. Between 1830 and 1835, about eight hundred miles of railroad were built in the United States, and the construction was active from that time up to the breaking out of the Civil War. Some of the important lines begun or completed, were the New York Central, the Boston and Albany, the Pennsylvania, the Michigan Central and the Michigan Southern. In 1854, the Chicago and Rock Island road was built between Chicago and the Mississippi River, and in the following year the Chicago and Galena Line, the beginning of the Northwestern System, was completed. This period also included the Chicago, Burlington and Quincy, the Illinois Central and the Chicago and Alton, besides a number of other roads of less importance. In 1861, there were about 30,000 miles of railroads in the United States, but during the Civil War, railroad construction was practically suspended. However, at that time the United States contained about half of the railway mileage of the world.

In the construction of these early roads, little attention was paid to uniformity in gauge or the distance between the rails, some of the roads using one measurement, and some another; but in time it was found that this variation led to many difficulties in constructing locomotives and cars, and gradually American roads came to adopt the standard gauge of four feet eight and one-half inches, which is the gauge first adopted by the English railways. In mountainous regions where high grades are necessary, a narrower gauge is sometimes used, but narrow-gauge roads are not common. At first all lines were short, and no attempt was made by the owners of one line to accommodate the patrons of another, even when the two lines ran into the same town, and such an accommodation would have been to the advantage of both; but the union of these lines and the formation of the great railway systems of today is a story by itself.

UNION OF AMERICAN RAILWAYS

The American railway system of today is the wonder and admiration of the world, but like some of the modern cities in Greece and Italy, it has been built upon the ruins of what preceded it. The construction of a railroad calls for a large investment of money, and after the line is built, it may be some months or even years before the income is sufficient to pay operating expenses, to say nothing of interest upon the capital invested. In the early history of the railway movement in the United States, comparatively few men understood the financial phase of the problem, and only an occasional line paid dividends on its stock. Many lines were practically bankrupt before the construction was completed. Moreover, the early railroad was to the people what a new toy is to a child. All communities wanted one, and the strife of towns, counties and states to secure railroads was often carried on with more zeal than discretion. People of all classes and conditions subscribed for the stock, regardless of their financial ability. Of course, many of these investors could ill afford to do without the income of their investments, much less could they make further investments to pay running expenses, and the managers occasionally found it difficult to obtain money for operating the roads. It is reported upon good authority that at one time the sheriff seized all the furniture in the offices of the Michigan Southern Railroad in New York, and that the directors had to borrow chairs from neighboring offices in which to sit while holding a meeting. Today, this road is second to none in its financial standing and its equipment.

But perhaps what is worse than all this, is the fact that then as now, unscrupulous men seized upon promotion schemes for railways as a means of swindling people, and in some instances sold large blocks of stock for which they received money and then disappeared with their ill gotten gains. Finally, the present method of financing a railroad by borrowing money on bonds or mortgages secured by the property was worked out. This left enough money from the sale of the stock to provide equipment and usually to pay operating expenses until the road had developed a traffic along its line. The employment of this method of finance has made our present railroad systems possible.

The difficulties attending the operation of some of these old lines are almost beyond our comprehension and the methods employed seem so far out of date that we are liable to think of them as belonging to another age. In 1844, a Kentucky road used rails of grooved stone faced with strap iron. The Pennsylvania Road, which today with its magnificent system is the model of the world, was at first operated in what to us seems a very laughable manner. Some years ago, a history of this road was published, and we are indebted to that work for the following incidents.

The first line was constructed in 1834 by the state, for the purpose of connecting Philadelphia with a canal which extended along the Susquehanna and Juniata Rivers. Just west of Philadelphia, an inclined plane 2840 feet long was constructed, to reach the summit of a range of hills 187 feet high. At the other end of the line, another incline lowered the cars to the canal. The cars were hauled over these inclines by stationary engines, but when they reached the summit, they could be hauled by horses or locomotives. Since the road was built at the expense of the state, it was free for the citizens and could be used like an ordinary highway. Anyone could place his wagon on the track and haul it with his own team.

After the legislature authorized the use of engines and cars on this line, the traffic was carried on by wagons hauled by horses or mules, and by trains hauled by locomotives. Since it was not possible for these conveyances to pass each other, none could proceed faster than the conveyance at the head of the procession; and whenever a driver stopped to water or feed his team, as frequently occurred, the indignation and language of the passengers in the cars hauled by locomotives can better be imagined than described. The confusion and dissatisfaction arising from such an arrangement caused the canal commissioners to take action, and they tried to remove all difficulties by restricting the passage of trains hauled by locomotives to certain hours of the day, granting the other hours to teams. Under this primitive arrangement, horses and wagons were allowed on this road until 1844.

The completion of the second track, in 1835, enabled the road to run trains in both directions without interference. Awkward as the method of operating may appear today, the construction of this line over the mountains was an important event in the history of transportation in the United States. What this and other lines meant to the people of that day, is illustrated by a single instance: before this section of the Pennsylvania Road was open to traffic, the cost of transporting a ton of goods from Blairsville to Hollidaysburg, a distance of fifty-three miles, was from twelve to sixteen dollars. On the completion of the road, the charge was reduced to four dollars.

Another illustration of growth from small beginnings is found in the New York Central lines, which began with a road seventeen miles long, and now operates 8000 miles of railway extending through the richest and most densely populated sections of the country, it being estimated by good authority that the section covered by this system contains one-half of the population of the United States. The present New York Central System, like the Pennsylvania and other large systems, has been formed by extending the original lines and by the purchase of others whose traffic was closely related to the traffic of the main lines. Before the lines which form the New York Central and Hudson River Railways were united, one had to travel over six lines of railway in going from New York to Buffalo. This meant that he had to change cars six times, buy six tickets, and have his baggage checked at each transfer. Annoying as this arrangement was, the passenger could make the journey and survive, but when it came to handling freight over six times, the expense of transportation was so great that the railroads afforded but little relief to their patrons. The leading men owning the various railroads soon saw the impracticability of such an arrangement, and took measures to form a traffic arrangement by which each line agreed to haul the cars of the other. This agreement was the first step toward consolidation of the short lines into one continuous system which formed the original New York Central and Hudson River Railroad, extending from New York to Albany, and thence westward across the Empire state to Buffalo. In a similar manner other lines became united, and before 1870 most of the great trunk lines east of the Mississippi had been formed. It remained, however, for these trunk lines to be merged into great systems.

AMERICAN RAILWAY SYSTEMS

Since 1870 the growth of railroads in the United States has been characterized by movements along three lines: construction of roads from Mississippi River points to the Pacific Coast, merging competing lines into great systems, and improving road beds, cars, locomotives and other property.

The Union Pacific and Central Pacific Railroads, combined to form the first so-called Trans-Continental line, were completed in 1869. This event marks such an important epoch in the industrial history of our country that the construction of this line of railway is worthy of special notice. As early as 1853, Congress made an appropriation for the survey of a route for a railroad extending across the plains to the Pacific Coast, but the rivalry between the northern and the southern states over the location of the line, made it impossible to secure further legislation until after the outbreak of the Civil War. With the beginning of that struggle, the Southern element was eliminated from the problem, and Congress could be united on a plan. Moreover, the difficulties of reaching certain points beyond the Mississippi, the hostility of Indian tribes, which was increased during the war, and the difficulty of communicating with California, all combined to emphasize the importance to the Government of such a line of railway. Consequently, in 1863, legislation was secured authorizing the construction of the Union Pacific and Central Pacific Railways, and work was begun on both lines the following year.

This was not only the first trans-continental line of railway, but it was also the first enterprise of this sort to which the national Government lent its aid. The Government did not build the road directly, but it granted to the companies authorized to construct it, alternate sections of land along the line, extending back from the railway for twenty miles on each side of the road. The total grant was about 66,000,000 acres, and equivalent to a strip of land twenty miles wide from Omaha, Nebraska, to San Francisco. The Government further guaranteed the bonds of the road to the amount of $16,000 per mile. The companies sold these bonds and in that way obtained the money for construction purposes. The land was held until the lines were completed, and from that time until it was all disposed of, it was sold to settlers.

We can scarcely realize the difficulties under which the companies labored in building this railway. No railroad had been built from Chicago across Iowa, and the Union Pacific had to depend for its supply of ties and other timber, upon the mountain forests, and the timber was floated down the streams. The Central Pacific was in an even more unfortunate condition, for all of its supplies which could not be manufactured in California had to be carried by boat around Cape Horn, and at this time all American vessels were subject to attack from the Confederate privateers, so that to the long distance was added the danger of capture and confiscation by the enemy. Again, the Indians were not at all friendly to this new and, to them, peculiar invasion of their domain, and the construction gangs were of necessity under the protection of military escorts from the beginning of the line until its completion. Nevertheless, after the work was begun, it was pushed forward rapidly. The granting of land to the two companies served as a stimulus, and each tried to outstrip the other, because the amount of land obtained depended upon the number of miles of road constructed. During the latter days of the work the Union Pacific construction force laid from five to eight miles of track per day, until on May 10th, 1869, the workmen of the two companies met at Promontory, near Ogden, Utah.

The last tie and rails were laid with elaborate ceremony. Montana, Idaho and Nevada presented spikes of silver and gold, and the last spike was of California gold. The engine from the Pacific faced that from the Atlantic, and Leland Stanford, then governor of California and founder of Leland Stanford Junior University, together with the Vice-President, Durant, drove the spike. Such was the interest in the completion of the line that the press throughout the country made elaborate preparations for reporting the ceremonies, and each movement was telegraphed from the seat of action as it occurred. The point of junction is 1086 miles west of the Missouri river, and 690 miles east of Sacramento. Not only was the event celebrated at the point where the lines met, but also in all the leading cities of the country.

With the completion of the Union Pacific line railway communication between the Atlantic and the Pacific Coasts was consummated. In 1876 traffic over this line had been brought to such a degree of perfection that trains from New York reached San Francisco in eighty-three hours and twenty minutes.

California was, by the construction of this line, brought into closer touch with the other states, and the knowledge of her wonderful resources, which was soon spread over the country, led to increased immigration to that state. On the completion of the work, Governor Stanford predicted that within a few years three tracks would be necessary to accommodate the traffic. He little realized the number of competing lines which would follow within the next half-century. After the war, the Southern interests were cared for by the Southern Pacific, extending through Texas, New Mexico and Arizona, and later merging with the Union Pacific and forming with that the great Southern Pacific system. The Northern Pacific was completed in 1888, and the Great Northern in 1893, and was built without government aid. After that, extension of lines to the coast ceased for a number of years. Then other roads began extending their lines westward, the Chicago, Milwaukee and Saint Paul System completing theirs in 1909. The Atchison, Topeka and Santa Fe, extending from Chicago to Los Angeles, is also considered a trans-continental line, although it has to make its connection with San Francisco over the Southern Pacific tracks. The Chicago, Rock Island and Pacific is another line of similar nature. Doubtless both of these in time will have their own tracks to San Francisco and other Pacific coast points.

But this is not all. Notwithstanding the numerous trans-continental lines in the United States, the Dominion of Canada has the Canadian Pacific which has been in successful operation almost since the formation of the Dominion, and it now has projected to Pacific coast points the Grand-Trunk Pacific and the Canadian Northern lines, both of which are under construction and will reach their western terminals within a short time.

For a number of years there was not enough business for these various trans-continental lines to enable them to pay expenses. When they were first constructed, only a narrow strip of territory along the Pacific coast had been settled, and this only sparsely. Between that strip of coast land and the western boundaries of Iowa, Minnesota and Kansas, there was a vast stretch of unoccupied country from which no revenue could be obtained. Each line naturally strove to secure all the traffic it could, and rates were often lowered beyond the point where even a good traffic would enable the line to pay expenses. Two good illustrations of competing lines are to be found in the Union Pacific and Southern Pacific, and in the Northern Pacific and Great Northern. All trans-continental lines are dependent upon through traffic, that is, traffic to and from the coast to points east of the Mississippi River, for an important portion of their revenue, and when lines located near each other were in close competition, one line might become overloaded while another would have scarcely any through business. This was unsatisfactory alike to the roads and to the shippers. Moreover, rates so low that they do not allow a margin of profit are usually accompanied by poor service, and what the shipper saves in freight he is liable to lose through delays. When all lines running through the same part of the country are under one management, these conditions can be avoided, and the assurance of a constant revenue by so dividing the transportation among the various lines of the system as to keep all employed, enables the roads to render more efficient service at a lower rate than is otherwise possible. Therefore, consolidation benefits both the roads and the public.

But this is not all. With a change of business conditions, a change of methods becomes necessary. The purpose of the first railroads was merely to serve local needs, but with the settlement of the country west of the Appalachian mountains, the demands upon the roads were far greater than was originally expected, and as we have seen, short lines were joined to form trunk lines. With the growth of the country still greater demands were made upon the roads, and the merging of trunk lines into systems became necessary. Concerning the development of this movement, Mr. James J. Hill, one of the greatest masters of transportation the country has ever known, says:

"Exactly as society and the work of the community have become more complex, so have the means by which material ends are achieved grown larger and more powerful. The union of numerous disconnected and weak railroads in one orderly and efficient system, the substitution of one great establishment for many small plants, are part of the natural and inevitable evolution of united action among men. With the settlement of the West, and especially with the growth of through traffic, a new condition arose. The difficulty of sending commodities over half a dozen lines, operated by as many companies, in one quick and continuous journey became too great for business to bear. To handle the immense through railroad business of this country by a host of small and isolated lines would be just as impracticable as to carry on our commerce with forty-six different kinds of money."

Not only was the consolidation of the trunk lines west of the Mississippi found necessary, but such a movement in the older and more densely settled portion of the country seemed equally desirable, and by 1910 all the important railroads of the country had been grouped into great systems. The names of most of these systems are derived from the names of the leading capitalist concerned in their formation, while the names of a few are from the original lines to which the other lines in the system were joined. The leading systems and their respective mileages are shown in the following table, which includes three-fourths of the railway mileage of the country:

Groups	Mileage
Vanderbilt	24,198
Pennsylvania	19,172
Harriman	28,112
Hill-Morgan	12,519
Morgan	12,618
Gould	20,983
Moore	27,912
Rockefeller	15,983

Groups	Mileage
Walters	11,143
Independent	27,212
Hawley	8,400
Total	208,252

The Vanderbilt group includes the New York Central, Lake Shore and Michigan Southern, Michigan Central, Lake Erie and Western, The Big Four, The West Shore, The Nickel Plate, and a few other less important lines. The Pennsylvania System includes all the lines under the management of the Pennsylvania Railroad Corporation. The Harriman System, named from the late Edward H. Harriman, includes the Union Pacific, Southern Pacific, Oregon Railroad and Navigation Company, Oregon Short Line, San Pedro, Los Angeles and Salt Lake Railway and a few other minor lines. This system has a very close traffic affiliation with the Chicago and Northwestern System. The Hill-Morgan and Morgan Systems include the Great Northern, the Northern Pacific and the Burlington Systems, with a few allied lines of less importance. The Gould lines embrace the Wabash, the Denver and Rio Grande, the Missouri Pacific, the St. Louis and Southwestern and the Texas Pacific. Moore's System includes the Chicago, Rock Island and Pacific Railway and its allied lines. Chief among the independent systems are the Atchison, Topeka and Santa Fe, the Chicago, Milwaukee and Saint Paul, the Chicago and Northwestern, the Southern Railway, Atlantic Coast Line Railway and the Baltimore and Ohio.

If one desires to become familiar with the locations of these great railway systems and their allied lines, one needs to study carefully a railway map of the United States. Such a study will show that each of the great systems practically controls the transportation in the section of country through which it extends. In connection with this, it may be interesting to know the railroad mileage of the world as distributed by continents. The following table shows such mileage at the close of 1907, the latest date at which authentic data were available:

Continents	Mileage
North America	268,058
Europe	199,385
Asia	56,294
South America	34,911
Africa	18,519
Australia	17,700
Total	594,862

The total mileage in the United States in 1908 was 233,678.

RAILWAY CONSTRUCTION

Having learned something of the original railroads, and seen how the early lines have been united first to form trunk lines and then great systems in order that they might meet the increasing demands constantly placed upon them, let us now look at the problems of construction which confront a company organized for building a line of road. The three great questions that must be settled before the work of construction can begin, are, the location of the line, the expense of grading and the traffic which may be secured from the adjoining country. The last item is a very important factor in determining the location of the road, and sometimes the line between two important points does not follow the shortest distance joining these points, because, by taking a more circuitous route, a larger volume of traffic can be secured.

While in general the policy determined upon is to locate the road through the country so that the cost of construction will be the least possible, yet it is sometimes good business to incur greater expense when, by so doing, important trade centers can be reached. When the route is decided upon, two surveys are made; the first including a strip of country from two hundred to a thousand feet wide, within which the line is to be located; the second for the purpose of definitely locating the road. Each survey is accompanied by a map, which is made as the work progresses from day to day. Two maps are made in connection with the final survey; the first showing the position of the line within the strip of country included in the first survey, and the second, known as the profile, showing the undulations of the ground surface and the cuts and fills that will have to be made in grading the road. The engineer usually tries to have the cuts and fills equal, so that the earth excavated from the cuts will be sufficient for the fills. This saves hauling the sand or gravel from long distances, and consequently considerable expense in grading the road.

After the location of the line is determined, the land, or right-of-way, as it is called, on which the road is to be built must be secured. This is usually a strip about one hundred feet in width, with additional ground for stations, shops and yards wherever these are required. Land is obtained by purchase, and in case the railroad company and the owner can not agree as to price, the company has the right to refer the matter to a court, and the owner is obliged to accept the price the court awards. This process is known as condemning land for public purposes, and the company is allowed to use this means because the road is a public institution, and must serve all who apply to it for transportation.

When these preliminary matters have been completed, the company is ready to begin the actual construction of the road bed. In most cases this work is done under contract, and is in charge of the engineer of the road and his assistants. It is the duty of the enginer to see that the contractor fulfills all specifications, and to see that the work is well done. As a general thing, the road bed for a single track is from fourteen to eighteen feet wide at the top, and from twenty to twenty-six feet wide at the base of the embankment, unless the embankment is very high, in which case a greater width is necessary. In the construction of the road, provision must be made for ditches in the cuts, so that the water will readily drain off, and for culverts wherever such will be necessary to drain the land upon either side of the road. Since these are permanent structures, it is necessary that the work upon them be done with the greatest of care, so that they will not need repair for many years.

When the road bed has been graded, the cross ties or timbers to which the rails are to be fastened, are laid upon it. These ties are of wood which is not easily rotted by exposure, such as oak, Southern pine, chestnut, cedar and red wood, the railway using the variety which can be most easily and cheaply obtained along the line. It is now customary to treat these ties with preservative before placing them in position. When so treated, they will last from seven to eight years. The rails are fastened to the ties by long spikes which have heads constructed especially for holding the rails in place.

When the track is laid upon this new road bed, it is very rough and uneven, and trains can be run over it only at a low rate of speed and with more than ordinary precaution. The next process consists in ballasting; that is, in filling the spaces between the ties with sand, gravel, earth or rock and leveling the ties so as to make an even and smooth track. During the process of ballasting, the sand or gravel is driven in around the ties so firmly that they are immovable, and the track is put in a finished condition. This includes raising the outer rail wherever there are curves, so that the trains will pass around the curves easily and without danger of being thrown from the rails by the force attendant upon running at a high rate of speed.

The rails are made of steel, and those now in use are the result of many years of study and experiment by the most eminent railway engineers. They vary in length on different roads and in different sections of the same road. Many are thirty-three feet long, some forty-five, and occasionally rails sixty feet in length are found. In weight they vary from sixty to eighty pounds per yard. The rails are fastened together where they meet, by laying the ends on a plate of metal which rests upon the ties, and joining them by strips of metal known as tie plates, which are placed upon each side of the rail, and through which, together with the rail, bolts are passed and fastened with burs. On curves special rail braces are used in fastening the outer rail in position. This is for the purpose of strengthening it against the pressure of the wheels.

At stations, and occasionally at points between stations, on single track lines, side tracks or sidings must be provided for the purpose of enabling trains going in opposite directions to pass each other, and in addition to these side tracks storage tracks are necessary. These are laid in railroad yards at the most convenient points, generally at the end of each division of the road. Some of these yards are very extensive and contain many tracks. Their design and construction are subjects of a great deal of care and effort. In general, the surface should be perfectly level so that cars may be moved over the tracks with the least amount of power. A complete yard contains two distinct sets of tracks, one for freight in each direction. Each set will have its storage tracks for incoming freight, its tracks for classifying freight, on which the mixed freight of an incoming train is sorted, and its outgoing storage tracks on which trains are made up for forwarding to their destinations. The main lines of track should pass at one side of the yard so that through trains will not be hindered by the switching of cars on side tracks.

Cars are transferred from one track to another by means of switches, which consist of two movable rails called switch rails, and so fastened together by iron bars that they can be moved at one end in such a manner as to turn the train from one track to the other. In connection with these switches are triangular rail structures called frogs, which also assist in guiding the train onto the desired track. The switches are operated by levers.

In addition to the main line side tracks, passenger and freight depots and water stations have to be provided at such points as are most convenient for the traffic and operation of the road. Most water stations along the road consist of wooden tanks holding about fifty thousand gallons each, and mounted upon a platform of sufficient height to place the bottom of the tank a few feet above the top of the tender of the engine with which it may be connected by a movable pipe. In cities, water is often provided by attaching the crane or pipe to the city water supply. On a few roads which run fast passenger trains, the main tracks are provided with what are known as track tanks. These consist of a steel trough about a quarter of a mile in length, laid in the center of the track and kept filled with water by a nearby pumping station. The engine tender is provided with a scoop which is lowered on approaching the tank, and through it the water is forced into the tank on the locomotive by the motion of the train. Since these tanks are very expensive, but few of them are found in the country. Those best known are connected with the main lines of the New York Central and Hudson River Railroad and the Pennsylvania road.

In addition to these ordinary expenses in the construction of a railroad, nearly all lines have to incur extraordinary expense at certain points. Expense of operation is an important item to be considered in constructing a railroad, and it often pays to expend large sums of money to reduce grades, remove curves and shorten distances between important points because in so doing the operating expenses are reduced and the carrying capacity of the road increased so that a greater profit can be secured than would be possible if these obstacles remained. Rivers, mountains and marshes are some of the most difficult obstacles encountered in reducing the expense of operation, and overcoming them has led to some of the greatest feats of engineering which the world has known.

Small streams can be bridged without difficulty, but such rivers as the Ohio, the Mississippi, the Missouri and the St. Lawrence call for bridges which cost millions of dollars and require the skill of the best engineers the country affords. The great railroad bridges of this and other lands have always attracted the admiration of the world. Some of the most noted bridges of foreign countries are, the New Tay bridge in Scotland, about two and a quarter miles in length, the Forth bridge, Scotland, nearly one and three-quarters miles in length, the Rapperschwyl bridge at Lake Zurich, Switzerland, some over a mile in length, and the bridge across the Zambesi, where the Cape-to-Cairo Railway crosses the river just below the celebrated Victoria Falls. This bridge is not noted for its great length, but its height is some over four hundred feet, making it one of the highest structures of the kind in the world.

One of the most celebrated long bridges constructed in North America is the Victoria bridge across the St. Lawrence river at Montreal, built in 1860. This bridge is a mile and a quarter in length, and supported on twenty-five piers. The first bridge was a rectangular tube, and spanned the river in the form of an arch, being some twenty-five feet higher at the center than at each end. It was built at an expense of nearly $7,000,000, and at the time was the most remarkable bridge in the world. After being in constant use for over forty years, it was replaced by a steel truss bridge of modern pattern. The bridge of the Illinois Central Railroad at Cairo, Illinois, is two miles in length, and is also one of the most remarkable structures of its kind in America. Other bridges of special note because cf their style and structure are the Eads bridge across the Mississippi at St. Louis, named from the celebrated engineer who planned it and superintended its construction; the great railroad bridge across the Ohio at Cincinnati; the cantilever bridge of the Michigan Central Railway at Niagara Falls, and the bridge across the Mississippi river at Thebes, Illinois. Each of these bridges is either steel truss or cantilever construction.

Another bridge around which a great deal of interest always centered was the old suspension bridge at Niagara Falls, which was built under the direction of John A. Roebling in 1854. This bridge spanned the chasm of the Niagara River just at the head of the Whirlpool Rapids. It was a double decked structure, having two railway tracks on top and a carriage road underneath. It was suspended and supported entirely by wire cables, and remained in position for over forty years, when it was replaced by the present steel-arch structure. The new bridge was erected and the old bridge removed without the stoppage of a train. With the completion of the old suspension bridge, a short through route was established between the eastern states and those of the great prairie region in the Mississippi Valley, and its completion marked an important event in railway transportation. Besides the bridges mentioned there are many others of nearly as great interest, but space will not permit calling attention to them. The literature of each great railroad system usually contains accurate and interesting descriptions of all remarkable structures along the lines controlled by that system, and one interested in them can obtain this information by securing these circulars.

Great tunnels have always been important in reducing the grades and straightening the distances between points. The first of these of note, constructed in the United States, is the Hoosic tunnel having its eastern terminal at North Adams, Massachusetts, and belonging to the Fitchburg Railroad. This tunnel is some over four and a half miles in length, and it required nearly seventeen years to excavate it. Since then many railway tunnels have been constructed in the United States, but most of them are short and of little interest. One of the most remarkable structures of this sort is the long tunnel of the Great Northern Railway where it passes through the Cascade Mountains. This tunnel is remarkable not so much for its length as for its form, which is nearly that of a horseshoe, so that when the train emerges it is going in the opposite direction from what it was when it entered the tunnel. The most noted of the European tunnels are those which have been constructed to remove the barrier formed by the Alps to railroad communication between northern and central Europe. The first of these was Mount Cenis, built in 1870. This tunnel is some eight miles in length. Following the Mount Cenis was the Saint Gothard, which has a total length of nine and a quarter miles, and connects northern Italy with Switzerland and the west-central German states; but the largest and most important of these tunnels is the Simplon, which has a length of twelve and a quarter miles, and consists of two tunnels running side by side. Trains run in one direction in one tube and in the opposite direction in the other. The completion of these great works of engineering in the Alps has practically removed that mountain barrier so far as railway communication between northern and central Europe and the countries south of the Alps is concerned.

Tunnels are constructed only when no other device of less expense will take their place, and in running a line of railroad through mountainous regions such as are encountered by all trans-continental lines of the country, various devices have been employed to reduce the grade to its lowest minimum and accomplish this at the least expense. In some places what is known as the switch-back has been employed. This consists of a series of tracks, each of which is an inclined plane and so arranged that by switching the train from one to the other and moving it in opposite directions, it is zig-zagged up the grade to the summit, and then moved downward on the opposite side in a similar manner. This device is expensive to operate, and also undesirable, because it causes the loss of much time.

Wherever possible, in place of the switch-back, curves are used, so that the road may form a loop or series of loops in order to overcome the grade. In this case the line may cross itself one or more times, each time upon a different level. The most celebrated of the loops known to railroad engineering are found in the Marshall Pass of the Denver and Rio Grande Railway, and the Hagerman Pass on the Colorado Midland Railway, where an altitude of 10,944 feet above the sea is reached. Starting from the low levels of the prairie region and following one of these lines over the mountains, the traveler passes from the almost semi-tropical climate of the plains until—

> "Up near the mountain's craggy crest,
>   The mighty moguls strong and proud;
> The snow drifts beating 'gainst their breast
>   With pointed pilots pierce the cloud.
> High mountains—seeming little hills—
>   Emboss the spreading plain below,
> And rivers look like laughing rills
>   As down the distant vale they flow."

Advantage must also be taken of the gorges formed by streams and other mountain valleys, in running lines of railway through these regions. Some of the devices that engineers have resorted to show that these men are men of remarkable resource and ingenuity. One of the most famous of these passes is the Royal Gorge in Colorado, which is so narrow that in one part, in order to have room for the river and the road bed, the engineer was obliged to resort to the principle of the suspended truss, as shown in the illustration. The scenery which one encounters in passing through this gorge is beyond description. The pass is barely wide enough for the roaring mountain torrent and the road bed, and upon either side the rocks rise to such a height that one can see the stars at mid-day and when the sun is shining brightly.

Another difficulty with which the engineers have to contend in mountain regions of northern latitudes or in great altitudes is that of snow, which in winter fills the cuts and has to be removed before traffic can be resumed. On all lines in the mountain regions we find miles and miles of snow fences and snow sheds. These are rough wooden structures sufficient to protect the track from snow. While they are a necessity, the sheds are anything but pleasant to the traveler, because they shut out many attractive views, and also cause the train to be filled with dust and the odors of gases escaping from the locomotive.

EQUIPMENT

In addition to the track, yards and other fixed properties referred to above, the equipment of a railroad consists of stations for passengers and freight depots, shops and round houses, coaling stations and rolling stock, by which is meant locomotives and cars.

The size and style of passenger stations depend upon the amount and nature of the passenger business at the point where the station is located. In small towns one building of modest structure usually accommodates both the freight and the passenger traffic. Junction points in the country or small towns also have plain structures of either wood or brick, which serve the same double purpose. Passenger stations are provided with waiting rooms for both men and women, such offices as are necessary to accomodate the business of the road at that point, and, where the traffic warrants, a restaurant which may consist of only a lunch counter or a lunch counter and dining room. The passenger stations in large cities are often large and expensive structures. These stations may accommodate the traffic of only one system, as in the case of the new station of the Chicago and Northwestern Railway in Chicago, and the station of the Pennsylvania Railway in New York, but most of them are union stations, and accommodate the traffic of several lines or systems, like the Union Station in St. Louis, the North and the South Stations in Boston, and the new Union Terminal Station in Washington, D. C.

The passenger station in a large city usually has an extended space devoted to train sheds, in which are a number of parallel tracks. The trains all enter these sheds from one end of the structure, and at the opposite end is the more elaborate part of the building, containing the station proper. In this are found elaborate waiting rooms, dining rooms and lunch counters, news stands, offices for the lines using the station, and sometimes hotel accomodations. There must also be provided rooms for incoming and outgoing baggage, and for the accommodation of the express companies using the lines whose trains enter and depart from that station. The waiting rooms, baggage and express rooms are so located that the sheds are easily reached from them, and the waiting rooms are reached through the main entrances to the station.

Some of the most celebrated stations in the United States and in the world are the Union Station in St. Louis, which is seven hundred feet long and six hundred feet wide and has a space in its train sheds for thirty tracks, and includes in its equipment an excellent hotel; the North and the South Stations in Boston, the latter being seven hundred feet wide and eight hundred feet long, and at the time of its completion the largest structure of its kind in the world; the new Union Terminal Station in Washington, D. C.; the Reading Station in Philadelphia; the Chicago, Rock Island and Pacific and Lake Shore and Michigan Southern Station in Chicago, and the new station of the Chicago and Northwestern Railway in the same city. These stations are constructed on two plans. Those in St. Louis and Boston are all upon the surface. The Reading Station and the Rock Island and Pacific and Northwestern Stations are entered upon elevated tracks, and have the rooms for baggage and express underneath. The station at Washington, D. C. combines the two plans, the suburban traffic entering and leaving upon tracks which are on a level with the street, while the through trains enter and leave on tracks that are below the level.

But exceeding any of these stations in magnitude and also the elegance of its equipment, is the new station erected by the Pennsylvania Railway in New York City, and forming the most imposing structure of its kind in the world. This station was erected to accommodate the passenger traffic of this great railway system which is brought to the city through its tunnels under the Hudson and East Rivers. The building is located between Thirty-first and Thirty-third streets and Seventh and Eighth avenues. It is built of granite and is at once an imposing and a beautiful structure. The main entrance leads through an arcade forty-five feet wide and two hundred twenty-five feet long, to the main waiting room which is one hundred three feet wide, two hundred seventy-seven feet long and has a height of one hundred fifty feet. The central portion of New York City Hall with its tower, could be placed upon the floor of this room without touching the walls, and the flag pole on the tower would fail to reach the roof by a distance of fully ten feet.

On the same level are two other waiting rooms and the main baggage room which is four hundred fifty feet long. The baggage is brought in this room and delivered to the tracks, which are below, by motor trucks and elevators. Stairs lead to the train platforms which are on the track level, forty feet beneath the surface. The part of the station which ordinarily corresponds to train sheds has room for twenty-one tracks and platforms and has direct connection with the tunnels from New Jersey and Long Island. The exterior measurements of the station are four hundred thirty feet on the avenues and seven hundred eighty-four feet on the streets. In addition to this, there has been excavated a space which includes more than five large city blocks, for a train yard. This yard has an area of twenty-eight acres, and includes sixteen miles of track, affording storage capacity for nearly four hundred passenger cars. All of this space was cleared of buildings and excavated to a depth of about fifty feet. See Frontispiece.

The entire structure includes an amount of work and expense almost beyond estimate, and as one learns of this enormous outlay, he is naturally led to ask why such expense is necessary, but it must be remembered that the great financiers who handle problems of this magnitude do not enter upon such operations blindly. In 1906 the railways which have their terminals on the western bank of the Hudson River, carried over 140,000,000 people, and this traffic is increasing continually. For years the greatest detriment to business in New York has been the difficulty of transportation to and from the residential sections around the city. By the completion of these tunnels and the construction of this station the facilities for suburban transportation have been greatly increased, and the Pennsylvania Railway Company believes that this increase in business will fully justify the expenditure of the large sum necessary to enable them to meet these demands.

In visiting one of these large stations we are not any more impressed with the size and magnificence of the building than with the perfect adaption of means to ends and the thorough system which characterizes every movement of the officers and employees connected with the place. Each has his particular work to do and is responsible for it. The

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being upholstered according to the class of passengers it is designed to carry. The compartments have no communication with each other, and there is no means of passing from one coach to another except by walking on a footboard along the side.

In making up a train these coaches are rigidly fastened together so that there is no shock or jar in stopping or starting. Coaches of this pattern can be loaded and unloaded with great rapidity and are of special advantage in handling large suburban traffic, but they have never found great favor in the United States. The Illinois Central Railroad during the World's Fair in Chicago in 1893, constructed a number of coaches on this plan except that the dividing partitions were omitted, and its trains handled an unusually large number of passengers with an excellent degree of facility. The success attending this effort was such that the company has continued the use of cars of this pattern on some of its suburban trains.

The American passenger coach consists of a long car with doors at each end and an aisle passing through the center. The car is mounted upon two bogies or trucks, having four or six wheels each, according to the size and weight of the car and the kind of service for which it is intended. All of the best passenger coaches now have six-wheeled bogies. These cars are usually about sixty feet in length, and will seat about seventy people, the number depending upon the space reserved at each end of the car for toilet rooms and smoking rooms which are now found in many of the best class of coaches.

A car of this pattern weighs about forty-two and a half tons and costs from eight to nine thousand dollars. In addition to the seats the appliances consist of water tanks, wash basins and heating and lighting apparatus.

On all of the best railways passenger coaches are now heated by steam, which is supplied from the locomotive. On local trains hot water heaters or stoves are still in use, although in many states the use of stoves has been prohibited by law because of the liability to fire in case of accident. The lighting systems of the best trains provide for the use of electricity or gas. In case of the latter, oil gas is used. By that is meant gas manufactured from oil. This is stored in cylindrical tanks under the car, into which it is forced under great pressure. Pipes extending from this tank to the chandeliers convey the gas to points where it is needed for use. The electric light is more modern, and in many cases more satisfactory. Where this is employed the electricity is either generated by a machine attached to the locomotive, or by an electric plant placed in a special car which is attached to the train next to the locomotive. In case the locomotive supplies the current, storage batteries are necessary in order to maintain light when the locomotive is detached from the train for the purpose of changing engines. These batteries will produce current which is usually of sufficient strength to maintain the lights for the time necessary.

But more important than the lighting system is that of the brakes and couplings, because upon these the safety and lives of the passengers depend. The early patterns of American cars provided for joining them to each other by a link and pin coupler, and this form of coupling was used for many years on both freight and passenger trains. It allowed several inches of space between the platforms of the cars, and in case of sudden stopping or starting of the train, the passengers experienced a severe jolt. Moreover, in case of sudden stopping or of collision, the trains joined together in this way were liable to destruction from the telescoping of one car by another. Railroad men early began to study means for avoiding these liabilities to accident. The car with the link and pin coupling also had the hand brake which could be applied only by the brakeman winding a chain and bringing the brake shoes in contact with the wheels. Only as many brakes could be set at once as there were brakemen on the train, and by this method it was impossible to stop a train running at a high rate of speed, until it had traveled some distance after the signal for stopping was given.

In 1869 the Westinghouse air brake was invented, and this is now used universally in the United States and extensively in other countries. This brake operates by compressed air. The appliances consist of an air compressor upon the locomotive and air cylinders under each car, in which are pistons that are attached to levers, which, when these pistons are moved, either set or release the brakes. The cylinder under each car is connected with those of all the other cars by tubes, and the first car is connected with the air compressor on the locomotive. This is under the control of the engineer, who, by opening or closing a valve, can set the brakes on all cars of the train, instantly. By this device a heavy train running at a high rate of speed can be stopped in a very short distance. After the train is brought to a stop, the engineer releases the air in the cylinders and automatic springs bring the pistons back into position and release the brakes.

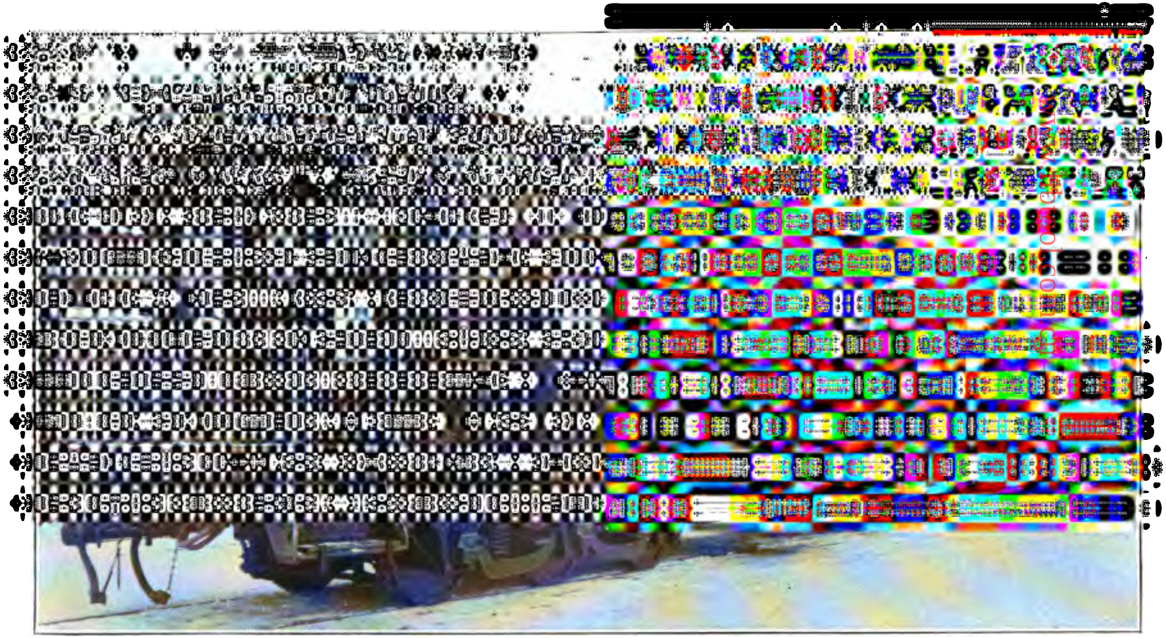
At about the same time the Miller coupler and buffer was invented, and this attachment is now in general use on passenger trains. Later came the vestibule which incloses the platforms of the cars so that now a first class passenger train resembles one large car with doors at equal intervals. All of these inventions have been the means of adding to the comfort and safety of the traveling public, and trains without them at the present time would seem somewhat strange. However, the writer can well remember experiences on passenger trains before any of these appliances were known.

No sooner had trunk lines been formed than the long distances traveled made it desirable to provide a more comfortable means of transportation, and this demand led to the invention of the sleeping car. Various patterns were constructed, and numerous devices employed, but previous to 1864 none was very successful, and up to that time sleeping cars were seldom run from one line over another. In 1864 Mr. George M. Pullman of Chicago, patented a sleeping car which he designed to meet the requirements of long distance travel. The success of this car was such that Pullman cars rapidly grew in favor and soon supplanted all other patterns. Mr. Pullman's first sleeper was employed upon the Chicago and Alton Railway, and about its first service was to bring the remains of President Lincoln from Washington to Springfield, Illinois.

In 1867 the Pullman Palace Car Company was organized for the purpose of constructing sleeping cars. Soon after, the Wagner Palace Car Company was organized for the same purpose, and for a number of years these two companies were engaged in providing the various railroad companies with sleeping cars, when the Pullman Company purchased the property and rights of the Wagner Company. Since the consolidation, the Pullman Company has continued to increase its business, and it has added to the manufacture of sleeping cars that of passenger cars, street cars and freight cars, until it now employs more than 11,000 men and is one of the largest and wealthiest corporations in America.

A modern sleeping car is seventy-two feet in length, eight and a half feet wide and nine and a half feet high, and weighs about fifty-seven and a half tons. It is divided into a smoking room, toilet rooms, one or more staterooms and the large space in which most of the berths are located. A car of this size may contain as many as twenty-six berths, but cars constructed for long distance travel usually contain more staterooms and fewer berths.

Pullman cars are finished in the highest grades of



OBSERVATION CAR

upholstery and the cabinet woods, and are virtually palaces on wheels. Their beds are as comfortable as those found in the best hotels, and when in charge of a faithful and obliging attendant, a journey across the continent can be made in one of these cars with little or no fatigue.

The parlor car is practically a Pullman day car, although many roads manufacture their own cars of this style. The car is seated with upholstered or cane chairs, contains about the same compartments that a sleeping car does, and is in the charge of a special attendant. Parlor cars are very comfortable, and the seats can be procured on payment of a slight additional charge to the first class ticket. Because of their comfort and convenience, and the avoidance of over-crowding common to the public coach, these cars are very popular on day trains running between large cities.

The observation car is a parlor car of special plan, designed for first class passengers who travel upon trans-continental trains or on first class trains passing though sections of country which are more than ordinarily interesting either because of their scenic beauty or their historical importance. The peculiar features of the observation car are, very large windows which enable one to get an excellent view of the surrounding country, and a large observation platform upon which a number of persons can be seated with comfort. The observation car is always attached to the rear of the train, and those passengers who are fortunate enough to secure seats upon its rear platform, obtain an excellent view of the region through which the train passes.

The dining car, of which the purpose is described by its name, was also invented by Mr. Pullman, and came into use very soon after the sleeper. The first dining car of modern pattern was also used upon the Chicago and Alton Railroad. These cars contain a dining room and a kitchen, which is inclosed by a tight partition so that the odors from it cannot escape into the dining room. Modern dining cars are furnished with glass, chinaware, linen and silver of the highest grade, and are under the charge of a car conductor. From three to four waiters are usually attached to each car, and two cooks are found in the kitchen. This latter apartment is remarkable for the ingenuity with which it is planned. It must contain a cooking range, storage room for all dishes used and for supplies from which the food is prepared, and a table for the use of the cooks. One not acquainted with such a kitchen can not understand how it is possible to serve expeditiously such a large number of persons as the demands of a heavily loaded train make upon the dining car, but this is accomplished successfully because of the convenience of arrangement and the system in management.

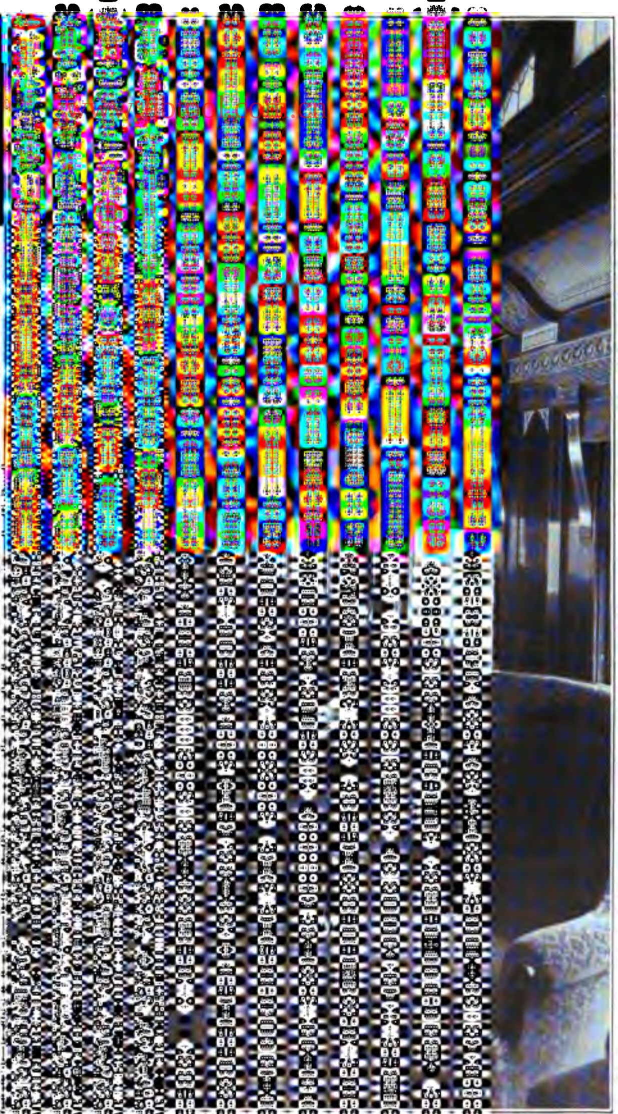
The buffet car, sometimes called the library car, is the most recent invention which has been added to the long-distance passenger train. The intention back of this invention was doubtless good, but one experienced in long-distance travel has learned that some of the uses to which these cars are put are not always of the best. The buffet car is seated with upholstered chairs, and usually contains a table upon which are placed most of the current periodicals, and also a desk where one may write letters, the desk being provided with stationery bearing the imprint of the railway over which the car travels. The buffet car is usually occupied by those who wish to smoke, and except in states where the sale of intoxicating liquors is prohibited by law, it serves as a sort of high class saloon. For this reason these cars are not frequented to any extent by those who are not addicted to the use of tobacco or spirituous liquors.

In addition to the cars already described, passenger trains contain at least one baggage car, and if a mail train, a mail car. To these may be added one or more cars for carrying express, according to the demands of the traffic.

A first-class train, then, contains baggage, mail and express cars, one or more passenger coaches and a parlor car, if it is traveling over distances which do not exceed twelve hours in time to cover. If it is a night train, the sleeper takes the place of the parlor car and the buffet car may be added. Long-distance trains, such as those running from New York or Boston to Buffalo and Chicago, or from Chicago to Pacific Coast points, contain buffet and observation cars in addition to the sleepers. Limited trains traversing these long distances do not carry day coaches because they make no local stops, and the speed required of them demands that the load be as light as possible. With the best of management, however, these trains seldom contain fewer than six cars, and more frequently eight.

Such a train is a first-class hotel upon wheels. Within it can be found all the conveniences and luxuries which the ingenuity of man has been able to invent for modern travel. Not only does the train contain the conveniences already named, but in addition, on the best trains, we find a bath room, a barber shop and on some a public stenographer whose services are free to the passengers. The cuisine upon the dining cars is of the best, and every attention is given the passengers by the train attendants, from the conductor down to the porter. A journey upon such a train is an experience to which one may look forward with the greatest anticipation and pleasure. So perfect is the service that ladies traveling alone, and even children unattended can go upon these trains from one end of the country to the other with perfect safety as well as amid the most luxurious surroundings.

We have given this attention to the passenger cars and trains because people are usually especially interested in those things with which they are personally associated. We must not forget, however, that all of the passenger cars together form but a small percentage of the entire number of cars in the country, by far the greater number being constructed for the carrying of freight. There are numerous classes of freight cars, each designed for the material which it is to carry. The simplest of these is the platform car, which is merely a platform upon wheels with irons attached to the sides, in which large, strong



stakes may be driven to keep whatever is placed upon the car from falling off. Platform cars are used in hauling lumber, wood, traction engines, carriages and other articles too large to place in a covered car.

Next to the platform car in simplicity is the open coal car or "gondola," which is a platform car with sides added, and open at the top. The sides are usually about six feet high. These cars are used for hauling coal, sand, iron ore and other commodities which are of such nature that they are not injured by exposure to the weather and can be handled most conveniently on cars without cover. The common box car is the most numerous of all styles of freight car, and, as its name implies, it is a plain wooden box roofed over. It is used for hauling all commodities which need protection from the weather and which can be laid into it with convenience. The common box car has been modified, however, in various instances, to meet special demands.

One of these modifications is the furniture car which is built larger than the ordinary box car. Another is the refrigerator car which is practically a refrigerator or ice house on wheels. The walls of this car are double, and the space between is filled with air or some other substance which is a non-conductor of heat. An ice chamber is provided in the roof, and when stocked with ice and tightly closed, this car will transport fresh meat or fruits for long distances without injury. Refrigerator cars exclusively are used by the great meat packing houses of the country and the fruit growers of California and the South. Stock cars are constructed for the purpose of hauling cattle, sheep, swine and horses to market. The sides have open spaces to provide for good ventilation. Cars that are designed for hauling stock long distances are provided with troughs in which food and water may be placed.

The cars used for hauling cattle have the doors in the sides at the center, and the animals are driven in and placed so that they usually stand across the car, each alternate animal heading in the opposite direction. In this way a car can be closely packed and the animals tend to support each other in their position. Cars designed for hauling swine and sheep are double decked. That is, they have two floors, one above the other, and each floor is loaded with stock. Cars for transporting horses are usually more carefully constructed and afford greater protection and comfort to the animals. The best of these cars are usually known as palace horse cars. Ore cars and gravel cars are frequently constructed for use in special localities. Many ore and coal cars have bottoms which can be opened so that when the car is run upon an elevated track it is easily and quickly unloaded by dumping its contents into a pit below.

Gravel cars are used by the railroads in ballasting track and filling in cuts. Tank cars are large steel tanks resembling a steam boiler and mounted on a platform. They are used for carrying kerosene and other oils. Caboose cars or cabooses are the cars used by the train men on freight and construction trains. Such a car has a cupola on top, and the conductor of the train, seated in this, is able to overlook his train and note any irregularity that may occur when the train is in motion. Sometimes these cars are provided with bunks in which the men may sleep when off duty. However, this style of caboose is not common. Practically all freight cars are now provided with air brakes and automatic couplers, so that the same advantages of operation are applied to them as are found on passenger cars.

Formerly all cars were constructed of wood, but now steel has replaced wood for many patterns of freight car and it is being used by the Pullman Company in the construction of passenger coaches and sleepers. Steel-constructed cars contain little or no wood. They are stronger than wooden cars and are not much heavier, while the durability is much greater. An ordinary freight car of the box pattern will carry a load of from forty to sixty tons, according to the size and strength of the car, while the capacity of coal cars or gondolas, is a little more than this.

We have seen that the car has developed from the old wagon and the old stage coach to the modern coach and palace car. The locomotive likewise has developed from the dwarf engine of Peter Cooper, which weighed less than a ton, to the huge monsters weighing over three hundred tons and used in climbing the grades in mountainous regions. The development of the locomotive does not consist merely in increase in size and power: it includes such perfection of the boiler and fire box as to enable the engine to utilize a much larger percentage of heat generated by the fuel than was at first possible, and also that fine adjustment of parts necessary to bring the enormous power exerted by the modern locomotive under perfect control, making it one of the most wonderful and perfect pieces of mechanism in the world.

In 1832 Mathias Baldwin of Philadelphia, built an engine which he named "Old Ironsides," and the construction of this engine was the beginning of the Baldwin Locomotive Works, now the largest establishment of the kind in the world. Mr. Baldwin, who was a maker of book binders' tools, made for the Peale Museum of Philadelphia a model engine to run on a circular track, for the purpose of satisfying the curiosity of visitors to that institution. The success of this model led to the construction of Old Ironsides, which was built after the pattern of the model but on a much larger scale. The wheels had cast iron hubs, wooden spokes and iron tires. The engine was without a cab, and compared with a modern locomotive was a primitive structure; yet it was very successful and remained in use a long time. This engine is important because it served as a pattern after which many other locomotives were constructed, and the locomotive of the present day is due largely to successive additions of parts and improvements in construction as well as to increase in size.

The modern locomotive of ordinary type has the forward end resting upon a swivel truck or bogie of four wheels and from four to eight drive wheels, [illegible] all wheels. [illegible] et in diam- [illegible] the engine [illegible] bar which [illegible] rod, with [illegible] The weight [illegible] rades runs [illegible] tons, and [illegible] increased [illegible] ders weigh [illegible]

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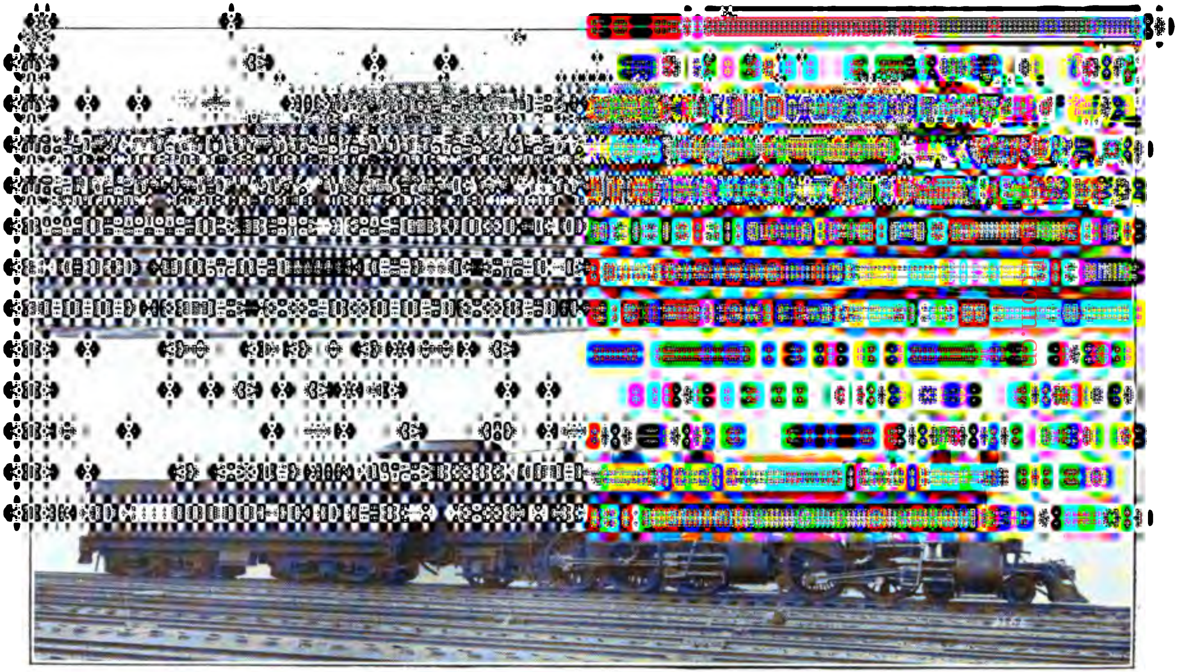
[illegible]

[illegible] ler is forty- [illegible] ne-half feet [illegible] with water, [illegible] ete locomo- [illegible] es by nine [illegible] sized living [illegible] eet and the [illegible] inch. This [illegible] which means that it is practically two engines joined in one, both of which are operated by steam from the same boiler. There are two sets of cylinders and two sets of drive wheels. The first set of cylinders takes the steam as it comes from the boiler, and it is here used in turning the rear set of drive wheels. As the steam passes from these first cylinders it enters a chamber where it is re-heated by gases from the furnace and then it enters the second set of cylinders which are of larger diameter and used in turning the second set of drive wheels, or those at the forward end of the engine. By this device the same steam is used twice, which not only increases the power of the locomotive, but also makes a great saving in fuel. The tender will hold 4000 gallons of oil, which is used for fuel, and 12,000 gallons of water. This engine will haul a load of 7500 tons at a speed of ten miles an hour on a level track. A number of other locomotives of the same pattern have been made for the Atchison, Topeka and Santa Fe Road to use in the mountain sections along its line. In these locomotives the building of railroad engines reached its highest point at the time of their construction, but since each year sees advancement, it is unsafe to predict what may be constructed in the future.

Some of the railroads construct their own locomotives, but the majority prefer to purchase them already made, and this preference has given rise to a number of establishments which are devoted entirely to the manufacture of locomotive engines. The largest of these is the Baldwin Locomotive Works



FREIGHT MODERN LOCOMOTIVES PASSENGER

at Philadelphia, which employs over 12,000 men and has a capacity of over 1200 locomotives a year. Other important locomotive works are, the Rogers at Paterson, New Jersey, employing about 1400 men, and the American Locomotive Works formed by the consolidation of eight different plants and having a combined capacity of about 1,700 locomotives a year.

Electric locomotives have taken the place of those operated by steam in some localities, particularly on the New York Central and Hudson River Railroad on its entrance to New York City, and on the Pennsylvania Railroad for hauling its trains through the tunnels by which its terminal station in the same city is reached. The New York, Hartford and New Haven Road has also placed the electric locomotives on a portion of its line. Other places where these locomotives are used are in the tunnel in Baltimore and Ohio, and in the tunnel under the St. Clair River at Port Huron, and in some of the tunnels on the line of the Great Northern Railroad in the Cascade Mountains. Some of these electric locomotives are nearly as heavy as the largest of the steam locomotives, and have an equal or greater capacity for work. The principle employed in the railway locomotive is similar to that used for the electric car motor. The advantages derived are, freedom from smoke, ease of manipulation and a possible saving of expenses. Doubtless, from this small beginning the use of electricity as a motive power on railways will in the next few years be largely extended.

In 1910 there were over 61,000 locomotives, 35,000 passenger cars and 2,176,321 freight cars in use in the United States, and in 1909 over 93,500 freight cars, and 2850 passenger cars, a total of over 96,000 cars, were built in the United States and Canada, and during the same year there were 3350 locomotives built in this country.

MANAGEMENT

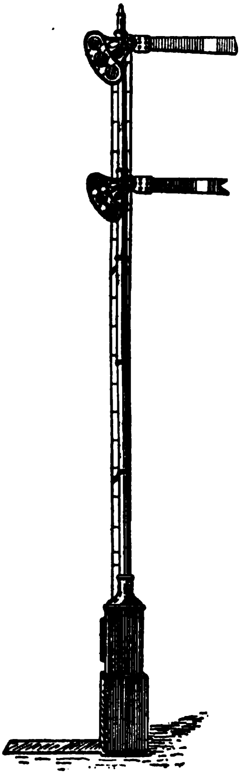
Railroads are owned by stockholders, who invested their money in purchasing the stock. Since there are many stockholders and they are often widely separated, it is necessary for them to delegate their authority to a small number of men, so the stockholders elect from their own number directors who are usually the men owning the largest number of shares of stock in the corporation. The directors meet and elect officers—a president, one or more vice-presidents, a secretary and a treasurer. Usually the president is the largest stockholder of the road, and he is virtually the head of the corporation, whether or not he assumes the active duties of the general manager. The nature of the work is such that "there must be an unbroken line of responsibility from the lowest subordinate to the president, and the organization by which this is accomplished must have enough flexibility to permit the improvement in service and the adoption of new technical and financial methods." To accomplish this necessary and desirable end, the organization must be very carefully planned. Three lines of work need to be provided for, finances, the maintenance of the road and the transportation of commodities. Usually each of these is placed in charge of a vice-president, unless the president chooses to assume one line of work himself.

The transportation division has for its general duties the maintenance of the road and the rolling stock, furnishing of suitable transportation facilities for patrons of the road, making traffic arrangements with the patrons and operating the department. All of this work is usually in charge of a general manager who has under him a general superintendent upon whom devolves the responsibility of the movement of trains throughout the line or system. In addition to these officials there is a civil engineer who maintains a department, and whose duty it is to look after all engineering problems in connection with construction and repairs. There is also a bridge department under a superintendent, which must keep all bridges and culverts in repair.

For convenience in operating the road, the line, if of any considerable length, is divided into divisions over each of which a division superintendent is placed. This official is responsible for the operation of the line throughout his division, and for seeing that all instructions of his superior officers are carried out. At division points are found railway yards, repair shops, water and coaling stations and such other conveniences as are found necessary to the expeditious movement of trains. Each division of the road is divided into sections having an average length of about five miles. Each section is in charge of a foreman or section boss, who has three or four helpers and whose duty it is to see that all minor repairs are made on the track in his section and that the roadway is kept free from grass, unsightly objects and obstacles. By these section men the road is traveled every few hours, so that no accident to the track will occur without being discovered before another train would be liable to suffer from the defect.

The train crews consist of the locomotive engineer or driver, the fireman, the conductor and as many brakemen as the size of the train demands. On limited passenger trains, which render the highest class of service, there are also numerous other attendants whose duty it is to serve the passengers in such ways as will contribute to their pleasure and comfort. These attendants are not a necessity, while the conductors and brakemen are.

The movement of trains is directed by train dispatchers, one being stationed at each division point. These dispatchers are expert telegraph operators and from reports which they are continually receiving, they know the position at any moment of every train on their divisions. On single track lines it is necessary that the train dispatchers use the greatest care in order that trains running in opposite directions may meet and pass each other with safety. By knowing the position of each train on his division, the dispatcher can telegraph to the agent at any station, directions for the incoming train. These directions are usually delivered in duplicate to the conductor and engineer, and tell where to meet and pass the next train coming in the opposite direction; or if the train is a fast one, where to pass a slow train going in the same direction. By faithfully following the directions of the dispatcher a large number of trains can be operated on a single track line without accident.



A SEMAPHORE

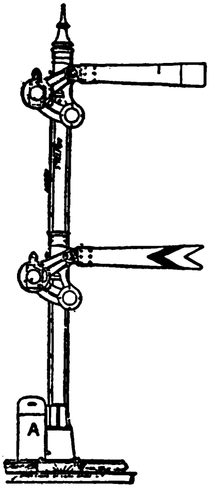
But this system contains many defects: agents forget; train men fail to obey orders, and sometimes the telegraph does not transmit the message correctly. Whenever any one of these failures occurs, accidents are almost certain to follow; therefore other means of preventing collision have been adopted on all of the best roads. These consist of systems of signals which operate automatically, but their introduction does not dispense with the train dispatcher because under any circumstances it is necessary for the office at the division points to know at all times where each train on that division is.

The railway signals in ordinary use consist of colored lights, semaphores and disks. The colored lights are attached to all switch posts and tell the engineer by the color thrown whether the switch is open, that is, leading from the main line to a side track, or closed. Three colors are employed, white, green and red. On the switch posts a white light indicates a clear track, a green light indicates the necessity for caution and a red light, danger. Some roads use only two colors, either the green and red or white and red, but all large systems use three.

A DISK SIGNAL

The signal most generally employed for direction of trains on the main lines is the semaphore, which is shown in the illustration. The position of the arms tells the engineer whether or not the track ahead of him is clear. The general code is, when the semaphore arm is raised to a horizontal position the train should stop; if inclined to an angle of forty-five degrees the train may proceed but with caution; if dropped to a vertical position the track is clear and the train may proceed at full speed. The standard to which the semaphore is attached holds a lantern, and a frame called the spectacle, containing disks of colored glass, is attached to the end of the semaphore arm nearest the standard, so that when the semaphore is raised to a horizontal position, a red light is shown; when it is dropped to an intermediate position a green light is seen, and a vertical position shows the white light. By this device the same signalling apparatus answers the purpose equally well for day and night trains.

The colored disk also shown in the illustration contains circular disks of colored silk, the colors corresponding to those already described for the lights. By day the engineer is guided by the appearance of this disk. At night a light which shows through an opening above the disk conveys the same intelligence that the disk does by daylight. On all of the best roads these signal devices are now operated by electricity or compressed air, and are connected with the rails by mechanism which enables the approaching train to set the signal at the desired position. When the train has reached a certain point on its departure, the signal is released.



AN AUTOMATIC BLOCK SIGNAL

By means of these signals and the use of what is known as the block system, collisions are almost entirely avoided. By the block system is meant the division of the line into sections a few miles in length, at each end of which is placed a semaphore or other signal which indicates to the approaching train whether or not there is a train in the block ahead. If the train approaching a block finds the arm of the semaphore at horizontal position, a train is in the block ahead, and as soon as the train ahead leaves the block the arm drops and the second train may proceed. Since these signals are operated automatically by the trains they afford a perfect protection so long as their mechanism is kept in order. We might also add that they afford this protection with the least amount of expense for labor. Practically all important lines in the United States are now operated by the block system.

The interlocking system is also in general use where two or more tracks meet or where lines cross each other. It is operated by a series of levers which are located in a tower so placed that the operator has a view of all lines converging upon the point to be protected. These levers are so arranged that when they are set to throw the signal for a clear track on one line, it is impossible for them to issue a similar signal on any other line. This same device is also used in large railway yards where there are many switches, and it prevents opening switches from the main lines when the levers are arranged to give a clear track on that line. By this device many accidents are avoided.

In large railway passenger yards the switches are operated by compressed air or electric motors, the device connected with each switch being controlled by the operator in the tower, and, since the same device which operates the switch sets the signal, one operator can control both movements. The connection between the tower and the various switches is made by means of wires, where electric motors are used, or tubes where compressed air is used. In the signal shown in the illustration the letter "A" marks the case in which the operating device is installed. This arrangement is so delicately adjusted that it not only sets the switch and signal in a proper position, but when this is done it makes connection with the tower and notifies the operator that the signal has been set. On double track systems there is, of course, little danger of the collision of trains going in opposite directions, but the block system is necessary to prevent rear end collisions, especially on those lines where trains run at a high rate of speed.

We can see by the above description something of the system and care used in the operation of a great railroad. While riding comfortably amid luxurious surroundings in a palace car, we seldom stop to think of the care which makes our rapid and pleasant journey not only possible but safe. Every mile of track is watched by day and by night, and every device upon which the safety of the trains depends is daily inspected. Nothing is left to chance nor to supposition. The railroad man must be a man of facts, and he must know, not surmise conditions.

The transportation provided by railroads includes the carrying of freight, passengers, mail and express. The freight constitutes by far the largest part of the business, and the income which the roads of the country receive from freight traffic is about four times that received from passenger traffic. "Freight business is carried on to enable men to secure what they want, and the more complex their demands, the more goods will be manufactured and transported."

Of the enormous amount of freight carried in the country, coal, iron ore and other minerals furnish about one-half of the tonnage, but since these commodities are carried at a low rate, their transportation does not yield one-half of the revenue. Manufacturers contribute about one-seventh, forest products one-eighth, agricultural products, one-ninth, and the balance of the tonnage is distributed among numerous commodities consisting of live stock and miscellaneous articles which are seldom classified. For convenience in making the traffic agreements, freight is divided into a number of classes, and this classification is systematized by mutual agreements of the railways, which have divided the country into three sections. First, that east of the Mississippi River and north of the Ohio, known as the eastern section; second, the southern section, which lies east of the Mississippi and south of the Ohio, and third, the western section, including all the country west of the Mississippi River. All the roads in each section have adopted a uniform classification. In the western and southern sections freight is divided into ten classes.

The class affects the rate of transportation, and in making a classification the space occupied by the commodity and the value of the article and the quantity transported are taken into consideration. To illustrate: lumber, coal and iron ore are commodities which require but little care in loading and little or no protection during their transportation; they are seldom shipped in less than carload lots and frequently in trainloads; therefore a lower rate per ton can be given than could be placed upon dry goods, glassware or furniture, each of which must be handled with care and protected from the elements during transportation, and each of which is liable to be carried in small quantities. It therefore follows that the same commodity when carried in carload lots may be in a different class than when carried in small lots. Live stock, fruit and some other commodities are given a special classification because of their perishable nature and the care which must be exercised in their transportation.

Freight is designated also as through and local, and each of these terms is used with different meanings. The railroad means by local freight, that which originates and ends upon its own line, and by through freight, that which may start on its own line and be carried to another, or that which it may receive from another line. The patrons of a line usually consider local freight that loaded or unloaded at local stations, and through freight that which is carried a long distance. What the shipper calls local freight, the railroad man usually designates as "way freight."

A careful record is kept of all freight received and transported. However, this record is very simple. When the shipper delivers to the railway agent a consignment of freight, he receives a record called a bill of lading which contains a description of the articles, their weight, destination and the freight charges. These bills are issued in duplicate, one is given to the shipper and the other is retained by the road. The bill usually contains a clause relieving the railroad from liability for loss or damage to the goods which may result from causes beyond the control of the carriers. It will be seen that this bill of lading is virtually a contract between the shipper and the railroad.

The agent receiving the freight issues another record called the way bill, which is given to the conductor of the train on which the goods are shipped and delivered by him to the station agent where they are unloaded, or to the conductor of the next train to which they may be transferred. This bill gives the number of the car, and the road to which it belongs, in which the goods are loaded, the destination of the goods and the route over which they are to be sent, as well as the name of the shipper or party to whom they are sent. When the goods reach their destination the agent at that station sends notice to the party to whom they are to be delivered, and if in carload lots they must be unloaded without delay, or if in smaller lots receipted for and taken away within specified time or charges for storage are collected. Charges upon cars which are held over the specified time are known as demurrage, and run all the way from two dollars a day up. Freight may be paid by the shipper or by the party to whom the goods are sent. Railroads refuse to receive certain commodities unless they are prepaid, but the tariff on most freight is paid by the one receiving the goods.

A daily record is kept of the movements of all cars on the line, so that a consignment of freight can be located within a very short time if it is delayed in transit. At large stations they try to load each car with freight designated for the same point, because this saves delay in unloading and also rehandling at junction points. Some of the large corportations, like the meat packing houses and steel companies, prefer to own their cars and pay the railroad for hauling them, but most of the freight is hauled in cars belonging to the railroad companies. Stock, fruit, garden truck and milk are usually transported on special trains which run at a high rate of speed and have the right of way over all other freight trains because of the perishable nature of the commodities. Ordinary milk cars resemble baggage cars in appearance and structure. Sometimes milk trains carry one or more passenger cars. They run but short distances and in all cases are local.

Passenger traffic is entirely different from freight traffic. Passenger trains must depart on schedule time and they are expected to arrive on schedule time, but aside from local or way freight trains, other freight trains depart when there is enough freight for a load, and the number of freight trains on any line depends upon the business at any given time. For instance, in the wheat belt there are many more freight trains operating just after the crop is harvested than there are at any other time in the year, and a large crop often taxes the entire capacity of the road to its fullest extent. Some of the roads connected with large cities place special passenger trains on their lines during the summer for the purpose of meeting the demands of their patrons for quick and frequent transportation to nearby country places, but with these exceptions the number of passenger trains is usually the same throughout the year. Neither does the time schedule vary more than a few minutes from one season to another. In the United States the traveling public demands speed, safety, good service and the removal of the discomforts of travel, and the railways have tried to meet these demands. Consequently, freight rates have lowered more rapidly than passenger rates.

When you wish to take a journey upon the railway, you purchase a ticket which stands to you in practically the same relation as the bill of lading does to the shipper of freight. This ticket is a contract between you and the railroad company. If it is a local ticket carrying you but a short distance, the contract is very simple: you pay your fare and the ticket entitles you to transportation between the points named; but if you are to travel from New York to Chicago or from Chicago to Saint Louis or to take a journey to any point which will require your riding over several other lines on the way, your ticket is of a much more complex nature. It consists of the main body of the ticket and various coupons. These are taken up respectively by the conductors of the various lines over which you pass.

The main body of the ticket contains the conditions of the contract and should be read carefully unless you are thoroughly familiar with these conditions from previous experience. The numbers on the margin give the length of time during which the ticket is valid, and on some tickets the margins also provide for a description of the purchaser. This is for the purpose of protecting the railway company when tickets are sold at reduced rates, and tickets of this sort can not be transferred by the purchaser to another party. Much annoyance and inconvenience would be saved both to the passengers and train officials if those purchasing tickets would take pains to read them carefully and then follow the directions which they contain. When differences between the passenger and train officials arise, the fault is usually with the passenger. The railway scrupulously fulfills its part of the contract unless it is prevented from so doing by circumstances beyond its control.

Passenger traffic may be divided into three groups, local, through and suburban. The local traffic accommodates the patrons between the various stations along the line of the road, the through traffic pertains to passengers who travel a long distance as between New York and Buffalo, Chicago and Saint Paul, Chicago and Saint Louis and other large cities. This traffic is more expensive to the railways and less remunerative than local traffic because of the luxurious trains which competition and the demands of the public have compelled the railways to provide. Suburban traffic includes the transportation between the business portions of large cities and the surrounding towns in which the people live. About such cities as New York, Chicago, Boston and Saint Louis it is the most valuable part of the passenger traffic which the railroads have, and special effort is made to handle it with satisfaction and dispatch. As we have already seen, the Pennsylvania

Railroad has recently incurred enormous expense to provide direct rail connection with New York City and Brooklyn, and this almost wholly because of the enormous suburban traffic which will result from this movement.

The average speed of local passenger trains is about thirty miles an hour, and the speed of express trains from thirty-five to forty miles an hour, but some of the special trains have a much greater speed than this, such as the Pennsylvania Special of the Pennsylvania Railway between Chicago and New York, and the Twentieth Century Limited of the Lake Shore and Michigan Southern Railway of the New York Central Lines. Each of these trains covers the distance of nearly one thousand miles in eighteen hours including stops. This of course means that over some portions of the line a speed much greater than the average must be attained, and these trains frequently run sixty-five to seventy miles an hour over certain portions of the track.

One whirled over the country at this rate scarcely realizes the speed at which he is traveling because of the perfect condition of the roadbed and the mechanism of the train in which he is traveling. Special fast trains are found between all large cities, but those mentioned have a higher average speed than most of the others. The Empire Express running between New York and Buffalo, however, has about the same average speed as the special trains between New York and Philadelphia. Other trains worthy of mention because of their high speed are those running from New York to Washington by way of Philadelphia over the Pennsylvania Lines and also over the Baltimore and Ohio.

The speed of freight trains varies with the grade and the weight of the train. Way freights seldom make more than ten or twelve miles an hour, but through freights carrying ordinary commodities may make from twenty to twenty-five miles per hour, while special fast freights, such as the trains carrying live stock, fruit and other perishable freight, often attain as high a rate of speed as local passenger trains.

Freight and passenger rates are regulated by law. Traffic within a state is subject to the regulations of the state legislature, and that including two or more states is regulated by the national government. In each case a maximum rate is fixed, and this is the highest tariff a road can charge. The tariff on through business is relatively less than that on local business, but discrimination between large and small shippers is prohibited, as are free passes on passenger trains in most states. Sometimes railroads have been unfairly treated in state legislatures, but the theory upon which legislation is based is that the roads are public servants which have been licensed as common carriers, and that they should treat all people alike. Each state has a railroad commission whose duty it is to see that roads obey laws in that state, and the national government has the Interstate Commerce Commission whose duties pertain to interstate traffic and are somewhat more extended than those of the state bodies. However, their chief duty is to see that the laws of the United States government in regard to interstate commerce are enforced.

We should not infer from what has been said in regard to regulating legislation, that the roads themselves are lacking in laws which regulate their own affairs, for they are much more systematic and thorough in making rules for themselves than either the state legislatures or the United States congress are in making rules for them. The railroad codes now in use on nearly all lines are the outgrowth of railway consolidation, and they have developed through various railway associations, the most important of which is the American Railway Association. This association originated in the meetings of railway financiers which began about 1872. These meetings were held semi-annually, and were devoted to the discussion of arrangemnets for through passenger trains between the east and the west and intermediate sections. The organization took the name of the General Time Convention, and it is to this body that the country is indebted for the standard time belts into which the United States and Canada were divided in 1883, and upon which these countries now depend for the transaction of all business.

Previous to the establishment of these time belts each railroad ran trains in accordance with local time. Consequently, much time was lost in making connections and many other inconveniences were encountered. With the establishment of the time belts these difficulties were removed and railway time was made uniform throughout the country. The organization continued to grow in extent and importance, and took the name of the American Railway Association, and it now includes all important lines in the United States and Canada. It is to this association that the railways are also indebted for the standard code of train rules which is in general use on all the important lines. Previous to the adoption of this code there was great confusion in train signals and rules, the same signal meaning one thing on one line and another thing on another, and one line having a set of rules for operating its trains and another line an entirely different set. Many accidents resulted from this confusion, and it prevented an employe on one line from engaging in service upon any other line until he had spent sufficient time to learn a new set of rules. Now signals and rules for operating trains are practically uniform throughout the country. This association also perfected and adopted a uniform set of rules for keeping account of cars going from one line to another and from one system to another. This was of very great importance because of the large number of freight cars which travel upon other lines than those to which they belong.

Other associations which have also contributed much to the perfection of railways are, the Master Car Builders' Association, to which the country is indebted for the uniform couplers now found upon freight cars; the American Railway Master Mechanics' Association, which has done much to improve the mechanism and safety of cars and locomotives; the Railway Transportation Association, which is concerned with the transportation of freight; the General Passenger Association, which has systematized the passenger traffic and adopted certain standard forms for tickets and also made rules governing the uniform rates on through passenger business over certain sections of the country. This association is made up of the New England Passenger Association, the Trunk Line Passenger Association, the Central Passenger Committee, the Western Passenger Committee, the Trans-Continental Passenger Committee and the Southeastern Passenger Committee, so that it now includes all sections of the country. Besides these there are numerous associations of less interest to the general public, but each of which is an important factor in securing uniformity in those departments which are related to the interchange of traffic between various trunk lines and systems.

The amount of business transacted by the railways of the country and the capital invested are almost beyond comprehension. In 1909 the railways of the United States carried 891,275,000 passengers and 1,521,065,000 tons of freight. Allowing seventy persons to a car, this number of passengers if loaded upon one train, would make a train which would extend six times around the earth, and if we allow thirty-five feet as the average length of the freight cars and fifty tons as the average load, the freight carried would require a train that would extend forty times around the earth, or nearly eight times the distance from the earth to the moon.

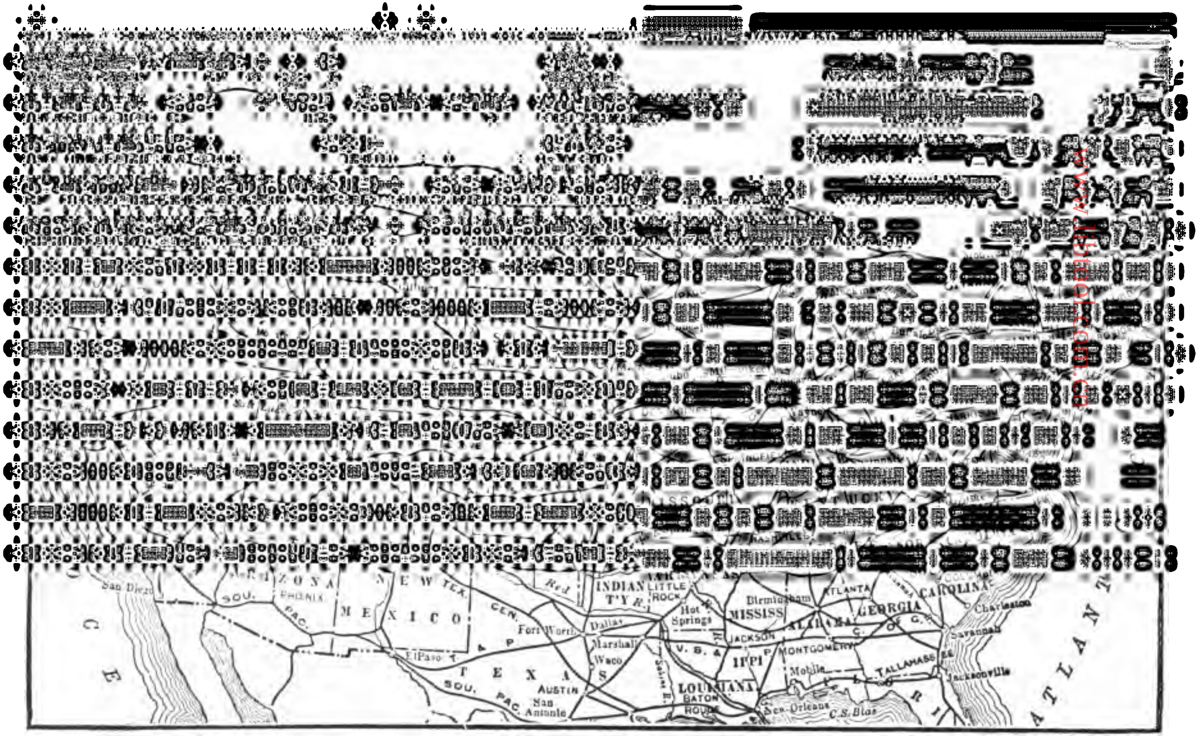
The total net earnings of the roads for the year amounted to $901,982,481, which exceeded the total revenue of the United States government by more than $238,000,000, and the capital invested in railways in the United States exceeded $19,370,000,000.

The safety of railway travel is also phenomenal, and American railways are now the safest in the world. In 1908 and 1909 the Pennsylvania System carried over 300,000,000 passengers with only one fatality, and in 1909 three hundred forty-seven companies carried over 570,000,000 passengers without a death from train accidents, while twenty-one other companies, carrying over 185,000,000 passengers, had only one fatality each. The mileage of these three hundred sixty-eight companies equals the railway mileage of Europe, excluding Russia but including the British Isles, and the record is one that the European roads have so far been unable to meet. This record is not the result of mere luck, for railroads do not trust to chance. It shows the application of improved methods of operation, perfect roadbeds, and above all, careful and conscientious work of railroad men from the president down to the track walker.

But what shall we say of the great army of men upon whom devolves the responsibility of carrying on this enormous business? In 1909 there were over 1,458,000 railway employees in the United States, and the Pennsylvania System alone carries upon its payroll over 153,000 men, or about five-sixths as many as were in the combined armies engaged in the battle of Gettysburg. It is due to this vast army of railway employees to say that in connection with no other occupation will so large a percentage of the men engaged be found to be sober, honest, clear-headed, faithful and uniformly courteous, as among railway employees of America. Most of the men enter upon their work when young, and achieve whatever success they can through hard work and faithful devotion to duty.

To secure a position on most of the roads, one must meet certain educational requirements and pass a thorough physical examination, and above all he must be of good habits. The use of intoxicating liquors ruins a man's chance for employment on a railroad, and some railroads consider entering a saloon or other place where these beverages are sold an offense which warrants the man's discharge. Railroad positions are not sinecures, and much of the work is of such a nature as to give one a rough exterior, but you may be sure that beneath that exterior is a sturdy character for otherwise the man would not be holding his position. We must give due credit to the great railway leaders who have conceived the railway systems and under whose direction these organizations have been carried out, but in doing this we should not overlook the fact that this perfection of organization has been made possible through the great army of faithful men who have borne the burden of toil and co-operated with the managers in the consummation of their plans.

On the other hand, the railway companies look after the interests of their employees. If a man is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Hot Springs
MISSISS
IPPI
JACKSON
LOUISIANA
BATON ROUGE
New Orleans
Birmingham
ATLANTA
GEORGIA
MONTGOMERY
Mobile
TALLAHASSEE
Savannah
Charleston
Jacksonville
CAROLINA

honest and faithful he is assured of an income for life when he connects himself with any of the great railroad companies. Some roads, like the Illinois Central, retire their men on part pay when they have reached a certain age. The Pennsylvania Road has a system of insurance which one may avail himself of when he enters the employ of that company. It provides benefits against sickness and accident, and also a full benefit to his family in case of death. This relief department is carried on by the company without expense to the employees. This railroad also has a liberal pension fund to which the employee contributes nothing except his years of faithful service. Furthermore, in 1887 the Pennsylvania Company established an employees savings fund which was virtually a savings bank with the resources of the entire system back of it. Under certain restrictions the employees of the company may deposit their savings with the station agents along the line and receive a low rate of interest upon their money. The value of this plan to the employees is evident when we learn that within seven years from its establishment, more than $10,000,000 had been deposited with the company and over $6,000,000 had been withdrawn by employees for the building of homes and other permanent investments. So satisfactory have these various benefit associations proved that all of the important roads now have some system by which employees are cared for through life.

OTHER COUNTRIES

The countries of Europe having over 20,000 miles of railway each are, Germany, Austria-Hungary, Great Britain, Ireland, France and Russia. The mileage of other countries ranges from 10,000 in Italy to less than 1000 in Greece. Compared with lines in the United States and Canada, European lines are short. However, they are well constructed and the service which they render is in most cases excellent. First, second and third class passenger coaches are provided, and by this means thousands of persons whose income would not permit them to incur the expense of first or second class passage, can travel in the European countries in third class coaches. The second class coach is the popular one, and it is patronized more generally than either of the others.

The following great trunk lines of railway, because of their extent and geographical position, deserve brief notice: Cape-to-Cairo Railway is a trunk line which was projected by the late Cecil Rhodes for the development of the interior of Africa, and will extend from Cape Town to Alexandria. From Cairo the line has been extended southward to Khartum, a distance of 1,200 miles, and from Cape Town northward for about 2,500 miles. When completed this will be one of the longest single lines of railway in the world, and will be unique in that it is the only trans-continental line running north and south in the world. It is connected with numerous short lines which act as feeders, and when it reaches Lake Victoria, it will be connected with the Uganda Railway extending from Mombasa to Port Florence. The completion of this railway will have an important influence upon the development of the interior of Africa.

Another line of almost equal extent is the Trans-Siberian Railway extending from Saint Petersburg and Moscow to Vladivostok and Port Arthur on the Pacific coast. The completion of the railway placed the important ports of China and Japan many miles nearer Europe than they had ever been before. Previous to the construction of this trunk line it required forty-five days to go from Saint Petersburg to Pekin by the way of the Suez Canal and Indian Ocean, or thirty-five days by way of New York and San Francisco. Now one can make the trip in ten to fifteen days, and if express trains were run over the line at the same rate that they are in the United States, this time could be reduced to about eight days from London to Pekin.

The most recently constructed trans-continental line is the Trans-Andean Railway, which connects Valparaiso, Chile, with Buenos Ayres in Argentine. The completion of this railway has practically removed the barrier of the Andes Mountains between the eastern and western ports in South America. The line is about nine hundred miles in length, and reaches an altitude of 11,000 feet where it crosses to the opposite side of the mountains through a tunnel some over five miles in length. This railway reduces the distance between Valparaiso and Buenos Ayres from about 4000 miles to less than 1000 miles, and the time from five days to thirty-six hours.

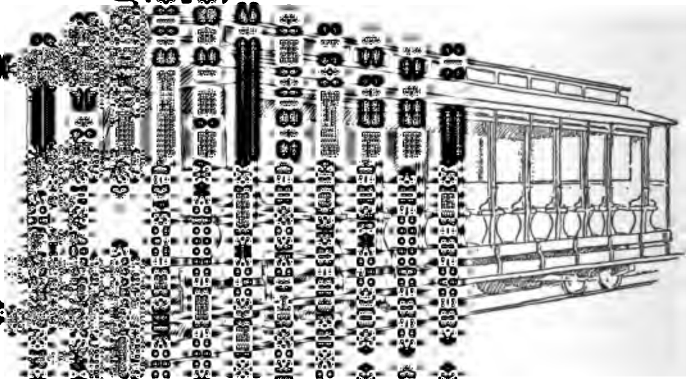
ELECTRIC RAILWAYS

The electric locomotive used to replace or to assist the steam locomotive on ordinary railways, is a development of the motor used on electric cars, and differs from such motor chiefly in being more powerful. For its origin we must look to the electric railway, which in the past few years has become common throughout the United States and most countries of Europe.

So far as is known, the first attempt at moving a car by electricity was made in 1835. The attempt ended before the experiment was completed. In 1851 Professor Page of the Smithsonian Institution, Washington, D. C., constructed an electric locomotive of sixteen horse power, that attained a speed of nineteen miles an hour. The electricity was generated by batteries placed in the locomotive. While this machine was successful, the expense of operating it was so great as to render it impractical for commercial purposes. Several other attempts at moving cars by electricity were also made, but it was not until after the invention of the dynamo that a practical electric motor came into existence, and even after the invention of this motor several years of experimenting were necessary before it was successfully applied to moving cars.

The first electric railway was the Union Passenger Railway of Richmond, Virginia, which was equipped with electric motors in 1887. Such was the success [illegible] next five years [illegible] applied to the [illegible] arge cities of the [illegible]

[illegible] tor placed above [illegible] by gearing. The [illegible] and trolley pole [illegible] charged over- [illegible] carried through



[illegible] icity is generated [illegible] ations containing [illegible] essary to operate [illegible] supply wires are [illegible] nnected with the [illegible] so as to keep the [illegible] re often encased [illegible] conducting mate- [illegible] electricity. The dynamos may be operated by a steam engine or by water power. In case the water power is used, the generating plant may be many miles from the railway system which it operates. For instance, the electricity for the street cars of Buffalo, New York is furnished by the power plant at Niagara Falls, more than twenty miles away; and that used by the street cars of San Francisco is generated by a mountain stream more than a hundred miles from the city. Since water power is much cheaper than steam, it is used wherever available.

The success of the electric street railways soon led to the extension of these lines to the suburbs of large cities and then to a still further extension into the country, so that now thousands of persons whose business is in the heart of the city live amid rural surroundings. This change in city life has led to an increase in the value of land near large cities, and to the development of a strong local trade where in many localities a few years ago there was only vacant land.

Following the development of the suburban traffic came the interurban lines, several of which have been extended into the country for more than a hundred miles, connecting important centers of population and trade. After the construction of the main line, connecting branches were built, so that in the course of time the line became a system joining all the important towns within its territory, and also accommodating a large rural community by providing frequent and cheap transportation for both passengers and freight. These interurban systems are now

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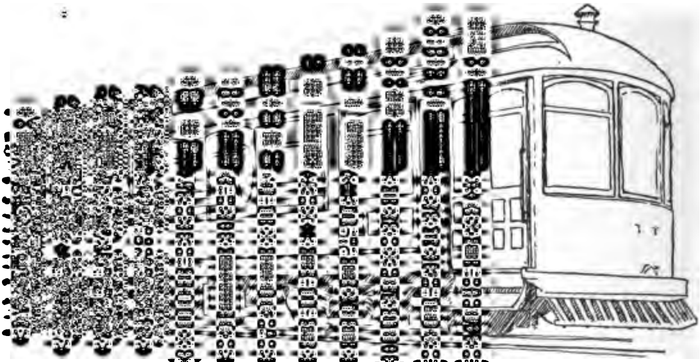

...s one on a steam ...cars and dining ...dities interurban ...the local passen- ... any appreciable

...ucted and oper- ...ailway. Conse- ...with profit into regions whose traffic would not warrant the construction of a steam railway. Moreover, electric cars can be operated on grades impossible for a steam railway to attempt, and so the electric line can accommodate regions which would otherwise be without railway facilities. Another point of advantage is frequency of service on interurban lines. Cars usually run as often as once an hour, while a steam railroad through the same region might have only one train a day each way. While within cities and towns the speed of electric cars is restricted to eight or ten miles an hour, in the country these cars run at the rate of twenty or thirty miles an hour, and make nearly as good time as local railroad trains. From all points of view the electric railway is of great advantage to the locality through which it passes. In 1910 there were about 40,000 miles of electric railways in the United States, and about 1,200 miles in Canada. Within the next few years these lines will reach practically every hamlet in the older and more densely populated states.

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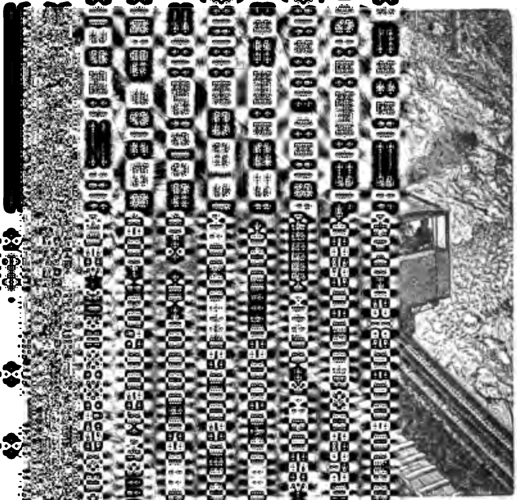

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White Mountains, in 1869, and it proved in every way to be successful. Since then similar railways have been constructed up Pike's Peak in Colorado, Mount Low near Los Angeles in California, and in numerous places among the Alps. These railways are not important factors in transportation, but because of their peculiar feature they are something of a curiosity, and their success shows that either by steam power or electricity vehicles can be propelled in almost any locality and over almost any grades.

In the construction of the mountain railway, what was supposed to be impossible was achieved. It is related that when Mr. Marsh, the projector of the Mount Washington Railway, applied to the legislature of New Hampshire for a charter, a member of that body moved that he be given a charter to build a railroad to the moon, because he thought that the inventor would be more liable to reach the moon than the summit of Mount Washington. But Marsh was prepared to meet all objection to the mechanical difficulties connected with his enterprise. He had constructed a model of his railway, engine, and cars. He obtained permission to exhibit this before the legislature. The little locomotive climbed the grade so readily that the charter was granted without opposition. The first locomotive used on this railway was exhibited at the World's Fair in Chicago in 1893, and is now in the Field Columbian Museum in that city.

EXPRESS

The term express as used in this country applies ordinarily to the carrying of packages of freight and of money upon passenger trains in charge of companies which are organized as public carriers and which make contracts with the railway companies for hauling the freight thus transported. The first attempt at this sort of transportation was in 1839, when William Harnden established a line of express between New York and Boston. Harnden made arrangements with one of the lines of railway running from Boston to a point on Long Island Sound, and then with a steamship line from that point to New York. He carried small packages of freight, money, stocks, bonds and other valuable matter, and delivered it directly to the parties to whom it was sent. His business increased with such rapidity that it was soon extended to Philadelphia and then to other cities.

In 1840 Alvin Adams began to compete for the New York and New England business, and this was the beginning of the Adams Express Company which was formed ten years later by the consolidation of Harnden's business with that developed by Adams, and with two or three other smaller companies. This company is still in existence and doing an extensive business throughout the country. Upon selling his interest to Adams, Harnden engaged in an express service between the United States and Europe.

The United States Express Company was formed in 1850; the Wells Company in 1845; and the American in 1850. This last has become the most extensive company in the country. The Wells Fargo Company was organized in 1852 to handle the California trade before there was any railroad to the Pacific coast. It now has an extensive trade in other parts of the country in addition to its trans-continental trade.

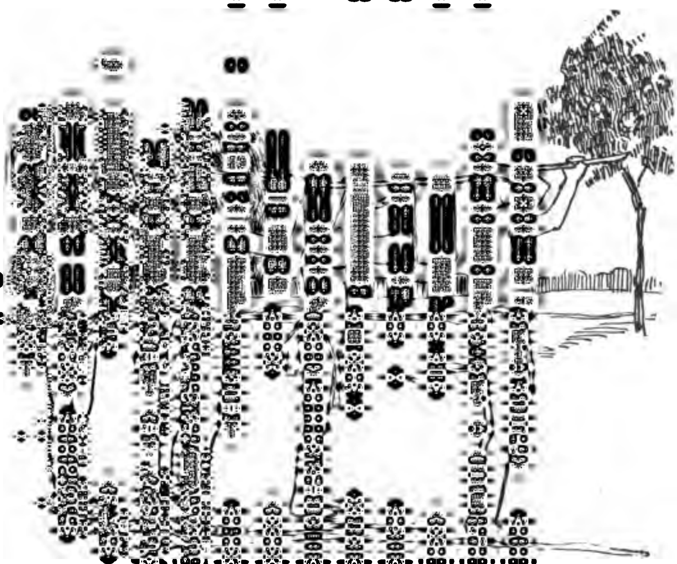
The express service in the United States is practically controlled by the companies named, and they have in a general way divided the territory among themselves. Each company makes contracts with the railroads and the steamship lines over whose lines and boats it secures a monopoly of the traffic and for which it reimburses the companies by paying a certain per cent of the rates charged for transportation. In large cities the companies collect and distribute the packages, but in smaller places they are left at the office of the company, from which place the owner must obtain them. The rates charged are usually about four times first class freight rates for the same distance. The service rendered is valuable and important, especially in the transportation of valuable packages and of perishable commodities. These companies also carry money and issue money orders similar to those issued by the Postoffice Department. One form of these orders is payable in almost any country of the world, and it affords a convenient means for carrying money when one is going abroad.

CARRYING THE MAILS

INTRODUCTION

The postoffice systems of this and other countries had their origin in the custom established by the rulers of ancient nations. Assyrian and Persian monarchs had their couriers stationed a day's journey from each other, with horses saddled and ready to carry with utmost speed the dispatches and orders of the ruler. The Roman Empire also had a similar arrangement, and the Romans named such a station "positum," a term meaning "place," and from this our name meaning "post" was derived. The Romans had a very perfect system of posts by means of which intelligence could be conveyed to and received from the very remotest parts of their great empire, and without doubt this conveyance of information had much to do with the prosperity of the empire and the general intelligence of the people.

At all times and in all ages civilized people have had some organized system of communication, and the degree of civilization to which a nation has arrived can be quite accurately determined by the stage of perfection which its system of communication has attained. So rapidly have systems of communication extended that now there is no part of the earth reached by civilized man, to which mails are not carried; and in some of their outlying colonies civilized nations today use the same methods for transporting [illegible] ancestors cen [illegible] region the [illegible] river ports by [illegible] and on the [illegible] winter men



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[illegible] om that of [illegible] stem is of [illegible] any other foreign nation. As far back as the middle of the thirteenth century royal messengers called "nuncii" were employed in England for carrying letters, but there was no regular system of posts established until the time of Henry VIII. Though these early postal systems were chiefly for carrying royal letters and the conveyance of persons traveling on the king's business, the post riders and postmasters soon found it both convenient and profitable to carry private letters and private travelers, and in Elizabeth's time this practice had become so general that the queen commanded that all packets on royal business should have precedence over private letters. James I. conferred upon post agents the exclusive right of letting horses to travelers, and he later forbade all persons not authorized by the Master of Posts from collecting, carrying and delivering letters. This may be considered to be the beginning of the government monopoly for mail carrying in England.

Strange as it may seem, it was not until 1680 that the citizens in one part of London could receive letters from and deliver them to those of another part of the city, notwithstanding the fact that for more than two centuries there had been a postal system throughout the country. In that year a merchant undertook the collection and distribution of city mail. For this purpose he divided London and its suburbs into seven districts in each of which was located a sorting office. He also opened between four and five hundred receiving stations throughout the city, and charged one penny for the delivering of each package, provided it did not exceed one pound in weight or ten pounds in value. The success of this experiment was such that the London system was within a short time incorporated into the regular postal system of the country, and this marks the beginning of the collection and delivery of mail in large cities.

Throughout the kingdom for a long time, the rates of postage were exceedingly high, and were based upon the number of sheets of paper in a letter and the distance it was to be carried. The postage was chargeable against the one receiving the letter instead of being paid in advance as at the present time. This led to many abuses and oftentimes to a loss to the carrier, since one might refuse the letter if he thought that the postage was too high. However, there were no radical changes in the British postal system until 1837, when Sir Rowland Hill issued a pamphlet on the improvement of the post. His suggestions were adopted by Parliament and were put into effect under his supervision. To him the people owe a great debt of gratitude, for he can truly be said to be the originator of the modern postal system of the world. The radical changes wrought by Hill were, the reduction of postage to a uniform rate, regardless of distance, and basing that rate upon the weight of the letter; the thorough organization of postal routes and postal agents; the enforcement of advance payment of postage, and the invention of the postage stamp. These measures have been adopted by all civilized countries, so that today, barring local conditions which are dependent upon the laws of the various countries, we have what may practically be considered a uniform postal system.

THE UNITED STATES

For a number of years after settlers began to come to America there was no regular postal system. The letters that were brought to the settlements were left in some convenient place, usually a coffee-house, and to this place the settlers went for them. In 1639 the General Court of Massachusetts passed an order appointing Richard Fairbanks of Boston, a postal agent, and directing that all letters brought into the town be delivered to him, and all that were to be sent out be received by him. Fairbanks was to see that the incoming letters were distributed to their owners, and that the outgoing mail was delivered to departing ships. For this service he was to receive one penny per letter. In 1657 the House of Burgesses in Virginia required each planter to provide a messenger to convey dispatches and letters as they arrived, to the next planter. Failure to comply with this order subjected the offender to a fine. These two orders may be considered to constitute the beginning of a postal system in the Colonies.

At first this system was purely local, but by 1672 a postal service had been established between the several colonies, and there was an arrangement between New York and Massachusetts by which mail was carried monthly between New York City and Boston. The Inter-Colonial postal system was really inaugurated in 1692, when Thomas Neale was appointed by the British sovereigns William and Mary as a sort of deputy postmaster general, and was authorized to establish posts in North America. Under this order a number of postal stations and postal routes were fixed, and as the colonies increased in population these were extended.

In 1737 Benjamin Franklin was appointed postmaster at Philadelphia, and he immediately brought to bear upon postal affairs of that city his organizing ability. So fruitful in results were his efforts that in 1753 he was appointed deputy postmaster general for the Colonies, and with Franklin's appointment we may consider that our present postoffice system began. He made a journey throughout the colonies to study local conditions and means and methods of transportation, and immediately set about the development of a postal system. Fortunately Franklin was allowed to remain in office long enough to place his system in good working order before political differences between himself and the British government caused his removal.

At the breaking out of the Revolutionary War, the postal affairs of the Colonies were assumed by the Continental Congress, and this body continued Franklin's system and plan. By the adoption of the Constitution the Federal government inherited the postal system of the Colonies. One of the clauses in the Constitution gives congress the power to establish postoffices and post roads, and under the power granted by this clause the postoffice department of the United States government has been developed.

As in England, the first mail carriers in the Colonies were post riders who traveled on horseback with frequent relays of horses. Later, when roads became passable, the contract for carrying mails was let to stage companies, and the coaches carried both passengers and mail. Progress, however, was slow. It took from two to three days to go from Philadelphia to New York and a week from New York to Boston. Mail started from each of these cities on Monday and reached its destination on Saturday. Whenever possible, vessels engaged in the coastwise trade carried mail between the towns where they stopped, but the length of their voyages was uncertain because the vessels depended upon the wind for propulsion. With the improvement of the roads conditions became better, but as late as 1833 it took a week to carry the news from Washington to New York, and the news from the National Capital was over a week old when published by the New York papers. In order to overcome this difficulty, two or three of the larger journals of New York engaged special lines of steamers or other means of quick transportation which were in service for some years before the telegraph came into use.

In the matter of postage the Colonies followed the English custom, basing the rate upon the size of the letter and the distance it was carried, and this custom was continued for some time by the Federal government. From the organization of the Postoffice Department in Washington's administration until 1816, the rates were, for a single letter, that is, one composed of a single piece of paper, eight cents for a distance not exceeding forty miles; under ninety miles, ten cents; and under one hundred fifty miles, twelve and a half cents; while for five hundred miles or over the postage was twenty five cents. With the introduction of railroads and steam boats and the improvement of travel by coach these rates were lowered from time to time; but the writer has distinct recollection of paying ten cents postage on letters to California and to Canada. The rate on the Canadian letters, however, was due to the necessity of adding Canadian rates to those in the United States.

Perhaps no better comment on the development of the postal systems of the world can be found than in the present rates of postage, which in the United States are two cents per ounce for all letters or other written matter, and five cents per ounce or less, with three cents for each additional ounce, in all countries of the Postal Union, which practically includes all foreign countries. Another significant item in connection with the reduction in postage is the application of these various reductions to newspapers and other periodicals. At first the rates on these were so high as to make the subscription price almost prohibitive, but now everywhere in the United States newspapers and periodicals are transported for one cent a pound, provided they can secure the advantages of what is known as "second class" mail matter. In order to secure these advantages, the periodical must be approved as such by the postoffice authorities at the postoffice where it is mailed, and in order to secure such approval the periodical should be of the nature of a newspaper or magazine whose purpose it is to disseminate general information, or information in the interests of some particular order, organization or trade. Periodical publications designed for the purpose of advertising the firm or party issuing them, or publications containing nothing but stories, find difficulty in securing the advantages of second class mail matter, because the quantity of this matter is so large that carrying it entails heavy expense upon the government. While it is the duty and purpose of the government to disseminate knowledge and information, it is not the duty of the government to assist those engaged in business, in advertising their wares.

Until comparatively recent date, pre-payment on all mail matter was not required in the United States. Even now, letters are forwarded to their destinations even though they are not fully prepaid, and the balance of the postage is charged against the one receiving the letter. Postage stamps were not introduced in this country until 1847.

We have already referred to the power to establish postoffices and post roads which the Constitution of the United States confers upon Congress. A post road is any road over which the mails are carried, and in law it may be a carriage road, a railway, a steamship line or a mere footpath through the forest, over which the mail carrier travels at regular periods, but it must be a public highway. Railroads had been in successful operation for a number of years before the government awarded them contracts for carrying the mails. The chief reason for this

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sections where rural free delivery routes have not yet been established. The history of these stage routes is varied and interesting, but that portion of their history which has in later years attracted most attention is that connected with the old stage routes in and across the Rocky Mountains, and employed for carrying mail and express before the days of the trans-continental railways. These stages were driven over well established routes, and usually were hauled by from four to six horses. They carried not only mail and passengers but oftentimes money and gold which was shipped from the mines to the United States mints or assaying offices in San Francisco or other cities.

These stage coaches were objects of great interest to mountain robbers, and they were often subjected to attacks from these desperadoes. Many tales of adventure both real and imaginary have been based upon these attacks. Most of the drivers were characters peculiar to their life and surroundings. One of them, named Hank White, attained national reputation from the ride which he gave Horace Greeley, the great editor of the "New York Tribune," when that gentleman was traveling through California, Oregon and Washington before railroads had been extended into that region.

It seems that Mr. Greeley had an appointment to address a public meeting in a certain western town, and elaborate preparations had been made for his reception. In order to reach his destination he was obliged to travel over the mountains several miles by stage coach. Fearing that the regular stage coach might be delayed, the company placed Mr. Greeley in a special coach in charge of White, with specific orders to the driver to get the great man there on time. As was customary with those drivers, White allowed his team to proceed leisurely up the steep incline to the summit of the road; then he made up lost time by driving at a breakneck speed down the decline on the opposite side of the mountain.

The slow progress upward caused Mr. Greeley to become nervous, and he frequently interrogated the driver as to the possibility of his reaching his destination on time, and suggested that he urge the team to a greater speed. To all of Mr. Greeley's expostulations the driver replied, "I've got my orders, sir." In the drive down the mountain White urged his team to such speed that Mr. Greeley was thrown from one side of the coach to the other and decidedly shaken up. He became very much frightened and finally expostulated with the driver and asked him if he did not think they would get there on time if they did not go so fast, but the expostulations only served to nerve White to greater efforts. It is needless to say that they reached the town on time, and when White drove up to the hotel, Mr. Greeley descended from the coach in a disheveled state, both in body and mind. Somehow or other the story got into the papers and traveled from one end of the country to the other, and in this way White became famous.

The mails of the country have increased in proportion to our increase in population and business. Previous to the Civil War they had become so heavy that the system then in vogue was not adequate to handling them in a satisfactory manner. Although all railway lines were employed in carrying mail, there had not been devised any means by which the mail could be sorted on trains. Instead, certain centers, usually large cities, were designated as distributing postoffices, and all mail designated for the section of country in the vicinity of such a city was placed in one package marked distributing postoffice at the city named. Here the package was opened and the mail re-sorted. Sometimes before reaching its destination a letter might be sent to two or more of these distributing offices, in each of which it was subject to a delay of from twelve to forty-eight hours. Under this system mail traveled much more slowly than passengers and business was often retarded and men were put to great inconvenience.

The war forced men into the armies, and often by the movement of armies concentrated battalions of soldiers in small towns, where divisions of the army often outnumbered the population of the town several times. The army mail was very heavy, since every soldier had friends at home who constantly sent him letters and papers. The result of these conditions and the methods of handling mail was that in many of these places the mail became so congested that it was almost impossible to distribute it. Hundreds of mail bags were delivered in the little postoffice, where they were piled one on top of the other without adequate help for handling their contents.

In addition to this, most of the men then in the postal service were new and unacquainted with their duties. When Abraham Lincoln was elected president, the Republican party came into power. Up to this time practically all political offices in the country had been held by democrats, and in accordance with political custom, these almost to a man, were removed and their places filled by those who were followers of the new party that had just come into power. The only requisite for appointment in the mail service seemed to be ability to read and write after a fashion, and ability to deliver a certain number of Republican votes. Under these circumstances it is no wonder that the mail conditions of the country reached such a stage as to cause universal dissatisfaction. The general complaint led to a study of the problem by a few men who still remained in the service and who were thoroughly conversant with the situation. As a result of this study the railway postoffice or railway mail car was developed, and its invention marked a new era in the mail service of the country.

There is dispute concerning the identity of the man to whom the honor of inventing the railway mail service is due. Some claim that William A. Davis, who at that time was postmaster at St. Joseph, Missouri, is entitled to the honor; while others and seemingly the majority, insist that the credit for this great invention is due to George P. Armstrong, who was for many years assistant postmaster at Chicago. However this may be, it is certain that the order for instituting such service was first given by the Postmaster General to Mr. Armstrong, and was dated July 1st, 1864. This order authorized Mr. Armstrong to make all arrangements with railway companies to furnish suitable cars for traveling postoffices, to designate the head offices with their dependent offices, and to select such assistants as he might need in carrying out the work.

Under these instructions the first railway postoffice in the United States began operation on the Chicago and Northwestern Railway, August 28, 1864. This railway postoffice ran between Chicago and Clinton, Iowa. It was established in a compartment in a baggage car. The compartment was fitted up with a case containing a large number of small boxes for the distribution of mail, the arrangement being similar to that in a postoffice. In the compartment was also a working table around which the mail pouches could be hung in such position that it was an easy matter to throw the mail into them as it was sorted. This constituted a distributing postoffice on wheels, and in it the mail was sorted and thrown off at each station as the train arrived, when another bag containing the mail from that station was taken on. The success of Mr. Armstrong's experiment was such that it was rapidly extended to all of the leading railways of the country, and within three years railway postoffice cars were constructed and adapted specially to this sort of service. These cars are now found running upon all lines of railway having any considerable mail business, while there are many compartment cars still running on branch lines where the mail business is light. No advance greater step in handling mail was ever devised than the railway postoffice, and to Mr. Armstrong and others associated with him is due the credit of laying the foundation for the present system of mail distribution throughout the country. Mr. Armstrong was made Superintendent of the railway mail service and directed it for the entire country.

The next step in advance was the establishment of the fast mail train. The credit for inaugurating the Fast Mail or special mail train is due to George S. Bangs, who became Mr. Armstrong's successor as superintendent of the railway mail service of the United States. The first train of this kind operated on the New York Central and Lake Shore and Michigan Southern Railways in 1875, leaving New York at four o'clock on the morning of September 16th, and being scheduled to arrive in Chicago at six o'clock on the morning of the following day. The running time was considered very short for railway conditions of that day, nevertheless the train reached its destination on time and the mail was handled expeditiously and in a highly satisfactory manner. With this train, the fast mail service in the United States was inaugurated, for from that time to the present there has never been a day in which the people of the country were willing to return to the old system.

But the development of the railway postoffice required more than the building of cars. Without a force of highly trained and skilful men to operate these cars the service would be very unsatisfactory. Mr. Bangs held the district superintendents strictly accountable for the efficiency of the railway mail service under their respective jurisdictions. He also instituted a system of checks through which delays could be traced to the person directly responsible. He divided the service into grades with advance in salary, and established conditions for promotion. A new man entered the lowest grade, from which after a trial extending over a period of about three months, he was promoted or discharged. Systems of training and examination were also instituted, and the superintendent of the railway mail service was given authority to drop political appointees when they were shown to be inefficient. By this means the railway mail service secured a body of highly trained men in which one could secure a permanent position only by thorough qualification for his work; and this was accomplished several years before the Civil Service reform movement was able to obtain legislation governing the admission of men to positions in the postoffice department.

The position of railway mail clerk is one of trust and responsibility, also one requiring a great amount of severe mental and physical labor. You will find mail cars standing at farther ends of the train sheds in most of the passenger stations in large cities like Saint Louis and Chicago. These cars have no doors at the ends, and they are attached to the train next to the locomotive. By walking down the track and looking in at the door, you will get an idea of the plan of the interior of the car. You will find a number of cases resembling those found in the postoffice, racks for suspending mail bags, and one or more working tables. Surrounding these tables will probably be a number of men hard at work sorting the mail that has been delivered to the car. If from your position you can get a good view of the interior, you will notice the rapidity and skill with which the mail clerks throw papers and packages into the various bags suspended from the rack, and the skill with which they distribute letters into the boxes or pigeon holes in the case. This sort of work must continue as long as the train runs, for just before starting, a new supply of mail will be delivered to the car, and at each station the mail for that station must be thrown off and another bag taken on.

The fast mail trains pass many stations at which they do not stop. The man in charge of the car must be well enough acquainted with his route to know when the train is approaching one of these stations. The mail bag has already been hung upon a device from which it can be caught by the hook on the mail car. This is a triangular arrangement made of iron and so attached to the car that when not in use it hangs flat against the side. When the mail bag is to be caught the clerk opens the door, takes the hook by the handle and raises it to a horizontal position. As the train thunders past the mail bag is caught and brought into the car and the one containing the mail for the station is thrown out. This work must be done with great rapidity while the train is running at full speed, and there is no cessation from labor until the end of the trip is reached. Large mail cars have several clerks, one of whom is the head clerk and has charge of the car and the working force.

So great is the strain under which these men labor that they are required to work only half-time. A clerk usually runs on his route one week and lays off the next, his place being taken by another clerk who alternates with him. But you must not think that these men are idle during the week that they are not running upon their routes. It matters not how long a man has been in the service or how efficient he may be on the route which he travels. He is constantly required to study new routes upon which he is examined at regular intervals. By means of this system of study, in the course of a few years every mail clerk in the service becomes thoroughly familiar with all routes in the country, so that should he for any reason be suddenly transferred to another route, he would be able to take up his work and carry it on satisfactorily.

There are numerous distributing offices along the routes, and these receive the largest amount of mail. From them mail is sent to villages and towns off the line of railway and given to those who travel the various free rural delivery routes that center at that postoffice; so that it is necessary that the railway postoffice clerk know not only the towns along the line of his road, but also the locations of all other towns and villages supplied by this route and their relations to the various distributing postoffices.

Handling the mails in a great city, like New York or Chicago, is a large business in itself. There is one central postoffice to which all incoming mails are sent unless their destinations lie beyond the city. If so, they are immediately transferred to the mail trains which take them to their destinations. As the mail reaches the central postoffice it is unloaded from the wagons down shafts or inclines into the basement of the building. From here it is carried by elevators operated by machinery to the various departments to which it belongs. In each department is a force of clerks who open the bags and redistribute the mail. In the more recently constructed postoffices these clerks are also supplied with dummy cars or other carriers which operate upon tracks, so that by throwing the mail into these it is taken automatically to whatever station in the building it should reach. That for the district immediately surrounding the central office goes to the carriers' room, where each carrier sorts out and makes up the mail for his route. That destined for the outlying sections of the city is sent to the substations, where it is distributed by the carriers of these stations.

The work is systematically arranged and everything possible is done to prevent delay. To illustrate: incoming mail on all important trains entering such cities as Saint Louis, Chicago and Boston, is sorted by the clerks in the mail car in such a manner that the mail for the business section of the city is ready for delivery to the carriers upon its arrival, and in some instances the mail designated for the different sub-stations is ready to be sent immediately to those stations. In Chicago, New York and some other large cities the central postoffice is connected with the railway stations by a system of pneumatic tubes. Cylindrical boxes containing the mail are sent through these tubes by compressed air, and they travel with almost lightning-like rapidity. This device enables late mail to be sent to trains just before their departure.

The collection of mails in a large city is as important as their distribution. Mail boxes for both letters and packages are distributed at frequent intervals throughout the city, and these are visitied every few hours by collectors whose sole business it is to collect the mails and to take them to the central office. Each collector has his specific route, and makes his rounds with great regularity. In Chicago and some other large cities street cars are employed for collecting and distributing mail. These cars are built after the same plan as the mail cars upon railways, and they are used in much the same manner. The mail clerk in charge so sorts the mail which he receives, as to prevent re-handling at the central office, and to send the letters that reach his car to the different sub-stations without delay.

In every city where there is free delivery the patrons have the benefit of a special delivery. This benefit can be secured by placing upon the letter ten cents in stamps in addition to the regular postage and marking the letter or package "special." In the larger cities a force of delivery clerks is connected with the central office and each sub-station, and these clerks give their entire time to the delivery of this sort of mail; but where there is no free delivery system there is nothing gained by placing the additional postage on the package and marking it "special," because in this case it will be delivered in the regular way.

Letters containing money, and valuable packages should never be sent through the mails without registering. Registration is secured by placing upon the package stamps to the value of ten cents, in addition to the regular postage, and stating to the clerk of the office where the package is delivered that you require it to be registered. Registration does not secure a guarantee from the government against loss, but it enables the authorities to trace the package in case of a loss, so that they can easily find the one responsible. When the registered package is received by the person to whom it is sent, he is required to sign a receipt which is returned to the sender. Upon reception of this receipt the sender knows that the package has reached its destination.

The postoffice Department also does an extensive business in the transmission of money by postal orders. The postal order is really a draft on the Postoffice Department payable to the person named on its face. It is absolutely safe, easily obtainable, and costs but a few cents, and wherever procurable affords a much more satisfactory way of transmitting money than by registered letter, since the order is so made out that no one except the person to whom it is directed can secure payment. In 1909 the money orders issued by the postoffices under control of the United States amounted to $498,511,747. In addition to this, international money orders providing for the payment of money in other countries were issued to the amount of $69,317,899; so that the banking business of the Postoffice Department is greater than that of any single bank in the country. In addition to this, in 1910 Congress passed an act providing for the establishing of postal savings banks, and when this act goes into effect, millions of dollars now horded by individuals who are afraid to deposit their money in banks will be deposited with the Postoffice Department, and thus will this large amount of money find its way into circulation where it can be used to advantage in building up the business of the country.

The department also maintains what is known as the "dead letter office," which is established at Washington, D. C. To this office is sent all mail which because of defective address or for other reasons can not be delivered. In this office these packages are opened and if possible the contents are returned to the writer or sender; but in many cases this is impossible because the writer fails to put his address and sometimes even his name upon the package.

Mail matter is divided into four classes. That of the first class includes letters and all other manuscripts written by the pen or upon the typewriter. Upon this postage is two cents an ounce or fraction thereof. Matter of the second class includes, as we have already stated, newspapers and other periodical publications, and postage on this is one cent a pound or fraction thereof. Matter of the third class includes proof sheets and corrected proof sheets and manuscript copy accompanying them, books, circulars and newspapers and magazines sent by those who are not the publishers. The rate on matter of this class is one cent for every two ounces or fraction thereof. The limit in weight is four pounds unless the package be a single book, upon which the weight is not limited. Matter of the fourth class includes all mailable matter not included in the three preceding classes. The rate of postage is one cent for each ounce or fraction thereof, except on seeds, roots, bulbs, cuttings and plants, on which the rate is one cent for each two ounces or fraction thereof. Packages must not exceed four pounds in weight.

With the exception of first class matter all packages must be unsealed and so wrapped that their contents can be easily examined. In every case the sender has the right to put his name and address upon the outside of the package, but any written matter other than the name and address of the sender and such words as "sample copy" and "marked copy," is prohibited. Liquids, live animals, substances emitting disagreeable odors, explosives, and objects which are liable to damage other packages unless they are suitably wrapped, are excluded from the mails, as is also all printed or written matter of an immoral, obscene or otherwise objectionable nature. Neither can one use the mails for fraudulent purposes, such as lotteries or any other devices into which the element of chance enters. Advertising dishonest business schemes and collecting money fraudulently through the mails subject the offender in case of arrest and conviction to severe punishment, and we might add that one seldom engages in any of these practices without being discovered and brought to justice.

The Postoffice Department is in charge of the

Postmaster General, who is a member of the President's Cabinet, and receives a salary of $12,000 per year. He has four assistants known respectively as the First Assistant Postmaster General, the Second Assistant Postmaster General, the Third Assistant Postmaster General and the Fourth Assistant Postmaster General. Each of these assistants has entire charge of certain divisions of the Department. In addition to them there are superintendents of various lines of work, such as foreign mails, money orders and the railway mail service. Each department head has a corps of clerks and other assistants to enable him to handle the business of his department expeditiously. There are in all some over 100,000 employees connected with the Postoffice Department, the largest number of these being postmasters.

In 1909 there were 60,144 postoffices in the United States, which were 16,500 fewer than in 1900. This decrease is due to the establishment of rural free delivery routes, since one of these routes often does the work that was formerly performed by two or three and possibly more small postoffices. Revenues from the Department for 1909 amounted to $202,562,383, and the expenditures to $221,400,102. From this we see that the Department is carried on at a heavy loss, and some have thought that this deficit should be overcome by either curtailing the work of the Department or by increasing the rates of postage. The general opinion in regard to this condition, however, is that it is the business of the Government to disseminate intelligence, and that in